Koalas

Release 1.5.0

The Koalas Team

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CONTENTS

The Koalas project makes data scientists more productive when interacting with big data, by implementing the pandas DataFrame API on top of Apache Spark. pandas is the de facto standard (single-node) DataFrame implementation in Python, while Spark is the de facto standard for big data processing. With this package, you can:

- Be immediately productive with Spark, with no learning curve, if you are already familiar with pandas.
- Have a single codebase that works both with pandas (tests, smaller datasets) and with Spark (distributed datasets).

We would love to have you try it and give us feedback, through our mailing lists or GitHub issues. Try the Koalas 10 minutes tutorial on a live Jupyter notebook here. The initial launch can take up to several minutes.

CHAPTER

ONE

GETTING STARTED

1.1 Installation

Koalas requires PySpark so please make sure your PySpark is available.

To install Koalas, you can use:

- Conda
- PyPI
- *Installation from source*

To install PySpark, you can use:

- Installation with the official release channel
- Conda
- PyPI
- Installation from source

1.1.1 Python version support

Officially Python 3.5 to 3.8.

1.1.2 Installing Koalas

Installing with Conda

First you will need Conda to be installed. After that, we should create a new conda environment. A conda environment is similar with a virtualenv that allows you to specify a specific version of Python and set of libraries. Run the following commands from a terminal window:

```
conda create --name koalas-dev-env
```

This will create a minimal environment with only Python installed in it. To put your self inside this environment run:

```
conda activate koalas-dev-env
```

The final step required is to install Koalas. This can be done with the following command:

```
conda install -c conda-forge koalas
```

To install a specific Koalas version:

```
conda install -c conda-forge koalas=1.3.0
```

Installing from PyPI

Koalas can be installed via pip from PyPI:

```
pip install koalas
```

Installing from source

See the *Contribution Guide* for complete instructions.

1.1.3 Installing PySpark

Installing with the official release channel

You can install PySpark by downloading a release in the official release channel. Once you download the release, un-tar it first as below:

```
tar xzvf spark-2.4.4-bin-hadoop2.7.tgz
```

After that, make sure set `SPARK_HOME` environment variable to indicate the directory you untar-ed:

```
cd spark-2.4.4-bin-hadoop2.7
export SPARK_HOME=`pwd`
```

Also, make sure your `PYTHONPATH` can find the PySpark and Py4J under `$SPARK_HOME/python/lib`:

```
export PYTHONPATH=$(ZIPS=("$SPARK_HOME"/python/lib/*.zip); IFS=:; echo "${ZIPS[*]}"):
↪$PYTHONPATH
```

Installing with Conda

PySpark can be installed via Conda:

```
conda install -c conda-forge pyspark
```

Installing with PyPI

PySpark can be installed via pip from PyPI:

```
pip install pyspark
```

Installing from source

To install PySpark from source, refer Building Spark.

Likewise, make sure you set `SPARK_HOME` environment variable to the git-cloned directory, and your `PYTHONPATH` environment variable can find the PySpark and Py4J under `$SPARK_HOME/python/lib`:

```
export PYTHONPATH=$(ZIPS=("$SPARK_HOME"/python/lib/*.zip); IFS=:; echo "${ZIPS[*]}"):
↪$PYTHONPATH
```

1.1.4 Dependencies

Package	Required version
pandas	>=0.23.2
pyspark	>=2.4.0
pyarrow	>=0.10
matplotlib	>=3.0.0,<3.3.0
numpy	>=1.14

Optional dependencies

Package	Required version
mlflow	>=1.0
plotly	>=4.8

1.2 10 minutes to Koalas

This is a short introduction to Koalas, geared mainly for new users. This notebook shows you some key differences between pandas and Koalas. You can run this examples by yourself on a live notebook here. For Databricks users, you can import the current .ipynb file and run it after installing Koalas.

Customarily, we import Koalas as follows:

[1]:
```
import pandas as pd
import numpy as np
import databricks.koalas as ks
from pyspark.sql import SparkSession
```

1.2.1 Object Creation

Creating a Koalas Series by passing a list of values, letting Koalas create a default integer index:

[2]:
```
s = ks.Series([1, 3, 5, np.nan, 6, 8])
```

[3]:
```
s
```

[3]:
```
0    1.0
1    3.0
2    5.0
3    NaN
4    6.0
5    8.0
dtype: float64
```

Creating a Koalas DataFrame by passing a dict of objects that can be converted to series-like.

[4]:
```
kdf = ks.DataFrame(
    {'a': [1, 2, 3, 4, 5, 6],
     'b': [100, 200, 300, 400, 500, 600],
     'c': ["one", "two", "three", "four", "five", "six"]},
    index=[10, 20, 30, 40, 50, 60])
```

[5]:
```
kdf
```

[5]:

	a	b	c
10	1	100	one
20	2	200	two
30	3	300	three
40	4	400	four
50	5	500	five
60	6	600	six

Creating a pandas DataFrame by passing a numpy array, with a datetime index and labeled columns:

[6]:
```
dates = pd.date_range('20130101', periods=6)
```

[7]:
```
dates
```

[7]:
```
DatetimeIndex(['2013-01-01', '2013-01-02', '2013-01-03', '2013-01-04',
               '2013-01-05', '2013-01-06'],
              dtype='datetime64[ns]', freq='D')
```

[8]:
```
pdf = pd.DataFrame(np.random.randn(6, 4), index=dates, columns=list('ABCD'))
```

[9]:
```
pdf
```

[9]:

	A	B	C	D
2013-01-01	-0.407291	0.066551	-0.073149	0.648219
2013-01-02	-0.848735	0.437277	0.632657	0.312861
2013-01-03	-0.415537	-1.787072	0.242221	0.125543
2013-01-04	-1.637271	1.134810	0.282532	0.133995
2013-01-05	-1.230477	-1.925734	0.736288	-0.547677
2013-01-06	1.092894	-1.071281	0.318752	-0.477591

Now, this pandas DataFrame can be converted to a Koalas DataFrame

[10]:
```
kdf = ks.from_pandas(pdf)
```

[11]:
```
type(kdf)
```

[11]:
```
databricks.koalas.frame.DataFrame
```

It looks and behaves the same as a pandas DataFrame though

[12]:
```
kdf
```

[12]:
```
                   A         B         C         D
2013-01-01 -0.407291  0.066551 -0.073149  0.648219
2013-01-02 -0.848735  0.437277  0.632657  0.312861
2013-01-03 -0.415537 -1.787072  0.242221  0.125543
2013-01-04 -1.637271  1.134810  0.282532  0.133995
2013-01-05 -1.230477 -1.925734  0.736288 -0.547677
2013-01-06  1.092894 -1.071281  0.318752 -0.477591
```

Also, it is possible to create a Koalas DataFrame from Spark DataFrame.

Creating a Spark DataFrame from pandas DataFrame

[13]:
```
spark = SparkSession.builder.getOrCreate()
```

[14]:
```
sdf = spark.createDataFrame(pdf)
```

[15]:
```
sdf.show()
```

```
+-------------------+-------------------+--------------------+--------------------+
|                  A|                  B|                   C|                   D|
+-------------------+-------------------+--------------------+--------------------+
|-0.40729126067930577|0.06655086061836445|-0.07314878758440578| 0.6482187447085683|
|  -0.848735274668907|0.43727685786558224|  0.6326566086816865|  0.312860815784838|
|-0.41553692955141575|-1.7870717259038067| 0.24222142308402184|  0.125543462922973|
|  -1.637270523583917| 1.1348099198020765|  0.2825324338895592|0.13399483028402598|
| -1.2304766522352943|-1.9257342346663335|  0.7362879432261002|-0.5476765308367703|
|  1.0928943198263723|-1.0712812856772376| 0.31875224896792975|-0.4775906715060247|
+-------------------+-------------------+--------------------+--------------------+
```

Creating Koalas DataFrame from Spark DataFrame. `to_koalas()` is automatically attached to Spark DataFrame and available as an API when Koalas is imported.

[16]:
```
kdf = sdf.to_koalas()
```

[17]:
```
kdf
```

[17]:
```
          A         B         C         D
0 -0.407291  0.066551 -0.073149  0.648219
1 -0.848735  0.437277  0.632657  0.312861
2 -0.415537 -1.787072  0.242221  0.125543
3 -1.637271  1.134810  0.282532  0.133995
4 -1.230477 -1.925734  0.736288 -0.547677
5  1.092894 -1.071281  0.318752 -0.477591
```

Having specific dtypes . Types that are common to both Spark and pandas are currently supported.

```
[18]: kdf.dtypes
```

```
[18]: A    float64
      B    float64
      C    float64
      D    float64
      dtype: object
```

1.2.2 Viewing Data

See the API Reference.

See the top rows of the frame. The results may not be the same as pandas though: unlike pandas, the data in a Spark dataframe is not *ordered*, it has no intrinsic notion of index. When asked for the head of a dataframe, Spark will just take the requested number of rows from a partition. Do not rely on it to return specific rows, use `.loc` or `iloc` instead.

```
[19]: kdf.head()
```

```
[19]:          A         B         C         D
      0 -0.407291  0.066551 -0.073149  0.648219
      1 -0.848735  0.437277  0.632657  0.312861
      2 -0.415537 -1.787072  0.242221  0.125543
      3 -1.637271  1.134810  0.282532  0.133995
      4 -1.230477 -1.925734  0.736288 -0.547677
```

Display the index, columns, and the underlying numpy data.

You can also retrieve the index; the index column can be ascribed to a DataFrame, see later

```
[20]: kdf.index
```

```
[20]: Int64Index([0, 1, 2, 3, 4, 5], dtype='int64')
```

```
[21]: kdf.columns
```

```
[21]: Index(['A', 'B', 'C', 'D'], dtype='object')
```

```
[22]: kdf.to_numpy()
```

```
[22]: array([[-0.40729126,  0.06655086, -0.07314879,  0.64821874],
             [-0.84873527,  0.43727686,  0.63265661,  0.31286082],
             [-0.41553693, -1.78707173,  0.24222142,  0.12554346],
             [-1.63727052,  1.13480992,  0.28253243,  0.13399483],
             [-1.23047665, -1.92573423,  0.73628794, -0.54767653],
             [ 1.09289432, -1.07128129,  0.31875225, -0.47759067]])
```

Describe shows a quick statistic summary of your data

```
[23]: kdf.describe()
```

```
[23]:              A         B         C         D
      count  6.000000  6.000000  6.000000  6.000000
      mean  -0.574403 -0.524242  0.356550  0.032558
      std    0.945349  1.255721  0.291566  0.463350
      min   -1.637271 -1.925734 -0.073149 -0.547677
      25%   -1.230477 -1.787072  0.242221 -0.477591
      50%   -0.848735 -1.071281  0.282532  0.125543
```

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```
75%   -0.407291  0.437277  0.632657  0.312861
max    1.092894  1.134810  0.736288  0.648219
```

Transposing your data

[24]:
```
kdf.T
```

[24]:
```
          0         1         2         3         4         5
A -0.407291 -0.848735 -0.415537 -1.637271 -1.230477  1.092894
B  0.066551  0.437277 -1.787072  1.134810 -1.925734 -1.071281
C -0.073149  0.632657  0.242221  0.282532  0.736288  0.318752
D  0.648219  0.312861  0.125543  0.133995 -0.547677 -0.477591
```

Sorting by its index

[25]:
```
kdf.sort_index(ascending=False)
```

[25]:
```
          A         B         C         D
5  1.092894 -1.071281  0.318752 -0.477591
4 -1.230477 -1.925734  0.736288 -0.547677
3 -1.637271  1.134810  0.282532  0.133995
2 -0.415537 -1.787072  0.242221  0.125543
1 -0.848735  0.437277  0.632657  0.312861
0 -0.407291  0.066551 -0.073149  0.648219
```

Sorting by value

[26]:
```
kdf.sort_values(by='B')
```

[26]:
```
          A         B         C         D
4 -1.230477 -1.925734  0.736288 -0.547677
2 -0.415537 -1.787072  0.242221  0.125543
5  1.092894 -1.071281  0.318752 -0.477591
0 -0.407291  0.066551 -0.073149  0.648219
1 -0.848735  0.437277  0.632657  0.312861
3 -1.637271  1.134810  0.282532  0.133995
```

1.2.3 Missing Data

Koalas primarily uses the value `np.nan` to represent missing data. It is by default not included in computations.

[27]:
```
pdf1 = pdf.reindex(index=dates[0:4], columns=list(pdf.columns) + ['E'])
```

[28]:
```
pdf1.loc[dates[0]:dates[1], 'E'] = 1
```

[29]:
```
kdf1 = ks.from_pandas(pdf1)
```

[30]:
```
kdf1
```

[30]:
```
                   A         B         C         D    E
2013-01-01 -0.407291  0.066551 -0.073149  0.648219  1.0
2013-01-02 -0.848735  0.437277  0.632657  0.312861  1.0
2013-01-03 -0.415537 -1.787072  0.242221  0.125543  NaN
2013-01-04 -1.637271  1.134810  0.282532  0.133995  NaN
```

To drop any rows that have missing data.

[31]:
```
kdf1.dropna(how='any')
```

[31]:
```
                   A         B         C         D    E
2013-01-01 -0.407291  0.066551 -0.073149  0.648219  1.0
2013-01-02 -0.848735  0.437277  0.632657  0.312861  1.0
```

Filling missing data.

[32]:
```
kdf1.fillna(value=5)
```

[32]:
```
                   A         B         C         D    E
2013-01-01 -0.407291  0.066551 -0.073149  0.648219  1.0
2013-01-02 -0.848735  0.437277  0.632657  0.312861  1.0
2013-01-03 -0.415537 -1.787072  0.242221  0.125543  5.0
2013-01-04 -1.637271  1.134810  0.282532  0.133995  5.0
```

1.2.4 Operations

Stats

Operations in general exclude missing data.

Performing a descriptive statistic:

[33]:
```
kdf.mean()
```

[33]:
```
A   -0.574403
B   -0.524242
C    0.356550
D    0.032558
dtype: float64
```

Spark Configurations

Various configurations in PySpark could be applied internally in Koalas. For example, you can enable Arrow optimization to hugely speed up internal pandas conversion. See PySpark Usage Guide for Pandas with Apache Arrow.

[34]:
```
prev = spark.conf.get("spark.sql.execution.arrow.enabled")  # Keep its default value.
ks.set_option("compute.default_index_type", "distributed")  # Use default index␣
↪prevent overhead.
import warnings
warnings.filterwarnings("ignore")  # Ignore warnings coming from Arrow optimizations.
```

[35]:
```
spark.conf.set("spark.sql.execution.arrow.enabled", True)
%timeit ks.range(300000).to_pandas()
```

```
493 ms ± 157 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

[36]:
```
spark.conf.set("spark.sql.execution.arrow.enabled", False)
%timeit ks.range(300000).to_pandas()
```

```
1.39 s ± 109 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

[37]:
```
ks.reset_option("compute.default_index_type")
spark.conf.set("spark.sql.execution.arrow.enabled", prev)  # Set its default value␣
↪back.
```

1.2.5 Grouping

By "group by" we are referring to a process involving one or more of the following steps:

- Splitting the data into groups based on some criteria
- Applying a function to each group independently
- Combining the results into a data structure

[38]:
```
kdf = ks.DataFrame({'A': ['foo', 'bar', 'foo', 'bar',
                          'foo', 'bar', 'foo', 'foo'],
                    'B': ['one', 'one', 'two', 'three',
                          'two', 'two', 'one', 'three'],
                    'C': np.random.randn(8),
                    'D': np.random.randn(8)})
```

[39]:
```
kdf
```

[39]:
```
     A      B         C         D
0  foo    one  1.028745 -0.804571
1  bar    one  0.593379 -1.592110
2  foo    two  0.051362  0.466273
3  bar  three  0.977622 -0.822670
4  foo    two -1.105357 -0.027466
5  bar    two -0.009076  0.977587
6  foo    one  0.643092  0.403405
7  foo  three -1.451129  0.230347
```

Grouping and then applying the sum() function to the resulting groups.

[40]:
```
kdf.groupby('A').sum()
```

[40]:
```
            C         D
A
bar  1.561925 -1.437193
foo -0.833286  0.267988
```

Grouping by multiple columns forms a hierarchical index, and again we can apply the sum function.

[41]:
```
kdf.groupby(['A', 'B']).sum()
```

[41]:
```
                  C         D
A   B
bar one    0.593379 -1.592110
    three  0.977622 -0.822670
    two   -0.009076  0.977587
foo one    1.671837 -0.401166
    three -1.451129  0.230347
    two   -1.053995  0.438807
```

1.2.6 Plotting

See the Plotting docs.

[42]:
```
%matplotlib inline
from matplotlib import pyplot as plt
```

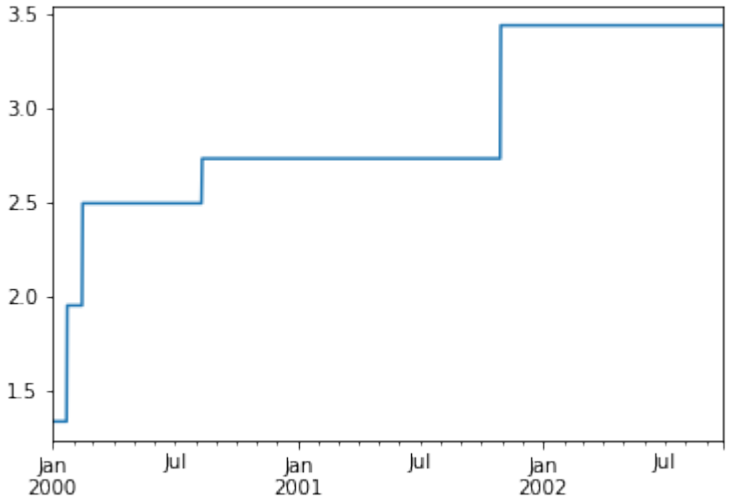
[43]:
```
pser = pd.Series(np.random.randn(1000),
                 index=pd.date_range('1/1/2000', periods=1000))
```

[44]:
```
kser = ks.Series(pser)
```

[45]:
```
kser = kser.cummax()
```

[46]:
```
kser.plot()
```

[46]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7feeb4b350b8>
```



On a DataFrame, the plot() method is a convenience to plot all of the columns with labels:

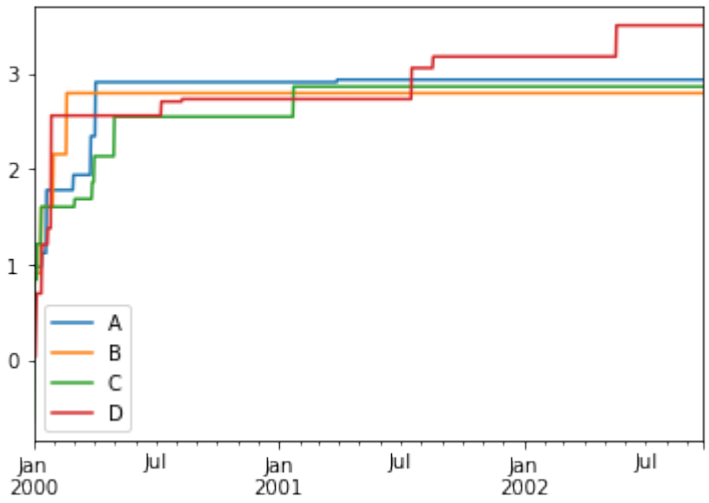
[47]:
```
pdf = pd.DataFrame(np.random.randn(1000, 4), index=pser.index,
                   columns=['A', 'B', 'C', 'D'])
```

[48]:
```
kdf = ks.from_pandas(pdf)
```

[49]:
```
kdf = kdf.cummax()
```

[50]:
```
kdf.plot()
```

[50]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7feebe266978>
```



1.2.7 Getting data in/out

See the Input/Output docs.

CSV

CSV is straightforward and easy to use. See here to write a CSV file and here to read a CSV file.

[51]:
```
kdf.to_csv('foo.csv')
ks.read_csv('foo.csv').head(10)
```

[51]:

	A	B	C	D
0	0.976091	0.910572	-0.640756	0.034655
1	0.976091	0.910572	-0.150827	0.034655
2	0.976091	0.910572	0.796879	0.034655
3	0.976091	0.910572	0.849741	0.034655
4	0.976091	0.910572	0.849741	0.370709
5	0.976091	0.910572	0.849741	0.698402
6	0.976091	0.910572	1.217456	0.698402
7	0.976091	0.910572	1.217456	0.698402
8	0.976091	0.910572	1.217456	0.698402
9	0.976091	0.910572	1.217456	0.698402

Parquet

Parquet is an efficient and compact file format to read and write faster. See here to write a Parquet file and here to read a Parquet file.

[52]:
```
kdf.to_parquet('bar.parquet')
ks.read_parquet('bar.parquet').head(10)
```

[52]:

	A	B	C	D
0	0.976091	0.910572	-0.640756	0.034655
1	0.976091	0.910572	-0.150827	0.034655
2	0.976091	0.910572	0.796879	0.034655

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```
3  0.976091  0.910572  0.849741  0.034655
4  0.976091  0.910572  0.849741  0.370709
5  0.976091  0.910572  0.849741  0.698402
6  0.976091  0.910572  1.217456  0.698402
7  0.976091  0.910572  1.217456  0.698402
8  0.976091  0.910572  1.217456  0.698402
9  0.976091  0.910572  1.217456  0.698402
```

Spark IO

In addition, Koalas fully support Spark's various datasources such as ORC and an external datasource. See here to write it to the specified datasource and here to read it from the datasource.

[53]:
```
kdf.to_spark_io('zoo.orc', format="orc")
ks.read_spark_io('zoo.orc', format="orc").head(10)
```

[53]:
```
          A         B         C         D
0  0.976091  0.910572 -0.640756  0.034655
1  0.976091  0.910572 -0.150827  0.034655
2  0.976091  0.910572  0.796879  0.034655
3  0.976091  0.910572  0.849741  0.034655
4  0.976091  0.910572  0.849741  0.370709
5  0.976091  0.910572  0.849741  0.698402
6  0.976091  0.910572  1.217456  0.698402
7  0.976091  0.910572  1.217456  0.698402
8  0.976091  0.910572  1.217456  0.698402
9  0.976091  0.910572  1.217456  0.698402
```

1.3 Koalas Talks and Blogs

1.3.1 Blog Posts

- Interoperability between Koalas and Apache Spark (Aug 11, 2020)
- Introducing Koalas 1.0 (Jun 24, 2020)
- 10 Minutes from pandas to Koalas on Apache Spark (Mar 31, 2020)
- Guest Blog: How Virgin Hyperloop One Reduced Processing Time from Hours to Minutes with Koalas (Aug 22, 2019)
- Koalas: Easy Transition from pandas to Apache Spark (Apr 24, 2019)

1.3.2 Data + AI Summit 2020 EUROPE (Nov 18-19, 2020)

Project Zen: Making Spark Pythonic

Koalas: Interoperability Between Koalas and Apache Spark

1.3.3 Spark + AI Summit 2020 (Jun 24, 2020)

Introducing Apache Spark 3.0: A retrospective of the Last 10 Years, and a Look Forward to the Next 10 Years to Come.

Koalas: Making an Easy Transition from Pandas to Apache Spark

Koalas: Pandas on Apache Spark

1.3.4 Webinar @ Databricks (Mar 27, 2020)

Reducing Time-To-Insight for Virgin Hyperloop's Data

1.3.5 PyData New York 2019 (Nov 4, 2019)

Pandas vs Koalas: The Ultimate Showdown

1.3.6 Spark + AI Summit Europe 2019 (Oct 16, 2019)

New Developments in the Open Source Ecosystem: Apache Spark 3.0, Delta Lake, and Koalas

Koalas: Making an Easy Transition from Pandas to Apache Spark

Koalas: Pandas on Apache Spark

1.3.7 PyBay 2019 (Aug 17, 2019)

Koalas Easy Transition from pandas to Apache Spark

1.3.8 Spark + AI Summit 2019 (Apr 24, 2019)

Official Announcement of Koalas Open Source Project

CHAPTER

TWO

USER GUIDE

2.1 Options and settings

Koalas has an options system that lets you customize some aspects of its behaviour, display-related options being those the user is most likely to adjust.

Options have a full "dotted-style", case-insensitive name (e.g. `display.max_rows`). You can get/set options directly as attributes of the top-level `options` attribute:

```
>>> import databricks.koalas as ks
>>> ks.options.display.max_rows
1000
>>> ks.options.display.max_rows = 10
>>> ks.options.display.max_rows
10
```

The API is composed of 3 relevant functions, available directly from the `koalas` namespace:

- *`get_option()`* / *`set_option()`* - get/set the value of a single option.
- *`reset_option()`* - reset one or more options to their default value.

Note: Developers can check out databricks/koalas/config.py for more information.

```
>>> import databricks.koalas as ks
>>> ks.get_option("display.max_rows")
1000
>>> ks.set_option("display.max_rows", 101)
>>> ks.get_option("display.max_rows")
101
```

2.1.1 Getting and setting options

As described above, *`get_option()`* and *`set_option()`* are available from the koalas namespace. To change an option, call `set_option('option name', new_value)`.

```
>>> import databricks.koalas as ks
>>> ks.get_option('compute.max_rows')
1000
>>> ks.set_option('compute.max_rows', 2000)
>>> ks.get_option('compute.max_rows')
2000
```

All options also have a default value, and you can use `reset_option` to do just that:

```
>>> import databricks.koalas as ks
>>> ks.reset_option("display.max_rows")
```

```
>>> import databricks.koalas as ks
>>> ks.get_option("display.max_rows")
1000
>>> ks.set_option("display.max_rows", 999)
>>> ks.get_option("display.max_rows")
999
>>> ks.reset_option("display.max_rows")
>>> ks.get_option("display.max_rows")
1000
```

`option_context` context manager has been exposed through the top-level API, allowing you to execute code with given option values. Option values are restored automatically when you exit the *with* block:

```
>>> with ks.option_context("display.max_rows", 10, "compute.max_rows", 5):
...     print(ks.get_option("display.max_rows"))
...     print(ks.get_option("compute.max_rows"))
10
5
>>> print(ks.get_option("display.max_rows"))
>>> print(ks.get_option("compute.max_rows"))
1000
1000
```

2.1.2 Operations on different DataFrames

Koalas disallows the operations on different DataFrames (or Series) by default to prevent expensive operations. It internally performs a join operation which can be expensive in general.

This can be enabled by setting *compute.ops_on_diff_frames* to *True* to allow such cases. See the examples below.

```
>>> import databricks.koalas as ks
>>> ks.set_option('compute.ops_on_diff_frames', True)
>>> kdf1 = ks.range(5)
>>> kdf2 = ks.DataFrame({'id': [5, 4, 3]})
>>> (kdf1 - kdf2).sort_index()
    id
0 -5.0
1 -3.0
2 -1.0
3  NaN
4  NaN
>>> ks.reset_option('compute.ops_on_diff_frames')
```

```
>>> import databricks.koalas as ks
>>> ks.set_option('compute.ops_on_diff_frames', True)
>>> kdf = ks.range(5)
>>> kser_a = ks.Series([1, 2, 3, 4])
>>> # 'kser_a' is not from 'kdf' DataFrame. So it is considered as a Series not from
↪'kdf'.
>>> kdf['new_col'] = kser_a
>>> kdf
   id  new_col
```

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```
0   0      1.0
1   1      2.0
3   3      4.0
2   2      3.0
4   4      NaN
>>> ks.reset_option('compute.ops_on_diff_frames')
```

2.1.3 Default Index type

In Koalas, the default index is used in several cases, for instance, when Spark DataFrame is converted into Koalas DataFrame. In this case, internally Koalas attaches a default index into Koalas DataFrame.

There are several types of the default index that can be configured by *compute.default_index_type* as below:

sequence: It implements a sequence that increases one by one, by PySpark's Window function without specifying partition. Therefore, it can end up with whole partition in single node. This index type should be avoided when the data is large. This is default. See the example below:

```
>>> import databricks.koalas as ks
>>> ks.set_option('compute.default_index_type', 'sequence')
>>> kdf = ks.range(3)
>>> ks.reset_option('compute.default_index_type')
>>> kdf.index
Int64Index([0, 1, 2], dtype='int64')
```

This is conceptually equivalent to the PySpark example as below:

```
>>> from pyspark.sql import functions as F, Window
>>> import databricks.koalas as ks
>>> spark_df = ks.range(3).to_spark()
>>> sequential_index = F.row_number().over(
...     Window.orderBy(F.monotonically_increasing_id().asc())) - 1
>>> spark_df.select(sequential_index).rdd.map(lambda r: r[0]).collect()
[0, 1, 2]
```

distributed-sequence: It implements a sequence that increases one by one, by group-by and group-map approach in a distributed manner. It still generates the sequential index globally. If the default index must be the sequence in a large dataset, this index has to be used. Note that if more data are added to the data source after creating this index, then it does not guarantee the sequential index. See the example below:

```
>>> import databricks.koalas as ks
>>> ks.set_option('compute.default_index_type', 'distributed-sequence')
>>> kdf = ks.range(3)
>>> ks.reset_option('compute.default_index_type')
>>> kdf.index
Int64Index([0, 1, 2], dtype='int64')
```

This is conceptually equivalent to the PySpark example as below:

```
>>> import databricks.koalas as ks
>>> spark_df = ks.range(3).to_spark()
>>> spark_df.rdd.zipWithIndex().map(lambda p: p[1]).collect()
[0, 1, 2]
```

distributed: It implements a monotonically increasing sequence simply by using PySpark's *monotonically_increasing_id* function in a fully distributed manner. The values are indeterministic. If the index does not

have to be a sequence that increases one by one, this index should be used. Performance-wise, this index almost does not have any penalty comparing to other index types. See the example below:

```
>>> import databricks.koalas as ks
>>> ks.set_option('compute.default_index_type', 'distributed')
>>> kdf = ks.range(3)
>>> ks.reset_option('compute.default_index_type')
>>> kdf.index
Int64Index([25769803776, 60129542144, 94489280512], dtype='int64')
```

This is conceptually equivalent to the PySpark example as below:

```
>>> from pyspark.sql import functions as F
>>> import databricks.koalas as ks
>>> spark_df = ks.range(3).to_spark()
>>> spark_df.select(F.monotonically_increasing_id()) \
...     .rdd.map(lambda r: r[0]).collect()
[25769803776, 60129542144, 94489280512]
```

Warning: It is very unlikely for this type of index to be used for computing two different dataframes because it is not guaranteed to have the same indexes in two dataframes. If you use this default index and turn on *compute.ops_on_diff_frames*, the result from the operations between two different DataFrames will likely be an unexpected output due to the indeterministic index values.

2.1.4 Available options

Option	Default	Description
display.max_rows	1000	This sets the maximum number of rows Koalas should output when printing out various output. For example, this value determines the number of rows to be shown at the repr() in a dataframe. Set *None* to unlimit the input length. Default is 1000.
compute.max_rows	1000	'compute.max_rows' sets the limit of the current DataFrame. Set *None* to unlimit the input length. When the limit is set, it is executed by the shortcut by collecting the data into driver side, and then using pandas API. If the limit is unset, the operation is executed by PySpark. Default is 1000.
compute.shortcut_limit	1000	'compute.shortcut_limit' sets the limit for a shortcut. It computes specified number of rows and use its schema. When the dataframe length is larger than this limit, Koalas uses PySpark to compute.
compute.ops_on_diff_frames	False	This determines whether or not to operate between two different dataframes. For example, 'combine_frames' function internally performs a join operation which can be expensive in general. So, if *compute.ops_on_diff_frames* variable is not True, that method throws an exception.
compute.default_index_type	'sequence'	This sets the default index type: sequence, distributed and distributed-sequence.
compute.ordered_head	False	'compute.ordered_head' sets whether or not to operate head with natural ordering. Koalas does not guarantee the row ordering so *head* could return some rows from distributed partitions. If 'compute.ordered_head' is set to True, Koalas performs natural ordering beforehand, but it will cause a performance overhead.
plotting.max_rows	1000	'plotting.max_rows' sets the visual limit on top-n- based plots such as *plot.bar* and *plot.pie*. If it is set to 1000, the first 1000 data points will be used for plotting. Default is 1000.
plotting.sample_ratio	None	'plotting.sample_ratio' sets the proportion of data that will be plotted for sample-based plots such as *plot.line* and *plot.area*. This option defaults to 'plotting.max_rows' option.
plotting.backend	'matplotlib'	Backend to use for plotting. Default is matplotlib. Supports any package that has a top-level *plot* method. Some options are: [matplotlib, plotly, pandas_bokeh, pandas_altair].

2.2 Working with pandas and PySpark

Users from pandas and/or PySpark face API compatibility issue sometimes when they work with Koalas. Since Koalas does not target 100% compatibility of both pandas and PySpark, users need to do some workaround to port their pandas and/or PySpark codes or get familiar with Koalas in this case. This page aims to describe it.

2.2.1 pandas

pandas users can access to full pandas APIs by calling `DataFrame.to_pandas()`. Koalas DataFrame and pandas DataFrame are similar. However, the former is distributed and the latter is in a single machine. When converting to each other, the data is transferred between multiple machines and the single client machine.

For example, if you need to call `pandas_df.values` of pandas DataFrame, you can do as below:

```
>>> import databricks.koalas as ks
>>>
>>> kdf = ks.range(10)
>>> pdf = kdf.to_pandas()
>>> pdf.values
array([[0],
```

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```
       [1],
       [2],
       [3],
       [4],
       [5],
       [6],
       [7],
       [8],
       [9]])
```

pandas DataFrame can be a Koalas DataFrame easily as below:

```
>>> ks.from_pandas(pdf)
   id
0   0
1   1
2   2
3   3
4   4
5   5
6   6
7   7
8   8
9   9
```

Note that converting Koalas DataFrame to pandas requires to collect all the data into the client machine; therefore, if possible, it is recommended to use Koalas or PySpark APIs instead.

2.2.2 PySpark

PySpark users can access to full PySpark APIs by calling *DataFrame.to_spark()*. Koalas DataFrame and Spark DataFrame are virtually interchangeable.

For example, if you need to call `spark_df.filter(...)` of Spark DataFrame, you can do as below:

```
>>> import databricks.koalas as ks
>>>
>>> kdf = ks.range(10)
>>> sdf = kdf.to_spark().filter("id > 5")
>>> sdf.show()
+---+
| id|
+---+
|  6|
|  7|
|  8|
|  9|
+---+
```

Spark DataFrame can be a Koalas DataFrame easily as below:

```
>>> sdf.to_koalas()
   id
0   6
1   7
```

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```
2   8
3   9
```

However, note that it requires to create new default index in case Koalas DataFrame is created from Spark DataFrame. See *Default Index Type*. In order to avoid this overhead, specify the column to use as an index when possible.

```
>>> # Create a Koalas DataFrame with an explicit index.
... kdf = ks.DataFrame({'id': range(10)}, index=range(10))
>>> # Keep the explicit index.
... sdf = kdf.to_spark(index_col='index')
>>> # Call Spark APIs
... sdf = sdf.filter("id > 5")
>>> # Uses the explicit index to avoid to create default index.
... sdf.to_koalas(index_col='index')
       id
index
6       6
7       7
8       8
9       9
```

2.3 Transform and apply a function

There are many APIs that allow users to apply a function against Koalas DataFrame such as *DataFrame.transform()*, *DataFrame.apply()*, *DataFrame.koalas.transform_batch()*, *DataFrame.koalas.apply_batch()*, *Series.koalas.transform_batch()*, etc. Each has a distinct purpose and works differently internally. This section describes the differences among them where users are confused often.

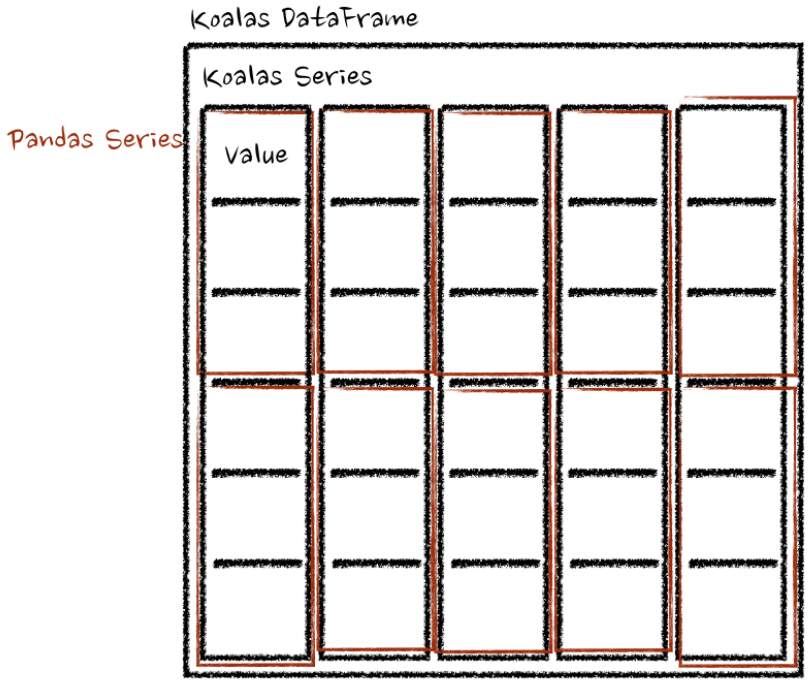
2.3.1 `transform` and `apply`

The main difference between *DataFrame.transform()* and *DataFrame.apply()* is that the former requires to return the same length of the input and the latter does not require this. See the example below:

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pser):
...     return pser + 1  # should always return the same length as input.
...
>>> kdf.transform(pandas_plus)
```

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[5,6,7]})
>>> def pandas_plus(pser):
...     return pser[pser % 2 == 1]  # allows an arbitrary length
...
>>> kdf.apply(pandas_plus)
```

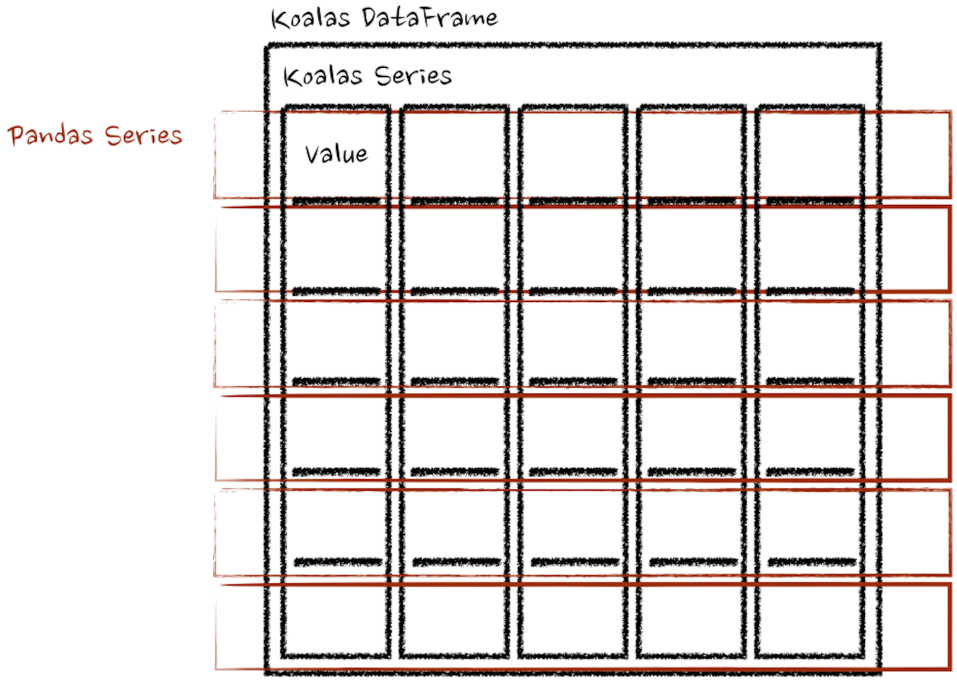
In this case, each function takes a pandas Series, and Koalas computes the functions in a distributed manner as below.



In case of 'column' axis, the function takes each row as a pandas Series.

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pser):
...     return sum(pser)  # allows an arbitrary length
...
>>> kdf.apply(pandas_plus, axis='columns')
```

The example above calculates the summation of each row as a pandas Series. See below:



In the examples above, the type hints were not used for simplicity but it is encouraged to use to avoid performance penalty. Please refer the API documentations.

2.3.2 `koalas.transform_batch` and `koalas.apply_batch`

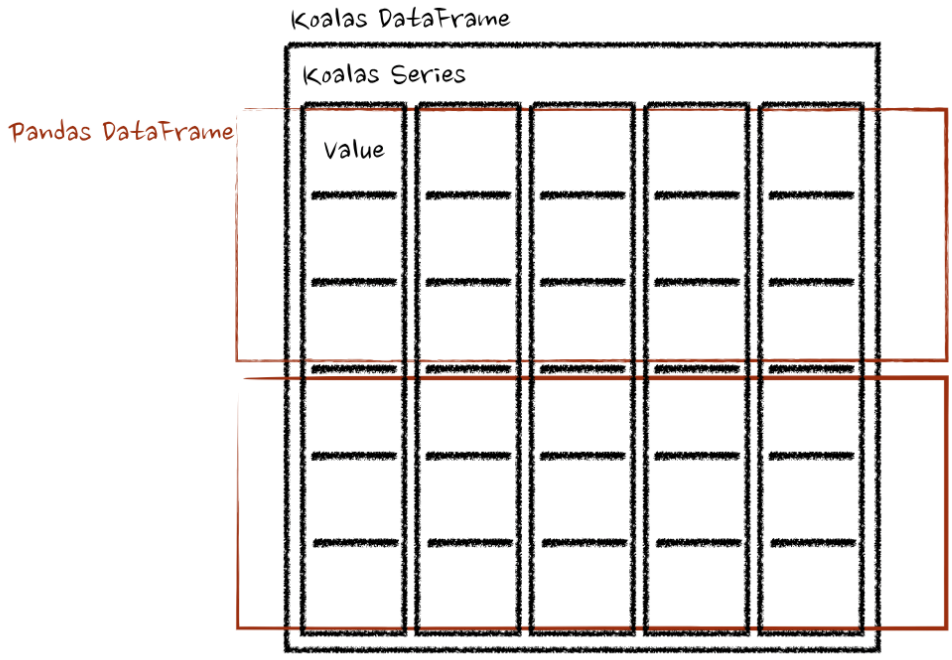
In *`DataFrame.koalas.transform_batch()`*, *`DataFrame.koalas.apply_batch()`*, *`Series.koalas.transform_batch()`*, etc., the `batch` postfix means each chunk in Koalas DataFrame or Series. The APIs slice the Koalas DataFrame or Series, and then applies the given function with pandas DataFrame or Series as input and output. See the examples below:

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pdf):
...     return pdf + 1  # should always return the same length as input.
...
>>> kdf.koalas.transform_batch(pandas_plus)
```

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pdf):
...     return pdf[pdf.a > 1]  # allow arbitrary length
...
>>> kdf.koalas.apply_batch(pandas_plus)
```

The functions in both examples take a pandas DataFrame as a chunk of Koalas DataFrame, and output a pandas DataFrame. Koalas combines the pandas DataFrames as a Koalas DataFrame.

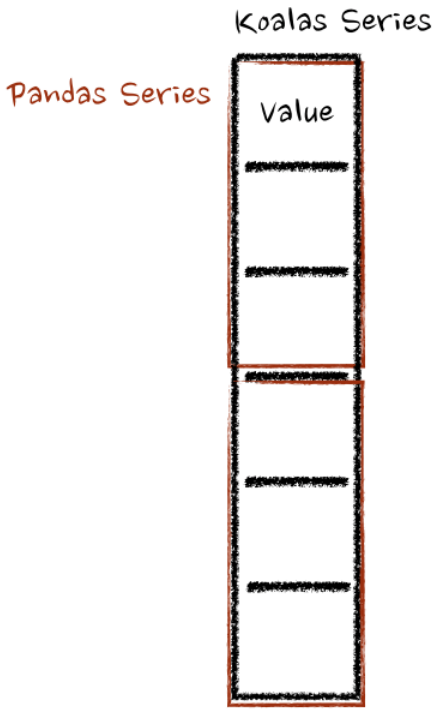
Note that *`DataFrame.koalas.transform_batch()`* has the length restriction - the length of input and output should be the same whereas *`DataFrame.koalas.apply_batch()`* does not. However, it is important to know that the output belongs to the same DataFrame when *`DataFrame.koalas.transform_batch()`* can a Series, and you can avoid a shuffle by the operations between different DataFrames. In case of *`DataFrame.koalas.apply_batch()`*, its output is always treated that it belongs to a new different DataFrame. See also *Operations on different DataFrames* for more details.



In case of *Series.koalas.transform_batch()*, it is also similar with *DataFrame.koalas.transform_batch()*; however, it takes a pandas Series as a chunk of Koalas Series.

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pser):
...     return pser + 1  # should always return the same length as input.
...
>>> kdf.a.koalas.transform_batch(pandas_plus)
```

Under the hood, each batch of Koalas Series is split to multiple pandas Series, and each function computes on that as below:



There are more details such as the type inference and preventing its performance penalty. Please refer the API documentations.

2.4 Type Support In Koalas

In this chapter, we will briefly show you how data types change when converting Koalas DataFrame from/to PySpark DataFrame or pandas DataFrame.

2.4.1 Type casting between PySpark and Koalas

When converting a Koalas DataFrame from/to PySpark DataFrame, the data types are automatically casted to the appropriate type.

The example below shows how data types are casted from PySpark DataFrame to Koalas DataFrame.

```
# 1. Create a PySpark DataFrame
>>> sdf = spark.createDataFrame([
...     (1, Decimal(1.0), 1., 1., 1, 1, 1, datetime(2020, 10, 27), "1", True,␣
↪datetime(2020, 10, 27)),
... ], 'tinyint tinyint, decimal decimal, float float, double double, integer integer,
↪ long long, short short, timestamp timestamp, string string, boolean boolean, date␣
↪date')

# 2. Check the PySpark data types
>>> sdf
```

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```
DataFrame[tinyint: tinyint, decimal: decimal(10,0), float: float, double: double,␣
↪integer: int, long: bigint, short: smallint, timestamp: timestamp, string: string,␣
↪boolean: boolean, date: date]

# 3. Convert PySpark DataFrame to Koalas DataFrame
>>> kdf = sdf.to_koalas()

# 4. Check the Koalas data types
>>> kdf.dtypes
tinyint                int8
decimal              object
float               float32
double              float64
integer               int32
long                  int64
short                 int16
timestamp    datetime64[ns]
string               object
boolean                bool
date                 object
dtype: object
```

The example below shows how data types are casted from Koalas DataFrame to PySpark DataFrame.

```
# 1. Create a Koalas DataFrame
>>> kdf = ks.DataFrame({"int8": [1], "bool": [True], "float32": [1.0], "float64": [1.
↪0], "int32": [1], "int64": [1], "int16": [1], "datetime": [datetime.datetime(2020,␣
↪10, 27)], "object_string": ["1"], "object_decimal": [decimal.Decimal("1.1")],
↪"object_date": [datetime.date(2020, 10, 27)]})

# 2. Type casting by using `astype`
>>> kdf['int8'] = kdf['int8'].astype('int8')
>>> kdf['int16'] = kdf['int16'].astype('int16')
>>> kdf['int32'] = kdf['int32'].astype('int32')
>>> kdf['float32'] = kdf['float32'].astype('float32')

# 3. Check the Koalas data types
>>> kdf.dtypes
int8                          int8
bool                          bool
float32                    float32
float64                    float64
int32                        int32
int64                        int64
int16                        int16
datetime           datetime64[ns]
object_string              object
object_decimal             object
object_date                object
dtype: object

# 4. Convert Koalas DataFrame to PySpark DataFrame
>>> sdf = kdf.to_spark()

# 5. Check the PySpark data types
>>> sdf
DataFrame[int8: tinyint, bool: boolean, float32: float, float64: double, int32: int,␣
↪int64: bigint, int16: smallint, datetime: timestamp, object_string: string, object_
↪decimal: decimal(2,1), object_date: date]
```

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2.4.2 Type casting between pandas and Koalas

When converting Koalas DataFrame to pandas DataFrame, and the data types are basically same as pandas.

```
# Convert Koalas DataFrame to pandas DataFrame
>>> pdf = kdf.to_pandas()

# Check the pandas data types
>>> pdf.dtypes
int8                          int8
bool                          bool
float32                    float32
float64                    float64
int32                        int32
int64                        int64
int16                        int16
datetime           datetime64[ns]
object_string              object
object_decimal             object
object_date                object
dtype: object
```

However, there are several data types only provided by pandas.

```
# pd.Catrgorical type is not supported in Koalas yet.
>>> ks.Series([pd.Categorical([1, 2, 3])])
Traceback (most recent call last):
...
pyarrow.lib.ArrowInvalid: Could not convert [1, 2, 3]
Categories (3, int64): [1, 2, 3] with type Categorical: did not recognize Python␣
↪value type when inferring an Arrow data type
```

These kind of pandas specific data types below are not currently supported in Koalas but planned to be supported.

- pd.Timedelta
- pd.Categorical
- pd.CategoricalDtype

The pandas specific data types below are not planned to be supported in Koalas yet.

- pd.SparseDtype
- pd.DatetimeTZDtype
- pd.UInt*Dtype
- pd.BooleanDtype
- pd.StringDtype

2.4.3 Internal type mapping

The table below shows which NumPy data types are matched to which PySpark data types internally in Koalas.

NumPy	PySpark
np.character	BinaryType
np.bytes_	BinaryType
np.string_	BinaryType
np.int8	ByteType
np.byte	ByteType
np.int16	ShortType
np.int32	IntegerType
np.int64	LongType
np.int	LongType
np.float32	FloatType
np.float	DoubleType
np.float64	DoubleType
np.str	StringType
np.unicode_	StringType
np.bool	BooleanType
np.datetime64	TimestampType
np.ndarray	ArrayType(StringType())

The table below shows which Python data types are matched to which PySpark data types internally in Koalas.

Python	PySpark
bytes	BinaryType
int	LongType
float	DoubleType
str	StringType
bool	BooleanType
datetime.datetime	TimestampType
datetime.date	DateType
decimal.Decimal	DecimalType(38, 18)

For decimal type, Koalas uses Spark's system default precision and scale.

You can check this mapping by using *as_spark_type* function.

```
>>> import typing
>>> import numpy as np
>>> from databricks.koalas.typedef import as_spark_type

>>> as_spark_type(int)
LongType

>>> as_spark_type(np.int32)
IntegerType

>>> as_spark_type(typing.List[float])
ArrayType(DoubleType,true)
```

You can also check the underlying PySpark data type of *Series* or schema of *DataFrame* by using Spark accessor.

```
>>> ks.Series([0.3, 0.1, 0.8]).spark.data_type
DoubleType

>>> ks.Series(["welcome", "to", "Koalas"]).spark.data_type
StringType

>>> ks.Series([[False, True, False]]).spark.data_type
ArrayType(BooleanType,true)

>>> ks.DataFrame({"d": [0.3, 0.1, 0.8], "s": ["welcome", "to", "Koalas"], "b": [False,
↪ True, False]}).spark.print_schema()
root
 |-- d: double (nullable = false)
 |-- s: string (nullable = false)
 |-- b: boolean (nullable = false)
```

2.5 Type Hints In Koalas

Koalas, by default, infers the schema by taking some top records from the output, in particular, when you use APIs that allow users to apply a function against Koalas DataFrame such as *DataFrame.transform()*, *DataFrame.apply()*, *DataFrame.koalas.apply_batch()*, *DataFrame.koalas.apply_batch()*, `Series.koalas.apply_batch()`, etc.

However, this is potentially expensive. If there are several expensive operations such as a shuffle in the upstream of the execution plan, Koalas will end up with executing the Spark job twice, once for schema inference, and once for processing actual data with the schema.

To avoid the consequences, Koalas has its own type hinting style to specify the schema to avoid schema inference. Koalas understands the type hints specified in the return type and converts it as a Spark schema for pandas UDFs used internally. The way of type hinting has been evolved over the time.

In this chapter, it covers the recommended way and the supported ways in details.

2.5.1 Koalas DataFrame and Pandas DataFrame

In the early Koalas version, it was introduced to specify a type hint in the function in order to use it as a Spark schema. As an example, you can specify the return type hint as below by using Koalas *DataFrame*.

```
>>> def pandas_div(pdf) -> ks.DataFrame[float, float]:
...     # pdf is a pandas DataFrame.
...     return pdf[['B', 'C']] / pdf[['B', 'C']]
...
>>> df = ks.DataFrame({'A': ['a', 'a', 'b'], 'B': [1, 2, 3], 'C': [4, 6, 5]})
>>> df.groupby('A').apply(pandas_div)
```

The function `pandas_div` actually takes and outputs a pandas DataFrame instead of Koalas *DataFrame*. However, Koalas has to force to set the mismatched type hints.

From Koalas 1.0 with Python 3.7+, now you can specify the type hints by using pandas instances.

```
>>> def pandas_div(pdf) -> pd.DataFrame[float, float]:
...     # pdf is a pandas DataFrame.
...     return pdf[['B', 'C']] / pdf[['B', 'C']]
...
```

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```
>>> df = ks.DataFrame({'A': ['a', 'a', 'b'], 'B': [1, 2, 3], 'C': [4, 6, 5]})
>>> df.groupby('A').apply(pandas_div)
```

Likewise, pandas Series can be also used as a type hints:

```
>>> def sqrt(x) -> pd.Series[float]:
...     return np.sqrt(x)
...
>>> df = ks.DataFrame([[4, 9]] * 3, columns=['A', 'B'])
>>> df.apply(sqrt, axis=0)
```

Currently, both Koalas and pandas instances can be used to specify the type hints; however, Koalas plans to move gradually towards using pandas instances only as the stability becomes proven.

2.5.2 Type Hinting with Names

In Koalas 1.0, the new style of type hinting was introduced to overcome the limitations in the existing type hinting especially for DataFrame. When you use a DataFrame as the return type hint, for example, `DataFrame[int, int]`, there is no way to specify the names of each Series. In the old way, Koalas just generates the column names as `c#` and this easily leads users to lose or forgot the Series mappings. See the example below:

```
>>> def transform(pdf) -> pd.DataFrame[int, int]:
...     pdf['A'] = pdf.id + 1
...     return pdf
...
>>> ks.range(5).koalas.apply_batch(transform)
```

```
   c0  c1
0   0   1
1   1   2
2   2   3
3   3   4
4   4   5
```

The new style of type hinting in Koalas is similar with the regular Python type hints in variables. The Series name is specified as a string, and the type is specified after a colon. The following example shows a simple case with the Series names, `id` and `A`, and `int` types respectively.

```
>>> def transform(pdf) -> pd.DataFrame["id": int, "A": int]:
...     pdf['A'] = pdf.id + 1
...     return pdf
...
>>> ks.range(5).koalas.apply_batch(transform)
```

```
   id   A
0   0   1
1   1   2
2   2   3
3   3   4
4   4   5
```

In addition, Koalas also dynamically supports `dtype` instance and the column index in pandas so that users can programmatically generate the return type and schema.

```
>>> def transform(pdf) -> pd.DataFrame[zip(pdf.columns, pdf.dtypes)]:
...     return pdf + 1
...
>>> kdf.koalas.apply_batch(transform)
```

Likewise, `dtype` instances from pandas DataFrame can be used alone and let Koalas generate column names.

```
>>> def transform(pdf) -> pd.DataFrame[pdf.dtypes]:
...     return pdf + 1
...
>>> kdf.koalas.apply_batch(transform)
```

Warning: This new style of type hinting is experimental. It could be changed or removed between minor releases without warnings.

2.6 Best Practices

2.6.1 Leverage PySpark APIs

Koalas uses Spark under the hood; therefore, many features and performance optimization are available in Koalas as well. Leverage and combine those cutting-edge features with Koalas.

Existing Spark context and Spark sessions are used out of the box in Koalas. If you already have your own configured Spark context or sessions running, Koalas uses them.

If there is no Spark context or session running in your environment (e.g., ordinary Python interpreter), such configurations can be set to `SparkContext` and/or `SparkSession`. Once Spark context and/or session is created, Koalas can use this context and/or session automatically. For example, if you want to configure the executor memory in Spark, you can do as below:

```
from pyspark import SparkConf, SparkContext
conf = SparkConf()
conf.set('spark.executor.memory', '2g')
# Koalas automatically uses this Spark context with the configurations set.
SparkContext(conf=conf)

import databricks.koalas as ks
...
```

Another common configuration might be Arrow optimization in PySpark. In case of SQL configuration, it can be set into Spark session as below:

```
from pyspark.sql import SparkSession
builder = SparkSession.builder.appName("Koalas")
builder = builder.config("spark.sql.execution.arrow.enabled", "true")
# Koalas automatically uses this Spark session with the configurations set.
builder.getOrCreate()

import databricks.koalas as ks
...
```

All Spark features such as history server, web UI and deployment modes can be used as are with Koalas. If you are interested in performance tuning, please see also Tuning Spark.

2.6.2 Check execution plans

Expensive operations can be predicted by leveraging PySpark API *DataFrame.spark.explain()* before the actual computation since Koalas is based on lazy execution. For example, see below.

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'id': range(10)})
>>> kdf = kdf[kdf.id > 5]
>>> kdf.spark.explain()
== Physical Plan ==
*(1) Filter (id#1L > 5)
+- *(1) Scan ExistingRDD[__index_level_0__#0L,id#1L]
```

Whenever you are not sure about such cases, you can check the actual execution plans and foresee the expensive cases.

Even though Koalas tries its best to optimize and reduce such shuffle operations by leveraging Spark optimizers, it is best to avoid shuffling in the application side whenever possible.

2.6.3 Use checkpoint

After a bunch of operations on Koalas objects, the underlying Spark planner can slow down due to the huge and complex plan. If the Spark plan becomes huge or it takes the planning long time, `DataFrame.spark.checkpoint()` or `DataFrame.spark.local_checkpoint()` would be helpful.

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'id': range(10)})
>>> kdf = kdf[kdf.id > 5]
>>> kdf['id'] = kdf['id'] + (10 * kdf['id'] + kdf['id'])
>>> kdf = kdf.groupby('id').head(2)
>>> kdf.spark.explain()
== Physical Plan ==
*(3) Project [__index_level_0__#0L, id#31L]
+- *(3) Filter (isnotnull(__row_number__#44) AND (__row_number__#44 <= 2))
   +- Window [row_number() windowspecdefinition(__groupkey_0__#36L, __natural_order__
↪#16L ASC NULLS FIRST, specifiedwindowframe(RowFrame, unboundedpreceding$(),␣
↪currentrow$())) AS __row_number__#44], [__groupkey_0__#36L], [__natural_order__#16L␣
↪ASC NULLS FIRST]
      +- *(2) Sort [__groupkey_0__#36L ASC NULLS FIRST, __natural_order__#16L ASC␣
↪NULLS FIRST], false, 0
         +- Exchange hashpartitioning(__groupkey_0__#36L, 200), true, [id=#33]
            +- *(1) Project [__index_level_0__#0L, (id#1L + ((id#1L * 10) + id#1L))␣
↪AS __groupkey_0__#36L, (id#1L + ((id#1L * 10) + id#1L)) AS id#31L, __natural_order__
↪#16L]
               +- *(1) Project [__index_level_0__#0L, id#1L, monotonically_increasing_
↪id() AS __natural_order__#16L]
                  +- *(1) Filter (id#1L > 5)
                     +- *(1) Scan ExistingRDD[__index_level_0__#0L,id#1L]

>>> kdf = kdf.spark.local_checkpoint()  # or kdf.spark.checkpoint()
>>> kdf.spark.explain()
== Physical Plan ==
*(1) Project [__index_level_0__#0L, id#31L]
+- *(1) Scan ExistingRDD[__index_level_0__#0L,id#31L,__natural_order__#59L]
```

As you can see, the previous Spark plan is dropped and starts with a simple plan. The result of the previous DataFrame is stored in the configured file system when calling `DataFrame.spark.checkpoint()`, or in the executor when calling `DataFrame.spark.local_checkpoint()`.

2.6.4 Avoid shuffling

Some operations such as `sort_values` are more difficult to do in a parallel or distributed environment than in in-memory on a single machine because it needs to send data to other nodes, and exchange the data across multiple nodes via networks. See the example below.

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'id': range(10)}).sort_values(by="id")
>>> kdf.spark.explain()
== Physical Plan ==
*(2) Sort [id#9L ASC NULLS LAST], true, 0
+- Exchange rangepartitioning(id#9L ASC NULLS LAST, 200), true, [id=#18]
   +- *(1) Scan ExistingRDD[__index_level_0__#8L,id#9L]
```

As you can see, it requires `Exchange` which requires a shuffle and it is likely expensive.

2.6.5 Avoid computation on single partition

Another common case is the computation on a single partition. Currently, some APIs such as DataFrame.rank uses PySpark's Window without specifying partition specification. This leads to move all data into a single partition in single machine and could cause serious performance degradation. Such APIs should be avoided very large dataset.

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'id': range(10)})
>>> kdf.rank().spark.explain()
== Physical Plan ==
*(4) Project [__index_level_0__#16L, id#24]
+- Window [avg(cast(_w0#26 as bigint)) windowspecdefinition(id#17L,␣
↪specifiedwindowframe(RowFrame, unboundedpreceding$(), unboundedfollowing$())) AS id
↪#24], [id#17L]
   +- *(3) Project [__index_level_0__#16L, _w0#26, id#17L]
      +- Window [row_number() windowspecdefinition(id#17L ASC NULLS FIRST,␣
↪specifiedwindowframe(RowFrame, unboundedpreceding$(), currentrow$())) AS _w0#26],␣
↪[id#17L ASC NULLS FIRST]
         +- *(2) Sort [id#17L ASC NULLS FIRST], false, 0
            +- Exchange SinglePartition, true, [id=#48]
               +- *(1) Scan ExistingRDD[__index_level_0__#16L,id#17L]
```

Instead, use GroupBy.rank as it is less expensive because data can be distributed and computed for each group.

2.6.6 Avoid reserved column names

Columns with leading __ and trailing __ are reserved in Koalas. To handle internal behaviors for, such as, index, Koalas uses some internal columns. Therefore, it is discouraged to use such column names and not guaranteed to work.

2.6.7 Do not use duplicated column names

It is disallowed to use duplicated column names because Spark SQL does not allow this in general. Koalas inherits this behavior. For instance, see below:

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'a': [1, 2], 'b':[3, 4]})
>>> kdf.columns = ["a", "a"]
...
Reference 'a' is ambiguous, could be: a, a.;
```

Additionally, it is strongly discouraged to use case sensitive column names. Koalas disallows it by default.

```
>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'a': [1, 2], 'A':[3, 4]})
...
Reference 'a' is ambiguous, could be: a, a.;
```

However, you can turn on `spark.sql.caseSensitive` in Spark configuration to enable it if you use on your own risk.

```
>>> from pyspark.sql import SparkSession
>>> builder = SparkSession.builder.appName("Koalas")
>>> builder = builder.config("spark.sql.caseSensitive", "true")
>>> builder.getOrCreate()

>>> import databricks.koalas as ks
>>> kdf = ks.DataFrame({'a': [1, 2], 'A':[3, 4]})
>>> kdf
   a  A
0  1  3
1  2  4
```

2.6.8 Specify the index column in conversion from Spark DataFrame to Koalas DataFrame

When Koalas Dataframe is converted from Spark DataFrame, it loses the index information, which results in using the default index in Koalas DataFrame. The default index is inefficient in general comparing to explicitly specifying the index column. Specify the index column whenever possible.

See *working with PySpark*

2.6.9 Use `distributed` or `distributed-sequence` default index

One common issue when Koalas users face is the slow performance by default index. Koalas attaches a default index when the index is unknown, for example, Spark DataFrame is directly converted to Koalas DataFrame.

This default index is `sequence` which requires the computation on single partition which is discouraged. If you plan to handle large data in production, make it distributed by configuring the default index to `distributed` or `distributed-sequence` .

See *Default Index Type* for more details about configuring default index.

2.6.10 Reduce the operations on different DataFrame/Series

Koalas disallows the operations on different DataFrames (or Series) by default to prevent expensive operations. It internally performs a join operation which can be expensive in general, which is discouraged. Whenever possible, this operation should be avoided.

See *Operations on different DataFrames* for more details.

2.6.11 Use Koalas APIs directly whenever possible

Although Koalas has most of the pandas-equivalent APIs, there are several APIs not implemented yet or explicitly unsupported.

As an example, Koalas does not implement `__iter__()` to prevent users from collecting all data into the client (driver) side from the whole cluster. Unfortunately, many external APIs such as Python built-in functions such as min, max, sum, etc. require the given argument to be iterable. In case of pandas, it works properly out of the box as below:

```
>>> import pandas as pd
>>> max(pd.Series([1, 2, 3]))
3
>>> min(pd.Series([1, 2, 3]))
1
>>> sum(pd.Series([1, 2, 3]))
6
```

pandas dataset lives in the single machine, and is naturally iterable locally within the same machine. However, Koalas dataset lives across multiple machines, and they are computed in a distributed manner. It is difficult to be locally iterable and it is very likely users collect the entire data into the client side without knowing it. Therefore, it is best to stick to using Koalas APIs. The examples above can be converted as below:

```
>>> import databricks.koalas as ks
>>> ks.Series([1, 2, 3]).max()
3
>>> ks.Series([1, 2, 3]).min()
1
>>> ks.Series([1, 2, 3]).sum()
6
```

Another common pattern from pandas users might be to rely on list comprehension or generator expression. However, it also assumes the dataset is locally iterable under the hood. Therefore, it works seamlessly in pandas as below:

```
>>> import pandas as pd
>>> data = []
>>> countries = ['London', 'New York', 'Helsinki']
>>> pser = pd.Series([20., 21., 12.], index=countries)
>>> for temperature in pser:
...     assert temperature > 0
...     if temperature > 1000:
...         temperature = None
...     data.append(temperature ** 2)
...
>>> pd.Series(data, index=countries)
London      400.0
New York    441.0
Helsinki    144.0
dtype: float64
```

However, for Koalas it does not work as the same reason above. The example above can be also changed to directly using Koalas APIs as below:

```
>>> import databricks.koalas as ks
>>> import numpy as np
>>> countries = ['London', 'New York', 'Helsinki']
>>> kser = ks.Series([20., 21., 12.], index=countries)
>>> def square(temperature) -> np.float64:
...     assert temperature > 0
...     if temperature > 1000:
...         temperature = None
...     return temperature ** 2
...
>>> kser.apply(square)
London      400.0
New York    441.0
Helsinki    144.0
dtype: float64
```

2.7 FAQ

2.7.1 What's the project's status?

Koalas 1.0.0 was released, and it is much more stable now. You might still face the following differences:

- Most of pandas-equivalent APIs are implemented but still some may be missing. Please create a GitHub issue if your favorite function is not yet supported. We also document all APIs that are not yet supported in the missing directory.
- Some behaviors may be different, in particular in the treatment of nulls: Pandas uses Not a Number (NaN) special constants to indicate missing values, while Spark has a special flag on each value to indicate missing values. We would love to hear from you if you come across any discrepancies
- Because Spark is lazy in nature, some operations like creating new columns only get performed when Spark needs to print or write the dataframe.

2.7.2 Is it Koalas or koalas?

It's Koalas. Unlike pandas, we use upper case here.

2.7.3 Should I use PySpark's DataFrame API or Koalas?

If you are already familiar with pandas and want to leverage Spark for big data, we recommend using Koalas. If you are learning Spark from ground up, we recommend you start with PySpark's API.

2.7.4 Does Koalas support Structured Streaming?

No, Koalas does not support Structured Streaming officially.

As a workaround, you can use Koalas APIs with *foreachBatch* in Structured Streaming which allows batch APIs:

```
>>> def func(batch_df, batch_id):
...     koalas_df = ks.DataFrame(batch_df)
...     koalas_df['a'] = 1
...     print(koalas_df)

>>> spark.readStream.format("rate").load().writeStream.foreachBatch(func).start()
                timestamp  value  a
0 2020-02-21 09:49:37.574      4  1
                timestamp  value  a
0 2020-02-21 09:49:38.574      5  1
...
```

2.7.5 How can I request support for a method?

File a GitHub issue: https://github.com/databricks/koalas/issues

Databricks customers are also welcome to file a support ticket to request a new feature.

2.7.6 How is Koalas different from Dask?

Different projects have different focuses. Spark is already deployed in virtually every organization, and often is the primary interface to the massive amount of data stored in data lakes. Koalas was inspired by Dask, and aims to make the transition from pandas to Spark easy for data scientists.

2.7.7 How can I contribute to Koalas?

See Contributing Guide.

2.7.8 Why a new project (instead of putting this in Apache Spark itself)?

Two reasons:

1. We want a venue in which we can rapidly iterate and make new releases. The overhead of making a release as a separate project is minuscule (in the order of minutes). A release on Spark takes a lot longer (in the order of days)

2. Koalas takes a different approach that might contradict Spark's API design principles, and those principles cannot be changed lightly given the large user base of Spark. A new, separate project provides an opportunity for us to experiment with new design principles.

CHAPTER

THREE

API REFERENCE

3.1 Input/Output

3.1.1 Data Generator

range(start[, end, step, num_partitions])	Create a DataFrame with some range of numbers.

databricks.koalas.range

databricks.koalas.**range**(*start: int*, *end: Optional[int] = None*, *step: int = 1*, *num_partitions: Optional[int] = None*) → databricks.koalas.frame.DataFrame

Create a DataFrame with some range of numbers.

The resulting DataFrame has a single int64 column named *id*, containing elements in a range from `start` to `end` (exclusive) with step value `step`. If only the first parameter (i.e. start) is specified, we treat it as the end value with the start value being 0.

This is similar to the range function in SparkSession and is used primarily for testing.

Parameters

start [int] the start value (inclusive)

end [int, optional] the end value (exclusive)

step [int, optional, default 1] the incremental step

num_partitions [int, optional] the number of partitions of the DataFrame

Returns

DataFrame

Examples

When the first parameter is specified, we generate a range of values up till that number.

```
>>> ks.range(5)
   id
0   0
1   1
2   2
```

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```
3   3
4   4
```

When start, end, and step are specified:

```
>>> ks.range(start = 100, end = 200, step = 20)
    id
0  100
1  120
2  140
3  160
4  180
```

3.1.2 Spark Metastore Table

read_table(name[, index_col])	Read a Spark table and return a DataFrame.
DataFrame.to_table(name[, format, mode, ...])	Write the DataFrame into a Spark table.

databricks.koalas.read_table

databricks.koalas.**read_table**(*name: str*, *index_col: Union[str, List[str], None] = None*) → databricks.koalas.frame.DataFrame

Read a Spark table and return a DataFrame.

Parameters

name [string] Table name in Spark.

index_col [str or list of str, optional, default: None] Index column of table in Spark.

Returns

DataFrame

See also:

DataFrame.to_table

read_delta

read_parquet

read_spark_io

Examples

```
>>> ks.range(1).to_table('%s.my_table' % db)
>>> ks.read_table('%s.my_table' % db)
   id
0   0
```

```
>>> ks.range(1).to_table('%s.my_table' % db, index_col="index")
>>> ks.read_table('%s.my_table' % db, index_col="index")
       id
```

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```
index
0       0
```

databricks.koalas.DataFrame.to_table

DataFrame.**to_table**(*name: str*, *format: Optional[str] = None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame into a Spark table. *DataFrame.spark.to_table()* is an alias of *DataFrame.to_table()*.

Parameters

name [str, required] Table name in Spark.

format [string, optional] Specifies the output data source format. Some common ones are:

- 'delta'
- 'parquet'
- 'orc'
- 'json'
- 'csv'

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'}, default] 'overwrite'. Specifies the behavior of the save operation when the table exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options Additional options passed directly to Spark.

Returns

None

See also:

read_table

DataFrame.to_spark_io

DataFrame.spark.to_spark_io

DataFrame.to_parquet

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

```
>>> df.to_table('%s.my_table' % db, partition_cols='date')
```

3.1.3 Delta Lake

read_delta(path[, version, timestamp, index_col])	Read a Delta Lake table on some file system and return a DataFrame.
DataFrame.to_delta(path[, mode, ...])	Write the DataFrame out as a Delta Lake table.

databricks.koalas.read_delta

databricks.koalas.**read_delta**(*path: str*, *version: Optional[str] = None*, *timestamp: Optional[str] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → databricks.koalas.frame.DataFrame

Read a Delta Lake table on some file system and return a DataFrame.

If the Delta Lake table is already stored in the catalog (aka the metastore), use 'read_table'.

Parameters

path [string] Path to the Delta Lake table.

version [string, optional] Specifies the table version (based on Delta's internal transaction version) to read from, using Delta's time travel feature. This sets Delta's 'versionAsOf' option.

timestamp [string, optional] Specifies the table version (based on timestamp) to read from, using Delta's time travel feature. This must be a valid date or timestamp string in Spark, and sets Delta's 'timestampAsOf' option.

index_col [str or list of str, optional, default: None] Index column of table in Spark.

options Additional options that can be passed onto Delta.

Returns

DataFrame

See also:

DataFrame.to_delta

read_table

read_spark_io

read_parquet

Examples

```
>>> ks.range(1).to_delta('%s/read_delta/foo' % path)
>>> ks.read_delta('%s/read_delta/foo' % path)
   id
0   0
```

```
>>> ks.range(10, 15, num_partitions=1).to_delta('%s/read_delta/foo' % path, mode=
↪'overwrite')
>>> ks.read_delta('%s/read_delta/foo' % path)
   id
0  10
1  11
2  12
3  13
4  14
```

```
>>> ks.read_delta('%s/read_delta/foo' % path, version=0)
   id
0   0
```

You can preserve the index in the roundtrip as below.

```
>>> ks.range(10, 15, num_partitions=1).to_delta(
...     '%s/read_delta/bar' % path, index_col="index")
>>> ks.read_delta('%s/read_delta/bar' % path, index_col="index")
...
       id
index
0      10
1      11
2      12
3      13
4      14
```

databricks.koalas.DataFrame.to_delta

DataFrame.**to_delta**(*path: str*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame out as a Delta Lake table.

Parameters

path [str, required] Path to write to.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'}, default] 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options [dict] All other options passed directly into Delta Lake.

See also:

read_delta

DataFrame.to_parquet

DataFrame.to_table

DataFrame.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

Create a new Delta Lake table, partitioned by one column:

```
>>> df.to_delta('%s/to_delta/foo' % path, partition_cols='date')
```

Partitioned by two columns:

```
>>> df.to_delta('%s/to_delta/bar' % path, partition_cols=['date', 'country'])
```

Overwrite an existing table's partitions, using the 'replaceWhere' capability in Delta:

```
>>> df.to_delta('%s/to_delta/bar' % path,
...             mode='overwrite', replaceWhere='date >= "2012-01-01"')
```

3.1.4 Parquet

read_parquet(path[, columns, index_col, ...])	Load a parquet object from the file path, returning a DataFrame.
DataFrame.to_parquet(path[, mode, ...])	Write the DataFrame out as a Parquet file or directory.

databricks.koalas.read_parquet

databricks.koalas.**read_parquet**(*path*, *columns=None*, *index_col=None*, *pandas_metadata=False*, ***options*) → databricks.koalas.frame.DataFrame

Load a parquet object from the file path, returning a DataFrame.

Parameters

path [string] File path

columns [list, default=None] If not None, only these columns will be read from the file.

index_col [str or list of str, optional, default: None] Index column of table in Spark.

pandas_metadata [bool, default: False] If True, try to respect the metadata if the Parquet file is written from pandas.

options [dict] All other options passed directly into Spark's data source.

Returns

DataFrame

See also:

DataFrame.to_parquet

DataFrame.read_table

DataFrame.read_delta

DataFrame.read_spark_io

Examples

```
>>> ks.range(1).to_parquet('%s/read_spark_io/data.parquet' % path)
>>> ks.read_parquet('%s/read_spark_io/data.parquet' % path, columns=['id'])
   id
0   0
```

You can preserve the index in the roundtrip as below.

```
>>> ks.range(1).to_parquet('%s/read_spark_io/data.parquet' % path, index_col=
↪"index")
>>> ks.read_parquet('%s/read_spark_io/data.parquet' % path, columns=['id'], index_
↪col="index")
...
       id
index
0       0
```

databricks.koalas.DataFrame.to_parquet

DataFrame.**to_parquet**(*path: str*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *compression: Optional[str] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame out as a Parquet file or directory.

Parameters

path [str, required] Path to write to.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'},] default 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

compression [str {'none', 'uncompressed', 'snappy', 'gzip', 'lzo', 'brotli', 'lz4', 'zstd'}] Compression codec to use when saving to file. If None is set, it uses the value specified in *spark.sql.parquet.compression.codec*.

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options [dict] All other options passed directly into Spark's data source.

See also:

read_parquet

DataFrame.to_delta

DataFrame.to_table

DataFrame.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

```
>>> df.to_parquet('%s/to_parquet/foo.parquet' % path, partition_cols='date')
```

```
>>> df.to_parquet(
...     '%s/to_parquet/foo.parquet' % path,
...     mode = 'overwrite',
...     partition_cols=['date', 'country'])
```

3.1.5 Generic Spark I/O

read_spark_io([path, format, schema, index_col])	Load a DataFrame from a Spark data source.
DataFrame.to_spark_io([path, format, mode, ...])	Write the DataFrame out to a Spark data source.

databricks.koalas.read_spark_io

databricks.koalas.**read_spark_io**(*path: Optional[str] = None*, *format: Optional[str] = None*, *schema: Union[str, StructType] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → databricks.koalas.frame.DataFrame

Load a DataFrame from a Spark data source.

Parameters

path [string, optional] Path to the data source.

format [string, optional] Specifies the output data source format. Some common ones are:

- 'delta'
- 'parquet'
- 'orc'
- 'json'
- 'csv'

schema [string or StructType, optional] Input schema. If none, Spark tries to infer the schema automatically. The schema can either be a Spark StructType, or a DDL-formatted string like *col0 INT, col1 DOUBLE*.

index_col [str or list of str, optional, default: None] Index column of table in Spark.

options [dict] All other options passed directly into Spark's data source.

See also:

DataFrame.to_spark_io

DataFrame.read_table

DataFrame.read_delta

DataFrame.read_parquet

Examples

```
>>> ks.range(1).to_spark_io('%s/read_spark_io/data.parquet' % path)
>>> ks.read_spark_io(
...     '%s/read_spark_io/data.parquet' % path, format='parquet', schema='id long
↪')
   id
0   0
```

```
>>> ks.range(10, 15, num_partitions=1).to_spark_io('%s/read_spark_io/data.json' %␣
↪path,
...                                                format='json', lineSep='__')
>>> ks.read_spark_io(
...     '%s/read_spark_io/data.json' % path, format='json', schema='id long',␣
↪lineSep='__')
   id
0  10
1  11
2  12
3  13
4  14
```

You can preserve the index in the roundtrip as below.

```
>>> ks.range(10, 15, num_partitions=1).to_spark_io('%s/read_spark_io/data.orc' %␣
↪path,
...                                                format='orc', index_col="index
↪")
>>> ks.read_spark_io(
...     path=r'%s/read_spark_io/data.orc' % path, format="orc", index_col="index")
...
       id
index
0      10
1      11
2      12
3      13
4      14
```

databricks.koalas.DataFrame.to_spark_io

DataFrame.**to_spark_io**(*path: Optional[str] = None*, *format: Optional[str] = None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame out to a Spark data source. *DataFrame.spark.to_spark_io()* is an alias of *DataFrame.to_spark_io()*.

Parameters

path [string, optional] Path to the data source.

format [string, optional] Specifies the output data source format. Some common ones are:

- 'delta'
- 'parquet'
- 'orc'

- 'json'
- 'csv'

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'}, default] 'overwrite'. Specifies the behavior of the save operation when data already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options [dict] All other options passed directly into Spark's data source.

Returns

None

See also:

read_spark_io

DataFrame.to_delta

DataFrame.to_parquet

DataFrame.to_table

DataFrame.to_spark_io

DataFrame.spark.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

```
>>> df.to_spark_io(path='%s/to_spark_io/foo.json' % path, format='json')
```

3.1.6 Flat File / CSV

read_csv(path[, sep, header, names, ...])	Read CSV (comma-separated) file into DataFrame or Series.
DataFrame.to_csv([path, sep, na_rep, ...])	Write object to a comma-separated values (csv) file.

databricks.koalas.read_csv

databricks.koalas.**read_csv**(*path*, *sep=','*, *header='infer'*, *names=None*, *index_col=None*, *usecols=None*, *squeeze=False*, *mangle_dupe_cols=True*, *dtype=None*, *nrows=None*, *parse_dates=False*, *quotechar=None*, *escapechar=None*, *comment=None*, ***options*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Read CSV (comma-separated) file into DataFrame or Series.

Parameters

path [str] The path string storing the CSV file to be read.

sep [str, default ‘,’] Delimiter to use. Must be a single character.

header [int, list of int, default ‘infer’] Whether to to use as the column names, and the start of the data. Default behavior is to infer the column names: if no names are passed the behavior is identical to *header=0* and column names are inferred from the first line of the file, if column names are passed explicitly then the behavior is identical to *header=None*. Explicitly pass *header=0* to be able to replace existing names

names [str or array-like, optional] List of column names to use. If file contains no header row, then you should explicitly pass *header=None*. Duplicates in this list will cause an error to be issued. If a string is given, it should be a DDL-formatted string in Spark SQL, which is preferred to avoid schema inference for better performance.

index_col: str or list of str, optional, default: None Index column of table in Spark.

usecols [list-like or callable, optional] Return a subset of the columns. If list-like, all elements must either be positional (i.e. integer indices into the document columns) or strings that correspond to column names provided either by the user in names or inferred from the document header row(s). If callable, the callable function will be evaluated against the column names, returning names where the callable function evaluates to *True*.

squeeze [bool, default False] If the parsed data only contains one column then return a Series.

mangle_dupe_cols [bool, default True] Duplicate columns will be specified as ‘X0’, ‘X1’, ... ‘XN’, rather than ‘X’ ... ‘X’. Passing in False will cause data to be overwritten if there are duplicate names in the columns. Currently only *True* is allowed.

dtype [Type name or dict of column -> type, default None] Data type for data or columns. E.g. {‘a’: np.float64, ‘b’: np.int32} Use str or object together with suitable na_values settings to preserve and not interpret dtype.

nrows [int, default None] Number of rows to read from the CSV file.

parse_dates [boolean or list of ints or names or list of lists or dict, default *False*.] Currently only *False* is allowed.

quotechar [str (length 1), optional] The character used to denote the start and end of a quoted item. Quoted items can include the delimiter and it will be ignored.

escapechar [str (length 1), default None] One-character string used to escape delimiter

comment: str, optional Indicates the line should not be parsed.

options [dict] All other options passed directly into Spark's data source.

Returns

DataFrame or Series

See also:

DataFrame.to_csv Write DataFrame to a comma-separated values (csv) file.

Examples

```
>>> ks.read_csv('data.csv')
```

databricks.koalas.DataFrame.to_csv

DataFrame.**to_csv**(*path=None*, *sep=','*, *na_rep=''*, *columns=None*, *header=True*, *quotechar='"'*, *date_format=None*, *escapechar=None*, *num_files=None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → Optional[str]

Write object to a comma-separated values (csv) file.

Note: Koalas *to_csv* writes files to a path or URI. Unlike pandas', Koalas respects HDFS's property such as 'fs.default.name'.

Note: Koalas writes CSV files into the directory, *path*, and writes multiple *part-...* files in the directory when *path* is specified. This behaviour was inherited from Apache Spark. The number of files can be controlled by *num_files*.

Parameters

path [str, default None] File path. If None is provided the result is returned as a string.

sep [str, default ','] String of length 1. Field delimiter for the output file.

na_rep [str, default ''] Missing data representation.

columns [sequence, optional] Columns to write.

header [bool or list of str, default True] Write out the column names. If a list of strings is given it is assumed to be aliases for the column names.

quotechar [str, default '"'] String of length 1. Character used to quote fields.

date_format [str, default None] Format string for datetime objects.

escapechar [str, default None] String of length 1. Character used to escape *sep* and *quotechar* when appropriate.

num_files [the number of files to be written in *path* directory when] this is a path.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'},] default 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options: keyword arguments for additional options specific to PySpark. This kwargs are specific to PySpark's CSV options to pass. Check the options in PySpark's API documentation for spark.write.csv(...). It has higher priority and overwrites all other options. This parameter only works when *path* is specified.

Returns

str or None

See also:

read_csv

DataFrame.to_delta

DataFrame.to_table

DataFrame.to_parquet

DataFrame.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df.sort_values(by="date")
                  date country  code
... 2012-01-31 12:00:00      KR     1
... 2012-02-29 12:00:00      US     2
... 2012-03-31 12:00:00      JP     3
```

```
>>> print(df.to_csv())
date,country,code
2012-01-31 12:00:00,KR,1
2012-02-29 12:00:00,US,2
2012-03-31 12:00:00,JP,3
```

```
>>> df.cummax().to_csv(path=r'%s/to_csv/foo.csv' % path, num_files=1)
>>> ks.read_csv(
...    path=r'%s/to_csv/foo.csv' % path
... ).sort_values(by="date")
                  date country  code
... 2012-01-31 12:00:00      KR     1
```

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```
... 2012-02-29 12:00:00      US     2
... 2012-03-31 12:00:00      US     3
```

In case of Series,

```
>>> print(df.date.to_csv())
date
2012-01-31 12:00:00
2012-02-29 12:00:00
2012-03-31 12:00:00
```

```
>>> df.date.to_csv(path=r'%s/to_csv/foo.csv' % path, num_files=1)
>>> ks.read_csv(
...     path=r'%s/to_csv/foo.csv' % path
... ).sort_values(by="date")
                    date
... 2012-01-31 12:00:00
... 2012-02-29 12:00:00
... 2012-03-31 12:00:00
```

You can preserve the index in the roundtrip as below.

```
>>> df.set_index("country", append=True, inplace=True)
>>> df.date.to_csv(
...     path=r'%s/to_csv/bar.csv' % path,
...     num_files=1,
...     index_col=["index1", "index2"])
>>> ks.read_csv(
...     path=r'%s/to_csv/bar.csv' % path, index_col=["index1", "index2"]
... ).sort_values(by="date")
                            date
index1 index2
...    ...    2012-01-31 12:00:00
...    ...    2012-02-29 12:00:00
...    ...    2012-03-31 12:00:00
```

3.1.7 Clipboard

read_clipboard([sep])	Read text from clipboard and pass to read_csv.
DataFrame.to_clipboard([excel, sep])	Copy object to the system clipboard.

databricks.koalas.read_clipboard

databricks.koalas.**read_clipboard**(*sep='\\s+'*, ***kwargs*) → databricks.koalas.frame.DataFrame

Read text from clipboard and pass to read_csv. See read_csv for the full argument list

Parameters

sep [str, default '\s+'] A string or regex delimiter. The default of 's+' denotes one or more whitespace characters.

Returns

parsed [DataFrame]

See also:

DataFrame.to_clipboard Write text out to clipboard.

databricks.koalas.DataFrame.to_clipboard

DataFrame.**to_clipboard**(*excel=True*, *sep=None*, ***kwargs*) → None

Copy object to the system clipboard.

Write a text representation of object to the system clipboard. This can be pasted into Excel, for example.

Note: This method should only be used if the resulting DataFrame is expected to be small, as all the data is loaded into the driver's memory.

Parameters

excel [bool, default True]

- True, use the provided separator, writing in a csv format for allowing easy pasting into excel.
- False, write a string representation of the object to the clipboard.

sep [str, default `'\t'`] Field delimiter.

****kwargs** These parameters will be passed to DataFrame.to_csv.

See also:

read_clipboard Read text from clipboard.

Notes

Requirements for your platform.

- Linux : *xclip*, or *xsel* (with *gtk* or *PyQt4* modules)
- Windows : none
- OS X : none

Examples

Copy the contents of a DataFrame to the clipboard.

```
>>> df = ks.DataFrame([[1, 2, 3], [4, 5, 6]], columns=['A', 'B', 'C'])
>>> df.to_clipboard(sep=',')
... # Wrote the following to the system clipboard:
... # ,A,B,C
... # 0,1,2,3
... # 1,4,5,6
```

We can omit the index by passing the keyword *index* and setting it to false.

```
>>> df.to_clipboard(sep=',', index=False)
... # Wrote the following to the system clipboard:
... # A,B,C
... # 1,2,3
... # 4,5,6
```

This function also works for Series:

```
>>> df = ks.Series([1, 2, 3, 4, 5, 6, 7], name='x')
>>> df.to_clipboard(sep=',')
... # Wrote the following to the system clipboard:
... # 0, 1
... # 1, 2
... # 2, 3
... # 3, 4
... # 4, 5
... # 5, 6
... # 6, 7
```

3.1.8 Excel

read_excel(io[, sheet_name, header, names, ...])	Read an Excel file into a Koalas DataFrame or Series.
DataFrame.to_excel(excel_writer[, ...])	Write object to an Excel sheet.

databricks.koalas.read_excel

databricks.koalas.**read_excel**(*io*, *sheet_name=0*, *header=0*, *names=None*, *index_col=None*, *usecols=None*, *squeeze=False*, *dtype=None*, *engine=None*, *converters=None*, *true_values=None*, *false_values=None*, *skiprows=None*, *nrows=None*, *na_values=None*, *keep_default_na=True*, *verbose=False*, *parse_dates=False*, *date_parser=None*, *thousands=None*, *comment=None*, *skipfooter=0*, *convert_float=True*, *mangle_dupe_cols=True*, ***kwds*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series, collections.OrderedDict]

Read an Excel file into a Koalas DataFrame or Series.

Support both *xls* and *xlsx* file extensions from a local filesystem or URL. Support an option to read a single sheet or a list of sheets.

Parameters

io [str, file descriptor, pathlib.Path, ExcelFile or xlrd.Book] The string could be a URL. The value URL must be available in Spark's DataFrameReader.

Note: If the underlying Spark is below 3.0, the parameter as a string is not supported. You can use *ks.from_pandas(pd.read_excel(...))* as a workaround.

---

sheet_name [str, int, list, or None, default 0] Strings are used for sheet names. Integers are used in zero-indexed sheet positions. Lists of strings/integers are used to request multiple sheets. Specify None to get all sheets.

Available cases:

- Defaults to `0`: 1st sheet as a *DataFrame*
- `1`: 2nd sheet as a *DataFrame*
- `"Sheet1"`: Load sheet with name "Sheet1"
- `[0, 1, "Sheet5"]`: Load first, second and sheet named "Sheet5" as a dict of *DataFrame*
- None: All sheets.

header [int, list of int, default 0] Row (0-indexed) to use for the column labels of the parsed DataFrame. If a list of integers is passed those row positions will be combined into a `MultiIndex`. Use None if there is no header.

names [array-like, default None] List of column names to use. If file contains no header row, then you should explicitly pass header=None.

index_col [int, list of int, default None] Column (0-indexed) to use as the row labels of the DataFrame. Pass None if there is no such column. If a list is passed, those columns will be combined into a `MultiIndex`. If a subset of data is selected with `usecols`, index_col is based on the subset.

usecols [int, str, list-like, or callable default None] Return a subset of the columns.

- If None, then parse all columns.
- If str, then indicates comma separated list of Excel column letters and column ranges (e.g. "A:E" or "A,C,E:F"). Ranges are inclusive of both sides.
- If list of int, then indicates list of column numbers to be parsed.
- If list of string, then indicates list of column names to be parsed.
- If callable, then evaluate each column name against it and parse the column if the callable returns `True`.

squeeze [bool, default False] If the parsed data only contains one column then return a Series.

dtype [Type name or dict of column -> type, default None] Data type for data or columns. E.g. {'a': np.float64, 'b': np.int32} Use *object* to preserve data as stored in Excel and not interpret dtype. If converters are specified, they will be applied INSTEAD of dtype conversion.

engine [str, default None] If io is not a buffer or path, this must be set to identify io. Acceptable values are None or xlrd.

converters [dict, default None] Dict of functions for converting values in certain columns. Keys can either be integers or column labels, values are functions that take one input argument, the Excel cell content, and return the transformed content.

true_values [list, default None] Values to consider as True.

false_values [list, default None] Values to consider as False.

skiprows [list-like] Rows to skip at the beginning (0-indexed).

nrows [int, default None] Number of rows to parse.

na_values [scalar, str, list-like, or dict, default None] Additional strings to recognize as NA/NaN. If dict passed, specific per-column NA values. By default the following values are interpreted as NaN.

keep_default_na [bool, default True] If na_values are specified and keep_default_na is False the default NaN values are overridden, otherwise they're appended to.

verbose [bool, default False] Indicate number of NA values placed in non-numeric columns.

parse_dates [bool, list-like, or dict, default False] The behavior is as follows:

- bool. If True -> try parsing the index.
- list of int or names. e.g. If [1, 2, 3] -> try parsing columns 1, 2, 3 each as a separate date column.
- list of lists. e.g. If [[1, 3]] -> combine columns 1 and 3 and parse as a single date column.
- dict, e.g. {{'foo' : [1, 3]}} -> parse columns 1, 3 as date and call result 'foo'

If a column or index contains an unparseable date, the entire column or index will be returned unaltered as an object data type. For non-standard datetime parsing, use `pd.to_datetime` after `pd.read_csv`

Note: A fast-path exists for iso8601-formatted dates.

date_parser [function, optional] Function to use for converting a sequence of string columns to an array of datetime instances. The default uses `dateutil.parser.parser` to do the conversion. Koalas will try to call *date_parser* in three different ways, advancing to the next if an exception occurs: 1) Pass one or more arrays (as defined by *parse_dates*) as arguments; 2) concatenate (row-wise) the string values from the columns defined by *parse_dates* into a single array and pass that; and 3) call *date_parser* once for each row using one or more strings (corresponding to the columns defined by *parse_dates*) as arguments.

thousands [str, default None] Thousands separator for parsing string columns to numeric. Note that this parameter is only necessary for columns stored as TEXT in Excel, any numeric columns will automatically be parsed, regardless of display format.

comment [str, default None] Comments out remainder of line. Pass a character or characters to this argument to indicate comments in the input file. Any data between the comment string and the end of the current line is ignored.

skipfooter [int, default 0] Rows at the end to skip (0-indexed).

convert_float [bool, default True] Convert integral floats to int (i.e., 1.0 –> 1). If False, all numeric data will be read in as floats: Excel stores all numbers as floats internally.

mangle_dupe_cols [bool, default True] Duplicate columns will be specified as 'X', 'X.1', ...'X.N', rather than 'X'...'X'. Passing in False will cause data to be overwritten if there are duplicate names in the columns.

****kwds** [optional] Optional keyword arguments can be passed to `TextFileReader`.

Returns

DataFrame or dict of DataFrames DataFrame from the passed in Excel file. See notes in sheet_name argument for more information on when a dict of DataFrames is returned.

See also:

DataFrame.to_excel Write DataFrame to an Excel file.

DataFrame.to_csv Write DataFrame to a comma-separated values (csv) file.

read_csv Read a comma-separated values (csv) file into DataFrame.

Examples

The file can be read using the file name as string or an open file object:

```
>>> ks.read_excel('tmp.xlsx', index_col=0)
       Name  Value
0   string1      1
1   string2      2
2  #Comment      3
```

```
>>> ks.read_excel(open('tmp.xlsx', 'rb'),
...               sheet_name='Sheet3')
   Unnamed: 0      Name  Value
0           0   string1      1
1           1   string2      2
2           2  #Comment      3
```

Index and header can be specified via the *index_col* and *header* arguments

```
>>> ks.read_excel('tmp.xlsx', index_col=None, header=None)
     0         1      2
0  NaN      Name  Value
1  0.0   string1      1
2  1.0   string2      2
3  2.0  #Comment      3
```

Column types are inferred but can be explicitly specified

```
>>> ks.read_excel('tmp.xlsx', index_col=0,
...               dtype={'Name': str, 'Value': float})
       Name  Value
0   string1    1.0
1   string2    2.0
2  #Comment    3.0
```

True, False, and NA values, and thousands separators have defaults, but can be explicitly specified, too. Supply the values you would like as strings or lists of strings!

```
>>> ks.read_excel('tmp.xlsx', index_col=0,
...               na_values=['string1', 'string2'])
       Name  Value
0      None      1
1      None      2
2  #Comment      3
```

Comment lines in the excel input file can be skipped using the *comment* kwarg

```
>>> ks.read_excel('tmp.xlsx', index_col=0, comment='#')
      Name  Value
0  string1    1.0
1  string2    2.0
2     None    NaN
```

databricks.koalas.DataFrame.to_excel

DataFrame.**to_excel**(*excel_writer*, *sheet_name='Sheet1'*, *na_rep=''*, *float_format=None*, *columns=None*, *header=True*, *index=True*, *index_label=None*, *startrow=0*, *startcol=0*, *engine=None*, *merge_cells=True*, *encoding=None*, *inf_rep='inf'*, *verbose=True*, *freeze_panes=None*) → None

Write object to an Excel sheet.

Note: This method should only be used if the resulting DataFrame is expected to be small, as all the data is loaded into the driver's memory.

To write a single object to an Excel .xlsx file it is only necessary to specify a target file name. To write to multiple sheets it is necessary to create an *ExcelWriter* object with a target file name, and specify a sheet in the file to write to.

Multiple sheets may be written to by specifying unique *sheet_name*. With all data written to the file it is necessary to save the changes. Note that creating an *ExcelWriter* object with a file name that already exists will result in the contents of the existing file being erased.

Parameters

excel_writer [str or ExcelWriter object] File path or existing ExcelWriter.

sheet_name [str, default 'Sheet1'] Name of sheet which will contain DataFrame.

na_rep [str, default ''] Missing data representation.

float_format [str, optional] Format string for floating point numbers. For example `float_format="%%.2f"` will format 0.1234 to 0.12.

columns [sequence or list of str, optional] Columns to write.

header [bool or list of str, default True] Write out the column names. If a list of string is given it is assumed to be aliases for the column names.

index [bool, default True] Write row names (index).

index_label [str or sequence, optional] Column label for index column(s) if desired. If not specified, and *header* and *index* are True, then the index names are used. A sequence should be given if the DataFrame uses MultiIndex.

startrow [int, default 0] Upper left cell row to dump data frame.

startcol [int, default 0] Upper left cell column to dump data frame.

engine [str, optional] Write engine to use, 'openpyxl' or 'xlsxwriter'. You can also set this via the options `io.excel.xlsx.writer`, `io.excel.xls.writer`, and `io.excel.xlsm.writer`.

merge_cells [bool, default True] Write MultiIndex and Hierarchical Rows as merged cells.

encoding [str, optional] Encoding of the resulting excel file. Only necessary for xlwt, other writers support unicode natively.

inf_rep [str, default 'inf'] Representation for infinity (there is no native representation for infinity in Excel).

verbose [bool, default True] Display more information in the error logs.

freeze_panes [tuple of int (length 2), optional] Specifies the one-based bottommost row and rightmost column that is to be frozen.

See also:

read_excel Read Excel file.

Notes

Once a workbook has been saved it is not possible write further data without rewriting the whole workbook.

Examples

Create, write to and save a workbook:

```
>>> df1 = ks.DataFrame([['a', 'b'], ['c', 'd']],
...                    index=['row 1', 'row 2'],
...                    columns=['col 1', 'col 2'])
>>> df1.to_excel("output.xlsx")
```

To specify the sheet name:

```
>>> df1.to_excel("output.xlsx")
>>> df1.to_excel("output.xlsx",
...              sheet_name='Sheet_name_1')
```

If you wish to write to more than one sheet in the workbook, it is necessary to specify an ExcelWriter object:

```
>>> with pd.ExcelWriter('output.xlsx') as writer:
...      df1.to_excel(writer, sheet_name='Sheet_name_1')
...      df2.to_excel(writer, sheet_name='Sheet_name_2')
```

To set the library that is used to write the Excel file, you can pass the *engine* keyword (the default engine is automatically chosen depending on the file extension):

```
>>> df1.to_excel('output1.xlsx', engine='xlsxwriter')
```

3.1.9 JSON

read_json(path[, index_col])	Convert a JSON string to DataFrame.
DataFrame.to_json([path, compression, . . .])	Convert the object to a JSON string.

databricks.koalas.read_json

databricks.koalas.**read_json**(*path: str*, *index_col: Union[str, List[str], None] = None*, ***options*)
→ databricks.koalas.frame.DataFrame

Convert a JSON string to DataFrame.

Parameters

path [string] File path

index_col [str or list of str, optional, default: None] Index column of table in Spark.

options [dict] All other options passed directly into Spark's data source.

Examples

```
>>> df = ks.DataFrame([['a', 'b'], ['c', 'd']],
...                   columns=['col 1', 'col 2'])
```

```
>>> df.to_json(path=r'%s/read_json/foo.json' % path, num_files=1)
>>> ks.read_json(
...     path=r'%s/read_json/foo.json' % path
... ).sort_values(by="col 1")
  col 1 col 2
0     a     b
1     c     d
```

```
>>> df.to_json(path=r'%s/read_json/foo.json' % path, num_files=1, lineSep='___')
>>> ks.read_json(
...     path=r'%s/read_json/foo.json' % path, lineSep='___'
... ).sort_values(by="col 1")
  col 1 col 2
0     a     b
1     c     d
```

You can preserve the index in the roundtrip as below.

```
>>> df.to_json(path=r'%s/read_json/bar.json' % path, num_files=1, index_col="index
↪")
>>> ks.read_json(
...     path=r'%s/read_json/bar.json' % path, index_col="index"
... ).sort_values(by="col 1")
      col 1 col 2
index
0         a     b
1         c     d
```

databricks.koalas.DataFrame.to_json

DataFrame.**to_json**(*path=None*, *compression='uncompressed'*, *num_files=None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → Optional[str]

Convert the object to a JSON string.

Note: Koalas *to_json* writes files to a path or URI. Unlike pandas', Koalas respects HDFS's property such as 'fs.default.name'.

Note: Koalas writes JSON files into the directory, *path*, and writes multiple *part-...* files in the directory when *path* is specified. This behaviour was inherited from Apache Spark. The number of files can be controlled by *num_files*.

Note: output JSON format is different from pandas'. It always use *orient='records'* for its output. This behaviour might have to change in the near future.

Note NaN's and None will be converted to null and datetime objects will be converted to UNIX timestamps.

Parameters

path [string, optional] File path. If not specified, the result is returned as a string.

compression [{'gzip', 'bz2', 'xz', None}] A string representing the compression to use in the output file, only used when the first argument is a filename. By default, the compression is inferred from the filename.

num_files [the number of files to be written in *path* directory when] this is a path.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'},] default 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options: keyword arguments for additional options specific to PySpark. It is specific to PySpark's JSON options to pass. Check the options in PySpark's API documentation for *spark.write.json(...)*. It has a higher priority and overwrites all other options. This parameter only works when *path* is specified.

Returns

str or None

Examples

```
>>> df = ks.DataFrame([['a', 'b'], ['c', 'd']],
...                   columns=['col 1', 'col 2'])
>>> df.to_json()
'[{"col 1":"a","col 2":"b"},{"col 1":"c","col 2":"d"}]'
```

```
>>> df['col 1'].to_json()
'[{"col 1":"a"},{"col 1":"c"}]'
```

```
>>> df.to_json(path=r'%s/to_json/foo.json' % path, num_files=1)
>>> ks.read_json(
...     path=r'%s/to_json/foo.json' % path
... ).sort_values(by="col 1")
  col 1 col 2
0     a     b
1     c     d
```

```
>>> df['col 1'].to_json(path=r'%s/to_json/foo.json' % path, num_files=1, index_
↪col="index")
>>> ks.read_json(
...     path=r'%s/to_json/foo.json' % path, index_col="index"
```

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```
... ).sort_values(by="col 1")
      col 1
index
0         a
1         c
```

3.1.10 HTML

read_html(io[, match, flavor, header, ...])	Read HTML tables into a `list` of `DataFrame` objects.
DataFrame.to_html([buf, columns, col_space, ...])	Render a DataFrame as an HTML table.

databricks.koalas.read_html

databricks.koalas.**read_html**(*io*, *match='.+'*, *flavor=None*, *header=None*, *index_col=None*, *skiprows=None*, *attrs=None*, *parse_dates=False*, *thousands=','*, *encoding=None*, *decimal='.'*, *converters=None*, *na_values=None*, *keep_default_na=True*, *displayed_only=True*) → List[databricks.koalas.frame.DataFrame]

Read HTML tables into a `list` of `DataFrame` objects.

Parameters

io [str or file-like] A URL, a file-like object, or a raw string containing HTML. Note that lxml only accepts the http, ftp and file url protocols. If you have a URL that starts with `'https'` you might try removing the `'s'`.

match [str or compiled regular expression, optional] The set of tables containing text matching this regex or string will be returned. Unless the HTML is extremely simple you will probably need to pass a non-empty string here. Defaults to '.+' (match any non-empty string). The default value will return all tables contained on a page. This value is converted to a regular expression so that there is consistent behavior between Beautiful Soup and lxml.

flavor [str or None, container of strings] The parsing engine to use. 'bs4' and 'html5lib' are synonymous with each other, they are both there for backwards compatibility. The default of `None` tries to use `lxml` to parse and if that fails it falls back on `bs4` + `html5lib`.

header [int or list-like or None, optional] The row (or list of rows for a `MultiIndex`) to use to make the columns headers.

index_col [int or list-like or None, optional] The column (or list of columns) to use to create the index.

skiprows [int or list-like or slice or None, optional] 0-based. Number of rows to skip after parsing the column integer. If a sequence of integers or a slice is given, will skip the rows indexed by that sequence. Note that a single element sequence means 'skip the nth row' whereas an integer means 'skip n rows'.

attrs [dict or None, optional] This is a dictionary of attributes that you can pass to use to identify the table in the HTML. These are not checked for validity before being passed to lxml or Beautiful Soup. However, these attributes must be valid HTML table attributes to work correctly. For example,

```
attrs = {'id': 'table'}
```

is a valid attribute dictionary because the 'id' HTML tag attribute is a valid HTML attribute for *any* HTML tag as per this document.

```
attrs = {'asdf': 'table'}
```

is *not* a valid attribute dictionary because 'asdf' is not a valid HTML attribute even if it is a valid XML attribute. Valid HTML 4.01 table attributes can be found here. A working draft of the HTML 5 spec can be found here. It contains the latest information on table attributes for the modern web.

parse_dates [bool, optional] See `read_csv()` for more details.

thousands [str, optional] Separator to use to parse thousands. Defaults to `','`.

encoding [str or None, optional] The encoding used to decode the web page. Defaults to `None`.``None`` preserves the previous encoding behavior, which depends on the underlying parser library (e.g., the parser library will try to use the encoding provided by the document).

decimal [str, default '.'] Character to recognize as decimal point (e.g. use ',' for European data).

converters [dict, default None] Dict of functions for converting values in certain columns. Keys can either be integers or column labels, values are functions that take one input argument, the cell (not column) content, and return the transformed content.

na_values [iterable, default None] Custom NA values

keep_default_na [bool, default True] If na_values are specified and keep_default_na is False the default NaN values are overridden, otherwise they're appended to

displayed_only [bool, default True] Whether elements with "display: none" should be parsed

Returns

dfs [list of DataFrames]

See also:

read_csv

DataFrame.to_html

databricks.koalas.DataFrame.to_html

DataFrame.**to_html**(*buf=None*, *columns=None*, *col_space=None*, *header=True*, *index=True*, *na_rep='NaN'*, *formatters=None*, *float_format=None*, *sparsify=None*, *index_names=True*, *justify=None*, *max_rows=None*, *max_cols=None*, *show_dimensions=False*, *decimal='.'*, *bold_rows=True*, *classes=None*, *escape=True*, *notebook=False*, *border=None*, *table_id=None*, *render_links=False*) → Optional[str]

Render a DataFrame as an HTML table.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory. If the input is large, set max_rows parameter.

Parameters

buf [StringIO-like, optional] Buffer to write to.

columns [sequence, optional, default None] The subset of columns to write. Writes all columns by default.

col_space [int, optional] The minimum width of each column.

header [bool, optional] Write out the column names. If a list of strings is given, it is assumed to be aliases for the column names

index [bool, optional, default True] Whether to print index (row) labels.

na_rep [str, optional, default 'NaN'] String representation of NAN to use.

formatters [list or dict of one-param. functions, optional] Formatter functions to apply to columns' elements by position or name. The result of each function must be a unicode string. List must be of length equal to the number of columns.

float_format [one-parameter function, optional, default None] Formatter function to apply to columns' elements if they are floats. The result of this function must be a unicode string.

sparsify [bool, optional, default True] Set to False for a DataFrame with a hierarchical index to print every multiindex key at each row.

index_names [bool, optional, default True] Prints the names of the indexes.

justify [str, default None] How to justify the column labels. If None uses the option from the print configuration (controlled by set_option), 'right' out of the box. Valid values are

- left
- right
- center
- justify
- justify-all
- start
- end
- inherit
- match-parent
- initial
- unset.

max_rows [int, optional] Maximum number of rows to display in the console.

max_cols [int, optional] Maximum number of columns to display in the console.

show_dimensions [bool, default False] Display DataFrame dimensions (number of rows by number of columns).

decimal [str, default '.'] Character recognized as decimal separator, e.g. ',' in Europe.

bold_rows [bool, default True] Make the row labels bold in the output.

classes [str or list or tuple, default None] CSS class(es) to apply to the resulting html table.

escape [bool, default True] Convert the characters <, >, and & to HTML-safe sequences.

notebook [{True, False}, default False] Whether the generated HTML is for IPython Notebook.

border [int] A `border=border` attribute is included in the opening <*table*> tag. Default `pd.options.html.border`.

table_id [str, optional] A css id is included in the opening <*table*> tag if specified.

render_links [bool, default False] Convert URLs to HTML links (only works with pandas 0.24+).

Returns

str (or unicode, depending on data and options) String representation of the dataframe.

See also:

to_string Convert DataFrame to a string.

3.1.11 SQL

read_sql_table(table_name, con[, schema, ...])	Read SQL database table into a DataFrame.
read_sql_query(sql, con[, index_col])	Read SQL query into a DataFrame.
read_sql(sql, con[, index_col, columns])	Read SQL query or database table into a DataFrame.

databricks.koalas.read_sql_table

databricks.koalas.**read_sql_table**(*table_name*, *con*, *schema=None*, *index_col=None*, *columns=None*, ***options*) → databricks.koalas.frame.DataFrame

Read SQL database table into a DataFrame.

Given a table name and a JDBC URI, returns a DataFrame.

Parameters

table_name [str] Name of SQL table in database.

con [str] A JDBC URI could be provided as as str.

> **Note:** The URI must be JDBC URI instead of Python's database URI.

schema [str, default None] Name of SQL schema in database to query (if database flavor supports this). Uses default schema if None (default).

index_col [str or list of str, optional, default: None] Column(s) to set as index(MultiIndex).

columns [list, default None] List of column names to select from SQL table.

options [dict] All other options passed directly into Spark's JDBC data source.

Returns

DataFrame A SQL table is returned as two-dimensional data structure with labeled axes.

See also:

read_sql_query Read SQL query into a DataFrame.

read_sql Read SQL query or database table into a DataFrame.

Examples

```
>>> ks.read_sql_table('table_name', 'jdbc:postgresql:db_name')
```

databricks.koalas.read_sql_query

databricks.koalas.**read_sql_query**(*sql*, *con*, *index_col=None*, ***options*) → databricks.koalas.frame.DataFrame

Read SQL query into a DataFrame.

Returns a DataFrame corresponding to the result set of the query string. Optionally provide an *index_col* parameter to use one of the columns as the index, otherwise default index will be used.

Note: Some database might hit the issue of Spark: SPARK-27596

Parameters

sql [string SQL query] SQL query to be executed.

con [str] A JDBC URI could be provided as as str.

Note: The URI must be JDBC URI instead of Python's database URI.

index_col [string or list of strings, optional, default: None] Column(s) to set as index(MultiIndex).

options [dict] All other options passed directly into Spark's JDBC data source.

Returns

DataFrame

See also:

read_sql_table Read SQL database table into a DataFrame.

read_sql

Examples

```
>>> ks.read_sql_query('SELECT * FROM table_name', 'jdbc:postgresql:db_name')
```

databricks.koalas.read_sql

databricks.koalas.**read_sql**(*sql*, *con*, *index_col=None*, *columns=None*, ***options*) → databricks.koalas.frame.DataFrame

Read SQL query or database table into a DataFrame.

This function is a convenience wrapper around `read_sql_table` and `read_sql_query` (for backward compatibility). It will delegate to the specific function depending on the provided input. A SQL query will be routed to `read_sql_query`, while a database table name will be routed to `read_sql_table`. Note that the delegated function might have more specific notes about their functionality not listed here.

Note: Some database might hit the issue of Spark: SPARK-27596

Parameters

sql [string] SQL query to be executed or a table name.

con [str] A JDBC URI could be provided as as str.

Note: The URI must be JDBC URI instead of Python's database URI.

index_col [string or list of strings, optional, default: None] Column(s) to set as index(MultiIndex).

columns [list, default: None] List of column names to select from SQL table (only used when reading a table).

options [dict] All other options passed directly into Spark's JDBC data source.

Returns

DataFrame

See also:

read_sql_table Read SQL database table into a DataFrame.

read_sql_query Read SQL query into a DataFrame.

Examples

```
>>> ks.read_sql('table_name', 'jdbc:postgresql:db_name')
>>> ks.read_sql('SELECT * FROM table_name', 'jdbc:postgresql:db_name')
```

3.2 General functions

3.2.1 Working with options

reset_option(key)	Reset one option to their default value.
get_option(key[, default])	Retrieves the value of the specified option.
set_option(key, value)	Sets the value of the specified option.
option_context(*args)	Context manager to temporarily set options in the *with* statement context.

databricks.koalas.reset_option

databricks.koalas.**reset_option**(*key: str*) → None

Reset one option to their default value.

Pass "all" as argument to reset all options.

Parameters

key [str] If specified only option will be reset.

Returns

None

databricks.koalas.get_option

databricks.koalas.**get_option**(*key: str*, *default: Union[Any, pyspark._globals._NoValueType] = <no value>*) → Any

Retrieves the value of the specified option.

Parameters

key [str] The key which should match a single option.

default [object] The default value if the option is not set yet. The value should be JSON serializable.

Returns

result [the value of the option]

Raises

OptionError [if no such option exists and the default is not provided]

databricks.koalas.set_option

databricks.koalas.**set_option**(*key: str*, *value: Any*) → None

Sets the value of the specified option.

Parameters

key [str] The key which should match a single option.

value [object] New value of option. The value should be JSON serializable.

Returns

None

databricks.koalas.option_context

databricks.koalas.**option_context**(**args*)

Context manager to temporarily set options in the *with* statement context.

You need to invoke as `option_context(pat, val, [(pat, val), ...])`.

Examples

```
>>> with option_context('display.max_rows', 10, 'compute.max_rows', 5):
...     print(get_option('display.max_rows'), get_option('compute.max_rows'))
10 5
>>> print(get_option('display.max_rows'), get_option('compute.max_rows'))
1000 1000
```

3.2.2 Data manipulations and SQL

melt(frame[, id_vars, value_vars, var_name, ...])	Unpivot a DataFrame from wide format to long format, optionally leaving identifier variables set.
merge(obj, right[, how, on, left_on, ...])	Merge DataFrame objects with a database-style join.
get_dummies(data[, prefix, prefix_sep, ...])	Convert categorical variable into dummy/indicator variables, also known as one hot encoding.
concat(objs[, axis, join, ignore_index, sort])	Concatenate Koalas objects along a particular axis with optional set logic along the other axes.
sql(query[, globals, locals])	Execute a SQL query and return the result as a Koalas DataFrame.
broadcast(obj)	Marks a DataFrame as small enough for use in broadcast joins.

databricks.koalas.melt

databricks.koalas.**melt**(*frame*, *id_vars=None*, *value_vars=None*, *var_name=None*, *value_name='value'*) → databricks.koalas.frame.DataFrame

Unpivot a DataFrame from wide format to long format, optionally leaving identifier variables set.

This function is useful to massage a DataFrame into a format where one or more columns are identifier variables (*id_vars*), while all other columns, considered measured variables (*value_vars*), are "unpivoted" to the row axis, leaving just two non-identifier columns, 'variable' and 'value'.

Parameters

frame [DataFrame]

id_vars [tuple, list, or ndarray, optional] Column(s) to use as identifier variables.

value_vars [tuple, list, or ndarray, optional] Column(s) to unpivot. If not specified, uses all columns that are not set as *id_vars*.

var_name [scalar, default 'variable'] Name to use for the 'variable' column. If None it uses *frame.columns.name* or 'variable'.

value_name [scalar, default 'value'] Name to use for the 'value' column.

Returns

DataFrame Unpivoted DataFrame.

Examples

```
>>> df = ks.DataFrame({'A': {0: 'a', 1: 'b', 2: 'c'},
...                    'B': {0: 1, 1: 3, 2: 5},
...                    'C': {0: 2, 1: 4, 2: 6}},
...                   columns=['A', 'B', 'C'])
>>> df
   A  B  C
0  a  1  2
1  b  3  4
2  c  5  6
```

```
>>> ks.melt(df)
  variable value
0        A     a
1        B     1
2        C     2
3        A     b
4        B     3
5        C     4
6        A     c
7        B     5
8        C     6
```

```
>>> df.melt(id_vars='A')
   A variable  value
0  a        B      1
1  a        C      2
2  b        B      3
3  b        C      4
4  c        B      5
5  c        C      6
```

```
>>> df.melt(value_vars='A')
  variable value
0        A     a
1        A     b
2        A     c
```

```
>>> ks.melt(df, id_vars=['A', 'B'])
   A  B variable  value
0  a  1        C      2
1  b  3        C      4
2  c  5        C      6
```

```
>>> df.melt(id_vars=['A'], value_vars=['C'])
   A variable  value
0  a        C      2
1  b        C      4
2  c        C      6
```

The names of ‘variable’ and ‘value’ columns can be customized:

```
>>> ks.melt(df, id_vars=['A'], value_vars=['B'],
...         var_name='myVarname', value_name='myValname')
   A myVarname  myValname
0  a         B          1
1  b         B          3
2  c         B          5
```

databricks.koalas.merge

databricks.koalas.**merge**(*obj*, *right: databricks.koalas.frame.DataFrame*, *how: str = 'inner'*, *on: Union[Any, List[Any], Tuple, List[Tuple]] = None*, *left_on: Union[Any, List[Any], Tuple, List[Tuple]] = None*, *right_on: Union[Any, List[Any], Tuple, List[Tuple]] = None*, *left_index: bool = False*, *right_index: bool = False*, *suffixes: Tuple[str, str] = ('_x', '_y')*) → databricks.koalas.frame.DataFrame

Merge DataFrame objects with a database-style join.

The index of the resulting DataFrame will be one of the following:

- 0...n if no index is used for merging
- Index of the left DataFrame if merged only on the index of the right DataFrame
- Index of the right DataFrame if merged only on the index of the left DataFrame
- **All involved indices if merged using the indices of both DataFrames** e.g. if *left* with indices (a, x) and *right* with indices (b, x), the result will be an index (x, a, b)

Parameters

right: Object to merge with.

how: Type of merge to be performed. {'left', 'right', 'outer', 'inner'}, default 'inner'

left: use only keys from left frame, similar to a SQL left outer join; preserve key order.

right: use only keys from right frame, similar to a SQL right outer join; preserve key order.

outer: use union of keys from both frames, similar to a SQL full outer join; sort keys lexicographically.

inner: use intersection of keys from both frames, similar to a SQL inner join; preserve the order of the left keys.

on: Column or index level names to join on. These must be found in both DataFrames. If on is None and not merging on indexes then this defaults to the intersection of the columns in both DataFrames.

left_on: Column or index level names to join on in the left DataFrame. Can also be an array or list of arrays of the length of the left DataFrame. These arrays are treated as if they are columns.

right_on: Column or index level names to join on in the right DataFrame. Can also be an array or list of arrays of the length of the right DataFrame. These arrays are treated as if they are columns.

left_index: Use the index from the left DataFrame as the join key(s). If it is a MultiIndex, the number of keys in the other DataFrame (either the index or a number of columns) must match the number of levels.

right_index: Use the index from the right DataFrame as the join key. Same caveats as left_index.

suffixes: Suffix to apply to overlapping column names in the left and right side, respectively.

Returns

DataFrame A DataFrame of the two merged objects.

Notes

As described in #263, joining string columns currently returns None for missing values instead of NaN.

Examples

```
>>> df1 = ks.DataFrame({'lkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [1, 2, 3, 5]},
...                    columns=['lkey', 'value'])
>>> df2 = ks.DataFrame({'rkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [5, 6, 7, 8]},
...                    columns=['rkey', 'value'])
>>> df1
  lkey  value
0  foo      1
1  bar      2
2  baz      3
3  foo      5
>>> df2
  rkey  value
0  foo      5
1  bar      6
2  baz      7
3  foo      8
```

Merge df1 and df2 on the lkey and rkey columns. The value columns have the default suffixes, _x and _y, appended.

```
>>> merged = ks.merge(df1, df2, left_on='lkey', right_on='rkey')
>>> merged.sort_values(by=['lkey', 'value_x', 'rkey', 'value_y'])
  lkey  value_x rkey  value_y
...bar        2  bar        6
...baz        3  baz        7
...foo        1  foo        5
...foo        1  foo        8
...foo        5  foo        5
...foo        5  foo        8
```

```
>>> left_kdf = ks.DataFrame({'A': [1, 2]})
>>> right_kdf = ks.DataFrame({'B': ['x', 'y']}, index=[1, 2])
```

```
>>> ks.merge(left_kdf, right_kdf, left_index=True, right_index=True).sort_index()
   A  B
1  2  x
```

```
>>> ks.merge(left_kdf, right_kdf, left_index=True, right_index=True, how='left').
↪sort_index()
   A     B
0  1  None
1  2     x
```

```
>>> ks.merge(left_kdf, right_kdf, left_index=True, right_index=True, how='right').
↪sort_index()
     A  B
1  2.0  x
2  NaN  y
```

```
>>> ks.merge(left_kdf, right_kdf, left_index=True, right_index=True, how='outer').
↪sort_index()
     A     B
0  1.0  None
1  2.0     x
2  NaN     y
```

databricks.koalas.get_dummies

databricks.koalas.**get_dummies**(*data*, *prefix=None*, *prefix_sep='_'*, *dummy_na=False*, *columns=None*, *sparse=False*, *drop_first=False*, *dtype=None*)
→ databricks.koalas.frame.DataFrame

Convert categorical variable into dummy/indicator variables, also known as one hot encoding.

Parameters

data [array-like, Series, or DataFrame]

prefix [string, list of strings, or dict of strings, default None] String to append DataFrame column names. Pass a list with length equal to the number of columns when calling get_dummies on a DataFrame. Alternatively, *prefix* can be a dictionary mapping column names to prefixes.

prefix_sep [string, default '_'] If appending prefix, separator/delimiter to use. Or pass a list or dictionary as with *prefix.*

dummy_na [bool, default False] Add a column to indicate NaNs, if False NaNs are ignored.

columns [list-like, default None] Column names in the DataFrame to be encoded. If *columns* is None then all the columns with *object* or *category* dtype will be converted.

sparse [bool, default False] Whether the dummy-encoded columns should be be backed by a `SparseArray` (True) or a regular NumPy array (False). In Koalas, this value must be "False".

drop_first [bool, default False] Whether to get k-1 dummies out of k categorical levels by removing the first level.

dtype [dtype, default np.uint8] Data type for new columns. Only a single dtype is allowed.

Returns

dummies [DataFrame]

See also:

Series.str.get_dummies

Examples

```
>>> s = ks.Series(list('abca'))
```

```
>>> ks.get_dummies(s)
   a  b  c
0  1  0  0
1  0  1  0
2  0  0  1
3  1  0  0
```

```
>>> df = ks.DataFrame({'A': ['a', 'b', 'a'], 'B': ['b', 'a', 'c'],
...                    'C': [1, 2, 3]},
...                   columns=['A', 'B', 'C'])
```

```
>>> ks.get_dummies(df, prefix=['col1', 'col2'])
   C  col1_a  col1_b  col2_a  col2_b  col2_c
0  1       1       0       0       1       0
1  2       0       1       1       0       0
2  3       1       0       0       0       1
```

```
>>> ks.get_dummies(ks.Series(list('abcaa')))
   a  b  c
0  1  0  0
1  0  1  0
2  0  0  1
3  1  0  0
4  1  0  0
```

```
>>> ks.get_dummies(ks.Series(list('abcaa')), drop_first=True)
   b  c
0  0  0
1  1  0
2  0  1
3  0  0
4  0  0
```

```
>>> ks.get_dummies(ks.Series(list('abc')), dtype=float)
     a    b    c
0  1.0  0.0  0.0
1  0.0  1.0  0.0
2  0.0  0.0  1.0
```

databricks.koalas.concat

databricks.koalas.**concat**(*objs*, *axis=0*, *join='outer'*, *ignore_index=False*, *sort=False*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Concatenate Koalas objects along a particular axis with optional set logic along the other axes.

Parameters

objs [a sequence of Series or DataFrame] Any None objects will be dropped silently unless they are all None in which case a ValueError will be raised

axis [{0/'index', 1/'columns'}, default 0] The axis to concatenate along.

join [{'inner', 'outer'}, default 'outer'] How to handle indexes on other axis (or axes).

ignore_index [bool, default False] If True, do not use the index values along the concatenation axis. The resulting axis will be labeled 0, ..., n - 1. This is useful if you are concatenating objects where the concatenation axis does not have meaningful indexing information. Note the index values on the other axes are still respected in the join.

sort [bool, default False] Sort non-concatenation axis if it is not already aligned.

Returns

object, type of objs When concatenating all `Series` along the index (axis=0), a `Series` is returned. When `objs` contains at least one `DataFrame`, a `DataFrame` is returned. When concatenating along the columns (axis=1), a `DataFrame` is returned.

See also:

Series.append Concatenate Series.

DataFrame.join Join DataFrames using indexes.

DataFrame.merge Merge DataFrames by indexes or columns.

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
```

Combine two `Series`.

```
>>> s1 = ks.Series(['a', 'b'])
>>> s2 = ks.Series(['c', 'd'])
>>> ks.concat([s1, s2])
0    a
1    b
0    c
1    d
dtype: object
```

Clear the existing index and reset it in the result by setting the `ignore_index` option to `True`.

```
>>> ks.concat([s1, s2], ignore_index=True)
0    a
1    b
2    c
3    d
dtype: object
```

Combine two `DataFrame` objects with identical columns.

```
>>> df1 = ks.DataFrame([['a', 1], ['b', 2]],
...                    columns=['letter', 'number'])
>>> df1
  letter  number
0      a       1
1      b       2
>>> df2 = ks.DataFrame([['c', 3], ['d', 4]],
```

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```
...                     columns=['letter', 'number'])
>>> df2
  letter  number
0      c       3
1      d       4
```

```
>>> ks.concat([df1, df2])
  letter  number
0      a       1
1      b       2
0      c       3
1      d       4
```

Combine `DataFrame` and `Series` objects with different columns.

```
>>> ks.concat([df2, s1])
  letter  number     0
0      c     3.0  None
1      d     4.0  None
0   None     NaN     a
1   None     NaN     b
```

Combine `DataFrame` objects with overlapping columns and return everything. Columns outside the intersection will be filled with `None` values.

```
>>> df3 = ks.DataFrame([['c', 3, 'cat'], ['d', 4, 'dog']],
...                    columns=['letter', 'number', 'animal'])
>>> df3
  letter  number animal
0      c       3    cat
1      d       4    dog
```

```
>>> ks.concat([df1, df3])
  letter  number animal
0      a       1   None
1      b       2   None
0      c       3    cat
1      d       4    dog
```

Sort the columns.

```
>>> ks.concat([df1, df3], sort=True)
  animal letter  number
0   None      a       1
1   None      b       2
0    cat      c       3
1    dog      d       4
```

Combine `DataFrame` objects with overlapping columns and return only those that are shared by passing `inner` to the `join` keyword argument.

```
>>> ks.concat([df1, df3], join="inner")
  letter  number
0      a       1
1      b       2
```

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```
0      c       3
1      d       4
```

```
>>> df4 = ks.DataFrame([['bird', 'polly'], ['monkey', 'george']],
...                    columns=['animal', 'name'])
```

Combine with column axis.

```
>>> ks.concat([df1, df4], axis=1)
  letter  number  animal    name
0      a       1    bird   polly
1      b       2  monkey  george
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.sql

databricks.koalas.**sql**(*query: str*, *globals=None*, *locals=None*, ***kwargs*) → databricks.koalas.frame.DataFrame

Execute a SQL query and return the result as a Koalas DataFrame.

This function also supports embedding Python variables (locals, globals, and parameters) in the SQL statement by wrapping them in curly braces. See examples section for details.

In addition to the locals, globals and parameters, the function will also attempt to determine if the program currently runs in an IPython (or Jupyter) environment and to import the variables from this environment. The variables have the same precedence as globals.

The following variable types are supported:

- string
- int
- float
- list, tuple, range of above types
- Koalas DataFrame
- Koalas Series
- pandas DataFrame

Parameters

query [str] the SQL query

globals [dict, optional] the dictionary of global variables, if explicitly set by the user

locals [dict, optional] the dictionary of local variables, if explicitly set by the user

kwargs other variables that the user may want to set manually that can be referenced in the query

Returns

Koalas DataFrame

Examples

Calling a built-in SQL function.

```
>>> ks.sql("select * from range(10) where id > 7")
   id
0   8
1   9
```

A query can also reference a local variable or parameter by wrapping them in curly braces:

```
>>> bound1 = 7
>>> ks.sql("select * from range(10) where id > {bound1} and id < {bound2}",␣
↪bound2=9)
   id
0   8
```

You can also wrap a DataFrame with curly braces to query it directly. Note that when you do that, the indexes, if any, automatically become top level columns.

```
>>> mydf = ks.range(10)
>>> x = range(4)
>>> ks.sql("SELECT * from {mydf} WHERE id IN {x}")
   id
0   0
1   1
2   2
3   3
```

Queries can also be arbitrarily nested in functions:

```
>>> def statement():
...     mydf2 = ks.DataFrame({"x": range(2)})
...     return ks.sql("SELECT * from {mydf2}")
>>> statement()
   x
0  0
1  1
```

Mixing Koalas and pandas DataFrames in a join operation. Note that the index is dropped.

```
>>> ks.sql('''
...   SELECT m1.a, m2.b
...   FROM {table1} m1 INNER JOIN {table2} m2
...   ON m1.key = m2.key
...   ORDER BY m1.a, m2.b''',
...   table1=ks.DataFrame({"a": [1,2], "key": ["a", "b"]}),
...   table2=pd.DataFrame({"b": [3,4,5], "key": ["a", "b", "b"]}))
   a  b
0  1  3
1  2  4
2  2  5
```

Also, it is possible to query using Series.

```
>>> myser = ks.Series({'a': [1.0, 2.0, 3.0], 'b': [15.0, 30.0, 45.0]})
>>> ks.sql("SELECT * from {myser}")
```

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```
                      0
0      [1.0, 2.0, 3.0]
1   [15.0, 30.0, 45.0]
```

databricks.koalas.broadcast

databricks.koalas.**broadcast**(*obj*) → databricks.koalas.frame.DataFrame

Marks a DataFrame as small enough for use in broadcast joins.

Parameters

obj [DataFrame]

Returns

ret [DataFrame with broadcast hint.]

See also:

DataFrame.merge Merge DataFrame objects with a database-style join.

DataFrame.join Join columns of another DataFrame.

DataFrame.update Modify in place using non-NA values from another DataFrame.

DataFrame.hint Specifies some hint on the current DataFrame.

Examples

```
>>> df1 = ks.DataFrame({'lkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [1, 2, 3, 5]},
...                    columns=['lkey', 'value']).set_index('lkey')
>>> df2 = ks.DataFrame({'rkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [5, 6, 7, 8]},
...                    columns=['rkey', 'value']).set_index('rkey')
>>> merged = df1.merge(ks.broadcast(df2), left_index=True, right_index=True)
>>> merged.spark.explain()
== Physical Plan ==
...
...BroadcastHashJoin...
...
```

3.2.3 Top-level missing data

to_numeric(arg)	Convert argument to a numeric type.
isna(obj)	Detect missing values for an array-like object.
isnull(obj)	Detect missing values for an array-like object.
notna(obj)	Detect existing (non-missing) values.
notnull(obj)	Detect existing (non-missing) values.

databricks.koalas.to_numeric

databricks.koalas.**to_numeric**(*arg*)

Convert argument to a numeric type.

Parameters

arg [scalar, list, tuple, 1-d array, or Series]

Returns

ret [numeric if parsing succeeded.]

See also:

DataFrame.astype Cast argument to a specified dtype.

to_datetime Convert argument to datetime.

to_timedelta Convert argument to timedelta.

numpy.ndarray.astype Cast a numpy array to a specified type.

Examples

```
>>> kser = ks.Series(['1.0', '2', '-3'])
>>> kser
0    1.0
1      2
2     -3
dtype: object
```

```
>>> ks.to_numeric(kser)
0    1.0
1    2.0
2   -3.0
dtype: float32
```

If given Series contains invalid value to cast float, just cast it to *np.nan*

```
>>> kser = ks.Series(['apple', '1.0', '2', '-3'])
>>> kser
0    apple
1      1.0
2        2
3       -3
dtype: object
```

```
>>> ks.to_numeric(kser)
0    NaN
1    1.0
2    2.0
3   -3.0
dtype: float32
```

Also support for list, tuple, np.array, or a scalar

```
>>> ks.to_numeric(['1.0', '2', '-3'])
array([ 1.,  2., -3.])
```

```
>>> ks.to_numeric(('1.0', '2', '-3'))
array([ 1.,  2., -3.])
```

```
>>> ks.to_numeric(np.array(['1.0', '2', '-3']))
array([ 1.,  2., -3.])
```

```
>>> ks.to_numeric('1.0')
1.0
```

databricks.koalas.isna

databricks.koalas.**isna**(*obj*)

Detect missing values for an array-like object.

This function takes a scalar or array-like object and indicates whether values are missing (NaN in numeric arrays, None or NaN in object arrays).

Parameters

obj [scalar or array-like] Object to check for null or missing values.

Returns

bool or array-like of bool For scalar input, returns a scalar boolean. For array input, returns an array of boolean indicating whether each corresponding element is missing.

See also:

Series.isna Detect missing values in a Series.

Series.isnull Detect missing values in a Series.

DataFrame.isna Detect missing values in a DataFrame.

DataFrame.isnull Detect missing values in a DataFrame.

Index.isna Detect missing values in an Index.

Index.isnull Detect missing values in an Index.

Examples

Scalar arguments (including strings) result in a scalar boolean.

```
>>> ks.isna('dog')
False
```

```
>>> ks.isna(np.nan)
True
```

ndarrays result in an ndarray of booleans.

```
>>> array = np.array([[1, np.nan, 3], [4, 5, np.nan]])
>>> array
array([[ 1., nan,  3.],
       [ 4.,  5., nan]])
>>> ks.isna(array)
```

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```
array([[False,  True, False],
       [False, False,  True]])
```

For Series and DataFrame, the same type is returned, containing booleans.

```
>>> df = ks.DataFrame({'a': ['ant', 'bee', 'cat'], 'b': ['dog', None, 'fly']})
>>> df
     a     b
0  ant   dog
1  bee  None
2  cat   fly
```

```
>>> ks.isna(df)
       a      b
0  False  False
1  False   True
2  False  False
```

```
>>> ks.isnull(df.b)
0    False
1     True
2    False
Name: b, dtype: bool
```

databricks.koalas.isnull

databricks.koalas.**isnull**(*obj*)

Detect missing values for an array-like object.

This function takes a scalar or array-like object and indicates whether values are missing (`NaN` in numeric arrays, `None` or `NaN` in object arrays).

Parameters

obj [scalar or array-like] Object to check for null or missing values.

Returns

bool or array-like of bool For scalar input, returns a scalar boolean. For array input, returns an array of boolean indicating whether each corresponding element is missing.

See also:

Series.isna Detect missing values in a Series.

Series.isnull Detect missing values in a Series.

DataFrame.isna Detect missing values in a DataFrame.

DataFrame.isnull Detect missing values in a DataFrame.

Index.isna Detect missing values in an Index.

Index.isnull Detect missing values in an Index.

Examples

Scalar arguments (including strings) result in a scalar boolean.

```
>>> ks.isna('dog')
False
```

```
>>> ks.isna(np.nan)
True
```

ndarrays result in an ndarray of booleans.

```
>>> array = np.array([[1, np.nan, 3], [4, 5, np.nan]])
>>> array
array([[ 1., nan,  3.],
       [ 4.,  5., nan]])
>>> ks.isna(array)
array([[False,  True, False],
       [False, False,  True]])
```

For Series and DataFrame, the same type is returned, containing booleans.

```
>>> df = ks.DataFrame({'a': ['ant', 'bee', 'cat'], 'b': ['dog', None, 'fly']})
>>> df
     a     b
0  ant   dog
1  bee  None
2  cat   fly
```

```
>>> ks.isna(df)
       a      b
0  False  False
1  False   True
2  False  False
```

```
>>> ks.isnull(df.b)
0    False
1     True
2    False
Name: b, dtype: bool
```

databricks.koalas.notna

databricks.koalas.**notna**(*obj*)

Detect existing (non-missing) values.

Return a boolean same-sized object indicating if the values are not NA. Non-missing values get mapped to True. NA values, such as None or `numpy.NaN`, get mapped to False values.

Returns

bool or array-like of bool Mask of bool values for each element that indicates whether an element is not an NA value.

See also:

isna Detect missing values for an array-like object.

Series.notna Boolean inverse of Series.isna.

DataFrame.notnull Boolean inverse of DataFrame.isnull.

Index.notna Boolean inverse of Index.isna.

Index.notnull Boolean inverse of Index.isnull.

Examples

Show which entries in a DataFrame are not NA.

```
>>> df = ks.DataFrame({'age': [5, 6, np.NaN],
...                    'born': [pd.NaT, pd.Timestamp('1939-05-27'),
...                             pd.Timestamp('1940-04-25')],
...                    'name': ['Alfred', 'Batman', ''],
...                    'toy': [None, 'Batmobile', 'Joker']})
>>> df
   age       born    name        toy
0  5.0        NaT  Alfred       None
1  6.0 1939-05-27  Batman  Batmobile
2  NaN 1940-04-25              Joker
```

```
>>> df.notnull()
     age   born  name    toy
0   True  False  True  False
1   True   True  True   True
2  False   True  True   True
```

Show which entries in a Series are not NA.

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser
0    5.0
1    6.0
2    NaN
dtype: float64
```

```
>>> ks.notna(ser)
0     True
1     True
2    False
dtype: bool
```

```
>>> ks.notna(ser.index)
True
```

databricks.koalas.notnull

databricks.koalas.**notnull**(*obj*)

Detect existing (non-missing) values.

Return a boolean same-sized object indicating if the values are not NA. Non-missing values get mapped to True. NA values, such as None or `numpy.NaN`, get mapped to False values.

Returns

bool or array-like of bool Mask of bool values for each element that indicates whether an element is not an NA value.

See also:

isna Detect missing values for an array-like object.

Series.notna Boolean inverse of Series.isna.

DataFrame.notnull Boolean inverse of DataFrame.isnull.

Index.notna Boolean inverse of Index.isna.

Index.notnull Boolean inverse of Index.isnull.

Examples

Show which entries in a DataFrame are not NA.

```
>>> df = ks.DataFrame({'age': [5, 6, np.NaN],
...                    'born': [pd.NaT, pd.Timestamp('1939-05-27'),
...                             pd.Timestamp('1940-04-25')],
...                    'name': ['Alfred', 'Batman', ''],
...                    'toy': [None, 'Batmobile', 'Joker']})
>>> df
   age       born    name        toy
0  5.0        NaT  Alfred       None
1  6.0 1939-05-27  Batman  Batmobile
2  NaN 1940-04-25              Joker
```

```
>>> df.notnull()
     age   born  name    toy
0   True  False  True  False
1   True   True  True   True
2  False   True  True   True
```

Show which entries in a Series are not NA.

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser
0    5.0
1    6.0
2    NaN
dtype: float64
```

```
>>> ks.notna(ser)
0     True
1     True
```

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```
2    False
dtype: bool
```

```
>>> ks.notna(ser.index)
True
```

3.2.4 Top-level dealing with datetimelike

to_datetime(arg[, errors, format, unit, ...])	Convert argument to datetime.

databricks.koalas.to_datetime

databricks.koalas.**to_datetime**(*arg*, *errors='raise'*, *format=None*, *unit=None*, *infer_datetime_format=False*, *origin='unix'*)

Convert argument to datetime.

Parameters

arg [integer, float, string, datetime, list, tuple, 1-d array, Series] or DataFrame/dict-like

errors [{'ignore', 'raise', 'coerce'}, default 'raise']

- If 'raise', then invalid parsing will raise an exception
- If 'coerce', then invalid parsing will be set as NaT
- If 'ignore', then invalid parsing will return the input

format [string, default None] strftime to parse time, eg "%d/%m/%Y", note that "%f" will parse all the way up to nanoseconds.

unit [string, default None] unit of the arg (D,s,ms,us,ns) denote the unit, which is an integer or float number. This will be based off the origin. Example, with unit='ms' and origin='unix' (the default), this would calculate the number of milliseconds to the unix epoch start.

infer_datetime_format [boolean, default False] If True and no *format* is given, attempt to infer the format of the datetime strings, and if it can be inferred, switch to a faster method of parsing them. In some cases this can increase the parsing speed by ~5-10x.

origin [scalar, default 'unix'] Define the reference date. The numeric values would be parsed as number of units (defined by *unit*) since this reference date.

- If 'unix' (or POSIX) time; origin is set to 1970-01-01.
- If 'julian', unit must be 'D', and origin is set to beginning of Julian Calendar. Julian day number 0 is assigned to the day starting at noon on January 1, 4713 BC.
- If Timestamp convertible, origin is set to Timestamp identified by origin.

Returns

ret [datetime if parsing succeeded.] Return type depends on input:

- list-like: DatetimeIndex
- Series: Series of datetime64 dtype
- scalar: Timestamp

In case when it is not possible to return designated types (e.g. when any element of input is before Timestamp.min or after Timestamp.max) return will have datetime.datetime type (or corresponding array/Series).

Examples

Assembling a datetime from multiple columns of a DataFrame. The keys can be common abbreviations like ['year', 'month', 'day', 'minute', 'second', 'ms', 'us', 'ns']) or plurals of the same

```
>>> df = ks.DataFrame({'year': [2015, 2016],
...                    'month': [2, 3],
...                    'day': [4, 5]})
>>> ks.to_datetime(df)
0   2015-02-04
1   2016-03-05
dtype: datetime64[ns]
```

If a date does not meet the timestamp limitations, passing errors='ignore' will return the original input instead of raising any exception.

Passing errors='coerce' will force an out-of-bounds date to NaT, in addition to forcing non-dates (or non-parseable dates) to NaT.

```
>>> ks.to_datetime('13000101', format='%Y%m%d', errors='ignore')
datetime.datetime(1300, 1, 1, 0, 0)
>>> ks.to_datetime('13000101', format='%Y%m%d', errors='coerce')
NaT
```

Passing infer_datetime_format=True can often-times speedup a parsing if its not an ISO8601 format exactly, but in a regular format.

```
>>> s = ks.Series(['3/11/2000', '3/12/2000', '3/13/2000'] * 1000)
>>> s.head()
0    3/11/2000
1    3/12/2000
2    3/13/2000
3    3/11/2000
4    3/12/2000
dtype: object
```

```
>>> import timeit
>>> timeit.timeit(
...     lambda: repr(ks.to_datetime(s, infer_datetime_format=True)),
...     number = 1)
0.35832712500000063
```

```
>>> timeit.timeit(
...     lambda: repr(ks.to_datetime(s, infer_datetime_format=False)),
...     number = 1)
0.8895321660000004
```

Using a unix epoch time

```
>>> ks.to_datetime(1490195805, unit='s')
Timestamp('2017-03-22 15:16:45')
```

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```
>>> ks.to_datetime(1490195805433502912, unit='ns')
Timestamp('2017-03-22 15:16:45.433502912')
```

Using a non-unix epoch origin

```
>>> ks.to_datetime([1, 2, 3], unit='D', origin=pd.Timestamp('1960-01-01'))
DatetimeIndex(['1960-01-02', '1960-01-03', '1960-01-04'], dtype='datetime64[ns]',␣
↪freq=None)
```

3.3 Series

3.3.1 Constructor

Series([data, index, dtype, name, copy, ...])	Koalas Series that corresponds to pandas Series logically.

databricks.koalas.Series

class databricks.koalas.**Series**(*data=None*, *index=None*, *dtype=None*, *name=None*, *copy=False*, *fastpath=False*)

Koalas Series that corresponds to pandas Series logically. This holds Spark Column internally.

Variables

- **_internal** – an internal immutable Frame to manage metadata.
- **_kdf** – Parent's Koalas DataFrame

Parameters

data [array-like, dict, or scalar value, pandas Series] Contains data stored in Series If data is a dict, argument order is maintained for Python 3.6 and later. Note that if *data* is a pandas Series, other arguments should not be used.

index [array-like or Index (1d)] Values must be hashable and have the same length as *data*. Non-unique index values are allowed. Will default to RangeIndex (0, 1, 2, ..., n) if not provided. If both a dict and index sequence are used, the index will override the keys found in the dict.

dtype [numpy.dtype or None] If None, dtype will be inferred

copy [boolean, default False] Copy input data

__init__(*data=None*, *index=None*, *dtype=None*, *name=None*, *copy=False*, *fastpath=False*)

Initialize self. See help(type(self)) for accurate signature.

Methods

`__init__`([data, index, dtype, name, copy, ...])	Initialize self.
`abs`()	Return a Series/DataFrame with absolute numeric value of each element.
`add`(other)	Return Addition of series and other, element-wise (binary operator +).
`add_prefix`(prefix)	Prefix labels with string *prefix*.
`add_suffix`(suffix)	Suffix labels with string suffix.
`agg`(func)	Aggregate using one or more operations over the specified axis.
`aggregate`(func)	Aggregate using one or more operations over the specified axis.
`alias`(name)	An alias for `Series.rename()`.
`all`([axis])	Return whether all elements are True.
`any`([axis])	Return whether any element is True.
`append`(to_append[, ignore_index, ...])	Concatenate two or more Series.
`apply`(func[, args])	Invoke function on values of Series.
`argmax`()	Return int position of the largest value in the Series.
`argmin`()	Return int position of the smallest value in the Series.
`argsort`()	Return the integer indices that would sort the Series values.
`asof`(where)	Return the last row(s) without any NaNs before *where*.
`astype`(dtype)	Cast a Koalas object to a specified dtype `dtype`.
`backfill`([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
`between`(left, right[, inclusive])	Return boolean Series equivalent to left <= series <= right.
`bfill`([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
`bool`()	Return the bool of a single element in the current object.
`clip`([lower, upper])	Trim values at input threshold(s).
`combine_first`(other)	Combine Series values, choosing the calling Series's values first.
`compare`(other[, keep_shape, keep_equal])	Compare to another Series and show the differences.
`copy`([deep])	Make a copy of this object's indices and data.
`corr`(other[, method])	Compute correlation with *other* Series, excluding missing values.
`count`()	Return number of non-NA/null observations in the Series.
`cummax`([skipna])	Return cumulative maximum over a DataFrame or Series axis.
`cummin`([skipna])	Return cumulative minimum over a DataFrame or Series axis.
`cumprod`([skipna])	Return cumulative product over a DataFrame or Series axis.
`cumsum`([skipna])	Return cumulative sum over a DataFrame or Series axis.

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describe([percentiles])	Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN values.
diff([periods])	First discrete difference of element.
div(other)	Return Floating division of series and other, element-wise (binary operator /).
divide(other)	Return Floating division of series and other, element-wise (binary operator /).
divmod(other)	Return Integer division and modulo of series and other, element-wise (binary operator *divmod*).
dot(other)	Compute the dot product between the Series and the columns of other.
drop([labels, index, level])	Return Series with specified index labels removed.
drop_duplicates([keep, inplace])	Return Series with duplicate values removed.
droplevel(level)	Return Series with requested index level(s) removed.
dropna([axis, inplace])	Return a new Series with missing values removed.
eq(other)	Compare if the current value is equal to the other.
equals(other)	Compare if the current value is equal to the other.
expanding([min_periods])	Provide expanding transformations.
explode()	Transform each element of a list-like to a row.
ffill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with method=`ffill`.
fillna([value, method, axis, inplace, limit])	Fill NA/NaN values.
filter([items, like, regex, axis])	Subset rows or columns of dataframe according to labels in the specified index.
first_valid_index()	Retrieves the index of the first valid value.
floordiv(other)	Return Integer division of series and other, element-wise (binary operator //).
ge(other)	Compare if the current value is greater than or equal to the other.
get(key[, default])	Get item from object for given key (DataFrame column, Panel slice, etc.).
get_dtype_counts()	Return counts of unique dtypes in this object.
groupby(by[, axis, as_index, dropna])	Group DataFrame or Series using a Series of columns.
gt(other)	Compare if the current value is greater than the other.
head([n])	Return the first n rows.
hist([bins])	Draw one histogram of the DataFrame's columns.
idxmax([skipna])	Return the row label of the maximum value.
idxmin([skipna])	Return the row label of the minimum value.
isin(values)	Check whether *values* are contained in Series or Index.
isna()	Detect existing (non-missing) values.
isnull()	Detect existing (non-missing) values.
item()	Return the first element of the underlying data as a Python scalar.
items()	This is an alias of iteritems.
iteritems()	Lazily iterate over (index, value) tuples.
keys()	Return alias for index.
kurt([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).

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kurtosis([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
last_valid_index()	Return index for last non-NA/null value.
le(other)	Compare if the current value is less than or equal to the other.
lt(other)	Compare if the current value is less than the other.
mad()	Return the mean absolute deviation of values.
map(arg)	Map values of Series according to input correspondence.
mask(cond[, other])	Replace values where the condition is True.
max([axis, numeric_only])	Return the maximum of the values.
mean([axis, numeric_only])	Return the mean of the values.
median([axis, numeric_only, accuracy])	Return the median of the values for the requested axis.
min([axis, numeric_only])	Return the minimum of the values.
mod(other)	Return Modulo of series and other, element-wise (binary operator %).
mode([dropna])	Return the mode(s) of the dataset.
mul(other)	Return Multiplication of series and other, element-wise (binary operator *).
multiply(other)	Return Multiplication of series and other, element-wise (binary operator *).
ne(other)	Compare if the current value is not equal to the other.
nlargest([n])	Return the largest *n* elements.
notna()	Detect existing (non-missing) values.
notnull()	Detect existing (non-missing) values.
nsmallest([n])	Return the smallest *n* elements.
nunique([dropna, approx, rsd])	Return number of unique elements in the object.
pad([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill`.
pct_change([periods])	Percentage change between the current and a prior element.
pipe(func, *args, **kwargs)	Apply func(self, *args, **kwargs).
pop(item)	Return item and drop from series.
pow(other)	Return Exponential power of series of series and other, element-wise (binary operator **).
prod([min_count])	Return the product of the values.
product([min_count])	Return the product of the values.
quantile([q, accuracy])	Return value at the given quantile.
radd(other)	Return Reverse Addition of series and other, element-wise (binary operator +).
rank([method, ascending])	Compute numerical data ranks (1 through n) along axis.
rdiv(other)	Return Reverse Floating division of series and other, element-wise (binary operator /).
rdivmod(other)	Return Integer division and modulo of series and other, element-wise (binary operator *rdivmod*).
reindex([index, fill_value])	Conform Series to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index.

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reindex_like(other)	Return a Series with matching indices as other object.
rename([index])	Alter Series name.
rename_axis([mapper, index, inplace])	Set the name of the axis for the index or columns.
repeat(repeats)	Repeat elements of a Series.
replace([to_replace, value, regex])	Replace values given in to_replace with value.
reset_index([level, drop, name, inplace])	Generate a new DataFrame or Series with the index reset.
rfloordiv(other)	Return Reverse Integer division of series and other, element-wise (binary operator //).
rmod(other)	Return Reverse Modulo of series and other, element-wise (binary operator %).
rmul(other)	Return Reverse Multiplication of series and other, element-wise (binary operator *).
rolling(window[, min_periods])	Provide rolling transformations.
round([decimals])	Round each value in a Series to the given number of decimals.
rpow(other)	Return Reverse Exponential power of series and other, element-wise (binary operator **).
rsub(other)	Return Reverse Subtraction of series and other, element-wise (binary operator -).
rtruediv(other)	Return Reverse Floating division of series and other, element-wise (binary operator /).
sample([n, frac, replace, random_state])	Return a random sample of items from an axis of object.
shift([periods, fill_value])	Shift Series/Index by desired number of periods.
skew([axis, numeric_only])	Return unbiased skew normalized by N-1.
sort_index([axis, level, ascending, ...])	Sort object by labels (along an axis)
sort_values([ascending, inplace, na_position])	Sort by the values.
squeeze([axis])	Squeeze 1 dimensional axis objects into scalars.
std([axis, numeric_only])	Return sample standard deviation.
sub(other)	Return Subtraction of series and other, element-wise (binary operator -).
subtract(other)	Return Subtraction of series and other, element-wise (binary operator -).
sum([axis, numeric_only])	Return the sum of the values.
swapaxes(i, j[, copy])	Interchange axes and swap values axes appropriately.
swaplevel([i, j, copy])	Swap levels i and j in a MultiIndex.
tail([n])	Return the last *n* rows.
take(indices)	Return the elements in the given *positional* indices along an axis.
toPandas()	Return a pandas Series.
to_clipboard([excel, sep])	Copy object to the system clipboard.
to_csv([path, sep, na_rep, columns, header, ...])	Write object to a comma-separated values (csv) file.
to_dataframe([name])	Convert Series to DataFrame.
to_dict([into])	Convert Series to {label -> value} dict or dict-like object.
to_excel(excel_writer[, sheet_name, na_rep, ...])	Write object to an Excel sheet.
to_frame([name])	Convert Series to DataFrame.
to_json([path, compression, num_files, ...])	Convert the object to a JSON string.

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to_latex([buf, columns, col_space, header, ...])	Render an object to a LaTeX tabular environment table.
to_list()	Return a list of the values.
to_markdown([buf, mode])	Print Series or DataFrame in Markdown-friendly format.
to_numpy()	A NumPy ndarray representing the values in this DataFrame or Series.
to_pandas()	Return a pandas Series.
to_string([buf, na_rep, float_format, ...])	Render a string representation of the Series.
tolist()	Return a list of the values.
transform(func[, axis])	Call `func` producing the same type as *self* with transformed values and that has the same axis length as input.
transform_batch(func, *args, **kwargs)	Transform the data with the function that takes pandas Series and outputs pandas Series.
transpose(*args, **kwargs)	Return the transpose, which is by definition self.
truediv(other)	Return Floating division of series and other, element-wise (binary operator /).
truncate([before, after, axis, copy])	Truncate a Series or DataFrame before and after some index value.
unique()	Return unique values of Series object.
unstack([level])	Unstack, a.k.a.
update(other)	Modify Series in place using non-NA values from passed Series.
value_counts([normalize, sort, ascending, ...])	Return a Series containing counts of unique values.
var([axis, numeric_only])	Return unbiased variance.
where(cond[, other])	Replace values where the condition is False.
xs(key[, level])	Return cross-section from the Series.

Attributes

T	Return the transpose, which is by definition self.
at	Access a single value for a row/column label pair.
axes	Return a list of the row axis labels.
dtype	Return the dtype object of the underlying data.
dtypes	Return the dtype object of the underlying data.
empty	Returns true if the current object is empty.
hasnans	Return True if it has any missing values.
iat	Access a single value for a row/column pair by integer position.
iloc	Purely integer-location based indexing for selection by position.
index	The index (axis labels) Column of the Series.
is_monotonic	Return boolean if values in the object are monotonically increasing.
is_monotonic_decreasing	Return boolean if values in the object are monotonically decreasing.
is_monotonic_increasing	Return boolean if values in the object are monotonically increasing.

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is_unique	Return boolean if values in the object are unique
loc	Access a group of rows and columns by label(s) or a boolean Series.
name	Return name of the Series.
ndim	Return an int representing the number of array dimensions.
shape	Return a tuple of the shape of the underlying data.
size	Return an int representing the number of elements in this object.
spark_column	Spark Column object representing the Series/Index.
spark_type	Returns the data type as defined by Spark, as a Spark DataType object.
values	Return a Numpy representation of the DataFrame or the Series.

3.3.2 Attributes

Series.index	The index (axis labels) Column of the Series.
Series.dtype	Return the dtype object of the underlying data.
Series.dtypes	Return the dtype object of the underlying data.
Series.ndim	Return an int representing the number of array dimensions.
Series.name	Return name of the Series.
Series.shape	Return a tuple of the shape of the underlying data.
Series.axes	Return a list of the row axis labels.
Series.size	Return an int representing the number of elements in this object.
Series.empty	Returns true if the current object is empty.
Series.T	Return the transpose, which is by definition self.
Series.hasnans	Return True if it has any missing values.
Series.values	Return a Numpy representation of the DataFrame or the Series.

databricks.koalas.Series.index

property Series.**index**

The index (axis labels) Column of the Series.

See also:

Index

databricks.koalas.Series.dtype

property Series.**dtype**
Return the dtype object of the underlying data.

Examples

```
>>> s = ks.Series([1, 2, 3])
>>> s.dtype
dtype('int64')
```

```
>>> s = ks.Series(list('abc'))
>>> s.dtype
dtype('O')
```

```
>>> s = ks.Series(pd.date_range('20130101', periods=3))
>>> s.dtype
dtype('<M8[ns]')
```

```
>>> s.rename("a").to_frame().set_index("a").index.dtype
dtype('<M8[ns]')
```

databricks.koalas.Series.dtypes

property Series.**dtypes**
Return the dtype object of the underlying data.

```
>>> s = ks.Series(list('abc'))
>>> s.dtype == s.dtypes
True
```

databricks.koalas.Series.ndim

property Series.**ndim**
Return an int representing the number of array dimensions.

Return 1 for Series / Index / MultiIndex.

Examples

For Series

```
>>> s = ks.Series([None, 1, 2, 3, 4], index=[4, 5, 2, 1, 8])
>>> s.ndim
1
```

For Index

```
>>> s.index.ndim
1
```

For MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index.ndim
1
```

databricks.koalas.Series.name

property Series.**name**

Return name of the Series.

databricks.koalas.Series.shape

property Series.**shape**

Return a tuple of the shape of the underlying data.

databricks.koalas.Series.axes

property Series.**axes**

Return a list of the row axis labels.

Examples

```
>>> kser = ks.Series([1, 2, 3])
>>> kser.axes
[Int64Index([0, 1, 2], dtype='int64')]
```

databricks.koalas.Series.size

property Series.**size**

Return an int representing the number of elements in this object.

Return the number of rows if Series. Otherwise return the number of rows times number of columns if DataFrame.

Examples

```
>>> s = ks.Series({'a': 1, 'b': 2, 'c': None})
>>> s.size
3
```

```
>>> df = ks.DataFrame({'col1': [1, 2, None], 'col2': [3, 4, None]})
>>> df.size
6
```

```
>>> df = ks.DataFrame(index=[1, 2, None])
>>> df.size
0
```

databricks.koalas.Series.empty

property Series.**empty**

Returns true if the current object is empty. Otherwise, returns false.

```
>>> ks.range(10).id.empty
False
```

```
>>> ks.range(0).id.empty
True
```

```
>>> ks.DataFrame({}, index=list('abc')).index.empty
False
```

databricks.koalas.Series.T

property Series.**T**

Return the transpose, which is by definition self.

Examples

It returns the same object as the transpose of the given series object, which is by definition self.

```
>>> s = ks.Series([1, 2, 3])
>>> s
0    1
1    2
2    3
dtype: int64
```

```
>>> s.transpose()
0    1
1    2
2    3
dtype: int64
```

databricks.koalas.Series.hasnans

property Series.**hasnans**

Return True if it has any missing values. Otherwise, it returns False.

```
>>> ks.DataFrame({}, index=list('abc')).index.hasnans
False
```

```
>>> ks.Series(['a', None]).hasnans
True
```

```
>>> ks.Series([1.0, 2.0, np.nan]).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).hasnans
False
```

```
>>> (ks.Series([1.0, 2.0, np.nan]) + 1).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).rename("a").to_frame().set_index("a").index.hasnans
False
```

databricks.koalas.Series.values

property Series.**values**

Return a Numpy representation of the DataFrame or the Series.

Warning: We recommend using *DataFrame.to_numpy()* or *Series.to_numpy()* instead.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

Examples

A DataFrame where all columns are the same type (e.g., int64) results in an array of the same type.

```
>>> df = ks.DataFrame({'age':    [ 3,  29],
...                    'height': [94, 170],
...                    'weight': [31, 115]})
>>> df
   age  height  weight
0    3      94      31
1   29     170     115
>>> df.dtypes
age       int64
height    int64
weight    int64
dtype: object
>>> df.values
array([[  3,  94,  31],
       [ 29, 170, 115]])
```

A DataFrame with mixed type columns(e.g., str/object, int64, float32) results in an ndarray of the broadest type that accommodates these mixed types (e.g., object).

```
>>> df2 = ks.DataFrame([('parrot',   24.0, 'second'),
...                     ('lion',     80.5, 'first'),
...                     ('monkey', np.nan, None)],
...                    columns=('name', 'max_speed', 'rank'))
>>> df2.dtypes
name          object
max_speed    float64
rank          object
dtype: object
>>> df2.values
array([['parrot', 24.0, 'second'],
       ['lion', 80.5, 'first'],
       ['monkey', nan, None]], dtype=object)
```

For Series,

```
>>> ks.Series([1, 2, 3]).values
array([1, 2, 3])
```

```
>>> ks.Series(list('aabc')).values
array(['a', 'a', 'b', 'c'], dtype=object)
```

3.3.3 Conversion

Series.astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.
Series.copy([deep])	Make a copy of this object's indices and data.
Series.bool()	Return the bool of a single element in the current object.

databricks.koalas.Series.astype

`Series.`**`astype`**(*dtype*) → Union[Index, Series]

Cast a Koalas object to a specified dtype `dtype`.

Parameters

dtype [data type] Use a numpy.dtype or Python type to cast entire pandas object to the same type.

Returns

casted [same type as caller]

See also:

to_datetime Convert argument to datetime.

Examples

```
>>> ser = ks.Series([1, 2], dtype='int32')
>>> ser
0    1
1    2
dtype: int32
```

```
>>> ser.astype('int64')
0    1
1    2
dtype: int64
```

```
>>> ser.rename("a").to_frame().set_index("a").index.astype('int64')
Int64Index([1, 2], dtype='int64', name='a')
```

databricks.koalas.Series.copy

Series.**copy**(*deep=None*) → databricks.koalas.series.Series

Make a copy of this object's indices and data.

Parameters

deep [None] this parameter is not supported but just dummy parameter to match pandas.

Returns

copy [Series]

Examples

```
>>> s = ks.Series([1, 2], index=["a", "b"])
>>> s
a    1
b    2
dtype: int64
>>> s_copy = s.copy()
>>> s_copy
a    1
b    2
dtype: int64
```

databricks.koalas.Series.bool

Series.**bool**() → bool

Return the bool of a single element in the current object.

This must be a boolean scalar value, either True or False. Raise a ValueError if the object does not have exactly 1 element, or that element is not boolean

Returns

bool

Examples

```
>>> ks.DataFrame({'a': [True]}).bool()
True
```

```
>>> ks.Series([False]).bool()
False
```

If there are non-boolean or multiple values exist, it raises an exception in all cases as below.

```
>>> ks.DataFrame({'a': ['a']}).bool()
Traceback (most recent call last):
  ...
ValueError: bool cannot act on a non-boolean single element DataFrame
```

```
>>> ks.DataFrame({'a': [True], 'b': [False]}).bool()
Traceback (most recent call last):
  ...
ValueError: The truth value of a DataFrame is ambiguous. Use a.empty, a.bool(),
a.item(), a.any() or a.all().
```

```
>>> ks.Series([1]).bool()
Traceback (most recent call last):
  ...
ValueError: bool cannot act on a non-boolean single element DataFrame
```

3.3.4 Indexing, iteration

Series.at	Access a single value for a row/column label pair.
Series.iat	Access a single value for a row/column pair by integer position.
Series.loc	Access a group of rows and columns by label(s) or a boolean Series.
Series.iloc	Purely integer-location based indexing for selection by position.
Series.keys()	Return alias for index.
Series.pop(item)	Return item and drop from series.
Series.items()	This is an alias of `iteritems`.
Series.iteritems()	Lazily iterate over (index, value) tuples.
Series.item()	Return the first element of the underlying data as a Python scalar.
Series.xs(key[, level])	Return cross-section from the Series.
Series.get(key[, default])	Get item from object for given key (DataFrame column, Panel slice, etc.).

databricks.koalas.Series.at

property Series.**at**

Access a single value for a row/column label pair. If the index is not unique, all matching pairs are returned as an array. Similar to `loc`, in that both provide label-based lookups. Use `at` if you only need to get a single value in a DataFrame or Series.

Note: Unlike pandas, Koalas only allows using `at` to get values but not to set them.

Note: Warning: If `row_index` matches a lot of rows, large amounts of data will be fetched, potentially causing your machine to run out of memory.

Raises

KeyError When label does not exist in DataFrame

Examples

```
>>> kdf = ks.DataFrame([[0, 2, 3], [0, 4, 1], [10, 20, 30]],
...                    index=[4, 5, 5], columns=['A', 'B', 'C'])
>>> kdf
    A   B   C
4   0   2   3
5   0   4   1
5  10  20  30
```

Get value at specified row/column pair

```
>>> kdf.at[4, 'B']
2
```

Get array if an index occurs multiple times

```
>>> kdf.at[5, 'B']
array([ 4, 20])
```

databricks.koalas.Series.iat

property Series.**iat**

Access a single value for a row/column pair by integer position.

Similar to `iloc`, in that both provide integer-based lookups. Use `iat` if you only need to get or set a single value in a DataFrame or Series.

Raises

KeyError When label does not exist in DataFrame

Examples

```
>>> df = ks.DataFrame([[0, 2, 3], [0, 4, 1], [10, 20, 30]],
...                   columns=['A', 'B', 'C'])
>>> df
    A   B   C
0   0   2   3
1   0   4   1
2  10  20  30
```

Get value at specified row/column pair

```
>>> df.iat[1, 2]
1
```

Get value within a series

```
>>> kser = ks.Series([1, 2, 3], index=[10, 20, 30])
>>> kser
10    1
20    2
30    3
dtype: int64
```

```
>>> kser.iat[1]
2
```

databricks.koalas.Series.loc

property Series.**loc**

Access a group of rows and columns by label(s) or a boolean Series.

`.loc[]` is primarily label based, but may also be used with a conditional boolean Series derived from the DataFrame or Series.

Allowed inputs are:

- A single label, e.g. `5` or `'a'`, (note that `5` is interpreted as a *label* of the index, and **never** as an integer position along the index) for column selection.
- A list or array of labels, e.g. `['a', 'b', 'c']`.
- A slice object with labels, e.g. `'a':'f'`.
- A conditional boolean Series derived from the DataFrame or Series

Not allowed inputs which pandas allows are:

- A boolean array of the same length as the axis being sliced, e.g. `[True, False, True]`.
- A `callable` function with one argument (the calling Series, DataFrame or Panel) and that returns valid output for indexing (one of the above)

Note: MultiIndex is not supported yet.

Note: Note that contrary to usual python slices, **both** the start and the stop are included, and the step of the slice is not allowed.

Note: With a list or array of labels for row selection, Koalas behaves as a filter without reordering by the labels.

See also:

Series.loc Access group of values using labels.

Examples

Getting values

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df
            max_speed  shield
cobra               1       2
viper               4       5
sidewinder          7       8
```

Single label. Note this returns the row as a Series.

```
>>> df.loc['viper']
max_speed    4
shield       5
Name: viper, dtype: int64
```

List of labels. Note using `[[]]` returns a DataFrame. Also note that Koalas behaves just a filter without reordering by the labels.

```
>>> df.loc[['viper', 'sidewinder']]
            max_speed  shield
viper               4       5
sidewinder          7       8
```

```
>>> df.loc[['sidewinder', 'viper']]
            max_speed  shield
viper               4       5
sidewinder          7       8
```

Single label for column.

```
>>> df.loc['cobra', 'shield']
2
```

List of labels for row.

```
>>> df.loc[['cobra'], 'shield']
cobra    2
Name: shield, dtype: int64
```

List of labels for column.

```
>>> df.loc['cobra', ['shield']]
shield    2
Name: cobra, dtype: int64
```

List of labels for both row and column.

```
>>> df.loc[['cobra'], ['shield']]
       shield
cobra       2
```

Slice with labels for row and single label for column. As mentioned above, note that both the start and stop of the slice are included.

```
>>> df.loc['cobra':'viper', 'max_speed']
cobra    1
viper    4
Name: max_speed, dtype: int64
```

Conditional that returns a boolean Series

```
>>> df.loc[df['shield'] > 6]
            max_speed  shield
sidewinder          7       8
```

Conditional that returns a boolean Series with column labels specified

```
>>> df.loc[df['shield'] > 6, ['max_speed']]
            max_speed
sidewinder          7
```

Setting values

Setting value for all items matching the list of labels.

```
>>> df.loc[['viper', 'sidewinder'], ['shield']] = 50
>>> df
            max_speed  shield
cobra               1       2
viper               4      50
sidewinder          7      50
```

Setting value for an entire row

```
>>> df.loc['cobra'] = 10
>>> df
            max_speed  shield
cobra              10      10
viper               4      50
sidewinder          7      50
```

Set value for an entire column

```
>>> df.loc[:, 'max_speed'] = 30
>>> df
            max_speed  shield
cobra              30      10
```

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```
viper              30      50
sidewinder         30      50
```

Set value for an entire list of columns

```
>>> df.loc[:, ['max_speed', 'shield']] = 100
>>> df
            max_speed  shield
cobra             100     100
viper             100     100
sidewinder        100     100
```

Set value with Series

```
>>> df.loc[:, 'shield'] = df['shield'] * 2
>>> df
            max_speed  shield
cobra             100     200
viper             100     200
sidewinder        100     200
```

Getting values on a DataFrame with an index that has integer labels

Another example using integers for the index

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=[7, 8, 9],
...                   columns=['max_speed', 'shield'])
>>> df
   max_speed  shield
7          1       2
8          4       5
9          7       8
```

Slice with integer labels for rows. As mentioned above, note that both the start and stop of the slice are included.

```
>>> df.loc[7:9]
   max_speed  shield
7          1       2
8          4       5
9          7       8
```

databricks.koalas.Series.iloc

property Series.**iloc**

Purely integer-location based indexing for selection by position.

`.iloc[]` is primarily integer position based (from `0` to `length-1` of the axis), but may also be used with a conditional boolean Series.

Allowed inputs are:

- An integer for column selection, e.g. `5`.
- A list or array of integers for row selection with distinct index values, e.g. `[3, 4, 0]`
- A list or array of integers for column selection, e.g. `[4, 3, 0]`.

- A boolean array for column selection.
- A slice object with ints for row and column selection, e.g. `1:7`.

Not allowed inputs which pandas allows are:

- A list or array of integers for row selection with duplicated indexes, e.g. `[4, 4, 0]`.
- A boolean array for row selection.
- A `callable` function with one argument (the calling Series, DataFrame or Panel) and that returns valid output for indexing (one of the above). This is useful in method chains, when you don't have a reference to the calling object, but would like to base your selection on some value.

`.iloc` will raise `IndexError` if a requested indexer is out-of-bounds, except *slice* indexers which allow out-of-bounds indexing (this conforms with python/numpy *slice* semantics).

See also:

DataFrame.loc Purely label-location based indexer for selection by label.

Series.iloc Purely integer-location based indexing for selection by position.

Examples

```
>>> mydict = [{'a': 1, 'b': 2, 'c': 3, 'd': 4},
...           {'a': 100, 'b': 200, 'c': 300, 'd': 400},
...           {'a': 1000, 'b': 2000, 'c': 3000, 'd': 4000 }]
>>> df = ks.DataFrame(mydict, columns=['a', 'b', 'c', 'd'])
>>> df
      a     b     c     d
0     1     2     3     4
1   100   200   300   400
2  1000  2000  3000  4000
```

Indexing just the rows

A scalar integer for row selection.

```
>>> df.iloc[1]
a    100
b    200
c    300
d    400
Name: 1, dtype: int64
```

```
>>> df.iloc[[0]]
   a  b  c  d
0  1  2  3  4
```

With a *slice* object.

```
>>> df.iloc[:3]
      a     b     c     d
0     1     2     3     4
1   100   200   300   400
2  1000  2000  3000  4000
```

Indexing both axes

You can mix the indexer types for the index and columns. Use `:` to select the entire axis.

With scalar integers.

```
>>> df.iloc[:1, 1]
0    2
Name: b, dtype: int64
```

With lists of integers.

```
>>> df.iloc[:2, [1, 3]]
     b    d
0    2    4
1  200  400
```

With *slice* objects.

```
>>> df.iloc[:2, 0:3]
     a    b    c
0    1    2    3
1  100  200  300
```

With a boolean array whose length matches the columns.

```
>>> df.iloc[:, [True, False, True, False]]
      a     c
0     1     3
1   100   300
2  1000  3000
```

Setting values

Setting value for all items matching the list of labels.

```
>>> df.iloc[[1, 2], [1]] = 50
>>> df
      a   b     c     d
0     1   2     3     4
1   100  50   300   400
2  1000  50  3000  4000
```

Setting value for an entire row

```
>>> df.iloc[0] = 10
>>> df
      a   b     c     d
0    10  10    10    10
1   100  50   300   400
2  1000  50  3000  4000
```

Set value for an entire column

```
>>> df.iloc[:, 2] = 30
>>> df
      a   b   c     d
0    10  10  30    10
```

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```
1   100  50  30   400
2  1000  50  30  4000
```

Set value for an entire list of columns

```
>>> df.iloc[:, [2, 3]] = 100
>>> df
      a   b    c    d
0    10  10  100  100
1   100  50  100  100
2  1000  50  100  100
```

Set value with Series

```
>>> df.iloc[:, 3] = df.iloc[:, 3] * 2
>>> df
      a   b    c    d
0    10  10  100  200
1   100  50  100  200
2  1000  50  100  200
```

databricks.koalas.Series.keys

`Series.keys()` → databricks.koalas.indexes.Index

Return alias for index.

Returns

Index Index of the Series.

Examples

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> kser = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
```

```
>>> kser.keys()
MultiIndex([(  'lama',  'speed'),
            (  'lama', 'weight'),
            (  'lama', 'length'),
            (   'cow',  'speed'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon',  'speed'),
            ('falcon', 'weight'),
            ('falcon', 'length')],
           )
```

databricks.koalas.Series.pop

Series.**pop**(*item*) → Union[databricks.koalas.series.Series, int, float, str, bytes, decimal.Decimal, datetime.date, None]

Return item and drop from series.

Parameters

item [str] Label of index to be popped.

Returns

Value that is popped from series.

Examples

```
>>> s = ks.Series(data=np.arange(3), index=['A', 'B', 'C'])
>>> s
A    0
B    1
C    2
dtype: int64
```

```
>>> s.pop('A')
0
```

```
>>> s
B    1
C    2
dtype: int64
```

```
>>> s = ks.Series(data=np.arange(3), index=['A', 'A', 'C'])
>>> s
A    0
A    1
C    2
dtype: int64
```

```
>>> s.pop('A')
A    0
A    1
dtype: int64
```

```
>>> s
C    2
dtype: int64
```

Also support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx)
>>> s
```

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```
lama    speed      45.0
        weight    200.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.pop('lama')
speed      45.0
weight    200.0
length      1.2
dtype: float64
```

```
>>> s
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

Also support for MultiIndex with several indexs.

```
>>> midx = pd.MultiIndex([['a', 'b', 'c'],
...                       ['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 0, 0, 0, 1, 1, 1],
...                       [0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 0, 2]]
...  )
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx)
>>> s
a  lama    speed      45.0
           weight    200.0
           length      1.2
   cow     speed      30.0
           weight    250.0
           length      1.5
b  falcon  speed     320.0
           speed       1.0
           length      0.3
dtype: float64
```

```
>>> s.pop(('a', 'lama'))
speed      45.0
weight    200.0
length      1.2
dtype: float64
```

```
>>> s
a  cow     speed      30.0
           weight    250.0
           length      1.5
b  falcon  speed     320.0
           speed       1.0
           length      0.3
dtype: float64
```

```
>>> s.pop(('b', 'falcon', 'speed'))
(b, falcon, speed)    320.0
(b, falcon, speed)      1.0
dtype: float64
```

databricks.koalas.Series.items

Series.**items**() → collections.abc.Iterable
This is an alias of iteritems.

databricks.koalas.Series.iteritems

Series.**iteritems**() → collections.abc.Iterable
Lazily iterate over (index, value) tuples.

This method returns an iterable tuple (index, value). This is convenient if you want to create a lazy iterator.

Note: Unlike pandas', the iteritems in Koalas returns generator rather zip object

---

Returns

iterable Iterable of tuples containing the (index, value) pairs from a Series.

See also:

DataFrame.items Iterate over (column name, Series) pairs.

DataFrame.iterrows Iterate over DataFrame rows as (index, Series) pairs.

Examples

```
>>> s = ks.Series(['A', 'B', 'C'])
>>> for index, value in s.items():
...     print("Index : {}, Value : {}".format(index, value))
Index : 0, Value : A
Index : 1, Value : B
Index : 2, Value : C
```

databricks.koalas.Series.item

Series.**item**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None]
Return the first element of the underlying data as a Python scalar.

Returns

scalar The first element of Series.

Raises

ValueError If the data is not length-1.

Examples

```
>>> kser = ks.Series([10])
>>> kser.item()
10
```

databricks.koalas.Series.xs

Series.**xs**(*key*, *level=None*) → databricks.koalas.series.Series
Return cross-section from the Series.

This method takes a *key* argument to select data at a particular level of a MultiIndex.

Parameters

key [label or tuple of label] Label contained in the index, or partially in a MultiIndex.

level [object, defaults to first n levels (n=1 or len(key))] In case of a key partially contained in a MultiIndex, indicate which levels are used. Levels can be referred by label or position.

Returns

Series Cross-section from the original Series corresponding to the selected index levels.

Examples

```
>>> midx = pd.MultiIndex([['a', 'b', 'c'],
...                       ['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx)
>>> s
a  lama    speed      45.0
           weight    200.0
           length      1.2
b  cow     speed      30.0
           weight    250.0
           length      1.5
c  falcon  speed     320.0
           weight      1.0
```

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```
           length      0.3
dtype: float64
```

Get values at specified index

```
>>> s.xs('a')
lama  speed      45.0
      weight    200.0
      length      1.2
dtype: float64
```

Get values at several indexes

```
>>> s.xs(('a', 'lama'))
speed      45.0
weight    200.0
length      1.2
dtype: float64
```

Get values at specified index and level

```
>>> s.xs('lama', level=1)
a  speed      45.0
   weight    200.0
   length      1.2
dtype: float64
```

databricks.koalas.Series.get

`Series.`**`get`**(*key*, *default=None*) → Any

Get item from object for given key (DataFrame column, Panel slice, etc.). Returns default value if not found.

Parameters

key [object]

Returns

value [same type as items contained in object]

Examples

```
>>> df = ks.DataFrame({'x':range(3), 'y':['a','b','b'], 'z':['a','b','b']},
...                   columns=['x', 'y', 'z'], index=[10, 20, 20])
>>> df
    x  y  z
10  0  a  a
20  1  b  b
20  2  b  b
```

```
>>> df.get('x')
10    0
20    1
20    2
Name: x, dtype: int64
```

```
>>> df.get(['x', 'y'])
    x  y
10  0  a
20  1  b
20  2  b
```

```
>>> df.x.get(10)
0
```

```
>>> df.x.get(20)
20    1
20    2
Name: x, dtype: int64
```

```
>>> df.x.get(15, -1)
-1
```

3.3.5 Binary operator functions

Series.add(other)	Return Addition of series and other, element-wise (binary operator +).
Series.div(other)	Return Floating division of series and other, element-wise (binary operator /).
Series.mul(other)	Return Multiplication of series and other, element-wise (binary operator *).
Series.radd(other)	Return Reverse Addition of series and other, element-wise (binary operator +).
Series.rdiv(other)	Return Reverse Floating division of series and other, element-wise (binary operator /).
Series.rmul(other)	Return Reverse Multiplication of series and other, element-wise (binary operator *).
Series.rsub(other)	Return Reverse Subtraction of series and other, element-wise (binary operator -).
Series.rtruediv(other)	Return Reverse Floating division of series and other, element-wise (binary operator /).
Series.sub(other)	Return Subtraction of series and other, element-wise (binary operator -).
Series.truediv(other)	Return Floating division of series and other, element-wise (binary operator /).
Series.pow(other)	Return Exponential power of series of series and other, element-wise (binary operator **).
Series.rpow(other)	Return Reverse Exponential power of series and other, element-wise (binary operator **).
Series.mod(other)	Return Modulo of series and other, element-wise (binary operator %).
Series.rmod(other)	Return Reverse Modulo of series and other, element-wise (binary operator %).
Series.floordiv(other)	Return Integer division of series and other, element-wise (binary operator //).

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Series.rfloordiv(other)	Return Reverse Integer division of series and other, element-wise (binary operator *//*).
Series.divmod(other)	Return Integer division and modulo of series and other, element-wise (binary operator *divmod*).
Series.rdivmod(other)	Return Integer division and modulo of series and other, element-wise (binary operator *rdivmod*).
Series.combine_first(other)	Combine Series values, choosing the calling Series's values first.
Series.lt(other)	Compare if the current value is less than the other.
Series.gt(other)	Compare if the current value is greater than the other.
Series.le(other)	Compare if the current value is less than or equal to the other.
Series.ge(other)	Compare if the current value is greater than or equal to the other.
Series.ne(other)	Compare if the current value is not equal to the other.
Series.eq(other)	Compare if the current value is equal to the other.
Series.product([min_count])	Return the product of the values.
Series.dot(other)	Compute the dot product between the Series and the columns of other.

databricks.koalas.Series.add

`Series.`**`add`**`(`*other*`)` → databricks.koalas.series.Series

Return Addition of series and other, element-wise (binary operator +).

Equivalent to `series + other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.radd

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.add(df.b)
a    4.0
```

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```
b    NaN
c    6.0
d    NaN
dtype: float64
```

```
>>> df.a.radd(df.b)
a    4.0
b    NaN
c    6.0
d    NaN
dtype: float64
```

databricks.koalas.Series.div

`Series.`**`div`**`(`*`other`*`)` → databricks.koalas.series.Series

Return Floating division of series and other, element-wise (binary operator */*).

Equivalent to `series / other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rdiv

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.divide(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rdiv(df.b)
a    1.0
b    NaN
c    0.5
```

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```
d    NaN
dtype: float64
```

databricks.koalas.Series.mul

`Series.`**`mul`**`(`*other*`)` → databricks.koalas.series.Series

Return Multiplication of series and other, element-wise (binary operator *).

Equivalent to `series * other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rmul

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.multiply(df.b)
a    4.0
b    NaN
c    8.0
d    NaN
dtype: float64
```

```
>>> df.a.rmul(df.b)
a    4.0
b    NaN
c    8.0
d    NaN
dtype: float64
```

databricks.koalas.Series.radd

Series.**radd**(*other*) → databricks.koalas.series.Series
Return Reverse Addition of series and other, element-wise (binary operator +).

Equivalent to `other + series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.add

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.add(df.b)
a    4.0
b    NaN
c    6.0
d    NaN
dtype: float64
```

```
>>> df.a.radd(df.b)
a    4.0
b    NaN
c    6.0
d    NaN
dtype: float64
```

databricks.koalas.Series.rdiv

Series.**rdiv**(*other*) → databricks.koalas.series.Series
Return Reverse Floating division of series and other, element-wise (binary operator /).

Equivalent to `other / series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.div

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.divide(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rdiv(df.b)
a    1.0
b    NaN
c    0.5
d    NaN
dtype: float64
```

databricks.koalas.Series.rmul

`Series.`**`rmul`**(*other*) → databricks.koalas.series.Series

Return Reverse Multiplication of series and other, element-wise (binary operator *).

Equivalent to `other * series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.mul

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.multiply(df.b)
a    4.0
b    NaN
c    8.0
d    NaN
dtype: float64
```

```
>>> df.a.rmul(df.b)
a    4.0
b    NaN
c    8.0
d    NaN
dtype: float64
```

databricks.koalas.Series.rsub

`Series.`**`rsub`**(*other*) → databricks.koalas.series.Series

Return Reverse Subtraction of series and other, element-wise (binary operator -).

Equivalent to `other - series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.sub

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.subtract(df.b)
a    0.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rsub(df.b)
a    0.0
b    NaN
c   -2.0
d    NaN
dtype: float64
```

databricks.koalas.Series.rtruediv

`Series.`**`rtruediv`**`(`*other*`)` → databricks.koalas.series.Series

Return Reverse Floating division of series and other, element-wise (binary operator /).

Equivalent to `other / series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.truediv

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.divide(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rdiv(df.b)
a    1.0
b    NaN
```

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```
c    0.5
d    NaN
dtype: float64
```

databricks.koalas.Series.sub

Series.**sub**(*other*) → databricks.koalas.series.Series

Return Subtraction of series and other, element-wise (binary operator -).

Equivalent to `series - other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rsub

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.subtract(df.b)
a    0.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rsub(df.b)
a    0.0
b    NaN
c   -2.0
d    NaN
dtype: float64
```

databricks.koalas.Series.truediv

Series.**truediv**(*other*) → databricks.koalas.series.Series
Return Floating division of series and other, element-wise (binary operator /).

Equivalent to `series / other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rtruediv

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.divide(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rdiv(df.b)
a    1.0
b    NaN
c    0.5
d    NaN
dtype: float64
```

databricks.koalas.Series.pow

Series.**pow**(*other*) → databricks.koalas.series.Series
Return Exponential power of series of series and other, element-wise (binary operator **).

Equivalent to `series ** other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rpow

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.pow(df.b)
a     4.0
b     NaN
c    16.0
d     NaN
dtype: float64
```

```
>>> df.a.rpow(df.b)
a     4.0
b     NaN
c    16.0
d     NaN
dtype: float64
```

databricks.koalas.Series.rpow

Series.**rpow**(*other*) → databricks.koalas.series.Series

Return Reverse Exponential power of series and other, element-wise (binary operator **).

Equivalent to `other ** series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.pow

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.pow(df.b)
a     4.0
b     NaN
c    16.0
d     NaN
dtype: float64
```

```
>>> df.a.rpow(df.b)
a     4.0
b     NaN
c    16.0
d     NaN
dtype: float64
```

databricks.koalas.Series.mod

`Series.`**`mod`**(*other*) → databricks.koalas.series.Series

Return Modulo of series and other, element-wise (binary operator %).

Equivalent to `series % other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rmod

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.mod(df.b)
a    0.0
b    NaN
c    0.0
d    NaN
dtype: float64
```

```
>>> df.a.rmod(df.b)
a    0.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

databricks.koalas.Series.rmod

`Series.`**`rmod`**(*other*) → databricks.koalas.series.Series

Return Reverse Modulo of series and other, element-wise (binary operator %).

Equivalent to `other % series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.mod

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.mod(df.b)
a    0.0
b    NaN
c    0.0
d    NaN
dtype: float64
```

```
>>> df.a.rmod(df.b)
a    0.0
b    NaN
```

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```
c    2.0
d    NaN
dtype: float64
```

databricks.koalas.Series.floordiv

`Series.`**`floordiv`**`(`*other*`)` → databricks.koalas.series.Series

Return Integer division of series and other, element-wise (binary operator *//*).

Equivalent to `series // other`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.rfloordiv

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.floordiv(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rfloordiv(df.b)
a    1.0
b    NaN
c    0.0
d    NaN
dtype: float64
```

databricks.koalas.Series.rfloordiv

`Series.`**`rfloordiv`**`(`*other*`)` → databricks.koalas.series.Series

Return Reverse Integer division of series and other, element-wise (binary operator //).

Equivalent to `other // series`

Parameters

other [Series or scalar value]

Returns

Series The result of the operation.

See also:

Series.floordiv

Examples

```
>>> df = ks.DataFrame({'a': [2, 2, 4, np.nan],
...                    'b': [2, np.nan, 2, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
>>> df
     a    b
a  2.0  2.0
b  2.0  NaN
c  4.0  2.0
d  NaN  NaN
```

```
>>> df.a.floordiv(df.b)
a    1.0
b    NaN
c    2.0
d    NaN
dtype: float64
```

```
>>> df.a.rfloordiv(df.b)
a    1.0
b    NaN
c    0.0
d    NaN
dtype: float64
```

databricks.koalas.Series.divmod

`Series.`**`divmod`**`(`*other*`)` → Tuple[databricks.koalas.series.Series, databricks.koalas.series.Series]

Return Integer division and modulo of series and other, element-wise (binary operator *divmod*).

Parameters

other [Series or scalar value]

Returns

2-Tuple of Series The result of the operation.

See also:

Series.rdivmod

databricks.koalas.Series.rdivmod

Series.**rdivmod**(*other*) → Tuple[databricks.koalas.series.Series, databricks.koalas.series.Series]

Return Integer division and modulo of series and other, element-wise (binary operator *rdivmod*).

Parameters

other [Series or scalar value]

Returns

2-Tuple of Series The result of the operation.

See also:

Series.divmod

databricks.koalas.Series.combine_first

Series.**combine_first**(*other*) → databricks.koalas.series.Series

Combine Series values, choosing the calling Series's values first.

Parameters

other [Series] The value(s) to be combined with the *Series*.

Returns

Series The result of combining the Series with the other object.

See also:

Series.combine Perform elementwise operation on two Series using a given function.

Notes

Result index will be the union of the two indexes.

Examples

```
>>> s1 = ks.Series([1, np.nan])
>>> s2 = ks.Series([3, 4])
>>> with ks.option_context("compute.ops_on_diff_frames", True):
...     s1.combine_first(s2)
0    1.0
1    4.0
dtype: float64
```

databricks.koalas.Series.lt

`Series.lt`(*other*) → databricks.koalas.series.Series

Compare if the current value is less than the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a < 1
a    False
b    False
c    False
d    False
Name: a, dtype: bool
```

```
>>> df.b.lt(2)
a     True
b    False
c     True
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.gt

`Series.gt`(*other*) → databricks.koalas.series.Series

Compare if the current value is greater than the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a > 1
a    False
b     True
c     True
d     True
Name: a, dtype: bool
```

```
>>> df.b.gt(1)
a    False
b    False
c    False
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.le

`Series.le`(*other*) → databricks.koalas.series.Series

Compare if the current value is less than or equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a <= 2
a     True
b     True
c    False
d    False
Name: a, dtype: bool
```

```
>>> df.b.le(2)
a     True
b    False
c     True
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.ge

`Series.ge`(*other*) → databricks.koalas.series.Series

Compare if the current value is greater than or equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a >= 2
a    False
b     True
c     True
d     True
Name: a, dtype: bool
```

```
>>> df.b.ge(2)
a    False
b    False
c    False
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.ne

`Series.ne`(*other*) → databricks.koalas.series.Series

Compare if the current value is not equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a != 1
a    False
b     True
c     True
d     True
Name: a, dtype: bool
```

```
>>> df.b.ne(1)
a    False
b     True
c    False
d     True
Name: b, dtype: bool
```

databricks.koalas.Series.eq

`Series.eq`(*other*) → bool

Compare if the current value is equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a == 1
a     True
b    False
c    False
d    False
Name: a, dtype: bool
```

```
>>> df.b.eq(1)
a     True
b    False
c     True
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.product

Series.**product**(*min_count=0*) → Union[int, float]

Return the product of the values.

Note: unlike pandas', Koalas' emulates product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Parameters

min_count [int, default 0] The required number of valid values to perform the operation. If fewer than `min_count` non-NA values are present the result will be NA.

Examples

```
>>> ks.Series([1, 2, 3, 4, 5]).prod()
120
```

By default, the product of an empty or all-NA Series is `1`

```
>>> ks.Series([]).prod()
1.0
```

This can be controlled with the `min_count` parameter

```
>>> ks.Series([]).prod(min_count=1)
nan
```

databricks.koalas.Series.dot

Series.**dot**(*other: Union[Series, databricks.koalas.frame.DataFrame]*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Compute the dot product between the Series and the columns of other.

This method computes the dot product between the Series and another one, or the Series and each columns of a DataFrame.

It can also be called using *self @ other* in Python >= 3.5.

Note: This API is slightly different from pandas when indexes from both Series are not aligned. To match with pandas', it requires to read the whole data for, for example, counting. pandas raises an exception; however, Koalas just proceeds and performs by ignoring mismatches with NaN permissively.

```
>>> pdf1 = pd.Series([1, 2, 3], index=[0, 1, 2])
>>> pdf2 = pd.Series([1, 2, 3], index=[0, 1, 3])
>>> pdf1.dot(pdf2)
...
ValueError: matrices are not aligned
```

```
>>> kdf1 = ks.Series([1, 2, 3], index=[0, 1, 2])
>>> kdf2 = ks.Series([1, 2, 3], index=[0, 1, 3])
>>> kdf1.dot(kdf2)
5
```

Parameters

other [Series, DataFrame.] The other object to compute the dot product with its columns.

Returns

scalar, Series Return the dot product of the Series and other if other is a Series, the Series of the dot product of Series and each rows of other if other is a DataFrame.

Notes

The Series and other has to share the same index if other is a Series or a DataFrame.

Examples

```
>>> s = ks.Series([0, 1, 2, 3])
```

```
>>> s.dot(s)
14
```

```
>>> s @ s
14
```

```
>>> kdf = ks.DataFrame({'x': [0, 1, 2, 3], 'y': [0, -1, -2, -3]})
>>> kdf
   x  y
0  0  0
1  1 -1
2  2 -2
3  3 -3
```

```
>>> with ks.option_context("compute.ops_on_diff_frames", True):
...     s.dot(kdf)
...
x    14
y   -14
dtype: int64
```

3.3.6 Function application, GroupBy & Window

Series.apply(func[, args])	Invoke function on values of Series.
Series.agg(func)	Aggregate using one or more operations over the specified axis.
Series.aggregate(func)	Aggregate using one or more operations over the specified axis.
Series.transform(func[, axis])	Call `func` producing the same type as *self* with transformed values and that has the same axis length as input.
Series.map(arg)	Map values of Series according to input correspondence.

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Table 23 – continued from previous page

Series.groupby(by[, axis, as_index, dropna])	Group DataFrame or Series using a Series of columns.
Series.rolling(window[, min_periods])	Provide rolling transformations.
Series.expanding([min_periods])	Provide expanding transformations.
Series.pipe(func, *args, **kwargs)	Apply func(self, *args, **kwargs).

databricks.koalas.Series.apply

Series.**apply**(*func*, *args=()*, ***kwds*) → databricks.koalas.series.Series

Invoke function on values of Series.

Can be a Python function that only works on the Series.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def square(x) -> np.int32:
...     return x ** 2
```

Koalas uses return type hint and does not try to infer the type.

Parameters

func [function] Python function to apply. Note that type hint for return type is required.

args [tuple] Positional arguments passed to func after the series value.

****kwds** Additional keyword arguments passed to func.

Returns

Series

See also:

Series.aggregate Only perform aggregating type operations.

Series.transform Only perform transforming type operations.

DataFrame.apply The equivalent function for DataFrame.

Examples

Create a Series with typical summer temperatures for each city.

```
>>> s = ks.Series([20, 21, 12],
...               index=['London', 'New York', 'Helsinki'])
>>> s
London      20
New York    21
Helsinki    12
dtype: int64
```

Square the values by defining a function and passing it as an argument to `apply()`.

```
>>> def square(x) -> np.int64:
...     return x ** 2
>>> s.apply(square)
London      400
New York    441
Helsinki    144
dtype: int64
```

Define a custom function that needs additional positional arguments and pass these additional arguments using the `args` keyword

```
>>> def subtract_custom_value(x, custom_value) -> np.int64:
...     return x - custom_value
```

```
>>> s.apply(subtract_custom_value, args=(5,))
London      15
New York    16
Helsinki     7
dtype: int64
```

Define a custom function that takes keyword arguments and pass these arguments to `apply`

```
>>> def add_custom_values(x, **kwargs) -> np.int64:
...     for month in kwargs:
...         x += kwargs[month]
...     return x
```

```
>>> s.apply(add_custom_values, june=30, july=20, august=25)
London      95
New York    96
Helsinki    87
dtype: int64
```

Use a function from the Numpy library

```
>>> def numpy_log(col) -> np.float64:
...     return np.log(col)
>>> s.apply(numpy_log)
London      2.995732
New York    3.044522
Helsinki    2.484907
dtype: float64
```

You can omit the type hint and let Koalas infer its type.

```
>>> s.apply(np.log)
London      2.995732
New York    3.044522
Helsinki    2.484907
dtype: float64
```

databricks.koalas.Series.agg

Series.**agg**(*func: Union[str, List[str]]*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Aggregate using one or more operations over the specified axis.

Parameters

func [str or a list of str] function name(s) as string apply to series.

Returns

scalar, Series The return can be: - scalar : when Series.agg is called with single function - Series : when Series.agg is called with several functions

See also:

Series.apply Invoke function on a Series.

Series.transform Only perform transforming type operations.

Series.groupby Perform operations over groups.

DataFrame.aggregate The equivalent function for DataFrame.

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s.agg('min')
1
```

```
>>> s.agg(['min', 'max']).sort_index()
max    4
min    1
dtype: int64
```

databricks.koalas.Series.aggregate

Series.**aggregate**(*func: Union[str, List[str]]*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Aggregate using one or more operations over the specified axis.

Parameters

func [str or a list of str] function name(s) as string apply to series.

Returns

scalar, Series The return can be: - scalar : when Series.agg is called with single function - Series : when Series.agg is called with several functions

See also:

Series.apply Invoke function on a Series.

Series.transform Only perform transforming type operations.

Series.groupby Perform operations over groups.

DataFrame.aggregate The equivalent function for DataFrame.

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s.agg('min')
1
```

```
>>> s.agg(['min', 'max']).sort_index()
max    4
min    1
dtype: int64
```

databricks.koalas.Series.transform

Series.**transform**(*func*, *axis=0*, **args*, ***kwargs*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Call `func` producing the same type as *self* with transformed values and that has the same axis length as input.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def square(x) -> np.int32:
...     return x ** 2
```

Koalas uses return type hint and does not try to infer the type.

Parameters

func [function or list] A function or a list of functions to use for transforming the data.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

***args** Positional arguments to pass to *func*.

****kwargs** Keyword arguments to pass to *func*.

Returns

An instance of the same type with *self* that must have the same length as input.

See also:

Series.aggregate Only perform aggregating type operations.

Series.apply Invoke function on Series.

DataFrame.transform The equivalent function for DataFrame.

Examples

```
>>> s = ks.Series(range(3))
>>> s
0    0
1    1
2    2
dtype: int64
```

```
>>> def sqrt(x) -> float:
...     return np.sqrt(x)
>>> s.transform(sqrt)
0    0.000000
1    1.000000
2    1.414214
dtype: float64
```

Even though the resulting instance must have the same length as the input, it is possible to provide several input functions:

```
>>> def exp(x) -> float:
...     return np.exp(x)
>>> s.transform([sqrt, exp])
       sqrt       exp
0  0.000000  1.000000
1  1.000000  2.718282
2  1.414214  7.389056
```

You can omit the type hint and let Koalas infer its type.

```
>>> s.transform([np.sqrt, np.exp])
       sqrt       exp
0  0.000000  1.000000
1  1.000000  2.718282
2  1.414214  7.389056
```

databricks.koalas.Series.map

`Series.`**`map`**`(`*arg*`)` → databricks.koalas.series.Series

Map values of Series according to input correspondence.

Used for substituting each value in a Series with another value, that may be derived from a function, a `dict`.

Note: make sure the size of the dictionary is not huge because it could downgrade the performance or throw OutOfMemoryError due to a huge expression within Spark. Consider the input as a functions as an alternative instead in this case.

Parameters

arg [function or dict] Mapping correspondence.

Returns

Series Same index as caller.

See also:

Series.apply For applying more complex functions on a Series.

DataFrame.applymap Apply a function elementwise on a whole DataFrame.

Notes

When `arg` is a dictionary, values in Series that are not in the dictionary (as keys) are converted to `None`. However, if the dictionary is a `dict` subclass that defines `__missing__` (i.e. provides a method for default values), then this default is used rather than `None`.

Examples

```
>>> s = ks.Series(['cat', 'dog', None, 'rabbit'])
>>> s
0       cat
1       dog
2      None
3    rabbit
dtype: object
```

`map` accepts a `dict`. Values that are not found in the `dict` are converted to `None`, unless the dict has a default value (e.g. `defaultdict`):

```
>>> s.map({'cat': 'kitten', 'dog': 'puppy'})
0    kitten
1     puppy
2      None
3      None
dtype: object
```

It also accepts a function:

```
>>> def format(x) -> str:
...     return 'I am a {}'.format(x)
```

```
>>> s.map(format)
0       I am a cat
1       I am a dog
2      I am a None
3    I am a rabbit
dtype: object
```

databricks.koalas.Series.groupby

Series.**groupby**(*by*, *axis=0*, *as_index: bool = True*, *dropna: bool = True*) → Union[DataFrameGroupBy, SeriesGroupBy]

Group DataFrame or Series using a Series of columns.

A groupby operation involves some combination of splitting the object, applying a function, and combining the results. This can be used to group large amounts of data and compute operations on these groups.

Parameters

by [Series, label, or list of labels] Used to determine the groups for the groupby. If Series is passed, the Series or dict VALUES will be used to determine the groups. A label or list of labels may be passed to group by the columns in `self`.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

as_index [bool, default True] For aggregated output, return object with group labels as the index. Only relevant for DataFrame input. as_index=False is effectively "SQL-style" grouped output.

dropna [bool, default True] If True, and if group keys contain NA values, NA values together with row/column will be dropped. If False, NA values will also be treated as the key in groups.

Returns

DataFrameGroupBy or SeriesGroupBy Depends on the calling object and returns groupby object that contains information about the groups.

See also:

koalas.groupby.GroupBy

Examples

```
>>> df = ks.DataFrame({'Animal': ['Falcon', 'Falcon',
...                               'Parrot', 'Parrot'],
...                    'Max Speed': [380., 370., 24., 26.]},
...                   columns=['Animal', 'Max Speed'])
>>> df
   Animal  Max Speed
0  Falcon      380.0
1  Falcon      370.0
2  Parrot       24.0
3  Parrot       26.0
```

```
>>> df.groupby(['Animal']).mean().sort_index()
        Max Speed
Animal
Falcon      375.0
Parrot       25.0
```

```
>>> df.groupby(['Animal'], as_index=False).mean().sort_values('Animal')
...
   Animal  Max Speed
...Falcon      375.0
...Parrot       25.0
```

We can also choose to include NA in group keys or not by setting dropna parameter, the default setting is True:

```
>>> l = [[1, 2, 3], [1, None, 4], [2, 1, 3], [1, 2, 2]]
>>> df = ks.DataFrame(l, columns=["a", "b", "c"])
>>> df.groupby(by=["b"]).sum().sort_index()
     a  c
b
1.0  2  3
2.0  2  5
```

```
>>> df.groupby(by=["b"], dropna=False).sum().sort_index()
     a  c
b
1.0  2  3
2.0  2  5
NaN  1  4
```

databricks.koalas.Series.rolling

Series.**rolling**(*window*, *min_periods=None*) → databricks.koalas.window.Rolling
Provide rolling transformations.

Note: 'min_periods' in Koalas works as a fixed window size unlike pandas. Unlike pandas, NA is also counted as the period. This might be changed in the near future.

Parameters

window [int, or offset] Size of the moving window. This is the number of observations used for calculating the statistic. Each window will be a fixed size.

min_periods [int, default None] Minimum number of observations in window required to have a value (otherwise result is NA). For a window that is specified by an offset, min_periods will default to 1. Otherwise, min_periods will default to the size of the window.

Returns

a Window sub-classed for the particular operation

databricks.koalas.Series.expanding

Series.**expanding**(*min_periods=1*) → databricks.koalas.window.Expanding
Provide expanding transformations.

Note: 'min_periods' in Koalas works as a fixed window size unlike pandas. Unlike pandas, NA is also counted as the period. This might be changed in the near future.

Parameters

min_periods [int, default 1] Minimum number of observations in window required to have a value (otherwise result is NA).

Returns

a Window sub-classed for the particular operation

databricks.koalas.Series.pipe

`Series.`**`pipe`**(*func*, **args*, ***kwargs*) → Any

Apply func(self, *args, **kwargs).

Parameters

func [function] function to apply to the DataFrame. `args`, and `kwargs` are passed into `func`. Alternatively a `(callable, data_keyword)` tuple where `data_keyword` is a string indicating the keyword of `callable` that expects the DataFrames.

args [iterable, optional] positional arguments passed into `func`.

kwargs [mapping, optional] a dictionary of keyword arguments passed into `func`.

Returns

object [the return type of `func`.]

Notes

Use `.pipe` when chaining together functions that expect Series, DataFrames or GroupBy objects. For example, given

```
>>> df = ks.DataFrame({'category': ['A', 'A', 'B'],
...                    'col1': [1, 2, 3],
...                    'col2': [4, 5, 6]},
...                   columns=['category', 'col1', 'col2'])
>>> def keep_category_a(df):
...     return df[df['category'] == 'A']
>>> def add_one(df, column):
...     return df.assign(col3=df[column] + 1)
>>> def multiply(df, column1, column2):
...     return df.assign(col4=df[column1] * df[column2])
```

instead of writing

```
>>> multiply(add_one(keep_category_a(df), column="col1"), column1="col2", column2=
↪"col3")
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

You can write

```
>>> (df.pipe(keep_category_a)
...    .pipe(add_one, column="col1")
...    .pipe(multiply, column1="col2", column2="col3")
... )
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

If you have a function that takes the data as (say) the second argument, pass a tuple indicating which keyword expects the data. For example, suppose `f` takes its data as `df`:

```
>>> def multiply_2(column1, df, column2):
...     return df.assign(col4=df[column1] * df[column2])
```

Then you can write

```
>>> (df.pipe(keep_category_a)
...     .pipe(add_one, column="col1")
...     .pipe((multiply_2, 'df'), column1="col2", column2="col3")
... )
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

You can use lambda as wel

```
>>> ks.Series([1, 2, 3]).pipe(lambda x: (x + 1).rename("value"))
0    2
1    3
2    4
Name: value, dtype: int64
```

3.3.7 Computations / Descriptive Stats

Series.abs()	Return a Series/DataFrame with absolute numeric value of each element.
Series.all([axis])	Return whether all elements are True.
Series.any([axis])	Return whether any element is True.
Series.between(left, right[, inclusive])	Return boolean Series equivalent to left <= series <= right.
Series.clip([lower, upper])	Trim values at input threshold(s).
Series.corr(other[, method])	Compute correlation with *other* Series, excluding missing values.
Series.count()	Return number of non-NA/null observations in the Series.
Series.cummax([skipna])	Return cumulative maximum over a DataFrame or Series axis.
Series.cummin([skipna])	Return cumulative minimum over a DataFrame or Series axis.
Series.cumsum([skipna])	Return cumulative sum over a DataFrame or Series axis.
Series.cumprod([skipna])	Return cumulative product over a DataFrame or Series axis.
Series.describe([percentiles])	Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding `NaN` values.
Series.filter([items, like, regex, axis])	Subset rows or columns of dataframe according to labels in the specified index.
Series.kurt([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
Series.mad()	Return the mean absolute deviation of values.
Series.max([axis, numeric_only])	Return the maximum of the values.
Series.mean([axis, numeric_only])	Return the mean of the values.
Series.min([axis, numeric_only])	Return the minimum of the values.
Series.mode([dropna])	Return the mode(s) of the dataset.
Series.nlargest([n])	Return the largest *n* elements.
Series.nsmallest([n])	Return the smallest *n* elements.

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Series.pct_change([periods])	Percentage change between the current and a prior element.
Series.prod([min_count])	Return the product of the values.
Series.nunique([dropna, approx, rsd])	Return number of unique elements in the object.
Series.is_unique	Return boolean if values in the object are unique
Series.quantile([q, accuracy])	Return value at the given quantile.
Series.rank([method, ascending])	Compute numerical data ranks (1 through n) along axis.
Series.skew([axis, numeric_only])	Return unbiased skew normalized by N-1.
Series.std([axis, numeric_only])	Return sample standard deviation.
Series.sum([axis, numeric_only])	Return the sum of the values.
Series.median([axis, numeric_only, accuracy])	Return the median of the values for the requested axis.
Series.var([axis, numeric_only])	Return unbiased variance.
Series.kurtosis([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
Series.unique()	Return unique values of Series object.
Series.value_counts([normalize, sort, ...])	Return a Series containing counts of unique values.
Series.round([decimals])	Round each value in a Series to the given number of decimals.
Series.diff([periods])	First discrete difference of element.
Series.is_monotonic	Return boolean if values in the object are monotonically increasing.
Series.is_monotonic_increasing	Return boolean if values in the object are monotonically increasing.
Series.is_monotonic_decreasing	Return boolean if values in the object are monotonically decreasing.

databricks.koalas.Series.abs

Series.**abs**() → Union[DataFrame, Series]

Return a Series/DataFrame with absolute numeric value of each element.

Returns

abs [Series/DataFrame containing the absolute value of each element.]

Examples

Absolute numeric values in a Series.

```
>>> s = ks.Series([-1.10, 2, -3.33, 4])
>>> s.abs()
0    1.10
1    2.00
2    3.33
3    4.00
dtype: float64
```

Absolute numeric values in a DataFrame.

```
>>> df = ks.DataFrame({
...     'a': [4, 5, 6, 7],
...     'b': [10, 20, 30, 40],
```

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```
...     'c': [100, 50, -30, -50]
...   },
...   columns=['a', 'b', 'c'])
>>> df.abs()
   a   b    c
0  4  10  100
1  5  20   50
2  6  30   30
3  7  40   50
```

databricks.koalas.Series.all

`Series.`**`all`**(*axis: Union[int, str] = 0*) → bool

Return whether all elements are True.

Returns True unless there at least one element within a series that is False or equivalent (e.g. zero or empty)

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Examples

```
>>> ks.Series([True, True]).all()
True
```

```
>>> ks.Series([True, False]).all()
False
```

```
>>> ks.Series([0, 1]).all()
False
```

```
>>> ks.Series([1, 2, 3]).all()
True
```

```
>>> ks.Series([True, True, None]).all()
True
```

```
>>> ks.Series([True, False, None]).all()
False
```

```
>>> ks.Series([]).all()
True
```

```
>>> ks.Series([np.nan]).all()
True
```

```
>>> df = ks.Series([True, False, None]).rename("a").to_frame()
>>> df.set_index("a").index.all()
False
```

databricks.koalas.Series.any

Series.**any**(*axis: Union[int, str] = 0*) → bool

Return whether any element is True.

Returns False unless there at least one element within a series that is True or equivalent (e.g. non-zero or non-empty).

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Examples

```
>>> ks.Series([False, False]).any()
False
```

```
>>> ks.Series([True, False]).any()
True
```

```
>>> ks.Series([0, 0]).any()
False
```

```
>>> ks.Series([0, 1, 2]).any()
True
```

```
>>> ks.Series([False, False, None]).any()
False
```

```
>>> ks.Series([True, False, None]).any()
True
```

```
>>> ks.Series([]).any()
False
```

```
>>> ks.Series([np.nan]).any()
False
```

```
>>> df = ks.Series([True, False, None]).rename("a").to_frame()
>>> df.set_index("a").index.any()
True
```

databricks.koalas.Series.between

Series.**between**(*left*, *right*, *inclusive=True*) → databricks.koalas.series.Series

Return boolean Series equivalent to left <= series <= right. This function returns a boolean vector containing *True* wherever the corresponding Series element is between the boundary values *left* and *right*. NA values are treated as *False*.

Parameters

left [scalar or list-like] Left boundary.

right [scalar or list-like] Right boundary.

inclusive [bool, default True] Include boundaries.

Returns

Series Series representing whether each element is between left and right (inclusive).

See also:

Series.gt Greater than of series and other.

Series.lt Less than of series and other.

Notes

This function is equivalent to `(left <= ser) & (ser <= right)`

Examples

```
>>> s = ks.Series([2, 0, 4, 8, np.nan])
```

Boundary values are included by default:

```
>>> s.between(1, 4)
0     True
1    False
2     True
3    False
4    False
dtype: bool
```

With *inclusive* set to `False` boundary values are excluded:

```
>>> s.between(1, 4, inclusive=False)
0     True
1    False
2    False
3    False
4    False
dtype: bool
```

left and *right* can be any scalar value:

```
>>> s = ks.Series(['Alice', 'Bob', 'Carol', 'Eve'])
>>> s.between('Anna', 'Daniel')
0    False
1     True
2     True
3    False
dtype: bool
```

databricks.koalas.Series.clip

Series.**clip**(*lower: Union[float, int] = None*, *upper: Union[float, int] = None*) → databricks.koalas.series.Series

Trim values at input threshold(s).

Assigns values outside boundary to boundary values.

Parameters

lower [float or int, default None] Minimum threshold value. All values below this threshold will be set to it.

upper [float or int, default None] Maximum threshold value. All values above this threshold will be set to it.

Returns

Series Series with the values outside the clip boundaries replaced

Notes

One difference between this implementation and pandas is that running *pd.Series(['a', 'b']).clip(0, 1)* will crash with "TypeError: '<=' not supported between instances of 'str' and 'int'" while *ks.Series(['a', 'b']).clip(0, 1)* will output the original Series, simply ignoring the incompatible types.

Examples

```
>>> ks.Series([0, 2, 4]).clip(1, 3)
0    1
1    2
2    3
dtype: int64
```

databricks.koalas.Series.corr

Series.**corr**(*other*, *method='pearson'*) → float

Compute correlation with *other* Series, excluding missing values.

Parameters

other [Series]

method [{'pearson', 'spearman'}]

- pearson : standard correlation coefficient
- spearman : Spearman rank correlation

Returns

correlation [float]

Notes

There are behavior differences between Koalas and pandas.

- the *method* argument only accepts 'pearson', 'spearman'
- the data should not contain NaNs. Koalas will return an error.
- Koalas doesn't support the following argument(s).
  - *min_periods* argument is not supported

Examples

```
>>> df = ks.DataFrame({'s1': [.2, .0, .6, .2],
...                    's2': [.3, .6, .0, .1]})
>>> s1 = df.s1
>>> s2 = df.s2
>>> s1.corr(s2, method='pearson')
-0.851064...
```

```
>>> s1.corr(s2, method='spearman')
-0.948683...
```

databricks.koalas.Series.count

`Series.`**`count`**`()` → int

Return number of non-NA/null observations in the Series.

Returns

nobs [int]

Examples

Constructing DataFrame from a dictionary:

```
>>> df = ks.DataFrame({"Person":
...                    ["John", "Myla", "Lewis", "John", "Myla"],
...                    "Age": [24., np.nan, 21., 33, 26]})
```

Notice the uncounted NA values:

```
>>> df['Person'].count()
5
```

```
>>> df['Age'].count()
4
```

databricks.koalas.Series.cummax

Series.**cummax**(*skipna: bool = True*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Return cumulative maximum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative maximum.

Note: the current implementation of cummax uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.max Return the maximum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.max Return the maximum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the maximum in each column.

```
>>> df.cummax()
     A    B
0  2.0  1.0
1  3.0  NaN
2  3.0  1.0
```

It works identically in Series.

```
>>> df.B.cummax()
0    1.0
1    NaN
2    1.0
Name: B, dtype: float64
```

databricks.koalas.Series.cummin

Series.**cummin**(*skipna: bool = True*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Return cumulative minimum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative minimum.

Note: the current implementation of cummin uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.min Return the minimum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

Series.min Return the minimum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the minimum in each column.

```
>>> df.cummin()
     A    B
0  2.0  1.0
1  2.0  NaN
2  1.0  0.0
```

It works identically in Series.

```
>>> df.A.cummin()
0    2.0
1    2.0
2    1.0
Name: A, dtype: float64
```

databricks.koalas.Series.cumsum

Series.**cumsum**(*skipna: bool = True*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Return cumulative sum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative sum.

Note: the current implementation of cumsum uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.sum Return the sum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.sum Return the sum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.cumsum()
     A    B
0  2.0  1.0
1  5.0  NaN
2  6.0  1.0
```

It works identically in Series.

```
>>> df.A.cumsum()
0    2.0
1    5.0
2    6.0
Name: A, dtype: float64
```

databricks.koalas.Series.cumprod

`Series.`**`cumprod`**(*skipna: bool = True*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Return cumulative product over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative product.

Note: the current implementation of cumprod uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Note: unlike pandas', Koalas' emulates cumulative product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

Raises

Exception [If the values is equal to or lower than 0.]

See also:

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [4.0, 10.0]], columns=list('AB'))
>>> df
     A     B
0  2.0   1.0
1  3.0   NaN
2  4.0  10.0
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.cumprod()
      A     B
0   2.0   1.0
1   6.0   NaN
2  24.0  10.0
```

It works identically in Series.

```
>>> df.A.cumprod()
0     2.0
1     6.0
2    24.0
Name: A, dtype: float64
```

databricks.koalas.Series.describe

`Series.describe`(*percentiles: Optional[List[float]] = None*) → databricks.koalas.series.Series

Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding `NaN` values.

Analyzes both numeric and object series, as well as `DataFrame` column sets of mixed data types. The output will vary depending on what is provided. Refer to the notes below for more detail.

Parameters

percentiles [list of `float` in range [0.0, 1.0], default [0.25, 0.5, 0.75]] A list of percentiles to be computed.

Returns

DataFrame Summary statistics of the Dataframe provided.

See also:

DataFrame.count Count number of non-NA/null observations.

DataFrame.max Maximum of the values in the object.

DataFrame.min Minimum of the values in the object.

DataFrame.mean Mean of the values.

DataFrame.std Standard deviation of the observations.

Notes

For numeric data, the result's index will include `count`, `mean`, `std`, `min`, `25%`, `50%`, `75%`, `max`.

Currently only numeric data is supported.

Examples

Describing a numeric `Series`.

```
>>> s = ks.Series([1, 2, 3])
>>> s.describe()
count    3.0
mean     2.0
std      1.0
min      1.0
25%      1.0
50%      2.0
75%      3.0
max      3.0
dtype: float64
```

Describing a `DataFrame`. Only numeric fields are returned.

```
>>> df = ks.DataFrame({'numeric1': [1, 2, 3],
...                    'numeric2': [4.0, 5.0, 6.0],
...                    'object': ['a', 'b', 'c']
...                   },
...                   columns=['numeric1', 'numeric2', 'object'])
```

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```
>>> df.describe()
       numeric1  numeric2
count       3.0       3.0
mean        2.0       5.0
std         1.0       1.0
min         1.0       4.0
25%         1.0       4.0
50%         2.0       5.0
75%         3.0       6.0
max         3.0       6.0
```

For multi-index columns:

```
>>> df.columns = [('num', 'a'), ('num', 'b'), ('obj', 'c')]
>>> df.describe()
       num
         a    b
count  3.0  3.0
mean   2.0  5.0
std    1.0  1.0
min    1.0  4.0
25%    1.0  4.0
50%    2.0  5.0
75%    3.0  6.0
max    3.0  6.0
```

```
>>> df[('num', 'b')].describe()
count    3.0
mean     5.0
std      1.0
min      4.0
25%      4.0
50%      5.0
75%      6.0
max      6.0
Name: (num, b), dtype: float64
```

Describing a `DataFrame` and selecting custom percentiles.

```
>>> df = ks.DataFrame({'numeric1': [1, 2, 3],
...                    'numeric2': [4.0, 5.0, 6.0]
...                   },
...                   columns=['numeric1', 'numeric2'])
>>> df.describe(percentiles = [0.85, 0.15])
       numeric1  numeric2
count       3.0       3.0
mean        2.0       5.0
std         1.0       1.0
min         1.0       4.0
15%         1.0       4.0
50%         2.0       5.0
85%         3.0       6.0
max         3.0       6.0
```

Describing a column from a `DataFrame` by accessing it as an attribute.

```
>>> df.numeric1.describe()
count    3.0
mean     2.0
std      1.0
min      1.0
25%      1.0
50%      2.0
75%      3.0
max      3.0
Name: numeric1, dtype: float64
```

Describing a column from a `DataFrame` by accessing it as an attribute and selecting custom percentiles.

```
>>> df.numeric1.describe(percentiles = [0.85, 0.15])
count    3.0
mean     2.0
std      1.0
min      1.0
15%      1.0
50%      2.0
85%      3.0
max      3.0
Name: numeric1, dtype: float64
```

databricks.koalas.Series.filter

`Series.`**`filter`**(*items=None*, *like=None*, *regex=None*, *axis=None*) → databricks.koalas.series.Series

Subset rows or columns of dataframe according to labels in the specified index.

Note that this routine does not filter a dataframe on its contents. The filter is applied to the labels of the index.

Parameters

items [list-like] Keep labels from axis which are in items.

like [string] Keep labels from axis for which "like in label == True".

regex [string (regular expression)] Keep labels from axis for which re.search(regex, label) == True.

axis [int or string axis name] The axis to filter on. By default this is the info axis, 'index' for Series, 'columns' for DataFrame.

Returns

same type as input object

See also:

`DataFrame.loc`

Notes

The `items`, `like`, and `regex` parameters are enforced to be mutually exclusive.

`axis` defaults to the info axis that is used when indexing with `[]`.

Examples

```
>>> df = ks.DataFrame(np.array(([1, 2, 3], [4, 5, 6])),
...                   index=['mouse', 'rabbit'],
...                   columns=['one', 'two', 'three'])
```

```
>>> # select columns by name
>>> df.filter(items=['one', 'three'])
        one  three
mouse     1      3
rabbit    4      6
```

```
>>> # select columns by regular expression
>>> df.filter(regex='e$', axis=1)
        one  three
mouse     1      3
rabbit    4      6
```

```
>>> # select rows containing 'bbi'
>>> df.filter(like='bbi', axis=0)
        one  two  three
rabbit    4    5      6
```

For a Series,

```
>>> # select rows by name
>>> df.one.filter(items=['rabbit'])
rabbit    4
Name: one, dtype: int64
```

```
>>> # select rows by regular expression
>>> df.one.filter(regex='e$')
mouse    1
Name: one, dtype: int64
```

```
>>> # select rows containing 'bbi'
>>> df.one.filter(like='bbi')
rabbit    4
Name: one, dtype: int64
```

databricks.koalas.Series.kurt

Series.**kurt**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0). Normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

kurt [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.kurtosis()
a   -1.5
b   -1.5
dtype: float64
```

On a Series:

```
>>> df['a'].kurtosis()
-1.5
```

databricks.koalas.Series.mad

Series.**mad**() → float

Return the mean absolute deviation of values.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s
0    1
1    2
2    3
3    4
dtype: int64
```

```
>>> s.mad()
1.0
```

databricks.koalas.Series.max

Series.**max**(*axis=None*, *numeric_only=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the maximum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default None] If True, include only float, int, boolean columns. This parameter is mainly for pandas compatibility. False is supported; however, the columns should be all numeric or all non-numeric.

Returns

max [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.max()
a    3.0
b    0.3
dtype: float64
```

```
>>> df.max(axis=1)
0    1.0
1    2.0
2    3.0
3    NaN
dtype: float64
```

On a Series:

```
>>> df['a'].max()
3.0
```

databricks.koalas.Series.mean

Series.**mean**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the mean of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

mean [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.mean()
a    2.0
b    0.2
dtype: float64
```

```
>>> df.mean(axis=1)
0    0.55
1    1.10
2    1.65
3     NaN
dtype: float64
```

On a Series:

```
>>> df['a'].mean()
2.0
```

databricks.koalas.Series.min

`Series.`**`min`**(*axis=None*, *numeric_only=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the minimum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default None] If True, include only float, int, boolean columns. This parameter is mainly for pandas compatibility. False is supported; however, the columns should be all numeric or all non-numeric.

Returns

min [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.min()
a    1.0
b    0.1
dtype: float64
```

```
>>> df.min(axis=1)
0    0.1
1    0.2
2    0.3
3    NaN
dtype: float64
```

On a Series:

```
>>> df['a'].min()
1.0
```

databricks.koalas.Series.mode

`Series.mode` (*dropna=True*) → databricks.koalas.series.Series

Return the mode(s) of the dataset.

Always returns Series even if only one value is returned.

Parameters

dropna [bool, default True] Don't consider counts of NaN/NaT.

Returns

Series Modes of the Series.

Examples

```
>>> s = ks.Series([0, 0, 1, 1, 1, np.nan, np.nan, np.nan])
>>> s
0    0.0
1    0.0
2    1.0
3    1.0
4    1.0
5    NaN
6    NaN
7    NaN
dtype: float64
```

```
>>> s.mode()
0    1.0
dtype: float64
```

If there are several same modes, all items are shown

```
>>> s = ks.Series([0, 0, 1, 1, 1, 2, 2, 2, 3, 3, 3,
...                np.nan, np.nan, np.nan])
>>> s
0     0.0
1     0.0
2     1.0
3     1.0
4     1.0
5     2.0
```

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```
6     2.0
7     2.0
8     3.0
9     3.0
10    3.0
11    NaN
12    NaN
13    NaN
dtype: float64
```

```
>>> s.mode().sort_values()

...  1.0
...  2.0
...  3.0
dtype: float64
```

With 'dropna' set to 'False', we can also see NaN in the result

```
>>> s.mode(False).sort_values()

...  1.0
...  2.0
...  3.0
...  NaN
dtype: float64
```

databricks.koalas.Series.nlargest

`Series.`**`nlargest`**(*n: int = 5*) → databricks.koalas.series.Series

Return the largest *n* elements.

Parameters

n [int, default 5]

Returns

Series The *n* largest values in the Series, sorted in decreasing order.

See also:

Series.nsmallest Get the *n* smallest elements.

Series.sort_values Sort Series by values.

Series.head Return the first *n* rows.

Notes

Faster than `.sort_values(ascending=False).head(n)` for small *n* relative to the size of the `Series` object.

In Koalas, thanks to Spark's lazy execution and query optimizer, the two would have same performance.

Examples

```
>>> data = [1, 2, 3, 4, np.nan ,6, 7, 8]
>>> s = ks.Series(data)
>>> s
0    1.0
1    2.0
2    3.0
3    4.0
4    NaN
5    6.0
6    7.0
7    8.0
dtype: float64
```

The *n* largest elements where `n=5` by default.

```
>>> s.nlargest()
7    8.0
6    7.0
5    6.0
3    4.0
2    3.0
dtype: float64
```

```
>>> s.nlargest(n=3)
7    8.0
6    7.0
5    6.0
dtype: float64
```

databricks.koalas.Series.nsmallest

`Series.`**`nsmallest`**(*n: int = 5*) → databricks.koalas.series.Series

Return the smallest *n* elements.

Parameters

n [int, default 5] Return this many ascending sorted values.

Returns

Series The *n* smallest values in the Series, sorted in increasing order.

See also:

Series.nlargest Get the *n* largest elements.

Series.sort_values Sort Series by values.

Series.head Return the first *n* rows.

Notes

Faster than `.sort_values().head(n)` for small *n* relative to the size of the `Series` object. In Koalas, thanks to Spark's lazy execution and query optimizer, the two would have same performance.

Examples

```
>>> data = [1, 2, 3, 4, np.nan ,6, 7, 8]
>>> s = ks.Series(data)
>>> s
0    1.0
1    2.0
2    3.0
3    4.0
4    NaN
5    6.0
6    7.0
7    8.0
dtype: float64
```

The *n* largest elements where `n=5` by default.

```
>>> s.nsmallest()
0    1.0
1    2.0
2    3.0
3    4.0
5    6.0
dtype: float64
```

```
>>> s.nsmallest(3)
0    1.0
1    2.0
2    3.0
dtype: float64
```

databricks.koalas.Series.pct_change

`Series.`**`pct_change`**(*periods=1*) → databricks.koalas.series.Series

Percentage change between the current and a prior element.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int, default 1] Periods to shift for forming percent change.

Returns

Series

Examples

```
>>> kser = ks.Series([90, 91, 85], index=[2, 4, 1])
>>> kser
2    90
4    91
1    85
dtype: int64
```

```
>>> kser.pct_change()
2         NaN
4    0.011111
1   -0.065934
dtype: float64
```

```
>>> kser.sort_index().pct_change()
1         NaN
2    0.058824
4    0.011111
dtype: float64
```

```
>>> kser.pct_change(periods=2)
2         NaN
4         NaN
1   -0.055556
dtype: float64
```

databricks.koalas.Series.prod

`Series.`**`prod`**(*min_count=0*) → Union[int, float]

Return the product of the values.

Note: unlike pandas', Koalas' emulates product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Parameters

min_count [int, default 0] The required number of valid values to perform the operation. If fewer than `min_count` non-NA values are present the result will be NA.

Examples

```
>>> ks.Series([1, 2, 3, 4, 5]).prod()
120
```

By default, the product of an empty or all-NA Series is `1`

```
>>> ks.Series([]).prod()
1.0
```

This can be controlled with the `min_count` parameter

```
>>> ks.Series([]).prod(min_count=1)
nan
```

databricks.koalas.Series.nunique

`Series.`**`nunique`**(*dropna: bool = True*, *approx: bool = False*, *rsd: float = 0.05*) → int

Return number of unique elements in the object. Excludes NA values by default.

Parameters

dropna [bool, default True] Don't include NaN in the count.

approx: bool, default False If False, will use the exact algorithm and return the exact number of unique. If True, it uses the HyperLogLog approximate algorithm, which is significantly faster for large amount of data. Note: This parameter is specific to Koalas and is not found in pandas.

rsd: float, default 0.05 Maximum estimation error allowed in the HyperLogLog algorithm. Note: Just like `approx` this parameter is specific to Koalas.

Returns

int

See also:

DataFrame.nunique Method nunique for DataFrame.

Series.count Count non-NA/null observations in the Series.

Examples

```
>>> ks.Series([1, 2, 3, np.nan]).nunique()
3
```

```
>>> ks.Series([1, 2, 3, np.nan]).nunique(dropna=False)
4
```

On big data, we recommend using the approximate algorithm to speed up this function. The result will be very close to the exact unique count.

```
>>> ks.Series([1, 2, 3, np.nan]).nunique(approx=True)
3
```

```
>>> idx = ks.Index([1, 1, 2, None])
>>> idx
Float64Index([1.0, 1.0, 2.0, nan], dtype='float64')
```

```
>>> idx.nunique()
2
```

```
>>> idx.nunique(dropna=False)
3
```

databricks.koalas.Series.is_unique

property Series.**is_unique**

Return boolean if values in the object are unique

Returns

is_unique [boolean]

```
>>> ks.Series([1, 2, 3]).is_unique
    ..
```

True

```
>>> ks.Series([1, 2, 2]).is_unique
    ..
```

False

```
>>> ks.Series([1, 2, 3, None]).is_unique
    ..
```

True

databricks.koalas.Series.quantile

Series.**quantile**(*q=0.5*, *accuracy=10000*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return value at the given quantile.

Note: Unlike pandas', the quantile in Koalas is an approximated quantile based upon approximate percentile computation because computing quantile across a large dataset is extremely expensive.

Parameters

q [float or array-like, default 0.5 (50% quantile)] 0 <= q <= 1, the quantile(s) to compute.

accuracy [int, optional] Default accuracy of approximation. Larger value means better accuracy. The relative error can be deduced by 1.0 / accuracy.

Returns

float or Series If the current object is a Series and `q` is an array, a Series will be returned where the index is `q` and the values are the quantiles, otherwise a float will be returned.

Examples

```
>>> s = ks.Series([1, 2, 3, 4, 5])
>>> s.quantile(.5)
3
```

```
>>> (s + 1).quantile(.5)
4
```

```
>>> s.quantile([.25, .5, .75])
0.25    2
0.5     3
0.75    4
dtype: int64
```

```
>>> (s + 1).quantile([.25, .5, .75])
0.25    3
0.5     4
0.75    5
dtype: int64
```

databricks.koalas.Series.rank

Series.**rank**(*method='average'*, *ascending=True*) → databricks.koalas.series.Series

Compute numerical data ranks (1 through n) along axis. Equal values are assigned a rank that is the average of the ranks of those values.

Note: the current implementation of rank uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

method [{'average', 'min', 'max', 'first', 'dense'}]

- average: average rank of group
- min: lowest rank in group
- max: highest rank in group
- first: ranks assigned in order they appear in the array
- dense: like 'min', but rank always increases by 1 between groups

ascending [boolean, default True] False for ranks by high (1) to low (N)

Returns

ranks [same type as caller]

Examples

```
>>> s = ks.Series([1, 2, 2, 3], name='A')
>>> s
0    1
1    2
2    2
3    3
Name: A, dtype: int64
```

```
>>> s.rank()
0    1.0
1    2.5
2    2.5
3    4.0
Name: A, dtype: float64
```

If method is set to ‘min’, it use lowest rank in group.

```
>>> s.rank(method='min')
0    1.0
1    2.0
2    2.0
3    4.0
Name: A, dtype: float64
```

If method is set to ‘max’, it use highest rank in group.

```
>>> s.rank(method='max')
0    1.0
1    3.0
2    3.0
3    4.0
Name: A, dtype: float64
```

If method is set to ‘first’, it is assigned rank in order without groups.

```
>>> s.rank(method='first')
0    1.0
1    2.0
2    3.0
3    4.0
Name: A, dtype: float64
```

If method is set to ‘dense’, it leaves no gaps in group.

```
>>> s.rank(method='dense')
0    1.0
1    2.0
2    2.0
3    3.0
Name: A, dtype: float64
```

databricks.koalas.Series.skew

Series.**skew**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return unbiased skew normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

skew [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.skew()
a    0.000000e+00
b   -3.319678e-16
dtype: float64
```

On a Series:

```
>>> df['a'].skew()
0.0
```

databricks.koalas.Series.std

Series.**std**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return sample standard deviation.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

std [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.std()
a    1.0
b    0.1
dtype: float64
```

```
>>> df.std(axis=1)
0    0.636396
1    1.272792
2    1.909188
3         NaN
dtype: float64
```

On a Series:

```
>>> df['a'].std()
1.0
```

databricks.koalas.Series.sum

Series.**sum**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the sum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

sum [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.sum()
a    6.0
b    0.6
dtype: float64
```

```
>>> df.sum(axis=1)
0    1.1
1    2.2
2    3.3
3    0.0
dtype: float64
```

On a Series:

```
>>> df['a'].sum()
6.0
```

databricks.koalas.Series.median

Series.**median**(*axis=None*, *numeric_only=True*, *accuracy=10000*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the median of the values for the requested axis.

Note: Unlike pandas', the median in Koalas is an approximated median based upon approximate percentile computation because computing median across a large dataset is extremely expensive.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

accuracy [int, optional] Default accuracy of approximation. Larger value means better accuracy. The relative error can be deduced by 1.0 / accuracy.

Returns

median [scalar or Series]

Examples

```
>>> df = ks.DataFrame({
...     'a': [24., 21., 25., 33., 26.], 'b': [1., 2., 3., 4., 5.]}, columns=['a',
↪'b'])
>>> df
      a    b
0  24.0  1.0
1  21.0  2.0
2  25.0  3.0
3  33.0  4.0
4  26.0  5.0
```

On a DataFrame:

```
>>> df.median()
a    25.0
b     3.0
dtype: float64
```

On a Series:

```
>>> df['a'].median()
25.0
>>> (df['a'] + 100).median()
125.0
```

For multi-index columns,

```
>>> df.columns = pd.MultiIndex.from_tuples([('x', 'a'), ('y', 'b')])
>>> df
      x    y
      a    b
0  24.0  1.0
1  21.0  2.0
2  25.0  3.0
3  33.0  4.0
4  26.0  5.0
```

On a DataFrame:

```
>>> df.median()
x  a    25.0
y  b     3.0
dtype: float64
```

```
>>> df.median(axis=1)
0    12.5
1    11.5
2    14.0
3    18.5
4    15.5
dtype: float64
```

On a Series:

```
>>> df[('x', 'a')].median()
25.0
>>> (df[('x', 'a')] + 100).median()
125.0
```

databricks.koalas.Series.var

`Series.`**`var`**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return unbiased variance.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

var [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.var()
a    1.00
b    0.01
dtype: float64
```

```
>>> df.var(axis=1)
0    0.405
1    1.620
2    3.645
3      NaN
dtype: float64
```

On a Series:

```
>>> df['a'].var()
1.0
```

databricks.koalas.Series.kurtosis

Series.**kurtosis**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0). Normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

kurt [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.kurtosis()
a   -1.5
b   -1.5
dtype: float64
```

On a Series:

```
>>> df['a'].kurtosis()
-1.5
```

databricks.koalas.Series.unique

Series.**unique**() → databricks.koalas.series.Series

Return unique values of Series object.

Uniques are returned in order of appearance. Hash table-based unique, therefore does NOT sort.

Note: This method returns newly created Series whereas pandas returns the unique values as a NumPy array.

Returns

Returns the unique values as a Series.

See also:

Index.unique

groupby.SeriesGroupBy.unique

Examples

```
>>> kser = ks.Series([2, 1, 3, 3], name='A')
>>> kser.unique().sort_values()

...  1
...  2
...  3
Name: A, dtype: int64
```

```
>>> ks.Series([pd.Timestamp('2016-01-01') for _ in range(3)]).unique()
0   2016-01-01
dtype: datetime64[ns]
```

```
>>> kser.name = ('x', 'a')
>>> kser.unique().sort_values()

...  1
...  2
...  3
Name: (x, a), dtype: int64
```

databricks.koalas.Series.value_counts

Series.**value_counts**(*normalize=False*, *sort=True*, *ascending=False*, *bins=None*, *dropna=True*) → Series

Return a Series containing counts of unique values. The resulting object will be in descending order so that the first element is the most frequently-occurring element. Excludes NA values by default.

Parameters

normalize [boolean, default False] If True then the object returned will contain the relative frequencies of the unique values.

sort [boolean, default True] Sort by values.

ascending [boolean, default False] Sort in ascending order.

bins [Not Yet Supported]

dropna [boolean, default True] Don't include counts of NaN.

Returns

counts [Series]

See also:

Series.count Number of non-NA elements in a Series.

Examples

For Series

```
>>> df = ks.DataFrame({'x':[0, 0, 1, 1, 1, np.nan]})
>>> df.x.value_counts()
1.0    3
0.0    2
Name: x, dtype: int64
```

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> df.x.value_counts(normalize=True)
1.0    0.6
0.0    0.4
Name: x, dtype: float64
```

dropna With *dropna* set to *False* we can also see NaN index values.

```
>>> df.x.value_counts(dropna=False)
1.0    3
0.0    2
NaN    1
Name: x, dtype: int64
```

For Index

```
>>> idx = ks.Index([3, 1, 2, 3, 4, np.nan])
>>> idx
Float64Index([3.0, 1.0, 2.0, 3.0, 4.0, nan], dtype='float64')
```

```
>>> idx.value_counts().sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

sort

With *sort* set to *False*, the result wouldn't be sorted by number of count.

```
>>> idx.value_counts(sort=True).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

normalize

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> idx.value_counts(normalize=True).sort_index()
1.0    0.2
2.0    0.2
3.0    0.4
4.0    0.2
dtype: float64
```

dropna

With *dropna* set to *False* we can also see NaN index values.

```
>>> idx.value_counts(dropna=False).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
NaN    1
dtype: int64
```

For MultiIndex.

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index
MultiIndex([(  'lama', 'weight'),
            (  'lama', 'weight'),
            (  'lama', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon', 'weight'),
            ('falcon', 'length'),
            ('falcon', 'length')],
           )
```

```
>>> s.index.value_counts().sort_index()
(cow, length)       1
(cow, weight)       2
(falcon, length)    2
(falcon, weight)    1
(lama, weight)      3
dtype: int64
```

```
>>> s.index.value_counts(normalize=True).sort_index()
(cow, length)       0.111111
(cow, weight)       0.222222
(falcon, length)    0.222222
(falcon, weight)    0.111111
(lama, weight)      0.333333
dtype: float64
```

If Index has name, keep the name up.

```
>>> idx = ks.Index([0, 0, 0, 1, 1, 2, 3], name='koalas')
>>> idx.value_counts().sort_index()
0    3
1    2
2    1
3    1
Name: koalas, dtype: int64
```

databricks.koalas.Series.round

`Series.`**`round`**(*decimals=0*) → databricks.koalas.series.Series

Round each value in a Series to the given number of decimals.

Parameters

decimals [int] Number of decimal places to round to (default: 0). If decimals is negative, it specifies the number of positions to the left of the decimal point.

Returns

Series object

See also:

DataFrame.round

Examples

```
>>> df = ks.Series([0.028208, 0.038683, 0.877076], name='x')
>>> df
0    0.028208
1    0.038683
2    0.877076
Name: x, dtype: float64
```

```
>>> df.round(2)
0    0.03
1    0.04
2    0.88
Name: x, dtype: float64
```

databricks.koalas.Series.diff

Series.**diff**(*periods=1*) → databricks.koalas.series.Series

First discrete difference of element.

Calculates the difference of a Series element compared with another element in the DataFrame (default is the element in the same column of the previous row).

Note: the current implementation of diff uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int, default 1] Periods to shift for calculating difference, accepts negative values.

Returns

diffed [Series]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4, 5, 6],
...                    'b': [1, 1, 2, 3, 5, 8],
...                    'c': [1, 4, 9, 16, 25, 36]}, columns=['a', 'b', 'c'])
>>> df
   a  b   c
0  1  1   1
1  2  1   4
2  3  2   9
3  4  3  16
4  5  5  25
5  6  8  36
```

```
>>> df.b.diff()
0    NaN
1    0.0
2    1.0
3    1.0
4    2.0
5    3.0
Name: b, dtype: float64
```

Difference with previous value

```
>>> df.c.diff(periods=3)
0     NaN
1     NaN
2     NaN
3    15.0
4    21.0
5    27.0
Name: c, dtype: float64
```

Difference with following value

```
>>> df.c.diff(periods=-1)
0    -3.0
1    -5.0
2    -7.0
3    -9.0
4   -11.0
5     NaN
Name: c, dtype: float64
```

databricks.koalas.Series.is_monotonic

property Series.**is_monotonic**

Return boolean if values in the object are monotonically increasing.

Note: the current implementation of is_monotonic requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['1/1/2018', '3/1/2018', '4/1/2018'])
>>> ser.is_monotonic
True
```

```
>>> df = ks.DataFrame({'dates': [None, '1/1/2018', '2/1/2018', '3/1/2018']})
>>> df.dates.is_monotonic
False
```

```
>>> df.index.is_monotonic
True
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic
False
```

```
>>> ser.index.is_monotonic
True
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic
True
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'a'), ('z', 'b'), ('y', 'c'), ('y', 'd'), ('x', 'e')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
>>> midx.is_monotonic
False
```

databricks.koalas.Series.is_monotonic_increasing

property Series.**is_monotonic_increasing**

Return boolean if values in the object are monotonically increasing.

Note: the current implementation of is_monotonic requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['1/1/2018', '3/1/2018', '4/1/2018'])
>>> ser.is_monotonic
True
```

```
>>> df = ks.DataFrame({'dates': [None, '1/1/2018', '2/1/2018', '3/1/2018']})
>>> df.dates.is_monotonic
False
```

```
>>> df.index.is_monotonic
True
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic
False
```

```
>>> ser.index.is_monotonic
True
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic
True
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'a'), ('z', 'b'), ('y', 'c'), ('y', 'd'), ('x', 'e')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
```

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```
>>> midx.is_monotonic
False
```

databricks.koalas.Series.is_monotonic_decreasing

property Series.**is_monotonic_decreasing**

Return boolean if values in the object are monotonically decreasing.

Note: the current implementation of is_monotonic_decreasing requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['4/1/2018', '3/1/2018', '1/1/2018'])
>>> ser.is_monotonic_decreasing
True
```

```
>>> df = ks.DataFrame({'dates': [None, '3/1/2018', '2/1/2018', '1/1/2018']})
>>> df.dates.is_monotonic_decreasing
False
```

```
>>> df.index.is_monotonic_decreasing
False
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic_decreasing
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser.index.is_monotonic_decreasing
False
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic_decreasing
False
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'e'), ('z', 'd'), ('y', 'c'), ('y', 'b'), ('x', 'a')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
>>> midx.is_monotonic_decreasing
True
```

3.3.8 Reindexing / Selection / Label manipulation

Series.drop([labels, index, level])	Return Series with specified index labels removed.
Series.droplevel(level)	Return Series with requested index level(s) removed.
Series.drop_duplicates([keep, inplace])	Return Series with duplicate values removed.
Series.equals(other)	Compare if the current value is equal to the other.
Series.add_prefix(prefix)	Prefix labels with string *prefix*.
Series.add_suffix(suffix)	Suffix labels with string suffix.
Series.head([n])	Return the first n rows.
Series.idxmax([skipna])	Return the row label of the maximum value.
Series.idxmin([skipna])	Return the row label of the minimum value.
Series.isin(values)	Check whether *values* are contained in Series or Index.
Series.rename([index])	Alter Series name.
Series.rename_axis([mapper, index, inplace])	Set the name of the axis for the index or columns.
Series.reindex([index, fill_value])	Conform Series to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index.
Series.reindex_like(other)	Return a Series with matching indices as other object.
Series.reset_index([level, drop, name, inplace])	Generate a new DataFrame or Series with the index reset.
Series.sample([n, frac, replace, random_state])	Return a random sample of items from an axis of object.
Series.swaplevel([i, j, copy])	Swap levels i and j in a MultiIndex.
Series.swapaxes(i, j[, copy])	Interchange axes and swap values axes appropriately.
Series.take(indices)	Return the elements in the given *positional* indices along an axis.
Series.tail([n])	Return the last *n* rows.
Series.where(cond[, other])	Replace values where the condition is False.

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Series.mask(cond[, other])	Replace values where the condition is True.
Series.truncate([before, after, axis, copy])	Truncate a Series or DataFrame before and after some index value.

databricks.koalas.Series.drop

Series.**drop**(*labels=None*, *index: Union[Any, Tuple, List[Any], List[Tuple]] = None*, *level=None*) → databricks.koalas.series.Series

Return Series with specified index labels removed.

Remove elements of a Series based on specifying the index labels. When using a multi-index, labels on different levels can be removed by specifying the level.

Parameters

labels [single label or list-like] Index labels to drop.

index [None] Redundant for application on Series, but index can be used instead of labels.

level [int or level name, optional] For MultiIndex, level for which the labels will be removed.

Returns

Series Series with specified index labels removed.

See also:

Series.dropna

Examples

```
>>> s = ks.Series(data=np.arange(3), index=['A', 'B', 'C'])
>>> s
A    0
B    1
C    2
dtype: int64
```

Drop single label A

```
>>> s.drop('A')
B    1
C    2
dtype: int64
```

Drop labels B and C

```
>>> s.drop(labels=['B', 'C'])
A    0
dtype: int64
```

With ‘index’ rather than ‘labels’ returns exactly same result.

```
>>> s.drop(index='A')
B    1
C    2
dtype: int64
```

```
>>> s.drop(index=['B', 'C'])
A    0
dtype: int64
```

Also support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx)
>>> s
lama    speed      45.0
        weight    200.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.drop(labels='weight', level=1)
lama    speed      45.0
        length      1.2
cow     speed      30.0
        length      1.5
falcon  speed     320.0
        length      0.3
dtype: float64
```

```
>>> s.drop(('lama', 'weight'))
lama    speed      45.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.drop([('lama', 'speed'), ('falcon', 'weight')])
lama    weight    200.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        length      0.3
dtype: float64
```

databricks.koalas.Series.droplevel

`Series.droplevel`(*level*) → databricks.koalas.series.Series
Return Series with requested index level(s) removed.

Parameters

level [int, str, or list-like] If a string is given, must be the name of a level If list-like, elements must be names or positional indexes of levels.

Returns

Series Series with requested index level(s) removed.

Examples

```
>>> kser = ks.Series(
...     [1, 2, 3],
...     index=pd.MultiIndex.from_tuples(
...         [("x", "a"), ("x", "b"), ("y", "c")], names=["level_1", "level_2"]
...     ),
... )
>>> kser
level_1  level_2
x        a          1
         b          2
y        c          3
dtype: int64
```

Removing specific index level by level

```
>>> kser.droplevel(0)
level_2
a    1
b    2
c    3
dtype: int64
```

Removing specific index level by name

```
>>> kser.droplevel("level_2")
level_1
x    1
x    2
y    3
dtype: int64
```

databricks.koalas.Series.drop_duplicates

`Series.`**`drop_duplicates`**(*keep='first'*, *inplace=False*) → Optional[databricks.koalas.series.Series]
Return Series with duplicate values removed.

Parameters

keep [{'first', 'last', `False`}, default 'first'] Method to handle dropping duplicates: - 'first' : Drop duplicates except for the first occurrence. - 'last' : Drop duplicates except for the last occurrence. - `False` : Drop all duplicates.

inplace [bool, default `False`] If `True`, performs operation inplace and returns None.

Returns

Series Series with duplicates dropped.

Examples

Generate a Series with duplicated entries.

```
>>> s = ks.Series(['lama', 'cow', 'lama', 'beetle', 'lama', 'hippo'],
...               name='animal')
>>> s.sort_index()
0      lama
1       cow
2      lama
3    beetle
4      lama
5     hippo
Name: animal, dtype: object
```

With the 'keep' parameter, the selection behaviour of duplicated values can be changed. The value 'first' keeps the first occurrence for each set of duplicated entries. The default value of keep is 'first'.

```
>>> s.drop_duplicates().sort_index()
0      lama
1       cow
3    beetle
5     hippo
Name: animal, dtype: object
```

The value 'last' for parameter 'keep' keeps the last occurrence for each set of duplicated entries.

```
>>> s.drop_duplicates(keep='last').sort_index()
1       cow
3    beetle
4      lama
5     hippo
Name: animal, dtype: object
```

The value `False` for parameter 'keep' discards all sets of duplicated entries. Setting the value of 'inplace' to `True` performs the operation inplace and returns `None`.

```
>>> s.drop_duplicates(keep=False, inplace=True)
>>> s.sort_index()
1       cow
3    beetle
```

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```
5     hippo
Name: animal, dtype: object
```

databricks.koalas.Series.equals

Series.**equals**(*other*) → bool

Compare if the current value is equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.a == 1
a     True
b    False
c    False
d    False
Name: a, dtype: bool
```

```
>>> df.b.eq(1)
a     True
b    False
c     True
d    False
Name: b, dtype: bool
```

databricks.koalas.Series.add_prefix

Series.**add_prefix**(*prefix*) → databricks.koalas.series.Series

Prefix labels with string *prefix*.

For Series, the row labels are prefixed. For DataFrame, the column labels are prefixed.

Parameters

prefix [str] The string to add before each label.

Returns

Series New Series with updated labels.

See also:

Series.add_suffix Suffix column labels with string *suffix*.

DataFrame.add_suffix Suffix column labels with string *suffix*.

DataFrame.add_prefix Prefix column labels with string *prefix*.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s
0    1
1    2
2    3
3    4
dtype: int64
```

```
>>> s.add_prefix('item_')
item_0    1
item_1    2
item_2    3
item_3    4
dtype: int64
```

databricks.koalas.Series.add_suffix

Series.**add_suffix**(*suffix*) → databricks.koalas.series.Series

Suffix labels with string suffix.

For Series, the row labels are suffixed. For DataFrame, the column labels are suffixed.

Parameters

suffix [str] The string to add after each label.

Returns

Series New Series with updated labels.

See also:

Series.add_prefix Prefix row labels with string *prefix*.

DataFrame.add_prefix Prefix column labels with string *prefix*.

DataFrame.add_suffix Suffix column labels with string *suffix*.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s
0    1
1    2
2    3
3    4
dtype: int64
```

```
>>> s.add_suffix('_item')
0_item    1
1_item    2
2_item    3
3_item    4
dtype: int64
```

databricks.koalas.Series.head

Series.**head**(*n: int = 5*) → databricks.koalas.series.Series
Return the first n rows.

This function returns the first n rows for the object based on position. It is useful for quickly testing if your object has the right type of data in it.

Parameters

n [Integer, default = 5]

Returns

The first n rows of the caller object.

Examples

```
>>> df = ks.DataFrame({'animal':['alligator', 'bee', 'falcon', 'lion']})
>>> df.animal.head(2)
0     alligator
1     bee
Name: animal, dtype: object
```

databricks.koalas.Series.idxmax

Series.**idxmax**(*skipna=True*) → Union[Tuple, Any]
Return the row label of the maximum value.

If multiple values equal the maximum, the first row label with that value is returned.

Parameters

skipna [bool, default True] Exclude NA/null values. If the entire Series is NA, the result will be NA.

Returns

Index Label of the maximum value.

Raises

ValueError If the Series is empty.

See also:

Series.idxmin Return index *label* of the first occurrence of minimum of values.

Examples

```
>>> s = ks.Series(data=[1, None, 4, 3, 5],
...               index=['A', 'B', 'C', 'D', 'E'])
>>> s
A    1.0
B    NaN
C    4.0
D    3.0
```

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```
E    5.0
dtype: float64
```

```
>>> s.idxmax()
'E'
```

If *skipna* is False and there is an NA value in the data, the function returns `nan`.

```
>>> s.idxmax(skipna=False)
nan
```

In case of multi-index, you get a tuple:

```
>>> index = pd.MultiIndex.from_arrays([
...     ['a', 'a', 'b', 'b'], ['c', 'd', 'e', 'f']], names=('first', 'second'))
>>> s = ks.Series(data=[1, None, 4, 5], index=index)
>>> s
first  second
a      c         1.0
       d         NaN
b      e         4.0
       f         5.0
dtype: float64
```

```
>>> s.idxmax()
('b', 'f')
```

If multiple values equal the maximum, the first row label with that value is returned.

```
>>> s = ks.Series([1, 100, 1, 100, 1, 100], index=[10, 3, 5, 2, 1, 8])
>>> s
10      1
3     100
5       1
2     100
1       1
8     100
dtype: int64
```

```
>>> s.idxmax()
3
```

databricks.koalas.Series.idxmin

`Series.`**`idxmin`**(*skipna=True*) → Union[Tuple, Any]

Return the row label of the minimum value.

If multiple values equal the minimum, the first row label with that value is returned.

Parameters

skipna [bool, default True] Exclude NA/null values. If the entire Series is NA, the result will be NA.

Returns

Index Label of the minimum value.

Raises

ValueError If the Series is empty.

See also:

Series.idxmax Return index *label* of the first occurrence of maximum of values.

Notes

This method is the Series version of `ndarray.argmin`. This method returns the label of the minimum, while `ndarray.argmin` returns the position. To get the position, use `series.values.argmin()`.

Examples

```
>>> s = ks.Series(data=[1, None, 4, 0],
...               index=['A', 'B', 'C', 'D'])
>>> s
A    1.0
B    NaN
C    4.0
D    0.0
dtype: float64
```

```
>>> s.idxmin()
'D'
```

If *skipna* is False and there is an NA value in the data, the function returns `nan`.

```
>>> s.idxmin(skipna=False)
nan
```

In case of multi-index, you get a tuple:

```
>>> index = pd.MultiIndex.from_arrays([
...     ['a', 'a', 'b', 'b'], ['c', 'd', 'e', 'f']], names=('first', 'second'))
>>> s = ks.Series(data=[1, None, 4, 0], index=index)
>>> s
first  second
a      c         1.0
       d         NaN
b      e         4.0
       f         0.0
dtype: float64
```

```
>>> s.idxmin()
('b', 'f')
```

If multiple values equal the minimum, the first row label with that value is returned.

```
>>> s = ks.Series([1, 100, 1, 100, 1, 100], index=[10, 3, 5, 2, 1, 8])
>>> s
10      1
```

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```
3     100
5       1
2     100
1       1
8     100
dtype: int64
```

```
>>> s.idxmin()
10
```

databricks.koalas.Series.isin

Series.**isin**(*values*) → Union[Series, Index]

Check whether *values* are contained in Series or Index.

Return a boolean Series or Index showing whether each element in the Series matches an element in the passed sequence of *values* exactly.

Parameters

values [list or set] The sequence of values to test.

Returns

isin [Series (bool dtype) or Index (bool dtype)]

Examples

```
>>> s = ks.Series(['lama', 'cow', 'lama', 'beetle', 'lama',
...                'hippo'], name='animal')
>>> s.isin(['cow', 'lama'])
0     True
1     True
2     True
3    False
4     True
5    False
Name: animal, dtype: bool
```

Passing a single string as `s.isin('lama')` will raise an error. Use a list of one element instead:

```
>>> s.isin(['lama'])
0     True
1    False
2     True
3    False
4     True
5    False
Name: animal, dtype: bool
```

```
>>> s.rename("a").to_frame().set_index("a").index.isin(['lama'])
Index([True, False, True, False, True, False], dtype='object', name='a')
```

databricks.koalas.Series.rename

Series.**rename**(*index=None*, ***kwargs*) → databricks.koalas.series.Series
Alter Series name.

Parameters

index [scalar] Scalar will alter the `Series.name` attribute.

inplace [bool, default False] Whether to return a new Series. If True then value of copy is ignored.

Returns

Series Series with name altered.

Examples

```
>>> s = ks.Series([1, 2, 3])
>>> s
0    1
1    2
2    3
dtype: int64
```

```
>>> s.rename("my_name")  # scalar, changes Series.name
0    1
1    2
2    3
Name: my_name, dtype: int64
```

databricks.koalas.Series.rename_axis

Series.**rename_axis**(*mapper: Optional[Any] = None*, *index: Optional[Any] = None*, *inplace: bool = False*) → Optional[databricks.koalas.series.Series]
Set the name of the axis for the index or columns.

Parameters

mapper, index [scalar, list-like, dict-like or function, optional] A scalar, list-like, dict-like or functions transformations to apply to the index values.

inplace [bool, default False] Modifies the object directly, instead of creating a new Series.

Returns

Series, or None if *inplace* is True.

See also:

Series.rename Alter Series index labels or name.

DataFrame.rename Alter DataFrame index labels or name.

Index.rename Set new names on index.

Examples

```
>>> s = ks.Series(["dog", "cat", "monkey"], name="animal")
>>> s
0       dog
1       cat
2    monkey
Name: animal, dtype: object
>>> s.rename_axis("index").sort_index()
index
0       dog
1       cat
2    monkey
Name: animal, dtype: object
```

MultiIndex

```
>>> index = pd.MultiIndex.from_product([['mammal'],
...                                     ['dog', 'cat', 'monkey']],
...                                    names=['type', 'name'])
>>> s = ks.Series([4, 4, 2], index=index, name='num_legs')
>>> s
type    name
mammal  dog       4
        cat       4
        monkey    2
Name: num_legs, dtype: int64
>>> s.rename_axis(index={'type': 'class'}).sort_index()
class   name
mammal  cat       4
        dog       4
        monkey    2
Name: num_legs, dtype: int64
>>> s.rename_axis(index=str.upper).sort_index()
TYPE    NAME
mammal  cat       4
        dog       4
        monkey    2
Name: num_legs, dtype: int64
```

databricks.koalas.Series.reindex

Series.**reindex**(*index: Optional[Any] = None*, *fill_value: Optional[Any] = None*) → databricks.koalas.series.Series

Conform Series to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index. A new object is produced.

Parameters

index: array-like, optional New labels / index to conform to, should be specified using keywords. Preferably an Index object to avoid duplicating data

fill_value [scalar, default np.NaN] Value to use for missing values. Defaults to NaN, but can be any "compatible" value.

Returns

Series with changed index.

See also:

Series.reset_index Remove row labels or move them to new columns.

Examples

Create a series with some fictional data.

```
>>> index = ['Firefox', 'Chrome', 'Safari', 'IE10', 'Konqueror']
>>> ser = ks.Series([200, 200, 404, 404, 301],
...                 index=index, name='http_status')
>>> ser
Firefox      200
Chrome       200
Safari       404
IE10         404
Konqueror    301
Name: http_status, dtype: int64
```

Create a new index and reindex the Series. By default values in the new index that do not have corresponding records in the Series are assigned `NaN`.

```
>>> new_index= ['Safari', 'Iceweasel', 'Comodo Dragon', 'IE10',
...             'Chrome']
>>> ser.reindex(new_index).sort_index()
Chrome           200.0
Comodo Dragon      NaN
IE10             404.0
Iceweasel          NaN
Safari           404.0
Name: http_status, dtype: float64
```

We can fill in the missing values by passing a value to the keyword `fill_value`.

```
>>> ser.reindex(new_index, fill_value=0).sort_index()
Chrome           200
Comodo Dragon      0
IE10             404
Iceweasel          0
Safari           404
Name: http_status, dtype: int64
```

To further illustrate the filling functionality in `reindex`, we will create a Series with a monotonically increasing index (for example, a sequence of dates).

```
>>> date_index = pd.date_range('1/1/2010', periods=6, freq='D')
>>> ser2 = ks.Series([100, 101, np.nan, 100, 89, 88],
...                  name='prices', index=date_index)
>>> ser2.sort_index()
2010-01-01    100.0
2010-01-02    101.0
2010-01-03      NaN
2010-01-04    100.0
2010-01-05     89.0
2010-01-06     88.0
Name: prices, dtype: float64
```

Suppose we decide to expand the series to cover a wider date range.

```
>>> date_index2 = pd.date_range('12/29/2009', periods=10, freq='D')
>>> ser2.reindex(date_index2).sort_index()
2009-12-29      NaN
2009-12-30      NaN
2009-12-31      NaN
2010-01-01    100.0
2010-01-02    101.0
2010-01-03      NaN
2010-01-04    100.0
2010-01-05     89.0
2010-01-06     88.0
2010-01-07      NaN
Name: prices, dtype: float64
```

databricks.koalas.Series.reindex_like

`Series.`**`reindex_like`**(*other: Union[Series, DataFrame]*) → databricks.koalas.series.Series

Return a Series with matching indices as other object.

Conform the object to the same index on all axes. Places NA/NaN in locations having no value in the previous index.

Parameters

other [Series or DataFrame] Its row and column indices are used to define the new indices of this object.

Returns

Series Series with changed indices on each axis.

See also:

DataFrame.set_index Set row labels.

DataFrame.reset_index Remove row labels or move them to new columns.

DataFrame.reindex Change to new indices or expand indices.

Notes

Same as calling `.reindex(index=other.index, ...)`.

Examples

```
>>> s1 = ks.Series([24.3, 31.0, 22.0, 35.0],
...                index=pd.date_range(start='2014-02-12',
...                                    end='2014-02-15', freq='D'),
...                name="temp_celsius")
>>> s1
2014-02-12    24.3
2014-02-13    31.0
2014-02-14    22.0
2014-02-15    35.0
Name: temp_celsius, dtype: float64
```

```
>>> s2 = ks.Series(["low", "low", "medium"],
...                index=pd.DatetimeIndex(['2014-02-12', '2014-02-13',
...                                        '2014-02-15']),
...                name="winspeed")
>>> s2
2014-02-12       low
2014-02-13       low
2014-02-15    medium
Name: winspeed, dtype: object
```

```
>>> s2.reindex_like(s1).sort_index()
2014-02-12       low
2014-02-13       low
2014-02-14      None
2014-02-15    medium
Name: winspeed, dtype: object
```

databricks.koalas.Series.reset_index

Series.**reset_index**(*level=None*, *drop=False*, *name=None*, *inplace=False*) → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame, None]

Generate a new DataFrame or Series with the index reset.

This is useful when the index needs to be treated as a column, or when the index is meaningless and needs to be reset to the default before another operation.

Parameters

level [int, str, tuple, or list, default optional] For a Series with a MultiIndex, only remove the specified levels from the index. Removes all levels by default.

drop [bool, default False] Just reset the index, without inserting it as a column in the new DataFrame.

name [object, optional] The name to use for the column containing the original Series values. Uses self.name by default. This argument is ignored when drop is True.

inplace [bool, default False] Modify the Series in place (do not create a new object).

Returns

Series or DataFrame When *drop* is False (the default), a DataFrame is returned. The newly created columns will come first in the DataFrame, followed by the original Series values. When *drop* is True, a *Series* is returned. In either case, if `inplace=True`, no value is returned.

Examples

```
>>> s = ks.Series([1, 2, 3, 4], index=pd.Index(['a', 'b', 'c', 'd'], name='idx'))
```

Generate a DataFrame with default index.

```
>>> s.reset_index()
  idx  0
0   a  1
1   b  2
```

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```
2   c  3
3   d  4
```

To specify the name of the new column use *name*.

```
>>> s.reset_index(name='values')
  idx  values
0   a       1
1   b       2
2   c       3
3   d       4
```

To generate a new Series with the default set *drop* to True.

```
>>> s.reset_index(drop=True)
0    1
1    2
2    3
3    4
dtype: int64
```

To update the Series in place, without generating a new one set *inplace* to True. Note that it also requires `drop=True`.

```
>>> s.reset_index(inplace=True, drop=True)
>>> s
0    1
1    2
2    3
3    4
dtype: int64
```

databricks.koalas.Series.sample

`Series.`**`sample`**(*n: Optional[int] = None*, *frac: Optional[float] = None*, *replace: bool = False*, *random_state: Optional[int] = None*) → databricks.koalas.series.Series

Return a random sample of items from an axis of object.

Please call this function using named argument by specifying the `frac` argument.

You can use *random_state* for reproducibility. However, note that different from pandas, specifying a seed in Koalas/Spark does not guarantee the sampled rows will be fixed. The result set depends on not only the seed, but also how the data is distributed across machines and to some extent network randomness when shuffle operations are involved. Even in the simplest case, the result set will depend on the system's CPU core count.

Parameters

n [int, optional] Number of items to return. This is currently NOT supported. Use frac instead.

frac [float, optional] Fraction of axis items to return.

replace [bool, default False] Sample with or without replacement.

random_state [int, optional] Seed for the random number generator (if int).

Returns

Series or DataFrame A new object of same type as caller containing the sampled items.

Examples

```
>>> df = ks.DataFrame({'num_legs': [2, 4, 8, 0],
...                    'num_wings': [2, 0, 0, 0],
...                    'num_specimen_seen': [10, 2, 1, 8]},
...                   index=['falcon', 'dog', 'spider', 'fish'],
...                   columns=['num_legs', 'num_wings', 'num_specimen_seen'])
>>> df
        num_legs  num_wings  num_specimen_seen
falcon         2          2                 10
dog            4          0                  2
spider         8          0                  1
fish           0          0                  8
```

A random 25% sample of the `DataFrame`. Note that we use *random_state* to ensure the reproducibility of the examples.

```
>>> df.sample(frac=0.25, random_state=1)
        num_legs  num_wings  num_specimen_seen
falcon         2          2                 10
fish           0          0                  8
```

Extract 25% random elements from the `Series` `df['num_legs']`, with replacement, so the same items could appear more than once.

```
>>> df['num_legs'].sample(frac=0.4, replace=True, random_state=1)
falcon    2
spider    8
spider    8
Name: num_legs, dtype: int64
```

Specifying the exact number of items to return is not supported at the moment.

```
>>> df.sample(n=5)
Traceback (most recent call last):
    ...
NotImplementedError: Function sample currently does not support specifying ...
```

databricks.koalas.Series.swaplevel

`Series.`**`swaplevel`**(*i=- 2*, *j=- 1*, *copy: bool = True*) → databricks.koalas.series.Series

Swap levels i and j in a MultiIndex. Default is to swap the two innermost levels of the index.

Parameters

i, j [int, str] Level of the indices to be swapped. Can pass level name as string.

copy [bool, default True] Whether to copy underlying data. Must be True.

Returns

Series Series with levels swapped in MultiIndex.

Examples

```
>>> midx = pd.MultiIndex.from_arrays([['a', 'b'], [1, 2]], names = ['word',
↪'number'])
>>> midx
MultiIndex([('a', 1),
            ('b', 2)],
           names=['word', 'number'])
>>> kser = ks.Series(['x', 'y'], index=midx)
>>> kser
word  number
a     1         x
b     2         y
dtype: object
>>> kser.swaplevel()
number  word
1       a       x
2       b       y
dtype: object
>>> kser.swaplevel(0, 1)
number  word
1       a       x
2       b       y
dtype: object
>>> kser.swaplevel('number', 'word')
number  word
1       a       x
2       b       y
dtype: object
```

databricks.koalas.Series.swapaxes

Series.**swapaxes**(*i: Union[str, int]*, *j: Union[str, int]*, *copy: bool = True*) → databricks.koalas.series.Series

Interchange axes and swap values axes appropriately.

Parameters

i: {0 or 'index', 1 or 'columns'}. The axis to swap.

j: {0 or 'index', 1 or 'columns'}. The axis to swap.

copy [bool, default True.]

Returns

Series

Examples

```
>>> kser = ks.Series([1, 2, 3], index=["x", "y", "z"])
>>> kser
x    1
y    2
z    3
dtype: int64
>>>
>>> kser.swapaxes(0, 0)
x    1
y    2
z    3
dtype: int64
```

databricks.koalas.Series.take

Series.**take**(*indices*) → Union[Series, Index]

Return the elements in the given *positional* indices along an axis.

This means that we are not indexing according to actual values in the index attribute of the object. We are indexing according to the actual position of the element in the object.

Parameters

indices [array-like] An array of ints indicating which positions to take.

Returns

taken [same type as caller] An array-like containing the elements taken from the object.

See also:

DataFrame.loc Select a subset of a DataFrame by labels.

DataFrame.iloc Select a subset of a DataFrame by positions.

numpy.take Take elements from an array along an axis.

Examples

Series

```
>>> kser = ks.Series([100, 200, 300, 400, 500])
>>> kser
0    100
1    200
2    300
3    400
4    500
dtype: int64
```

```
>>> kser.take([0, 2, 4]).sort_index()
0    100
2    300
4    500
dtype: int64
```

Index

```
>>> kidx = ks.Index([100, 200, 300, 400, 500])
>>> kidx
Int64Index([100, 200, 300, 400, 500], dtype='int64')
```

```
>>> kidx.take([0, 2, 4]).sort_values()
Int64Index([100, 300, 500], dtype='int64')
```

MultiIndex

```
>>> kmidx = ks.MultiIndex.from_tuples([("x", "a"), ("x", "b"), ("x", "c")])
>>> kmidx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('x', 'c')],
           )
```

```
>>> kmidx.take([0, 2])
MultiIndex([('x', 'a'),
            ('x', 'c')],
           )
```

databricks.koalas.Series.tail

`Series.`**`tail`**(*n=5*) → databricks.koalas.series.Series

Return the last *n* rows.

This function returns last *n* rows from the object based on position. It is useful for quickly verifying data, for example, after sorting or appending rows.

For negative values of *n*, this function returns all rows except the first *n* rows, equivalent to `df[n:]`.

Parameters

n [int, default 5] Number of rows to select.

Returns

type of caller The last *n* rows of the caller object.

See also:

DataFrame.head The first *n* rows of the caller object.

Examples

```
>>> kser = ks.Series([1, 2, 3, 4, 5])
>>> kser
0    1
1    2
2    3
3    4
4    5
dtype: int64
```

```
>>> kser.tail(3)
2    3
3    4
4    5
dtype: int64
```

databricks.koalas.Series.where

Series.**where**(*cond*, *other=nan*) → databricks.koalas.series.Series

Replace values where the condition is False.

Parameters

cond [boolean Series] Where cond is True, keep the original value. Where False, replace with corresponding value from other.

other [scalar, Series] Entries where cond is False are replaced with corresponding value from other.

Returns

Series

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> s1 = ks.Series([0, 1, 2, 3, 4])
>>> s2 = ks.Series([100, 200, 300, 400, 500])
>>> s1.where(s1 > 0).sort_index()
0    NaN
1    1.0
2    2.0
3    3.0
4    4.0
dtype: float64
```

```
>>> s1.where(s1 > 1, 10).sort_index()
0    10
1    10
2     2
3     3
4     4
dtype: int64
```

```
>>> s1.where(s1 > 1, s1 + 100).sort_index()
0    100
1    101
2      2
3      3
4      4
dtype: int64
```

```
>>> s1.where(s1 > 1, s2).sort_index()
0    100
1    200
2      2
3      3
4      4
dtype: int64
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.Series.mask

Series.**mask**(*cond*, *other=nan*) → databricks.koalas.series.Series

Replace values where the condition is True.

Parameters

cond [boolean Series] Where cond is False, keep the original value. Where True, replace with corresponding value from other.

other [scalar, Series] Entries where cond is True are replaced with corresponding value from other.

Returns

Series

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> s1 = ks.Series([0, 1, 2, 3, 4])
>>> s2 = ks.Series([100, 200, 300, 400, 500])
>>> s1.mask(s1 > 0).sort_index()
0    0.0
1    NaN
2    NaN
3    NaN
4    NaN
dtype: float64
```

```
>>> s1.mask(s1 > 1, 10).sort_index()
0     0
1     1
2    10
3    10
4    10
dtype: int64
```

```
>>> s1.mask(s1 > 1, s1 + 100).sort_index()
0      0
1      1
2    102
3    103
```

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```
4    104
dtype: int64
```

```
>>> s1.mask(s1 > 1, s2).sort_index()
0      0
1      1
2    300
3    400
4    500
dtype: int64
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.Series.truncate

Series.**truncate**(*before=None*, *after=None*, *axis=None*, *copy=True*) → Union[DataFrame, Series]

Truncate a Series or DataFrame before and after some index value.

This is a useful shorthand for boolean indexing based on index values above or below certain thresholds.

Note: This API is dependent on *Index.is_monotonic_increasing()* which can be expensive.

Parameters

before [date, str, int] Truncate all rows before this index value.

after [date, str, int] Truncate all rows after this index value.

axis [{0 or 'index', 1 or 'columns'}, optional] Axis to truncate. Truncates the index (rows) by default.

copy [bool, default is True,] Return a copy of the truncated section.

Returns

type of caller The truncated Series or DataFrame.

See also:

DataFrame.loc Select a subset of a DataFrame by label.

DataFrame.iloc Select a subset of a DataFrame by position.

Examples

```
>>> df = ks.DataFrame({'A': ['a', 'b', 'c', 'd', 'e'],
...                    'B': ['f', 'g', 'h', 'i', 'j'],
...                    'C': ['k', 'l', 'm', 'n', 'o']},
...                   index=[1, 2, 3, 4, 5])
>>> df
   A  B  C
1  a  f  k
2  b  g  l
```

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```
3  c  h  m
4  d  i  n
5  e  j  o
```

```
>>> df.truncate(before=2, after=4)
   A  B  C
2  b  g  l
3  c  h  m
4  d  i  n
```

The columns of a DataFrame can be truncated.

```
>>> df.truncate(before="A", after="B", axis="columns")
   A  B
1  a  f
2  b  g
3  c  h
4  d  i
5  e  j
```

For Series, only rows can be truncated.

```
>>> df['A'].truncate(before=2, after=4)
2    b
3    c
4    d
Name: A, dtype: object
```

A Series has index that sorted integers.

```
>>> s = ks.Series([10, 20, 30, 40, 50, 60, 70],
...               index=[1, 2, 3, 4, 5, 6, 7])
>>> s
1    10
2    20
3    30
4    40
5    50
6    60
7    70
dtype: int64
```

```
>>> s.truncate(2, 5)
2    20
3    30
4    40
5    50
dtype: int64
```

A Series has index that sorted strings.

```
>>> s = ks.Series([10, 20, 30, 40, 50, 60, 70],
...               index=['a', 'b', 'c', 'd', 'e', 'f', 'g'])
>>> s
a    10
b    20
```

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```
c    30
d    40
e    50
f    60
g    70
dtype: int64
```

```
>>> s.truncate('b', 'e')
b    20
c    30
d    40
e    50
dtype: int64
```

3.3.9 Missing data handling

Series.backfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
Series.bfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
Series.isna()	Detect existing (non-missing) values.
Series.isnull()	Detect existing (non-missing) values.
Series.notna()	Detect existing (non-missing) values.
Series.notnull()	Detect existing (non-missing) values.
Series.pad([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill``.
Series.dropna([axis, inplace])	Return a new Series with missing values removed.
Series.fillna([value, method, axis, ...])	Fill NA/NaN values.

databricks.koalas.Series.backfill

`Series.`**`backfill`**`(`*axis=None*, *inplace=False*, *limit=None*`)` → Union[DataFrame, Series]

Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.

Note: the current implementation of 'bfill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> kdf.bfill()
     A    B    C  D
0  3.0  2.0  1.0  0
1  3.0  4.0  1.0  1
2  NaN  3.0  1.0  5
3  NaN  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([None, None, None, 1])
>>> kser
0    NaN
1    NaN
2    NaN
3    1.0
dtype: float64
```

```
>>> kser.bfill()
0    1.0
1    1.0
2    1.0
3    1.0
dtype: float64
```

databricks.koalas.Series.bfill

`Series.bfill(axis=None, inplace=False, limit=None)` → Union[DataFrame, Series]
Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.

Note: the current implementation of 'bfill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> kdf.bfill()
     A    B    C  D
0  3.0  2.0  1.0  0
1  3.0  4.0  1.0  1
2  NaN  3.0  1.0  5
3  NaN  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([None, None, None, 1])
>>> kser
0    NaN
```

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```
1    NaN
2    NaN
3    1.0
dtype: float64
```

```
>>> kser.bfill()
0    1.0
1    1.0
2    1.0
3    1.0
dtype: float64
```

databricks.koalas.Series.isna

Series.**isna**() → Union[Series, Index]

Detect existing (non-missing) values.

Return a boolean same-sized object indicating if the values are NA. NA values, such as None or numpy.NaN, gets mapped to True values. Everything else gets mapped to False values. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True).

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser.isna()
0    False
1    False
2     True
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.isna()
Index([False, False, True], dtype='object', name='a')
```

databricks.koalas.Series.isnull

Series.**isnull**() → Union[Series, Index]

Detect existing (non-missing) values.

Return a boolean same-sized object indicating if the values are NA. NA values, such as None or numpy.NaN, gets mapped to True values. Everything else gets mapped to False values. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True).

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser.isna()
0    False
1    False
2     True
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.isna()
Index([False, False, True], dtype='object', name='a')
```

databricks.koalas.Series.notna

Series.**notna**() → Union[Series, Index]

Detect existing (non-missing) values. Return a boolean same-sized object indicating if the values are not NA. Non-missing values get mapped to True. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True). NA values, such as None or numpy.NaN, get mapped to False values.

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

Show which entries in a Series are not NA.

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser
0    5.0
1    6.0
2    NaN
dtype: float64
```

```
>>> ser.notna()
0     True
1     True
2    False
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.notna()
Index([True, True, False], dtype='object', name='a')
```

databricks.koalas.Series.notnull

Series.**notnull**() → Union[Series, Index]

Detect existing (non-missing) values. Return a boolean same-sized object indicating if the values are not NA. Non-missing values get mapped to True. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True). NA values, such as None or numpy.NaN, get mapped to False values.

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

Show which entries in a Series are not NA.

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser
0    5.0
1    6.0
2    NaN
dtype: float64
```

```
>>> ser.notna()
0     True
1     True
2    False
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.notna()
Index([True, True, False], dtype='object', name='a')
```

databricks.koalas.Series.pad

Series.**pad**(*axis=None*, *inplace=False*, *limit=None*) → Union[DataFrame, Series]

Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill`.

Note: the current implementation of 'ffill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values forward.

```
>>> kdf.ffill()
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  3.0  4.0  NaN  5
3  3.0  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([2, 4, None, 3])
>>> kser
0    2.0
1    4.0
2    NaN
3    3.0
dtype: float64
```

```
>>> kser.ffill()
0    2.0
1    4.0
2    4.0
3    3.0
dtype: float64
```

databricks.koalas.Series.dropna

Series.**dropna**(*axis=0*, *inplace=False*, ***kwargs*) → Optional[databricks.koalas.series.Series]
Return a new Series with missing values removed.

Parameters

axis [{0 or 'index'}, default 0] There is only one axis to drop values from.

inplace [bool, default False] If True, do operation inplace and return None.

****kwargs** Not in use.

Returns

Series Series with NA entries dropped from it.

Examples

```
>>> ser = ks.Series([1., 2., np.nan])
>>> ser
0    1.0
1    2.0
2    NaN
dtype: float64
```

Drop NA values from a Series.

```
>>> ser.dropna()
0    1.0
1    2.0
dtype: float64
```

Keep the Series with valid entries in the same variable.

```
>>> ser.dropna(inplace=True)
>>> ser
0    1.0
1    2.0
dtype: float64
```

databricks.koalas.Series.fillna

Series.**fillna**(*value=None*, *method=None*, *axis=None*, *inplace=False*, *limit=None*) → Optional[databricks.koalas.series.Series]
Fill NA/NaN values.

Note: the current implementation of 'method' parameter in fillna uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

value [scalar, dict, Series] Value to use to fill holes. alternately a dict/Series of values specifying which value to use for each column. DataFrame is not supported.

method [{'backfill', 'bfill', 'pad', 'ffill', None}, default None] Method to use for filling holes in reindexed Series pad / ffill: propagate last valid observation forward to next valid backfill / bfill: use NEXT valid observation to fill gap

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

Series Series with NA entries filled.

Examples

```
>>> s = ks.Series([np.nan, 2, 3, 4, np.nan, 6], name='x')
>>> s
0    NaN
1    2.0
2    3.0
3    4.0
4    NaN
5    6.0
Name: x, dtype: float64
```

Replace all NaN elements with 0s.

```
>>> s.fillna(0)
0    0.0
1    2.0
2    3.0
3    4.0
4    0.0
5    6.0
Name: x, dtype: float64
```

We can also propagate non-null values forward or backward.

```
>>> s.fillna(method='ffill')
0    NaN
1    2.0
2    3.0
3    4.0
4    4.0
5    6.0
Name: x, dtype: float64
```

```
>>> s = ks.Series([np.nan, 'a', 'b', 'c', np.nan], name='x')
>>> s.fillna(method='ffill')
0    None
1       a
2       b
```

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```
3       c
4       c
Name: x, dtype: object
```

3.3.10 Reshaping, sorting, transposing

Series.argsort()	Return the integer indices that would sort the Series values.
Series.argmin()	Return int position of the smallest value in the Series.
Series.argmax()	Return int position of the largest value in the Series.
Series.sort_index([axis, level, ascending, ...])	Sort object by labels (along an axis)
Series.sort_values([ascending, inplace, ...])	Sort by the values.
Series.unstack([level])	Unstack, a.k.a.
Series.explode()	Transform each element of a list-like to a row.
Series.repeat(repeats)	Repeat elements of a Series.
Series.squeeze([axis])	Squeeze 1 dimensional axis objects into scalars.

databricks.koalas.Series.argsort

Series.**argsort**() → databricks.koalas.series.Series

Return the integer indices that would sort the Series values. Unlike pandas, the index order is not preserved in the result.

Returns

Series Positions of values within the sort order with -1 indicating nan values.

Examples

```
>>> kser = ks.Series([3, 3, 4, 1, 6, 2, 3, 7, 8, 7, 10])
>>> kser
0       3
1       3
2       4
3       1
4       6
5       2
6       3
7       7
8       8
9       7
10     10
dtype: int64
```

```
>>> kser.argsort().sort_index()
0       3
1       5
2       0
3       1
4       6
```

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```
5      2
6      4
7      7
8      9
9      8
10    10
dtype: int64
```

databricks.koalas.Series.argmin

Series.**argmin**() → int

Return int position of the smallest value in the Series.

If the minimum is achieved in multiple locations, the first row position is returned.

Returns

int Row position of the minimum value.

Examples

Consider dataset containing cereal calories

```
>>> s = ks.Series({'Corn Flakes': 100.0, 'Almond Delight': 110.0,
...                'Cinnamon Toast Crunch': 120.0, 'Cocoa Puff': 110.0})
>>> s
Corn Flakes              100.0
Almond Delight           110.0
Cinnamon Toast Crunch    120.0
Cocoa Puff               110.0
dtype: float64
```

```
>>> s.argmin()
0
```

databricks.koalas.Series.argmax

Series.**argmax**() → int

Return int position of the largest value in the Series.

If the maximum is achieved in multiple locations, the first row position is returned.

Returns

int Row position of the maximum value.

Examples

Consider dataset containing cereal calories

```
>>> s = ks.Series({'Corn Flakes': 100.0, 'Almond Delight': 110.0,
...                'Cinnamon Toast Crunch': 120.0, 'Cocoa Puff': 110.0})
>>> s
Corn Flakes              100.0
Almond Delight           110.0
Cinnamon Toast Crunch    120.0
Cocoa Puff               110.0
dtype: float64
```

```
>>> s.argmax()
2
```

databricks.koalas.Series.sort_index

Series.**sort_index**(*axis: int = 0*, *level: Union[int, List[int], None] = None*, *ascending: bool = True*, *inplace: bool = False*, *kind: str = None*, *na_position: str = 'last'*) → Optional[databricks.koalas.series.Series]

Sort object by labels (along an axis)

Parameters

axis [index, columns to direct sorting. Currently, only axis = 0 is supported.]

level [int or level name or list of ints or list of level names] if not None, sort on values in specified index level(s)

ascending [boolean, default True] Sort ascending vs. descending

inplace [bool, default False] if True, perform operation in-place

kind [str, default None] Koalas does not allow specifying the sorting algorithm at the moment, default None

na_position [{'first', 'last'}, default 'last'] first puts NaNs at the beginning, last puts NaNs at the end. Not implemented for MultiIndex.

Returns

sorted_obj [Series]

Examples

```
>>> df = ks.Series([2, 1, np.nan], index=['b', 'a', np.nan])
```

```
>>> df.sort_index()
a      1.0
b      2.0
NaN    NaN
dtype: float64
```

```
>>> df.sort_index(ascending=False)
b      2.0
a      1.0
NaN    NaN
dtype: float64
```

```
>>> df.sort_index(na_position='first')
NaN    NaN
a      1.0
b      2.0
dtype: float64
```

```
>>> df.sort_index(inplace=True)
>>> df
a      1.0
b      2.0
NaN    NaN
dtype: float64
```

```
>>> df = ks.Series(range(4), index=[['b', 'b', 'a', 'a'], [1, 0, 1, 0]], name='0')
```

```
>>> df.sort_index()
a  0    3
   1    2
b  0    1
   1    0
Name: 0, dtype: int64
```

```
>>> df.sort_index(level=1)
a  0    3
b  0    1
a  1    2
b  1    0
Name: 0, dtype: int64
```

```
>>> df.sort_index(level=[1, 0])
a  0    3
b  0    1
a  1    2
b  1    0
Name: 0, dtype: int64
```

databricks.koalas.Series.sort_values

Series.**sort_values**(*ascending: bool = True*, *inplace: bool = False*, *na_position: str = 'last'*) → Optional[databricks.koalas.series.Series]

Sort by the values.

Sort a Series in ascending or descending order by some criterion.

Parameters

ascending [bool or list of bool, default True] Sort ascending vs. descending. Specify list for multiple sort orders. If this is a list of bools, must match the length of the by.

inplace [bool, default False] if True, perform operation in-place

na_position [{'first', 'last'}, default 'last'] *first* puts NaNs at the beginning, *last* puts NaNs at the end

Returns

sorted_obj [Series ordered by values.]

Examples

```
>>> s = ks.Series([np.nan, 1, 3, 10, 5])
>>> s
0     NaN
1     1.0
2     3.0
3    10.0
4     5.0
dtype: float64
```

Sort values ascending order (default behaviour)

```
>>> s.sort_values(ascending=True)
1     1.0
2     3.0
4     5.0
3    10.0
0     NaN
dtype: float64
```

Sort values descending order

```
>>> s.sort_values(ascending=False)
3    10.0
4     5.0
2     3.0
1     1.0
0     NaN
dtype: float64
```

Sort values inplace

```
>>> s.sort_values(ascending=False, inplace=True)
>>> s
3    10.0
4     5.0
2     3.0
1     1.0
0     NaN
dtype: float64
```

Sort values putting NAs first

```
>>> s.sort_values(na_position='first')
0     NaN
1     1.0
2     3.0
4     5.0
3    10.0
dtype: float64
```

Sort a series of strings

```
>>> s = ks.Series(['z', 'b', 'd', 'a', 'c'])
>>> s
0    z
1    b
2    d
3    a
4    c
dtype: object
```

```
>>> s.sort_values()
3    a
1    b
4    c
2    d
0    z
dtype: object
```

databricks.koalas.Series.unstack

`Series.`**`unstack`**(*level=-1*) → databricks.koalas.frame.DataFrame

Unstack, a.k.a. pivot, Series with MultiIndex to produce DataFrame. The level involved will automatically get sorted.

Parameters

level [int, str, or list of these, default last level] Level(s) to unstack, can pass level name.

Returns

DataFrame Unstacked Series.

Notes

Unlike pandas, Koalas doesn't check whether an index is duplicated or not because the checking of duplicated index requires scanning whole data which can be quite expensive.

Examples

```
>>> s = ks.Series([1, 2, 3, 4],
...               index=pd.MultiIndex.from_product([['one', 'two'],
...                                                 ['a', 'b']]))
>>> s
one  a    1
     b    2
two  a    3
     b    4
dtype: int64
```

```
>>> s.unstack(level=-1).sort_index()
     a  b
one  1  2
two  3  4
```

```
>>> s.unstack(level=0).sort_index()
   one  two
a    1    3
b    2    4
```

databricks.koalas.Series.explode

Series.**explode**() → databricks.koalas.series.Series

Transform each element of a list-like to a row.

Returns

Series Exploded lists to rows; index will be duplicated for these rows.

See also:

Series.str.split Split string values on specified separator.

Series.unstack Unstack, a.k.a. pivot, Series with MultiIndex to produce DataFrame.

DataFrame.melt Unpivot a DataFrame from wide format to long format.

DataFrame.explode Explode a DataFrame from list-like columns to long format.

Examples

```
>>> kser = ks.Series([[1, 2, 3], [], [3, 4]])
>>> kser
0    [1, 2, 3]
1           []
2       [3, 4]
dtype: object
```

```
>>> kser.explode()
0    1.0
0    2.0
0    3.0
1    NaN
2    3.0
2    4.0
dtype: float64
```

databricks.koalas.Series.repeat

Series.**repeat**(*repeats: Union[int, Series]*) → databricks.koalas.series.Series

Repeat elements of a Series.

Returns a new Series where each element of the current Series is repeated consecutively a given number of times.

Parameters

repeats [int or Series] The number of repetitions for each element. This should be a non-negative integer. Repeating 0 times will return an empty Series.

Returns

Series Newly created Series with repeated elements.

See also:

Index.repeat Equivalent function for Index.

Examples

```
>>> s = ks.Series(['a', 'b', 'c'])
>>> s
0    a
1    b
2    c
dtype: object
>>> s.repeat(2)
0    a
1    b
2    c
0    a
1    b
2    c
dtype: object
>>> ks.Series([1, 2, 3]).repeat(0)
Series([], dtype: int64)
```

databricks.koalas.Series.squeeze

Series.**squeeze**(*axis=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, DataFrame, Series]

Squeeze 1 dimensional axis objects into scalars.

Series or DataFrames with a single element are squeezed to a scalar. DataFrames with a single column or a single row are squeezed to a Series. Otherwise the object is unchanged.

This method is most useful when you don't know if your object is a Series or DataFrame, but you do know it has just a single column. In that case you can safely call *squeeze* to ensure you have a Series.

Parameters

axis [{0 or 'index', 1 or 'columns', None}, default None] A specific axis to squeeze. By default, all length-1 axes are squeezed.

Returns

DataFrame, Series, or scalar The projection after squeezing *axis* or all the axes.

See also:

Series.iloc Integer-location based indexing for selecting scalars.

DataFrame.iloc Integer-location based indexing for selecting Series.

Series.to_frame Inverse of DataFrame.squeeze for a single-column DataFrame.

Examples

```
>>> primes = ks.Series([2, 3, 5, 7])
```

Slicing might produce a Series with a single value:

```
>>> even_primes = primes[primes % 2 == 0]
>>> even_primes
0    2
dtype: int64
```

```
>>> even_primes.squeeze()
2
```

Squeezing objects with more than one value in every axis does nothing:

```
>>> odd_primes = primes[primes % 2 == 1]
>>> odd_primes
1    3
2    5
3    7
dtype: int64
```

```
>>> odd_primes.squeeze()
1    3
2    5
3    7
dtype: int64
```

Squeezing is even more effective when used with DataFrames.

```
>>> df = ks.DataFrame([[1, 2], [3, 4]], columns=['a', 'b'])
>>> df
   a  b
0  1  2
1  3  4
```

Slicing a single column will produce a DataFrame with the columns having only one value:

```
>>> df_a = df[['a']]
>>> df_a
   a
0  1
1  3
```

So the columns can be squeezed down, resulting in a Series:

```
>>> df_a.squeeze('columns')
0    1
1    3
Name: a, dtype: int64
```

Slicing a single row from a single column will produce a single scalar DataFrame:

```
>>> df_1a = df.loc[[1], ['a']]
>>> df_1a
```

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```
   a
1  3
```

Squeezing the rows produces a single scalar Series:

```
>>> df_1a.squeeze('rows')
a    3
Name: 1, dtype: int64
```

Squeezing all axes will project directly into a scalar:

```
>>> df_1a.squeeze()
3
```

3.3.11 Combining / joining / merging

Series.append(to_append[, ignore_index, ...])	Concatenate two or more Series.
Series.compare(other[, keep_shape, keep_equal])	Compare to another Series and show the differences.
Series.replace([to_replace, value, regex])	Replace values given in to_replace with value.
Series.update(other)	Modify Series in place using non-NA values from passed Series.

databricks.koalas.Series.append

Series.**append**(*to_append: databricks.koalas.series.Series*, *ignore_index: bool = False*, *verify_integrity: bool = False*) → databricks.koalas.series.Series

Concatenate two or more Series.

Parameters

to_append [Series or list/tuple of Series]

ignore_index [boolean, default False] If True, do not use the index labels.

verify_integrity [boolean, default False] If True, raise Exception on creating index with duplicates

Returns

appended [Series]

Examples

```
>>> s1 = ks.Series([1, 2, 3])
>>> s2 = ks.Series([4, 5, 6])
>>> s3 = ks.Series([4, 5, 6], index=[3,4,5])
```

```
>>> s1.append(s2)
0    1
1    2
2    3
0    4
```

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```
1    5
2    6
dtype: int64
```

```
>>> s1.append(s3)
0    1
1    2
2    3
3    4
4    5
5    6
dtype: int64
```

With ignore_index set to True:

```
>>> s1.append(s2, ignore_index=True)
0    1
1    2
2    3
3    4
4    5
5    6
dtype: int64
```

databricks.koalas.Series.compare

Series.**compare**(*other: databricks.koalas.series.Series*, *keep_shape: bool = False*, *keep_equal: bool = False*) → databricks.koalas.frame.DataFrame

Compare to another Series and show the differences.

Parameters

other [Series] Object to compare with.

keep_shape [bool, default False] If true, all rows and columns are kept. Otherwise, only the ones with different values are kept.

keep_equal [bool, default False] If true, the result keeps values that are equal. Otherwise, equal values are shown as NaNs.

Returns

DataFrame

Notes

Matching NaNs will not appear as a difference.

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> s1 = ks.Series(["a", "b", "c", "d", "e"])
>>> s2 = ks.Series(["a", "a", "c", "b", "e"])
```

Align the differences on columns

```
>>> s1.compare(s2).sort_index()
  self other
1    b     a
3    d     b
```

Keep all original rows

```
>>> s1.compare(s2, keep_shape=True).sort_index()
   self other
0  None  None
1     b     a
2  None  None
3     d     b
4  None  None
```

Keep all original rows and also all original values

```
>>> s1.compare(s2, keep_shape=True, keep_equal=True).sort_index()
  self other
0    a     a
1    b     a
2    c     c
3    d     b
4    e     e
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.Series.replace

`Series.`**`replace`**(*to_replace=None*, *value=None*, *regex=False*) → databricks.koalas.series.Series

Replace values given in to_replace with value. Values of the Series are replaced with other values dynamically.

Parameters

to_replace [str, list, dict, Series, int, float, or None] How to find the values that will be replaced.
* numeric, str:

- numeric: numeric values equal to to_replace will be replaced with value
- str: string exactly matching to_replace will be replaced with value
- list of str or numeric:
  - if to_replace and value are both lists, they must be the same length.
  - str and numeric rules apply as above.
- dict:

- Dicts can be used to specify different replacement values for different existing values. For example, {'a': 'b', 'y': 'z'} replaces the value 'a' with 'b' and 'y' with 'z'. To use a dict in this way the value parameter should be None.
- For a DataFrame a dict can specify that different values should be replaced in different columns. For example, {'a': 1, 'b': 'z'} looks for the value 1 in column 'a' and the value 'z' in column 'b' and replaces these values with whatever is specified in value. The value parameter should not be None in this case. You can treat this as a special case of passing two lists except that you are specifying the column to search in.

See the examples section for examples of each of these.

value [scalar, dict, list, str default None] Value to replace any values matching to_replace with. For a DataFrame a dict of values can be used to specify which value to use for each column (columns not in the dict will not be filled). Regular expressions, strings and lists or dicts of such objects are also allowed.

Returns

Series Object after replacement.

Examples

Scalar *to_replace* and *value*

```
>>> s = ks.Series([0, 1, 2, 3, 4])
>>> s
0    0
1    1
2    2
3    3
4    4
dtype: int64
```

```
>>> s.replace(0, 5)
0    5
1    1
2    2
3    3
4    4
dtype: int64
```

List-like *to_replace*

```
>>> s.replace([0, 4], 5000)
0    5000
1       1
2       2
3       3
4    5000
dtype: int64
```

```
>>> s.replace([1, 2, 3], [10, 20, 30])
0     0
1    10
2    20
```

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```
3    30
4     4
dtype: int64
```

Dict-like *to_replace*

```
>>> s.replace({1: 1000, 2: 2000, 3: 3000, 4: 4000})
0       0
1    1000
2    2000
3    3000
4    4000
dtype: int64
```

Also support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx)
>>> s
lama    speed      45.0
        weight    200.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.replace(45, 450)
lama    speed     450.0
        weight    200.0
        length      1.2
cow     speed      30.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.replace([45, 30, 320], 500)
lama    speed     500.0
        weight    200.0
        length      1.2
cow     speed     500.0
        weight    250.0
        length      1.5
falcon  speed     500.0
        weight      1.0
        length      0.3
```

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```
dtype: float64
```

```
>>> s.replace({45: 450, 30: 300})
lama    speed     450.0
        weight    200.0
        length      1.2
cow     speed     300.0
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

databricks.koalas.Series.update

Series.**update**(*other*) → None

Modify Series in place using non-NA values from passed Series. Aligns on index.

Parameters

other [Series]

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> s = ks.Series([1, 2, 3])
>>> s.update(ks.Series([4, 5, 6]))
>>> s.sort_index()
0    4
1    5
2    6
dtype: int64
```

```
>>> s = ks.Series(['a', 'b', 'c'])
>>> s.update(ks.Series(['d', 'e'], index=[0, 2]))
>>> s.sort_index()
0    d
1    b
2    e
dtype: object
```

```
>>> s = ks.Series([1, 2, 3])
>>> s.update(ks.Series([4, 5, 6, 7, 8]))
>>> s.sort_index()
0    4
1    5
2    6
dtype: int64
```

```
>>> s = ks.Series([1, 2, 3], index=[10, 11, 12])
>>> s
```

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```
10    1
11    2
12    3
dtype: int64
```

```
>>> s.update(ks.Series([4, 5, 6]))
>>> s.sort_index()
10    1
11    2
12    3
dtype: int64
```

```
>>> s.update(ks.Series([4, 5, 6], index=[11, 12, 13]))
>>> s.sort_index()
10    1
11    4
12    5
dtype: int64
```

If `other` contains NaNs the corresponding values are not updated in the original Series.

```
>>> s = ks.Series([1, 2, 3])
>>> s.update(ks.Series([4, np.nan, 6]))
>>> s.sort_index()
0    4.0
1    2.0
2    6.0
dtype: float64
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

3.3.12 Time series-related

Series.asof(where)	Return the last row(s) without any NaNs before *where*.
Series.shift([periods, fill_value])	Shift Series/Index by desired number of periods.
Series.first_valid_index()	Retrieves the index of the first valid value.
Series.last_valid_index()	Return index for last non-NA/null value.

databricks.koalas.Series.asof

Series.**asof**(*where*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, databricks.koalas.series.Series]

Return the last row(s) without any NaNs before *where*.

The last row (for each element in *where*, if list) without any NaN is taken.

If there is no good value, NaN is returned.

Note: This API is dependent on *Index.is_monotonic_increasing()* which can be expensive.

Parameters

where [index or array-like of indices]

Returns

scalar or Series The return can be:

- scalar : when *self* is a Series and *where* is a scalar
- Series: when *self* is a Series and *where* is an array-like

Return scalar or Series

Notes

Indices are assumed to be sorted. Raises if this is not the case.

Examples

```
>>> s = ks.Series([1, 2, np.nan, 4], index=[10, 20, 30, 40])
>>> s
10    1.0
20    2.0
30    NaN
40    4.0
dtype: float64
```

A scalar *where*.

```
>>> s.asof(20)
2.0
```

For a sequence *where*, a Series is returned. The first value is NaN, because the first element of *where* is before the first index value.

```
>>> s.asof([5, 20]).sort_index()
5     NaN
20    2.0
dtype: float64
```

Missing values are not considered. The following is `2.0`, not NaN, even though NaN is at the index location for `30`.

```
>>> s.asof(30)
2.0
```

databricks.koalas.Series.shift

Series.**shift**(*periods=1*, *fill_value=None*) → Union[Series, Index]
Shift Series/Index by desired number of periods.

Note: the current implementation of shift uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int] Number of periods to shift. Can be positive or negative.

fill_value [object, optional] The scalar value to use for newly introduced missing values. The default depends on the dtype of self. For numeric data, np.nan is used.

Returns

Copy of input Series/Index, shifted.

Examples

```
>>> df = ks.DataFrame({'Col1': [10, 20, 15, 30, 45],
...                    'Col2': [13, 23, 18, 33, 48],
...                    'Col3': [17, 27, 22, 37, 52]},
...                   columns=['Col1', 'Col2', 'Col3'])
```

```
>>> df.Col1.shift(periods=3)
0     NaN
1     NaN
2     NaN
3    10.0
4    20.0
Name: Col1, dtype: float64
```

```
>>> df.Col2.shift(periods=3, fill_value=0)
0     0
1     0
2     0
3    13
4    23
Name: Col2, dtype: int64
```

```
>>> df.index.shift(periods=3, fill_value=0)
Int64Index([0, 0, 0, 0, 1], dtype='int64')
```

databricks.koalas.Series.first_valid_index

Series.**first_valid_index**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Retrieves the index of the first valid value.

Returns

scalar, tuple, or None

Examples

Support for DataFrame

```
>>> kdf = ks.DataFrame({'a': [None, 2, 3, 2],
...                     'b': [None, 2.0, 3.0, 1.0],
...                     'c': [None, 200, 400, 200]},
...                     index=['Q', 'W', 'E', 'R'])
>>> kdf
     a    b      c
Q  NaN  NaN    NaN
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  2.0  1.0  200.0
```

```
>>> kdf.first_valid_index()
'W'
```

Support for MultiIndex columns

```
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
     a    b      c
     x    y      z
Q  NaN  NaN    NaN
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  2.0  1.0  200.0
```

```
>>> kdf.first_valid_index()
'W'
```

Support for Series.

```
>>> s = ks.Series([None, None, 3, 4, 5], index=[100, 200, 300, 400, 500])
>>> s
100    NaN
200    NaN
300    3.0
400    4.0
500    5.0
dtype: float64
```

```
>>> s.first_valid_index()
300
```

Support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([None, None, None, None, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s
lama    speed       NaN
        weight      NaN
        length      NaN
cow     speed       NaN
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.first_valid_index()
('cow', 'weight')
```

databricks.koalas.Series.last_valid_index

Series.**last_valid_index**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return index for last non-NA/null value.

Returns

scalar, tuple, or None

Notes

This API only works with PySpark >= 3.0.

Examples

Support for DataFrame

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, None],
...                     'b': [1.0, 2.0, 3.0, None],
...                     'c': [100, 200, 400, None]},
...                     index=['Q', 'W', 'E', 'R'])
>>> kdf
     a    b      c
Q  1.0  1.0  100.0
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  NaN  NaN    NaN
```

```
>>> kdf.last_valid_index()
'E'
```

Support for MultiIndex columns

```
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
     a    b      c
     x    y      z
Q  1.0  1.0  100.0
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  NaN  NaN    NaN
```

```
>>> kdf.last_valid_index()
'E'
```

Support for Series.

```
>>> s = ks.Series([1, 2, 3, None, None], index=[100, 200, 300, 400, 500])
>>> s
100    1.0
200    2.0
300    3.0
400    NaN
500    NaN
dtype: float64
```

```
>>> s.last_valid_index()
300
```

Support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([250, 1.5, 320, 1, 0.3, None, None, None, None], index=midx)
>>> s
lama    speed     250.0
        weight      1.5
        length    320.0
cow     speed       1.0
        weight      0.3
        length      NaN
falcon  speed       NaN
        weight      NaN
        length      NaN
dtype: float64
```

```
>>> s.last_valid_index()
('cow', 'weight')
```

3.3.13 Spark-related

`Series.spark` provides features that does not exist in pandas but in Spark. These can be accessed by `Series.spark.<function/property>`.

Series.spark.data_type	Returns the data type as defined by Spark, as a Spark DataType object.
Series.spark.nullable	Returns the nullability as defined by Spark.
Series.spark.column	Spark Column object representing the Series/Index.
Series.spark.transform(func)	Applies a function that takes and returns a Spark column.
Series.spark.apply(func)	Applies a function that takes and returns a Spark column.

databricks.koalas.Series.spark.data_type

property spark.**data_type**
Returns the data type as defined by Spark, as a Spark DataType object.

databricks.koalas.Series.spark.nullable

property spark.**nullable**
Returns the nullability as defined by Spark.

databricks.koalas.Series.spark.column

property spark.**column**
Spark Column object representing the Series/Index.

Note: This Spark Column object is strictly stick to its base DataFrame the Series/Index was derived from.

databricks.koalas.Series.spark.transform

spark.**transform**(*func*) → ks.Series
Applies a function that takes and returns a Spark column. It allows to natively apply a Spark function and column APIs with the Spark column internally used in Series or Index. The output length of the Spark column should be same as input's.

Note: It requires to have the same input and output length; therefore, the aggregate Spark functions such as count does not work.

Parameters

func [function] Function to use for transforming the data by using Spark columns.

Returns

Series or Index

Raises

ValueError [If the output from the function is not a Spark column.]

Examples

```
>>> from pyspark.sql.functions import log
>>> df = ks.DataFrame({"a": [1, 2, 3], "b": [4, 5, 6]}, columns=["a", "b"])
>>> df
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> df.a.spark.transform(lambda c: log(c))
0    0.000000
1    0.693147
2    1.098612
Name: a, dtype: float64
```

```
>>> df.index.spark.transform(lambda c: c + 10)
Int64Index([10, 11, 12], dtype='int64')
```

```
>>> df.a.spark.transform(lambda c: c + df.b.spark.column)
0    5
1    7
2    9
Name: a, dtype: int64
```

databricks.koalas.Series.spark.apply

`spark.apply`(*func*) → ks.Series

Applies a function that takes and returns a Spark column. It allows to natively apply a Spark function and column APIs with the Spark column internally used in Series or Index.

Note: It forces to lose the index and end up with using default index. It is preferred to use `Series.spark.transform()` or *:meth:`DataFrame.spark.apply* with specifying the *inedx_col*.

Note: It does not require to have the same length of the input and output. However, it requires to create a new DataFrame internally which will require to set *compute.ops_on_diff_frames* to compute even with the same origin DataFrame that is expensive, whereas `Series.spark.transform()` does not require it.

Parameters

func [function] Function to apply the function against the data by using Spark columns.

Returns

Series

Raises

ValueError [If the output from the function is not a Spark column.]

Examples

```
>>> from databricks import koalas as ks
>>> from pyspark.sql.functions import count, lit
>>> df = ks.DataFrame({"a": [1, 2, 3], "b": [4, 5, 6]}, columns=["a", "b"])
>>> df
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> df.a.spark.apply(lambda c: count(c))
0    3
Name: a, dtype: int64
```

```
>>> df.a.spark.apply(lambda c: c + df.b.spark.column)
0    5
1    7
2    9
Name: a, dtype: int64
```

3.3.14 Accessors

Koalas provides dtype-specific methods under various accessors. These are separate namespaces within *Series* that only apply to specific data types.

Data Type	Accessor
Datetime	*dt*
String	*str*

3.3.15 Date Time Handling

`Series.dt` can be used to access the values of the series as datetimelike and return several properties. These can be accessed like `Series.dt.<property>`.

Datetime Properties

Series.dt.date	Returns a Series of python datetime.date objects (namely, the date part of Timestamps without timezone information).
Series.dt.year	The year of the datetime.
Series.dt.month	The month of the timestamp as January = 1 December = 12.
Series.dt.day	The days of the datetime.
Series.dt.hour	The hours of the datetime.
Series.dt.minute	The minutes of the datetime.
Series.dt.second	The seconds of the datetime.
Series.dt.microsecond	The microseconds of the datetime.
Series.dt.week	The week ordinal of the year.

continues on next page

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Series.dt.weekofyear	The week ordinal of the year.
Series.dt.dayofweek	The day of the week with Monday=0, Sunday=6.
Series.dt.weekday	The day of the week with Monday=0, Sunday=6.
Series.dt.dayofyear	The ordinal day of the year.
Series.dt.quarter	The quarter of the date.
Series.dt.is_month_start	Indicates whether the date is the first day of the month.
Series.dt.is_month_end	Indicates whether the date is the last day of the month.
Series.dt.is_quarter_start	Indicator for whether the date is the first day of a quarter.
Series.dt.is_quarter_end	Indicator for whether the date is the last day of a quarter.
Series.dt.is_year_start	Indicate whether the date is the first day of a year.
Series.dt.is_year_end	Indicate whether the date is the last day of the year.
Series.dt.is_leap_year	Boolean indicator if the date belongs to a leap year.
Series.dt.daysinmonth	The number of days in the month.
Series.dt.days_in_month	The number of days in the month.

databricks.koalas.Series.dt.date

property dt.**date**
Returns a Series of python datetime.date objects (namely, the date part of Timestamps without timezone information).

databricks.koalas.Series.dt.year

property dt.**year**
The year of the datetime.

databricks.koalas.Series.dt.month

property dt.**month**
The month of the timestamp as January = 1 December = 12.

databricks.koalas.Series.dt.day

property dt.**day**
The days of the datetime.

databricks.koalas.Series.dt.hour

property dt.**hour**
The hours of the datetime.

databricks.koalas.Series.dt.minute

property dt.**minute**
The minutes of the datetime.

databricks.koalas.Series.dt.second

property dt.**second**
The seconds of the datetime.

databricks.koalas.Series.dt.microsecond

property dt.**microsecond**
The microseconds of the datetime.

databricks.koalas.Series.dt.week

property dt.**week**
The week ordinal of the year.

databricks.koalas.Series.dt.weekofyear

property dt.**weekofyear**
The week ordinal of the year.

databricks.koalas.Series.dt.dayofweek

property dt.**dayofweek**
The day of the week with Monday=0, Sunday=6.

Return the day of the week. It is assumed the week starts on Monday, which is denoted by 0 and ends on Sunday which is denoted by 6. This method is available on both Series with datetime values (using the *dt* accessor).

Returns

Series Containing integers indicating the day number.

See also:

Series.dt.dayofweek Alias.

Series.dt.weekday Alias.

Series.dt.day_name Returns the name of the day of the week.

Examples

```
>>> s = ks.from_pandas(pd.date_range('2016-12-31', '2017-01-08', freq='D').to_
↪series())
>>> s.dt.dayofweek
2016-12-31    5
2017-01-01    6
2017-01-02    0
2017-01-03    1
2017-01-04    2
2017-01-05    3
2017-01-06    4
2017-01-07    5
2017-01-08    6
dtype: int64
```

databricks.koalas.Series.dt.weekday

property dt.**weekday**

The day of the week with Monday=0, Sunday=6.

Return the day of the week. It is assumed the week starts on Monday, which is denoted by 0 and ends on Sunday which is denoted by 6. This method is available on both Series with datetime values (using the *dt* accessor).

Returns

Series Containing integers indicating the day number.

See also:

Series.dt.dayofweek Alias.

Series.dt.weekday Alias.

Series.dt.day_name Returns the name of the day of the week.

Examples

```
>>> s = ks.from_pandas(pd.date_range('2016-12-31', '2017-01-08', freq='D').to_
↪series())
>>> s.dt.dayofweek
2016-12-31    5
2017-01-01    6
2017-01-02    0
2017-01-03    1
2017-01-04    2
2017-01-05    3
2017-01-06    4
2017-01-07    5
2017-01-08    6
dtype: int64
```

databricks.koalas.Series.dt.dayofyear

property dt.**dayofyear**
The ordinal day of the year.

databricks.koalas.Series.dt.quarter

property dt.**quarter**
The quarter of the date.

databricks.koalas.Series.dt.is_month_start

property dt.**is_month_start**
Indicates whether the date is the first day of the month.

Returns

Series For Series, returns a Series with boolean values.

See also:

is_month_end Return a boolean indicating whether the date is the last day of the month.

Examples

This method is available on Series with datetime values under the .dt accessor.

```
>>> s = ks.Series(pd.date_range("2018-02-27", periods=3))
>>> s
0   2018-02-27
1   2018-02-28
2   2018-03-01
dtype: datetime64[ns]
```

```
>>> s.dt.is_month_start
0    False
1    False
2     True
dtype: bool
```

databricks.koalas.Series.dt.is_month_end

property dt.**is_month_end**
Indicates whether the date is the last day of the month.

Returns

Series For Series, returns a Series with boolean values.

See also:

is_month_start Return a boolean indicating whether the date is the first day of the month.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> s = ks.Series(pd.date_range("2018-02-27", periods=3))
>>> s
0   2018-02-27
1   2018-02-28
2   2018-03-01
dtype: datetime64[ns]
```

```
>>> s.dt.is_month_end
0    False
1     True
2    False
dtype: bool
```

databricks.koalas.Series.dt.is_quarter_start

property dt.**is_quarter_start**

Indicator for whether the date is the first day of a quarter.

Returns

is_quarter_start [Series] The same type as the original data with boolean values. Series will have the same name and index.

See also:

quarter Return the quarter of the date.

is_quarter_end Similar property for indicating the quarter start.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> df = ks.DataFrame({'dates': pd.date_range("2017-03-30",
...                   periods=4)})
>>> df
       dates
0 2017-03-30
1 2017-03-31
2 2017-04-01
3 2017-04-02
```

```
>>> df.dates.dt.quarter
0    1
1    1
2    2
3    2
Name: dates, dtype: int64
```

```
>>> df.dates.dt.is_quarter_start
0    False
1    False
2     True
3    False
Name: dates, dtype: bool
```

databricks.koalas.Series.dt.is_quarter_end

property dt.**is_quarter_end**

Indicator for whether the date is the last day of a quarter.

Returns

is_quarter_end [Series] The same type as the original data with boolean values. Series will have the same name and index.

See also:

quarter Return the quarter of the date.

is_quarter_start Similar property indicating the quarter start.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> df = ks.DataFrame({'dates': pd.date_range("2017-03-30",
...                   periods=4)})
>>> df
       dates
0 2017-03-30
1 2017-03-31
2 2017-04-01
3 2017-04-02
```

```
>>> df.dates.dt.quarter
0    1
1    1
2    2
3    2
Name: dates, dtype: int64
```

```
>>> df.dates.dt.is_quarter_start
0    False
1    False
2     True
3    False
Name: dates, dtype: bool
```

databricks.koalas.Series.dt.is_year_start

property dt.**is_year_start**

Indicate whether the date is the first day of a year.

Returns

Series The same type as the original data with boolean values. Series will have the same name and index.

See also:

is_year_end Similar property indicating the last day of the year.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> dates = ks.Series(pd.date_range("2017-12-30", periods=3))
>>> dates
0   2017-12-30
1   2017-12-31
2   2018-01-01
dtype: datetime64[ns]
```

```
>>> dates.dt.is_year_start
0    False
1    False
2     True
dtype: bool
```

databricks.koalas.Series.dt.is_year_end

property dt.**is_year_end**

Indicate whether the date is the last day of the year.

Returns

Series The same type as the original data with boolean values. Series will have the same name and index.

See also:

is_year_start Similar property indicating the start of the year.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> dates = ks.Series(pd.date_range("2017-12-30", periods=3))
>>> dates
0   2017-12-30
1   2017-12-31
2   2018-01-01
dtype: datetime64[ns]
```

```
>>> dates.dt.is_year_end
0    False
1     True
2    False
dtype: bool
```

databricks.koalas.Series.dt.is_leap_year

property dt.**is_leap_year**

Boolean indicator if the date belongs to a leap year.

A leap year is a year, which has 366 days (instead of 365) including 29th of February as an intercalary day. Leap years are years which are multiples of four with the exception of years divisible by 100 but not by 400.

Returns

Series Booleans indicating if dates belong to a leap year.

Examples

This method is available on Series with datetime values under the `.dt` accessor.

```
>>> dates_series = ks.Series(pd.date_range("2012-01-01", "2015-01-01", freq="Y"))
>>> dates_series
0   2012-12-31
1   2013-12-31
2   2014-12-31
dtype: datetime64[ns]
```

```
>>> dates_series.dt.is_leap_year
0     True
1    False
2    False
dtype: bool
```

databricks.koalas.Series.dt.daysinmonth

property dt.**daysinmonth**
The number of days in the month.

databricks.koalas.Series.dt.days_in_month

property dt.**days_in_month**
The number of days in the month.

Datetime Methods

Series.dt.normalize()	Convert times to midnight.
Series.dt.strftime(date_format)	Convert to a string Series using specified date_format.
Series.dt.round(freq, *args, **kwargs)	Perform round operation on the data to the specified freq.
Series.dt.floor(freq, *args, **kwargs)	Perform floor operation on the data to the specified freq.
Series.dt.ceil(freq, *args, **kwargs)	Perform ceil operation on the data to the specified freq.
Series.dt.month_name([locale])	Return the month names of the series with specified locale.
Series.dt.day_name([locale])	Return the day names of the series with specified locale.

databricks.koalas.Series.dt.normalize

dt.**normalize**() → ks.Series
Convert times to midnight.

The time component of the date-time is converted to midnight i.e. 00:00:00. This is useful in cases, when the time does not matter. Length is unaltered. The timezones are unaffected.

This method is available on Series with datetime values under the .dt accessor, and directly on Datetime Array.

Returns

Series The same type as the original data. Series will have the same name and index.

See also:

floor Floor the series to the specified freq.

ceil Ceil the series to the specified freq.

round Round the series to the specified freq.

Examples

```
>>> series = ks.Series(pd.Series(pd.date_range('2012-1-1 12:45:31', periods=3,␣
↪freq='M')))
>>> series.dt.normalize()
0   2012-01-31
1   2012-02-29
2   2012-03-31
dtype: datetime64[ns]
```

databricks.koalas.Series.dt.strftime

dt.**strftime**(*date_format*) → ks.Series

Convert to a string Series using specified date_format.

Return an series of formatted strings specified by date_format, which supports the same string format as the python standard library. Details of the string format can be found in python string format doc.

Parameters

date_format [str] Date format string (e.g. "%%Y-%%m-%%d").

Returns

Series Series of formatted strings.

See also:

to_datetime Convert the given argument to datetime.

normalize Return series with times to midnight.

round Round the series to the specified freq.

floor Floor the series to the specified freq.

Examples

```
>>> series = ks.Series(pd.date_range(pd.Timestamp("2018-03-10 09:00"),
...                                  periods=3, freq='s'))
>>> series
0   2018-03-10 09:00:00
1   2018-03-10 09:00:01
2   2018-03-10 09:00:02
dtype: datetime64[ns]
```

```
>>> series.dt.strftime('%B %d, %Y, %r')
0    March 10, 2018, 09:00:00 AM
1    March 10, 2018, 09:00:01 AM
2    March 10, 2018, 09:00:02 AM
dtype: object
```

databricks.koalas.Series.dt.round

dt.**round**(*freq*, **args*, ***kwargs*) → ks.Series

Perform round operation on the data to the specified freq.

Parameters

freq [str or Offset] The frequency level to round the index to. Must be a fixed frequency like 'S' (second) not 'ME' (month end).

nonexistent ['shift_forward', 'shift_backward, 'NaT', timedelta, default 'raise'] A nonexistent time does not exist in a particular timezone where clocks moved forward due to DST.

- 'shift_forward' will shift the nonexistent time forward to the closest existing time
- 'shift_backward' will shift the nonexistent time backward to the closest existing time
- 'NaT' will return NaT where there are nonexistent times
- timedelta objects will shift nonexistent times by the timedelta
- 'raise' will raise an NonExistentTimeError if there are nonexistent times

---

Note: this option only works with pandas 0.24.0+

Returns

Series a Series with the same index for a Series.

Raises

ValueError if the *freq* cannot be converted.

Examples

```
>>> series = ks.Series(pd.date_range('1/1/2018 11:59:00', periods=3, freq='min'))
>>> series
0   2018-01-01 11:59:00
1   2018-01-01 12:00:00
2   2018-01-01 12:01:00
dtype: datetime64[ns]
```

```
>>> series.dt.round("H")
0   2018-01-01 12:00:00
1   2018-01-01 12:00:00
2   2018-01-01 12:00:00
dtype: datetime64[ns]
```

databricks.koalas.Series.dt.floor

dt.**floor**(*freq*, **args*, ***kwargs*) → ks.Series

Perform floor operation on the data to the specified freq.

Parameters

freq [str or Offset] The frequency level to floor the index to. Must be a fixed frequency like 'S' (second) not 'ME' (month end).

nonexistent ['shift_forward', 'shift_backward, 'NaT', timedelta, default 'raise'] A nonexistent time does not exist in a particular timezone where clocks moved forward due to DST.

- 'shift_forward' will shift the nonexistent time forward to the closest existing time
- 'shift_backward' will shift the nonexistent time backward to the closest existing time
- 'NaT' will return NaT where there are nonexistent times
- timedelta objects will shift nonexistent times by the timedelta
- 'raise' will raise an NonExistentTimeError if there are nonexistent times

Note: this option only works with pandas 0.24.0+

Returns

Series a Series with the same index for a Series.

Raises

ValueError if the *freq* cannot be converted.

Examples

```
>>> series = ks.Series(pd.date_range('1/1/2018 11:59:00', periods=3, freq='min'))
>>> series
0   2018-01-01 11:59:00
1   2018-01-01 12:00:00
2   2018-01-01 12:01:00
dtype: datetime64[ns]
```

```
>>> series.dt.floor("H")
0   2018-01-01 11:00:00
1   2018-01-01 12:00:00
2   2018-01-01 12:00:00
dtype: datetime64[ns]
```

databricks.koalas.Series.dt.ceil

dt.**ceil**(*freq*, **args*, ***kwargs*) → ks.Series

Perform ceil operation on the data to the specified freq.

Parameters

freq [str or Offset] The frequency level to round the index to. Must be a fixed frequency like 'S' (second) not 'ME' (month end).

nonexistent ['shift_forward', 'shift_backward, 'NaT', timedelta, default 'raise'] A nonexistent time does not exist in a particular timezone where clocks moved forward due to DST.

- 'shift_forward' will shift the nonexistent time forward to the closest existing time
- 'shift_backward' will shift the nonexistent time backward to the closest existing time
- 'NaT' will return NaT where there are nonexistent times
- timedelta objects will shift nonexistent times by the timedelta
- 'raise' will raise an NonExistentTimeError if there are nonexistent times

---

Note: this option only works with pandas 0.24.0+

Returns

Series a Series with the same index for a Series.

Raises

ValueError if the *freq* cannot be converted.

Examples

```
>>> series = ks.Series(pd.date_range('1/1/2018 11:59:00', periods=3, freq='min'))
>>> series
0   2018-01-01 11:59:00
1   2018-01-01 12:00:00
2   2018-01-01 12:01:00
dtype: datetime64[ns]
```

```
>>> series.dt.ceil("H")
0   2018-01-01 12:00:00
1   2018-01-01 12:00:00
2   2018-01-01 13:00:00
dtype: datetime64[ns]
```

databricks.koalas.Series.dt.month_name

dt.**month_name**(*locale=None*) → ks.Series

Return the month names of the series with specified locale.

Parameters

locale [str, optional] Locale determining the language in which to return the month name. Default is English locale.

Returns

Series Series of month names.

Examples

```
>>> series = ks.Series(pd.date_range(start='2018-01', freq='M', periods=3))
>>> series
0   2018-01-31
1   2018-02-28
2   2018-03-31
dtype: datetime64[ns]
```

```
>>> series.dt.month_name()
0     January
1    February
2       March
dtype: object
```

databricks.koalas.Series.dt.day_name

dt.**day_name**(*locale=None*) → ks.Series

Return the day names of the series with specified locale.

Parameters

locale [str, optional] Locale determining the language in which to return the day name. Default is English locale.

Returns

Series Series of day names.

Examples

```
>>> series = ks.Series(pd.date_range(start='2018-01-01', freq='D', periods=3))
>>> series
0   2018-01-01
1   2018-01-02
2   2018-01-03
dtype: datetime64[ns]
```

```
>>> series.dt.day_name()
0       Monday
1      Tuesday
2    Wednesday
dtype: object
```

3.3.16 String Handling

`Series.str` can be used to access the values of the series as strings and apply several methods to it. These can be accessed like `Series.str.<function/property>`.

Series.str.capitalize()	Convert Strings in the series to be capitalized.
Series.str.cat([others, sep, na_rep, join])	Not supported.
Series.str.center(width[, fillchar])	Filling left and right side of strings in the Series/Index with an additional character.
Series.str.contains(pat[, case, flags, na, ...])	Test if pattern or regex is contained within a string of a Series.
Series.str.count(pat[, flags])	Count occurrences of pattern in each string of the Series.
Series.str.decode(encoding[, errors])	Not supported.
Series.str.encode(encoding[, errors])	Not supported.
Series.str.endswith(pattern[, na])	Test if the end of each string element matches a pattern.
Series.str.extract(pat[, flags, expand])	Not supported.
Series.str.extractall(pat[, flags])	Not supported.
Series.str.find(sub[, start, end])	Return lowest indexes in each strings in the Series where the substring is fully contained between [start:end].
Series.str.findall(pat[, flags])	Find all occurrences of pattern or regular expression in the Series.
Series.str.get(i)	Extract element from each string or string list/tuple in the Series at the specified position.
Series.str.get_dummies([sep])	Not supported.
Series.str.index(sub[, start, end])	Return lowest indexes in each strings where the substring is fully contained between [start:end].
Series.str.isalnum()	Check whether all characters in each string are alphanumeric.
Series.str.isalpha()	Check whether all characters in each string are alphabetic.
Series.str.isdigit()	Check whether all characters in each string are digits.
Series.str.isspace()	Check whether all characters in each string are whitespaces.
Series.str.islower()	Check whether all characters in each string are lowercase.
Series.str.isupper()	Check whether all characters in each string are uppercase.
Series.str.istitle()	Check whether all characters in each string are titlecase.
Series.str.isnumeric()	Check whether all characters in each string are numeric.
Series.str.isdecimal()	Check whether all characters in each string are decimals.
Series.str.join(sep)	Join lists contained as elements in the Series with passed delimiter.
Series.str.len()	Computes the length of each element in the Series.

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Series.str.ljust(width[, fillchar])	Filling right side of strings in the Series with an additional character.
Series.str.lower()	Convert strings in the Series/Index to all lowercase.
Series.str.lstrip([to_strip])	Remove leading characters.
Series.str.match(pat[, case, flags, na])	Determine if each string matches a regular expression.
Series.str.normalize(form)	Return the Unicode normal form for the strings in the Series.
Series.str.pad(width[, side, fillchar])	Pad strings in the Series up to width.
Series.str.partition([sep, expand])	Not supported.
Series.str.repeat(repeats)	Duplicate each string in the Series.
Series.str.replace(pat, repl[, n, case, ...])	Replace occurrences of pattern/regex in the Series with some other string.
Series.str.rfind(sub[, start, end])	Return highest indexes in each strings in the Series where the substring is fully contained between [start:end].
Series.str.rindex(sub[, start, end])	Return highest indexes in each strings where the substring is fully contained between [start:end].
Series.str.rjust(width[, fillchar])	Filling left side of strings in the Series with an additional character.
Series.str.rpartition([sep, expand])	Not supported.
Series.str.rsplit([pat, n, expand])	Split strings around given separator/delimiter.
Series.str.rstrip([to_strip])	Remove trailing characters.
Series.str.slice([start, stop, step])	Slice substrings from each element in the Series.
Series.str.slice_replace([start, stop, repl])	Slice substrings from each element in the Series.
Series.str.split([pat, n, expand])	Split strings around given separator/delimiter.
Series.str.startswith(pattern[, na])	Test if the start of each string element matches a pattern.
Series.str.strip([to_strip])	Remove leading and trailing characters.
Series.str.swapcase()	Convert strings in the Series/Index to be swapcased.
Series.str.title()	Convert Strings in the series to be titlecase.
Series.str.translate(table)	Map all characters in the string through the given mapping table.
Series.str.upper()	Convert strings in the Series/Index to all uppercase.
Series.str.wrap(width, **kwargs)	Wrap long strings in the Series to be formatted in paragraphs with length less than a given width.
Series.str.zfill(width)	Pad strings in the Series by prepending '0' characters.

databricks.koalas.Series.str.capitalize

str.**capitalize**() → ks.Series

Convert Strings in the series to be capitalized.

Examples

```
>>> s = ks.Series(['lower', 'CAPITALS', 'this is a sentence', 'SwApCaSe'])
>>> s
0                 lower
1              CAPITALS
2    this is a sentence
3              SwApCaSe
dtype: object
```

```
>>> s.str.capitalize()
0                 Lower
1              Capitals
2    This is a sentence
3              Swapcase
dtype: object
```

databricks.koalas.Series.str.cat

`str.cat`(*others=None*, *sep=None*, *na_rep=None*, *join=None*) → ks.Series
Not supported.

databricks.koalas.Series.str.center

`str.center`(*width*, *fillchar=' '*) → ks.Series
Filling left and right side of strings in the Series/Index with an additional character. Equivalent to *str.center()*.

Parameters

width [int] Minimum width of resulting string; additional characters will be filled with fillchar.

fillchar [str] Additional character for filling, default is whitespace.

Returns

Series of objects

Examples

```
>>> s = ks.Series(["caribou", "tiger"])
>>> s
0    caribou
1      tiger
dtype: object
```

```
>>> s.str.center(width=10, fillchar='-')
0    -caribou--
1    --tiger---
dtype: object
```

databricks.koalas.Series.str.contains

`str.contains`(*pat*, *case=True*, *flags=0*, *na=None*, *regex=True*) → ks.Series

Test if pattern or regex is contained within a string of a Series.

Return boolean Series based on whether a given pattern or regex is contained within a string of a Series.

Analogous to *match()*, but less strict, relying on `re.search()` instead of `re.match()`.

Parameters

pat [str] Character sequence or regular expression.

case [bool, default True] If True, case sensitive.

flags [int, default 0 (no flags)] Flags to pass through to the re module, e.g. re.IGNORECASE.

na [default None] Fill value for missing values. NaN converted to None.

regex [bool, default True] If True, assumes the pat is a regular expression. If False, treats the pat as a literal string.

Returns

Series of boolean values or object A Series of boolean values indicating whether the given pattern is contained within the string of each element of the Series.

Examples

Returning a Series of booleans using only a literal pattern.

```
>>> s1 = ks.Series(['Mouse', 'dog', 'house and parrot', '23', np.NaN])
>>> s1.str.contains('og', regex=False)
0    False
1     True
2    False
3    False
4     None
dtype: object
```

Specifying case sensitivity using case.

```
>>> s1.str.contains('oG', case=True, regex=True)
0    False
1    False
2    False
3    False
4     None
dtype: object
```

Specifying na to be False instead of NaN replaces NaN values with False. If Series does not contain NaN values the resultant dtype will be bool, otherwise, an object dtype.

```
>>> s1.str.contains('og', na=False, regex=True)
0    False
1     True
2    False
3    False
4    False
dtype: bool
```

Returning 'house' or 'dog' when either expression occurs in a string.

```
>>> s1.str.contains('house|dog', regex=True)
0    False
1     True
2     True
3    False
4     None
dtype: object
```

Ignoring case sensitivity using flags with regex.

```
>>> import re
>>> s1.str.contains('PARROT', flags=re.IGNORECASE, regex=True)
0    False
1    False
2     True
3    False
4     None
dtype: object
```

Returning any digit using regular expression.

```
>>> s1.str.contains('[0-9]', regex=True)
0    False
1    False
2    False
3     True
4     None
dtype: object
```

Ensure pat is a not a literal pattern when regex is set to True. Note in the following example one might expect only s2[1] and s2[3] to return True. However, '.0' as a regex matches any character followed by a 0.

```
>>> s2 = ks.Series(['40','40.0','41','41.0','35'])
>>> s2.str.contains('.0', regex=True)
0     True
1     True
2    False
3     True
4    False
dtype: bool
```

databricks.koalas.Series.str.count

`str.`**`count`**(*pat*, *flags=0*) → ks.Series

Count occurrences of pattern in each string of the Series.

This function is used to count the number of times a particular regex pattern is repeated in each of the string elements of the Series.

Parameters

pat [str] Valid regular expression.

flags [int, default 0 (no flags)] Flags for the re module.

Returns

Series of int A Series containing the integer counts of pattern matches.

Examples

```
>>> s = ks.Series(['A', 'B', 'Aaba', 'Baca', np.NaN, 'CABA', 'cat'])
>>> s.str.count('a')
0    0.0
1    0.0
2    2.0
3    2.0
4    NaN
5    0.0
6    1.0
dtype: float64
```

Escape '$' to find the literal dollar sign.

```
>>> s = ks.Series(['$', 'B', 'Aab$', '$$ca', 'C$B$', 'cat'])
>>> s.str.count('\$')
0    1
1    0
2    1
3    2
4    2
5    0
dtype: int64
```

databricks.koalas.Series.str.decode

`str.`**`decode`**(*encoding*, *errors='strict'*) → ks.Series
Not supported.

databricks.koalas.Series.str.encode

`str.`**`encode`**(*encoding*, *errors='strict'*) → ks.Series
Not supported.

databricks.koalas.Series.str.endswith

`str.`**`endswith`**(*pattern*, *na=None*) → ks.Series
Test if the end of each string element matches a pattern.

Equivalent to *`str.endswith()`*.

Parameters

pattern [str] Character sequence. Regular expressions are not accepted.

na [object, default None] Object shown if element is not a string. NaN converted to None.

Returns

Series of bool or object Koalas Series of booleans indicating whether the given pattern matches the end of each string element.

Examples

```
>>> s = ks.Series(['bat', 'Bear', 'cat', np.nan])
>>> s
0     bat
1    Bear
2     cat
3    None
dtype: object
```

```
>>> s.str.endswith('t')
0     True
1    False
2     True
3     None
dtype: object
```

Specifying na to be False instead of None.

```
>>> s.str.endswith('t', na=False)
0     True
1    False
2     True
3    False
dtype: bool
```

databricks.koalas.Series.str.extract

`str.`**`extract`**(*pat*, *flags=0*, *expand=True*) → ks.Series
Not supported.

databricks.koalas.Series.str.extractall

`str.`**`extractall`**(*pat*, *flags=0*) → ks.Series
Not supported.

databricks.koalas.Series.str.find

`str.`**`find`**(*sub*, *start=0*, *end=None*) → ks.Series
Return lowest indexes in each strings in the Series where the substring is fully contained between [start:end].

Return -1 on failure. Equivalent to standard *`str.find()`*.

Parameters

sub [str] Substring being searched.

start [int] Left edge index.

end [int] Right edge index.

Returns

Series of int Series of lowest matching indexes.

Examples

```
>>> s = ks.Series(['apple', 'oranges', 'bananas'])
```

```
>>> s.str.find('a')
0    0
1    2
2    1
dtype: int64
```

```
>>> s.str.find('a', start=2)
0   -1
1    2
2    3
dtype: int64
```

```
>>> s.str.find('a', end=1)
0    0
1   -1
2   -1
dtype: int64
```

```
>>> s.str.find('a', start=2, end=2)
0   -1
1   -1
2   -1
dtype: int64
```

databricks.koalas.Series.str.findall

`str.`**`findall`**(*pat*, *flags=0*) → ks.Series

Find all occurrences of pattern or regular expression in the Series.

Equivalent to applying `re.findall()` to all the elements in the Series.

Parameters

pat [str] Pattern or regular expression.

flags [int, default 0 (no flags)] *re* module flags, e.g. *re.IGNORECASE*.

Returns

Series of object All non-overlapping matches of pattern or regular expression in each string of this Series.

Examples

```
>>> s = ks.Series(['Lion', 'Monkey', 'Rabbit'])
```

The search for the pattern 'Monkey' returns one match:

```
>>> s.str.findall('Monkey')
0          []
1    [Monkey]
2          []
dtype: object
```

On the other hand, the search for the pattern 'MONKEY' doesn't return any match:

```
>>> s.str.findall('MONKEY')
0    []
1    []
2    []
dtype: object
```

Flags can be added to the pattern or regular expression. For instance, to find the pattern 'MONKEY' ignoring the case:

```
>>> import re
>>> s.str.findall('MONKEY', flags=re.IGNORECASE)
0          []
1    [Monkey]
2          []
dtype: object
```

When the pattern matches more than one string in the Series, all matches are returned:

```
>>> s.str.findall('on')
0    [on]
1    [on]
2      []
dtype: object
```

Regular expressions are supported too. For instance, the search for all the strings ending with the word 'on' is shown next:

```
>>> s.str.findall('on$')
0    [on]
1      []
2      []
dtype: object
```

If the pattern is found more than once in the same string, then a list of multiple strings is returned:

```
>>> s.str.findall('b')
0        []
1        []
2    [b, b]
dtype: object
```

databricks.koalas.Series.str.get

`str.get`(*i*) → ks.Series

Extract element from each string or string list/tuple in the Series at the specified position.

Parameters

i [int] Position of element to extract.

Returns

Series of objects

Examples

```
>>> s1 = ks.Series(["String", "123"])
>>> s1
0    String
1       123
dtype: object
```

```
>>> s1.str.get(1)
0    t
1    2
dtype: object
```

```
>>> s1.str.get(-1)
0    g
1    3
dtype: object
```

```
>>> s2 = ks.Series([["a", "b", "c"], ["x", "y"]])
>>> s2
0    [a, b, c]
1       [x, y]
dtype: object
```

```
>>> s2.str.get(0)
0    a
1    x
dtype: object
```

```
>>> s2.str.get(2)
0       c
1    None
dtype: object
```

databricks.koalas.Series.str.get_dummies

str.**get_dummies**(*sep='|'*)
Not supported.

databricks.koalas.Series.str.index

str.**index**(*sub*, *start=0*, *end=None*) → ks.Series
Return lowest indexes in each strings where the substring is fully contained between [start:end].

This is the same as *str.find()* except instead of returning -1, it raises a ValueError when the substring is not found. Equivalent to standard *str.index()*.

Parameters

sub [str] Substring being searched.

start [int] Left edge index.

end [int] Right edge index.

Returns

Series of int Series of lowest matching indexes.

Examples

```
>>> s = ks.Series(['apple', 'oranges', 'bananas'])
```

```
>>> s.str.index('a')
0    0
1    2
2    1
dtype: int64
```

The following expression throws an exception:

```
>>> s.str.index('a', start=2)
```

databricks.koalas.Series.str.isalnum

str.**isalnum**() → ks.Series
Check whether all characters in each string are alphanumeric.

This is equivalent to running the Python string method *str.isalnum()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s1 = ks.Series(['one', 'one1', '1', ''])
```

```
>>> s1.str.isalnum()
0     True
1     True
2     True
3    False
dtype: bool
```

Note that checks against characters mixed with any additional punctuation or whitespace will evaluate to false for an alphanumeric check.

```
>>> s2 = ks.Series(['A B', '1.5', '3,000'])
>>> s2.str.isalnum()
0    False
1    False
2    False
dtype: bool
```

databricks.koalas.Series.str.isalpha

str.**isalpha**() → ks.Series
Check whether all characters in each string are alphabetic.

This is equivalent to running the Python string method *str.isalpha()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s1 = ks.Series(['one', 'one1', '1', ''])
```

```
>>> s1.str.isalpha()
0     True
1    False
2    False
3    False
dtype: bool
```

databricks.koalas.Series.str.isdigit

str.**isdigit**() → ks.Series
Check whether all characters in each string are digits.

This is equivalent to running the Python string method *str.isdigit()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series(['23', '³', '', ''])
```

The s.str.isdecimal method checks for characters used to form numbers in base 10.

```
>>> s.str.isdecimal()
0     True
1    False
2    False
3    False
dtype: bool
```

The s.str.isdigit method is the same as s.str.isdecimal but also includes special digits, like superscripted and subscripted digits in unicode.

```
>>> s.str.isdigit()
0     True
1     True
2    False
3    False
dtype: bool
```

The s.str.isnumeric method is the same as s.str.isdigit but also includes other characters that can represent quantities such as unicode fractions.

```
>>> s.str.isnumeric()
0     True
1     True
2     True
3    False
dtype: bool
```

databricks.koalas.Series.str.isspace

`str.`**`isspace`**`()` → ks.Series

Check whether all characters in each string are whitespaces.

This is equivalent to running the Python string method *`str.isspace()`* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series([' ', '\t\r\n ', ''])
>>> s.str.isspace()
0     True
1     True
2    False
dtype: bool
```

databricks.koalas.Series.str.islower

str.**islower**() → ks.Series
Check whether all characters in each string are lowercase.

This is equivalent to running the Python string method *str.islower()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series(['leopard', 'Golden Eagle', 'SNAKE', ''])
>>> s.str.islower()
0     True
1    False
2    False
3    False
dtype: bool
```

databricks.koalas.Series.str.isupper

str.**isupper**() → ks.Series
Check whether all characters in each string are uppercase.

This is equivalent to running the Python string method *str.isupper()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series(['leopard', 'Golden Eagle', 'SNAKE', ''])
>>> s.str.isupper()
0    False
1    False
2     True
3    False
dtype: bool
```

databricks.koalas.Series.str.istitle

str.**istitle**() → ks.Series
Check whether all characters in each string are titlecase.

This is equivalent to running the Python string method *str.istitle()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series(['leopard', 'Golden Eagle', 'SNAKE', ''])
```

The s.str.istitle method checks for whether all words are in title case (whether only the first letter of each word is capitalized). Words are assumed to be as any sequence of non-numeric characters separated by whitespace characters.

```
>>> s.str.istitle()
0    False
1     True
2    False
3    False
dtype: bool
```

databricks.koalas.Series.str.isnumeric

str.**isnumeric**() → ks.Series

Check whether all characters in each string are numeric.

This is equivalent to running the Python string method *str.isnumeric()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s1 = ks.Series(['one', 'one1', '1', ''])
>>> s1.str.isnumeric()
0    False
1    False
2     True
3    False
dtype: bool
```

```
>>> s2 = ks.Series(['23', '³', '', ''])
```

The s2.str.isdecimal method checks for characters used to form numbers in base 10.

```
>>> s2.str.isdecimal()
0     True
1    False
2    False
3    False
dtype: bool
```

The s2.str.isdigit method is the same as s2.str.isdecimal but also includes special digits, like superscripted and subscripted digits in unicode.

```
>>> s2.str.isdigit()
0     True
1     True
2    False
3    False
dtype: bool
```

The s2.str.isnumeric method is the same as s2.str.isdigit but also includes other characters that can represent quantities such as unicode fractions.

```
>>> s2.str.isnumeric()
0     True
1     True
2     True
3    False
dtype: bool
```

databricks.koalas.Series.str.isdecimal

str.**isdecimal**() → ks.Series
Check whether all characters in each string are decimals.

This is equivalent to running the Python string method *str.isdecimal()* for each element of the Series/Index. If a string has zero characters, False is returned for that check.

Examples

```
>>> s = ks.Series(['23', '³', '', ''])
```

The s.str.isdecimal method checks for characters used to form numbers in base 10.

```
>>> s.str.isdecimal()
0     True
1    False
2    False
3    False
dtype: bool
```

The s.str.isdigit method is the same as s.str.isdecimal but also includes special digits, like superscripted and subscripted digits in unicode.

```
>>> s.str.isdigit()
0     True
1     True
2    False
3    False
dtype: bool
```

The s.str.isnumeric method is the same as s.str.isdigit but also includes other characters that can represent quantities such as unicode fractions.

```
>>> s.str.isnumeric()
0     True
1     True
2     True
3    False
dtype: bool
```

databricks.koalas.Series.str.join

`str.`**`join`**`(`*sep*`)` → ks.Series
Join lists contained as elements in the Series with passed delimiter.

If the elements of a Series are lists themselves, join the content of these lists using the delimiter passed to the function. This function is an equivalent to calling *`str.join()`* on the lists.

Parameters

sep [str] Delimiter to use between list entries.

Returns

Series of object Series with list entries concatenated by intervening occurrences of the delimiter.

See also:

`str.split` Split strings around given separator/delimiter.

`str.rsplit` Splits string around given separator/delimiter, starting from the right.

Examples

Example with a list that contains a None element.

```
>>> s = ks.Series([['lion', 'elephant', 'zebra'],
...                ['cat', None, 'dog']])
>>> s
0    [lion, elephant, zebra]
1           [cat, None, dog]
dtype: object
```

Join all lists using a '-'. The list containing None will produce None.

```
>>> s.str.join('-')
0    lion-elephant-zebra
1                   None
dtype: object
```

databricks.koalas.Series.str.len

`str.`**`len`**`()` → ks.Series
Computes the length of each element in the Series.

The element may be a sequence (such as a string, tuple or list).

Returns

Series of int A Series of integer values indicating the length of each element in the Series.

Examples

Returns the length (number of characters) in a string. Returns the number of entries for lists or tuples.

```
>>> s1 = ks.Series(['dog', 'monkey'])
>>> s1.str.len()
0    3
1    6
dtype: int64
```

```
>>> s2 = ks.Series([["a", "b", "c"], []])
>>> s2.str.len()
0    3
1    0
dtype: int64
```

databricks.koalas.Series.str.ljust

`str.`**`ljust`**(*width*, *fillchar=' '*) → ks.Series

Filling right side of strings in the Series with an additional character. Equivalent to *`str.ljust()`*.

Parameters

width [int] Minimum width of resulting string; additional characters will be filled with *fillchar*.

fillchar [str] Additional character for filling, default is whitespace.

Returns

Series of object

Examples

```
>>> s = ks.Series(["caribou", "tiger"])
>>> s
0    caribou
1      tiger
dtype: object
```

```
>>> s.str.ljust(width=10, fillchar='-')
0    caribou---
1    tiger-----
dtype: object
```

databricks.koalas.Series.str.lower

`str.`**`lower`**() → ks.Series

Convert strings in the Series/Index to all lowercase.

Examples

```
>>> s = ks.Series(['lower', 'CAPITALS', 'this is a sentence', 'SwApCaSe'])
>>> s
0                 lower
1              CAPITALS
2    this is a sentence
3              SwApCaSe
dtype: object
```

```
>>> s.str.lower()
0                 lower
1              capitals
2    this is a sentence
3              swapcase
dtype: object
```

databricks.koalas.Series.str.lstrip

str.**lstrip**(*to_strip=None*) → ks.Series

Remove leading characters.

Strip whitespaces (including newlines) or a set of specified characters from each string in the Series/Index from left side. Equivalent to *str.lstrip()*.

Parameters

to_strip [str] Specifying the set of characters to be removed. All combinations of this set of characters will be stripped. If None then whitespaces are removed.

Returns

Series of object

Examples

```
>>> s = ks.Series(['1. Ant.', '2. Bee!\t', None])
>>> s
0      1. Ant.
1    2. Bee!\t
2         None
dtype: object
```

```
>>> s.str.lstrip('12.')
0       Ant.
1     Bee!\t
2       None
dtype: object
```

databricks.koalas.Series.str.match

`str.match`(*pat*, *case=True*, *flags=0*, *na=nan*) → ks.Series
Determine if each string matches a regular expression.

Analogous to *contains()*, but more strict, relying on `re.match()` instead of `re.search()`.

Parameters

pat [str] Character sequence or regular expression.

case [bool, default True] If True, case sensitive.

flags [int, default 0 (no flags)] Flags to pass through to the re module, e.g. re.IGNORECASE.

na [default NaN] Fill value for missing values.

Returns

Series of boolean values or object A Series of boolean values indicating whether the given pattern can be matched in the string of each element of the Series.

Examples

```
>>> s = ks.Series(['Mouse', 'dog', 'house and parrot', '23', np.NaN])
>>> s.str.match('dog')
0    False
1     True
2    False
3    False
4     None
dtype: object
```

```
>>> s.str.match('mouse|dog', case=False)
0     True
1     True
2    False
3    False
4     None
dtype: object
```

```
>>> s.str.match('.+and.+', na=True)
0    False
1    False
2     True
3    False
4     True
dtype: bool
```

```
>>> import re
>>> s.str.match('MOUSE', flags=re.IGNORECASE)
0     True
1    False
2    False
3    False
4     None
dtype: object
```

databricks.koalas.Series.str.normalize

`str.`**`normalize`**(*form*) → ks.Series
Return the Unicode normal form for the strings in the Series.

For more information on the forms, see the `unicodedata.normalize()`.

Parameters

form [{'NFC', 'NFKC', 'NFD', 'NFKD'}] Unicode form.

Returns

Series of objects A Series of normalized strings.

databricks.koalas.Series.str.pad

`str.`**`pad`**(*width*, *side='left'*, *fillchar=' '*) → ks.Series
Pad strings in the Series up to width.

Parameters

width [int] Minimum width of resulting string; additional characters will be filled with character defined in *fillchar*.

side [{'left', 'right', 'both'}, default 'left'] Side from which to fill resulting string.

fillchar [str, default ' '] Additional character for filling, default is whitespace.

Returns

Series of object Returns Series with minimum number of char in object.

Examples

```
>>> s = ks.Series(["caribou", "tiger"])
>>> s
0    caribou
1      tiger
dtype: object
```

```
>>> s.str.pad(width=10)
0       caribou
1         tiger
dtype: object
```

```
>>> s.str.pad(width=10, side='right', fillchar='-')
0    caribou---
1    tiger-----
dtype: object
```

```
>>> s.str.pad(width=10, side='both', fillchar='-')
0    -caribou--
1    --tiger---
dtype: object
```

databricks.koalas.Series.str.partition

str.**partition**(*sep=' '*, *expand=True*) → ks.Series
Not supported.

databricks.koalas.Series.str.repeat

str.**repeat**(*repeats*) → ks.Series
Duplicate each string in the Series.

Parameters

repeats [int] Repeat the string given number of times (int). Sequence of int is not supported.

Returns

Series of object Series or Index of repeated string objects specified by input parameter repeats.

Examples

```
>>> s = ks.Series(['a', 'b', 'c'])
>>> s
0    a
1    b
2    c
dtype: object
```

Single int repeats string in Series

```
>>> s.str.repeat(repeats=2)
0    aa
1    bb
2    cc
dtype: object
```

databricks.koalas.Series.str.replace

str.**replace**(*pat*, *repl*, *n=- 1*, *case=None*, *flags=0*, *regex=True*) → ks.Series
Replace occurrences of pattern/regex in the Series with some other string. Equivalent to *str.replace()* or re.sub().

Parameters

pat [str or compiled regex] String can be a character sequence or regular expression.

repl [str or callable] Replacement string or a callable. The callable is passed the regex match object and must return a replacement string to be used. See re.sub().

n [int, default -1 (all)] Number of replacements to make from start.

case [boolean, default None] If True, case sensitive (the default if pat is a string). Set to False for case insensitive. Cannot be set if pat is a compiled regex.

flags: int, default 0 (no flags) re module flags, e.g. re.IGNORECASE. Cannot be set if pat is a compiled regex.

regex [boolean, default True] If True, assumes the passed-in pattern is a regular expression. If False, treats the pattern as a literal string. Cannot be set to False if pat is a compile regex or repl is a callable.

Returns

Series of object A copy of the string with all matching occurrences of pat replaced by repl.

Examples

When pat is a string and regex is True (the default), the given pat is compiled as a regex. When repl is a string, it replaces matching regex patterns as with `re.sub()`. NaN value(s) in the Series are changed to None:

```
>>> ks.Series(['foo', 'fuz', np.nan]).str.replace('f.', 'ba', regex=True)
0     bao
1     baz
2    None
dtype: object
```

When pat is a string and regex is False, every pat is replaced with repl as with *str.replace()*:

```
>>> ks.Series(['f.o', 'fuz', np.nan]).str.replace('f.', 'ba', regex=False)
0     bao
1     fuz
2    None
dtype: object
```

When repl is a callable, it is called on every pat using `re.sub()`. The callable should expect one positional argument (a regex object) and return a string.

Reverse every lowercase alphabetic word:

```
>>> repl = lambda m: m.group(0)[::-1]
>>> ks.Series(['foo 123', 'bar baz', np.nan]).str.replace(r'[a-z]+', repl)
0    oof 123
1    rab zab
2       None
dtype: object
```

Using regex groups (extract second group and swap case):

```
>>> pat = r"(?P<one>\w+) (?P<two>\w+) (?P<three>\w+)"
>>> repl = lambda m: m.group('two').swapcase()
>>> ks.Series(['One Two Three', 'Foo Bar Baz']).str.replace(pat, repl)
0    tWO
1    bAR
dtype: object
```

Using a compiled regex with flags:

```
>>> import re
>>> regex_pat = re.compile(r'FUZ', flags=re.IGNORECASE)
>>> ks.Series(['foo', 'fuz', np.nan]).str.replace(regex_pat, 'bar')
0     foo
1     bar
2    None
dtype: object
```

databricks.koalas.Series.str.rfind

`str.`**`rfind`**(*sub*, *start=0*, *end=None*) → ks.Series

Return highest indexes in each strings in the Series where the substring is fully contained between [start:end].

Return -1 on failure. Equivalent to standard *`str.rfind()`*.

Parameters

sub [str] Substring being searched.

start [int] Left edge index.

end [int] Right edge index.

Returns

Series of int Series of highest matching indexes.

Examples

```
>>> s = ks.Series(['apple', 'oranges', 'bananas'])
```

```
>>> s.str.rfind('a')
0    0
1    2
2    5
dtype: int64
```

```
>>> s.str.rfind('a', start=2)
0   -1
1    2
2    5
dtype: int64
```

```
>>> s.str.rfind('a', end=1)
0    0
1   -1
2   -1
dtype: int64
```

```
>>> s.str.rfind('a', start=2, end=2)
0   -1
1   -1
2   -1
dtype: int64
```

databricks.koalas.Series.str.rindex

`str.`**`rindex`**(*sub*, *start=0*, *end=None*) → ks.Series
Return highest indexes in each strings where the substring is fully contained between [start:end].

This is the same as *`str.rfind()`* except instead of returning -1, it raises a ValueError when the substring is not found. Equivalent to standard *`str.rindex()`*.

Parameters

sub [str] Substring being searched.

start [int] Left edge index.

end [int] Right edge index.

Returns

Series of int Series of highest matching indexes.

Examples

```
>>> s = ks.Series(['apple', 'oranges', 'bananas'])
```

```
>>> s.str.rindex('a')
0    0
1    2
2    5
dtype: int64
```

The following expression throws an exception:

```
>>> s.str.rindex('a', start=2)
```

databricks.koalas.Series.str.rjust

`str.`**`rjust`**(*width*, *fillchar=' '*) → ks.Series
Filling left side of strings in the Series with an additional character. Equivalent to *`str.rjust()`*.

Parameters

width [int] Minimum width of resulting string; additional characters will be filled with *fillchar*.

fillchar [str] Additional character for filling, default is whitespace.

Returns

Series of object

Examples

```
>>> s = ks.Series(["caribou", "tiger"])
>>> s
0    caribou
1      tiger
dtype: object
```

```
>>> s.str.rjust(width=10)
0       caribou
1         tiger
dtype: object
```

```
>>> s.str.rjust(width=10, fillchar='-')
0    ---caribou
1    -----tiger
dtype: object
```

databricks.koalas.Series.str.rpartition

`str.`**`rpartition`**(*sep=' '*, *expand=True*) → ks.Series
Not supported.

databricks.koalas.Series.str.rsplit

`str.`**`rsplit`**(*pat=None*, *n=- 1*, *expand=False*) → Union[ks.Series, ks.DataFrame]
Split strings around given separator/delimiter.

Splits the string in the Series from the end, at the specified delimiter string. Equivalent to *`str.rsplit()`*.

Parameters

pat [str, optional] String or regular expression to split on. If not specified, split on whitespace.

n [int, default -1 (all)] Limit number of splits in output. None, 0 and -1 will be interpreted as return all splits.

expand [bool, default False] Expand the splitted strings into separate columns.

- If `True`, *n* must be a positive integer, and return DataFrame expanding dimensionality.
- If `False`, return Series, containing lists of strings.

Returns

Series, DataFrame Type matches caller unless *expand=True* (see Notes).

See also:

`str.split` Split strings around given separator/delimiter.

`str.join` Join lists contained as elements in the Series/Index with passed delimiter.

Notes

The handling of the *n* keyword depends on the number of found splits:

- If found splits > *n*, make first *n* splits only
- If found splits <= *n*, make all splits
- If for a certain row the number of found splits < *n*, append *None* for padding up to *n* if `expand=True`

If using `expand=True`, Series callers return DataFrame objects with *n + 1* columns.

Note: Even if *n* is much larger than found splits, the number of columns does NOT shrink unlike pandas.

Examples

```
>>> s = ks.Series(["this is a regular sentence",
...                "https://docs.python.org/3/tutorial/index.html",
...                np.nan])
```

In the default setting, the string is split by whitespace.

```
>>> s.str.split()
0                   [this, is, a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

Without the n parameter, the outputs of rsplit and split are identical.

```
>>> s.str.rsplit()
0                   [this, is, a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

The n parameter can be used to limit the number of splits on the delimiter. The outputs of split and rsplit are different.

```
>>> s.str.split(n=2)
0                     [this, is, a regular sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

```
>>> s.str.rsplit(n=2)
0                     [this is a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

When using `expand=True`, the split elements will expand out into separate columns. If NaN is present, it is propagated throughout the columns during the split.

```
>>> s.str.split(n=4, expand=True)
                                                 0     1     2        3         4
0                                           this    is     a  regular  sentence
1  https://docs.python.org/3/tutorial/index.html  None  None     None      None
2                                             None  None  None     None      None
```

For slightly more complex use cases like splitting the html document name from a url, a combination of parameter settings can be used.

```
>>> s.str.rsplit("/", n=1, expand=True)
                                    0           1
0          this is a regular sentence        None
1  https://docs.python.org/3/tutorial  index.html
2                                None        None
```

Remember to escape special characters when explicitly using regular expressions.

```
>>> s = ks.Series(["1+1=2"])
>>> s.str.split(r"\+|=", n=2, expand=True)
   0  1  2
0  1  1  2
```

databricks.koalas.Series.str.rstrip

`str.`**`rstrip`**(*to_strip=None*) → ks.Series

Remove trailing characters.

Strip whitespaces (including newlines) or a set of specified characters from each string in the Series/Index from right side. Equivalent to *`str.rstrip()`*.

Parameters

to_strip [str] Specifying the set of characters to be removed. All combinations of this set of characters will be stripped. If None then whitespaces are removed.

Returns

Series of object

Examples

```
>>> s = ks.Series(['1. Ant.', '2. Bee!\t', None])
>>> s
0      1. Ant.
1    2. Bee!\t
2         None
dtype: object
```

```
>>> s.str.rstrip('.!\t')
0    1. Ant
1    2. Bee
2      None
dtype: object
```

databricks.koalas.Series.str.slice

`str.slice`(*start=None*, *stop=None*, *step=None*) → ks.Series
Slice substrings from each element in the Series.

Parameters

start [int, optional] Start position for slice operation.

stop [int, optional] Stop position for slice operation.

step [int, optional] Step size for slice operation.

Returns

Series of object Series from sliced substrings from original string objects.

Examples

```
>>> s = ks.Series(["koala", "fox", "chameleon"])
>>> s
0        koala
1          fox
2    chameleon
dtype: object
```

```
>>> s.str.slice(start=1)
0        oala
1          ox
2    hameleon
dtype: object
```

```
>>> s.str.slice(stop=2)
0    ko
1    fo
2    ch
dtype: object
```

```
>>> s.str.slice(step=2)
0      kaa
1       fx
2    caeen
dtype: object
```

```
>>> s.str.slice(start=0, stop=5, step=3)
0    kl
1     f
2    cm
dtype: object
```

databricks.koalas.Series.str.slice_replace

str.**slice_replace**(*start=None*, *stop=None*, *repl=None*) → ks.Series
Slice substrings from each element in the Series.

Parameters

start [int, optional] Start position for slice operation. If not specified (None), the slice is unbounded on the left, i.e. slice from the start of the string.

stop [int, optional] Stop position for slice operation. If not specified (None), the slice is unbounded on the right, i.e. slice until the end of the string.

repl [str, optional] String for replacement. If not specified (None), the sliced region is replaced with an empty string.

Returns

Series of object Series from sliced substrings from original string objects.

Examples

```
>>> s = ks.Series(['a', 'ab', 'abc', 'abdc', 'abcde'])
>>> s
0        a
1       ab
2      abc
3     abdc
4    abcde
dtype: object
```

Specify just start, meaning replace start until the end of the string with repl.

```
>>> s.str.slice_replace(1, repl='X')
0    aX
1    aX
2    aX
3    aX
4    aX
dtype: object
```

Specify just stop, meaning the start of the string to stop is replaced with repl, and the rest of the string is included.

```
>>> s.str.slice_replace(stop=2, repl='X')
0       X
1       X
2      Xc
3     Xdc
4    Xcde
dtype: object
```

Specify start and stop, meaning the slice from start to stop is replaced with repl. Everything before or after start and stop is included as is.

```
>>> s.str.slice_replace(start=1, stop=3, repl='X')
0      aX
1      aX
2      aX
```

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```
3     aXc
4    aXde
dtype: object
```

databricks.koalas.Series.str.split

`str.`**`split`**(*pat=None*, *n=- 1*, *expand=False*) → Union[ks.Series, ks.DataFrame]

Split strings around given separator/delimiter.

Splits the string in the Series from the beginning, at the specified delimiter string. Equivalent to *`str.split()`*.

Parameters

pat [str, optional] String or regular expression to split on. If not specified, split on whitespace.

n [int, default -1 (all)] Limit number of splits in output. None, 0 and -1 will be interpreted as return all splits.

expand [bool, default False] Expand the splitted strings into separate columns.

- If `True`, *n* must be a positive integer, and return DataFrame expanding dimensionality.
- If `False`, return Series, containing lists of strings.

Returns

Series, DataFrame Type matches caller unless *expand=True* (see Notes).

See also:

`str.rsplit` Splits string around given separator/delimiter, starting from the right.

`str.join` Join lists contained as elements in the Series/Index with passed delimiter.

Notes

The handling of the *n* keyword depends on the number of found splits:

- If found splits > *n*, make first *n* splits only
- If found splits <= *n*, make all splits
- If for a certain row the number of found splits < *n*, append *None* for padding up to *n* if `expand=True`

If using `expand=True`, Series callers return DataFrame objects with *n + 1* columns.

Note: Even if *n* is much larger than found splits, the number of columns does NOT shrink unlike pandas.

Examples

```
>>> s = ks.Series(["this is a regular sentence",
...                "https://docs.python.org/3/tutorial/index.html",
...                np.nan])
```

In the default setting, the string is split by whitespace.

```
>>> s.str.split()
0                   [this, is, a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

Without the n parameter, the outputs of rsplit and split are identical.

```
>>> s.str.rsplit()
0                   [this, is, a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

The n parameter can be used to limit the number of splits on the delimiter. The outputs of split and rsplit are different.

```
>>> s.str.split(n=2)
0                     [this, is, a regular sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

```
>>> s.str.rsplit(n=2)
0                     [this is a, regular, sentence]
1    [https://docs.python.org/3/tutorial/index.html]
2                                                None
dtype: object
```

The pat parameter can be used to split by other characters.

```
>>> s.str.split(pat = "/")
0                         [this is a regular sentence]
1    [https:, , docs.python.org, 3, tutorial, index...
2                                                  None
dtype: object
```

When using `expand=True`, the split elements will expand out into separate columns. If NaN is present, it is propagated throughout the columns during the split.

```
>>> s.str.split(n=4, expand=True)
                                               0     1     2        3         4
0                                           this    is     a  regular  sentence
1  https://docs.python.org/3/tutorial/index.html  None  None     None      None
2                                           None  None  None     None      None
```

For slightly more complex use cases like splitting the html document name from a url, a combination of parameter settings can be used.

```
>>> s.str.rsplit("/", n=1, expand=True)
                                       0           1
0          this is a regular sentence         None
1  https://docs.python.org/3/tutorial  index.html
2                                 None        None
```

Remember to escape special characters when explicitly using regular expressions.

```
>>> s = ks.Series(["1+1=2"])
>>> s.str.split(r"\+|=", n=2, expand=True)
   0  1  2
0  1  1  2
```

databricks.koalas.Series.str.startswith

`str.`**`startswith`**(*pattern*, *na=None*) → ks.Series

Test if the start of each string element matches a pattern.

Equivalent to *`str.startswith()`*.

Parameters

pattern [str] Character sequence. Regular expressions are not accepted.

na [object, default None] Object shown if element is not a string. NaN converted to None.

Returns

Series of bool or object Koalas Series of booleans indicating whether the given pattern matches the start of each string element.

Examples

```
>>> s = ks.Series(['bat', 'Bear', 'cat', np.nan])
>>> s
0     bat
1    Bear
2     cat
3    None
dtype: object
```

```
>>> s.str.startswith('b')
0     True
1    False
2    False
3     None
dtype: object
```

Specifying na to be False instead of None.

```
>>> s.str.startswith('b', na=False)
0     True
1    False
2    False
3    False
dtype: bool
```

databricks.koalas.Series.str.strip

str.**strip**(*to_strip=None*) → ks.Series
Remove leading and trailing characters.

Strip whitespaces (including newlines) or a set of specified characters from each string in the Series/Index from left and right sides. Equivalent to *str.strip()*.

Parameters

to_strip [str] Specifying the set of characters to be removed. All combinations of this set of characters will be stripped. If None then whitespaces are removed.

Returns

Series of objects

Examples

```
>>> s = ks.Series(['1. Ant.', '2. Bee!\t', None])
>>> s
0      1. Ant.
1    2. Bee!\t
2         None
dtype: object
```

```
>>> s.str.strip()
0    1. Ant.
1    2. Bee!
2       None
dtype: object
```

```
>>> s.str.strip('12.')
0        Ant
1     Bee!\t
2       None
dtype: object
```

```
>>> s.str.strip('.!\t')
0    1. Ant
1    2. Bee
2      None
dtype: object
```

databricks.koalas.Series.str.swapcase

str.**swapcase**() → ks.Series
Convert strings in the Series/Index to be swapcased.

Examples

```
>>> s = ks.Series(['lower', 'CAPITALS', 'this is a sentence', 'SwApCaSe'])
>>> s
0                 lower
1              CAPITALS
2    this is a sentence
3              SwApCaSe
dtype: object
```

```
>>> s.str.swapcase()
0                 LOWER
1              capitals
2    THIS IS A SENTENCE
3              sWaPcAsE
dtype: object
```

databricks.koalas.Series.str.title

`str.`**`title`**`()` → ks.Series

Convert Strings in the series to be titlecase.

Examples

```
>>> s = ks.Series(['lower', 'CAPITALS', 'this is a sentence', 'SwApCaSe'])
>>> s
0                 lower
1              CAPITALS
2    this is a sentence
3              SwApCaSe
dtype: object
```

```
>>> s.str.title()
0                 Lower
1              Capitals
2    This Is A Sentence
3              Swapcase
dtype: object
```

databricks.koalas.Series.str.translate

`str.`**`translate`**`(`*table*`)` → ks.Series

Map all characters in the string through the given mapping table. Equivalent to standard *`str.translate()`*.

Parameters

table [dict] Table is a mapping of Unicode ordinals to Unicode ordinals, strings, or None. Unmapped characters are left untouched. Characters mapped to None are deleted. `str.maketrans()` is a helper function for making translation tables.

Returns

Series of object Series with translated strings.

Examples

```
>>> s = ks.Series(["dog", "cat", "bird"])
>>> m = str.maketrans({'a': 'X', 'i': 'Y', 'o': None})
>>> s.str.translate(m)
0      dg
1     cXt
2    bYrd
dtype: object
```

databricks.koalas.Series.str.upper

`str.upper()` → ks.Series

Convert strings in the Series/Index to all uppercase.

Examples

```
>>> s = ks.Series(['lower', 'CAPITALS', 'this is a sentence', 'SwApCaSe'])
>>> s
0                 lower
1              CAPITALS
2    this is a sentence
3              SwApCaSe
dtype: object
```

```
>>> s.str.upper()
0                 LOWER
1              CAPITALS
2    THIS IS A SENTENCE
3              SWAPCASE
dtype: object
```

databricks.koalas.Series.str.wrap

`str.wrap`(*width*, ***kwargs*) → ks.Series

Wrap long strings in the Series to be formatted in paragraphs with length less than a given width.

This method has the same keyword parameters and defaults as `textwrap.TextWrapper`.

Parameters

width [int] Maximum line-width. Lines separated with newline char.

expand_tabs [bool, optional] If true, tab characters will be expanded to spaces (default: True).

replace_whitespace [bool, optional] If true, each whitespace character remaining after tab expansion will be replaced by a single space (default: True).

drop_whitespace [bool, optional] If true, whitespace that, after wrapping, happens to end up at the beginning or end of a line is dropped (default: True).

break_long_words [bool, optional] If true, then words longer than width will be broken in order to ensure that no lines are longer than width. If it is false, long words will not be broken, and some lines may be longer than width (default: True).

break_on_hyphens [bool, optional] If true, wrapping will occur preferably on whitespace and right after hyphens in compound words, as it is customary in English. If false, only whitespaces will be considered as potentially good places for line breaks, but you need to set break_long_words to false if you want truly insecable words (default: True).

Returns

Series of object Series with wrapped strings.

Examples

```
>>> s = ks.Series(['line to be wrapped', 'another line to be wrapped'])
>>> s.str.wrap(12)
0             line to be\nwrapped
1    another line\nto be\nwrapped
dtype: object
```

databricks.koalas.Series.str.zfill

`str.`**`zfill`**`(`*width*`)` → ks.Series

Pad strings in the Series by prepending '0' characters.

Strings in the Series are padded with '0' characters on the left of the string to reach a total string length width. Strings in the Series with length greater or equal to width are unchanged.

Differs from *`str.zfill()`* which has special handling for '+'/'-' in the string.

Parameters

width [int] Minimum length of resulting string; strings with length less than width be prepended with '0' characters.

Returns

Series of object Series with '0' left-padded strings.

Examples

```
>>> s = ks.Series(['-1', '1', '1000', np.nan])
>>> s
0      -1
1       1
2    1000
3    None
dtype: object
```

Note that NaN is not a string, therefore it is converted to NaN. The minus sign in '-1' is treated as a regular character and the zero is added to the left of it (*`str.zfill()`* would have moved it to the left). 1000 remains unchanged as it is longer than width.

```
>>> s.str.zfill(3)
0     0-1
1     001
2    1000
3    None
dtype: object
```

3.3.17 Plotting

`Series.plot` is both a callable method and a namespace attribute for specific plotting methods of the form `Series.plot.<kind>`.

Series.plot	alias of `databricks.koalas.plot.core.KoalasPlotAccessor`
Series.plot.area([x, y, stacked])	Draw a stacked area plot.
Series.plot.bar([x, y])	Vertical bar plot.
Series.plot.barh([x, y])	Make a horizontal bar plot.
Series.plot.box(**kwds)	Make a box plot of the Series columns.
Series.plot.density([bw_method, ind])	Generate Kernel Density Estimate plot using Gaussian kernels.
Series.plot.hist([bins])	Draw one histogram of the DataFrame's columns.
Series.plot.line([x, y])	Plot DataFrame/Series as lines.
Series.plot.pie([y])	Generate a pie plot.
Series.plot.kde([bw_method, ind])	Generate Kernel Density Estimate plot using Gaussian kernels.
Series.hist([bins])	Draw one histogram of the DataFrame's columns.

databricks.koalas.Series.plot

`databricks.koalas.Series.`**`plot`**

alias of `databricks.koalas.plot.core.KoalasPlotAccessor`

databricks.koalas.Series.plot.area

`plot.`**`area`**(*x=None*, *y=None*, *stacked=True*, ***kwds*)

Draw a stacked area plot.

An area plot displays quantitative data visually. This function wraps the matplotlib area function.

Parameters

x [label or position, optional] Coordinates for the X axis. By default uses the index.

y [label or position, optional] Column to plot. By default uses all columns.

stacked [bool, default True] Area plots are stacked by default. Set to False to create a unstacked plot.

****kwds** [optional] Additional keyword arguments are documented in `DataFrame.plot()`.

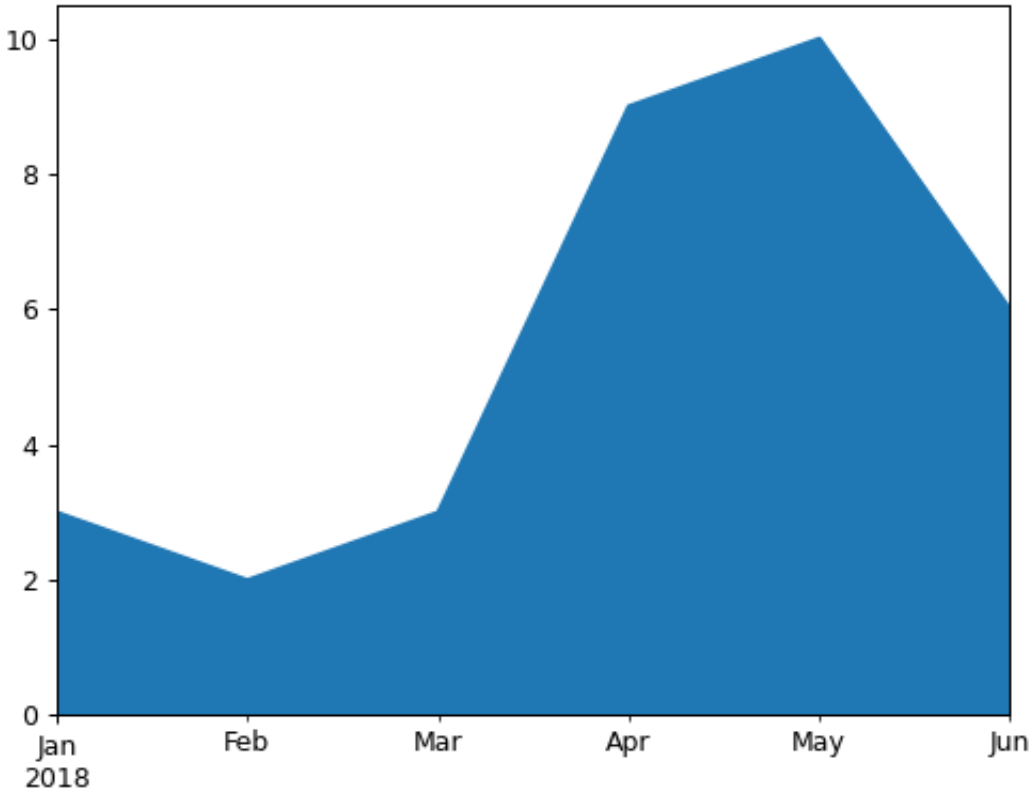
Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

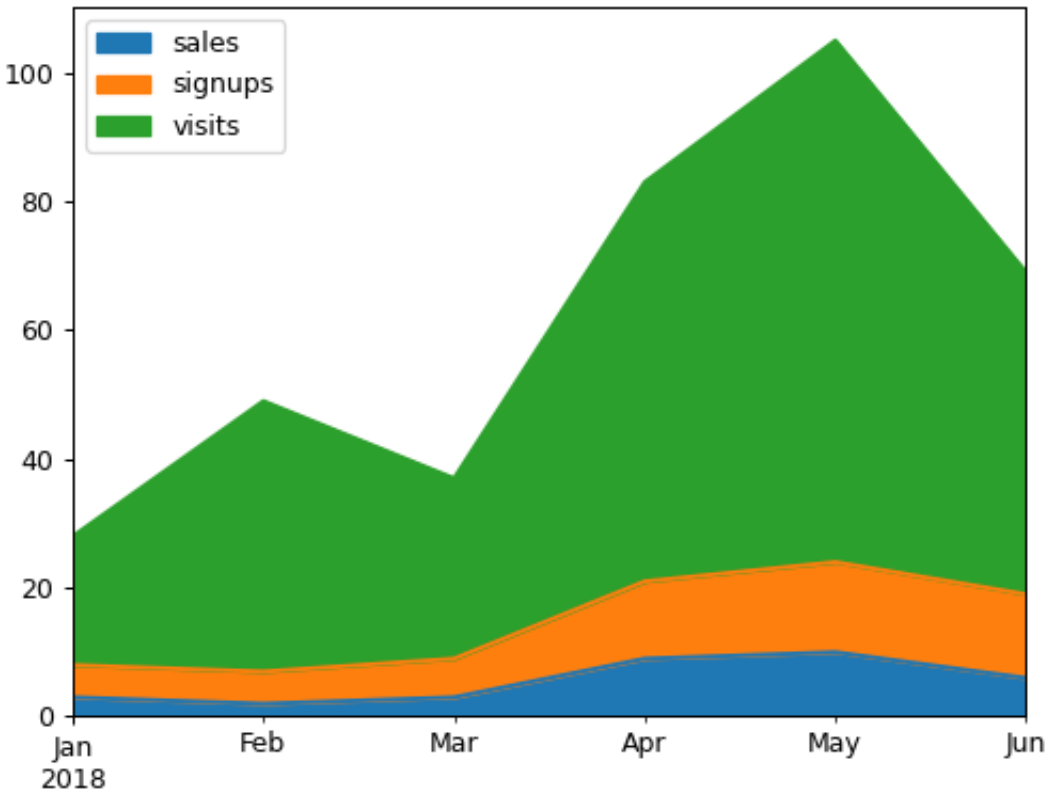
For Series

```
>>> df = ks.DataFrame({
...     'sales': [3, 2, 3, 9, 10, 6],
...     'signups': [5, 5, 6, 12, 14, 13],
...     'visits': [20, 42, 28, 62, 81, 50],
... }, index=pd.date_range(start='2018/01/01', end='2018/07/01',
...                        freq='M'))
>>> plot = df.sales.plot.area()
```



For DataFrame

```
>>> df = ks.DataFrame({
...     'sales': [3, 2, 3, 9, 10, 6],
...     'signups': [5, 5, 6, 12, 14, 13],
...     'visits': [20, 42, 28, 62, 81, 50],
... }, index=pd.date_range(start='2018/01/01', end='2018/07/01',
...                        freq='M'))
>>> plot = df.plot.area()
```


sales
signups
visits
100
80
60
40
20
0
Jan
2018
Feb
Mar
Apr
May
Jun

databricks.koalas.Series.plot.bar

`plot.bar(x=None, y=None, **kwds)`

Vertical bar plot.

Parameters

x [label or position, optional] Allows plotting of one column versus another. If not specified, the index of the DataFrame is used.

y [label or position, optional] Allows plotting of one column versus another. If not specified, all numerical columns are used.

****kwds** [optional] Additional keyword arguments are documented in `Koalas.Series.plot()` or `Koalas.DataFrame.plot()`.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

Basic plot.

For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.bar()
```

For DataFrame:

```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> ax = df.plot.bar(x='lab', y='val', rot=0)
```

Plot a whole dataframe to a bar plot. Each column is assigned a distinct color, and each row is nested in a group along the horizontal axis.

```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.bar(rot=0)
```

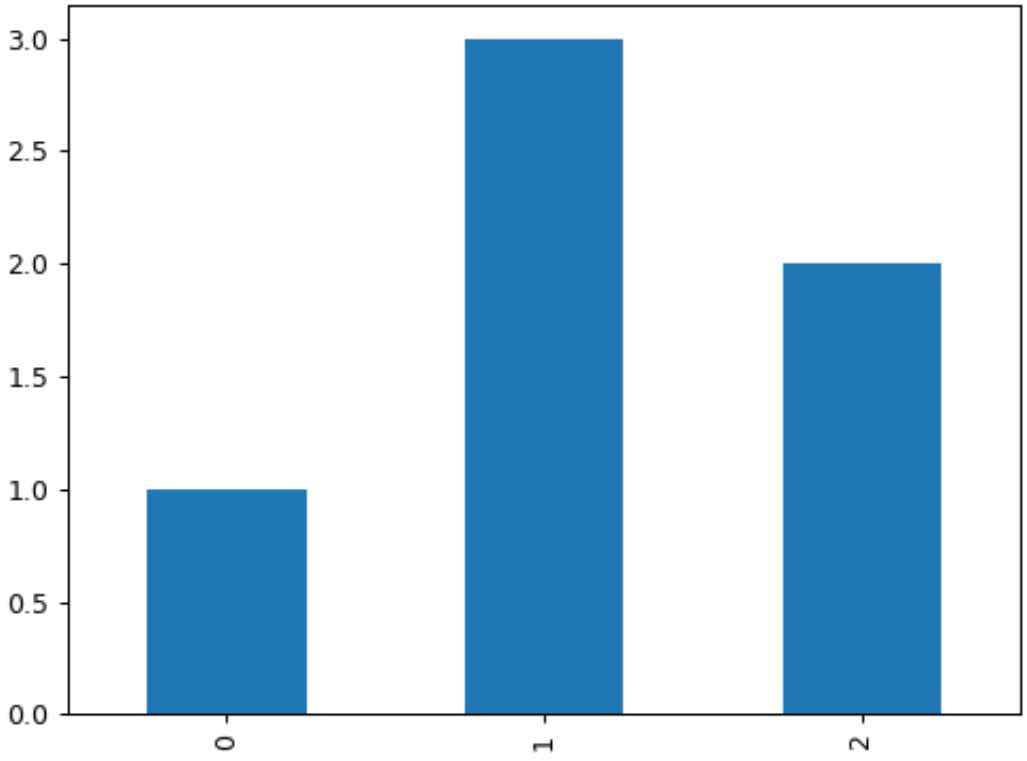
Instead of nesting, the figure can be split by column with `subplots=True`. In this case, a `numpy.ndarray` of `matplotlib.axes.Axes` are returned.

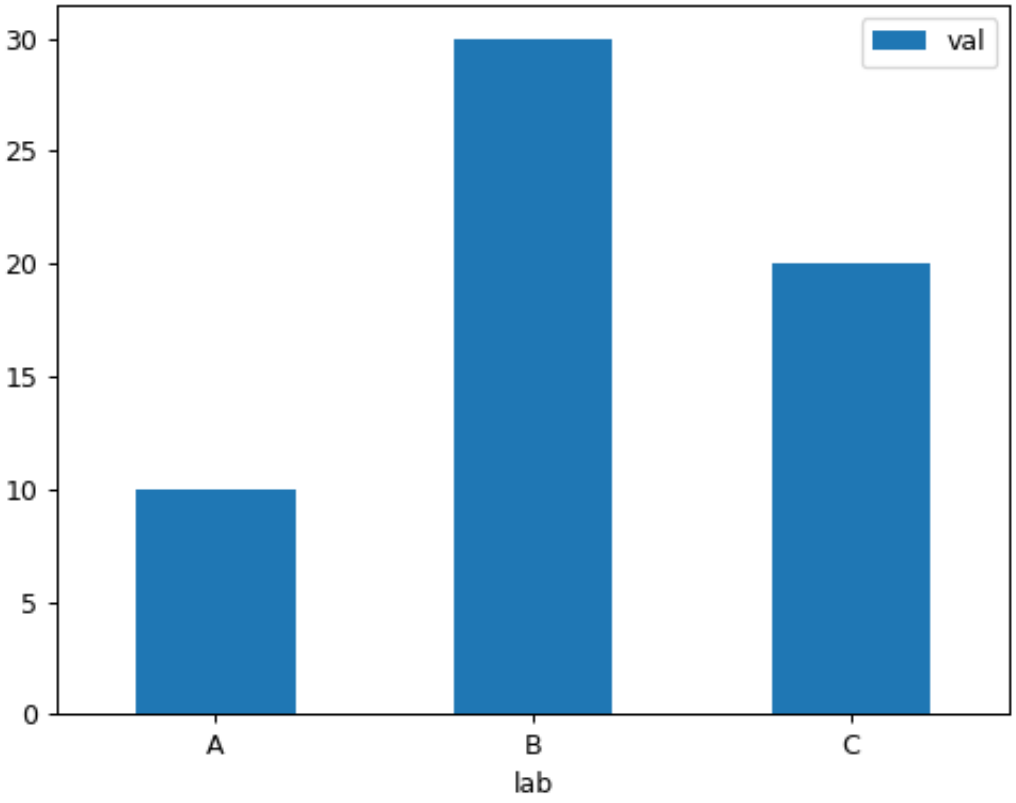
```
>>> axes = df.plot.bar(rot=0, subplots=True)
>>> axes[1].legend(loc=2)
```

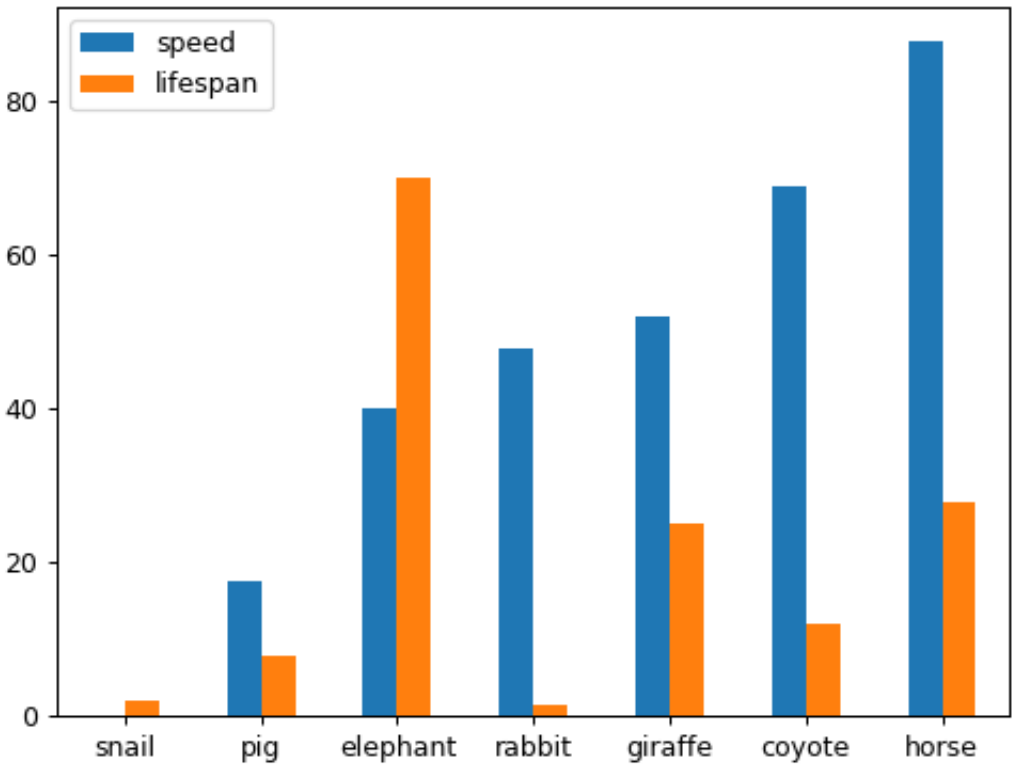
Plot a single column.

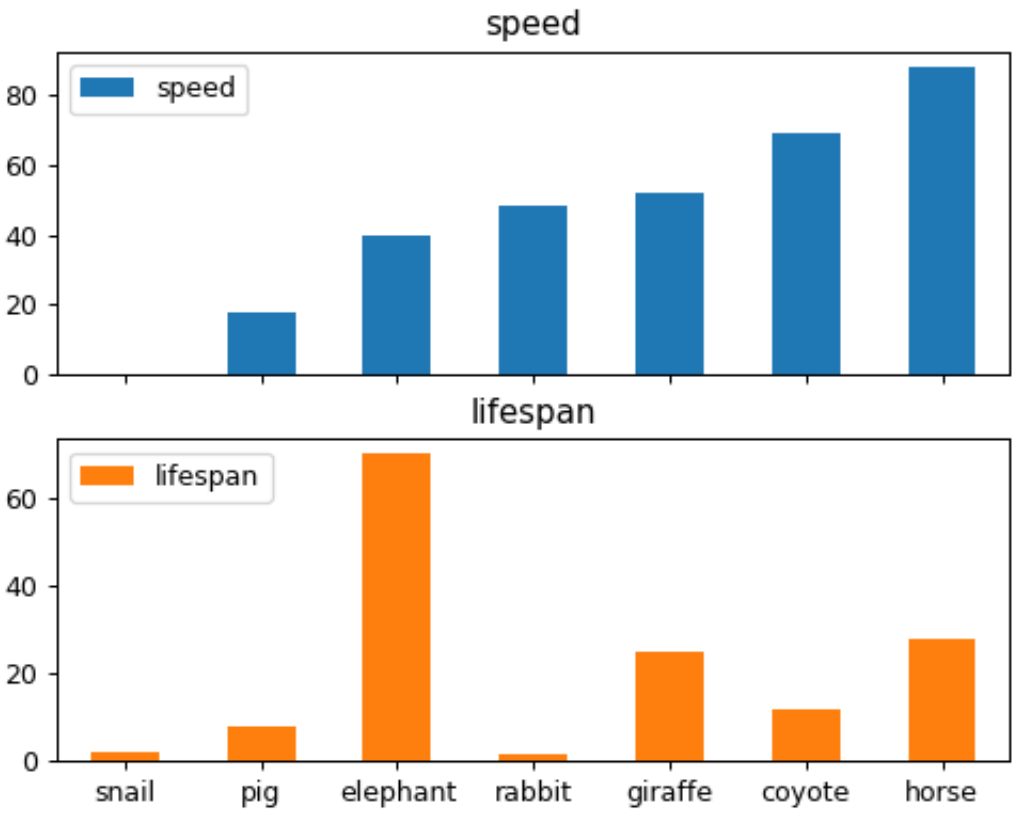
```
>>> ax = df.plot.bar(y='speed', rot=0)
```

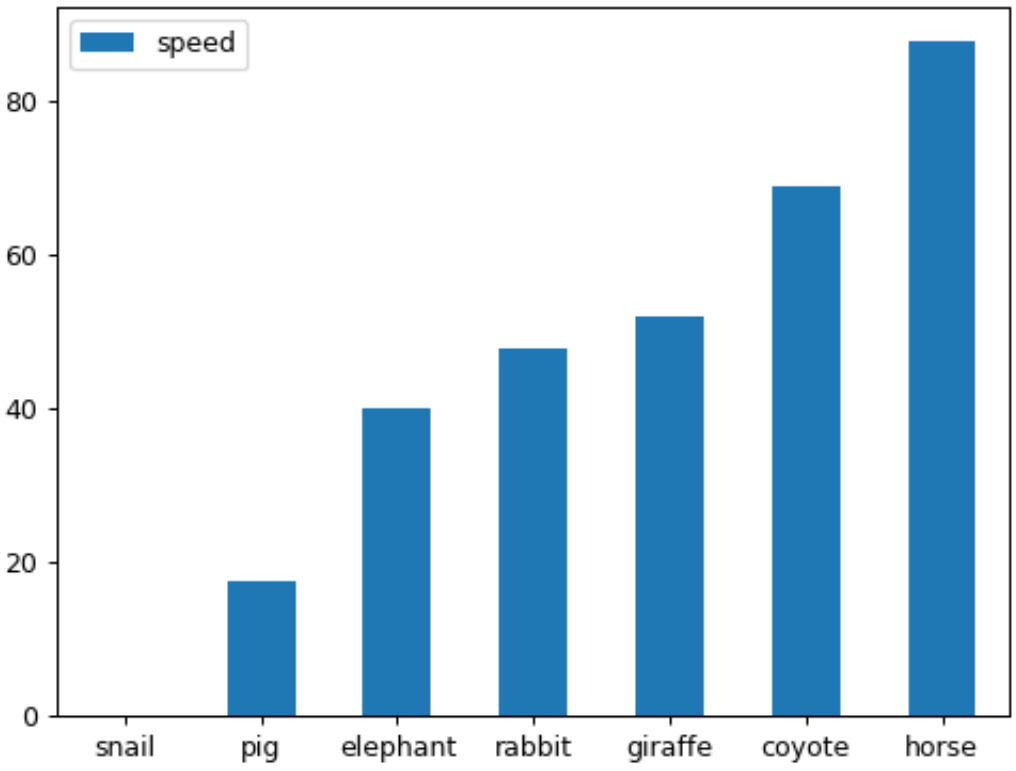
Plot only selected categories for the DataFrame.


3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2

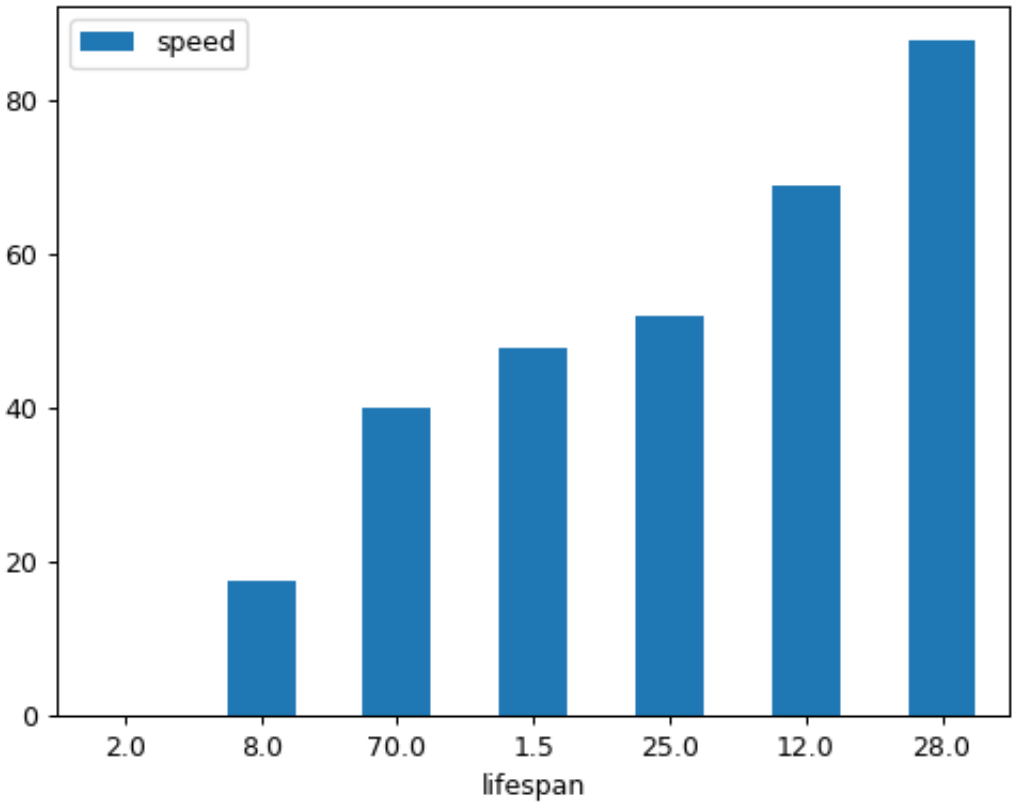

val
30
25
20
15
10
5
0
A
B
C
lab


speed
lifespan
80
60
40
20
0
snail
pig
elephant
rabbit
giraffe
coyote
horse


speed
speed
80
60
40
20
0
lifespan
lifespan
60
40
20
0
snail
pig
elephant
rabbit
giraffe
coyote
horse


speed
80
60
40
20
0
snail
pig
elephant
rabbit
giraffe
coyote
horse

```
>>> ax = df.plot.bar(x='lifespan', rot=0)
```



databricks.koalas.Series.plot.barh

`plot.`**`barh`**(*x=None*, *y=None*, ***kwargs*)

Make a horizontal bar plot.

A horizontal bar plot is a plot that presents quantitative data with rectangular bars with lengths proportional to the values that they represent. A bar plot shows comparisons among discrete categories. One axis of the plot shows the specific categories being compared, and the other axis represents a measured value.

Parameters

x [label or position, default DataFrame.index] Column to be used for categories.

y [label or position, default All numeric columns in dataframe] Columns to be plotted from the DataFrame.

****kwds** Keyword arguments to pass on to *databricks.koalas.DataFrame.plot()* or *databricks.koalas.Series.plot()*.

Returns

matplotlib.axes.Axes or numpy.ndarray of them

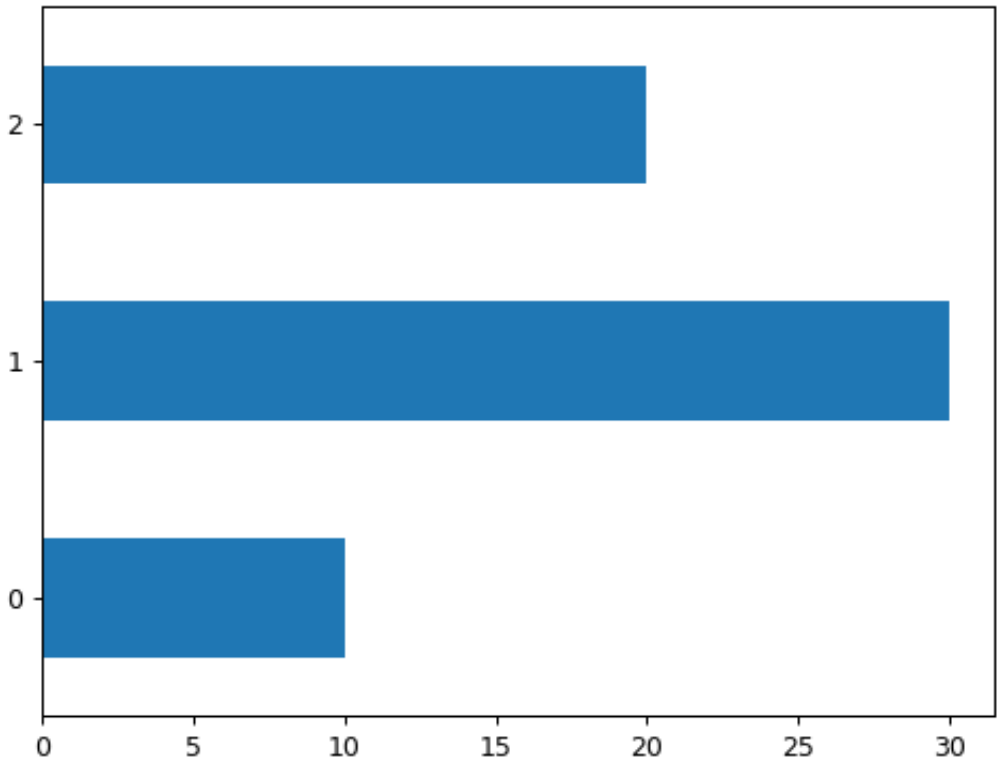
See also:

matplotlib.axes.Axes.bar Plot a vertical bar plot using matplotlib.

Examples

For Series:

```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> plot = df.val.plot.barh()
```



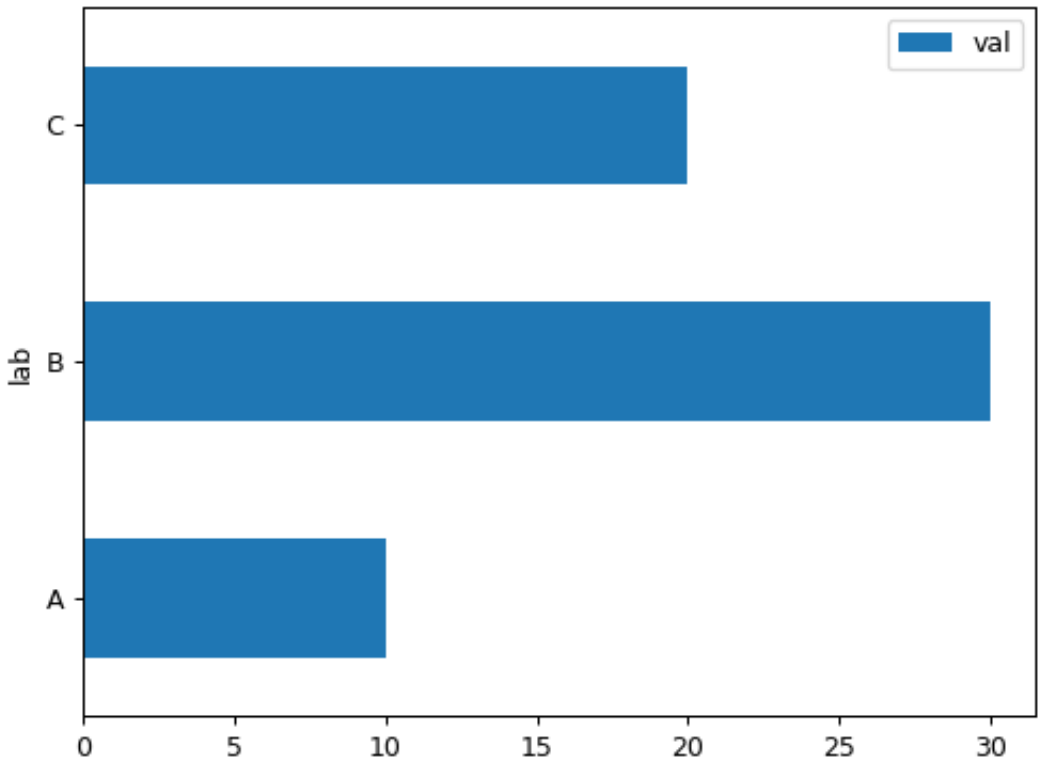
For DataFrame:

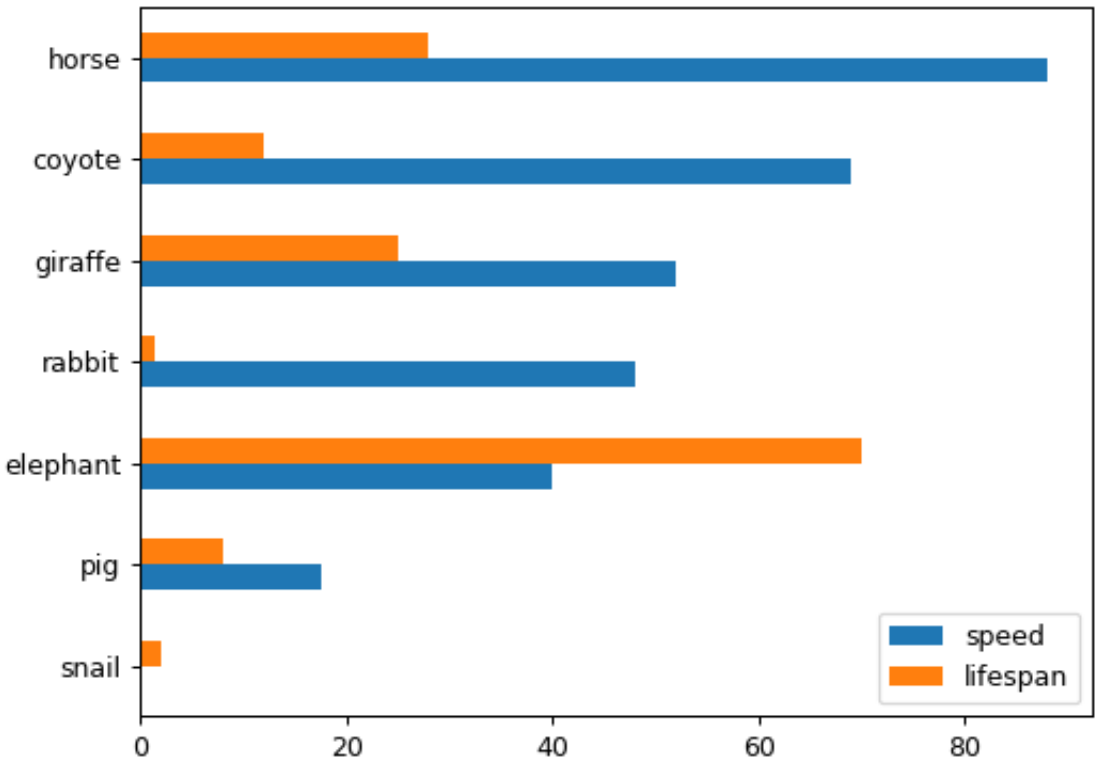
```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> ax = df.plot.barh(x='lab', y='val')
```

Plot a whole DataFrame to a horizontal bar plot

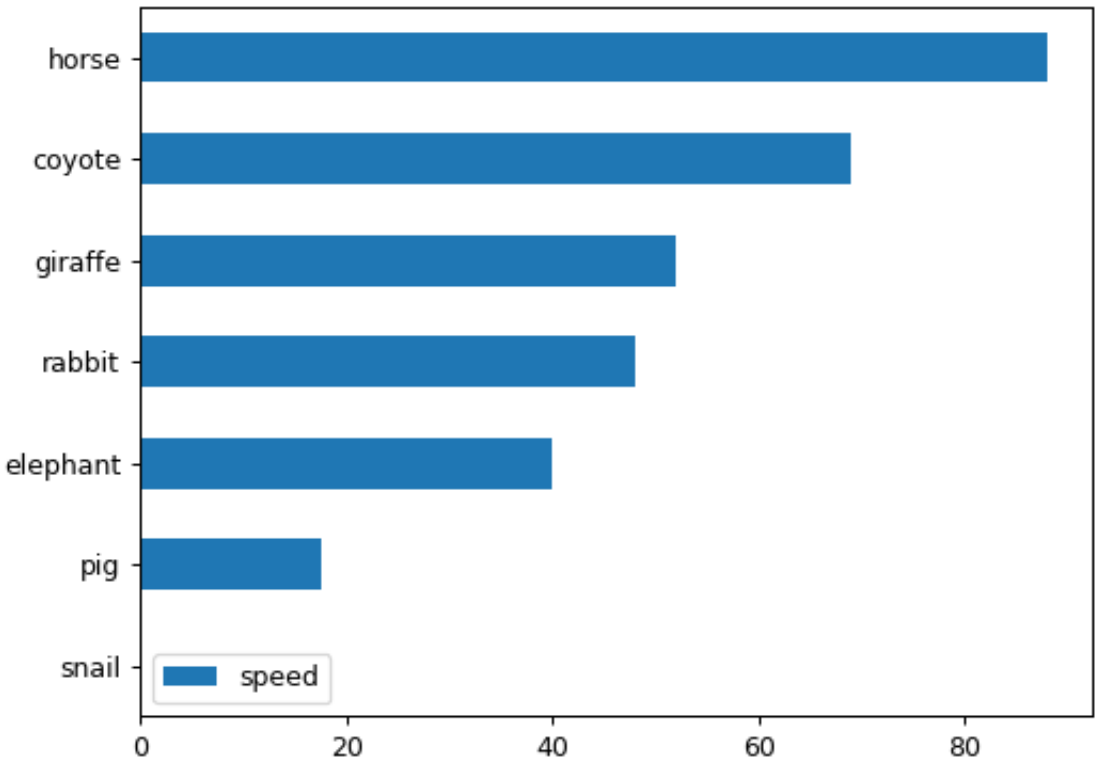
```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh()
```

Plot a column of the DataFrame to a horizontal bar plot


val
C
B
A
lab
0
5
10
15
20
25
30

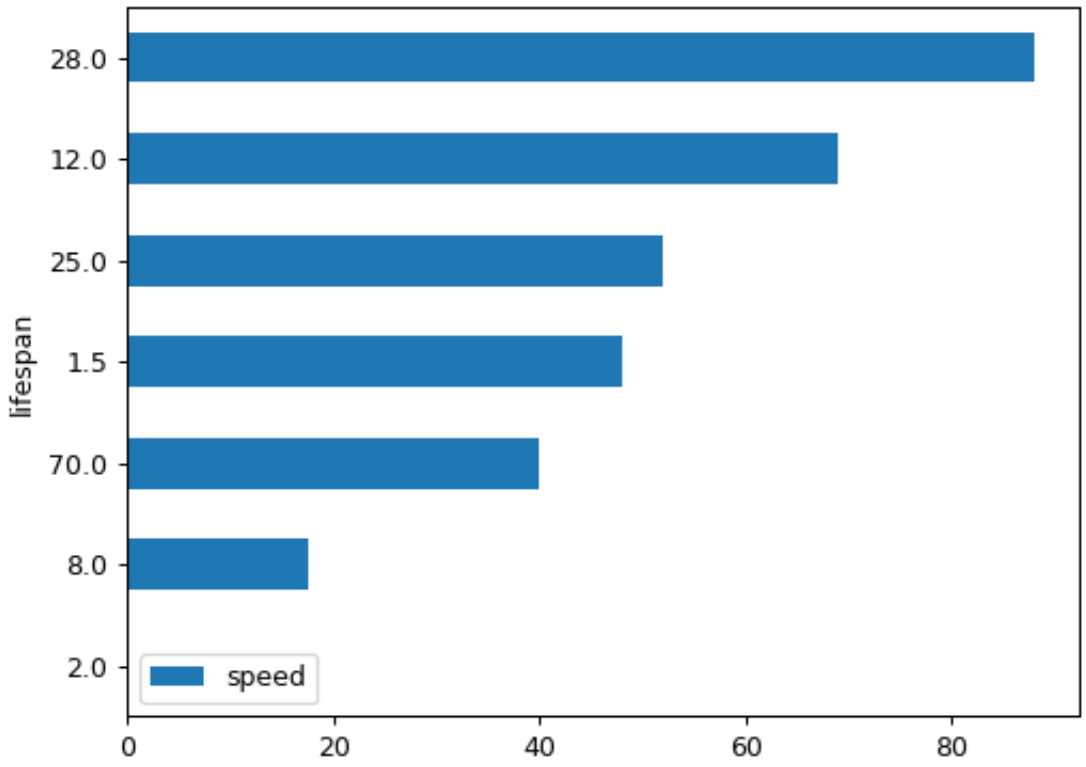

horse
coyote
giraffe
rabbit
elephant
pig
snail
0
20
40
60
80
speed
lifespan

```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh(y='speed')
```



Plot DataFrame versus the desired column

```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh(x='lifespan')
```


28.0
12.0
25.0
1.5
70.0
8.0
2.0
lifespan
speed
0
20
40
60
80

databricks.koalas.Series.plot.box

`plot.box(**kwds)`

Make a box plot of the Series columns.

Parameters

****kwds** [optional] Additional keyword arguments are documented in `Koalas.Series.plot()`.

precision: scalar, default = 0.01 This argument is used by Koalas to compute approximate statistics for building a boxplot. Use *smaller* values to get more precise statistics.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Notes

There are behavior differences between Koalas and pandas.

- Koalas computes approximate statistics - expect differences between pandas and Koalas boxplots, especially regarding 1st and 3rd quartiles.
- The *whis* argument is only supported as a single number.
- Koalas doesn't support the following argument(s).
  - *bootstrap* argument is not supported
  - *autorange* argument is not supported

Examples

Draw a box plot from a DataFrame with four columns of randomly generated data.

For Series:

```
>>> data = np.random.randn(25, 4)
>>> df = ks.DataFrame(data, columns=list('ABCD'))
>>> ax = df['A'].plot.box()
```

This is an unsupported function for DataFrame type

databricks.koalas.Series.plot.density

`plot.density(bw_method=None, ind=None, **kwargs)`

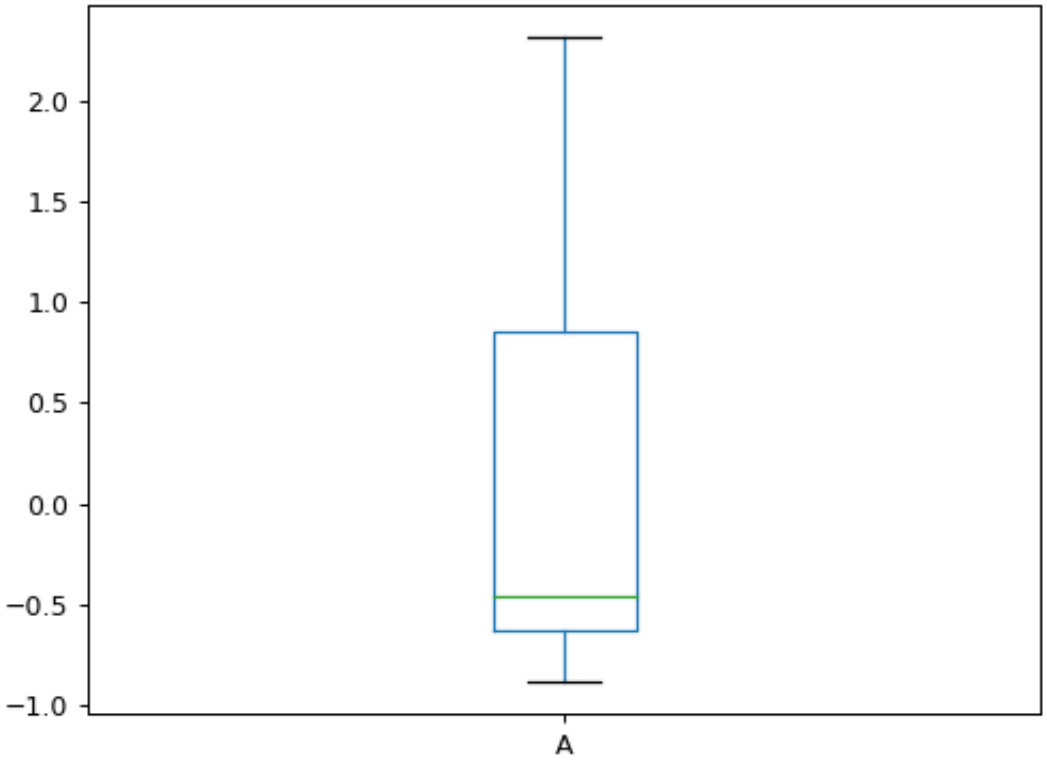
Generate Kernel Density Estimate plot using Gaussian kernels.

Parameters

bw_method [scalar] The method used to calculate the estimator bandwidth. See KernelDensity in PySpark for more information.

ind [NumPy array or integer, optional] Evaluation points for the estimated PDF. If None (default), 1000 equally spaced points are used. If *ind* is a NumPy array, the KDE is evaluated at the points passed. If *ind* is an integer, *ind* number of equally spaced points are used.

****kwargs** [optional] Keyword arguments to pass on to `Koalas.Series.plot()`.


2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
A

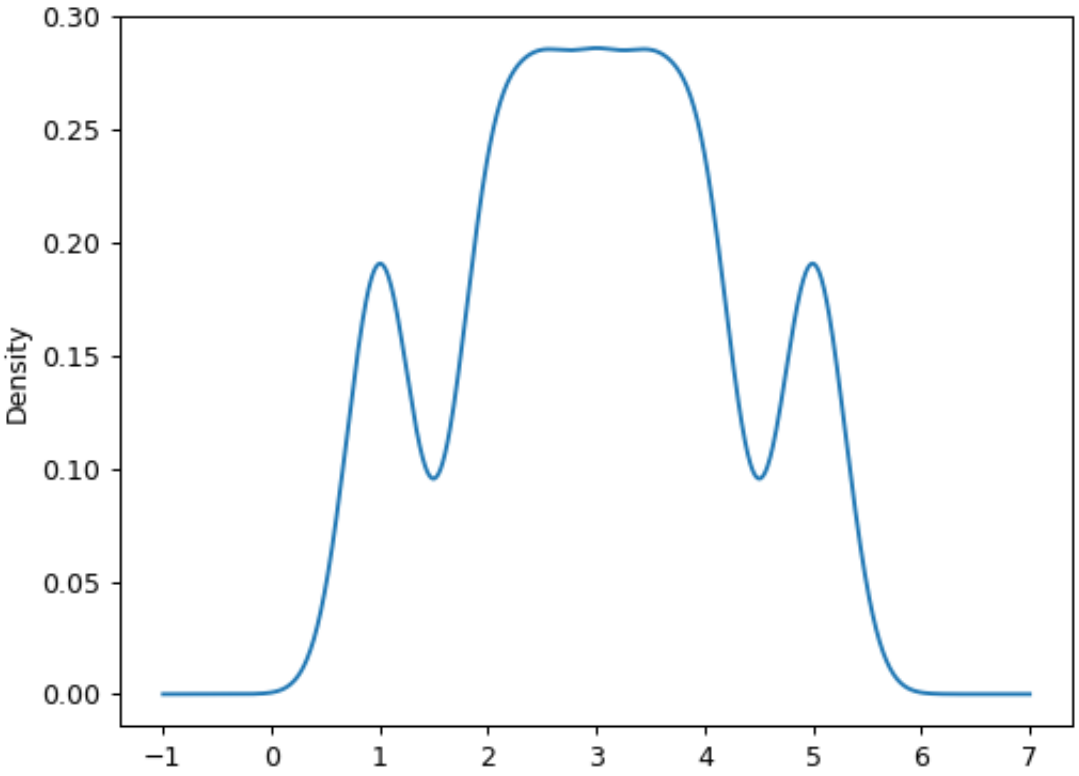
Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

A scalar bandwidth should be specified. Using a small bandwidth value can lead to over-fitting, while using a large bandwidth value may result in under-fitting:

```
>>> s = ks.Series([1, 2, 2.5, 3, 3.5, 4, 5])
>>> ax = s.plot.kde(bw_method=0.3)
```




```
>>> ax = s.plot.kde(bw_method=3)
```

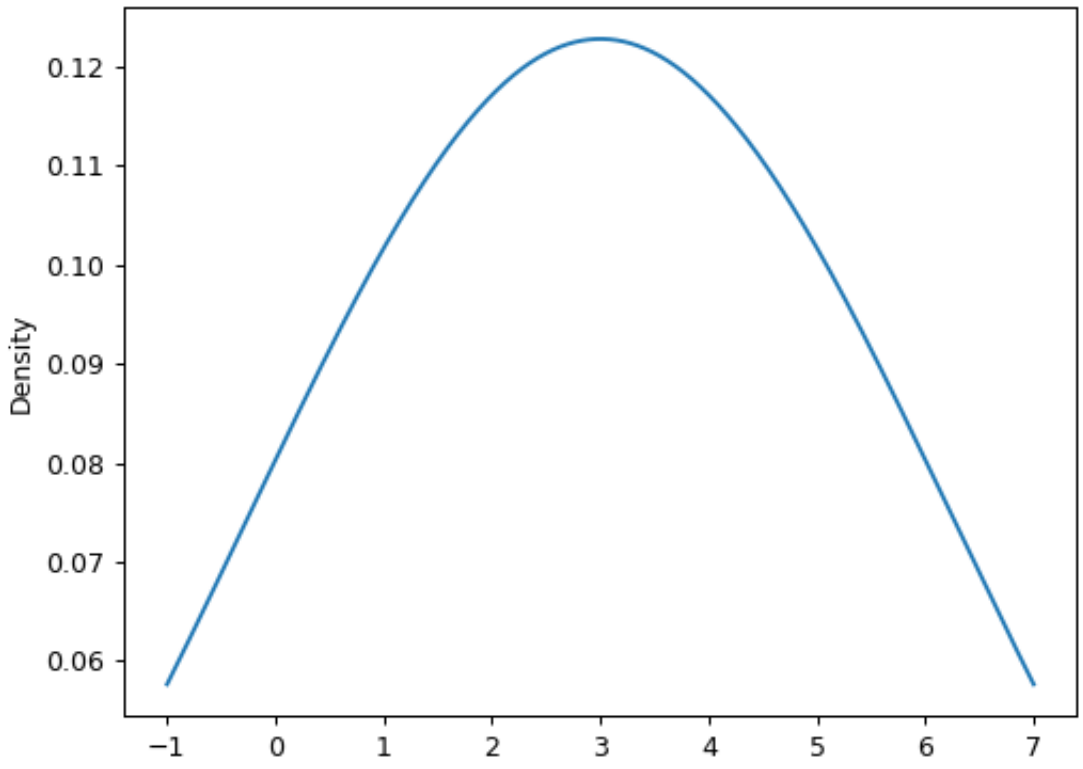
The *ind* parameter determines the evaluation points for the plot of the estimated KDF:

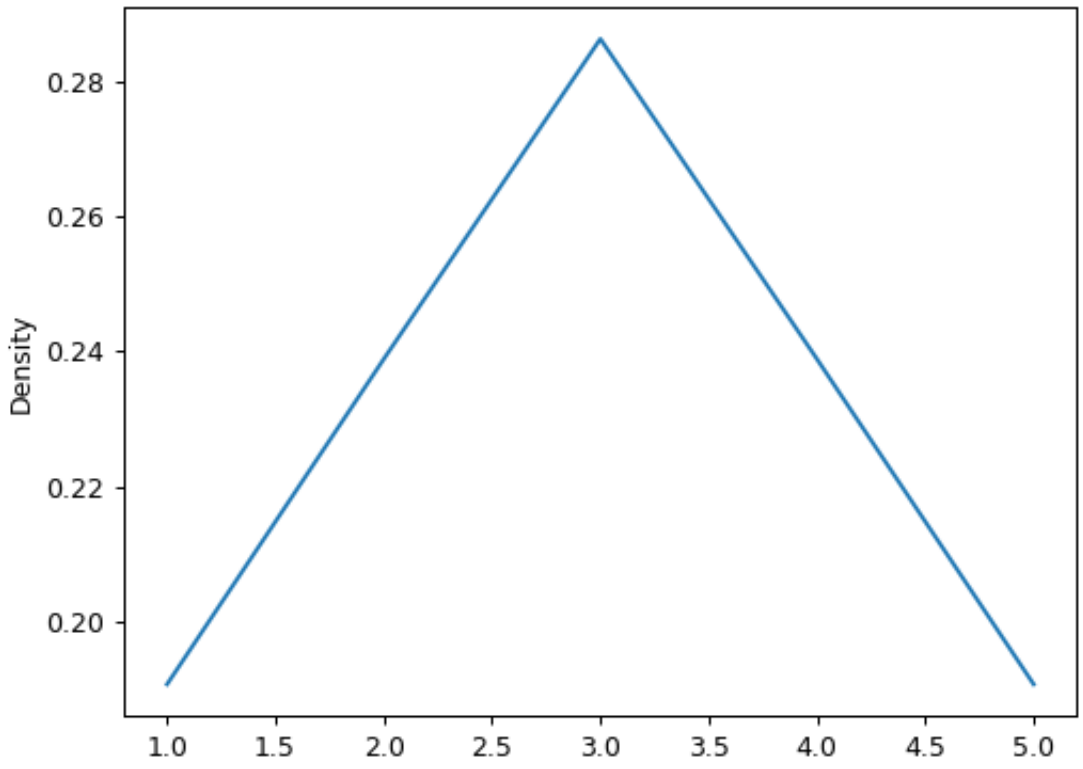
```
>>> ax = s.plot.kde(ind=[1, 2, 3, 4, 5], bw_method=0.3)
```

For DataFrame, it works in the same way as Series:

```
>>> df = ks.DataFrame({
...     'x': [1, 2, 2.5, 3, 3.5, 4, 5],
```

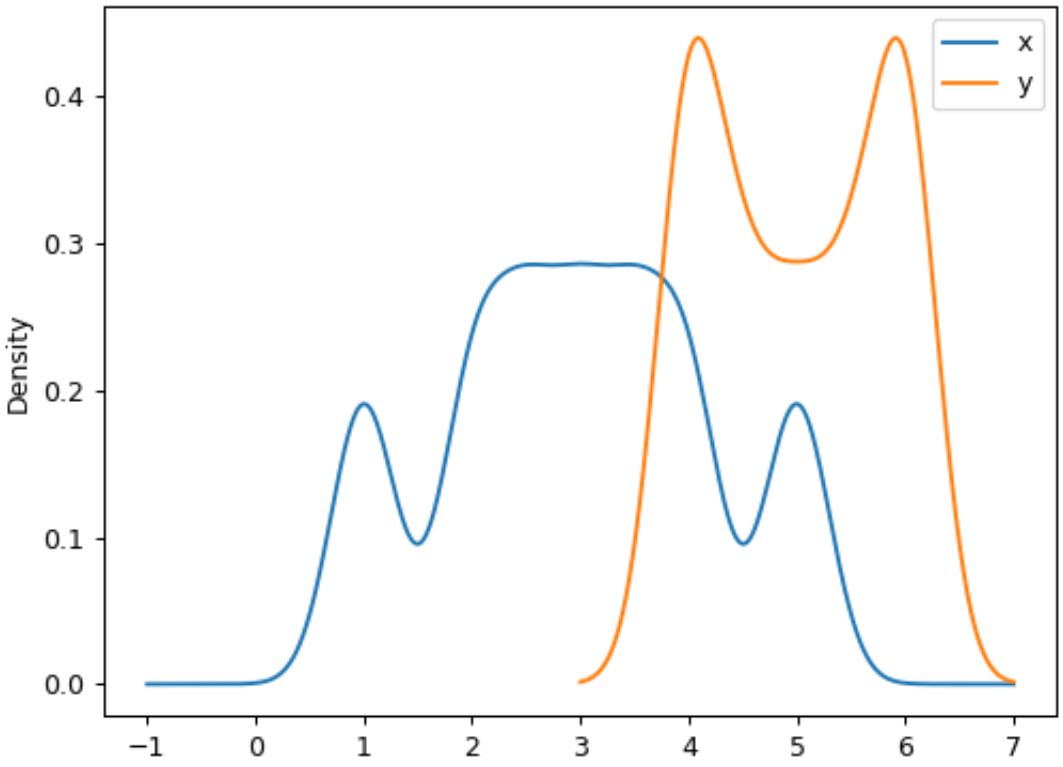
(continues on next page)


0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7


0.28
0.26
0.24
0.22
0.20
Density
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

(continued from previous page)

```
...     'y': [4, 4, 4.5, 5, 5.5, 6, 6],
... })
>>> ax = df.plot.kde(bw_method=0.3)
```




```
>>> ax = df.plot.kde(bw_method=3)
```

```
>>> ax = df.plot.kde(ind=[1, 2, 3, 4, 5, 6], bw_method=0.3)
```

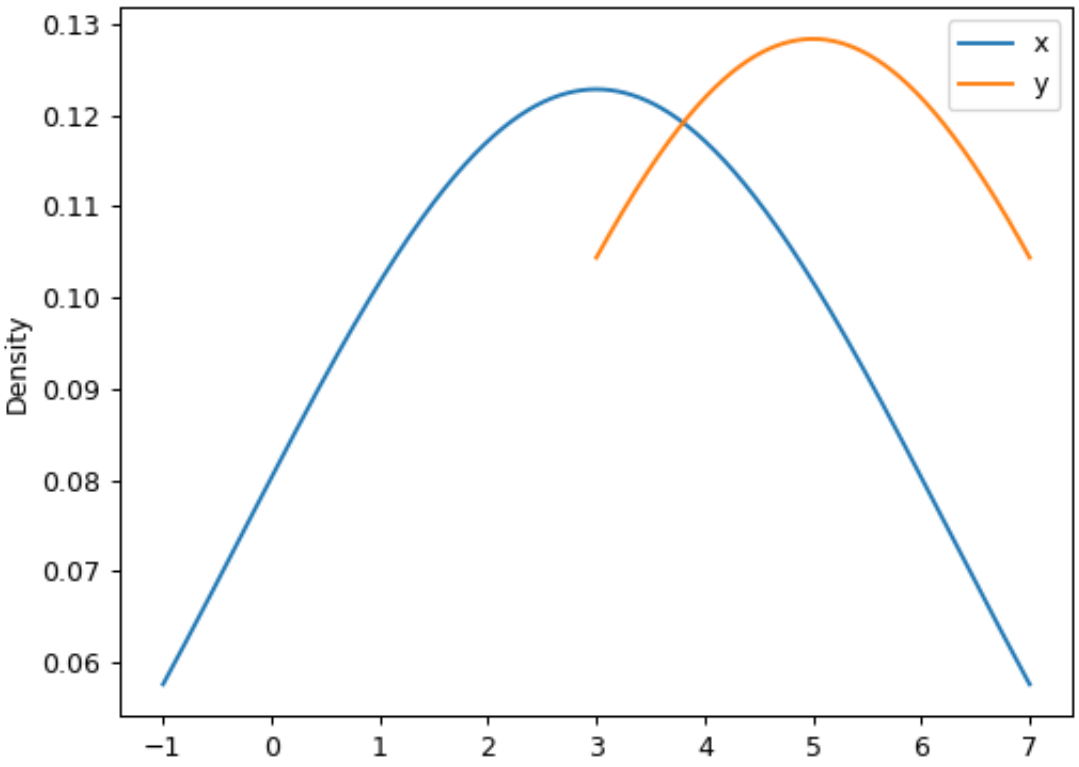
databricks.koalas.Series.plot.hist

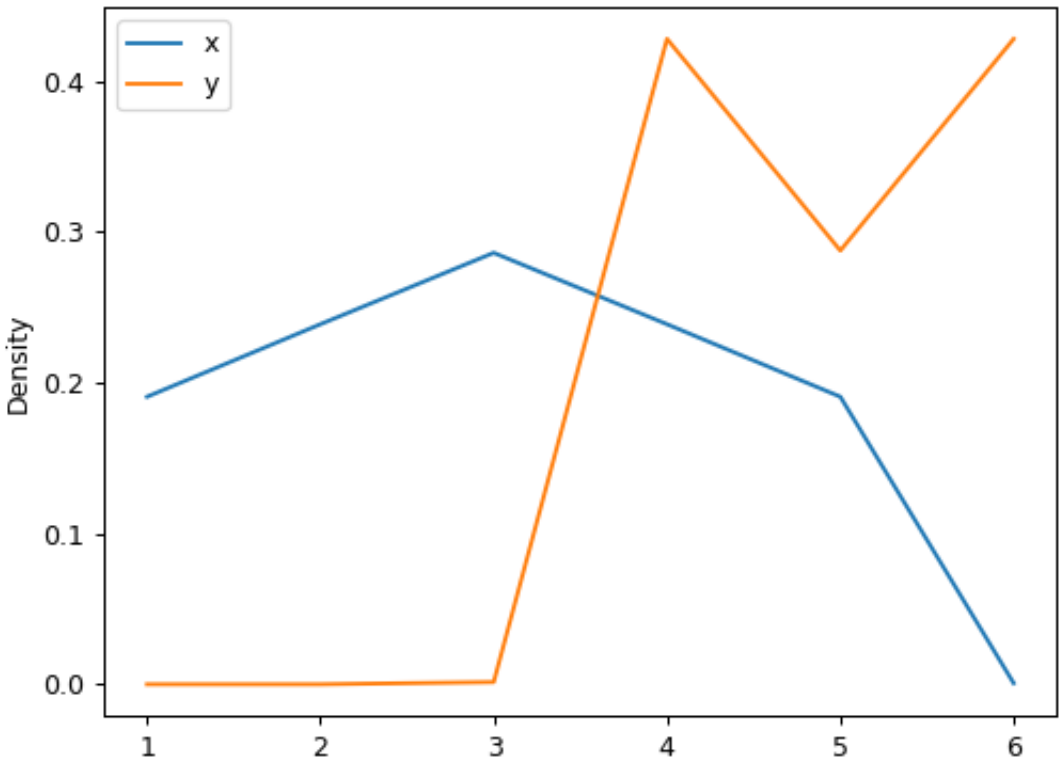
`plot.`**`hist`**(*bins=10*, ***kwds*)

Draw one histogram of the DataFrame's columns. A histogram is a representation of the distribution of data. This function calls `matplotlib.pyplot.hist()` or `plotting.backend.plot()`, on each series in the DataFrame, resulting in one histogram per column.

Parameters

bins [integer or sequence, default 10] Number of histogram bins to be used. If an integer is given, bins + 1 bin edges are calculated and returned. If bins is a sequence, gives bin edges, including left edge of first bin and right edge of last bin. In this case, bins is returned unmodified.


0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7
x
y


x
y
0.4
0.3
0.2
0.1
0.0
Density
1
2
3
4
5
6

****kwds** All other plotting keyword arguments to be passed to `matplotlib.pyplot.hist()` Koalas.Series.plot.

Returns

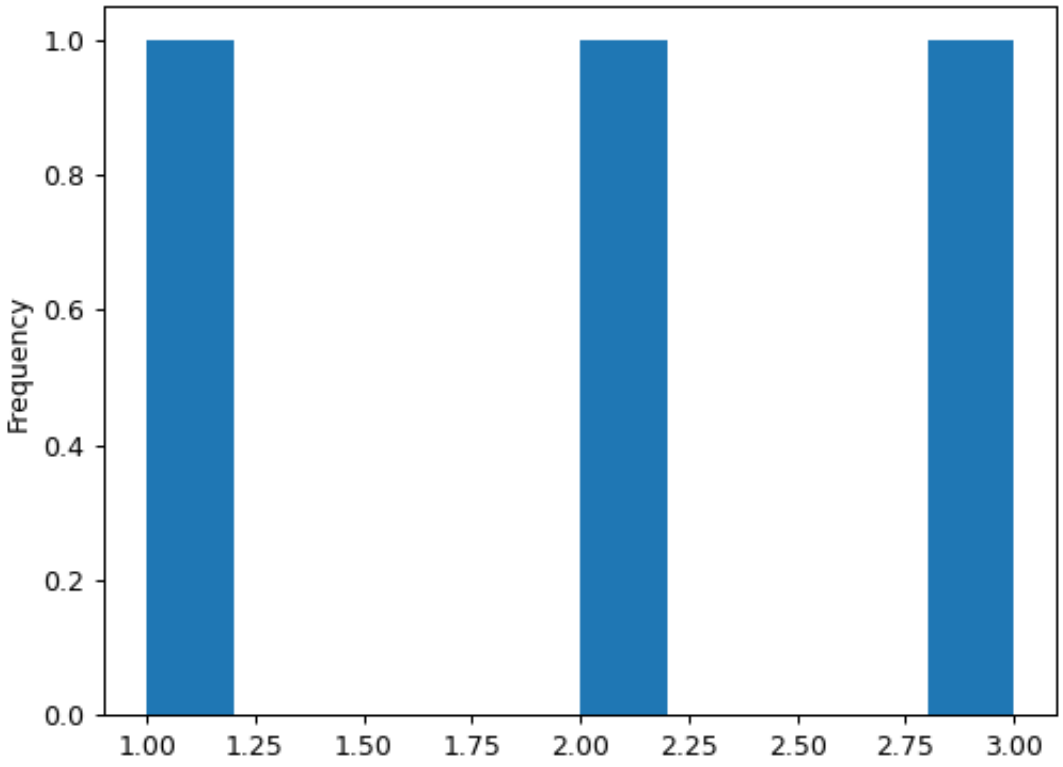
axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

Basic plot.

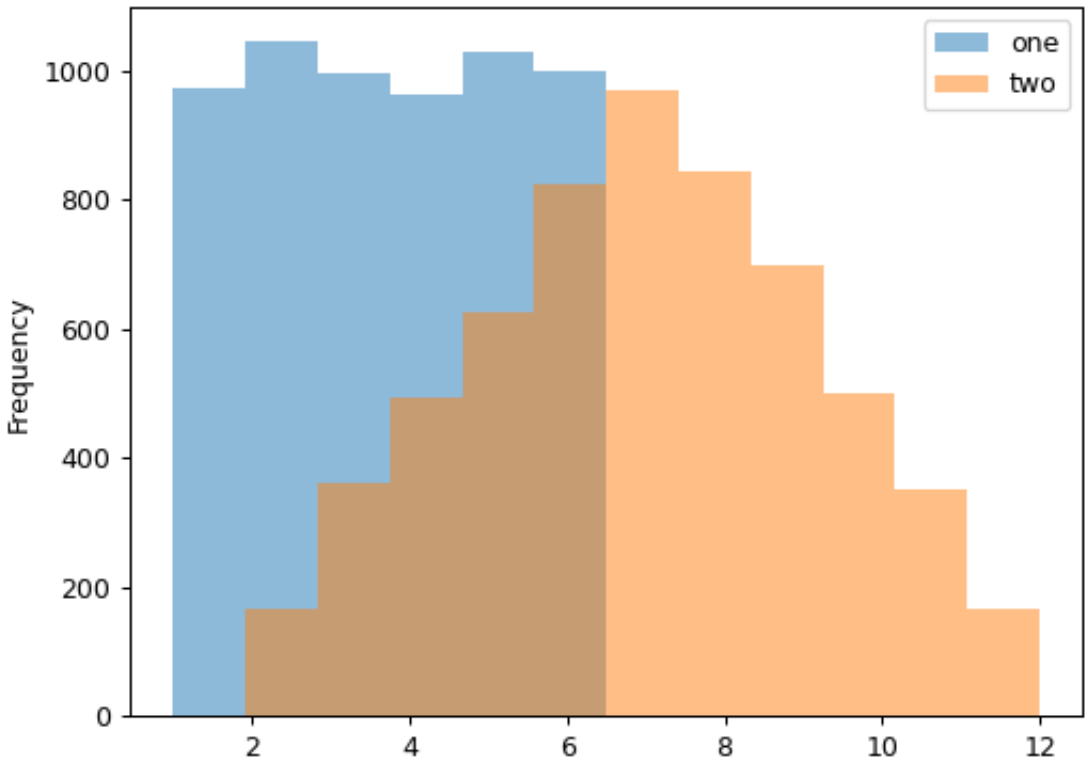
For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.hist()
```



For DataFrame:

```
>>> df = pd.DataFrame(
...     np.random.randint(1, 7, 6000),
...     columns=['one'])
>>> df['two'] = df['one'] + np.random.randint(1, 7, 6000)
>>> df = ks.from_pandas(df)
>>> ax = df.plot.hist(bins=12, alpha=0.5)
```


one
two
Frequency
0
200
400
600
800
1000
2
4
6
8
10
12

databricks.koalas.Series.plot.line

`plot.line(x=None, y=None, **kwargs)`

Plot DataFrame/Series as lines.

This function is useful to plot lines using Series's values as coordinates.

Parameters

x [int or str, optional] Columns to use for the horizontal axis. Either the location or the label of the columns to be used. By default, it will use the DataFrame indices.

y [int, str, or list of them, optional] The values to be plotted. Either the location or the label of the columns to be used. By default, it will use the remaining DataFrame numeric columns.

****kwds** Keyword arguments to pass on to `Series.plot()` or `DataFrame.plot()`.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

See also:

matplotlib.pyplot.plot Plot y versus x as lines and/or markers.

Examples

Basic plot.

For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.line()
```

For DataFrame:

The following example shows the populations for some animals over the years.

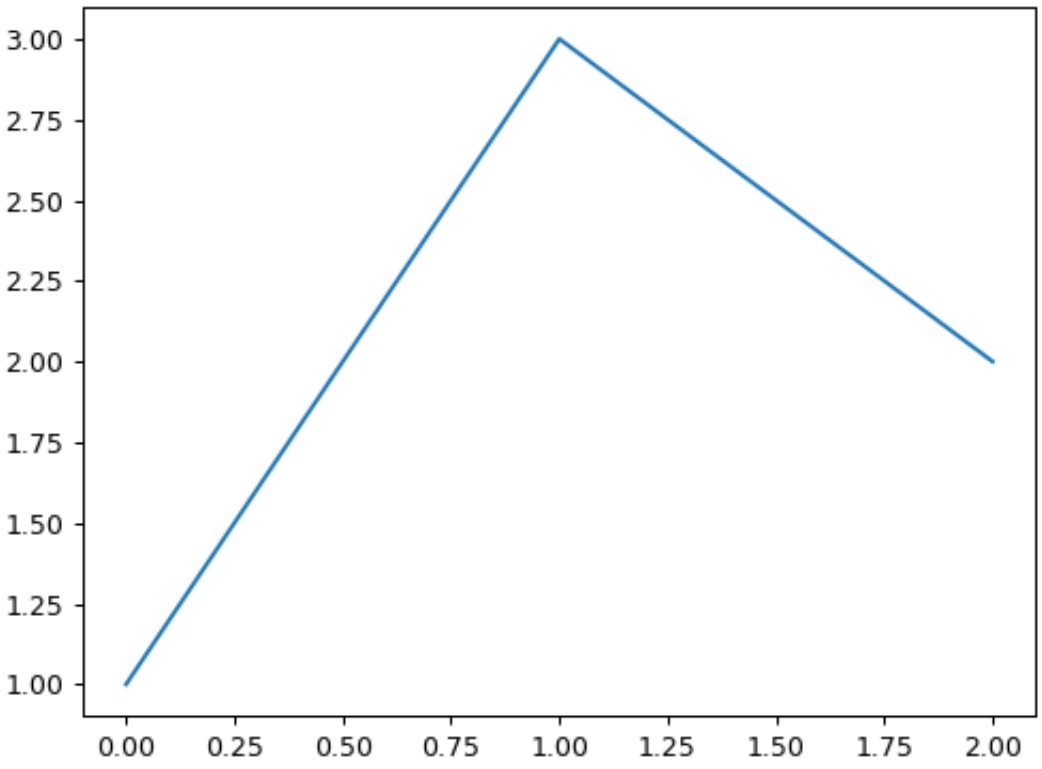
```
>>> df = ks.DataFrame({'pig': [20, 18, 489, 675, 1776],
...                    'horse': [4, 25, 281, 600, 1900]},
...                   index=[1990, 1997, 2003, 2009, 2014])
>>> lines = df.plot.line()
```

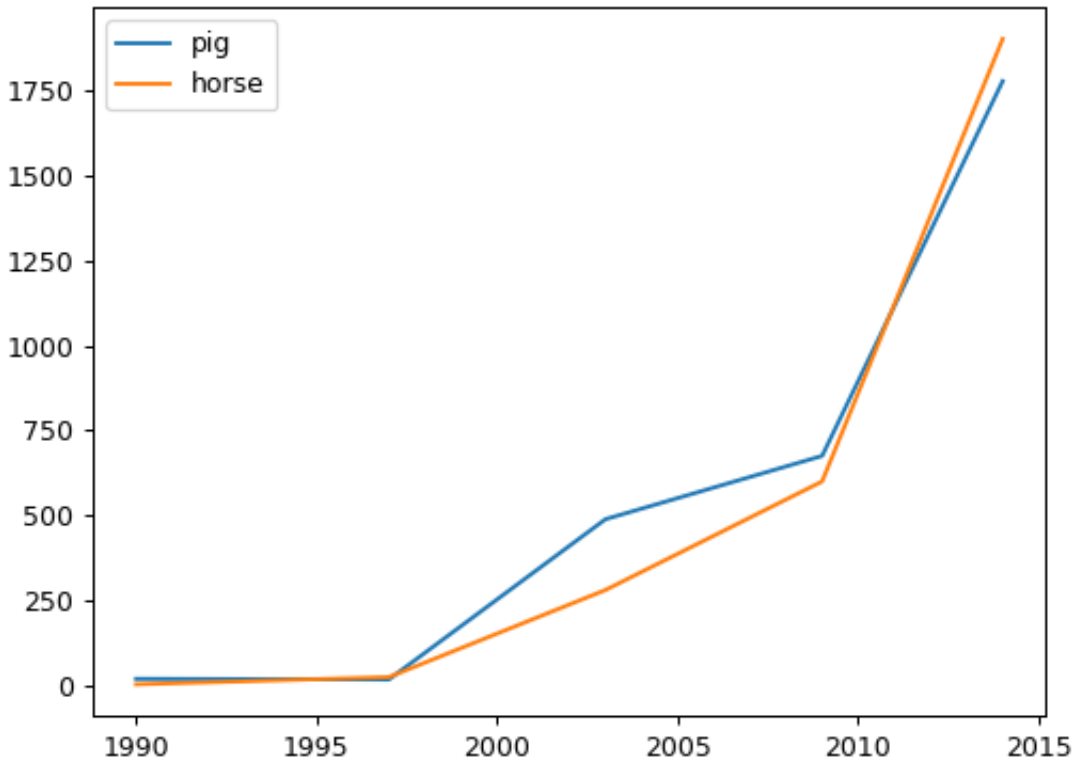
An example with subplots, so an array of axes is returned.

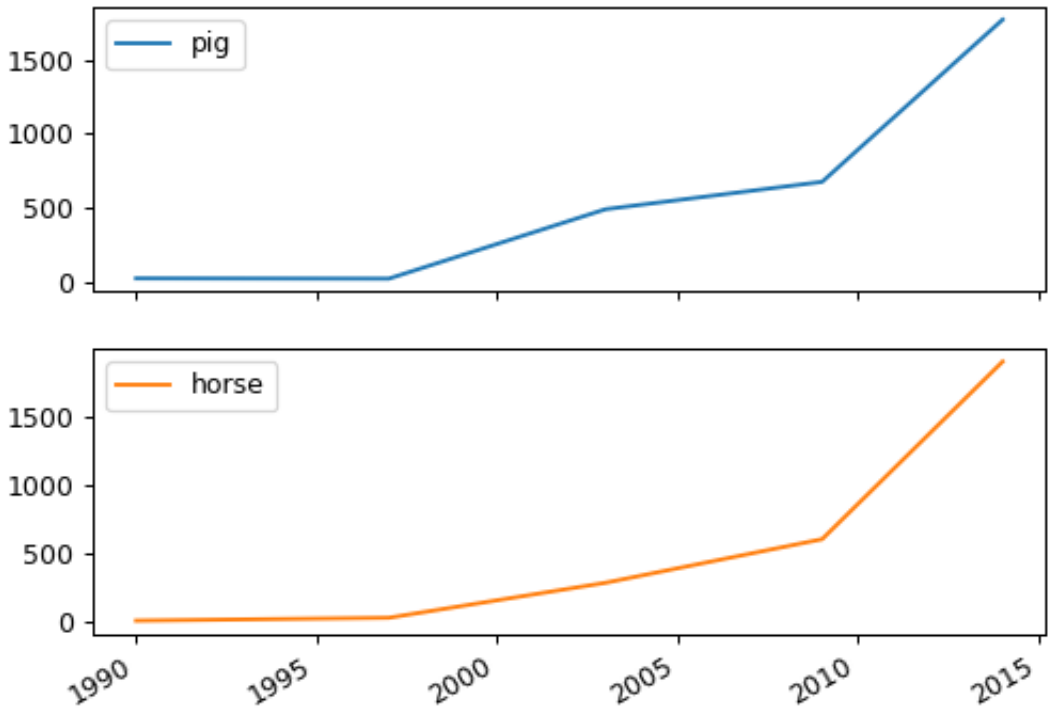
```
>>> axes = df.plot.line(subplots=True)
>>> type(axes)
<class 'numpy.ndarray'>
```

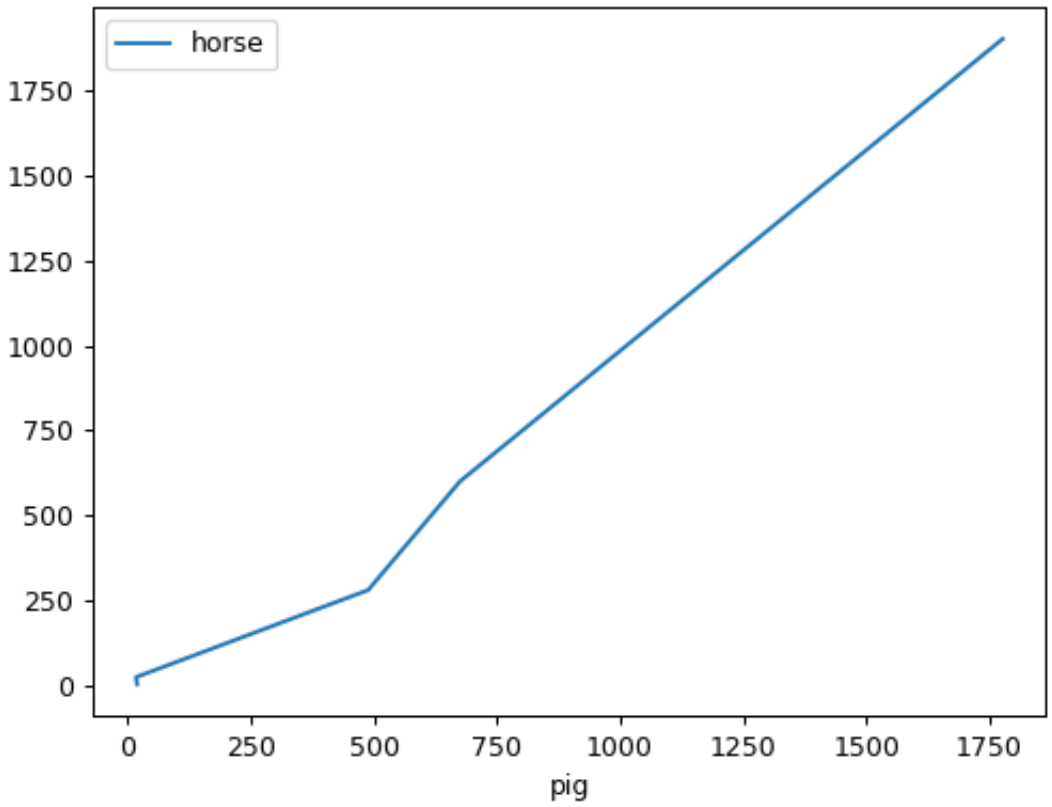
The following example shows the relationship between both populations.

```
>>> lines = df.plot.line(x='pig', y='horse')
```


3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00


pig
horse
1750
1500
1250
1000
750
500
250
0
1990
1995
2000
2005
2010
2015


pig
1500
1000
500
0
horse
1500
1000
500
0
1990
1995
2000
2005
2010
2015


horse
1750
1500
1250
1000
750
500
250
0
0
250
500
750
1000
1250
1500
1750
pig

databricks.koalas.Series.plot.pie

`plot.pie(y=None, **kwds)`

Generate a pie plot.

A pie plot is a proportional representation of the numerical data in a column. This function wraps `matplotlib.pyplot.pie()` for the specified column. If no column reference is passed and `subplots=True` a pie plot is drawn for each numerical column independently.

Parameters

y [int or label, optional] Label or position of the column to plot. If not provided, `subplots=True` argument must be passed.

****kwds** Keyword arguments to pass on to `Koalas.Series.plot()`.

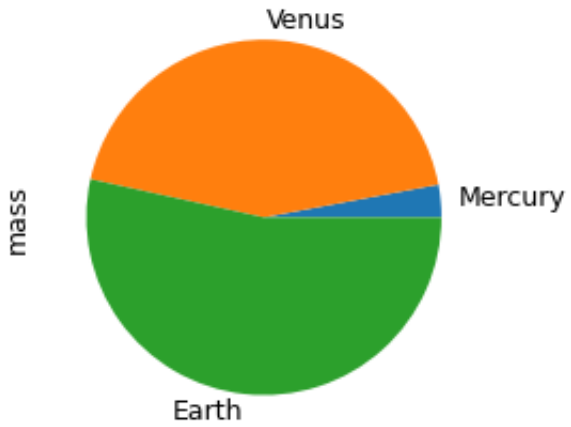
Returns

matplotlib.axes.Axes or np.ndarray of them A NumPy array is returned when *subplots* is True.

Examples

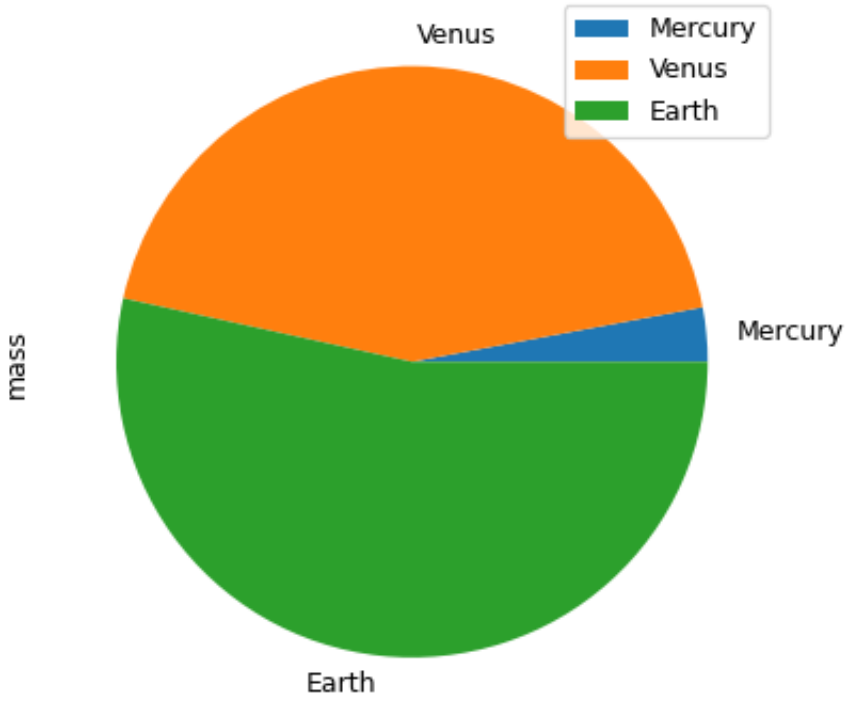
For Series:

```
>>> df = ks.DataFrame({'mass': [0.330, 4.87, 5.97],
...                    'radius': [2439.7, 6051.8, 6378.1]},
...                   index=['Mercury', 'Venus', 'Earth'])
>>> plot = df.mass.plot.pie(subplots=True, figsize=(6, 3))
```



For DataFrame:

```
>>> plot = df.plot.pie(y='mass', figsize=(5, 5))
```


Venus
Mercury
Venus
Earth
Mercury
mass
Earth

databricks.koalas.Series.plot.kde

`plot.kde(bw_method=None, ind=None, **kwargs)`

Generate Kernel Density Estimate plot using Gaussian kernels.

Parameters

bw_method [scalar] The method used to calculate the estimator bandwidth. See KernelDensity in PySpark for more information.

ind [NumPy array or integer, optional] Evaluation points for the estimated PDF. If None (default), 1000 equally spaced points are used. If *ind* is a NumPy array, the KDE is evaluated at the points passed. If *ind* is an integer, *ind* number of equally spaced points are used.

****kwargs** [optional] Keyword arguments to pass on to `Koalas.Series.plot()`.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

A scalar bandwidth should be specified. Using a small bandwidth value can lead to over-fitting, while using a large bandwidth value may result in under-fitting:

```
>>> s = ks.Series([1, 2, 2.5, 3, 3.5, 4, 5])
>>> ax = s.plot.kde(bw_method=0.3)
```

```
>>> ax = s.plot.kde(bw_method=3)
```

The *ind* parameter determines the evaluation points for the plot of the estimated KDF:

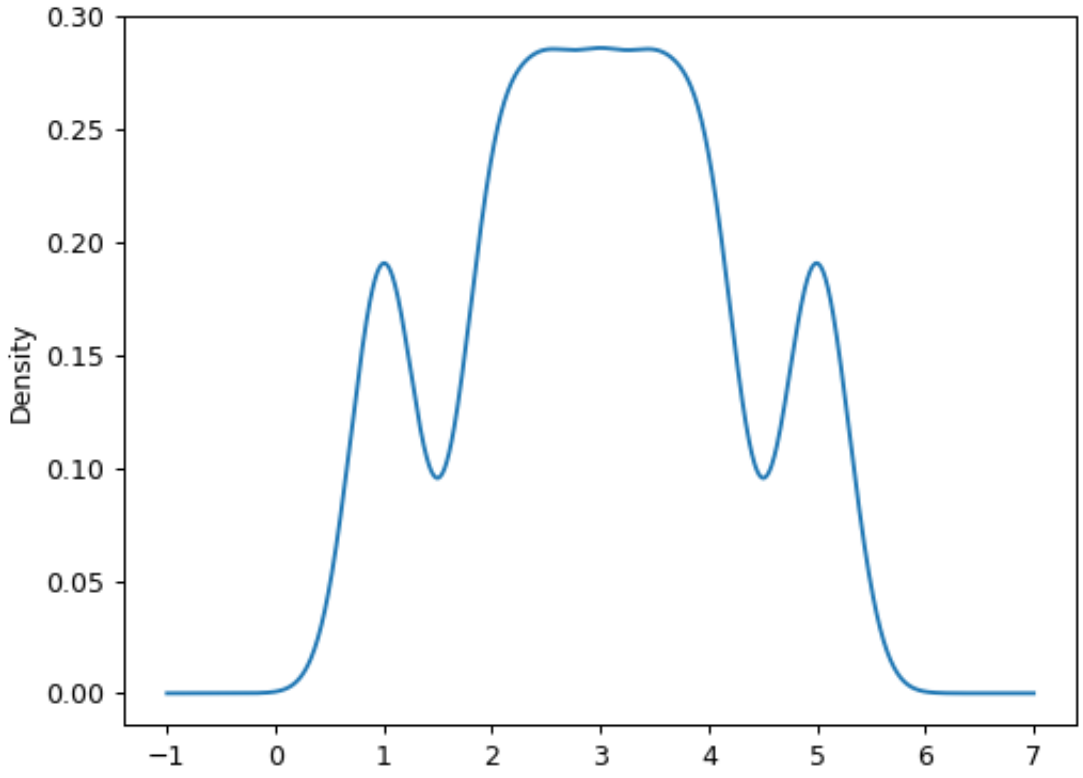
```
>>> ax = s.plot.kde(ind=[1, 2, 3, 4, 5], bw_method=0.3)
```

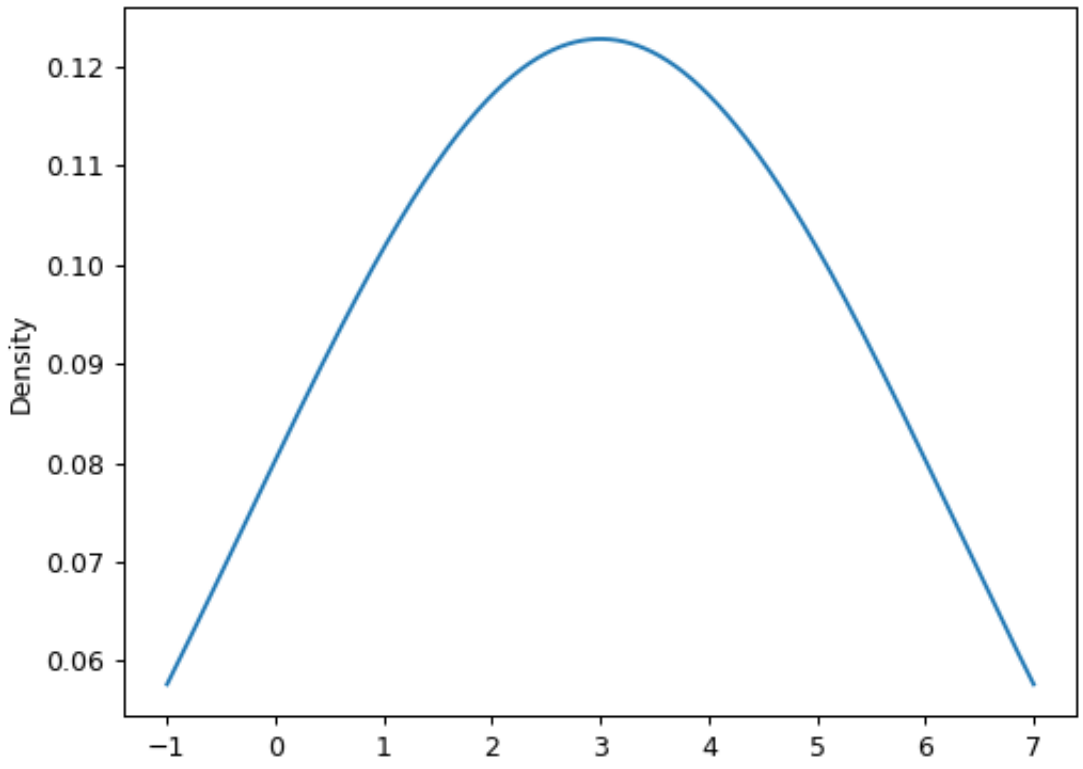
For DataFrame, it works in the same way as Series:

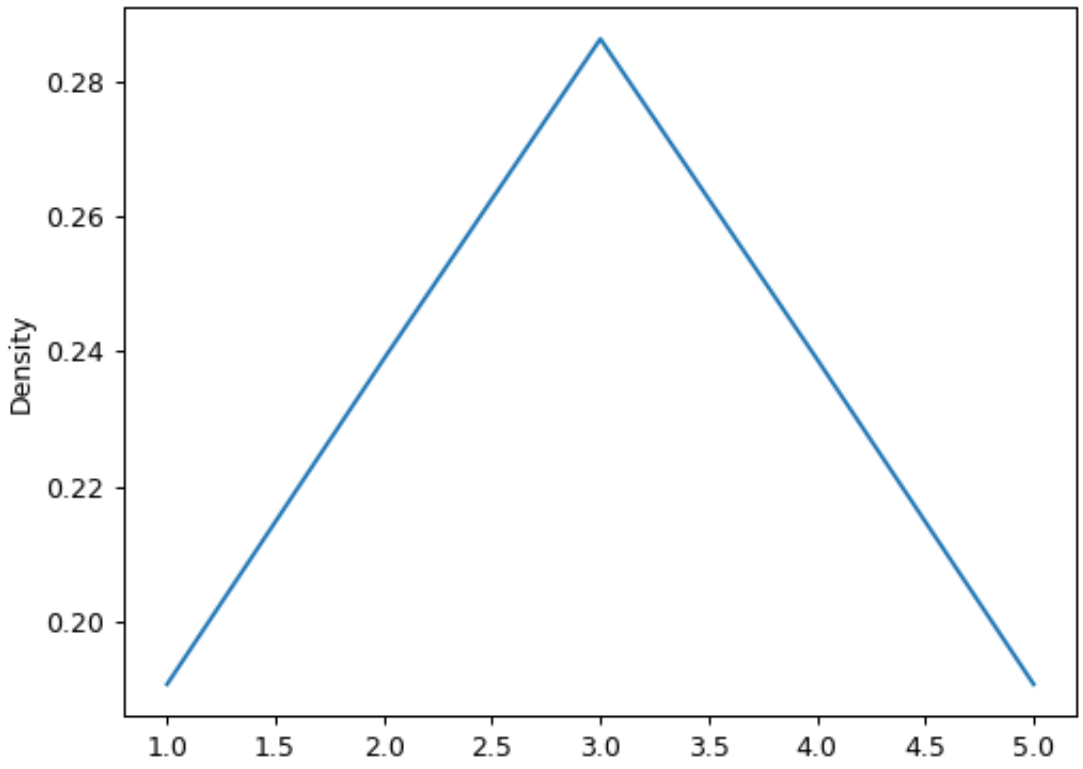
```
>>> df = ks.DataFrame({
...     'x': [1, 2, 2.5, 3, 3.5, 4, 5],
...     'y': [4, 4, 4.5, 5, 5.5, 6, 6],
... })
>>> ax = df.plot.kde(bw_method=0.3)
```

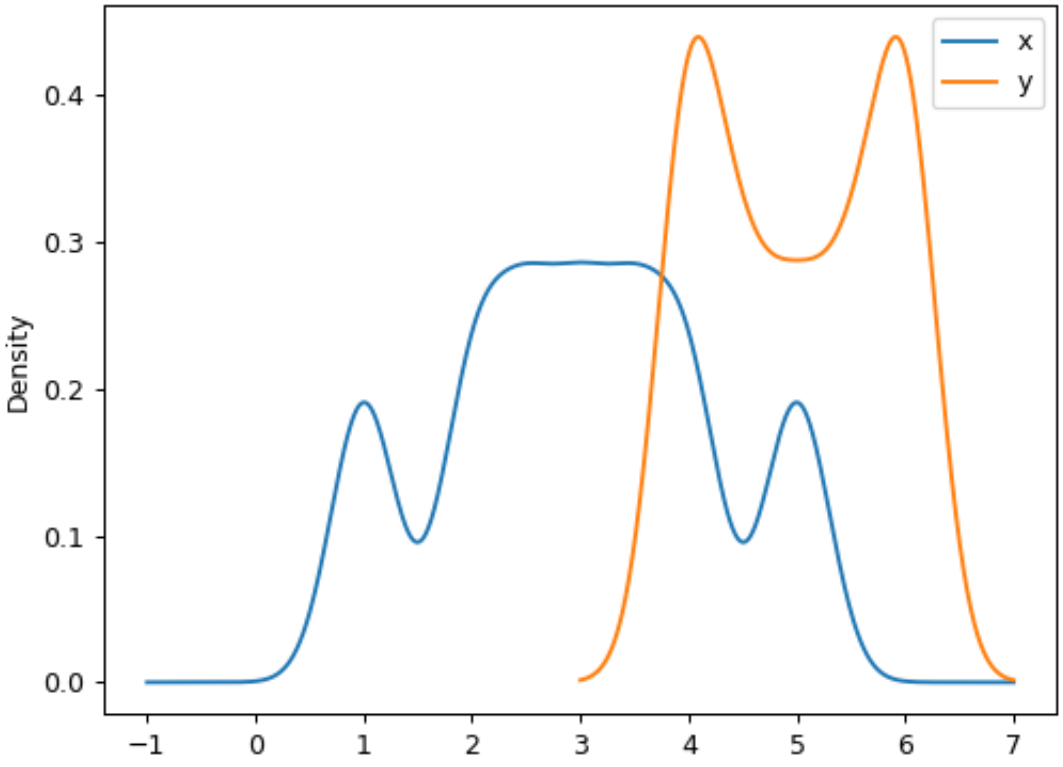
```
>>> ax = df.plot.kde(bw_method=3)
```

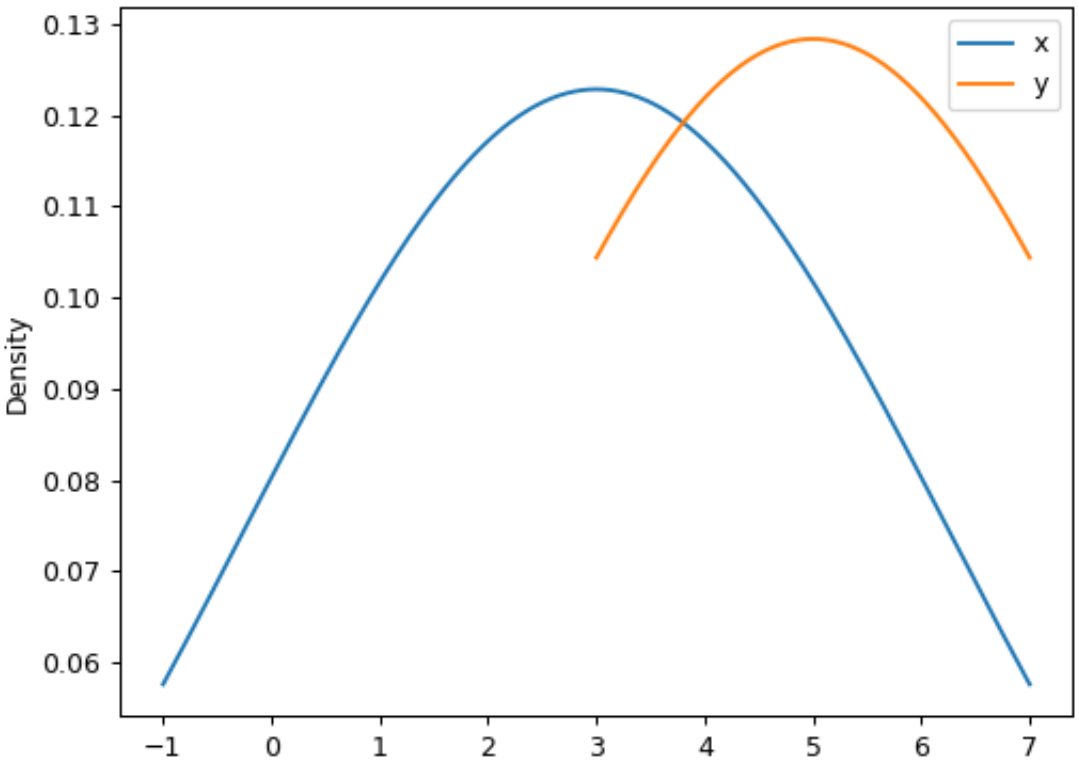
```
>>> ax = df.plot.kde(ind=[1, 2, 3, 4, 5, 6], bw_method=0.3)
```

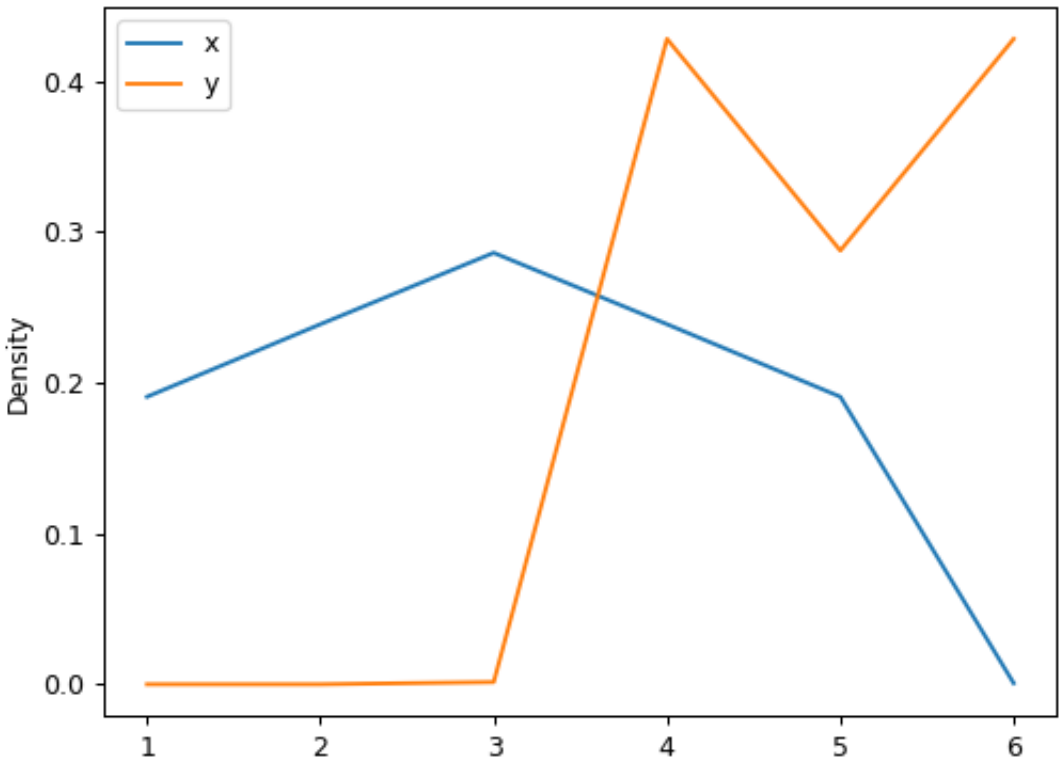

0.30
0.25
0.20
0.15
0.10
0.05
0.00
Density
−1
0
1
2
3
4
5
6
7


0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7


Density
0.28
0.26
0.24
0.22
0.20
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


x
y
Density
0.4
0.3
0.2
0.1
0.0
−1
0
1
2
3
4
5
6
7


0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7
x
y


x
y
Density
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
6

databricks.koalas.Series.hist

Series.**hist**(*bins=10*, ***kwds*) → matplotlib.axes._axes.Axes

Draw one histogram of the DataFrame's columns. A histogram is a representation of the distribution of data. This function calls `matplotlib.pyplot.hist()` or `plotting.backend.plot()`, on each series in the DataFrame, resulting in one histogram per column.

Parameters

bins [integer or sequence, default 10] Number of histogram bins to be used. If an integer is given, bins + 1 bin edges are calculated and returned. If bins is a sequence, gives bin edges, including left edge of first bin and right edge of last bin. In this case, bins is returned unmodified.

****kwds** All other plotting keyword arguments to be passed to `matplotlib.pyplot.hist()` Koalas.Series.plot.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

Basic plot.

For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.hist()
```

For DataFrame:

```
>>> df = pd.DataFrame(
...     np.random.randint(1, 7, 6000),
...     columns=['one'])
>>> df['two'] = df['one'] + np.random.randint(1, 7, 6000)
>>> df = ks.from_pandas(df)
>>> ax = df.plot.hist(bins=12, alpha=0.5)
```

3.3.18 Serialization / IO / Conversion

Series.to_pandas()	Return a pandas Series.
Series.to_numpy()	A NumPy ndarray representing the values in this DataFrame or Series.
Series.to_list()	Return a list of the values.
Series.to_string([buf, na_rep, ...])	Render a string representation of the Series.
Series.to_dict([into])	Convert Series to {label -> value} dict or dict-like object.
Series.to_clipboard([excel, sep])	Copy object to the system clipboard.
Series.to_latex([buf, columns, col_space, ...])	Render an object to a LaTeX tabular environment table.
Series.to_markdown([buf, mode])	Print Series or DataFrame in Markdown-friendly format.
Series.to_json([path, compression, ...])	Convert the object to a JSON string.

continues on next page

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Series.to_csv([path, sep, na_rep, columns, ...])	Write object to a comma-separated values (csv) file.
Series.to_excel(excel_writer[, sheet_name, ...])	Write object to an Excel sheet.
Series.to_frame([name])	Convert Series to DataFrame.

databricks.koalas.Series.to_pandas

Series.**to_pandas**() → pandas.core.series.Series
Return a pandas Series.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory.

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)], columns=['dogs',
↪'cats'])
>>> df['dogs'].to_pandas()
0    0.2
1    0.0
2    0.6
3    0.2
Name: dogs, dtype: float64
```

databricks.koalas.Series.to_numpy

Series.**to_numpy**() → numpy.ndarray
A NumPy ndarray representing the values in this DataFrame or Series.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

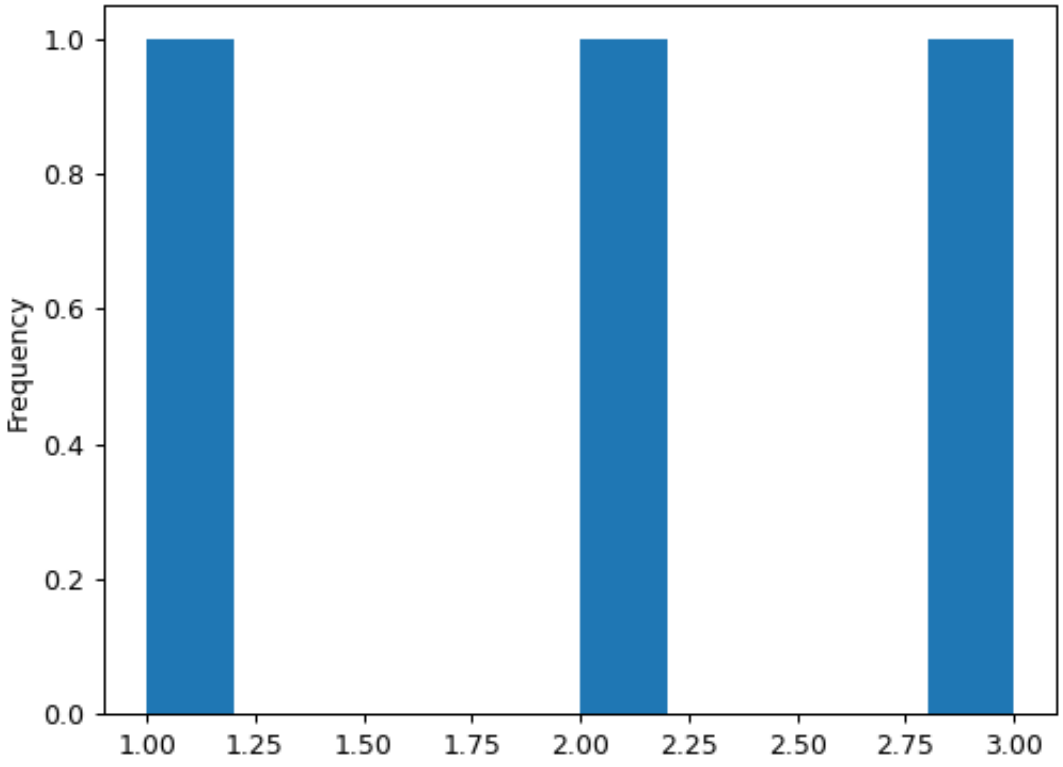
Examples

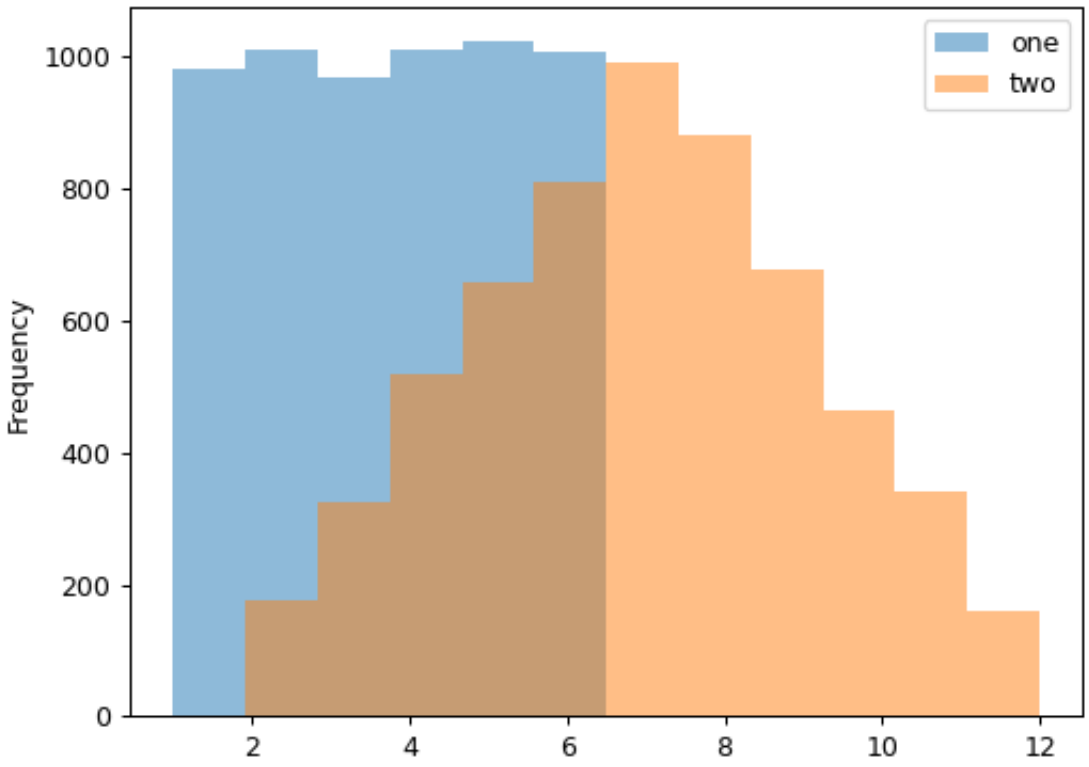
```
>>> ks.DataFrame({"A": [1, 2], "B": [3, 4]}).to_numpy()
array([[1, 3],
       [2, 4]])
```

With heterogeneous data, the lowest common type will have to be used.

```
>>> ks.DataFrame({"A": [1, 2], "B": [3.0, 4.5]}).to_numpy()
array([[1. , 3. ],
       [2. , 4.5]])
```

For a mix of numeric and non-numeric types, the output array will have object dtype.


Frequency
1.0
0.8
0.6
0.4
0.2
0.0
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00


one
two
Frequency
0
200
400
600
800
1000
2
4
6
8
10
12

```
>>> df = ks.DataFrame({"A": [1, 2], "B": [3.0, 4.5], "C": pd.date_range('2000',␣
↪periods=2)})
>>> df.to_numpy()
array([[1, 3.0, Timestamp('2000-01-01 00:00:00')],
       [2, 4.5, Timestamp('2000-01-02 00:00:00')]], dtype=object)
```

For Series,

```
>>> ks.Series(['a', 'b', 'a']).to_numpy()
array(['a', 'b', 'a'], dtype=object)
```

databricks.koalas.Series.to_list

Series.**to_list**() → List

Return a list of the values.

These are each a scalar type, which is a Python scalar (for str, int, float) or a pandas scalar (for Timestamp/Timedelta/Interval/Period)

Note: This method should only be used if the resulting list is expected to be small, as all the data is loaded into the driver's memory.

---

databricks.koalas.Series.to_string

Series.**to_string**(*buf=None*, *na_rep='NaN'*, *float_format=None*, *header=True*, *index=True*, *length=False*, *dtype=False*, *name=False*, *max_rows=None*) → str

Render a string representation of the Series.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory. If the input is large, set max_rows parameter.

Parameters

buf [StringIO-like, optional] buffer to write to

na_rep [string, optional] string representation of NAN to use, default 'NaN'

float_format [one-parameter function, optional] formatter function to apply to columns' elements if they are floats default None

header [boolean, default True] Add the Series header (index name)

index [bool, optional] Add index (row) labels, default True

length [boolean, default False] Add the Series length

dtype [boolean, default False] Add the Series dtype

name [boolean, default False] Add the Series name if not None

max_rows [int, optional] Maximum number of rows to show before truncating. If None, show all.

Returns

formatted [string (if not buffer passed)]

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)], columns=['dogs',
↪'cats'])
>>> print(df['dogs'].to_string())
0    0.2
1    0.0
2    0.6
3    0.2
```

```
>>> print(df['dogs'].to_string(max_rows=2))
0    0.2
1    0.0
```

databricks.koalas.Series.to_dict

`Series.`**`to_dict`**(*into=<class 'dict'>*) → collections.abc.Mapping

Convert Series to {label -> value} dict or dict-like object.

Note: This method should only be used if the resulting pandas DataFrame is expected to be small, as all the data is loaded into the driver's memory.

Parameters

into [class, default dict] The collections.abc.Mapping subclass to use as the return object. Can be the actual class or an empty instance of the mapping type you want. If you want a collections.defaultdict, you must pass it initialized.

Returns

collections.abc.Mapping Key-value representation of Series.

Examples

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s_dict = s.to_dict()
>>> sorted(s_dict.items())
[(0, 1), (1, 2), (2, 3), (3, 4)]
```

```
>>> from collections import OrderedDict, defaultdict
>>> s.to_dict(OrderedDict)
OrderedDict([(0, 1), (1, 2), (2, 3), (3, 4)])
```

```
>>> dd = defaultdict(list)
>>> s.to_dict(dd)
defaultdict(<class 'list'>, {...})
```

databricks.koalas.Series.to_clipboard

`Series.`**`to_clipboard`**(*excel=True*, *sep=None*, ***kwargs*) → None

Copy object to the system clipboard.

Write a text representation of object to the system clipboard. This can be pasted into Excel, for example.

Note: This method should only be used if the resulting DataFrame is expected to be small, as all the data is loaded into the driver's memory.

Parameters

excel [bool, default True]

- True, use the provided separator, writing in a csv format for allowing easy pasting into excel.
- False, write a string representation of the object to the clipboard.

sep [str, default `'\t'`] Field delimiter.

****kwargs** These parameters will be passed to DataFrame.to_csv.

See also:

read_clipboard Read text from clipboard.

Notes

Requirements for your platform.

- Linux : *xclip*, or *xsel* (with *gtk* or *PyQt4* modules)
- Windows : none
- OS X : none

Examples

Copy the contents of a DataFrame to the clipboard.

```
>>> df = ks.DataFrame([[1, 2, 3], [4, 5, 6]], columns=['A', 'B', 'C'])
>>> df.to_clipboard(sep=',')
... # Wrote the following to the system clipboard:
... # ,A,B,C
... # 0,1,2,3
... # 1,4,5,6
```

We can omit the index by passing the keyword *index* and setting it to false.

```
>>> df.to_clipboard(sep=',', index=False)
... # Wrote the following to the system clipboard:
... # A,B,C
... # 1,2,3
... # 4,5,6
```

This function also works for Series:

```
>>> df = ks.Series([1, 2, 3, 4, 5, 6, 7], name='x')
>>> df.to_clipboard(sep=',')
... # Wrote the following to the system clipboard:
... # 0, 1
... # 1, 2
... # 2, 3
... # 3, 4
... # 4, 5
... # 5, 6
... # 6, 7
```

databricks.koalas.Series.to_latex

Series.**to_latex**(*buf=None*, *columns=None*, *col_space=None*, *header=True*, *index=True*, *na_rep='NaN'*, *formatters=None*, *float_format=None*, *sparsify=None*, *index_names=True*, *bold_rows=False*, *column_format=None*, *longtable=None*, *escape=None*, *encoding=None*, *decimal='.'*, *multicolumn=None*, *multicolumn_format=None*, *multirow=None*) → Optional[str]

Render an object to a LaTeX tabular environment table.

Render an object to a tabular environment table. You can splice this into a LaTeX document. Requires usepackage{booktabs}.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory. If the input is large, consider alternative formats.

Parameters

buf [file descriptor or None] Buffer to write to. If None, the output is returned as a string.

columns [list of label, optional] The subset of columns to write. Writes all columns by default.

col_space [int, optional] The minimum width of each column.

header [bool or list of str, default True] Write out the column names. If a list of strings is given, it is assumed to be aliases for the column names.

index [bool, default True] Write row names (index).

na_rep [str, default 'NaN'] Missing data representation.

formatters [list of functions or dict of {str: function}, optional] Formatter functions to apply to columns' elements by position or name. The result of each function must be a unicode string. List must be of length equal to the number of columns.

float_format [str, optional] Format string for floating point numbers.

sparsify [bool, optional] Set to False for a DataFrame with a hierarchical index to print every multiindex key at each row. By default, the value will be read from the config module.

index_names [bool, default True] Prints the names of the indexes.

bold_rows [bool, default False] Make the row labels bold in the output.

column_format [str, optional] The columns format as specified in LaTeX table format e.g. 'rcl' for 3 columns. By default, 'l' will be used for all columns except columns of numbers, which default to 'r'.

longtable [bool, optional] By default, the value will be read from the pandas config module. Use a longtable environment instead of tabular. Requires adding a usepackage{longtable} to your LaTeX preamble.

escape [bool, optional] By default, the value will be read from the pandas config module. When set to False prevents from escaping latex special characters in column names.

encoding [str, optional] A string representing the encoding to use in the output file, defaults to 'ascii' on Python 2 and 'utf-8' on Python 3.

decimal [str, default '.'] Character recognized as decimal separator, e.g. ',' in Europe.

multicolumn [bool, default True] Use multicolumn to enhance MultiIndex columns. The default will be read from the config module.

multicolumn_format [str, default 'l'] The alignment for multicolumns, similar to column_format The default will be read from the config module.

multirow [bool, default False] Use multirow to enhance MultiIndex rows. Requires adding a usepackage{multirow} to your LaTeX preamble. Will print centered labels (instead of top-aligned) across the contained rows, separating groups via clines. The default will be read from the pandas config module.

Returns

str or None If buf is None, returns the resulting LateX format as a string. Otherwise returns None.

See also:

DataFrame.to_string Render a DataFrame to a console-friendly tabular output.

DataFrame.to_html Render a DataFrame as an HTML table.

Examples

```
>>> df = ks.DataFrame({'name': ['Raphael', 'Donatello'],
...                    'mask': ['red', 'purple'],
...                    'weapon': ['sai', 'bo staff']},
...                   columns=['name', 'mask', 'weapon'])
>>> df.to_latex(index=False)
'\\begin{tabular}{lll}\n\\toprule\n name & mask & weapon
\\\\\n\\midrule\n Raphael & red & sai \\\\\n Donatello &
purple & bo staff \\\\\n\\bottomrule\n\\end{tabular}\n'
```

databricks.koalas.Series.to_markdown

`Series.`**`to_markdown`**(*buf=None*, *mode=None*) → str

Print Series or DataFrame in Markdown-friendly format.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory.

Parameters

buf [writable buffer, defaults to sys.stdout] Where to send the output. By default, the output is printed to sys.stdout. Pass a writable buffer if you need to further process the output.

mode [str, optional] Mode in which file is opened.

****kwargs** These parameters will be passed to *tabulate*.

Returns

str Series or DataFrame in Markdown-friendly format.

Examples

```
>>> kser = ks.Series(["elk", "pig", "dog", "quetzal"], name="animal")
>>> print(kser.to_markdown())
|    | animal   |
|---:|:---------|
|  0 | elk      |
|  1 | pig      |
|  2 | dog      |
|  3 | quetzal  |
```

```
>>> kdf = ks.DataFrame(
...     data={"animal_1": ["elk", "pig"], "animal_2": ["dog", "quetzal"]}
... )
>>> print(kdf.to_markdown())
|    | animal_1   | animal_2   |
|---:|:-----------|:-----------|
|  0 | elk        | dog        |
|  1 | pig        | quetzal    |
```

databricks.koalas.Series.to_json

Series.**to_json**(*path=None*, *compression='uncompressed'*, *num_files=None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → Optional[str]

Convert the object to a JSON string.

Note: Koalas *to_json* writes files to a path or URI. Unlike pandas', Koalas respects HDFS's property such as 'fs.default.name'.

Note: Koalas writes JSON files into the directory, *path*, and writes multiple *part-...* files in the directory when *path* is specified. This behaviour was inherited from Apache Spark. The number of files can be controlled by *num_files*.

Note: output JSON format is different from pandas'. It always use *orient='records'* for its output. This behaviour might have to change in the near future.

Note NaN's and None will be converted to null and datetime objects will be converted to UNIX timestamps.

Parameters

path [string, optional] File path. If not specified, the result is returned as a string.

compression [{'gzip', 'bz2', 'xz', None}] A string representing the compression to use in the output file, only used when the first argument is a filename. By default, the compression is inferred from the filename.

num_files [the number of files to be written in *path* directory when] this is a path.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'},] default 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options: keyword arguments for additional options specific to PySpark. It is specific to PySpark's JSON options to pass. Check the options in PySpark's API documentation for *spark.write.json(...)*. It has a higher priority and overwrites all other options. This parameter only works when *path* is specified.

Returns

str or None

Examples

```
>>> df = ks.DataFrame([['a', 'b'], ['c', 'd']],
...                   columns=['col 1', 'col 2'])
>>> df.to_json()
'[{"col 1":"a","col 2":"b"},{"col 1":"c","col 2":"d"}]'
```

```
>>> df['col 1'].to_json()
'[{"col 1":"a"},{"col 1":"c"}]'
```

```
>>> df.to_json(path=r'%s/to_json/foo.json' % path, num_files=1)
>>> ks.read_json(
...     path=r'%s/to_json/foo.json' % path
... ).sort_values(by="col 1")
  col 1 col 2
0     a     b
1     c     d
```

```
>>> df['col 1'].to_json(path=r'%s/to_json/foo.json' % path, num_files=1, index_
↪col="index")
>>> ks.read_json(
...     path=r'%s/to_json/foo.json' % path, index_col="index"
... ).sort_values(by="col 1")
      col 1
index
```

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```
0          a
1          c
```

databricks.koalas.Series.to_csv

Series.**to_csv**(*path=None*, *sep=','*, *na_rep=''*, *columns=None*, *header=True*, *quotechar='"'*, *date_format=None*, *escapechar=None*, *num_files=None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → Optional[str]

Write object to a comma-separated values (csv) file.

Note: Koalas *to_csv* writes files to a path or URI. Unlike pandas', Koalas respects HDFS's property such as 'fs.default.name'.

Note: Koalas writes CSV files into the directory, *path*, and writes multiple *part-...* files in the directory when *path* is specified. This behaviour was inherited from Apache Spark. The number of files can be controlled by *num_files*.

Parameters

path [str, default None] File path. If None is provided the result is returned as a string.

sep [str, default ','] String of length 1. Field delimiter for the output file.

na_rep [str, default ''] Missing data representation.

columns [sequence, optional] Columns to write.

header [bool or list of str, default True] Write out the column names. If a list of strings is given it is assumed to be aliases for the column names.

quotechar [str, default '"'] String of length 1. Character used to quote fields.

date_format [str, default None] Format string for datetime objects.

escapechar [str, default None] String of length 1. Character used to escape *sep* and *quotechar* when appropriate.

num_files [the number of files to be written in *path* directory when] this is a path.

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'},] default 'overwrite'. Specifies the behavior of the save operation when the destination exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options: keyword arguments for additional options specific to PySpark. This kwargs are specific to PySpark's CSV options to pass. Check the options in PySpark's API documentation for spark.write.csv(...). It has higher priority and overwrites all other options. This parameter only works when *path* is specified.

Returns

str or None

See also:

read_csv

DataFrame.to_delta

DataFrame.to_table

DataFrame.to_parquet

DataFrame.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df.sort_values(by="date")
                   date country  code
... 2012-01-31 12:00:00      KR     1
... 2012-02-29 12:00:00      US     2
... 2012-03-31 12:00:00      JP     3
```

```
>>> print(df.to_csv())
date,country,code
2012-01-31 12:00:00,KR,1
2012-02-29 12:00:00,US,2
2012-03-31 12:00:00,JP,3
```

```
>>> df.cummax().to_csv(path=r'%s/to_csv/foo.csv' % path, num_files=1)
>>> ks.read_csv(
...    path=r'%s/to_csv/foo.csv' % path
... ).sort_values(by="date")
                   date country  code
... 2012-01-31 12:00:00      KR     1
... 2012-02-29 12:00:00      US     2
... 2012-03-31 12:00:00      US     3
```

In case of Series,

```
>>> print(df.date.to_csv())
date
2012-01-31 12:00:00
2012-02-29 12:00:00
2012-03-31 12:00:00
```

```
>>> df.date.to_csv(path=r'%s/to_csv/foo.csv' % path, num_files=1)
>>> ks.read_csv(
...     path=r'%s/to_csv/foo.csv' % path
... ).sort_values(by="date")
                   date
... 2012-01-31 12:00:00
... 2012-02-29 12:00:00
... 2012-03-31 12:00:00
```

You can preserve the index in the roundtrip as below.

```
>>> df.set_index("country", append=True, inplace=True)
>>> df.date.to_csv(
...     path=r'%s/to_csv/bar.csv' % path,
...     num_files=1,
...     index_col=["index1", "index2"])
>>> ks.read_csv(
...     path=r'%s/to_csv/bar.csv' % path, index_col=["index1", "index2"]
... ).sort_values(by="date")
                             date
index1 index2
...    ...    2012-01-31 12:00:00
...    ...    2012-02-29 12:00:00
...    ...    2012-03-31 12:00:00
```

databricks.koalas.Series.to_excel

Series.**to_excel**(*excel_writer*, *sheet_name='Sheet1'*, *na_rep=''*, *float_format=None*, *columns=None*, *header=True*, *index=True*, *index_label=None*, *startrow=0*, *startcol=0*, *engine=None*, *merge_cells=True*, *encoding=None*, *inf_rep='inf'*, *verbose=True*, *freeze_panes=None*) → None

Write object to an Excel sheet.

Note: This method should only be used if the resulting DataFrame is expected to be small, as all the data is loaded into the driver's memory.

To write a single object to an Excel .xlsx file it is only necessary to specify a target file name. To write to multiple sheets it is necessary to create an *ExcelWriter* object with a target file name, and specify a sheet in the file to write to.

Multiple sheets may be written to by specifying unique *sheet_name*. With all data written to the file it is necessary to save the changes. Note that creating an *ExcelWriter* object with a file name that already exists will result in the contents of the existing file being erased.

Parameters

excel_writer [str or ExcelWriter object] File path or existing ExcelWriter.

sheet_name [str, default 'Sheet1'] Name of sheet which will contain DataFrame.

na_rep [str, default ''] Missing data representation.

float_format [str, optional] Format string for floating point numbers. For example `float_format="%%.2f"` will format 0.1234 to 0.12.

columns [sequence or list of str, optional] Columns to write.

header [bool or list of str, default True] Write out the column names. If a list of string is given it is assumed to be aliases for the column names.

index [bool, default True] Write row names (index).

index_label [str or sequence, optional] Column label for index column(s) if desired. If not specified, and *header* and *index* are True, then the index names are used. A sequence should be given if the DataFrame uses MultiIndex.

startrow [int, default 0] Upper left cell row to dump data frame.

startcol [int, default 0] Upper left cell column to dump data frame.

engine [str, optional] Write engine to use, 'openpyxl' or 'xlsxwriter'. You can also set this via the options `io.excel.xlsx.writer`, `io.excel.xls.writer`, and `io.excel.xlsm.writer`.

merge_cells [bool, default True] Write MultiIndex and Hierarchical Rows as merged cells.

encoding [str, optional] Encoding of the resulting excel file. Only necessary for xlwt, other writers support unicode natively.

inf_rep [str, default 'inf'] Representation for infinity (there is no native representation for infinity in Excel).

verbose [bool, default True] Display more information in the error logs.

freeze_panes [tuple of int (length 2), optional] Specifies the one-based bottommost row and rightmost column that is to be frozen.

See also:

read_excel Read Excel file.

Notes

Once a workbook has been saved it is not possible write further data without rewriting the whole workbook.

Examples

Create, write to and save a workbook:

```
>>> df1 = ks.DataFrame([['a', 'b'], ['c', 'd']],
...                    index=['row 1', 'row 2'],
...                    columns=['col 1', 'col 2'])
>>> df1.to_excel("output.xlsx")
```

To specify the sheet name:

```
>>> df1.to_excel("output.xlsx")
>>> df1.to_excel("output.xlsx",
...              sheet_name='Sheet_name_1')
```

If you wish to write to more than one sheet in the workbook, it is necessary to specify an ExcelWriter object:

```
>>> with pd.ExcelWriter('output.xlsx') as writer:
...      df1.to_excel(writer, sheet_name='Sheet_name_1')
...      df2.to_excel(writer, sheet_name='Sheet_name_2')
```

To set the library that is used to write the Excel file, you can pass the *engine* keyword (the default engine is automatically chosen depending on the file extension):

```
>>> df1.to_excel('output1.xlsx', engine='xlsxwriter')
```

databricks.koalas.Series.to_frame

Series.**to_frame**(*name: Union[Any, Tuple] = None*) → databricks.koalas.frame.DataFrame

Convert Series to DataFrame.

Parameters

name [object, default None] The passed name should substitute for the series name (if it has one).

Returns

DataFrame DataFrame representation of Series.

Examples

```
>>> s = ks.Series(["a", "b", "c"])
>>> s.to_frame()
   0
0  a
1  b
2  c
```

```
>>> s = ks.Series(["a", "b", "c"], name="vals")
>>> s.to_frame()
  vals
0    a
1    b
2    c
```

3.3.19 Koalas-specific

`Series.koalas` provides Koalas-specific features that exists only in Koalas. These can be accessed by `Series.koalas.<function/property>`.

Series.koalas.transform_batch(func, *args, ...)	Transform the data with the function that takes pandas Series and outputs pandas Series.

databricks.koalas.Series.koalas.transform_batch

koalas.**transform_batch**(*func*, **args*, ***kwargs*) → Series

Transform the data with the function that takes pandas Series and outputs pandas Series. The pandas Series given to the function is of a batch used internally.

See also Transform and apply a function.

Note: the *func* is unable to access to the whole input series. Koalas internally splits the input series into multiple batches and calls *func* with each batch multiple times. Therefore, operations such as global aggregations are impossible. See the example below.

```
>>> # This case does not return the length of whole frame but of the batch␣
↪internally
... # used.
... def length(pser) -> ks.Series[int]:
...     return pd.Series([len(pser)] * len(pser))
...
>>> df = ks.DataFrame({'A': range(1000)})
>>> df.A.koalas.transform_batch(length)
    c0
0   83
1   83
2   83
...
```

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def plus_one(x) -> ks.Series[int]:
...     return x + 1
```

Parameters

func [function] Function to apply to each pandas frame.

***args** Positional arguments to pass to func.

****kwargs** Keyword arguments to pass to func.

Returns

DataFrame

See also:

DataFrame.koalas.apply_batch Similar but it takes pandas DataFrame as its internal batch.

Examples

```
>>> df = ks.DataFrame([(1, 2), (3, 4), (5, 6)], columns=['A', 'B'])
>>> df
   A  B
0  1  2
1  3  4
2  5  6
```

```
>>> def plus_one_func(pser) -> ks.Series[np.int64]:
...     return pser + 1
>>> df.A.koalas.transform_batch(plus_one_func)
0    2
1    4
2    6
Name: A, dtype: int64
```

You can also omit the type hints so Koalas infers the return schema as below:

```
>>> df.A.koalas.transform_batch(lambda pser: pser + 1)
0    2
1    4
2    6
Name: A, dtype: int64
```

You can also specify extra arguments.

```
>>> def plus_one_func(pser, a, b, c=3) -> ks.Series[np.int64]:
...     return pser + a + b + c
>>> df.A.koalas.transform_batch(plus_one_func, 1, b=2)
0     7
1     9
2    11
Name: A, dtype: int64
```

You can also use `np.ufunc` and built-in functions as input.

```
>>> df.A.koalas.transform_batch(np.add, 10)
0    11
1    13
2    15
Name: A, dtype: int64
```

```
>>> (df * -1).A.koalas.transform_batch(abs)
0    1
1    3
2    5
Name: A, dtype: int64
```

3.4 DataFrame

3.4.1 Constructor

DataFrame([data, index, columns, dtype, copy])	Koalas DataFrame that corresponds to pandas DataFrame logically.

databricks.koalas.DataFrame

class databricks.koalas.**DataFrame**(*data=None*, *index=None*, *columns=None*, *dtype=None*, *copy=False*)

Koalas DataFrame that corresponds to pandas DataFrame logically. This holds Spark DataFrame internally.

Variables **_internal** – an internal immutable Frame to manage metadata.

Parameters

data [numpy ndarray (structured or homogeneous), dict, pandas DataFrame, Spark DataFrame or Koalas Series] Dict can contain Series, arrays, constants, or list-like objects If data is a dict, argument order is maintained for Python 3.6 and later. Note that if *data* is a pandas DataFrame, a Spark DataFrame, and a Koalas Series, other arguments should not be used.

index [Index or array-like] Index to use for resulting frame. Will default to RangeIndex if no indexing information part of input data and no index provided

columns [Index or array-like] Column labels to use for resulting frame. Will default to RangeIndex (0, 1, 2, …, n) if no column labels are provided

dtype [dtype, default None] Data type to force. Only a single dtype is allowed. If None, infer

copy [boolean, default False] Copy data from inputs. Only affects DataFrame / 2d ndarray input

Examples

Constructing DataFrame from a dictionary.

```
>>> d = {'col1': [1, 2], 'col2': [3, 4]}
>>> df = ks.DataFrame(data=d, columns=['col1', 'col2'])
>>> df
   col1  col2
0     1     3
1     2     4
```

Constructing DataFrame from pandas DataFrame

```
>>> df = ks.DataFrame(pd.DataFrame(data=d, columns=['col1', 'col2']))
>>> df
   col1  col2
0     1     3
1     2     4
```

Notice that the inferred dtype is int64.

```
>>> df.dtypes
col1    int64
col2    int64
dtype: object
```

To enforce a single dtype:

```
>>> df = ks.DataFrame(data=d, dtype=np.int8)
>>> df.dtypes
col1    int8
col2    int8
dtype: object
```

Constructing DataFrame from numpy ndarray:

```
>>> df2 = ks.DataFrame(np.random.randint(low=0, high=10, size=(5, 5)),
...                    columns=['a', 'b', 'c', 'd', 'e'])
>>> df2
   a  b  c  d  e
0  3  1  4  9  8
1  4  8  4  8  4
2  7  6  5  6  7
3  8  7  9  1  0
4  2  5  4  3  9
```

__init__(*data=None*, *index=None*, *columns=None*, *dtype=None*, *copy=False*)
Initialize self. See help(type(self)) for accurate signature.

Methods

__init__([data, index, columns, dtype, copy])	Initialize self.
abs()	Return a Series/DataFrame with absolute numeric value of each element.
add(other)	Get Addition of dataframe and other, element-wise (binary operator +).
add_prefix(prefix)	Prefix labels with string *prefix*.
add_suffix(suffix)	Suffix labels with string *suffix*.
agg(func)	Aggregate using one or more operations over the specified axis.
aggregate(func)	Aggregate using one or more operations over the specified axis.
all([axis])	Return whether all elements are True.
any([axis])	Return whether any element is True.
append(other[, ignore_index, ...])	Append rows of other to the end of caller, returning a new object.
apply(func[, axis, args])	Apply a function along an axis of the DataFrame.
apply_batch(func[, args])	Apply a function that takes pandas DataFrame and outputs pandas DataFrame.
applymap(func)	Apply a function to a Dataframe elementwise.
assign(**kwargs)	Assign new columns to a DataFrame.
astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.

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backfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
bfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
bool()	Return the bool of a single element in the current object.
cache()	Yields and caches the current DataFrame.
clip([lower, upper])	Trim values at input threshold(s).
copy([deep])	Make a copy of this object's indices and data.
corr([method])	Compute pairwise correlation of columns, excluding NA/null values.
count([axis])	Count non-NA cells for each column.
cummax([skipna])	Return cumulative maximum over a DataFrame or Series axis.
cummin([skipna])	Return cumulative minimum over a DataFrame or Series axis.
cumprod([skipna])	Return cumulative product over a DataFrame or Series axis.
cumsum([skipna])	Return cumulative sum over a DataFrame or Series axis.
describe([percentiles])	Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding `NaN` values.
diff([periods, axis])	First discrete difference of element.
div(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
divide(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
dot(other)	Compute the matrix multiplication between the DataFrame and other.
drop([labels, axis, columns])	Drop specified labels from columns.
drop_duplicates([subset, keep, inplace])	Return DataFrame with duplicate rows removed, optionally only considering certain columns.
droplevel(level[, axis])	Return DataFrame with requested index / column level(s) removed.
dropna([axis, how, thresh, subset, inplace])	Remove missing values.
duplicated([subset, keep])	Return boolean Series denoting duplicate rows, optionally only considering certain columns.
eq(other)	Compare if the current value is equal to the other.
equals(other)	Compare if the current value is equal to the other.
eval(expr[, inplace])	Evaluate a string describing operations on DataFrame columns.
expanding([min_periods])	Provide expanding transformations.
explain([extended, mode])	Prints the underlying (logical and physical) Spark plans to the console for debugging purpose.
explode(column)	Transform each element of a list-like to a row, replicating index values.
ffill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill``.
fillna([value, method, axis, inplace, limit])	Fill NA/NaN values.

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filter([items, like, regex, axis])	Subset rows or columns of dataframe according to labels in the specified index.
first_valid_index()	Retrieves the index of the first valid value.
floordiv(other)	Get Integer division of dataframe and other, element-wise (binary operator //).
from_dict(data[, orient, dtype, columns])	Construct DataFrame from dict of array-like or dicts.
from_records(data[, index, exclude, ...])	Convert structured or record ndarray to DataFrame.
ge(other)	Compare if the current value is greater than or equal to the other.
get(key[, default])	Get item from object for given key (DataFrame column, Panel slice, etc.).
get_dtype_counts()	Return counts of unique dtypes in this object.
groupby(by[, axis, as_index, dropna])	Group DataFrame or Series using a Series of columns.
gt(other)	Compare if the current value is greater than the other.
head([n])	Return the first *n* rows.
hint(name, *parameters)	Specifies some hint on the current DataFrame.
hist([bins])	Draw one histogram of the DataFrame's columns.
idxmax([axis])	Return index of first occurrence of maximum over requested axis.
idxmin([axis])	Return index of first occurrence of minimum over requested axis.
info([verbose, buf, max_cols, null_counts])	Print a concise summary of a DataFrame.
isin(values)	Whether each element in the DataFrame is contained in values.
isna()	Detects missing values for items in the current Dataframe.
isnull()	Detects missing values for items in the current Dataframe.
items()	This is an alias of iteritems.
iteritems()	Iterator over (column name, Series) pairs.
iterrows()	Iterate over DataFrame rows as (index, Series) pairs.
itertuples([index, name])	Iterate over DataFrame rows as namedtuples.
join(right[, on, how, lsuffix, rsuffix])	Join columns of another DataFrame.
kde([bw_method, ind])	Generate Kernel Density Estimate plot using Gaussian kernels.
keys()	Return alias for columns.
kurt([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
kurtosis([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
last_valid_index()	Return index for last non-NA/null value.
le(other)	Compare if the current value is less than or equal to the other.
lt(other)	Compare if the current value is less than the other.
mad([axis])	Return the mean absolute deviation of values.
map_in_pandas(func)	Apply a function that takes pandas DataFrame and outputs pandas DataFrame.
mask(cond[, other])	Replace values where the condition is True.
max([axis, numeric_only])	Return the maximum of the values.
mean([axis, numeric_only])	Return the mean of the values.

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median([axis, numeric_only, accuracy])	Return the median of the values for the requested axis.
melt([id_vars, value_vars, var_name, value_name])	Unpivot a DataFrame from wide format to long format, optionally leaving identifier variables set.
merge(right[, how, on, left_on, right_on, ...])	Merge DataFrame objects with a database-style join.
min([axis, numeric_only])	Return the minimum of the values.
mod(other)	Get Modulo of dataframe and other, element-wise (binary operator %).
mul(other)	Get Multiplication of dataframe and other, element-wise (binary operator *).
multiply(other)	Get Multiplication of dataframe and other, element-wise (binary operator *).
ne(other)	Compare if the current value is not equal to the other.
nlargest(n, columns)	Return the first *n* rows ordered by *columns* in descending order.
notna()	Detects non-missing values for items in the current Dataframe.
notnull()	Detects non-missing values for items in the current Dataframe.
nsmallest(n, columns)	Return the first *n* rows ordered by *columns* in ascending order.
nunique([axis, dropna, approx, rsd])	Return number of unique elements in the object.
pad([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill``.
pct_change([periods])	Percentage change between the current and a prior element.
persist([storage_level])	Yields and caches the current DataFrame with a specific StorageLevel.
pipe(func, *args, **kwargs)	Apply func(self, *args, **kwargs).
pivot([index, columns, values])	Return reshaped DataFrame organized by given index / column values.
pivot_table([values, index, columns, ...])	Create a spreadsheet-style pivot table as a DataFrame.
pop(item)	Return item and drop from frame.
pow(other)	Get Exponential power of series of dataframe and other, element-wise (binary operator **).
print_schema([index_col])	Prints out the underlying Spark schema in the tree format.
prod()	Return the product of the values as Series.
product()	Return the product of the values as Series.
quantile([q, axis, numeric_only, accuracy])	Return value at the given quantile.
query(expr[, inplace])	Query the columns of a DataFrame with a boolean expression.
radd(other)	Get Addition of dataframe and other, element-wise (binary operator +).
rank([method, ascending])	Compute numerical data ranks (1 through n) along axis.
rdiv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).

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reindex([labels, index, columns, axis, ...])	Conform DataFrame to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index.
reindex_like(other[, copy])	Return a DataFrame with matching indices as other object.
rename([mapper, index, columns, axis, ...])	Alter axes labels.
rename_axis([mapper, index, columns, axis, ...])	Set the name of the axis for the index or columns.
replace([to_replace, value, inplace, limit, ...])	Returns a new DataFrame replacing a value with another value.
reset_index([level, drop, inplace, ...])	Reset the index, or a level of it.
rfloordiv(other)	Get Integer division of dataframe and other, element-wise (binary operator //).
rmod(other)	Get Modulo of dataframe and other, element-wise (binary operator %).
rmul(other)	Get Multiplication of dataframe and other, element-wise (binary operator *).
rolling(window[, min_periods])	Provide rolling transformations.
round([decimals])	Round a DataFrame to a variable number of decimal places.
rpow(other)	Get Exponential power of dataframe and other, element-wise (binary operator **).
rsub(other)	Get Subtraction of dataframe and other, element-wise (binary operator -).
rtruediv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
sample([n, frac, replace, random_state])	Return a random sample of items from an axis of object.
select_dtypes([include, exclude])	Return a subset of the DataFrame's columns based on the column dtypes.
set_index(keys[, drop, append, inplace])	Set the DataFrame index (row labels) using one or more existing columns.
shift([periods, fill_value])	Shift DataFrame by desired number of periods.
skew([axis, numeric_only])	Return unbiased skew normalized by N-1.
sort_index([axis, level, ascending, ...])	Sort object by labels (along an axis)
sort_values(by[, ascending, inplace, ...])	Sort by the values along either axis.
spark_schema([index_col])	Returns the underlying Spark schema.
squeeze([axis])	Squeeze 1 dimensional axis objects into scalars.
stack()	Stack the prescribed level(s) from columns to index.
std([axis, numeric_only])	Return sample standard deviation.
sub(other)	Get Subtraction of dataframe and other, element-wise (binary operator -).
subtract(other)	Get Subtraction of dataframe and other, element-wise (binary operator -).
sum([axis, numeric_only])	Return the sum of the values.
swapaxes(i, j[, copy])	Interchange axes and swap values axes appropriately.
swaplevel([i, j, axis])	Swap levels i and j in a MultiIndex on a particular axis.
tail([n])	Return the last *n* rows.
take(indices[, axis])	Return the elements in the given *positional* indices along an axis.

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toPandas()	Return a pandas DataFrame.
to_clipboard([excel, sep])	Copy object to the system clipboard.
to_csv([path, sep, na_rep, columns, header, ...])	Write object to a comma-separated values (csv) file.
to_delta(path[, mode, partition_cols, index_col])	Write the DataFrame out as a Delta Lake table.
to_dict([orient, into])	Convert the DataFrame to a dictionary.
to_excel(excel_writer[, sheet_name, na_rep, ...])	Write object to an Excel sheet.
to_html([buf, columns, col_space, header, ...])	Render a DataFrame as an HTML table.
to_json([path, compression, num_files, ...])	Convert the object to a JSON string.
to_koalas([index_col])	Converts the existing DataFrame into a Koalas DataFrame.
to_latex([buf, columns, col_space, header, ...])	Render an object to a LaTeX tabular environment table.
to_markdown([buf, mode])	Print Series or DataFrame in Markdown-friendly format.
to_numpy()	A NumPy ndarray representing the values in this DataFrame or Series.
to_pandas()	Return a pandas DataFrame.
to_parquet(path[, mode, partition_cols, ...])	Write the DataFrame out as a Parquet file or directory.
to_records([index, column_dtypes, index_dtypes])	Convert DataFrame to a NumPy record array.
to_spark([index_col])	Spark related features.
to_spark_io([path, format, mode, ...])	Write the DataFrame out to a Spark data source.
to_string([buf, columns, col_space, header, ...])	Render a DataFrame to a console-friendly tabular output.
to_table(name[, format, mode, ...])	Write the DataFrame into a Spark table.
transform(func[, axis])	Call func on self producing a Series with transformed values and that has the same length as its input.
transform_batch(func, *args, **kwargs)	Transform chunks with a function that takes pandas DataFrame and outputs pandas DataFrame.
transpose()	Transpose index and columns.
truediv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
truncate([before, after, axis, copy])	Truncate a Series or DataFrame before and after some index value.
unstack()	Pivot the (necessarily hierarchical) index labels.
update(other[, join, overwrite])	Modify in place using non-NA values from another DataFrame.
var([axis, numeric_only])	Return unbiased variance.
where(cond[, other])	Replace values where the condition is False.
xs(key[, axis, level])	Return cross-section from the DataFrame.

Attributes

T	Transpose index and columns.
at	Access a single value for a row/column label pair.
axes	Return a list representing the axes of the DataFrame.
columns	The column labels of the DataFrame.
dtypes	Return the dtypes in the DataFrame.
empty	Returns true if the current DataFrame is empty.
iat	Access a single value for a row/column pair by integer position.
iloc	Purely integer-location based indexing for selection by position.
index	The index (row labels) Column of the DataFrame.
is_dataframe	
loc	Access a group of rows and columns by label(s) or a boolean Series.
ndim	Return an int representing the number of array dimensions.
shape	Return a tuple representing the dimensionality of the DataFrame.
size	Return an int representing the number of elements in this object.
style	Property returning a Styler object containing methods for building a styled HTML representation for the DataFrame.
values	Return a Numpy representation of the DataFrame or the Series.

3.4.2 Attributes and underlying data

DataFrame.index	The index (row labels) Column of the DataFrame.
DataFrame.columns	The column labels of the DataFrame.
DataFrame.empty	Returns true if the current DataFrame is empty.

databricks.koalas.DataFrame.index

property DataFrame.**index**

The index (row labels) Column of the DataFrame.

Currently not supported when the DataFrame has no index.

See also:

Index

databricks.koalas.DataFrame.columns

property DataFrame.**columns**
The column labels of the DataFrame.

databricks.koalas.DataFrame.empty

property DataFrame.**empty**
Returns true if the current DataFrame is empty. Otherwise, returns false.

Examples

```
>>> ks.range(10).empty
False
```

```
>>> ks.range(0).empty
True
```

```
>>> ks.DataFrame({}, index=list('abc')).empty
True
```

DataFrame.dtypes	Return the dtypes in the DataFrame.
DataFrame.shape	Return a tuple representing the dimensionality of the DataFrame.
DataFrame.axes	Return a list representing the axes of the DataFrame.
DataFrame.ndim	Return an int representing the number of array dimensions.
DataFrame.size	Return an int representing the number of elements in this object.
DataFrame.select_dtypes([include, exclude])	Return a subset of the DataFrame's columns based on the column dtypes.
DataFrame.values	Return a Numpy representation of the DataFrame or the Series.

databricks.koalas.DataFrame.dtypes

property DataFrame.**dtypes**
Return the dtypes in the DataFrame.

This returns a Series with the data type of each column. The result's index is the original DataFrame's columns. Columns with mixed types are stored with the object dtype.

Returns

pd.Series The data type of each column.

Examples

```
>>> df = ks.DataFrame({'a': list('abc'),
...                    'b': list(range(1, 4)),
...                    'c': np.arange(3, 6).astype('i1'),
...                    'd': np.arange(4.0, 7.0, dtype='float64'),
...                    'e': [True, False, True],
...                    'f': pd.date_range('20130101', periods=3)},
...                   columns=['a', 'b', 'c', 'd', 'e', 'f'])
>>> df.dtypes
a            object
b             int64
c              int8
d           float64
e              bool
f    datetime64[ns]
dtype: object
```

databricks.koalas.DataFrame.shape

property DataFrame.**shape**

Return a tuple representing the dimensionality of the DataFrame.

Examples

```
>>> df = ks.DataFrame({'col1': [1, 2], 'col2': [3, 4]})
>>> df.shape
(2, 2)
```

```
>>> df = ks.DataFrame({'col1': [1, 2], 'col2': [3, 4],
...                    'col3': [5, 6]})
>>> df.shape
(2, 3)
```

databricks.koalas.DataFrame.axes

property DataFrame.**axes**

Return a list representing the axes of the DataFrame.

It has the row axis labels and column axis labels as the only members. They are returned in that order.

Examples

```
>>> df = ks.DataFrame({'col1': [1, 2], 'col2': [3, 4]})
>>> df.axes
[Int64Index([0, 1], dtype='int64'), Index(['col1', 'col2'], dtype='object')]
```

databricks.koalas.DataFrame.ndim

property DataFrame.**ndim**

Return an int representing the number of array dimensions.

return 2 for DataFrame.

Examples

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', None],
...                   columns=['max_speed', 'shield'])
>>> df
       max_speed  shield
cobra          1       2
viper          4       5
NaN            7       8
>>> df.ndim
2
```

databricks.koalas.DataFrame.size

property DataFrame.**size**

Return an int representing the number of elements in this object.

Return the number of rows if Series. Otherwise return the number of rows times number of columns if DataFrame.

Examples

```
>>> s = ks.Series({'a': 1, 'b': 2, 'c': None})
>>> s.size
3
```

```
>>> df = ks.DataFrame({'col1': [1, 2, None], 'col2': [3, 4, None]})
>>> df.size
6
```

```
>>> df = ks.DataFrame(index=[1, 2, None])
>>> df.size
0
```

databricks.koalas.DataFrame.select_dtypes

DataFrame.**select_dtypes**(*include=None*, *exclude=None*) → databricks.koalas.frame.DataFrame

Return a subset of the DataFrame's columns based on the column dtypes.

Parameters

include, exclude [scalar or list-like] A selection of dtypes or strings to be included/excluded. At least one of these parameters must be supplied. It also takes Spark SQL DDL type strings, for instance, 'string' and 'date'.

Returns

DataFrame The subset of the frame including the dtypes in `include` and excluding the dtypes in `exclude`.

Raises

ValueError

- If both of `include` and `exclude` are empty

```
>>> df = ks.DataFrame({'a': [1, 2] * 3,
...                    'b': [True, False] * 3,
...                    'c': [1.0, 2.0] * 3})
>>> df.select_dtypes()
Traceback (most recent call last):
...
ValueError: at least one of include or exclude must be nonempty
```

- If `include` and `exclude` have overlapping elements

```
>>> df = ks.DataFrame({'a': [1, 2] * 3,
...                    'b': [True, False] * 3,
...                    'c': [1.0, 2.0] * 3})
>>> df.select_dtypes(include='a', exclude='a')
Traceback (most recent call last):
...
ValueError: include and exclude overlap on {'a'}
```

Notes

- To select datetimes, use `np.datetime64`, `'datetime'` or `'datetime64'`

Examples

```
>>> df = ks.DataFrame({'a': [1, 2] * 3,
...                    'b': [True, False] * 3,
...                    'c': [1.0, 2.0] * 3,
...                    'd': ['a', 'b'] * 3}, columns=['a', 'b', 'c', 'd'])
>>> df
   a      b    c  d
0  1   True  1.0  a
1  2  False  2.0  b
2  1   True  1.0  a
3  2  False  2.0  b
4  1   True  1.0  a
5  2  False  2.0  b
```

```
>>> df.select_dtypes(include='bool')
       b
0   True
1  False
2   True
3  False
4   True
5  False
```

```
>>> df.select_dtypes(include=['float64'], exclude=['int'])
     c
0  1.0
1  2.0
2  1.0
3  2.0
4  1.0
5  2.0
```

```
>>> df.select_dtypes(exclude=['int'])
       b    c  d
0   True  1.0  a
1  False  2.0  b
2   True  1.0  a
3  False  2.0  b
4   True  1.0  a
5  False  2.0  b
```

Spark SQL DDL type strings can be used as well.

```
>>> df.select_dtypes(exclude=['string'])
   a      b    c
0  1   True  1.0
1  2  False  2.0
2  1   True  1.0
3  2  False  2.0
4  1   True  1.0
5  2  False  2.0
```

databricks.koalas.DataFrame.values

property DataFrame.**values**

Return a Numpy representation of the DataFrame or the Series.

Warning: We recommend using *DataFrame.to_numpy()* or *Series.to_numpy()* instead.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

Examples

A DataFrame where all columns are the same type (e.g., int64) results in an array of the same type.

```
>>> df = ks.DataFrame({'age':    [ 3,  29],
...                    'height': [94, 170],
...                    'weight': [31, 115]})
>>> df
   age  height  weight
0    3      94      31
1   29     170     115
>>> df.dtypes
age       int64
height    int64
weight    int64
dtype: object
>>> df.values
array([[  3,  94,  31],
       [ 29, 170, 115]])
```

A DataFrame with mixed type columns(e.g., str/object, int64, float32) results in an ndarray of the broadest type that accommodates these mixed types (e.g., object).

```
>>> df2 = ks.DataFrame([('parrot',   24.0, 'second'),
...                     ('lion',     80.5, 'first'),
...                     ('monkey', np.nan, None)],
...                    columns=('name', 'max_speed', 'rank'))
>>> df2.dtypes
name          object
max_speed    float64
rank          object
dtype: object
>>> df2.values
array([['parrot', 24.0, 'second'],
       ['lion', 80.5, 'first'],
       ['monkey', nan, None]], dtype=object)
```

For Series,

```
>>> ks.Series([1, 2, 3]).values
array([1, 2, 3])
```

```
>>> ks.Series(list('aabc')).values
array(['a', 'a', 'b', 'c'], dtype=object)
```

3.4.3 Conversion

DataFrame.copy([deep])	Make a copy of this object's indices and data.
DataFrame.isna()	Detects missing values for items in the current Dataframe.
DataFrame.astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.
DataFrame.isnull()	Detects missing values for items in the current Dataframe.

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DataFrame.notna()	Detects non-missing values for items in the current Dataframe.
DataFrame.notnull()	Detects non-missing values for items in the current Dataframe.
DataFrame.pad([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill`.
DataFrame.bool()	Return the bool of a single element in the current object.

databricks.koalas.DataFrame.copy

DataFrame.**copy**(*deep=None*) → databricks.koalas.frame.DataFrame

Make a copy of this object's indices and data.

Parameters

deep [None] this parameter is not supported but just dummy parameter to match pandas.

Returns

copy [DataFrame]

Examples

```
>>> df = ks.DataFrame({'x': [1, 2], 'y': [3, 4], 'z': [5, 6], 'w': [7, 8]},
...                   columns=['x', 'y', 'z', 'w'])
>>> df
   x  y  z  w
0  1  3  5  7
1  2  4  6  8
>>> df_copy = df.copy()
>>> df_copy
   x  y  z  w
0  1  3  5  7
1  2  4  6  8
```

databricks.koalas.DataFrame.isna

DataFrame.**isna**() → databricks.koalas.frame.DataFrame

Detects missing values for items in the current Dataframe.

Return a boolean same-sized Dataframe indicating if the values are NA. NA values, such as None or numpy.NaN, gets mapped to True values. Everything else gets mapped to False values.

See also:

DataFrame.notnull

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, None), (.6, None), (.2, .1)])
>>> df.isnull()
       0      1
0  False  False
1  False   True
2  False   True
3  False  False
```

```
>>> df = ks.DataFrame([[None, 'bee', None], ['dog', None, 'fly']])
>>> df.isnull()
       0      1      2
0   True  False   True
1  False   True  False
```

databricks.koalas.DataFrame.astype

DataFrame.**astype**(*dtype*) → databricks.koalas.frame.DataFrame

Cast a Koalas object to a specified dtype `dtype`.

Parameters

dtype [data type, or dict of column name -> data type] Use a numpy.dtype or Python type to cast entire Koalas object to the same type. Alternatively, use {col: dtype, ...}, where col is a column label and dtype is a numpy.dtype or Python type to cast one or more of the DataFrame's columns to column-specific types.

Returns

casted [same type as caller]

See also:

to_datetime Convert argument to datetime.

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3], 'b': [1, 2, 3]}, dtype='int64')
>>> df
   a  b
0  1  1
1  2  2
2  3  3
```

Convert to float type:

```
>>> df.astype('float')
     a    b
0  1.0  1.0
1  2.0  2.0
2  3.0  3.0
```

Convert to int64 type back:

```
>>> df.astype('int64')
   a  b
0  1  1
1  2  2
2  3  3
```

Convert column a to float type:

```
>>> df.astype({'a': float})
     a  b
0  1.0  1
1  2.0  2
2  3.0  3
```

databricks.koalas.DataFrame.isnull

DataFrame.**isnull**() → databricks.koalas.frame.DataFrame

Detects missing values for items in the current Dataframe.

Return a boolean same-sized Dataframe indicating if the values are NA. NA values, such as None or numpy.NaN, gets mapped to True values. Everything else gets mapped to False values.

See also:

DataFrame.notnull

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, None), (.6, None), (.2, .1)])
>>> df.isnull()
       0      1
0  False  False
1  False   True
2  False   True
3  False  False
```

```
>>> df = ks.DataFrame([[None, 'bee', None], ['dog', None, 'fly']])
>>> df.isnull()
       0      1      2
0   True  False   True
1  False   True  False
```

databricks.koalas.DataFrame.notna

DataFrame.**notna**() → databricks.koalas.frame.DataFrame

Detects non-missing values for items in the current Dataframe.

This function takes a dataframe and indicates whether it's values are valid (not missing, which is NaN in numeric datatypes, None or NaN in objects and NaT in datetimelike).

See also:

DataFrame.isnull

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, None), (.6, None), (.2, .1)])
>>> df.notnull()
      0      1
0  True   True
1  True  False
2  True  False
3  True   True
```

```
>>> df = ks.DataFrame([['ant', 'bee', 'cat'], ['dog', None, 'fly']])
>>> df.notnull()
      0      1     2
0  True   True  True
1  True  False  True
```

databricks.koalas.DataFrame.notnull

DataFrame.**notnull**() → databricks.koalas.frame.DataFrame

Detects non-missing values for items in the current Dataframe.

This function takes a dataframe and indicates whether it's values are valid (not missing, which is NaN in numeric datatypes, None or NaN in objects and NaT in datetimelike).

See also:

DataFrame.isnull

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, None), (.6, None), (.2, .1)])
>>> df.notnull()
      0      1
0  True   True
1  True  False
2  True  False
3  True   True
```

```
>>> df = ks.DataFrame([['ant', 'bee', 'cat'], ['dog', None, 'fly']])
>>> df.notnull()
      0      1     2
0  True   True  True
1  True  False  True
```

databricks.koalas.DataFrame.pad

DataFrame.**pad**(*axis=None*, *inplace=False*, *limit=None*) → Union[DataFrame, Series]
Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill`.

Note: the current implementation of 'ffill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values forward.

```
>>> kdf.ffill()
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  3.0  4.0  NaN  5
3  3.0  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([2, 4, None, 3])
>>> kser
0    2.0
```

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```
1    4.0
2    NaN
3    3.0
dtype: float64
```

```
>>> kser.ffill()
0    2.0
1    4.0
2    4.0
3    3.0
dtype: float64
```

databricks.koalas.DataFrame.bool

DataFrame.**bool**() → bool

Return the bool of a single element in the current object.

This must be a boolean scalar value, either True or False. Raise a ValueError if the object does not have exactly 1 element, or that element is not boolean

Returns

bool

Examples

```
>>> ks.DataFrame({'a': [True]}).bool()
True
```

```
>>> ks.Series([False]).bool()
False
```

If there are non-boolean or multiple values exist, it raises an exception in all cases as below.

```
>>> ks.DataFrame({'a': ['a']}).bool()
Traceback (most recent call last):
  ...
ValueError: bool cannot act on a non-boolean single element DataFrame
```

```
>>> ks.DataFrame({'a': [True], 'b': [False]}).bool()
Traceback (most recent call last):
  ...
ValueError: The truth value of a DataFrame is ambiguous. Use a.empty, a.bool(),
a.item(), a.any() or a.all().
```

```
>>> ks.Series([1]).bool()
Traceback (most recent call last):
  ...
ValueError: bool cannot act on a non-boolean single element DataFrame
```

3.4.4 Indexing, iteration

DataFrame.at	Access a single value for a row/column label pair.
DataFrame.iat	Access a single value for a row/column pair by integer position.
DataFrame.head([n])	Return the first *n* rows.
DataFrame.idxmax([axis])	Return index of first occurrence of maximum over requested axis.
DataFrame.idxmin([axis])	Return index of first occurrence of minimum over requested axis.
DataFrame.loc	Access a group of rows and columns by label(s) or a boolean Series.
DataFrame.iloc	Purely integer-location based indexing for selection by position.
DataFrame.items()	This is an alias of `iteritems`.
DataFrame.iteritems()	Iterator over (column name, Series) pairs.
DataFrame.iterrows()	Iterate over DataFrame rows as (index, Series) pairs.
DataFrame.itertuples([index, name])	Iterate over DataFrame rows as namedtuples.
DataFrame.keys()	Return alias for columns.
DataFrame.pop(item)	Return item and drop from frame.
DataFrame.tail([n])	Return the last *n* rows.
DataFrame.xs(key[, axis, level])	Return cross-section from the DataFrame.
DataFrame.get(key[, default])	Get item from object for given key (DataFrame column, Panel slice, etc.).
DataFrame.where(cond[, other])	Replace values where the condition is False.
DataFrame.mask(cond[, other])	Replace values where the condition is True.
DataFrame.query(expr[, inplace])	Query the columns of a DataFrame with a boolean expression.

databricks.koalas.DataFrame.at

property DataFrame.**at**

Access a single value for a row/column label pair. If the index is not unique, all matching pairs are returned as an array. Similar to `loc`, in that both provide label-based lookups. Use `at` if you only need to get a single value in a DataFrame or Series.

Note: Unlike pandas, Koalas only allows using `at` to get values but not to set them.

Note: Warning: If `row_index` matches a lot of rows, large amounts of data will be fetched, potentially causing your machine to run out of memory.

Raises

KeyError When label does not exist in DataFrame

Examples

```
>>> kdf = ks.DataFrame([[0, 2, 3], [0, 4, 1], [10, 20, 30]],
...                    index=[4, 5, 5], columns=['A', 'B', 'C'])
>>> kdf
    A   B   C
4   0   2   3
5   0   4   1
5  10  20  30
```

Get value at specified row/column pair

```
>>> kdf.at[4, 'B']
2
```

Get array if an index occurs multiple times

```
>>> kdf.at[5, 'B']
array([ 4, 20])
```

databricks.koalas.DataFrame.iat

property DataFrame.**iat**

Access a single value for a row/column pair by integer position.

Similar to `iloc`, in that both provide integer-based lookups. Use `iat` if you only need to get or set a single value in a DataFrame or Series.

Raises

KeyError When label does not exist in DataFrame

Examples

```
>>> df = ks.DataFrame([[0, 2, 3], [0, 4, 1], [10, 20, 30]],
...                   columns=['A', 'B', 'C'])
>>> df
    A   B   C
0   0   2   3
1   0   4   1
2  10  20  30
```

Get value at specified row/column pair

```
>>> df.iat[1, 2]
1
```

Get value within a series

```
>>> kser = ks.Series([1, 2, 3], index=[10, 20, 30])
>>> kser
10    1
20    2
30    3
dtype: int64
```

```
>>> kser.iat[1]
2
```

databricks.koalas.DataFrame.head

DataFrame.**head**(*n: int = 5*) → databricks.koalas.frame.DataFrame

Return the first *n* rows.

This function returns the first *n* rows for the object based on position. It is useful for quickly testing if your object has the right type of data in it.

Parameters

n [int, default 5] Number of rows to select.

Returns

obj_head [same type as caller] The first *n* rows of the caller object.

Examples

```
>>> df = ks.DataFrame({'animal':['alligator', 'bee', 'falcon', 'lion',
...                    'monkey', 'parrot', 'shark', 'whale', 'zebra']})
>>> df
      animal
0  alligator
1        bee
2     falcon
3       lion
4     monkey
5     parrot
6      shark
7      whale
8      zebra
```

Viewing the first 5 lines

```
>>> df.head()
      animal
0  alligator
1        bee
2     falcon
3       lion
4     monkey
```

Viewing the first *n* lines (three in this case)

```
>>> df.head(3)
      animal
0  alligator
1        bee
2     falcon
```

databricks.koalas.DataFrame.idxmax

DataFrame.**idxmax**(*axis=0*) → Series

Return index of first occurrence of maximum over requested axis. NA/null values are excluded.

Note: This API collect all rows with maximum value using *to_pandas()* because we suppose the number of rows with max values are usually small in general.

Parameters

axis [0 or 'index'] Can only be set to 0 at the moment.

Returns

Series

See also:

Series.idxmax

Examples

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, 2],
...                     'b': [4.0, 2.0, 3.0, 1.0],
...                     'c': [300, 200, 400, 200]})
>>> kdf
   a    b    c
0  1  4.0  300
1  2  2.0  200
2  3  3.0  400
3  2  1.0  200
```

```
>>> kdf.idxmax()
a    2
b    0
c    2
dtype: int64
```

For Multi-column Index

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, 2],
...                     'b': [4.0, 2.0, 3.0, 1.0],
...                     'c': [300, 200, 400, 200]})
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
   a    b    c
   x    y    z
0  1  4.0  300
1  2  2.0  200
2  3  3.0  400
3  2  1.0  200
```

```
>>> kdf.idxmax()
a  x    2
b  y    0
c  z    2
dtype: int64
```

databricks.koalas.DataFrame.idxmin

DataFrame.**idxmin**(*axis=0*) → Series

Return index of first occurrence of minimum over requested axis. NA/null values are excluded.

Note: This API collect all rows with minimum value using *to_pandas()* because we suppose the number of rows with min values are usually small in general.

Parameters

axis [0 or 'index'] Can only be set to 0 at the moment.

Returns

Series

See also:

Series.idxmin

Examples

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, 2],
...                     'b': [4.0, 2.0, 3.0, 1.0],
...                     'c': [300, 200, 400, 200]})
>>> kdf
   a    b    c
0  1  4.0  300
1  2  2.0  200
2  3  3.0  400
3  2  1.0  200
```

```
>>> kdf.idxmin()
a    0
b    3
c    1
dtype: int64
```

For Multi-column Index

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, 2],
...                     'b': [4.0, 2.0, 3.0, 1.0],
...                     'c': [300, 200, 400, 200]})
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
   a    b    c
```

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```
   x    y    z
0  1  4.0  300
1  2  2.0  200
2  3  3.0  400
3  2  1.0  200
```

```
>>> kdf.idxmin()
a  x    0
b  y    3
c  z    1
dtype: int64
```

databricks.koalas.DataFrame.loc

property DataFrame.**loc**

Access a group of rows and columns by label(s) or a boolean Series.

`.loc[]` is primarily label based, but may also be used with a conditional boolean Series derived from the DataFrame or Series.

Allowed inputs are:

- A single label, e.g. `5` or `'a'`, (note that `5` is interpreted as a *label* of the index, and **never** as an integer position along the index) for column selection.
- A list or array of labels, e.g. `['a', 'b', 'c']`.
- A slice object with labels, e.g. `'a':'f'`.
- A conditional boolean Series derived from the DataFrame or Series

Not allowed inputs which pandas allows are:

- A boolean array of the same length as the axis being sliced, e.g. `[True, False, True]`.
- A `callable` function with one argument (the calling Series, DataFrame or Panel) and that returns valid output for indexing (one of the above)

Note: MultiIndex is not supported yet.

Note: Note that contrary to usual python slices, **both** the start and the stop are included, and the step of the slice is not allowed.

Note: With a list or array of labels for row selection, Koalas behaves as a filter without reordering by the labels.

See also:

Series.loc Access group of values using labels.

Examples

Getting values

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df
            max_speed  shield
cobra               1       2
viper               4       5
sidewinder          7       8
```

Single label. Note this returns the row as a Series.

```
>>> df.loc['viper']
max_speed    4
shield       5
Name: viper, dtype: int64
```

List of labels. Note using `[[]]` returns a DataFrame. Also note that Koalas behaves just a filter without reordering by the labels.

```
>>> df.loc[['viper', 'sidewinder']]
            max_speed  shield
viper               4       5
sidewinder          7       8
```

```
>>> df.loc[['sidewinder', 'viper']]
            max_speed  shield
viper               4       5
sidewinder          7       8
```

Single label for column.

```
>>> df.loc['cobra', 'shield']
2
```

List of labels for row.

```
>>> df.loc[['cobra'], 'shield']
cobra    2
Name: shield, dtype: int64
```

List of labels for column.

```
>>> df.loc['cobra', ['shield']]
shield    2
Name: cobra, dtype: int64
```

List of labels for both row and column.

```
>>> df.loc[['cobra'], ['shield']]
       shield
cobra       2
```

Slice with labels for row and single label for column. As mentioned above, note that both the start and stop of the slice are included.

```
>>> df.loc['cobra':'viper', 'max_speed']
cobra    1
viper    4
Name: max_speed, dtype: int64
```

Conditional that returns a boolean Series

```
>>> df.loc[df['shield'] > 6]
            max_speed  shield
sidewinder          7       8
```

Conditional that returns a boolean Series with column labels specified

```
>>> df.loc[df['shield'] > 6, ['max_speed']]
            max_speed
sidewinder          7
```

Setting values

Setting value for all items matching the list of labels.

```
>>> df.loc[['viper', 'sidewinder'], ['shield']] = 50
>>> df
            max_speed  shield
cobra               1       2
viper               4      50
sidewinder          7      50
```

Setting value for an entire row

```
>>> df.loc['cobra'] = 10
>>> df
            max_speed  shield
cobra              10      10
viper               4      50
sidewinder          7      50
```

Set value for an entire column

```
>>> df.loc[:, 'max_speed'] = 30
>>> df
            max_speed  shield
cobra              30      10
viper              30      50
sidewinder         30      50
```

Set value for an entire list of columns

```
>>> df.loc[:, ['max_speed', 'shield']] = 100
>>> df
            max_speed  shield
cobra             100     100
viper             100     100
sidewinder        100     100
```

Set value with Series

```
>>> df.loc[:, 'shield'] = df['shield'] * 2
>>> df
            max_speed  shield
cobra             100     200
viper             100     200
sidewinder        100     200
```

Getting values on a DataFrame with an index that has integer labels

Another example using integers for the index

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=[7, 8, 9],
...                   columns=['max_speed', 'shield'])
>>> df
   max_speed  shield
7          1       2
8          4       5
9          7       8
```

Slice with integer labels for rows. As mentioned above, note that both the start and stop of the slice are included.

```
>>> df.loc[7:9]
   max_speed  shield
7          1       2
8          4       5
9          7       8
```

databricks.koalas.DataFrame.iloc

property DataFrame.**iloc**

Purely integer-location based indexing for selection by position.

`.iloc[]` is primarily integer position based (from `0` to `length-1` of the axis), but may also be used with a conditional boolean Series.

Allowed inputs are:

- An integer for column selection, e.g. `5`.
- A list or array of integers for row selection with distinct index values, e.g. `[3, 4, 0]`
- A list or array of integers for column selection, e.g. `[4, 3, 0]`.
- A boolean array for column selection.
- A slice object with ints for row and column selection, e.g. `1:7`.

Not allowed inputs which pandas allows are:

- A list or array of integers for row selection with duplicated indexes, e.g. `[4, 4, 0]`.
- A boolean array for row selection.
- A `callable` function with one argument (the calling Series, DataFrame or Panel) and that returns valid output for indexing (one of the above). This is useful in method chains, when you don't have a reference to the calling object, but would like to base your selection on some value.

`.iloc` will raise `IndexError` if a requested indexer is out-of-bounds, except *slice* indexers which allow out-of-bounds indexing (this conforms with python/numpy *slice* semantics).

See also:

DataFrame.loc Purely label-location based indexer for selection by label.

Series.iloc Purely integer-location based indexing for selection by position.

Examples

```
>>> mydict = [{'a': 1, 'b': 2, 'c': 3, 'd': 4},
...           {'a': 100, 'b': 200, 'c': 300, 'd': 400},
...           {'a': 1000, 'b': 2000, 'c': 3000, 'd': 4000 }]
>>> df = ks.DataFrame(mydict, columns=['a', 'b', 'c', 'd'])
>>> df
      a     b     c     d
0     1     2     3     4
1   100   200   300   400
2  1000  2000  3000  4000
```

Indexing just the rows

A scalar integer for row selection.

```
>>> df.iloc[1]
a    100
b    200
c    300
d    400
Name: 1, dtype: int64
```

```
>>> df.iloc[[0]]
   a  b  c  d
0  1  2  3  4
```

With a *slice* object.

```
>>> df.iloc[:3]
      a     b     c     d
0     1     2     3     4
1   100   200   300   400
2  1000  2000  3000  4000
```

Indexing both axes

You can mix the indexer types for the index and columns. Use `:` to select the entire axis.

With scalar integers.

```
>>> df.iloc[:1, 1]
0    2
Name: b, dtype: int64
```

With lists of integers.

```
>>> df.iloc[:2, [1, 3]]
     b    d
0    2    4
1  200  400
```

With *slice* objects.

```
>>> df.iloc[:2, 0:3]
     a    b    c
0    1    2    3
1  100  200  300
```

With a boolean array whose length matches the columns.

```
>>> df.iloc[:, [True, False, True, False]]
      a     c
0     1     3
1   100   300
2  1000  3000
```

Setting values

Setting value for all items matching the list of labels.

```
>>> df.iloc[[1, 2], [1]] = 50
>>> df
      a   b     c     d
0     1   2     3     4
1   100  50   300   400
2  1000  50  3000  4000
```

Setting value for an entire row

```
>>> df.iloc[0] = 10
>>> df
      a   b     c     d
0    10  10    10    10
1   100  50   300   400
2  1000  50  3000  4000
```

Set value for an entire column

```
>>> df.iloc[:, 2] = 30
>>> df
      a   b   c     d
0    10  10  30    10
1   100  50  30   400
2  1000  50  30  4000
```

Set value for an entire list of columns

```
>>> df.iloc[:, [2, 3]] = 100
>>> df
      a   b    c    d
0    10  10  100  100
1   100  50  100  100
2  1000  50  100  100
```

Set value with Series

```
>>> df.iloc[:, 3] = df.iloc[:, 3] * 2
>>> df
      a   b    c    d
```

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```
0    10  10  100  200
1   100  50  100  200
2  1000  50  100  200
```

databricks.koalas.DataFrame.items

DataFrame.**items**() → Iterator
This is an alias of iteritems.

databricks.koalas.DataFrame.iteritems

DataFrame.**iteritems**() → Iterator
Iterator over (column name, Series) pairs.

Iterates over the DataFrame columns, returning a tuple with the column name and the content as a Series.

Returns

label [object] The column names for the DataFrame being iterated over.

content [Series] The column entries belonging to each label, as a Series.

Examples

```
>>> df = ks.DataFrame({'species': ['bear', 'bear', 'marsupial'],
...                    'population': [1864, 22000, 80000]},
...                   index=['panda', 'polar', 'koala'],
...                   columns=['species', 'population'])
>>> df
         species  population
panda       bear        1864
polar       bear       22000
koala  marsupial       80000
```

```
>>> for label, content in df.iteritems():
...    print('label:', label)
...    print('content:', content.to_string())
...
label: species
content: panda         bear
polar         bear
koala    marsupial
label: population
content: panda     1864
polar    22000
koala    80000
```

databricks.koalas.DataFrame.iterrows

DataFrame.**iterrows**() → Iterator
Iterate over DataFrame rows as (index, Series) pairs.

Yields

index [label or tuple of label] The index of the row. A tuple for a *MultiIndex*.

data [pandas.Series] The data of the row as a Series.

it [generator] A generator that iterates over the rows of the frame.

Notes

1. Because `iterrows` returns a Series for each row, it does **not** preserve dtypes across the rows (dtypes are preserved across columns for DataFrames). For example,

```
>>> df = ks.DataFrame([[1, 1.5]], columns=['int', 'float'])
>>> row = next(df.iterrows())[1]
>>> row
int      1.0
float    1.5
Name: 0, dtype: float64
>>> print(row['int'].dtype)
float64
>>> print(df['int'].dtype)
int64
```

   To preserve dtypes while iterating over the rows, it is better to use *itertuples()* which returns namedtuples of the values and which is generally faster than `iterrows`.

2. You should **never modify** something you are iterating over. This is not guaranteed to work in all cases. Depending on the data types, the iterator returns a copy and not a view, and writing to it will have no effect.

databricks.koalas.DataFrame.itertuples

DataFrame.**itertuples**(*index: bool = True*, *name: Optional[str] = 'Koalas'*) → Iterator
Iterate over DataFrame rows as namedtuples.

Parameters

index [bool, default True] If True, return the index as the first element of the tuple.

name [str or None, default "Koalas"] The name of the returned namedtuples or None to return regular tuples.

Returns

iterator An object to iterate over namedtuples for each row in the DataFrame with the first field possibly being the index and following fields being the column values.

See also:

DataFrame.iterrows Iterate over DataFrame rows as (index, Series) pairs.

DataFrame.items Iterate over (column name, Series) pairs.

Notes

The column names will be renamed to positional names if they are invalid Python identifiers, repeated, or start with an underscore. On python versions < 3.7 regular tuples are returned for DataFrames with a large number of columns (>254).

Examples

```
>>> df = ks.DataFrame({'num_legs': [4, 2], 'num_wings': [0, 2]},
...                   index=['dog', 'hawk'])
>>> df
      num_legs  num_wings
dog          4          0
hawk         2          2
```

```
>>> for row in df.itertuples():
...     print(row)
...
Koalas(Index='dog', num_legs=4, num_wings=0)
Koalas(Index='hawk', num_legs=2, num_wings=2)
```

By setting the *index* parameter to False we can remove the index as the first element of the tuple:

```
>>> for row in df.itertuples(index=False):
...     print(row)
...
Koalas(num_legs=4, num_wings=0)
Koalas(num_legs=2, num_wings=2)
```

With the *name* parameter set we set a custom name for the yielded namedtuples:

```
>>> for row in df.itertuples(name='Animal'):
...     print(row)
...
Animal(Index='dog', num_legs=4, num_wings=0)
Animal(Index='hawk', num_legs=2, num_wings=2)
```

databricks.koalas.DataFrame.keys

DataFrame.**keys**() → pandas.core.indexes.base.Index

Return alias for columns.

Returns

Index Columns of the DataFrame.

Examples

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df
            max_speed  shield
cobra               1       2
viper               4       5
sidewinder          7       8
```

```
>>> df.keys()
Index(['max_speed', 'shield'], dtype='object')
```

databricks.koalas.DataFrame.pop

DataFrame.**pop**(*item*) → databricks.koalas.frame.DataFrame

Return item and drop from frame. Raise KeyError if not found.

Parameters

item [str] Label of column to be popped.

Returns

Series

Examples

```
>>> df = ks.DataFrame([('falcon', 'bird', 389.0),
...                    ('parrot', 'bird', 24.0),
...                    ('lion', 'mammal', 80.5),
...                    ('monkey','mammal', np.nan)],
...                   columns=('name', 'class', 'max_speed'))
```

```
>>> df
     name   class  max_speed
0  falcon    bird      389.0
1  parrot    bird       24.0
2    lion  mammal       80.5
3  monkey  mammal        NaN
```

```
>>> df.pop('class')
0      bird
1      bird
2    mammal
3    mammal
Name: class, dtype: object
```

```
>>> df
     name  max_speed
0  falcon      389.0
1  parrot       24.0
2    lion       80.5
3  monkey        NaN
```

Also support for MultiIndex

```
>>> df = ks.DataFrame([('falcon', 'bird', 389.0),
...                    ('parrot', 'bird', 24.0),
...                    ('lion', 'mammal', 80.5),
...                    ('monkey','mammal', np.nan)],
...                   columns=('name', 'class', 'max_speed'))
>>> columns = [('a', 'name'), ('a', 'class'), ('b', 'max_speed')]
>>> df.columns = pd.MultiIndex.from_tuples(columns)
>>> df
        a                 b
     name   class max_speed
0  falcon    bird     389.0
1  parrot    bird      24.0
2    lion  mammal      80.5
3  monkey  mammal       NaN
```

```
>>> df.pop('a')
     name   class
0  falcon    bird
1  parrot    bird
2    lion  mammal
3  monkey  mammal
```

```
>>> df
          b
  max_speed
0     389.0
1      24.0
2      80.5
3       NaN
```

databricks.koalas.DataFrame.tail

DataFrame.**tail**(*n=5*) → databricks.koalas.frame.DataFrame

Return the last *n* rows.

This function returns last *n* rows from the object based on position. It is useful for quickly verifying data, for example, after sorting or appending rows.

For negative values of *n*, this function returns all rows except the first *n* rows, equivalent to `df[n:]`.

Parameters

n [int, default 5] Number of rows to select.

Returns

type of caller The last *n* rows of the caller object.

See also:

DataFrame.head The first *n* rows of the caller object.

Examples

```
>>> df = ks.DataFrame({'animal': ['alligator', 'bee', 'falcon', 'lion',
...                    'monkey', 'parrot', 'shark', 'whale', 'zebra']})
>>> df
      animal
0  alligator
1        bee
2     falcon
3       lion
4     monkey
5     parrot
6      shark
7      whale
8      zebra
```

Viewing the last 5 lines

```
>>> df.tail()
   animal
4  monkey
5  parrot
6   shark
7   whale
8   zebra
```

Viewing the last *n* lines (three in this case)

```
>>> df.tail(3)
  animal
6  shark
7  whale
8  zebra
```

For negative values of *n*

```
>>> df.tail(-3)
   animal
3    lion
4  monkey
5  parrot
6   shark
7   whale
8   zebra
```

databricks.koalas.DataFrame.xs

`DataFrame.xs`(*key*, *axis=0*, *level=None*) → Union[DataFrame, Series]

Return cross-section from the DataFrame.

This method takes a *key* argument to select data at a particular level of a MultiIndex.

Parameters

key [label or tuple of label] Label contained in the index, or partially in a MultiIndex.

axis [0 or 'index', default 0] Axis to retrieve cross-section on. currently only support 0 or 'index'

level [object, defaults to first n levels (n=1 or len(key))] In case of a key partially contained in a MultiIndex, indicate which levels are used. Levels can be referred by label or position.

Returns

DataFrame or Series Cross-section from the original DataFrame corresponding to the selected index levels.

See also:

DataFrame.loc Access a group of rows and columns by label(s) or a boolean array.

DataFrame.iloc Purely integer-location based indexing for selection by position.

Examples

```
>>> d = {'num_legs': [4, 4, 2, 2],
...      'num_wings': [0, 0, 2, 2],
...      'class': ['mammal', 'mammal', 'mammal', 'bird'],
...      'animal': ['cat', 'dog', 'bat', 'penguin'],
...      'locomotion': ['walks', 'walks', 'flies', 'walks']}
>>> df = ks.DataFrame(data=d)
>>> df = df.set_index(['class', 'animal', 'locomotion'])
>>> df
                           num_legs  num_wings
class  animal  locomotion
mammal cat     walks              4          0
       dog     walks              4          0
       bat     flies              2          2
bird   penguin walks              2          2
```

Get values at specified index

```
>>> df.xs('mammal')
                    num_legs  num_wings
animal locomotion
cat    walks               4          0
dog    walks               4          0
bat    flies               2          2
```

Get values at several indexes

```
>>> df.xs(('mammal', 'dog'))
            num_legs  num_wings
locomotion
walks              4          0
```

```
>>> df.xs(('mammal', 'dog', 'walks'))
num_legs     4
num_wings    0
Name: (mammal, dog, walks), dtype: int64
```

Get values at specified index and level

```
>>> df.xs('cat', level=1)
                    num_legs  num_wings
class  locomotion
mammal walks               4          0
```

databricks.koalas.DataFrame.get

DataFrame.**get**(*key*, *default=None*) → Any

Get item from object for given key (DataFrame column, Panel slice, etc.). Returns default value if not found.

Parameters

key [object]

Returns

value [same type as items contained in object]

Examples

```
>>> df = ks.DataFrame({'x':range(3), 'y':['a','b','b'], 'z':['a','b','b']},
...                   columns=['x', 'y', 'z'], index=[10, 20, 20])
>>> df
    x  y  z
10  0  a  a
20  1  b  b
20  2  b  b
```

```
>>> df.get('x')
10    0
20    1
20    2
Name: x, dtype: int64
```

```
>>> df.get(['x', 'y'])
    x  y
10  0  a
20  1  b
20  2  b
```

```
>>> df.x.get(10)
0
```

```
>>> df.x.get(20)
20    1
20    2
Name: x, dtype: int64
```

```
>>> df.x.get(15, -1)
-1
```

databricks.koalas.DataFrame.where

DataFrame.**where**(*cond*, *other=nan*) → databricks.koalas.frame.DataFrame

Replace values where the condition is False.

Parameters

cond [boolean DataFrame] Where cond is True, keep the original value. Where False, replace with corresponding value from other.

other [scalar, DataFrame] Entries where cond is False are replaced with corresponding value from other.

Returns

DataFrame

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> df1 = ks.DataFrame({'A': [0, 1, 2, 3, 4], 'B':[100, 200, 300, 400, 500]})
>>> df2 = ks.DataFrame({'A': [0, -1, -2, -3, -4], 'B':[-100, -200, -300, -400, -
↪500]})
>>> df1
   A    B
0  0  100
1  1  200
2  2  300
3  3  400
4  4  500
>>> df2
   A    B
0  0 -100
1 -1 -200
2 -2 -300
3 -3 -400
4 -4 -500
```

```
>>> df1.where(df1 > 0).sort_index()
     A      B
0  NaN  100.0
1  1.0  200.0
2  2.0  300.0
3  3.0  400.0
4  4.0  500.0
```

```
>>> df1.where(df1 > 1, 10).sort_index()
    A    B
0  10  100
1  10  200
2   2  300
3   3  400
4   4  500
```

```
>>> df1.where(df1 > 1, df1 + 100).sort_index()
     A    B
```

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```
0  100  100
1  101  200
2    2  300
3    3  400
4    4  500
```

```
>>> df1.where(df1 > 1, df2).sort_index()
   A    B
0  0  100
1 -1  200
2  2  300
3  3  400
4  4  500
```

When the column name of cond is different from self, it treats all values are False

```
>>> cond = ks.DataFrame({'C': [0, -1, -2, -3, -4], 'D':[4, 3, 2, 1, 0]}) % 3 == 0
>>> cond
       C      D
0   True  False
1  False   True
2  False  False
3   True  False
4  False   True
```

```
>>> df1.where(cond).sort_index()
    A   B
0 NaN NaN
1 NaN NaN
2 NaN NaN
3 NaN NaN
4 NaN NaN
```

When the type of cond is Series, it just check boolean regardless of column name

```
>>> cond = ks.Series([1, 2]) > 1
>>> cond
0    False
1     True
dtype: bool
```

```
>>> df1.where(cond).sort_index()
     A      B
0  NaN    NaN
1  1.0  200.0
2  NaN    NaN
3  NaN    NaN
4  NaN    NaN
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.DataFrame.mask

DataFrame.**mask**(*cond*, *other=nan*) → databricks.koalas.frame.DataFrame

Replace values where the condition is True.

Parameters

cond [boolean DataFrame] Where cond is False, keep the original value. Where True, replace with corresponding value from other.

other [scalar, DataFrame] Entries where cond is True are replaced with corresponding value from other.

Returns

DataFrame

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> df1 = ks.DataFrame({'A': [0, 1, 2, 3, 4], 'B':[100, 200, 300, 400, 500]})
>>> df2 = ks.DataFrame({'A': [0, -1, -2, -3, -4], 'B':[-100, -200, -300, -400, -
↪500]})
>>> df1
   A    B
0  0  100
1  1  200
2  2  300
3  3  400
4  4  500
>>> df2
   A    B
0  0 -100
1 -1 -200
2 -2 -300
3 -3 -400
4 -4 -500
```

```
>>> df1.mask(df1 > 0).sort_index()
     A   B
0  0.0 NaN
1  NaN NaN
2  NaN NaN
3  NaN NaN
4  NaN NaN
```

```
>>> df1.mask(df1 > 1, 10).sort_index()
    A   B
0   0  10
1   1  10
2  10  10
3  10  10
4  10  10
```

```
>>> df1.mask(df1 > 1, df1 + 100).sort_index()
     A    B
```

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```
0    0  200
1    1  300
2  102  400
3  103  500
4  104  600
```

```
>>> df1.mask(df1 > 1, df2).sort_index()
   A    B
0  0 -100
1  1 -200
2 -2 -300
3 -3 -400
4 -4 -500
```

```
>>> reset_option("compute.ops_on_diff_frames")
```

databricks.koalas.DataFrame.query

DataFrame.**query**(*expr*, *inplace=False*) → Optional[databricks.koalas.frame.DataFrame]

Query the columns of a DataFrame with a boolean expression.

Note: Internal columns that starting with a '__' prefix are able to access, however, they are not supposed to be accessed.

Note: This API delegates to Spark SQL so the syntax follows Spark SQL. Therefore, the pandas specific syntax such as @ is not supported. If you want the pandas syntax, you can work around with *DataFrame.koalas.apply_batch()*, but you should be aware that *query_func* will be executed at different nodes in a distributed manner. So, for example, to use @ syntax, make sure the variable is serialized by, for example, putting it within the closure as below.

```
>>> df = ks.DataFrame({'A': range(2000), 'B': range(2000)})
>>> def query_func(pdf):
...     num = 1995
...     return pdf.query('A > @num')
>>> df.koalas.apply_batch(query_func)
         A     B
1996  1996  1996
1997  1997  1997
1998  1998  1998
1999  1999  1999
```

Parameters

expr [str] The query string to evaluate.

You can refer to column names that contain spaces by surrounding them in backticks.

For example, if one of your columns is called `a a` and you want to sum it with `b`, your query should be `` `a a` + b ``.

inplace [bool] Whether the query should modify the data in place or return a modified copy.

Returns

DataFrame DataFrame resulting from the provided query expression.

Examples

```
>>> df = ks.DataFrame({'A': range(1, 6),
...                    'B': range(10, 0, -2),
...                    'C C': range(10, 5, -1)})
>>> df
   A   B  C C
0  1  10   10
1  2   8    9
2  3   6    8
3  4   4    7
4  5   2    6
```

```
>>> df.query('A > B')
   A  B  C C
4  5  2    6
```

The previous expression is equivalent to

```
>>> df[df.A > df.B]
   A  B  C C
4  5  2    6
```

For columns with spaces in their name, you can use backtick quoting.

```
>>> df.query('B == `C C`')
   A   B  C C
0  1  10   10
```

The previous expression is equivalent to

```
>>> df[df.B == df['C C']]
   A   B  C C
0  1  10   10
```

3.4.5 Binary operator functions

DataFrame.add(other)	Get Addition of dataframe and other, element-wise (binary operator +).
DataFrame.radd(other)	Get Addition of dataframe and other, element-wise (binary operator +).
DataFrame.div(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
DataFrame.rdiv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
DataFrame.truediv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).

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Table 44 – continued from previous page

DataFrame.rtruediv(other)	Get Floating division of dataframe and other, element-wise (binary operator /).
DataFrame.mul(other)	Get Multiplication of dataframe and other, element-wise (binary operator *).
DataFrame.rmul(other)	Get Multiplication of dataframe and other, element-wise (binary operator *).
DataFrame.sub(other)	Get Subtraction of dataframe and other, element-wise (binary operator -).
DataFrame.rsub(other)	Get Subtraction of dataframe and other, element-wise (binary operator -).
DataFrame.pow(other)	Get Exponential power of series of dataframe and other, element-wise (binary operator **).
DataFrame.rpow(other)	Get Exponential power of dataframe and other, element-wise (binary operator **).
DataFrame.mod(other)	Get Modulo of dataframe and other, element-wise (binary operator %).
DataFrame.rmod(other)	Get Modulo of dataframe and other, element-wise (binary operator %).
DataFrame.floordiv(other)	Get Integer division of dataframe and other, element-wise (binary operator //).
DataFrame.rfloordiv(other)	Get Integer division of dataframe and other, element-wise (binary operator //).
DataFrame.lt(other)	Compare if the current value is less than the other.
DataFrame.gt(other)	Compare if the current value is greater than the other.
DataFrame.le(other)	Compare if the current value is less than or equal to the other.
DataFrame.ge(other)	Compare if the current value is greater than or equal to the other.
DataFrame.ne(other)	Compare if the current value is not equal to the other.
DataFrame.eq(other)	Compare if the current value is equal to the other.
DataFrame.dot(other)	Compute the matrix multiplication between the DataFrame and other.

databricks.koalas.DataFrame.add

DataFrame.**add**(*other*) → databricks.koalas.frame.DataFrame

Get Addition of dataframe and other, element-wise (binary operator +).

Equivalent to `dataframe + other`. With reverse version, *radd*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.radd

`DataFrame.`**`radd`**`(`*other*`)` → databricks.koalas.frame.DataFrame

Get Addition of dataframe and other, element-wise (binary operator +).

Equivalent to `other + dataframe`. With reverse version, *add*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.div

`DataFrame.`**`div`**(*other*) → databricks.koalas.frame.DataFrame

Get Floating division of dataframe and other, element-wise (binary operator */*).

Equivalent to `dataframe / other`. With reverse version, *rdiv*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rdiv

DataFrame.**rdiv**(*other*) → databricks.koalas.frame.DataFrame

Get Floating division of dataframe and other, element-wise (binary operator /).

Equivalent to `other / dataframe`. With reverse version, *div*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.truediv

DataFrame.**truediv**(*other*) → databricks.koalas.frame.DataFrame

Get Floating division of dataframe and other, element-wise (binary operator /).

Equivalent to `dataframe / other`. With reverse version, *rtruediv*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rtruediv

DataFrame.**rtruediv**(*other*) → databricks.koalas.frame.DataFrame

Get Floating division of dataframe and other, element-wise (binary operator /).

Equivalent to `other / dataframe`. With reverse version, *truediv*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.mul

DataFrame.**mul**(*other*) → databricks.koalas.frame.DataFrame

Get Multiplication of dataframe and other, element-wise (binary operator *).

Equivalent to `dataframe * other`. With reverse version, *rmul*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rmul

DataFrame.**rmul**(*other*) → databricks.koalas.frame.DataFrame

Get Multiplication of dataframe and other, element-wise (binary operator *).

Equivalent to `other * dataframe`. With reverse version, *mul*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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(continued from previous page)

```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.sub

DataFrame.**sub**(*other*) → databricks.koalas.frame.DataFrame

Get Subtraction of dataframe and other, element-wise (binary operator -).

Equivalent to `dataframe - other`. With reverse version, *rsub*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rsub

DataFrame.**rsub**(*other*) → databricks.koalas.frame.DataFrame

Get Subtraction of dataframe and other, element-wise (binary operator -).

Equivalent to `other - dataframe`. With reverse version, *sub*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.pow

`DataFrame.`**`pow`**`(`*`other`*`)` → databricks.koalas.frame.DataFrame

Get Exponential power of series of dataframe and other, element-wise (binary operator **).

Equivalent to `dataframe ** other`. With reverse version, *rpow*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rpow

DataFrame.**rpow**(*other*) → databricks.koalas.frame.DataFrame

Get Exponential power of dataframe and other, element-wise (binary operator **).

Equivalent to `other ** dataframe`. With reverse version, *pow*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.mod

`DataFrame.`**`mod`**`(`*other*`)` → databricks.koalas.frame.DataFrame

Get Modulo of dataframe and other, element-wise (binary operator %).

Equivalent to `dataframe % other`. With reverse version, *rmod*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rmod

DataFrame.**rmod**(*other*) → databricks.koalas.frame.DataFrame

Get Modulo of dataframe and other, element-wise (binary operator %).

Equivalent to `other % dataframe`. With reverse version, *mod*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.floordiv

DataFrame.**floordiv**(*other*) → databricks.koalas.frame.DataFrame

Get Integer division of dataframe and other, element-wise (binary operator *//*).

Equivalent to `dataframe // other`. With reverse version, *rfloordiv*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
```

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```
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.rfloordiv

DataFrame.**rfloordiv**(*other*) → databricks.koalas.frame.DataFrame

Get Integer division of dataframe and other, element-wise (binary operator *//*).

Equivalent to `other // dataframe`. With reverse version, *floordiv*.

Among flexible wrappers (*add*, *sub*, *mul*, *div*) to arithmetic operators: +, -, *, /, //.

Parameters

other [scalar] Any single data

Returns

DataFrame Result of the arithmetic operation.

Examples

```
>>> df = ks.DataFrame({'angles': [0, 3, 4],
...                    'degrees': [360, 180, 360]},
...                   index=['circle', 'triangle', 'rectangle'],
...                   columns=['angles', 'degrees'])
>>> df
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Add a scalar with operator version which return the same results. Also reverse version.

```
>>> df + 1
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

```
>>> df.add(df)
           angles  degrees
circle          0      720
triangle        6      360
rectangle       8      720
```

```
>>> df + df + df
           angles  degrees
circle          0     1080
triangle        9      540
rectangle      12     1080
```

```
>>> df.radd(1)
           angles  degrees
circle          1      361
triangle        4      181
rectangle       5      361
```

Divide and true divide by constant with reverse version.

```
>>> df / 10
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.div(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rdiv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

```
>>> df.truediv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.3     18.0
rectangle     0.4     36.0
```

```
>>> df.rtruediv(10)
             angles   degrees
circle          inf  0.027778
triangle   3.333333  0.055556
rectangle  2.500000  0.027778
```

Subtract by constant with reverse version.

```
>>> df - 1
           angles  degrees
circle         -1      359
```

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```
triangle        2      179
rectangle       3      359
```

```
>>> df.sub(1)
           angles  degrees
circle         -1      359
triangle        2      179
rectangle       3      359
```

```
>>> df.rsub(1)
           angles  degrees
circle          1     -359
triangle       -2     -179
rectangle      -3     -359
```

Multiply by constant with reverse version.

```
>>> df * 1
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.mul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

```
>>> df.rmul(1)
           angles  degrees
circle          0      360
triangle        3      180
rectangle       4      360
```

Floor Divide by constant with reverse version.

```
>>> df // 10
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.floordiv(10)
           angles  degrees
circle        0.0     36.0
triangle      0.0     18.0
rectangle     0.0     36.0
```

```
>>> df.rfloordiv(10)
           angles  degrees
circle        inf      0.0
triangle      3.0      0.0
rectangle     2.0      0.0
```

Mod by constant with reverse version.

```
>>> df % 2
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.mod(2)
           angles  degrees
circle          0        0
triangle        1        0
rectangle       0        0
```

```
>>> df.rmod(2)
           angles  degrees
circle        NaN        2
triangle      2.0        2
rectangle     2.0        2
```

Power by constant with reverse version.

```
>>> df ** 2
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.pow(2)
           angles   degrees
circle        0.0  129600.0
triangle      9.0   32400.0
rectangle    16.0  129600.0
```

```
>>> df.rpow(2)
           angles        degrees
circle        1.0  2.348543e+108
triangle      8.0   1.532496e+54
rectangle    16.0  2.348543e+108
```

databricks.koalas.DataFrame.lt

DataFrame.**lt**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is less than the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.lt(1)
       a      b
a  False  False
b  False  False
c  False  False
d  False  False
```

databricks.koalas.DataFrame.gt

DataFrame.**gt**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is greater than the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.gt(2)
       a      b
a  False  False
b  False  False
c   True  False
d   True  False
```

databricks.koalas.DataFrame.le

DataFrame.**le**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is less than or equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.le(2)
       a      b
a   True   True
b   True  False
c  False   True
d  False  False
```

databricks.koalas.DataFrame.ge

DataFrame.**ge**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is greater than or equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.ge(1)
      a      b
a  True   True
b  True  False
c  True   True
d  True  False
```

databricks.koalas.DataFrame.ne

DataFrame.**ne**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is not equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.ne(1)
       a      b
a  False  False
b   True   True
c   True  False
d   True   True
```

databricks.koalas.DataFrame.eq

DataFrame.**eq**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.eq(1)
       a      b
a   True   True
b  False  False
c  False   True
d  False  False
```

databricks.koalas.DataFrame.dot

DataFrame.**dot**(*other: Series*) → Series

Compute the matrix multiplication between the DataFrame and other.

This method computes the matrix product between the DataFrame and the values of an other Series

It can also be called using `self @ other` in Python >= 3.5.

Note: This method is based on an expensive operation due to the nature of big data. Internally it needs to generate each row for each value, and then group twice - it is a huge operation. To prevent misusage, this method has the 'compute.max_rows' default limit of input length, and raises a ValueError.

```
>>> from databricks.koalas.config import option_context
>>> with option_context(
...     'compute.max_rows', 1000, "compute.ops_on_diff_frames", True
... ):
...     kdf = ks.DataFrame({'a': range(1001)})
...     kser = ks.Series([2], index=['a'])
...     kdf.dot(kser)
Traceback (most recent call last):
```

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```
  ...
ValueError: Current DataFrame has more then the given limit 1000 rows.
Please set 'compute.max_rows' by using 'databricks.koalas.config.set_option'
to retrieve to retrieve more than 1000 rows. Note that, before changing the
'compute.max_rows', this operation is considerably expensive.
```

Parameters

other [Series] The other object to compute the matrix product with.

Returns

Series Return the matrix product between self and other as a Series.

See also:

Series.dot Similar method for Series.

Notes

The dimensions of DataFrame and other must be compatible in order to compute the matrix multiplication. In addition, the column names of DataFrame and the index of other must contain the same values, as they will be aligned prior to the multiplication.

The dot method for Series computes the inner product, instead of the matrix product here.

Examples

```
>>> from databricks.koalas.config import set_option, reset_option
>>> set_option("compute.ops_on_diff_frames", True)
>>> kdf = ks.DataFrame([[0, 1, -2, -1], [1, 1, 1, 1]])
>>> kser = ks.Series([1, 1, 2, 1])
>>> kdf.dot(kser)
0   -4
1    5
dtype: int64
```

Note how shuffling of the objects does not change the result.

```
>>> kser2 = kser.reindex([1, 0, 2, 3])
>>> kdf.dot(kser2)
0   -4
1    5
dtype: int64
>>> kdf @ kser2
0   -4
1    5
dtype: int64
>>> reset_option("compute.ops_on_diff_frames")
```

3.4.6 Function application, GroupBy & Window

DataFrame.apply(func[, axis, args])	Apply a function along an axis of the DataFrame.
DataFrame.applymap(func)	Apply a function to a Dataframe elementwise.
DataFrame.pipe(func, *args, **kwargs)	Apply func(self, *args, **kwargs).
DataFrame.agg(func)	Aggregate using one or more operations over the specified axis.
DataFrame.aggregate(func)	Aggregate using one or more operations over the specified axis.
DataFrame.groupby(by[, axis, as_index, dropna])	Group DataFrame or Series using a Series of columns.
DataFrame.rolling(window[, min_periods])	Provide rolling transformations.
DataFrame.expanding([min_periods])	Provide expanding transformations.
DataFrame.transform(func[, axis])	Call `func` on self producing a Series with transformed values and that has the same length as its input.
DataFrame.map_in_pandas(func)	Apply a function that takes pandas DataFrame and outputs pandas DataFrame.

databricks.koalas.DataFrame.apply

`DataFrame.`**`apply`**(*func*, *axis=0*, *args=()*, ***kwds*) → Union[Series, DataFrame, Index]

Apply a function along an axis of the DataFrame.

Objects passed to the function are Series objects whose index is either the DataFrame's index (`axis=0`) or the DataFrame's columns (`axis=1`).

See also Transform and apply a function.

Note: when *axis* is 0 or 'index', the *func* is unable to access to the whole input series. Koalas internally splits the input series into multiple batches and calls *func* with each batch multiple times. Therefore, operations such as global aggregations are impossible. See the example below.

```
>>> # This case does not return the length of whole series but of the batch␣
↪internally
... # used.
... def length(s) -> int:
...     return len(s)
...
>>> df = ks.DataFrame({'A': range(1000)})
>>> df.apply(length, axis=0)
0     83
1     83
2     83
...
10    83
11    83
dtype: int32
```

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify the return type as *Series* or scalar value in `func`, for instance, as below:

```
>>> def square(s) -> ks.Series[np.int32]:
...     return s ** 2
```

Koalas uses return type hint and does not try to infer the type.

In case when axis is 1, it requires to specify *DataFrame* or scalar value with type hints as below:

```
>>> def plus_one(x) -> ks.DataFrame[float, float]:
...     return x + 1
```

If the return type is specified as *DataFrame*, the output column names become *c0, c1, c2 ... cn*. These names are positionally mapped to the returned DataFrame in `func`.

To specify the column names, you can assign them in a pandas friendly style as below:

```
>>> def plus_one(x) -> ks.DataFrame["a": float, "b": float]:
...     return x + 1
```

```
>>> pdf = pd.DataFrame({'a': [1, 2, 3], 'b': [3, 4, 5]})
>>> def plus_one(x) -> ks.DataFrame[zip(pdf.dtypes, pdf.columns)]:
...     return x + 1
```

However, this way switches the index type to default index type in the output because the type hint cannot express the index type at this moment. Use *reset_index()* to keep index as a workaround.

Parameters

func [function] Function to apply to each column or row.

axis [{0 or 'index', 1 or 'columns'}, default 0] Axis along which the function is applied:

- 0 or 'index': apply function to each column.
- 1 or 'columns': apply function to each row.

args [tuple] Positional arguments to pass to *func* in addition to the array/series.

****kwds** Additional keyword arguments to pass as keywords arguments to *func*.

Returns

Series or DataFrame Result of applying `func` along the given axis of the DataFrame.

See also:

DataFrame.applymap For elementwise operations.

DataFrame.aggregate Only perform aggregating type operations.

DataFrame.transform Only perform transforming type operations.

Series.apply The equivalent function for Series.

Examples

```
>>> df = ks.DataFrame([[4, 9]] * 3, columns=['A', 'B'])
>>> df
   A  B
0  4  9
1  4  9
2  4  9
```

Using a numpy universal function (in this case the same as `np.sqrt(df)`):

```
>>> def sqrt(x) -> ks.Series[float]:
...     return np.sqrt(x)
...
>>> df.apply(sqrt, axis=0)
     A    B
0  2.0  3.0
1  2.0  3.0
2  2.0  3.0
```

You can omit the type hint and let Koalas infer its type.

```
>>> df.apply(np.sqrt, axis=0)
     A    B
0  2.0  3.0
1  2.0  3.0
2  2.0  3.0
```

When *axis* is 1 or 'columns', it applies the function for each row.

```
>>> def summation(x) -> np.int64:
...     return np.sum(x)
...
>>> df.apply(summation, axis=1)
0    13
1    13
2    13
dtype: int64
```

Likewise, you can omit the type hint and let Koalas infer its type.

```
>>> df.apply(np.sum, axis=1)
0    13
1    13
2    13
dtype: int64
```

```
>>> df.apply(max, axis=1)
0    9
1    9
2    9
dtype: int64
```

Returning a list-like will result in a Series

```
>>> df.apply(lambda x: [1, 2], axis=1)
0    [1, 2]
```

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```
1    [1, 2]
2    [1, 2]
dtype: object
```

In order to specify the types when *axis* is '1', it should use DataFrame[...] annotation. In this case, the column names are automatically generated.

```
>>> def identify(x) -> ks.DataFrame['A': np.int64, 'B': np.int64]:
...     return x
...
>>> df.apply(identify, axis=1)
   A  B
0  4  9
1  4  9
2  4  9
```

You can also specify extra arguments.

```
>>> def plus_two(a, b, c) -> ks.DataFrame[np.int64, np.int64]:
...     return a + b + c
...
>>> df.apply(plus_two, axis=1, args=(1,), c=3)
   c0  c1
0   8  13
1   8  13
2   8  13
```

databricks.koalas.DataFrame.applymap

DataFrame.**applymap**(*func*) → databricks.koalas.frame.DataFrame

Apply a function to a Dataframe elementwise.

This method applies a function that accepts and returns a scalar to every element of a DataFrame.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def square(x) -> np.int32:
...     return x ** 2
```

Koalas uses return type hint and does not try to infer the type.

Parameters

func [callable] Python function, returns a single value from a single value.

Returns

DataFrame Transformed DataFrame.

Examples

```
>>> df = ks.DataFrame([[1, 2.12], [3.356, 4.567]])
>>> df
       0      1
0  1.000  2.120
1  3.356  4.567
```

```
>>> def str_len(x) -> int:
...     return len(str(x))
>>> df.applymap(str_len)
   0  1
0  3  4
1  5  5
```

```
>>> def power(x) -> float:
...     return x ** 2
>>> df.applymap(power)
           0          1
0   1.000000   4.494400
1  11.262736  20.857489
```

You can omit the type hint and let Koalas infer its type.

```
>>> df.applymap(lambda x: x ** 2)
           0          1
0   1.000000   4.494400
1  11.262736  20.857489
```

databricks.koalas.DataFrame.pipe

DataFrame.**pipe**(*func*, **args*, ***kwargs*) → Any

Apply func(self, *args, **kwargs).

Parameters

func [function] function to apply to the DataFrame. `args`, and `kwargs` are passed into `func`. Alternatively a `(callable, data_keyword)` tuple where `data_keyword` is a string indicating the keyword of `callable` that expects the DataFrames.

args [iterable, optional] positional arguments passed into `func`.

kwargs [mapping, optional] a dictionary of keyword arguments passed into `func`.

Returns

object [the return type of `func`.]

Notes

Use `.pipe` when chaining together functions that expect Series, DataFrames or GroupBy objects. For example, given

```
>>> df = ks.DataFrame({'category': ['A', 'A', 'B'],
...                    'col1': [1, 2, 3],
...                    'col2': [4, 5, 6]},
...                   columns=['category', 'col1', 'col2'])
>>> def keep_category_a(df):
...     return df[df['category'] == 'A']
>>> def add_one(df, column):
...     return df.assign(col3=df[column] + 1)
>>> def multiply(df, column1, column2):
...     return df.assign(col4=df[column1] * df[column2])
```

instead of writing

```
>>> multiply(add_one(keep_category_a(df), column="col1"), column1="col2", column2=
↪"col3")
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

You can write

```
>>> (df.pipe(keep_category_a)
...     .pipe(add_one, column="col1")
...     .pipe(multiply, column1="col2", column2="col3")
... )
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

If you have a function that takes the data as (say) the second argument, pass a tuple indicating which keyword expects the data. For example, suppose `f` takes its data as `df`:

```
>>> def multiply_2(column1, df, column2):
...     return df.assign(col4=df[column1] * df[column2])
```

Then you can write

```
>>> (df.pipe(keep_category_a)
...     .pipe(add_one, column="col1")
...     .pipe((multiply_2, 'df'), column1="col2", column2="col3")
... )
  category  col1  col2  col3  col4
0        A     1     4     2     8
1        A     2     5     3    15
```

You can use lambda as wel

```
>>> ks.Series([1, 2, 3]).pipe(lambda x: (x + 1).rename("value"))
0    2
1    3
2    4
Name: value, dtype: int64
```

databricks.koalas.DataFrame.agg

DataFrame.**agg**(*func: Union[List[str], Dict[Any, List[str]]]*) → Union[Series, DataFrame, Index]

Aggregate using one or more operations over the specified axis.

Parameters

func [dict or a list] a dict mapping from column name (string) to aggregate functions (list of strings). If a list is given, the aggregation is performed against all columns.

Returns

DataFrame

See also:

DataFrame.apply Invoke function on DataFrame.

DataFrame.transform Only perform transforming type operations.

DataFrame.groupby Perform operations over groups.

Series.aggregate The equivalent function for Series.

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> df = ks.DataFrame([[1, 2, 3],
...                    [4, 5, 6],
...                    [7, 8, 9],
...                    [np.nan, np.nan, np.nan]],
...                   columns=['A', 'B', 'C'])
```

```
>>> df
     A    B    C
0  1.0  2.0  3.0
1  4.0  5.0  6.0
2  7.0  8.0  9.0
3  NaN  NaN  NaN
```

Aggregate these functions over the rows.

```
>>> df.agg(['sum', 'min'])[['A', 'B', 'C']].sort_index()
        A     B     C
min   1.0   2.0   3.0
sum  12.0  15.0  18.0
```

Different aggregations per column.

```
>>> df.agg({'A' : ['sum', 'min'], 'B' : ['min', 'max']})[['A', 'B']].sort_index()
        A    B
max   NaN  8.0
min   1.0  2.0
sum  12.0  NaN
```

For multi-index columns:

```
>>> df.columns = pd.MultiIndex.from_tuples([("X", "A"), ("X", "B"), ("Y", "C")])
>>> df.agg(['sum', 'min'])[[("X", "A"), ("X", "B"), ("Y", "C")]].sort_index()
        X           Y
        A     B     C
min   1.0   2.0   3.0
sum  12.0  15.0  18.0
```

```
>>> aggregated = df.agg({("X", "A") : ['sum', 'min'], ("X", "B") : ['min', 'max']}
↪)
>>> aggregated[[("X", "A"), ("X", "B")]].sort_index()
        X
        A    B
max   NaN  8.0
min   1.0  2.0
sum  12.0  NaN
```

databricks.koalas.DataFrame.aggregate

DataFrame.**aggregate**(*func: Union[List[str], Dict[Any, List[str]]]*) → Union[Series, DataFrame, Index]

Aggregate using one or more operations over the specified axis.

Parameters

func [dict or a list] a dict mapping from column name (string) to aggregate functions (list of strings). If a list is given, the aggregation is performed against all columns.

Returns

DataFrame

See also:

DataFrame.apply Invoke function on DataFrame.

DataFrame.transform Only perform transforming type operations.

DataFrame.groupby Perform operations over groups.

Series.aggregate The equivalent function for Series.

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> df = ks.DataFrame([[1, 2, 3],
...                    [4, 5, 6],
...                    [7, 8, 9],
...                    [np.nan, np.nan, np.nan]],
...                   columns=['A', 'B', 'C'])
```

```
>>> df
     A    B    C
0  1.0  2.0  3.0
1  4.0  5.0  6.0
2  7.0  8.0  9.0
3  NaN  NaN  NaN
```

Aggregate these functions over the rows.

```
>>> df.agg(['sum', 'min'])[['A', 'B', 'C']].sort_index()
        A     B     C
min   1.0   2.0   3.0
sum  12.0  15.0  18.0
```

Different aggregations per column.

```
>>> df.agg({'A' : ['sum', 'min'], 'B' : ['min', 'max']})[['A', 'B']].sort_index()
        A    B
max   NaN  8.0
min   1.0  2.0
sum  12.0  NaN
```

For multi-index columns:

```
>>> df.columns = pd.MultiIndex.from_tuples([("X", "A"), ("X", "B"), ("Y", "C")])
>>> df.agg(['sum', 'min'])[[("X", "A"), ("X", "B"), ("Y", "C")]].sort_index()
        X           Y
        A     B     C
min   1.0   2.0   3.0
sum  12.0  15.0  18.0
```

```
>>> aggregated = df.agg({("X", "A") : ['sum', 'min'], ("X", "B") : ['min', 'max']}
↪)
>>> aggregated[[("X", "A"), ("X", "B")]].sort_index()
        X
        A    B
max   NaN  8.0
min   1.0  2.0
sum  12.0  NaN
```

databricks.koalas.DataFrame.groupby

DataFrame.**groupby**(*by*, *axis=0*, *as_index: bool = True*, *dropna: bool = True*) → Union[DataFrameGroupBy, SeriesGroupBy]

Group DataFrame or Series using a Series of columns.

A groupby operation involves some combination of splitting the object, applying a function, and combining the results. This can be used to group large amounts of data and compute operations on these groups.

Parameters

by [Series, label, or list of labels] Used to determine the groups for the groupby. If Series is passed, the Series or dict VALUES will be used to determine the groups. A label or list of labels may be passed to group by the columns in `self`.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

as_index [bool, default True] For aggregated output, return object with group labels as the index. Only relevant for DataFrame input. as_index=False is effectively "SQL-style" grouped output.

dropna [bool, default True] If True, and if group keys contain NA values, NA values together with row/column will be dropped. If False, NA values will also be treated as the key in groups.

Returns

DataFrameGroupBy or SeriesGroupBy Depends on the calling object and returns groupby object that contains information about the groups.

See also:

koalas.groupby.GroupBy

Examples

```
>>> df = ks.DataFrame({'Animal': ['Falcon', 'Falcon',
...                               'Parrot', 'Parrot'],
...                    'Max Speed': [380., 370., 24., 26.]},
...                   columns=['Animal', 'Max Speed'])
>>> df
   Animal  Max Speed
0  Falcon      380.0
1  Falcon      370.0
2  Parrot       24.0
3  Parrot       26.0
```

```
>>> df.groupby(['Animal']).mean().sort_index()
        Max Speed
Animal
Falcon      375.0
Parrot       25.0
```

```
>>> df.groupby(['Animal'], as_index=False).mean().sort_values('Animal')
...
   Animal  Max Speed
...Falcon      375.0
...Parrot       25.0
```

We can also choose to include NA in group keys or not by setting dropna parameter, the default setting is True:

```
>>> l = [[1, 2, 3], [1, None, 4], [2, 1, 3], [1, 2, 2]]
>>> df = ks.DataFrame(l, columns=["a", "b", "c"])
>>> df.groupby(by=["b"]).sum().sort_index()
     a  c
b
1.0  2  3
2.0  2  5
```

```
>>> df.groupby(by=["b"], dropna=False).sum().sort_index()
     a  c
b
1.0  2  3
```

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```
2.0  2  5
NaN  1  4
```

databricks.koalas.DataFrame.rolling

DataFrame.**rolling**(*window*, *min_periods=None*) → databricks.koalas.window.Rolling
Provide rolling transformations.

Note: 'min_periods' in Koalas works as a fixed window size unlike pandas. Unlike pandas, NA is also counted as the period. This might be changed in the near future.

Parameters

window [int, or offset] Size of the moving window. This is the number of observations used for calculating the statistic. Each window will be a fixed size.

min_periods [int, default None] Minimum number of observations in window required to have a value (otherwise result is NA). For a window that is specified by an offset, min_periods will default to 1. Otherwise, min_periods will default to the size of the window.

Returns

a Window sub-classed for the particular operation

databricks.koalas.DataFrame.expanding

DataFrame.**expanding**(*min_periods=1*) → databricks.koalas.window.Expanding
Provide expanding transformations.

Note: 'min_periods' in Koalas works as a fixed window size unlike pandas. Unlike pandas, NA is also counted as the period. This might be changed in the near future.

Parameters

min_periods [int, default 1] Minimum number of observations in window required to have a value (otherwise result is NA).

Returns

a Window sub-classed for the particular operation

databricks.koalas.DataFrame.transform

DataFrame.**transform**(*func*, *axis=0*, **args*, ***kwargs*) → databricks.koalas.frame.DataFrame

Call `func` on self producing a Series with transformed values and that has the same length as its input.

See also Transform and apply a function.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def square(x) -> ks.Series[np.int32]:
...     return x ** 2
```

Koalas uses return type hint and does not try to infer the type.

Note: the series within `func` is actually multiple pandas series as the segments of the whole Koalas series; therefore, the length of each series is not guaranteed. As an example, an aggregation against each series does work as a global aggregation but an aggregation of each segment. See below:

```
>>> def func(x) -> ks.Series[np.int32]:
...     return x + sum(x)
```

Parameters

func [function] Function to use for transforming the data. It must work when pandas Series is passed.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

***args** Positional arguments to pass to func.

****kwargs** Keyword arguments to pass to func.

Returns

DataFrame A DataFrame that must have the same length as self.

Raises

Exception [If the returned DataFrame has a different length than self.]

See also:

DataFrame.aggregate Only perform aggregating type operations.

DataFrame.apply Invoke function on DataFrame.

Series.transform The equivalent function for Series.

Examples

```
>>> df = ks.DataFrame({'A': range(3), 'B': range(1, 4)}, columns=['A', 'B'])
>>> df
   A  B
0  0  1
1  1  2
2  2  3
```

```
>>> def square(x) -> ks.Series[np.int32]:
...     return x ** 2
>>> df.transform(square)
   A  B
0  0  1
1  1  4
2  4  9
```

You can omit the type hint and let Koalas infer its type.

```
>>> df.transform(lambda x: x ** 2)
   A  B
0  0  1
1  1  4
2  4  9
```

For multi-index columns:

```
>>> df.columns = [('X', 'A'), ('X', 'B')]
>>> df.transform(square)
   X
   A  B
0  0  1
1  1  4
2  4  9
```

```
>>> (df * -1).transform(abs)
   X
   A  B
0  0  1
1  1  2
2  2  3
```

You can also specify extra arguments.

```
>>> def calculation(x, y, z) -> ks.Series[int]:
...     return x ** y + z
>>> df.transform(calculation, y=10, z=20)
      X
      A      B
0    20     21
1    21   1044
2  1044  59069
```

databricks.koalas.DataFrame.map_in_pandas

DataFrame.**map_in_pandas**(*func*) → databricks.koalas.frame.DataFrame

Apply a function that takes pandas DataFrame and outputs pandas DataFrame. The pandas DataFrame given to the function is of a batch used internally.

See also Transform and apply a function.

Note: the *func* is unable to access to the whole input frame. Koalas internally splits the input series into multiple batches and calls *func* with each batch multiple times. Therefore, operations such as global aggregations are impossible. See the example below.

```
>>> # This case does not return the length of whole frame but of the batch␣
↪internally
... # used.
... def length(pdf) -> ks.DataFrame[int]:
...     return pd.DataFrame([len(pdf)])
...
>>> df = ks.DataFrame({'A': range(1000)})
>>> df.koalas.apply_batch(length)
    c0
0   83
1   83
2   83
...
10  83
11  83
```

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def plus_one(x) -> ks.DataFrame[float, float]:
...     return x + 1
```

If the return type is specified, the output column names become *c0, c1, c2 ... cn*. These names are positionally mapped to the returned DataFrame in `func`.

To specify the column names, you can assign them in a pandas friendly style as below:

```
>>> def plus_one(x) -> ks.DataFrame["a": float, "b": float]:
...     return x + 1
```

```
>>> pdf = pd.DataFrame({'a': [1, 2, 3], 'b': [3, 4, 5]})
>>> def plus_one(x) -> ks.DataFrame[zip(pdf.dtypes, pdf.columns)]:
...     return x + 1
```

Parameters

func [function] Function to apply to each pandas frame.

args [tuple] Positional arguments to pass to *func* in addition to the array/series.

****kwds** Additional keyword arguments to pass as keywords arguments to *func*.

Returns

DataFrame

See also:

DataFrame.apply For row/columnwise operations.

DataFrame.applymap For elementwise operations.

DataFrame.aggregate Only perform aggregating type operations.

DataFrame.transform Only perform transforming type operations.

Series.koalas.transform_batch transform the search as each pandas chunks.

Examples

```
>>> df = ks.DataFrame([(1, 2), (3, 4), (5, 6)], columns=['A', 'B'])
>>> df
   A  B
0  1  2
1  3  4
2  5  6
```

```
>>> def query_func(pdf) -> ks.DataFrame[int, int]:
...     return pdf.query('A == 1')
>>> df.koalas.apply_batch(query_func)
   c0  c1
0   1   2
```

```
>>> def query_func(pdf) -> ks.DataFrame["A": int, "B": int]:
...     return pdf.query('A == 1')
>>> df.koalas.apply_batch(query_func)
   A  B
0  1  2
```

You can also omit the type hints so Koalas infers the return schema as below:

```
>>> df.koalas.apply_batch(lambda pdf: pdf.query('A == 1'))
   A  B
0  1  2
```

You can also specify extra arguments.

```
>>> def calculation(pdf, y, z) -> ks.DataFrame[int, int]:
...     return pdf ** y + z
>>> df.koalas.apply_batch(calculation, args=(10,), z=20)
        c0        c1
0       21      1044
1    59069   1048596
2  9765645  60466196
```

You can also use `np.ufunc` and built-in functions as input.

```
>>> df.koalas.apply_batch(np.add, args=(10,))
    A   B
0  11  12
1  13  14
2  15  16
```

```
>>> (df * -1).koalas.apply_batch(abs)
   A  B
0  1  2
1  3  4
2  5  6
```

3.4.7 Computations / Descriptive Stats

DataFrame.abs()	Return a Series/DataFrame with absolute numeric value of each element.
DataFrame.all([axis])	Return whether all elements are True.
DataFrame.any([axis])	Return whether any element is True.
DataFrame.clip([lower, upper])	Trim values at input threshold(s).
DataFrame.corr([method])	Compute pairwise correlation of columns, excluding NA/null values.
DataFrame.count([axis])	Count non-NA cells for each column.
DataFrame.describe([percentiles])	Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding `NaN` values.
DataFrame.kurt([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
DataFrame.kurtosis([axis, numeric_only])	Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0).
DataFrame.mad([axis])	Return the mean absolute deviation of values.
DataFrame.max([axis, numeric_only])	Return the maximum of the values.
DataFrame.mean([axis, numeric_only])	Return the mean of the values.
DataFrame.min([axis, numeric_only])	Return the minimum of the values.
DataFrame.median([axis, numeric_only, accuracy])	Return the median of the values for the requested axis.
DataFrame.pct_change([periods])	Percentage change between the current and a prior element.
DataFrame.prod()	Return the product of the values as Series.
DataFrame.product()	Return the product of the values as Series.
DataFrame.quantile([q, axis, numeric_only, ...])	Return value at the given quantile.
DataFrame.nunique([axis, dropna, approx, rsd])	Return number of unique elements in the object.
DataFrame.skew([axis, numeric_only])	Return unbiased skew normalized by N-1.
DataFrame.sum([axis, numeric_only])	Return the sum of the values.
DataFrame.std([axis, numeric_only])	Return sample standard deviation.
DataFrame.var([axis, numeric_only])	Return unbiased variance.
DataFrame.cummin([skipna])	Return cumulative minimum over a DataFrame or Series axis.
DataFrame.cummax([skipna])	Return cumulative maximum over a DataFrame or Series axis.

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DataFrame.cumsum([skipna])	Return cumulative sum over a DataFrame or Series axis.
DataFrame.cumprod([skipna])	Return cumulative product over a DataFrame or Series axis.
DataFrame.round([decimals])	Round a DataFrame to a variable number of decimal places.
DataFrame.diff([periods, axis])	First discrete difference of element.
DataFrame.eval(expr[, inplace])	Evaluate a string describing operations on DataFrame columns.

databricks.koalas.DataFrame.abs

DataFrame.**abs**() → Union[DataFrame, Series]

Return a Series/DataFrame with absolute numeric value of each element.

Returns

abs [Series/DataFrame containing the absolute value of each element.]

Examples

Absolute numeric values in a Series.

```
>>> s = ks.Series([-1.10, 2, -3.33, 4])
>>> s.abs()
0    1.10
1    2.00
2    3.33
3    4.00
dtype: float64
```

Absolute numeric values in a DataFrame.

```
>>> df = ks.DataFrame({
...     'a': [4, 5, 6, 7],
...     'b': [10, 20, 30, 40],
...     'c': [100, 50, -30, -50]
...   },
...   columns=['a', 'b', 'c'])
>>> df.abs()
   a   b    c
0  4  10  100
1  5  20   50
2  6  30   30
3  7  40   50
```

databricks.koalas.DataFrame.all

DataFrame.**all**(*axis: Union[int, str] = 0*) → Series

Return whether all elements are True.

Returns True unless there is at least one element within a series that is False or equivalent (e.g. zero or empty)

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Returns

Series

Examples

Create a dataframe from a dictionary.

```
>>> df = ks.DataFrame({
...     'col1': [True, True, True],
...     'col2': [True, False, False],
...     'col3': [0, 0, 0],
...     'col4': [1, 2, 3],
...     'col5': [True, True, None],
...     'col6': [True, False, None]},
...     columns=['col1', 'col2', 'col3', 'col4', 'col5', 'col6'])
```

Default behaviour checks if column-wise values all return a boolean.

```
>>> df.all()
col1     True
col2    False
col3    False
col4     True
col5     True
col6    False
dtype: bool
```

databricks.koalas.DataFrame.any

DataFrame.**any**(*axis: Union[int, str] = 0*) → Series

Return whether any element is True.

Returns False unless there is at least one element within a series that is True or equivalent (e.g. non-zero or non-empty).

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Returns

Series

Examples

Create a dataframe from a dictionary.

```
>>> df = ks.DataFrame({
...     'col1': [False, False, False],
...     'col2': [True, False, False],
...     'col3': [0, 0, 1],
...     'col4': [0, 1, 2],
...     'col5': [False, False, None],
...     'col6': [True, False, None]},
...     columns=['col1', 'col2', 'col3', 'col4', 'col5', 'col6'])
```

Default behaviour checks if column-wise values all return a boolean.

```
>>> df.any()
col1    False
col2     True
col3     True
col4     True
col5    False
col6     True
dtype: bool
```

databricks.koalas.DataFrame.clip

DataFrame.**clip**(*lower: Union[float, int] = None*, *upper: Union[float, int] = None*) → databricks.koalas.frame.DataFrame

Trim values at input threshold(s).

Assigns values outside boundary to boundary values.

Parameters

lower [float or int, default None] Minimum threshold value. All values below this threshold will be set to it.

upper [float or int, default None] Maximum threshold value. All values above this threshold will be set to it.

Returns

DataFrame DataFrame with the values outside the clip boundaries replaced.

Notes

One difference between this implementation and pandas is that running pd.DataFrame({'A': ['a', 'b']}).clip(0, 1) will crash with "TypeError: '<=' not supported between instances of 'str' and 'int'" while ks.DataFrame({'A': ['a', 'b']}).clip(0, 1) will output the original DataFrame, simply ignoring the incompatible types.

Examples

```
>>> ks.DataFrame({'A': [0, 2, 4]}).clip(1, 3)
   A
0  1
1  2
2  3
```

databricks.koalas.DataFrame.corr

DataFrame.**corr**(*method='pearson'*) → Union[Series, DataFrame, Index]

Compute pairwise correlation of columns, excluding NA/null values.

Parameters

method [{'pearson', 'spearman'}]

- pearson : standard correlation coefficient
- spearman : Spearman rank correlation

Returns

y [DataFrame]

See also:

Series.corr

Notes

There are behavior differences between Koalas and pandas.

- the *method* argument only accepts 'pearson', 'spearman'
- the data should not contain NaNs. Koalas will return an error.
- Koalas doesn't support the following argument(s).
  - *min_periods* argument is not supported

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'])
>>> df.corr('pearson')
          dogs      cats
dogs  1.000000 -0.851064
cats -0.851064  1.000000
```

```
>>> df.corr('spearman')
          dogs      cats
dogs  1.000000 -0.948683
cats -0.948683  1.000000
```

databricks.koalas.DataFrame.count

DataFrame.**count**(*axis=None*) → pandas.core.series.Series

Count non-NA cells for each column.

The values *None*, *NaN* are considered NA.

Parameters

axis [{0 or 'index', 1 or 'columns'}, default 0] If 0 or 'index' counts are generated for each column. If 1 or 'columns' counts are generated for each row.

Returns

pandas.Series

See also:

Series.count Number of non-NA elements in a Series.

DataFrame.shape Number of DataFrame rows and columns (including NA elements).

DataFrame.isna Boolean same-sized DataFrame showing places of NA elements.

Examples

Constructing DataFrame from a dictionary:

```
>>> df = ks.DataFrame({"Person":
...                    ["John", "Myla", "Lewis", "John", "Myla"],
...                    "Age": [24., np.nan, 21., 33, 26],
...                    "Single": [False, True, True, True, False]},
...                   columns=["Person", "Age", "Single"])
>>> df
  Person   Age  Single
0   John  24.0   False
1   Myla   NaN    True
2  Lewis  21.0    True
3   John  33.0    True
4   Myla  26.0   False
```

Notice the uncounted NA values:

```
>>> df.count()
Person    5
Age       4
Single    5
dtype: int64
```

```
>>> df.count(axis=1)
0    3
1    2
2    3
3    3
4    3
dtype: int64
```

databricks.koalas.DataFrame.describe

DataFrame.**describe**(*percentiles: Optional[List[float]] = None*) → databricks.koalas.frame.DataFrame

Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN values.

Analyzes both numeric and object series, as well as DataFrame column sets of mixed data types. The output will vary depending on what is provided. Refer to the notes below for more detail.

Parameters

percentiles [list of float in range [0.0, 1.0], default [0.25, 0.5, 0.75]] A list of percentiles to be computed.

Returns

DataFrame Summary statistics of the Dataframe provided.

See also:

DataFrame.count Count number of non-NA/null observations.

DataFrame.max Maximum of the values in the object.

DataFrame.min Minimum of the values in the object.

DataFrame.mean Mean of the values.

DataFrame.std Standard deviation of the observations.

Notes

For numeric data, the result's index will include count, mean, std, min, 25%, 50%, 75%, max.

Currently only numeric data is supported.

Examples

Describing a numeric Series.

```
>>> s = ks.Series([1, 2, 3])
>>> s.describe()
count    3.0
mean     2.0
std      1.0
min      1.0
25%      1.0
50%      2.0
75%      3.0
max      3.0
dtype: float64
```

Describing a DataFrame. Only numeric fields are returned.

```
>>> df = ks.DataFrame({'numeric1': [1, 2, 3],
...                    'numeric2': [4.0, 5.0, 6.0],
...                    'object': ['a', 'b', 'c']
...                   },
...                   columns=['numeric1', 'numeric2', 'object'])
```

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```
>>> df.describe()
       numeric1  numeric2
count       3.0       3.0
mean        2.0       5.0
std         1.0       1.0
min         1.0       4.0
25%         1.0       4.0
50%         2.0       5.0
75%         3.0       6.0
max         3.0       6.0
```

For multi-index columns:

```
>>> df.columns = [('num', 'a'), ('num', 'b'), ('obj', 'c')]
>>> df.describe()
       num
         a    b
count  3.0  3.0
mean   2.0  5.0
std    1.0  1.0
min    1.0  4.0
25%    1.0  4.0
50%    2.0  5.0
75%    3.0  6.0
max    3.0  6.0
```

```
>>> df[('num', 'b')].describe()
count    3.0
mean     5.0
std      1.0
min      4.0
25%      4.0
50%      5.0
75%      6.0
max      6.0
Name: (num, b), dtype: float64
```

Describing a `DataFrame` and selecting custom percentiles.

```
>>> df = ks.DataFrame({'numeric1': [1, 2, 3],
...                    'numeric2': [4.0, 5.0, 6.0]
...                   },
...                   columns=['numeric1', 'numeric2'])
>>> df.describe(percentiles = [0.85, 0.15])
       numeric1  numeric2
count       3.0       3.0
mean        2.0       5.0
std         1.0       1.0
min         1.0       4.0
15%         1.0       4.0
50%         2.0       5.0
85%         3.0       6.0
max         3.0       6.0
```

Describing a column from a `DataFrame` by accessing it as an attribute.

```
>>> df.numeric1.describe()
count    3.0
mean     2.0
std      1.0
min      1.0
25%      1.0
50%      2.0
75%      3.0
max      3.0
Name: numeric1, dtype: float64
```

Describing a column from a `DataFrame` by accessing it as an attribute and selecting custom percentiles.

```
>>> df.numeric1.describe(percentiles = [0.85, 0.15])
count    3.0
mean     2.0
std      1.0
min      1.0
15%      1.0
50%      2.0
85%      3.0
max      3.0
Name: numeric1, dtype: float64
```

databricks.koalas.DataFrame.kurt

`DataFrame.`**`kurt`**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0). Normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

kurt [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.kurtosis()
a   -1.5
b   -1.5
dtype: float64
```

On a Series:

```
>>> df['a'].kurtosis()
-1.5
```

databricks.koalas.DataFrame.kurtosis

DataFrame.**kurtosis**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return unbiased kurtosis using Fisher's definition of kurtosis (kurtosis of normal == 0.0). Normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

kurt [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.kurtosis()
a   -1.5
b   -1.5
dtype: float64
```

On a Series:

```
>>> df['a'].kurtosis()
-1.5
```

databricks.koalas.DataFrame.mad

DataFrame.**mad**(*axis=0*) → Series

Return the mean absolute deviation of values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

```
>>> df.mad()
a    0.666667
b    0.066667
dtype: float64
```

```
>>> df.mad(axis=1)
0    0.45
1    0.90
2    1.35
3     NaN
dtype: float64
```

databricks.koalas.DataFrame.max

DataFrame.**max**(*axis=None*, *numeric_only=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return the maximum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default None] If True, include only float, int, boolean columns. This parameter is mainly for pandas compatibility. False is supported; however, the columns should be all numeric or all non-numeric.

Returns

max [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.max()
a    3.0
b    0.3
dtype: float64
```

```
>>> df.max(axis=1)
0    1.0
1    2.0
2    3.0
3    NaN
dtype: float64
```

On a Series:

```
>>> df['a'].max()
3.0
```

databricks.koalas.DataFrame.mean

DataFrame.**mean**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return the mean of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

mean [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.mean()
a    2.0
b    0.2
dtype: float64
```

```
>>> df.mean(axis=1)
0    0.55
1    1.10
2    1.65
3     NaN
dtype: float64
```

On a Series:

```
>>> df['a'].mean()
2.0
```

databricks.koalas.DataFrame.min

DataFrame.**min**(*axis=None*, *numeric_only=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return the minimum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default None] If True, include only float, int, boolean columns. This parameter is mainly for pandas compatibility. False is supported; however, the columns should be all numeric or all non-numeric.

Returns

min [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.min()
a    1.0
b    0.1
dtype: float64
```

```
>>> df.min(axis=1)
0    0.1
1    0.2
2    0.3
3    NaN
dtype: float64
```

On a Series:

```
>>> df['a'].min()
1.0
```

databricks.koalas.DataFrame.median

DataFrame.**median**(*axis=None*, *numeric_only=True*, *accuracy=10000*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return the median of the values for the requested axis.

Note: Unlike pandas', the median in Koalas is an approximated median based upon approximate percentile computation because computing median across a large dataset is extremely expensive.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

accuracy [int, optional] Default accuracy of approximation. Larger value means better accuracy. The relative error can be deduced by 1.0 / accuracy.

Returns

median [scalar or Series]

Examples

```
>>> df = ks.DataFrame({
...     'a': [24., 21., 25., 33., 26.], 'b': [1., 2., 3., 4., 5.]}, columns=['a',
↪'b'])
>>> df
      a    b
0  24.0  1.0
1  21.0  2.0
2  25.0  3.0
3  33.0  4.0
4  26.0  5.0
```

On a DataFrame:

```
>>> df.median()
a    25.0
b     3.0
dtype: float64
```

On a Series:

```
>>> df['a'].median()
25.0
>>> (df['a'] + 100).median()
125.0
```

For multi-index columns,

```
>>> df.columns = pd.MultiIndex.from_tuples([('x', 'a'), ('y', 'b')])
>>> df
      x    y
      a    b
0  24.0  1.0
1  21.0  2.0
2  25.0  3.0
3  33.0  4.0
4  26.0  5.0
```

On a DataFrame:

```
>>> df.median()
x  a    25.0
y  b     3.0
dtype: float64
```

```
>>> df.median(axis=1)
0    12.5
1    11.5
2    14.0
3    18.5
4    15.5
dtype: float64
```

On a Series:

```
>>> df[('x', 'a')].median()
25.0
>>> (df[('x', 'a')] + 100).median()
125.0
```

databricks.koalas.DataFrame.pct_change

DataFrame.**pct_change**(*periods=1*) → databricks.koalas.frame.DataFrame

Percentage change between the current and a prior element.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int, default 1] Periods to shift for forming percent change.

Returns

DataFrame

Examples

Percentage change in French franc, Deutsche Mark, and Italian lira from 1980-01-01 to 1980-03-01.

```
>>> df = ks.DataFrame({
...     'FR': [4.0405, 4.0963, 4.3149],
...     'GR': [1.7246, 1.7482, 1.8519],
...     'IT': [804.74, 810.01, 860.13]},
...     index=['1980-01-01', '1980-02-01', '1980-03-01'])
>>> df
                FR      GR      IT
1980-01-01  4.0405  1.7246  804.74
1980-02-01  4.0963  1.7482  810.01
1980-03-01  4.3149  1.8519  860.13
```

```
>>> df.pct_change()
                  FR        GR        IT
1980-01-01       NaN       NaN       NaN
1980-02-01  0.013810  0.013684  0.006549
1980-03-01  0.053365  0.059318  0.061876
```

You can set periods to shift for forming percent change

```
>>> df.pct_change(2)
                  FR        GR       IT
1980-01-01       NaN       NaN      NaN
1980-02-01       NaN       NaN      NaN
1980-03-01  0.067912  0.073814  0.06883
```

databricks.koalas.DataFrame.prod

DataFrame.**prod**() → Series
Return the product of the values as Series.

Note: unlike pandas', Koalas' emulates product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Examples

Non-numeric type column is not included to the result.

```
>>> kdf = ks.DataFrame({'A': [1, 2, 3, 4, 5],
...                     'B': [10, 20, 30, 40, 50],
...                     'C': ['a', 'b', 'c', 'd', 'e']})
>>> kdf
   A   B  C
0  1  10  a
1  2  20  b
2  3  30  c
3  4  40  d
4  5  50  e
```

```
>>> kdf.prod().sort_index()
A         120
B    12000000
dtype: int64
```

If there is no numeric type columns, returns empty Series.

```
>>> ks.DataFrame({"key": ['a', 'b', 'c'], "val": ['x', 'y', 'z']}).prod()
Series([], dtype: float64)
```

databricks.koalas.DataFrame.product

DataFrame.**product**() → Series
Return the product of the values as Series.

Note: unlike pandas', Koalas' emulates product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Examples

Non-numeric type column is not included to the result.

```
>>> kdf = ks.DataFrame({'A': [1, 2, 3, 4, 5],
...                     'B': [10, 20, 30, 40, 50],
...                     'C': ['a', 'b', 'c', 'd', 'e']})
>>> kdf
   A   B  C
0  1  10  a
1  2  20  b
2  3  30  c
3  4  40  d
4  5  50  e
```

```
>>> kdf.prod().sort_index()
A         120
B    12000000
dtype: int64
```

If there is no numeric type columns, returns empty Series.

```
>>> ks.DataFrame({"key": ['a', 'b', 'c'], "val": ['x', 'y', 'z']}).prod()
Series([], dtype: float64)
```

databricks.koalas.DataFrame.quantile

DataFrame.**quantile**(*q=0.5*, *axis=0*, *numeric_only=True*, *accuracy=10000*) → Union[DataFrame, Series]

Return value at the given quantile.

Note: Unlike pandas', the quantile in Koalas is an approximated quantile based upon approximate percentile computation because computing quantile across a large dataset is extremely expensive.

Parameters

q [float or array-like, default 0.5 (50% quantile)] 0 <= q <= 1, the quantile(s) to compute.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

numeric_only [bool, default True] If False, the quantile of datetime and timedelta data will be computed as well. Can only be set to True at the moment.

accuracy [int, optional] Default accuracy of approximation. Larger value means better accuracy. The relative error can be deduced by 1.0 / accuracy.

Returns

Series or DataFrame If q is an array, a DataFrame will be returned where the index is q, the columns are the columns of self, and the values are the quantiles. If q is a float, a Series will be returned where the index is the columns of self and the values are the quantiles.

Examples

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, 4, 5], 'b': [6, 7, 8, 9, 0]})
>>> kdf
   a  b
0  1  6
1  2  7
2  3  8
3  4  9
4  5  0
```

```
>>> kdf.quantile(.5)
a    3
b    7
Name: 0.5, dtype: int64
```

```
>>> kdf.quantile([.25, .5, .75])
      a  b
0.25  2  6
0.5   3  7
0.75  4  8
```

databricks.koalas.DataFrame.nunique

DataFrame.**nunique**(*axis: Union[int, str] = 0*, *dropna: bool = True*, *approx: bool = False*, *rsd: float = 0.05*) → Series

Return number of unique elements in the object.

Excludes NA values by default.

Parameters

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

dropna [bool, default True] Don't include NaN in the count.

approx: bool, default False If False, will use the exact algorithm and return the exact number of unique. If True, it uses the HyperLogLog approximate algorithm, which is significantly faster for large amount of data. Note: This parameter is specific to Koalas and is not found in pandas.

rsd: float, default 0.05 Maximum estimation error allowed in the HyperLogLog algorithm. Note: Just like `approx` this parameter is specific to Koalas.

Returns

The number of unique values per column as a Koalas Series.

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 3], 'B': [np.nan, 3, np.nan]})
>>> df.nunique()
A    3
B    1
dtype: int64
```

```
>>> df.nunique(dropna=False)
A    3
B    2
dtype: int64
```

On big data, we recommend using the approximate algorithm to speed up this function. The result will be very close to the exact unique count.

```
>>> df.nunique(approx=True)
A    3
B    1
dtype: int64
```

databricks.koalas.DataFrame.skew

DataFrame.**skew**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return unbiased skew normalized by N-1.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

skew [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.skew()
a    0.000000e+00
b   -3.319678e-16
dtype: float64
```

On a Series:

```
>>> df['a'].skew()
0.0
```

databricks.koalas.DataFrame.sum

DataFrame.**sum**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return the sum of the values.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

sum [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.sum()
a    6.0
b    0.6
dtype: float64
```

```
>>> df.sum(axis=1)
0    1.1
1    2.2
2    3.3
3    0.0
dtype: float64
```

On a Series:

```
>>> df['a'].sum()
6.0
```

databricks.koalas.DataFrame.std

DataFrame.**std**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return sample standard deviation.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

std [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.std()
a    1.0
b    0.1
dtype: float64
```

```
>>> df.std(axis=1)
0    0.636396
1    1.272792
2    1.909188
3         NaN
dtype: float64
```

On a Series:

```
>>> df['a'].std()
1.0
```

databricks.koalas.DataFrame.var

DataFrame.**var**(*axis=None*, *numeric_only=True*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Series]

Return unbiased variance.

Parameters

axis [{index (0), columns (1)}] Axis for the function to be applied on.

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

var [scalar for a Series, and a Series for a DataFrame.]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, np.nan], 'b': [0.1, 0.2, 0.3, np.nan]},
...                   columns=['a', 'b'])
```

On a DataFrame:

```
>>> df.var()
a    1.00
b    0.01
dtype: float64
```

```
>>> df.var(axis=1)
0    0.405
1    1.620
2    3.645
3      NaN
dtype: float64
```

On a Series:

```
>>> df['a'].var()
1.0
```

databricks.koalas.DataFrame.cummin

DataFrame.**cummin**(*skipna: bool = True*) → Union[Series, DataFrame]

Return cumulative minimum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative minimum.

Note: the current implementation of cummin uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.min Return the minimum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

Series.min Return the minimum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the minimum in each column.

```
>>> df.cummin()
     A    B
0  2.0  1.0
1  2.0  NaN
2  1.0  0.0
```

It works identically in Series.

```
>>> df.A.cummin()
0    2.0
1    2.0
2    1.0
Name: A, dtype: float64
```

databricks.koalas.DataFrame.cummax

DataFrame.**cummax**(*skipna: bool = True*) → Union[Series, DataFrame]

Return cumulative maximum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative maximum.

Note: the current implementation of cummax uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.max Return the maximum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.max Return the maximum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the maximum in each column.

```
>>> df.cummax()
     A    B
0  2.0  1.0
1  3.0  NaN
2  3.0  1.0
```

It works identically in Series.

```
>>> df.B.cummax()
0    1.0
1    NaN
2    1.0
Name: B, dtype: float64
```

databricks.koalas.DataFrame.cumsum

DataFrame.**cumsum**(*skipna: bool = True*) → Union[Series, DataFrame]

Return cumulative sum over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative sum.

Note: the current implementation of cumsum uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

See also:

DataFrame.sum Return the sum over DataFrame axis.

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.sum Return the sum over Series axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [1.0, 0.0]], columns=list('AB'))
>>> df
     A    B
0  2.0  1.0
1  3.0  NaN
2  1.0  0.0
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.cumsum()
     A    B
0  2.0  1.0
1  5.0  NaN
2  6.0  1.0
```

It works identically in Series.

```
>>> df.A.cumsum()
0    2.0
1    5.0
2    6.0
Name: A, dtype: float64
```

databricks.koalas.DataFrame.cumprod

DataFrame.**cumprod**(*skipna: bool = True*) → Union[Series, DataFrame]

Return cumulative product over a DataFrame or Series axis.

Returns a DataFrame or Series of the same size containing the cumulative product.

Note: the current implementation of cumprod uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Note: unlike pandas', Koalas' emulates cumulative product by `exp(sum(log(...)))` trick. Therefore, it only works for positive numbers.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

Returns

DataFrame or Series

Raises

Exception [If the values is equal to or lower than 0.]

See also:

DataFrame.cummax Return cumulative maximum over DataFrame axis.

DataFrame.cummin Return cumulative minimum over DataFrame axis.

DataFrame.cumsum Return cumulative sum over DataFrame axis.

DataFrame.cumprod Return cumulative product over DataFrame axis.

Series.cummax Return cumulative maximum over Series axis.

Series.cummin Return cumulative minimum over Series axis.

Series.cumsum Return cumulative sum over Series axis.

Series.cumprod Return cumulative product over Series axis.

Examples

```
>>> df = ks.DataFrame([[2.0, 1.0], [3.0, None], [4.0, 10.0]], columns=list('AB'))
>>> df
     A     B
0  2.0   1.0
1  3.0   NaN
2  4.0  10.0
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.cumprod()
      A     B
0   2.0   1.0
1   6.0   NaN
2  24.0  10.0
```

It works identically in Series.

```
>>> df.A.cumprod()
0     2.0
1     6.0
2    24.0
Name: A, dtype: float64
```

databricks.koalas.DataFrame.round

DataFrame.**round**(*decimals=0*) → databricks.koalas.frame.DataFrame

Round a DataFrame to a variable number of decimal places.

Parameters

decimals [int, dict, Series] Number of decimal places to round each column to. If an int is given, round each column to the same number of places. Otherwise dict and Series round to variable numbers of places. Column names should be in the keys if *decimals* is a dict-like, or in the index if *decimals* is a Series. Any columns not included in *decimals* will be left as is. Elements of *decimals* which are not columns of the input will be ignored.

Note: If *decimals* is a Series, it is expected to be small, as all the data is loaded into the driver's memory.

Returns

DataFrame

See also:

Series.round

Examples

```
>>> df = ks.DataFrame({'A':[0.028208, 0.038683, 0.877076],
...                    'B':[0.992815, 0.645646, 0.149370],
...                    'C':[0.173891, 0.577595, 0.491027]},
...                    columns=['A', 'B', 'C'],
...                    index=['first', 'second', 'third'])
>>> df
                A         B         C
first    0.028208  0.992815  0.173891
second   0.038683  0.645646  0.577595
third    0.877076  0.149370  0.491027
```

```
>>> df.round(2)
           A     B     C
first   0.03  0.99  0.17
second  0.04  0.65  0.58
third   0.88  0.15  0.49
```

```
>>> df.round({'A': 1, 'C': 2})
          A         B     C
first   0.0  0.992815  0.17
second  0.0  0.645646  0.58
third   0.9  0.149370  0.49
```

```
>>> decimals = ks.Series([1, 0, 2], index=['A', 'B', 'C'])
>>> df.round(decimals)
          A    B     C
first   0.0  1.0  0.17
second  0.0  1.0  0.58
third   0.9  0.0  0.49
```

databricks.koalas.DataFrame.diff

DataFrame.**diff**(*periods: int = 1*, *axis: Union[int, str] = 0*) → databricks.koalas.frame.DataFrame

First discrete difference of element.

Calculates the difference of a DataFrame element compared with another element in the DataFrame (default is the element in the same column of the previous row).

Note: the current implementation of diff uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int, default 1] Periods to shift for calculating difference, accepts negative values.

axis [int, default 0 or 'index'] Can only be set to 0 at the moment.

Returns

diffed [DataFrame]

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4, 5, 6],
...                    'b': [1, 1, 2, 3, 5, 8],
...                    'c': [1, 4, 9, 16, 25, 36]}, columns=['a', 'b', 'c'])
>>> df
   a  b   c
0  1  1   1
1  2  1   4
2  3  2   9
3  4  3  16
4  5  5  25
5  6  8  36
```

```
>>> df.diff()
     a    b     c
0  NaN  NaN   NaN
1  1.0  0.0   3.0
2  1.0  1.0   5.0
3  1.0  1.0   7.0
4  1.0  2.0   9.0
5  1.0  3.0  11.0
```

Difference with previous column

```
>>> df.diff(periods=3)
     a    b     c
0  NaN  NaN   NaN
1  NaN  NaN   NaN
2  NaN  NaN   NaN
3  3.0  2.0  15.0
4  3.0  4.0  21.0
5  3.0  6.0  27.0
```

Difference with following row

```
>>> df.diff(periods=-1)
     a    b     c
0 -1.0  0.0  -3.0
1 -1.0 -1.0  -5.0
2 -1.0 -1.0  -7.0
3 -1.0 -2.0  -9.0
4 -1.0 -3.0 -11.0
5  NaN  NaN   NaN
```

databricks.koalas.DataFrame.eval

DataFrame.**eval**(*expr*, *inplace=False*) → Union[DataFrame, Series, None]

Evaluate a string describing operations on DataFrame columns.

Operates on columns only, not specific rows or elements. This allows *eval* to run arbitrary code, which can make you vulnerable to code injection if you pass user input to this function.

Parameters

expr [str] The expression string to evaluate.

inplace [bool, default False] If the expression contains an assignment, whether to perform the operation inplace and mutate the existing DataFrame. Otherwise, a new DataFrame is returned.

Returns

The result of the evaluation.

See also:

DataFrame.query Evaluates a boolean expression to query the columns of a frame.

DataFrame.assign Can evaluate an expression or function to create new values for a column.

eval Evaluate a Python expression as a string using various backends.

Examples

```
>>> df = ks.DataFrame({'A': range(1, 6), 'B': range(10, 0, -2)})
>>> df
   A   B
0  1  10
1  2   8
2  3   6
3  4   4
4  5   2
>>> df.eval('A + B')
0    11
1    10
2     9
3     8
4     7
dtype: int64
```

Assignment is allowed though by default the original DataFrame is not modified.

```
>>> df.eval('C = A + B')
   A   B   C
0  1  10  11
1  2   8  10
2  3   6   9
3  4   4   8
4  5   2   7
>>> df
   A   B
0  1  10
1  2   8
2  3   6
3  4   4
4  5   2
```

Use `inplace=True` to modify the original DataFrame.

```
>>> df.eval('C = A + B', inplace=True)
>>> df
   A   B   C
0  1  10  11
1  2   8  10
2  3   6   9
3  4   4   8
4  5   2   7
```

3.4.8 Reindexing / Selection / Label manipulation

DataFrame.add_prefix(prefix)	Prefix labels with string *prefix*.
DataFrame.add_suffix(suffix)	Suffix labels with string *suffix*.
DataFrame.drop([labels, axis, columns])	Drop specified labels from columns.
DataFrame.droplevel(level[, axis])	Return DataFrame with requested index / column level(s) removed.
DataFrame.drop_duplicates([subset, keep, ...])	Return DataFrame with duplicate rows removed, optionally only considering certain columns.
DataFrame.duplicated([subset, keep])	Return boolean Series denoting duplicate rows, optionally only considering certain columns.
DataFrame.equals(other)	Compare if the current value is equal to the other.
DataFrame.filter([items, like, regex, axis])	Subset rows or columns of dataframe according to labels in the specified index.
DataFrame.head([n])	Return the first *n* rows.
DataFrame.rename([mapper, index, columns, ...])	Alter axes labels.
DataFrame.rename_axis([mapper, index, ...])	Set the name of the axis for the index or columns.
DataFrame.reset_index([level, drop, ...])	Reset the index, or a level of it.
DataFrame.set_index(keys[, drop, append, ...])	Set the DataFrame index (row labels) using one or more existing columns.
DataFrame.swapaxes(i, j[, copy])	Interchange axes and swap values axes appropriately.
DataFrame.swaplevel([i, j, axis])	Swap levels i and j in a MultiIndex on a particular axis.
DataFrame.take(indices[, axis])	Return the elements in the given *positional* indices along an axis.
DataFrame.isin(values)	Whether each element in the DataFrame is contained in values.

continues on next page

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DataFrame.sample([n, frac, replace, ...])	Return a random sample of items from an axis of object.
DataFrame.truncate([before, after, axis, copy])	Truncate a Series or DataFrame before and after some index value.

databricks.koalas.DataFrame.add_prefix

DataFrame.**add_prefix**(*prefix*) → databricks.koalas.frame.DataFrame

Prefix labels with string *prefix*.

For Series, the row labels are prefixed. For DataFrame, the column labels are prefixed.

Parameters

prefix [str] The string to add before each label.

Returns

DataFrame New DataFrame with updated labels.

See also:

Series.add_prefix Prefix row labels with string *prefix*.

Series.add_suffix Suffix row labels with string *suffix*.

DataFrame.add_suffix Suffix column labels with string *suffix*.

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 3, 4], 'B': [3, 4, 5, 6]}, columns=['A', 'B'])
>>> df
   A  B
0  1  3
1  2  4
2  3  5
3  4  6
```

```
>>> df.add_prefix('col_')
   col_A  col_B
0      1      3
1      2      4
2      3      5
3      4      6
```

databricks.koalas.DataFrame.add_suffix

DataFrame.**add_suffix**(*suffix*) → databricks.koalas.frame.DataFrame

Suffix labels with string *suffix*.

For Series, the row labels are suffixed. For DataFrame, the column labels are suffixed.

Parameters

suffix [str] The string to add before each label.

Returns

DataFrame New DataFrame with updated labels.

See also:

Series.add_prefix Prefix row labels with string *prefix*.

Series.add_suffix Suffix row labels with string *suffix*.

DataFrame.add_prefix Prefix column labels with string *prefix*.

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 3, 4], 'B': [3, 4, 5, 6]}, columns=['A', 'B'])
>>> df
   A  B
0  1  3
1  2  4
2  3  5
3  4  6
```

```
>>> df.add_suffix('_col')
   A_col  B_col
0      1      3
1      2      4
2      3      5
3      4      6
```

databricks.koalas.DataFrame.drop

DataFrame.**drop**(*labels=None*, *axis=1*, *columns: Union[Any, Tuple, List[Any], List[Tuple]] = None*) → databricks.koalas.frame.DataFrame

Drop specified labels from columns.

Remove columns by specifying label names and axis=1 or columns. When specifying both labels and columns, only labels will be dropped. Removing rows is yet to be implemented.

Parameters

labels [single label or list-like] Column labels to drop.

axis [{1 or 'columns'}, default 1]

columns [single label or list-like] Alternative to specifying axis (`labels, axis=1` is equivalent to `columns=labels`).

Returns

dropped [DataFrame]

See also:

Series.dropna

Notes

Currently only axis = 1 is supported in this function, axis = 0 is yet to be implemented.

Examples

```
>>> df = ks.DataFrame({'x': [1, 2], 'y': [3, 4], 'z': [5, 6], 'w': [7, 8]},
...                   columns=['x', 'y', 'z', 'w'])
>>> df
   x  y  z  w
0  1  3  5  7
1  2  4  6  8
```

```
>>> df.drop('x', axis=1)
   y  z  w
0  3  5  7
1  4  6  8
```

```
>>> df.drop(['y', 'z'], axis=1)
   x  w
0  1  7
1  2  8
```

```
>>> df.drop(columns=['y', 'z'])
   x  w
0  1  7
1  2  8
```

Also support for MultiIndex

```
>>> df = ks.DataFrame({'x': [1, 2], 'y': [3, 4], 'z': [5, 6], 'w': [7, 8]},
...                   columns=['x', 'y', 'z', 'w'])
>>> columns = [('a', 'x'), ('a', 'y'), ('b', 'z'), ('b', 'w')]
>>> df.columns = pd.MultiIndex.from_tuples(columns)
>>> df
   a     b
   x  y  z  w
0  1  3  5  7
1  2  4  6  8
>>> df.drop('a')
   b
   z  w
0  5  7
1  6  8
```

databricks.koalas.DataFrame.droplevel

DataFrame.**droplevel**(*level*, *axis=0*) → databricks.koalas.frame.DataFrame
Return DataFrame with requested index / column level(s) removed.

Parameters

level: int, str, or list-like If a string is given, must be the name of a level If list-like, elements must be names or positional indexes of levels.

axis: {0 or 'index', 1 or 'columns'}, default 0

Returns

DataFrame with requested index / column level(s) removed.

Examples

```
>>> df = ks.DataFrame(
...     [[3, 4], [7, 8], [11, 12]],
...     index=pd.MultiIndex.from_tuples([(1, 2), (5, 6), (9, 10)], names=["a", "b
↪"]),
... )
```

```
>>> df.columns = pd.MultiIndex.from_tuples([
...   ('c', 'e'), ('d', 'f')
... ], names=['level_1', 'level_2'])
```

```
>>> df
level_1   c   d
level_2   e   f
a b
1 2       3   4
5 6       7   8
9 10     11  12
```

```
>>> df.droplevel('a')
level_1   c   d
level_2   e   f
b
2         3   4
6         7   8
10       11  12
```

```
>>> df.droplevel('level_2', axis=1)
level_1   c   d
a b
1 2       3   4
5 6       7   8
9 10     11  12
```

databricks.koalas.DataFrame.drop_duplicates

DataFrame.**drop_duplicates**(*subset=None*, *keep='first'*, *inplace=False*) → Optional[databricks.koalas.frame.DataFrame]

Return DataFrame with duplicate rows removed, optionally only considering certain columns.

Parameters

subset [column label or sequence of labels, optional] Only consider certain columns for identifying duplicates, by default use all of the columns.

keep [{'first', 'last', False}, default 'first'] Determines which duplicates (if any) to keep. - `first` : Drop duplicates except for the first occurrence. - `last` : Drop duplicates except for the last occurrence. - False : Drop all duplicates.

inplace [boolean, default False] Whether to drop duplicates in place or to return a copy.

Returns

DataFrame DataFrame with duplicates removed or None if `inplace=True`.

```
>>> df = ks.DataFrame(
    ..
```

... {'a': [1, 2, 2, 2, 3], 'b': ['a', 'a', 'a', 'c', 'd']}, columns = ['a', 'b'])

```
>>> df
    a  b
```

0 1 a

1 2 a

2 2 a

3 2 c

4 3 d

```
>>> df.drop_duplicates().sort_index()
    a  b
```

0 1 a

1 2 a

3 2 c

4 3 d

```
>>> df.drop_duplicates('a').sort_index()
    a  b
```

0 1 a

1 2 a

4 3 d

```
>>> df.drop_duplicates(['a', 'b']).sort_index()
    a  b
```

0 1 a

1 2 a

3 2 c

4 3 d

```
>>> df.drop_duplicates(keep='last').sort_index()
    a  b
```

0 1 a

2 2 a

3 2 c

4 3 d

```
>>> df.drop_duplicates(keep=False).sort_index()
    a  b
```

0 1 a

3 2 c

4 3 d

databricks.koalas.DataFrame.duplicated

DataFrame.**duplicated**(*subset=None*, *keep='first'*) → Series

Return boolean Series denoting duplicate rows, optionally only considering certain columns.

Parameters

subset [column label or sequence of labels, optional] Only consider certain columns for identifying duplicates, by default use all of the columns

keep [{'first', 'last', False}, default 'first']

- `first` : Mark duplicates as `True` except for the first occurrence.
- `last` : Mark duplicates as `True` except for the last occurrence.
- False : Mark all duplicates as `True`.

Returns

duplicated [Series]

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 3], 'b': [1, 1, 1, 4], 'c': [1, 1, 1, 5]},
...                   columns = ['a', 'b', 'c'])
>>> df
   a  b  c
0  1  1  1
1  1  1  1
2  1  1  1
3  3  4  5
```

```
>>> df.duplicated().sort_index()
0    False
1     True
2     True
3    False
dtype: bool
```

Mark duplicates as `True` except for the last occurrence.

```
>>> df.duplicated(keep='last').sort_index()
0     True
1     True
2    False
3    False
dtype: bool
```

Mark all duplicates as `True`.

```
>>> df.duplicated(keep=False).sort_index()
0     True
1     True
2     True
3    False
dtype: bool
```

databricks.koalas.DataFrame.equals

`DataFrame.`**`equals`**(*other*) → databricks.koalas.frame.DataFrame

Compare if the current value is equal to the other.

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4],
...                    'b': [1, np.nan, 1, np.nan]},
...                   index=['a', 'b', 'c', 'd'], columns=['a', 'b'])
```

```
>>> df.eq(1)
       a      b
a   True   True
b  False  False
c  False   True
d  False  False
```

databricks.koalas.DataFrame.filter

DataFrame.**filter**(*items=None*, *like=None*, *regex=None*, *axis=None*) → databricks.koalas.frame.DataFrame

Subset rows or columns of dataframe according to labels in the specified index.

Note that this routine does not filter a dataframe on its contents. The filter is applied to the labels of the index.

Parameters

items [list-like] Keep labels from axis which are in items.

like [string] Keep labels from axis for which "like in label == True".

regex [string (regular expression)] Keep labels from axis for which re.search(regex, label) == True.

axis [int or string axis name] The axis to filter on. By default this is the info axis, 'index' for Series, 'columns' for DataFrame.

Returns

same type as input object

See also:

DataFrame.loc

Notes

The `items`, `like`, and `regex` parameters are enforced to be mutually exclusive.

`axis` defaults to the info axis that is used when indexing with `[]`.

Examples

```
>>> df = ks.DataFrame(np.array(([1, 2, 3], [4, 5, 6])),
...                   index=['mouse', 'rabbit'],
...                   columns=['one', 'two', 'three'])
```

```
>>> # select columns by name
>>> df.filter(items=['one', 'three'])
        one  three
mouse     1      3
rabbit    4      6
```

```
>>> # select columns by regular expression
>>> df.filter(regex='e$', axis=1)
        one  three
mouse     1      3
rabbit    4      6
```

```
>>> # select rows containing 'bbi'
>>> df.filter(like='bbi', axis=0)
        one  two  three
rabbit    4    5      6
```

For a Series,

```
>>> # select rows by name
>>> df.one.filter(items=['rabbit'])
rabbit    4
Name: one, dtype: int64
```

```
>>> # select rows by regular expression
>>> df.one.filter(regex='e$')
mouse    1
Name: one, dtype: int64
```

```
>>> # select rows containing 'bbi'
>>> df.one.filter(like='bbi')
rabbit    4
Name: one, dtype: int64
```

databricks.koalas.DataFrame.rename

DataFrame.**rename**(*mapper=None*, *index=None*, *columns=None*, *axis='index'*, *inplace=False*, *level=None*, *errors='ignore'*) → Optional[databricks.koalas.frame.DataFrame]

Alter axes labels. Function / dict values must be unique (1-to-1). Labels not contained in a dict / Series will be left as-is. Extra labels listed don't throw an error.

Parameters

mapper [dict-like or function] Dict-like or functions transformations to apply to that axis' values. Use either *mapper* and *axis* to specify the axis to target with *mapper*, or *index* and *columns*.

index [dict-like or function] Alternative to specifying axis ("mapper, axis=0" is equivalent to "index=mapper").

columns [dict-like or function] Alternative to specifying axis ("mapper, axis=1" is equivalent to "columns=mapper").

axis [int or str, default 'index'] Axis to target with mapper. Can be either the axis name ('index', 'columns') or number (0, 1).

inplace [bool, default False] Whether to return a new DataFrame.

level [int or level name, default None] In case of a MultiIndex, only rename labels in the specified level.

errors [{'ignore', 'raise}, default 'ignore'] If 'raise', raise a *KeyError* when a dict-like *mapper*, *index*, or *columns* contains labels that are not present in the Index being transformed. If 'ignore', existing keys will be renamed and extra keys will be ignored.

Returns

DataFrame with the renamed axis labels.

Raises

KeyError If any of the labels is not found in the selected axis and "errors='raise'".

Examples

```
>>> kdf1 = ks.DataFrame({"A": [1, 2, 3], "B": [4, 5, 6]})
>>> kdf1.rename(columns={"A": "a", "B": "c"})
   a  c
0  1  4
1  2  5
2  3  6
```

```
>>> kdf1.rename(index={1: 10, 2: 20})
    A  B
0   1  4
10  2  5
20  3  6
```

```
>>> def str_lower(s) -> str:
...     return str.lower(s)
>>> kdf1.rename(str_lower, axis='columns')
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> def mul10(x) -> int:
...     return x * 10
>>> kdf1.rename(mul10, axis='index')
    A  B
0   1  4
10  2  5
20  3  6
```

```
>>> idx = pd.MultiIndex.from_tuples([('X', 'A'), ('X', 'B'), ('Y', 'C'), ('Y', 'D
↪')])
>>> kdf2 = ks.DataFrame([[1, 2, 3, 4], [5, 6, 7, 8]], columns=idx)
>>> kdf2.rename(columns=str_lower, level=0)
   x     y
   A  B  C  D
0  1  2  3  4
1  5  6  7  8
```

```
>>> kdf3 = ks.DataFrame([[1, 2], [3, 4], [5, 6], [7, 8]], index=idx, columns=list(
↪'ab'))
>>> kdf3.rename(index=str_lower)
     a  b
x a  1  2
  b  3  4
y c  5  6
  d  7  8
```

databricks.koalas.DataFrame.rename_axis

DataFrame.**rename_axis**(*mapper: Optional[Any] = None*, *index: Optional[Any] = None*, *columns: Optional[Any] = None*, *axis: Union[str, int, None] = 0*, *inplace: Optional[bool] = False*) → Optional[databricks.koalas.frame.DataFrame]

Set the name of the axis for the index or columns.

Parameters

mapper [scalar, list-like, optional] A scalar, list-like, dict-like or functions transformations to apply to the axis name attribute.

index, columns [scalar, list-like, dict-like or function, optional] A scalar, list-like, dict-like or functions transformations to apply to that axis' values.

Use either `mapper` and `axis` to specify the axis to target with `mapper`, or `index` and/or `columns`.

axis [{0 or 'index', 1 or 'columns'}, default 0] The axis to rename.

inplace [bool, default False] Modifies the object directly, instead of creating a new DataFrame.

Returns

DataFrame, or None if *inplace* is True.

See also:

Series.rename Alter Series index labels or name.

DataFrame.rename Alter DataFrame index labels or name.

Index.rename Set new names on index.

Notes

`DataFrame.rename_axis` supports two calling conventions

- `(index=index_mapper, columns=columns_mapper, ...)`
- `(mapper, axis={'index', 'columns'}, ...)`

The first calling convention will only modify the names of the index and/or the names of the Index object that is the columns.

The second calling convention will modify the names of the corresponding index specified by axis.

We *highly* recommend using keyword arguments to clarify your intent.

Examples

```
>>> df = ks.DataFrame({"num_legs": [4, 4, 2],
...                    "num_arms": [0, 0, 2]},
...                   index=["dog", "cat", "monkey"],
...                   columns=["num_legs", "num_arms"])
>>> df
        num_legs  num_arms
dog            4         0
cat            4         0
monkey         2         2
```

```
>>> df = df.rename_axis("animal").sort_index()
>>> df
        num_legs  num_arms
animal
cat            4         0
dog            4         0
monkey         2         2
```

```
>>> df = df.rename_axis("limbs", axis="columns").sort_index()
>>> df
limbs   num_legs  num_arms
animal
cat            4         0
dog            4         0
monkey         2         2
```

MultiIndex

```
>>> index = pd.MultiIndex.from_product([['mammal'],
...                                     ['dog', 'cat', 'monkey']],
...                                    names=['type', 'name'])
>>> df = ks.DataFrame({"num_legs": [4, 4, 2],
...                    "num_arms": [0, 0, 2]},
...                   index=index,
...                   columns=["num_legs", "num_arms"])
>>> df
               num_legs  num_arms
type   name
mammal dog            4         0
       cat            4         0
       monkey         2         2
```

```
>>> df.rename_axis(index={'type': 'class'}).sort_index()
               num_legs  num_arms
class  name
mammal cat            4         0
       dog            4         0
       monkey         2         2
```

```
>>> df.rename_axis(index=str.upper).sort_index()
               num_legs  num_arms
TYPE   NAME
mammal cat            4         0
       dog            4         0
       monkey         2         2
```

databricks.koalas.DataFrame.reset_index

DataFrame.**reset_index**(*level=None*, *drop=False*, *inplace=False*, *col_level=0*, *col_fill=''*) → Optional[databricks.koalas.frame.DataFrame]

Reset the index, or a level of it.

For DataFrame with multi-level index, return new DataFrame with labeling information in the columns under the index names, defaulting to 'level_0', 'level_1', etc. if any are None. For a standard index, the index name will be used (if set), otherwise a default 'index' or 'level_0' (if 'index' is already taken) will be used.

Parameters

level [int, str, tuple, or list, default None] Only remove the given levels from the index. Removes all levels by default.

drop [bool, default False] Do not try to insert index into dataframe columns. This resets the index to the default integer index.

inplace [bool, default False] Modify the DataFrame in place (do not create a new object).

col_level [int or str, default 0] If the columns have multiple levels, determines which level the labels are inserted into. By default it is inserted into the first level.

col_fill [object, default ''] If the columns have multiple levels, determines how the other levels are named. If None then the index name is repeated.

Returns

DataFrame DataFrame with the new index.

See also:

DataFrame.set_index Opposite of reset_index.

Examples

```
>>> df = ks.DataFrame([('bird', 389.0),
...                    ('bird', 24.0),
...                    ('mammal', 80.5),
...                    ('mammal', np.nan)],
...                   index=['falcon', 'parrot', 'lion', 'monkey'],
...                   columns=('class', 'max_speed'))
>>> df
         class  max_speed
falcon    bird      389.0
parrot    bird       24.0
lion    mammal       80.5
monkey  mammal        NaN
```

When we reset the index, the old index is added as a column. Unlike pandas, Koalas does not automatically add a sequential index. The following 0, 1, 2, 3 are only there when we display the DataFrame.

```
>>> df.reset_index()
    index   class  max_speed
0  falcon    bird      389.0
1  parrot    bird       24.0
2    lion  mammal       80.5
3  monkey  mammal        NaN
```

We can use the *drop* parameter to avoid the old index being added as a column:

```
>>> df.reset_index(drop=True)
    class  max_speed
0    bird      389.0
1    bird       24.0
2  mammal       80.5
3  mammal        NaN
```

You can also use *reset_index* with *MultiIndex*.

```
>>> index = pd.MultiIndex.from_tuples([('bird', 'falcon'),
...                                    ('bird', 'parrot'),
...                                    ('mammal', 'lion'),
...                                    ('mammal', 'monkey')],
...                                   names=['class', 'name'])
>>> columns = pd.MultiIndex.from_tuples([('speed', 'max'),
...                                      ('species', 'type')])
>>> df = ks.DataFrame([(389.0, 'fly'),
...                    ( 24.0, 'fly'),
...                    ( 80.5, 'run'),
...                    (np.nan, 'jump')],
...                   index=index,
...                   columns=columns)
>>> df
               speed species
                 max    type
class  name
bird   falcon  389.0     fly
       parrot   24.0     fly
mammal lion     80.5     run
       monkey    NaN    jump
```

If the index has multiple levels, we can reset a subset of them:

```
>>> df.reset_index(level='class')
         class  speed species
                  max    type
name
falcon    bird  389.0     fly
parrot    bird   24.0     fly
lion    mammal   80.5     run
monkey  mammal    NaN    jump
```

If we are not dropping the index, by default, it is placed in the top level. We can place it in another level:

```
>>> df.reset_index(level='class', col_level=1)
               speed species
         class    max    type
name
falcon    bird  389.0     fly
parrot    bird   24.0     fly
lion    mammal   80.5     run
monkey  mammal    NaN    jump
```

When the index is inserted under another level, we can specify under which one with the parameter *col_fill*:

```
>>> df.reset_index(level='class', col_level=1,
...                col_fill='species')
```

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```
              species  speed species
                class    max    type
name
falcon           bird  389.0     fly
parrot           bird   24.0     fly
lion           mammal   80.5     run
monkey         mammal    NaN    jump
```

If we specify a nonexistent level for *col_fill*, it is created:

```
>>> df.reset_index(level='class', col_level=1,
...                col_fill='genus')
               genus  speed species
               class    max    type
name
falcon           bird  389.0     fly
parrot           bird   24.0     fly
lion           mammal   80.5     run
monkey         mammal    NaN    jump
```

databricks.koalas.DataFrame.set_index

DataFrame.**set_index**(*keys*, *drop=True*, *append=False*, *inplace=False*) → Optional[databricks.koalas.frame.DataFrame]

Set the DataFrame index (row labels) using one or more existing columns.

Set the DataFrame index (row labels) using one or more existing columns or arrays (of the correct length). The index can replace the existing index or expand on it.

Parameters

keys [label or array-like or list of labels/arrays] This parameter can be either a single column key, a single array of the same length as the calling DataFrame, or a list containing an arbitrary combination of column keys and arrays. Here, "array" encompasses *Series*, *Index* and `np.ndarray`.

drop [bool, default True] Delete columns to be used as the new index.

append [bool, default False] Whether to append columns to existing index.

inplace [bool, default False] Modify the DataFrame in place (do not create a new object).

Returns

DataFrame Changed row labels.

See also:

DataFrame.reset_index Opposite of set_index.

Examples

```
>>> df = ks.DataFrame({'month': [1, 4, 7, 10],
...                    'year': [2012, 2014, 2013, 2014],
...                    'sale': [55, 40, 84, 31]},
...                   columns=['month', 'year', 'sale'])
>>> df
   month  year  sale
0      1  2012    55
1      4  2014    40
2      7  2013    84
3     10  2014    31
```

Set the index to become the 'month' column:

```
>>> df.set_index('month')
       year  sale
month
1      2012    55
4      2014    40
7      2013    84
10     2014    31
```

Create a MultiIndex using columns 'year' and 'month':

```
>>> df.set_index(['year', 'month'])
            sale
year  month
2012  1      55
2014  4      40
2013  7      84
2014  10     31
```

databricks.koalas.DataFrame.swapaxes

DataFrame.**swapaxes**(*i: Union[str, int]*, *j: Union[str, int]*, *copy: bool = True*) → databricks.koalas.frame.DataFrame

Interchange axes and swap values axes appropriately.

Note: This method is based on an expensive operation due to the nature of big data. Internally it needs to generate each row for each value, and then group twice - it is a huge operation. To prevent misusage, this method has the 'compute.max_rows' default limit of input length, and raises a ValueError.

```
>>> from databricks.koalas.config import option_context
>>> with option_context('compute.max_rows', 1000):
...     ks.DataFrame({'a': range(1001)}).swapaxes(i=0, j=1)
Traceback (most recent call last):
  ...
ValueError: Current DataFrame has more then the given limit 1000 rows.
Please set 'compute.max_rows' by using 'databricks.koalas.config.set_option'
to retrieve to retrieve more than 1000 rows. Note that, before changing the
'compute.max_rows', this operation is considerably expensive.
```

Parameters

i: {0 or 'index', 1 or 'columns'}. The axis to swap.

j: {0 or 'index', 1 or 'columns'}. The axis to swap.

copy [bool, default True.]

Returns

DataFrame

Examples

```
>>> kdf = ks.DataFrame(
...     [[1, 2, 3], [4, 5, 6], [7, 8, 9]], index=['x', 'y', 'z'], columns=['a', 'b
↪', 'c']
... )
>>> kdf
   a  b  c
x  1  2  3
y  4  5  6
z  7  8  9
>>> kdf.swapaxes(i=1, j=0)
   x  y  z
a  1  4  7
b  2  5  8
c  3  6  9
>>> kdf.swapaxes(i=1, j=1)
   a  b  c
x  1  2  3
y  4  5  6
z  7  8  9
```

databricks.koalas.DataFrame.swaplevel

DataFrame.**swaplevel**(*i=-2*, *j=-1*, *axis=0*) → databricks.koalas.frame.DataFrame

Swap levels i and j in a MultiIndex on a particular axis.

Parameters

i, j [int or str] Levels of the indices to be swapped. Can pass level name as string.

axis [{0 or 'index', 1 or 'columns'}, default 0] The axis to swap levels on. 0 or 'index' for row-wise, 1 or 'columns' for column-wise.

Returns

DataFrame DataFrame with levels swapped in MultiIndex.

Examples

```
>>> midx = pd.MultiIndex.from_arrays(
...     [['red', 'blue'], [1, 2], ['s', 'm']], names = ['color', 'number', 'size
↪'])
>>> midx
MultiIndex([( 'red', 1, 's'),
            ('blue', 2, 'm')],
           names=['color', 'number', 'size'])
```

Swap levels in a MultiIndex on index.

```
>>> kdf = ks.DataFrame({'x': [5, 6], 'y':[5, 6]}, index=midx)
>>> kdf
                   x  y
color number size
red   1      s     5  5
blue  2      m     6  6
```

```
>>> kdf.swaplevel()
                   x  y
color size number
red   s    1       5  5
blue  m    2       6  6
```

```
>>> kdf.swaplevel(0, 1)
                   x  y
number color size
1      red   s     5  5
2      blue  m     6  6
```

```
>>> kdf.swaplevel('number', 'size')
                   x  y
color size number
red   s    1       5  5
blue  m    2       6  6
```

Swap levels in a MultiIndex on columns.

```
>>> kdf = ks.DataFrame({'x': [5, 6], 'y':[5, 6]})
>>> kdf.columns = midx
>>> kdf
color  red blue
number   1    2
size     s    m
0        5    5
1        6    6
```

```
>>> kdf.swaplevel(axis=1)
color  red blue
size     s    m
number   1    2
0        5    5
1        6    6
```

```
>>> kdf.swaplevel(axis=1)
color  red blue
size     s    m
number   1    2
0        5    5
1        6    6
```

```
>>> kdf.swaplevel(0, 1, axis=1)
number   1    2
color  red blue
size     s    m
0        5    5
1        6    6
```

```
>>> kdf.swaplevel('number', 'color', axis=1)
number   1    2
color  red blue
size     s    m
0        5    5
1        6    6
```

databricks.koalas.DataFrame.take

DataFrame.**take**(*indices*, *axis=0*, ***kwargs*) → databricks.koalas.frame.DataFrame

Return the elements in the given *positional* indices along an axis.

This means that we are not indexing according to actual values in the index attribute of the object. We are indexing according to the actual position of the element in the object.

Parameters

indices [array-like] An array of ints indicating which positions to take.

axis [{0 or 'index', 1 or 'columns', None}, default 0] The axis on which to select elements. `0` means that we are selecting rows, `1` means that we are selecting columns.

****kwargs** For compatibility with `numpy.take()`. Has no effect on the output.

Returns

taken [same type as caller] An array-like containing the elements taken from the object.

See also:

DataFrame.loc Select a subset of a DataFrame by labels.

DataFrame.iloc Select a subset of a DataFrame by positions.

numpy.take Take elements from an array along an axis.

Examples

```
>>> df = ks.DataFrame([('falcon', 'bird', 389.0),
...                    ('parrot', 'bird', 24.0),
...                    ('lion', 'mammal', 80.5),
...                    ('monkey', 'mammal', np.nan)],
...                   columns=['name', 'class', 'max_speed'],
...                   index=[0, 2, 3, 1])
>>> df
     name   class  max_speed
0  falcon    bird      389.0
2  parrot    bird       24.0
3    lion  mammal       80.5
1  monkey  mammal        NaN
```

Take elements at positions 0 and 3 along the axis 0 (default).

Note how the actual indices selected (0 and 1) do not correspond to our selected indices 0 and 3. That's because we are selecting the 0th and 3rd rows, not rows whose indices equal 0 and 3.

```
>>> df.take([0, 3]).sort_index()
     name   class  max_speed
0  falcon    bird      389.0
1  monkey  mammal        NaN
```

Take elements at indices 1 and 2 along the axis 1 (column selection).

```
>>> df.take([1, 2], axis=1)
    class  max_speed
0    bird      389.0
2    bird       24.0
3  mammal       80.5
1  mammal        NaN
```

We may take elements using negative integers for positive indices, starting from the end of the object, just like with Python lists.

```
>>> df.take([-1, -2]).sort_index()
     name   class  max_speed
1  monkey  mammal        NaN
3    lion  mammal       80.5
```

databricks.koalas.DataFrame.isin

`DataFrame.`**`isin`**`(`*values*`)` → databricks.koalas.frame.DataFrame

Whether each element in the DataFrame is contained in values.

Parameters

values [iterable or dict] The sequence of values to test. If values is a dict, the keys must be the column names, which must match. Series and DataFrame are not supported.

Returns

DataFrame DataFrame of booleans showing whether each element in the DataFrame is contained in values.

Examples

```
>>> df = ks.DataFrame({'num_legs': [2, 4], 'num_wings': [2, 0]},
...                   index=['falcon', 'dog'],
...                   columns=['num_legs', 'num_wings'])
>>> df
        num_legs  num_wings
falcon         2          2
dog            4          0
```

When `values` is a list check whether every value in the DataFrame is present in the list (which animals have 0 or 2 legs or wings)

```
>>> df.isin([0, 2])
        num_legs  num_wings
falcon      True       True
dog        False       True
```

When `values` is a dict, we can pass values to check for each column separately:

```
>>> df.isin({'num_wings': [0, 3]})
        num_legs  num_wings
falcon     False      False
dog        False       True
```

databricks.koalas.DataFrame.sample

DataFrame.**sample**(*n: Optional[int] = None*, *frac: Optional[float] = None*, *replace: bool = False*, *random_state: Optional[int] = None*) → databricks.koalas.frame.DataFrame

Return a random sample of items from an axis of object.

Please call this function using named argument by specifying the `frac` argument.

You can use *random_state* for reproducibility. However, note that different from pandas, specifying a seed in Koalas/Spark does not guarantee the sampled rows will be fixed. The result set depends on not only the seed, but also how the data is distributed across machines and to some extent network randomness when shuffle operations are involved. Even in the simplest case, the result set will depend on the system's CPU core count.

Parameters

n [int, optional] Number of items to return. This is currently NOT supported. Use frac instead.

frac [float, optional] Fraction of axis items to return.

replace [bool, default False] Sample with or without replacement.

random_state [int, optional] Seed for the random number generator (if int).

Returns

Series or DataFrame A new object of same type as caller containing the sampled items.

Examples

```
>>> df = ks.DataFrame({'num_legs': [2, 4, 8, 0],
...                    'num_wings': [2, 0, 0, 0],
...                    'num_specimen_seen': [10, 2, 1, 8]},
...                   index=['falcon', 'dog', 'spider', 'fish'],
...                   columns=['num_legs', 'num_wings', 'num_specimen_seen'])
>>> df
        num_legs  num_wings  num_specimen_seen
falcon         2          2                 10
dog            4          0                  2
spider         8          0                  1
fish           0          0                  8
```

A random 25% sample of the `DataFrame`. Note that we use *random_state* to ensure the reproducibility of the examples.

```
>>> df.sample(frac=0.25, random_state=1)
        num_legs  num_wings  num_specimen_seen
falcon         2          2                 10
fish           0          0                  8
```

Extract 25% random elements from the `Series` `df['num_legs']`, with replacement, so the same items could appear more than once.

```
>>> df['num_legs'].sample(frac=0.4, replace=True, random_state=1)
falcon    2
spider    8
spider    8
Name: num_legs, dtype: int64
```

Specifying the exact number of items to return is not supported at the moment.

```
>>> df.sample(n=5)
Traceback (most recent call last):
    ...
NotImplementedError: Function sample currently does not support specifying ...
```

databricks.koalas.DataFrame.truncate

`DataFrame.`**`truncate`**(*before=None*, *after=None*, *axis=None*, *copy=True*) → Union[DataFrame, Series]

Truncate a Series or DataFrame before and after some index value.

This is a useful shorthand for boolean indexing based on index values above or below certain thresholds.

Note: This API is dependent on *`Index.is_monotonic_increasing()`* which can be expensive.

Parameters

before [date, str, int] Truncate all rows before this index value.

after [date, str, int] Truncate all rows after this index value.

axis [{0 or 'index', 1 or 'columns'}, optional] Axis to truncate. Truncates the index (rows) by default.

copy [bool, default is True,] Return a copy of the truncated section.

Returns

type of caller The truncated Series or DataFrame.

See also:

DataFrame.loc Select a subset of a DataFrame by label.

DataFrame.iloc Select a subset of a DataFrame by position.

Examples

```
>>> df = ks.DataFrame({'A': ['a', 'b', 'c', 'd', 'e'],
...                    'B': ['f', 'g', 'h', 'i', 'j'],
...                    'C': ['k', 'l', 'm', 'n', 'o']},
...                   index=[1, 2, 3, 4, 5])
>>> df
   A  B  C
1  a  f  k
2  b  g  l
3  c  h  m
4  d  i  n
5  e  j  o
```

```
>>> df.truncate(before=2, after=4)
   A  B  C
2  b  g  l
3  c  h  m
4  d  i  n
```

The columns of a DataFrame can be truncated.

```
>>> df.truncate(before="A", after="B", axis="columns")
   A  B
1  a  f
2  b  g
3  c  h
4  d  i
5  e  j
```

For Series, only rows can be truncated.

```
>>> df['A'].truncate(before=2, after=4)
2    b
3    c
4    d
Name: A, dtype: object
```

A Series has index that sorted integers.

```
>>> s = ks.Series([10, 20, 30, 40, 50, 60, 70],
...               index=[1, 2, 3, 4, 5, 6, 7])
>>> s
1    10
2    20
```

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```
3    30
4    40
5    50
6    60
7    70
dtype: int64
```

```
>>> s.truncate(2, 5)
2    20
3    30
4    40
5    50
dtype: int64
```

A Series has index that sorted strings.

```
>>> s = ks.Series([10, 20, 30, 40, 50, 60, 70],
...               index=['a', 'b', 'c', 'd', 'e', 'f', 'g'])
>>> s
a    10
b    20
c    30
d    40
e    50
f    60
g    70
dtype: int64
```

```
>>> s.truncate('b', 'e')
b    20
c    30
d    40
e    50
dtype: int64
```

3.4.9 Missing data handling

DataFrame.backfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
DataFrame.dropna([axis, how, thresh, ...])	Remove missing values.
DataFrame.fillna([value, method, axis, ...])	Fill NA/NaN values.
DataFrame.replace([to_replace, value, ...])	Returns a new DataFrame replacing a value with another value.
DataFrame.bfill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.
DataFrame.ffill([axis, inplace, limit])	Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill``.

databricks.koalas.DataFrame.backfill

DataFrame.**backfill**(*axis=None*, *inplace=False*, *limit=None*) → Union[DataFrame, Series]
Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.

Note: the current implementation of 'bfill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> kdf.bfill()
     A    B    C  D
0  3.0  2.0  1.0  0
1  3.0  4.0  1.0  1
2  NaN  3.0  1.0  5
3  NaN  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([None, None, None, 1])
>>> kser
0    NaN
```

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```
1    NaN
2    NaN
3    1.0
dtype: float64
```

```
>>> kser.bfill()
0    1.0
1    1.0
2    1.0
3    1.0
dtype: float64
```

databricks.koalas.DataFrame.dropna

DataFrame.**dropna**(*axis=0*, *how='any'*, *thresh=None*, *subset=None*, *inplace=False*) → Optional[databricks.koalas.frame.DataFrame]

Remove missing values.

Parameters

axis [{0 or 'index'}, default 0] Determine if rows or columns which contain missing values are removed.

- 0, or 'index' : Drop rows which contain missing values.

how [{'any', 'all'}, default 'any'] Determine if row or column is removed from DataFrame, when we have at least one NA or all NA.

- 'any' : If any NA values are present, drop that row or column.
- 'all' : If all values are NA, drop that row or column.

thresh [int, optional] Require that many non-NA values.

subset [array-like, optional] Labels along other axis to consider, e.g. if you are dropping rows these would be a list of columns to include.

inplace [bool, default False] If True, do operation inplace and return None.

Returns

DataFrame DataFrame with NA entries dropped from it.

See also:

DataFrame.drop Drop specified labels from columns.

DataFrame.isnull Indicate missing values.

DataFrame.notnull Indicate existing (non-missing) values.

Examples

```
>>> df = ks.DataFrame({"name": ['Alfred', 'Batman', 'Catwoman'],
...                    "toy": [None, 'Batmobile', 'Bullwhip'],
...                    "born": [None, "1940-04-25", None]},
...                   columns=['name', 'toy', 'born'])
>>> df
       name        toy        born
0    Alfred       None        None
1    Batman  Batmobile  1940-04-25
2  Catwoman   Bullwhip        None
```

Drop the rows where at least one element is missing.

```
>>> df.dropna()
     name        toy        born
1  Batman  Batmobile  1940-04-25
```

Drop the columns where at least one element is missing.

```
>>> df.dropna(axis='columns')
       name
0    Alfred
1    Batman
2  Catwoman
```

Drop the rows where all elements are missing.

```
>>> df.dropna(how='all')
       name        toy        born
0    Alfred       None        None
1    Batman  Batmobile  1940-04-25
2  Catwoman   Bullwhip        None
```

Keep only the rows with at least 2 non-NA values.

```
>>> df.dropna(thresh=2)
       name        toy        born
1    Batman  Batmobile  1940-04-25
2  Catwoman   Bullwhip        None
```

Define in which columns to look for missing values.

```
>>> df.dropna(subset=['name', 'born'])
     name        toy        born
1  Batman  Batmobile  1940-04-25
```

Keep the DataFrame with valid entries in the same variable.

```
>>> df.dropna(inplace=True)
>>> df
     name        toy        born
1  Batman  Batmobile  1940-04-25
```

databricks.koalas.DataFrame.fillna

DataFrame.**fillna**(*value=None*, *method=None*, *axis=None*, *inplace=False*, *limit=None*) → Optional[databricks.koalas.frame.DataFrame]

Fill NA/NaN values.

Note: the current implementation of 'method' parameter in fillna uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

value [scalar, dict, Series] Value to use to fill holes. alternately a dict/Series of values specifying which value to use for each column. DataFrame is not supported.

method [{'backfill', 'bfill', 'pad', 'ffill', None}, default None] Method to use for filling holes in reindexed Series pad / ffill: propagate last valid observation forward to next valid backfill / bfill: use NEXT valid observation to fill gap

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame DataFrame with NA entries filled.

Examples

```
>>> df = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> df
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Replace all NaN elements with 0s.

```
>>> df.fillna(0)
     A    B    C  D
0  0.0  2.0  0.0  0
1  3.0  4.0  0.0  1
```

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```
2  0.0  0.0  0.0  5
3  0.0  3.0  1.0  4
```

We can also propagate non-null values forward or backward.

```
>>> df.fillna(method='ffill')
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  3.0  4.0  NaN  5
3  3.0  3.0  1.0  4
```

Replace all NaN elements in column 'A', 'B', 'C', and 'D', with 0, 1, 2, and 3 respectively.

```
>>> values = {'A': 0, 'B': 1, 'C': 2, 'D': 3}
>>> df.fillna(value=values)
     A    B    C  D
0  0.0  2.0  2.0  0
1  3.0  4.0  2.0  1
2  0.0  1.0  2.0  5
3  0.0  3.0  1.0  4
```

databricks.koalas.DataFrame.replace

DataFrame.**replace**(*to_replace=None*, *value=None*, *inplace=False*, *limit=None*, *regex=False*, *method='pad'*) → Optional[databricks.koalas.frame.DataFrame]

Returns a new DataFrame replacing a value with another value.

Parameters

to_replace [int, float, string, list or dict] Value to be replaced.

value [int, float, string, or list] Value to use to replace holes. The replacement value must be an int, float, or string. If value is a list, value should be of the same length with to_replace.

inplace [boolean, default False] Fill in place (do not create a new object)

Returns

DataFrame Object after replacement.

Examples

```
>>> df = ks.DataFrame({"name": ['Ironman', 'Captain America', 'Thor', 'Hulk'],
...                    "weapon": ['Mark-45', 'Shield', 'Mjolnir', 'Smash']},
...                   columns=['name', 'weapon'])
>>> df
              name   weapon
0          Ironman  Mark-45
1  Captain America   Shield
2             Thor  Mjolnir
3             Hulk    Smash
```

Scalar *to_replace* and *value*

```
>>> df.replace('Ironman', 'War-Machine')
              name   weapon
0      War-Machine  Mark-45
1  Captain America   Shield
2             Thor  Mjolnir
3             Hulk    Smash
```

List like *to_replace* and *value*

```
>>> df.replace(['Ironman', 'Captain America'], ['Rescue', 'Hawkeye'],␣
↪inplace=True)
>>> df
      name   weapon
0   Rescue  Mark-45
1  Hawkeye   Shield
2     Thor  Mjolnir
3     Hulk    Smash
```

Dicts can be used to specify different replacement values for different existing values To use a dict in this way the value parameter should be None

```
>>> df.replace({'Mjolnir': 'Stormbuster'})
      name       weapon
0   Rescue      Mark-45
1  Hawkeye       Shield
2     Thor  Stormbuster
3     Hulk        Smash
```

Dict can specify that different values should be replaced in different columns The value parameter should not be None in this case

```
>>> df.replace({'weapon': 'Mjolnir'}, 'Stormbuster')
      name       weapon
0   Rescue      Mark-45
1  Hawkeye       Shield
2     Thor  Stormbuster
3     Hulk        Smash
```

Nested dictionaries The value parameter should be None to use a nested dict in this way

```
>>> df.replace({'weapon': {'Mjolnir': 'Stormbuster'}})
      name       weapon
0   Rescue      Mark-45
1  Hawkeye       Shield
2     Thor  Stormbuster
3     Hulk        Smash
```

databricks.koalas.DataFrame.bfill

DataFrame.**bfill**(*axis=None*, *inplace=False*, *limit=None*) → Union[DataFrame, Series]
Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`bfill``.

Note: the current implementation of 'bfill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> kdf.bfill()
     A    B    C  D
0  3.0  2.0  1.0  0
1  3.0  4.0  1.0  1
2  NaN  3.0  1.0  5
3  NaN  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([None, None, None, 1])
>>> kser
0    NaN
```

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```
1    NaN
2    NaN
3    1.0
dtype: float64
```

```
>>> kser.bfill()
0    1.0
1    1.0
2    1.0
3    1.0
dtype: float64
```

databricks.koalas.DataFrame.ffill

DataFrame.**ffill**(*axis=None*, *inplace=False*, *limit=None*) → Union[DataFrame, Series]

Synonym for *DataFrame.fillna()* or *Series.fillna()* with `method=`ffill`.

Note: the current implementation of 'ffill' uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame or Series DataFrame or Series with NA entries filled.

Examples

```
>>> kdf = ks.DataFrame({
...     'A': [None, 3, None, None],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> kdf
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  NaN  NaN  NaN  5
3  NaN  3.0  1.0  4
```

Propagate non-null values forward.

```
>>> kdf.ffill()
     A    B    C  D
0  NaN  2.0  NaN  0
1  3.0  4.0  NaN  1
2  3.0  4.0  NaN  5
3  3.0  3.0  1.0  4
```

For Series

```
>>> kser = ks.Series([2, 4, None, 3])
>>> kser
0    2.0
1    4.0
2    NaN
3    3.0
dtype: float64
```

```
>>> kser.ffill()
0    2.0
1    4.0
2    4.0
3    3.0
dtype: float64
```

3.4.10 Reshaping, sorting, transposing

DataFrame.pivot_table([values, index, ...])	Create a spreadsheet-style pivot table as a DataFrame.
DataFrame.pivot([index, columns, values])	Return reshaped DataFrame organized by given index / column values.
DataFrame.sort_index([axis, level, ...])	Sort object by labels (along an axis)
DataFrame.sort_values(by[, ascending, ...])	Sort by the values along either axis.
DataFrame.nlargest(n, columns)	Return the first *n* rows ordered by *columns* in descending order.
DataFrame.nsmallest(n, columns)	Return the first *n* rows ordered by *columns* in ascending order.
DataFrame.stack()	Stack the prescribed level(s) from columns to index.
DataFrame.unstack()	Pivot the (necessarily hierarchical) index labels.
DataFrame.melt([id_vars, value_vars, ...])	Unpivot a DataFrame from wide format to long format, optionally leaving identifier variables set.
DataFrame.explode(column)	Transform each element of a list-like to a row, replicating index values.
DataFrame.squeeze([axis])	Squeeze 1 dimensional axis objects into scalars.
DataFrame.T	Transpose index and columns.
DataFrame.transpose()	Transpose index and columns.
DataFrame.reindex([labels, index, columns, ...])	Conform DataFrame to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index.
DataFrame.reindex_like(other[, copy])	Return a DataFrame with matching indices as other object.
DataFrame.rank([method, ascending])	Compute numerical data ranks (1 through n) along axis.

databricks.koalas.DataFrame.pivot_table

DataFrame.**pivot_table**(*values=None*, *index=None*, *columns=None*, *aggfunc='mean'*, *fill_value=None*) → databricks.koalas.frame.DataFrame

Create a spreadsheet-style pivot table as a DataFrame. The levels in the pivot table will be stored in MultiIndex objects (hierarchical indexes) on the index and columns of the result DataFrame.

Parameters

values [column to aggregate.] They should be either a list less than three or a string.

index [column (string) or list of columns] If an array is passed, it must be the same length as the data. The list should contain string.

columns [column] Columns used in the pivot operation. Only one column is supported and it should be a string.

aggfunc [function (string), dict, default mean] If dict is passed, the key is column to aggregate and value is function or list of functions.

fill_value [scalar, default None] Value to replace missing values with.

Returns

table [DataFrame]

Examples

```
>>> df = ks.DataFrame({"A": ["foo", "foo", "foo", "foo", "foo",
...                          "bar", "bar", "bar", "bar"],
...                    "B": ["one", "one", "one", "two", "two",
...                          "one", "one", "two", "two"],
...                    "C": ["small", "large", "large", "small",
...                          "small", "large", "small", "small",
...                          "large"],
...                    "D": [1, 2, 2, 3, 3, 4, 5, 6, 7],
...                    "E": [2, 4, 5, 5, 6, 6, 8, 9, 9]},
...                   columns=['A', 'B', 'C', 'D', 'E'])
>>> df
     A    B      C  D  E
0  foo  one  small  1  2
1  foo  one  large  2  4
2  foo  one  large  2  5
3  foo  two  small  3  5
4  foo  two  small  3  6
5  bar  one  large  4  6
6  bar  one  small  5  8
7  bar  two  small  6  9
8  bar  two  large  7  9
```

This first example aggregates values by taking the sum.

```
>>> table = df.pivot_table(values='D', index=['A', 'B'],
...                        columns='C', aggfunc='sum')
>>> table.sort_index()
C        large  small
A   B
bar one    4.0      5
    two    7.0      6
```

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```
foo one    4.0      1
    two    NaN      6
```

We can also fill missing values using the *fill_value* parameter.

```
>>> table = df.pivot_table(values='D', index=['A', 'B'],
...                        columns='C', aggfunc='sum', fill_value=0)
>>> table.sort_index()
C        large  small
A   B
bar one      4      5
    two      7      6
foo one      4      1
    two      0      6
```

We can also calculate multiple types of aggregations for any given value column.

```
>>> table = df.pivot_table(values=['D'], index =['C'],
...                        columns="A", aggfunc={'D': 'mean'})
>>> table.sort_index()
         D
A      bar       foo
C
large  5.5  2.000000
small  5.5  2.333333
```

The next example aggregates on multiple values.

```
>>> table = df.pivot_table(index=['C'], columns="A", values=['D', 'E'],
...                         aggfunc={'D': 'mean', 'E': 'sum'})
>>> table.sort_index()
         D             E
A      bar       foo bar  foo
C
large  5.5  2.000000  15    9
small  5.5  2.333333  17   13
```

databricks.koalas.DataFrame.pivot

DataFrame.**pivot**(*index=None*, *columns=None*, *values=None*) → databricks.koalas.frame.DataFrame

Return reshaped DataFrame organized by given index / column values.

Reshape data (produce a "pivot" table) based on column values. Uses unique values from specified *index* / *columns* to form axes of the resulting DataFrame. This function does not support data aggregation.

Parameters

index [string, optional] Column to use to make new frame's index. If None, uses existing index.

columns [string] Column to use to make new frame's columns.

values [string, object or a list of the previous] Column(s) to use for populating new frame's values.

Returns

DataFrame Returns reshaped DataFrame.

See also:

DataFrame.pivot_table Generalization of pivot that can handle duplicate values for one index/column pair.

Examples

```
>>> df = ks.DataFrame({'foo': ['one', 'one', 'one', 'two', 'two',
...                            'two'],
...                    'bar': ['A', 'B', 'C', 'A', 'B', 'C'],
...                    'baz': [1, 2, 3, 4, 5, 6],
...                    'zoo': ['x', 'y', 'z', 'q', 'w', 't']},
...                   columns=['foo', 'bar', 'baz', 'zoo'])
>>> df
   foo bar  baz zoo
0  one   A    1   x
1  one   B    2   y
2  one   C    3   z
3  two   A    4   q
4  two   B    5   w
5  two   C    6   t
```

```
>>> df.pivot(index='foo', columns='bar', values='baz').sort_index()
...
bar  A  B  C
foo
one  1  2  3
two  4  5  6
```

```
>>> df.pivot(columns='bar', values='baz').sort_index()
bar  A    B    C
0  1.0  NaN  NaN
1  NaN  2.0  NaN
2  NaN  NaN  3.0
3  4.0  NaN  NaN
4  NaN  5.0  NaN
5  NaN  NaN  6.0
```

Notice that, unlike pandas raises an ValueError when duplicated values are found, Koalas' pivot still works with its first value it meets during operation because pivot is an expensive operation and it is preferred to permissively execute over failing fast when processing large data.

```
>>> df = ks.DataFrame({"foo": ['one', 'one', 'two', 'two'],
...                    "bar": ['A', 'A', 'B', 'C'],
...                    "baz": [1, 2, 3, 4]}, columns=['foo', 'bar', 'baz'])
>>> df
   foo bar  baz
0  one   A    1
1  one   A    2
2  two   B    3
3  two   C    4
```

```
>>> df.pivot(index='foo', columns='bar', values='baz').sort_index()
...
bar    A    B    C
```

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```
foo
one  1.0  NaN  NaN
two  NaN  3.0  4.0
```

It also support multi-index and multi-index column. >>> df.columns = pd.MultiIndex.from_tuples([('a', 'foo'), ('a', 'bar'), ('b', 'baz')])

```
>>> df = df.set_index(('a', 'bar'), append=True)
>>> df
              a   b
            foo baz
  (a, bar)
0 A         one   1
1 A         one   2
2 B         two   3
3 C         two   4
```

```
>>> df.pivot(columns=('a', 'foo'), values=('b', 'baz')).sort_index()
...
('a', 'foo')  one  two
  (a, bar)
0 A           1.0  NaN
1 A           2.0  NaN
2 B           NaN  3.0
3 C           NaN  4.0
```

databricks.koalas.DataFrame.sort_index

DataFrame.**sort_index**(*axis: int = 0*, *level: Union[int, List[int], None] = None*, *ascending: bool = True*, *inplace: bool = False*, *kind: str = None*, *na_position: str = 'last'*) → Optional[databricks.koalas.frame.DataFrame]

Sort object by labels (along an axis)

Parameters

axis [index, columns to direct sorting. Currently, only axis = 0 is supported.]

level [int or level name or list of ints or list of level names] if not None, sort on values in specified index level(s)

ascending [boolean, default True] Sort ascending vs. descending

inplace [bool, default False] if True, perform operation in-place

kind [str, default None] Koalas does not allow specifying the sorting algorithm at the moment, default None

na_position [{'first', 'last'}, default 'last'] first puts NaNs at the beginning, last puts NaNs at the end. Not implemented for MultiIndex.

Returns

sorted_obj [DataFrame]

Examples

```
>>> df = ks.DataFrame({'A': [2, 1, np.nan]}, index=['b', 'a', np.nan])
```

```
>>> df.sort_index()
       A
a    1.0
b    2.0
NaN  NaN
```

```
>>> df.sort_index(ascending=False)
       A
b    2.0
a    1.0
NaN  NaN
```

```
>>> df.sort_index(na_position='first')
       A
NaN  NaN
a    1.0
b    2.0
```

```
>>> df.sort_index(inplace=True)
>>> df
       A
a    1.0
b    2.0
NaN  NaN
```

```
>>> df = ks.DataFrame({'A': range(4), 'B': range(4)[::-1]},
...                   index=[['b', 'b', 'a', 'a'], [1, 0, 1, 0]],
...                   columns=['A', 'B'])
```

```
>>> df.sort_index()
     A  B
a 0  3  0
  1  2  1
b 0  1  2
  1  0  3
```

```
>>> df.sort_index(level=1)
     A  B
a 0  3  0
b 0  1  2
a 1  2  1
b 1  0  3
```

```
>>> df.sort_index(level=[1, 0])
     A  B
a 0  3  0
b 0  1  2
a 1  2  1
b 1  0  3
```

databricks.koalas.DataFrame.sort_values

DataFrame.**sort_values**(*by: Union[Any, List[Any], Tuple, List[Tuple]]*, *ascending: Union[bool, List[bool]] = True*, *inplace: bool = False*, *na_position: str = 'last'*) → Optional[databricks.koalas.frame.DataFrame]

Sort by the values along either axis.

Parameters

by [str or list of str]

ascending [bool or list of bool, default True] Sort ascending vs. descending. Specify list for multiple sort orders. If this is a list of bools, must match the length of the by.

inplace [bool, default False] if True, perform operation in-place

na_position [{'first', 'last'}, default 'last'] *first* puts NaNs at the beginning, *last* puts NaNs at the end

Returns

sorted_obj [DataFrame]

Examples

```
>>> df = ks.DataFrame({
...     'col1': ['A', 'B', None, 'D', 'C'],
...     'col2': [2, 9, 8, 7, 4],
...     'col3': [0, 9, 4, 2, 3],
...   },
...   columns=['col1', 'col2', 'col3'])
>>> df
   col1  col2  col3
0     A     2     0
1     B     9     9
2  None     8     4
3     D     7     2
4     C     4     3
```

Sort by col1

```
>>> df.sort_values(by=['col1'])
   col1  col2  col3
0     A     2     0
1     B     9     9
4     C     4     3
3     D     7     2
2  None     8     4
```

Sort Descending

```
>>> df.sort_values(by='col1', ascending=False)
   col1  col2  col3
3     D     7     2
4     C     4     3
1     B     9     9
0     A     2     0
2  None     8     4
```

Sort by multiple columns

```
>>> df = ks.DataFrame({
...     'col1': ['A', 'A', 'B', None, 'D', 'C'],
...     'col2': [2, 1, 9, 8, 7, 4],
...     'col3': [0, 1, 9, 4, 2, 3],
...   },
...   columns=['col1', 'col2', 'col3'])
>>> df.sort_values(by=['col1', 'col2'])
   col1  col2  col3
1     A     1     1
0     A     2     0
2     B     9     9
5     C     4     3
4     D     7     2
3  None     8     4
```

databricks.koalas.DataFrame.nlargest

`DataFrame.nlargest` (*n: int*, *columns: Any*) → databricks.koalas.frame.DataFrame

Return the first *n* rows ordered by *columns* in descending order.

Return the first *n* rows with the largest values in *columns*, in descending order. The columns that are not specified are returned as well, but not used for ordering.

This method is equivalent to `df.sort_values(columns, ascending=False).head(n)`, but more performant in pandas. In Koalas, thanks to Spark's lazy execution and query optimizer, the two would have same performance.

Parameters

n [int] Number of rows to return.

columns [label or list of labels] Column label(s) to order by.

Returns

DataFrame The first *n* rows ordered by the given columns in descending order.

See also:

DataFrame.nsmallest Return the first *n* rows ordered by *columns* in ascending order.

DataFrame.sort_values Sort DataFrame by the values.

DataFrame.head Return the first *n* rows without re-ordering.

Notes

This function cannot be used with all column types. For example, when specifying columns with *object* or *category* dtypes, `TypeError` is raised.

Examples

```
>>> df = ks.DataFrame({'X': [1, 2, 3, 5, 6, 7, np.nan],
...                    'Y': [6, 7, 8, 9, 10, 11, 12]})
>>> df
     X   Y
0  1.0   6
1  2.0   7
2  3.0   8
3  5.0   9
4  6.0  10
5  7.0  11
6  NaN  12
```

In the following example, we will use `nlargest` to select the three rows having the largest values in column "population".

```
>>> df.nlargest(n=3, columns='X')
     X   Y
5  7.0  11
4  6.0  10
3  5.0   9
```

```
>>> df.nlargest(n=3, columns=['Y', 'X'])
     X   Y
6  NaN  12
5  7.0  11
4  6.0  10
```

databricks.koalas.DataFrame.nsmallest

DataFrame.**nsmallest**(*n: int*, *columns: Any*) → databricks.koalas.frame.DataFrame

Return the first *n* rows ordered by *columns* in ascending order.

Return the first *n* rows with the smallest values in *columns*, in ascending order. The columns that are not specified are returned as well, but not used for ordering.

This method is equivalent to `df.sort_values(columns, ascending=True).head(n)`, but more performant. In Koalas, thanks to Spark's lazy execution and query optimizer, the two would have same performance.

Parameters

n [int] Number of items to retrieve.

columns [list or str] Column name or names to order by.

Returns

DataFrame

See also:

DataFrame.nlargest Return the first *n* rows ordered by *columns* in descending order.

DataFrame.sort_values Sort DataFrame by the values.

DataFrame.head Return the first *n* rows without re-ordering.

Examples

```
>>> df = ks.DataFrame({'X': [1, 2, 3, 5, 6, 7, np.nan],
...                    'Y': [6, 7, 8, 9, 10, 11, 12]})
>>> df
     X   Y
0  1.0   6
1  2.0   7
2  3.0   8
3  5.0   9
4  6.0  10
5  7.0  11
6  NaN  12
```

In the following example, we will use `nsmallest` to select the three rows having the smallest values in column "a".

```
>>> df.nsmallest(n=3, columns='X')
     X   Y
0  1.0   6
1  2.0   7
2  3.0   8
```

To order by the largest values in column "a" and then "c", we can specify multiple columns like in the next example.

```
>>> df.nsmallest(n=3, columns=['Y', 'X'])
     X   Y
0  1.0   6
1  2.0   7
2  3.0   8
```

databricks.koalas.DataFrame.stack

DataFrame.**stack**() → Union[DataFrame, Series]

Stack the prescribed level(s) from columns to index.

Return a reshaped DataFrame or Series having a multi-level index with one or more new inner-most levels compared to the current DataFrame. The new inner-most levels are created by pivoting the columns of the current dataframe:

- if the columns have a single level, the output is a Series;
- if the columns have multiple levels, the new index level(s) is (are) taken from the prescribed level(s) and the output is a DataFrame.

The new index levels are sorted.

Returns

DataFrame or Series Stacked dataframe or series.

See also:

DataFrame.unstack Unstack prescribed level(s) from index axis onto column axis.

DataFrame.pivot Reshape dataframe from long format to wide format.

DataFrame.pivot_table Create a spreadsheet-style pivot table as a DataFrame.

Notes

The function is named by analogy with a collection of books being reorganized from being side by side on a horizontal position (the columns of the dataframe) to being stacked vertically on top of each other (in the index of the dataframe).

Examples

Single level columns

```
>>> df_single_level_cols = ks.DataFrame([[0, 1], [2, 3]],
...                                     index=['cat', 'dog'],
...                                     columns=['weight', 'height'])
```

Stacking a dataframe with a single level column axis returns a Series:

```
>>> df_single_level_cols
     weight  height
cat       0       1
dog       2       3
>>> df_single_level_cols.stack().sort_index()
cat  height    1
     weight    0
dog  height    3
     weight    2
dtype: int64
```

Multi level columns: simple case

```
>>> multicol1 = pd.MultiIndex.from_tuples([('weight', 'kg'),
...                                        ('weight', 'pounds')])
>>> df_multi_level_cols1 = ks.DataFrame([[1, 2], [2, 4]],
...                                     index=['cat', 'dog'],
...                                     columns=multicol1)
```

Stacking a dataframe with a multi-level column axis:

```
>>> df_multi_level_cols1
    weight
        kg pounds
cat      1      2
dog      2      4
>>> df_multi_level_cols1.stack().sort_index()
            weight
cat kg           1
    pounds       2
dog kg           2
    pounds       4
```

Missing values

```
>>> multicol2 = pd.MultiIndex.from_tuples([('weight', 'kg'),
...                                        ('height', 'm')])
>>> df_multi_level_cols2 = ks.DataFrame([[1.0, 2.0], [3.0, 4.0]],
...                                     index=['cat', 'dog'],
...                                     columns=multicol2)
```

It is common to have missing values when stacking a dataframe with multi-level columns, as the stacked dataframe typically has more values than the original dataframe. Missing values are filled with NaNs:

```
>>> df_multi_level_cols2
    weight height
        kg      m
cat    1.0    2.0
dog    3.0    4.0
>>> df_multi_level_cols2.stack().sort_index()
        height  weight
cat kg     NaN     1.0
    m      2.0     NaN
dog kg     NaN     3.0
    m      4.0     NaN
```

databricks.koalas.DataFrame.unstack

DataFrame.**unstack**() → Union[DataFrame, Series]

Pivot the (necessarily hierarchical) index labels.

Returns a DataFrame having a new level of column labels whose inner-most level consists of the pivoted index labels.

If the index is not a MultiIndex, the output will be a Series.

Note: If the index is a MultiIndex, the output DataFrame could be very wide, and it could cause a serious performance degradation since Spark partitions it row based.

Returns

Series or DataFrame

See also:

DataFrame.pivot Pivot a table based on column values.

DataFrame.stack Pivot a level of the column labels (inverse operation from unstack).

Examples

```
>>> df = ks.DataFrame({"A": {"0": "a", "1": "b", "2": "c"},
...                    "B": {"0": "1", "1": "3", "2": "5"},
...                    "C": {"0": "2", "1": "4", "2": "6"}},
...                   columns=["A", "B", "C"])
>>> df
   A  B  C
0  a  1  2
1  b  3  4
2  c  5  6
```

```
>>> df.unstack().sort_index()
A  0    a
   1    b
```

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```
   2    c
B  0    1
   1    3
   2    5
C  0    2
   1    4
   2    6
dtype: object
```

```
>>> df.columns = pd.MultiIndex.from_tuples([('X', 'A'), ('X', 'B'), ('Y', 'C')])
>>> df.unstack().sort_index()
X  A  0    a
      1    b
      2    c
   B  0    1
      1    3
      2    5
Y  C  0    2
      1    4
      2    6
dtype: object
```

For MultiIndex case:

```
>>> df = ks.DataFrame({"A": ["a", "b", "c"],
...                    "B": [1, 3, 5],
...                    "C": [2, 4, 6]},
...                   columns=["A", "B", "C"])
>>> df = df.set_index('A', append=True)
>>> df
     B  C
  A
0 a  1  2
1 b  3  4
2 c  5  6
>>> df.unstack().sort_index()
     B              C
A    a    b    c    a    b    c
0  1.0  NaN  NaN  2.0  NaN  NaN
1  NaN  3.0  NaN  NaN  4.0  NaN
2  NaN  NaN  5.0  NaN  NaN  6.0
```

databricks.koalas.DataFrame.melt

DataFrame.**melt**(*id_vars=None*, *value_vars=None*, *var_name=None*, *value_name='value'*) → databricks.koalas.frame.DataFrame

Unpivot a DataFrame from wide format to long format, optionally leaving identifier variables set.

This function is useful to massage a DataFrame into a format where one or more columns are identifier variables (*id_vars*), while all other columns, considered measured variables (*value_vars*), are "unpivoted" to the row axis, leaving just two non-identifier columns, 'variable' and 'value'.

Parameters

frame [DataFrame]

id_vars [tuple, list, or ndarray, optional] Column(s) to use as identifier variables.

value_vars [tuple, list, or ndarray, optional] Column(s) to unpivot. If not specified, uses all columns that are not set as *id_vars*.

var_name [scalar, default 'variable'] Name to use for the 'variable' column. If None it uses *frame.columns.name* or 'variable'.

value_name [scalar, default 'value'] Name to use for the 'value' column.

Returns

DataFrame Unpivoted DataFrame.

Examples

```
>>> df = ks.DataFrame({'A': {0: 'a', 1: 'b', 2: 'c'},
...                    'B': {0: 1, 1: 3, 2: 5},
...                    'C': {0: 2, 1: 4, 2: 6}},
...                   columns=['A', 'B', 'C'])
>>> df
   A  B  C
0  a  1  2
1  b  3  4
2  c  5  6
```

```
>>> ks.melt(df)
  variable value
0        A     a
1        B     1
2        C     2
3        A     b
4        B     3
5        C     4
6        A     c
7        B     5
8        C     6
```

```
>>> df.melt(id_vars='A')
   A variable  value
0  a        B      1
1  a        C      2
2  b        B      3
3  b        C      4
4  c        B      5
5  c        C      6
```

```
>>> df.melt(value_vars='A')
  variable value
0        A     a
1        A     b
2        A     c
```

```
>>> ks.melt(df, id_vars=['A', 'B'])
   A  B variable  value
0  a  1        C      2
1  b  3        C      4
2  c  5        C      6
```

```
>>> df.melt(id_vars=['A'], value_vars=['C'])
   A variable  value
0  a        C      2
1  b        C      4
2  c        C      6
```

The names of 'variable' and 'value' columns can be customized:

```
>>> ks.melt(df, id_vars=['A'], value_vars=['B'],
...         var_name='myVarname', value_name='myValname')
   A myVarname  myValname
0  a         B          1
1  b         B          3
2  c         B          5
```

databricks.koalas.DataFrame.explode

DataFrame.**explode**(*column*) → databricks.koalas.frame.DataFrame

Transform each element of a list-like to a row, replicating index values.

Parameters

column [str or tuple] Column to explode.

Returns

DataFrame Exploded lists to rows of the subset columns; index will be duplicated for these rows.

See also:

DataFrame.unstack Pivot a level of the (necessarily hierarchical) index labels.

DataFrame.melt Unpivot a DataFrame from wide format to long format.

Examples

```
>>> df = ks.DataFrame({'A': [[1, 2, 3], [], [3, 4]], 'B': 1})
>>> df
           A  B
0  [1, 2, 3]  1
1         []  1
2     [3, 4]  1
```

```
>>> df.explode('A')
     A  B
0  1.0  1
0  2.0  1
0  3.0  1
1  NaN  1
2  3.0  1
2  4.0  1
```

databricks.koalas.DataFrame.squeeze

DataFrame.**squeeze**(*axis=None*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, DataFrame, Series]

Squeeze 1 dimensional axis objects into scalars.

Series or DataFrames with a single element are squeezed to a scalar. DataFrames with a single column or a single row are squeezed to a Series. Otherwise the object is unchanged.

This method is most useful when you don't know if your object is a Series or DataFrame, but you do know it has just a single column. In that case you can safely call *squeeze* to ensure you have a Series.

Parameters

axis [{0 or 'index', 1 or 'columns', None}, default None] A specific axis to squeeze. By default, all length-1 axes are squeezed.

Returns

DataFrame, Series, or scalar The projection after squeezing *axis* or all the axes.

See also:

Series.iloc Integer-location based indexing for selecting scalars.

DataFrame.iloc Integer-location based indexing for selecting Series.

Series.to_frame Inverse of DataFrame.squeeze for a single-column DataFrame.

Examples

```
>>> primes = ks.Series([2, 3, 5, 7])
```

Slicing might produce a Series with a single value:

```
>>> even_primes = primes[primes % 2 == 0]
>>> even_primes
0    2
dtype: int64
```

```
>>> even_primes.squeeze()
2
```

Squeezing objects with more than one value in every axis does nothing:

```
>>> odd_primes = primes[primes % 2 == 1]
>>> odd_primes
1    3
2    5
3    7
dtype: int64
```

```
>>> odd_primes.squeeze()
1    3
2    5
3    7
dtype: int64
```

Squeezing is even more effective when used with DataFrames.

```
>>> df = ks.DataFrame([[1, 2], [3, 4]], columns=['a', 'b'])
>>> df
   a  b
0  1  2
1  3  4
```

Slicing a single column will produce a DataFrame with the columns having only one value:

```
>>> df_a = df[['a']]
>>> df_a
   a
0  1
1  3
```

So the columns can be squeezed down, resulting in a Series:

```
>>> df_a.squeeze('columns')
0    1
1    3
Name: a, dtype: int64
```

Slicing a single row from a single column will produce a single scalar DataFrame:

```
>>> df_1a = df.loc[[1], ['a']]
>>> df_1a
   a
1  3
```

Squeezing the rows produces a single scalar Series:

```
>>> df_1a.squeeze('rows')
a    3
Name: 1, dtype: int64
```

Squeezing all axes will project directly into a scalar:

```
>>> df_1a.squeeze()
3
```

databricks.koalas.DataFrame.T

property DataFrame.**T**

Transpose index and columns.

Reflect the DataFrame over its main diagonal by writing rows as columns and vice-versa. The property *T* is an accessor to the method *transpose()*.

Note: This method is based on an expensive operation due to the nature of big data. Internally it needs to generate each row for each value, and then group twice - it is a huge operation. To prevent misusage, this method has the 'compute.max_rows' default limit of input length, and raises a ValueError.

```
>>> from databricks.koalas.config import option_context
>>> with option_context('compute.max_rows', 1000):
...     ks.DataFrame({'a': range(1001)}).transpose()
Traceback (most recent call last):
```

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```
  ...
ValueError: Current DataFrame has more then the given limit 1000 rows.
Please set 'compute.max_rows' by using 'databricks.koalas.config.set_option'
to retrieve to retrieve more than 1000 rows. Note that, before changing the
'compute.max_rows', this operation is considerably expensive.
```

Returns

DataFrame The transposed DataFrame.

Notes

Transposing a DataFrame with mixed dtypes will result in a homogeneous DataFrame with the coerced dtype. For instance, if int and float have to be placed in same column, it becomes float. If type coercion is not possible, it fails.

Also, note that the values in index should be unique because they become unique column names.

In addition, if Spark 2.3 is used, the types should always be exactly same.

Examples

Square DataFrame with homogeneous dtype

```
>>> d1 = {'col1': [1, 2], 'col2': [3, 4]}
>>> df1 = ks.DataFrame(data=d1, columns=['col1', 'col2'])
>>> df1
   col1  col2
0     1     3
1     2     4
```

```
>>> df1_transposed = df1.T.sort_index()
>>> df1_transposed
      0  1
col1  1  2
col2  3  4
```

When the dtype is homogeneous in the original DataFrame, we get a transposed DataFrame with the same dtype:

```
>>> df1.dtypes
col1    int64
col2    int64
dtype: object
>>> df1_transposed.dtypes
0    int64
1    int64
dtype: object
```

Non-square DataFrame with mixed dtypes

```
>>> d2 = {'score': [9.5, 8],
...       'kids': [0, 0],
...       'age': [12, 22]}
```

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```
>>> df2 = ks.DataFrame(data=d2, columns=['score', 'kids', 'age'])
>>> df2
   score  kids  age
0    9.5     0   12
1    8.0     0   22
```

```
>>> df2_transposed = df2.T.sort_index()
>>> df2_transposed
          0     1
age    12.0  22.0
kids    0.0   0.0
score   9.5   8.0
```

When the DataFrame has mixed dtypes, we get a transposed DataFrame with the coerced dtype:

```
>>> df2.dtypes
score    float64
kids       int64
age        int64
dtype: object
```

```
>>> df2_transposed.dtypes
0    float64
1    float64
dtype: object
```

databricks.koalas.DataFrame.transpose

DataFrame.**transpose**() → databricks.koalas.frame.DataFrame

Transpose index and columns.

Reflect the DataFrame over its main diagonal by writing rows as columns and vice-versa. The property *T* is an accessor to the method *transpose()*.

Note: This method is based on an expensive operation due to the nature of big data. Internally it needs to generate each row for each value, and then group twice - it is a huge operation. To prevent misusage, this method has the 'compute.max_rows' default limit of input length, and raises a ValueError.

```
>>> from databricks.koalas.config import option_context
>>> with option_context('compute.max_rows', 1000):
...     ks.DataFrame({'a': range(1001)}).transpose()
Traceback (most recent call last):
  ...
ValueError: Current DataFrame has more then the given limit 1000 rows.
Please set 'compute.max_rows' by using 'databricks.koalas.config.set_option'
to retrieve to retrieve more than 1000 rows. Note that, before changing the
'compute.max_rows', this operation is considerably expensive.
```

Returns

DataFrame The transposed DataFrame.

Notes

Transposing a DataFrame with mixed dtypes will result in a homogeneous DataFrame with the coerced dtype. For instance, if int and float have to be placed in same column, it becomes float. If type coercion is not possible, it fails.

Also, note that the values in index should be unique because they become unique column names.

In addition, if Spark 2.3 is used, the types should always be exactly same.

Examples

Square DataFrame with homogeneous dtype

```
>>> d1 = {'col1': [1, 2], 'col2': [3, 4]}
>>> df1 = ks.DataFrame(data=d1, columns=['col1', 'col2'])
>>> df1
   col1  col2
0     1     3
1     2     4
```

```
>>> df1_transposed = df1.T.sort_index()
>>> df1_transposed
      0  1
col1  1  2
col2  3  4
```

When the dtype is homogeneous in the original DataFrame, we get a transposed DataFrame with the same dtype:

```
>>> df1.dtypes
col1    int64
col2    int64
dtype: object
>>> df1_transposed.dtypes
0    int64
1    int64
dtype: object
```

Non-square DataFrame with mixed dtypes

```
>>> d2 = {'score': [9.5, 8],
...       'kids': [0, 0],
...       'age': [12, 22]}
>>> df2 = ks.DataFrame(data=d2, columns=['score', 'kids', 'age'])
>>> df2
   score  kids  age
0    9.5     0   12
1    8.0     0   22
```

```
>>> df2_transposed = df2.T.sort_index()
>>> df2_transposed
           0     1
age     12.0  22.0
kids     0.0   0.0
score    9.5   8.0
```

When the DataFrame has mixed dtypes, we get a transposed DataFrame with the coerced dtype:

```
>>> df2.dtypes
score    float64
kids       int64
age        int64
dtype: object
```

```
>>> df2_transposed.dtypes
0    float64
1    float64
dtype: object
```

databricks.koalas.DataFrame.reindex

DataFrame.**reindex**(*labels: Optional[Any] = None*, *index: Optional[Any] = None*, *columns: Optional[Any] = None*, *axis: Union[str, int, None] = None*, *copy: Optional[bool] = True*, *fill_value: Optional[Any] = None*) → databricks.koalas.frame.DataFrame

Conform DataFrame to new index with optional filling logic, placing NA/NaN in locations having no value in the previous index. A new object is produced unless the new index is equivalent to the current one and `copy=False`.

Parameters

labels: array-like, optional New labels / index to conform the axis specified by 'axis' to.

index, columns: array-like, optional New labels / index to conform to, should be specified using keywords. Preferably an Index object to avoid duplicating data

axis: int or str, optional Axis to target. Can be either the axis name ('index', 'columns') or number (0, 1).

copy [bool, default True] Return a new object, even if the passed indexes are the same.

fill_value [scalar, default np.NaN] Value to use for missing values. Defaults to NaN, but can be any "compatible" value.

Returns

DataFrame with changed index.

See also:

DataFrame.set_index Set row labels.

DataFrame.reset_index Remove row labels or move them to new columns.

Examples

`DataFrame.reindex` supports two calling conventions

- `(index=index_labels, columns=column_labels, ...)`
- `(labels, axis={'index', 'columns'}, ...)`

We *highly* recommend using keyword arguments to clarify your intent.

Create a dataframe with some fictional data.

```
>>> index = ['Firefox', 'Chrome', 'Safari', 'IE10', 'Konqueror']
>>> df = ks.DataFrame({
...       'http_status': [200, 200, 404, 404, 301],
...       'response_time': [0.04, 0.02, 0.07, 0.08, 1.0]},
...       index=index,
...       columns=['http_status', 'response_time'])
>>> df
           http_status  response_time
Firefox            200           0.04
Chrome             200           0.02
Safari             404           0.07
IE10               404           0.08
Konqueror          301           1.00
```

Create a new index and reindex the dataframe. By default values in the new index that do not have corresponding records in the dataframe are assigned `NaN`.

```
>>> new_index= ['Safari', 'Iceweasel', 'Comodo Dragon', 'IE10',
...             'Chrome']
>>> df.reindex(new_index).sort_index()
              http_status  response_time
Chrome              200.0           0.02
Comodo Dragon         NaN            NaN
IE10                404.0           0.08
Iceweasel             NaN            NaN
Safari              404.0           0.07
```

We can fill in the missing values by passing a value to the keyword `fill_value`.

```
>>> df.reindex(new_index, fill_value=0, copy=False).sort_index()
              http_status  response_time
Chrome                200           0.02
Comodo Dragon           0           0.00
IE10                  404           0.08
Iceweasel               0           0.00
Safari                404           0.07
```

We can also reindex the columns.

```
>>> df.reindex(columns=['http_status', 'user_agent']).sort_index()
           http_status  user_agent
Chrome             200         NaN
Firefox            200         NaN
IE10               404         NaN
Konqueror          301         NaN
Safari             404         NaN
```

Or we can use "axis-style" keyword arguments

```
>>> df.reindex(['http_status', 'user_agent'], axis="columns").sort_index()
           http_status  user_agent
Chrome             200         NaN
Firefox            200         NaN
IE10               404         NaN
Konqueror          301         NaN
Safari             404         NaN
```

To further illustrate the filling functionality in `reindex`, we will create a dataframe with a monotonically

increasing index (for example, a sequence of dates).

```
>>> date_index = pd.date_range('1/1/2010', periods=6, freq='D')
>>> df2 = ks.DataFrame({"prices": [100, 101, np.nan, 100, 89, 88]},
...                    index=date_index)
>>> df2.sort_index()
            prices
2010-01-01   100.0
2010-01-02   101.0
2010-01-03     NaN
2010-01-04   100.0
2010-01-05    89.0
2010-01-06    88.0
```

Suppose we decide to expand the dataframe to cover a wider date range.

```
>>> date_index2 = pd.date_range('12/29/2009', periods=10, freq='D')
>>> df2.reindex(date_index2).sort_index()
            prices
2009-12-29     NaN
2009-12-30     NaN
2009-12-31     NaN
2010-01-01   100.0
2010-01-02   101.0
2010-01-03     NaN
2010-01-04   100.0
2010-01-05    89.0
2010-01-06    88.0
2010-01-07     NaN
```

databricks.koalas.DataFrame.reindex_like

DataFrame.**reindex_like**(*other: databricks.koalas.frame.DataFrame*, *copy: bool = True*) → databricks.koalas.frame.DataFrame

Return a DataFrame with matching indices as other object.

Conform the object to the same index on all axes. Places NA/NaN in locations having no value in the previous index. A new object is produced unless the new index is equivalent to the current one and copy=False.

Parameters

other [DataFrame] Its row and column indices are used to define the new indices of this object.

copy [bool, default True] Return a new object, even if the passed indexes are the same.

Returns

DataFrame DataFrame with changed indices on each axis.

See also:

DataFrame.set_index Set row labels.

DataFrame.reset_index Remove row labels or move them to new columns.

DataFrame.reindex Change to new indices or expand indices.

Notes

Same as calling `.reindex(index=other.index, columns=other.columns,...)`.

Examples

```
>>> df1 = ks.DataFrame([[24.3, 75.7, 'high'],
...                     [31, 87.8, 'high'],
...                     [22, 71.6, 'medium'],
...                     [35, 95, 'medium']],
...                    columns=['temp_celsius', 'temp_fahrenheit',
...                             'windspeed'],
...                    index=pd.date_range(start='2014-02-12',
...                                        end='2014-02-15', freq='D'))
>>> df1
            temp_celsius  temp_fahrenheit windspeed
2014-02-12          24.3             75.7      high
2014-02-13          31.0             87.8      high
2014-02-14          22.0             71.6    medium
2014-02-15          35.0             95.0    medium
```

```
>>> df2 = ks.DataFrame([[28, 'low'],
...                     [30, 'low'],
...                     [35.1, 'medium']],
...                    columns=['temp_celsius', 'windspeed'],
...                    index=pd.DatetimeIndex(['2014-02-12', '2014-02-13',
...                                            '2014-02-15']))
>>> df2
            temp_celsius windspeed
2014-02-12          28.0       low
2014-02-13          30.0       low
2014-02-15          35.1    medium
```

```
>>> df2.reindex_like(df1).sort_index()
            temp_celsius  temp_fahrenheit windspeed
2014-02-12          28.0              NaN       low
2014-02-13          30.0              NaN       low
2014-02-14           NaN              NaN      None
2014-02-15          35.1              NaN    medium
```

databricks.koalas.DataFrame.rank

DataFrame.**rank**(*method='average'*, *ascending=True*) → databricks.koalas.frame.DataFrame

Compute numerical data ranks (1 through n) along axis. Equal values are assigned a rank that is the average of the ranks of those values.

Note: the current implementation of rank uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

method [{'average', 'min', 'max', 'first', 'dense'}]

- average: average rank of group
- min: lowest rank in group
- max: highest rank in group
- first: ranks assigned in order they appear in the array
- dense: like 'min', but rank always increases by 1 between groups

ascending [boolean, default True] False for ranks by high (1) to low (N)

Returns

ranks [same type as caller]

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 2, 3], 'B': [4, 3, 2, 1]}, columns= ['A', 'B'])
>>> df
   A  B
0  1  4
1  2  3
2  2  2
3  3  1
```

```
>>> df.rank().sort_index()
     A    B
0  1.0  4.0
1  2.5  3.0
2  2.5  2.0
3  4.0  1.0
```

If method is set to 'min', it use lowest rank in group.

```
>>> df.rank(method='min').sort_index()
     A    B
0  1.0  4.0
1  2.0  3.0
2  2.0  2.0
3  4.0  1.0
```

If method is set to 'max', it use highest rank in group.

```
>>> df.rank(method='max').sort_index()
     A    B
0  1.0  4.0
1  3.0  3.0
2  3.0  2.0
3  4.0  1.0
```

If method is set to 'dense', it leaves no gaps in group.

```
>>> df.rank(method='dense').sort_index()
     A    B
0  1.0  4.0
1  2.0  3.0
2  2.0  2.0
3  3.0  1.0
```

3.4.11 Combining / joining / merging

DataFrame.append(other[, ignore_index, ...])	Append rows of other to the end of caller, returning a new object.
DataFrame.assign(**kwargs)	Assign new columns to a DataFrame.
DataFrame.merge(right[, how, on, left_on, ...])	Merge DataFrame objects with a database-style join.
DataFrame.join(right[, on, how, lsuffix, ...])	Join columns of another DataFrame.
DataFrame.update(other[, join, overwrite])	Modify in place using non-NA values from another DataFrame.

databricks.koalas.DataFrame.append

DataFrame.**append**(*other: databricks.koalas.frame.DataFrame*, *ignore_index: bool = False*, *verify_integrity: bool = False*, *sort: bool = False*) → databricks.koalas.frame.DataFrame

Append rows of other to the end of caller, returning a new object.

Columns in other that are not in the caller are added as new columns.

Parameters

other [DataFrame or Series/dict-like object, or list of these] The data to append.

ignore_index [boolean, default False] If True, do not use the index labels.

verify_integrity [boolean, default False] If True, raise ValueError on creating index with duplicates.

sort [boolean, default False] Currently not supported.

Returns

appended [DataFrame]

Examples

```
>>> df = ks.DataFrame([[1, 2], [3, 4]], columns=list('AB'))
```

```
>>> df.append(df)
   A  B
0  1  2
1  3  4
0  1  2
1  3  4
```

```
>>> df.append(df, ignore_index=True)
   A  B
0  1  2
1  3  4
2  1  2
3  3  4
```

databricks.koalas.DataFrame.assign

DataFrame.**assign**(***kwargs*) → databricks.koalas.frame.DataFrame

Assign new columns to a DataFrame.

Returns a new object with all original columns in addition to new ones. Existing columns that are re-assigned will be overwritten.

Parameters

****kwargs** [dict of {str: callable, Series or Index}] The column names are keywords. If the values are callable, they are computed on the DataFrame and assigned to the new columns. The callable must not change input DataFrame (though Koalas doesn't check it). If the values are not callable, (e.g. a Series or a literal), they are simply assigned.

Returns

DataFrame A new DataFrame with the new columns in addition to all the existing columns.

Notes

Assigning multiple columns within the same `assign` is possible but you cannot refer to newly created or modified columns. This feature is supported in pandas for Python 3.6 and later but not in Koalas. In Koalas, all items are computed first, and then assigned.

Examples

```
>>> df = ks.DataFrame({'temp_c': [17.0, 25.0]},
...                   index=['Portland', 'Berkeley'])
>>> df
          temp_c
Portland    17.0
Berkeley    25.0
```

Where the value is a callable, evaluated on *df*:

```
>>> df.assign(temp_f=lambda x: x.temp_c * 9 / 5 + 32)
          temp_c  temp_f
Portland    17.0    62.6
Berkeley    25.0    77.0
```

Alternatively, the same behavior can be achieved by directly referencing an existing Series or sequence and you can also create multiple columns within the same assign.

```
>>> assigned = df.assign(temp_f=df['temp_c'] * 9 / 5 + 32,
...                      temp_k=df['temp_c'] + 273.15,
...                      temp_idx=df.index)
>>> assigned[['temp_c', 'temp_f', 'temp_k', 'temp_idx']]
          temp_c  temp_f  temp_k  temp_idx
Portland    17.0    62.6  290.15  Portland
Berkeley    25.0    77.0  298.15  Berkeley
```

databricks.koalas.DataFrame.merge

DataFrame.**merge**(*right: databricks.koalas.frame.DataFrame*, *how: str = 'inner'*, *on: Union[Any, List[Any], Tuple, List[Tuple], None] = None*, *left_on: Union[Any, List[Any], Tuple, List[Tuple], None] = None*, *right_on: Union[Any, List[Any], Tuple, List[Tuple], None] = None*, *left_index: bool = False*, *right_index: bool = False*, *suffixes: Tuple[str, str] = ('_x', '_y')*) → databricks.koalas.frame.DataFrame

Merge DataFrame objects with a database-style join.

The index of the resulting DataFrame will be one of the following:

- 0...n if no index is used for merging
- Index of the left DataFrame if merged only on the index of the right DataFrame
- Index of the right DataFrame if merged only on the index of the left DataFrame
- **All involved indices if merged using the indices of both DataFrames** e.g. if *left* with indices (a, x) and *right* with indices (b, x), the result will be an index (x, a, b)

Parameters

right: Object to merge with.

how: Type of merge to be performed. {'left', 'right', 'outer', 'inner'}, default 'inner'

left: use only keys from left frame, similar to a SQL left outer join; not preserve key order unlike pandas.

right: use only keys from right frame, similar to a SQL right outer join; not preserve key order unlike pandas.

outer: use union of keys from both frames, similar to a SQL full outer join; sort keys lexicographically.

inner: use intersection of keys from both frames, similar to a SQL inner join; not preserve the order of the left keys unlike pandas.

on: Column or index level names to join on. These must be found in both DataFrames. If on is None and not merging on indexes then this defaults to the intersection of the columns in both DataFrames.

left_on: Column or index level names to join on in the left DataFrame. Can also be an array or list of arrays of the length of the left DataFrame. These arrays are treated as if they are columns.

right_on: Column or index level names to join on in the right DataFrame. Can also be an array or list of arrays of the length of the right DataFrame. These arrays are treated as if they are columns.

left_index: Use the index from the left DataFrame as the join key(s). If it is a MultiIndex, the number of keys in the other DataFrame (either the index or a number of columns) must match the number of levels.

right_index: Use the index from the right DataFrame as the join key. Same caveats as left_index.

suffixes: Suffix to apply to overlapping column names in the left and right side, respectively.

Returns

DataFrame A DataFrame of the two merged objects.

See also:

DataFrame.join Join columns of another DataFrame.

DataFrame.update Modify in place using non-NA values from another DataFrame.

DataFrame.hint Specifies some hint on the current DataFrame.

broadcast Marks a DataFrame as small enough for use in broadcast joins.

Notes

As described in #263, joining string columns currently returns None for missing values instead of NaN.

Examples

```
>>> df1 = ks.DataFrame({'lkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [1, 2, 3, 5]},
...                    columns=['lkey', 'value'])
>>> df2 = ks.DataFrame({'rkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [5, 6, 7, 8]},
...                    columns=['rkey', 'value'])
>>> df1
  lkey  value
0  foo      1
1  bar      2
2  baz      3
3  foo      5
>>> df2
  rkey  value
0  foo      5
1  bar      6
2  baz      7
3  foo      8
```

Merge df1 and df2 on the lkey and rkey columns. The value columns have the default suffixes, _x and _y, appended.

```
>>> merged = df1.merge(df2, left_on='lkey', right_on='rkey')
>>> merged.sort_values(by=['lkey', 'value_x', 'rkey', 'value_y'])
  lkey  value_x rkey  value_y
...bar        2  bar        6
...baz        3  baz        7
...foo        1  foo        5
...foo        1  foo        8
...foo        5  foo        5
...foo        5  foo        8
```

```
>>> left_kdf = ks.DataFrame({'A': [1, 2]})
>>> right_kdf = ks.DataFrame({'B': ['x', 'y']}, index=[1, 2])
```

```
>>> left_kdf.merge(right_kdf, left_index=True, right_index=True).sort_index()
   A  B
1  2  x
```

```
>>> left_kdf.merge(right_kdf, left_index=True, right_index=True, how='left').sort_
↪index()
   A     B
0  1  None
1  2     x
```

```
>>> left_kdf.merge(right_kdf, left_index=True, right_index=True, how='right').
↪sort_index()
     A  B
1  2.0  x
2  NaN  y
```

```
>>> left_kdf.merge(right_kdf, left_index=True, right_index=True, how='outer').
↪sort_index()
     A     B
0  1.0  None
1  2.0     x
2  NaN     y
```

databricks.koalas.DataFrame.join

DataFrame.**join**(*right: databricks.koalas.frame.DataFrame*, *on: Union[Any, List[Any], Tuple, List[Tuple], None] = None*, *how: str = 'left'*, *lsuffix: str = ''*, *rsuffix: str = ''*) → databricks.koalas.frame.DataFrame

Join columns of another DataFrame.

Join columns with *right* DataFrame either on index or on a key column. Efficiently join multiple DataFrame objects by index at once by passing a list.

Parameters

right: DataFrame, Series

on: str, list of str, or array-like, optional Column or index level name(s) in the caller to join on the index in *right*, otherwise joins index-on-index. If multiple values given, the *right* DataFrame must have a MultiIndex. Can pass an array as the join key if it is not already contained in the calling DataFrame. Like an Excel VLOOKUP operation.

how: {'left', 'right', 'outer', 'inner'}, default 'left' How to handle the operation of the two objects.

- left: use *left* frame's index (or column if on is specified).
- right: use *right*'s index.
- outer: form union of *left* frame's index (or column if on is specified) with right's index, and sort it. lexicographically.
- inner: form intersection of *left* frame's index (or column if on is specified) with *right*'s index, preserving the order of the *left*'s one.

lsuffix [str, default ''] Suffix to use from left frame's overlapping columns.

rsuffix [str, default ''] Suffix to use from *right* frame's overlapping columns.

Returns

DataFrame A dataframe containing columns from both the *left* and *right*.

See also:

DataFrame.merge For column(s)-on-columns(s) operations.

DataFrame.update Modify in place using non-NA values from another DataFrame.

DataFrame.hint Specifies some hint on the current DataFrame.

broadcast Marks a DataFrame as small enough for use in broadcast joins.

Notes

Parameters on, lsuffix, and rsuffix are not supported when passing a list of DataFrame objects.

Examples

```
>>> kdf1 = ks.DataFrame({'key': ['K0', 'K1', 'K2', 'K3'],
...                      'A': ['A0', 'A1', 'A2', 'A3']},
...                     columns=['key', 'A'])
>>> kdf2 = ks.DataFrame({'key': ['K0', 'K1', 'K2'],
...                      'B': ['B0', 'B1', 'B2']},
...                     columns=['key', 'B'])
>>> kdf1
  key   A
0  K0  A0
1  K1  A1
2  K2  A2
3  K3  A3
>>> kdf2
  key   B
0  K0  B0
1  K1  B1
2  K2  B2
```

Join DataFrames using their indexes.

```
>>> join_kdf = kdf1.join(kdf2, lsuffix='_left', rsuffix='_right')
>>> join_kdf.sort_values(by=join_kdf.columns)
  key_left   A key_right     B
0       K0  A0        K0    B0
1       K1  A1        K1    B1
2       K2  A2        K2    B2
3       K3  A3      None  None
```

If we want to join using the key columns, we need to set key to be the index in both df and right. The joined DataFrame will have key as its index.

```
>>> join_kdf = kdf1.set_index('key').join(kdf2.set_index('key'))
>>> join_kdf.sort_values(by=join_kdf.columns)
      A     B
key
K0   A0    B0
K1   A1    B1
K2   A2    B2
K3   A3  None
```

Another option to join using the key columns is to use the on parameter. DataFrame.join always uses right's index but we can use any column in df. This method not preserve the original DataFrame's index in the result unlike pandas.

```
>>> join_kdf = kdf1.join(kdf2.set_index('key'), on='key')
>>> join_kdf.index
Int64Index([0, 1, 2, 3], dtype='int64')
```

databricks.koalas.DataFrame.update

DataFrame.**update**(*other: databricks.koalas.frame.DataFrame*, *join: str = 'left'*, *overwrite: bool = True*) → None

Modify in place using non-NA values from another DataFrame. Aligns on indices. There is no return value.

Parameters

other [DataFrame, or Series]

join [‘left’, default ‘left’] Only left join is implemented, keeping the index and columns of the original object.

overwrite [bool, default True] How to handle non-NA values for overlapping keys:

- True: overwrite original DataFrame’s values with values from *other*.
- False: only update values that are NA in the original DataFrame.

Returns

None [method directly changes calling object]

See also:

DataFrame.merge For column(s)-on-columns(s) operations.

DataFrame.join Join columns of another DataFrame.

DataFrame.hint Specifies some hint on the current DataFrame.

broadcast Marks a DataFrame as small enough for use in broadcast joins.

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 3], 'B': [400, 500, 600]}, columns=['A', 'B'])
>>> new_df = ks.DataFrame({'B': [4, 5, 6], 'C': [7, 8, 9]}, columns=['B', 'C'])
>>> df.update(new_df)
>>> df.sort_index()
   A  B
0  1  4
1  2  5
2  3  6
```

The DataFrame’s length does not increase as a result of the update, only values at matching index/column labels are updated.

```
>>> df = ks.DataFrame({'A': ['a', 'b', 'c'], 'B': ['x', 'y', 'z']}, columns=['A',
↪'B'])
>>> new_df = ks.DataFrame({'B': ['d', 'e', 'f', 'g', 'h', 'i']}, columns=['B'])
>>> df.update(new_df)
>>> df.sort_index()
   A  B
0  a  d
```

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```
1  b  e
2  c  f
```

For Series, it's name attribute must be set.

```
>>> df = ks.DataFrame({'A': ['a', 'b', 'c'], 'B': ['x', 'y', 'z']}, columns=['A',
↪'B'])
>>> new_column = ks.Series(['d', 'e'], name='B', index=[0, 2])
>>> df.update(new_column)
>>> df.sort_index()
   A  B
0  a  d
1  b  y
2  c  e
```

If *other* contains None the corresponding values are not updated in the original dataframe.

```
>>> df = ks.DataFrame({'A': [1, 2, 3], 'B': [400, 500, 600]}, columns=['A', 'B'])
>>> new_df = ks.DataFrame({'B': [4, None, 6]}, columns=['B'])
>>> df.update(new_df)
>>> df.sort_index()
   A      B
0  1    4.0
1  2  500.0
2  3    6.0
```

3.4.12 Time series-related

DataFrame.shift([periods, fill_value])	Shift DataFrame by desired number of periods.
DataFrame.first_valid_index()	Retrieves the index of the first valid value.
DataFrame.last_valid_index()	Return index for last non-NA/null value.

databricks.koalas.DataFrame.shift

DataFrame.**shift**(*periods=1*, *fill_value=None*) → databricks.koalas.frame.DataFrame

Shift DataFrame by desired number of periods.

Note: the current implementation of shift uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int] Number of periods to shift. Can be positive or negative.

fill_value [object, optional] The scalar value to use for newly introduced missing values. The default depends on the dtype of self. For numeric data, np.nan is used.

Returns

Copy of input DataFrame, shifted.

Examples

```
>>> df = ks.DataFrame({'Col1': [10, 20, 15, 30, 45],
...                    'Col2': [13, 23, 18, 33, 48],
...                    'Col3': [17, 27, 22, 37, 52]},
...                   columns=['Col1', 'Col2', 'Col3'])
```

```
>>> df.shift(periods=3)
   Col1  Col2  Col3
0   NaN   NaN   NaN
1   NaN   NaN   NaN
2   NaN   NaN   NaN
3  10.0  13.0  17.0
4  20.0  23.0  27.0
```

```
>>> df.shift(periods=3, fill_value=0)
   Col1  Col2  Col3
0     0     0     0
1     0     0     0
2     0     0     0
3    10    13    17
4    20    23    27
```

databricks.koalas.DataFrame.first_valid_index

DataFrame.**first_valid_index**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Retrieves the index of the first valid value.

Returns

scalar, tuple, or None

Examples

Support for DataFrame

```
>>> kdf = ks.DataFrame({'a': [None, 2, 3, 2],
...                     'b': [None, 2.0, 3.0, 1.0],
...                     'c': [None, 200, 400, 200]},
...                     index=['Q', 'W', 'E', 'R'])
>>> kdf
     a    b      c
Q  NaN  NaN    NaN
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  2.0  1.0  200.0
```

```
>>> kdf.first_valid_index()
'W'
```

Support for MultiIndex columns

```
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
     a    b      c
     x    y      z
Q  NaN  NaN    NaN
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  2.0  1.0  200.0
```

```
>>> kdf.first_valid_index()
'W'
```

Support for Series.

```
>>> s = ks.Series([None, None, 3, 4, 5], index=[100, 200, 300, 400, 500])
>>> s
100    NaN
200    NaN
300    3.0
400    4.0
500    5.0
dtype: float64
```

```
>>> s.first_valid_index()
300
```

Support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([None, None, None, None, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s
lama    speed       NaN
        weight      NaN
        length      NaN
cow     speed       NaN
        weight    250.0
        length      1.5
falcon  speed     320.0
        weight      1.0
        length      0.3
dtype: float64
```

```
>>> s.first_valid_index()
('cow', 'weight')
```

databricks.koalas.DataFrame.last_valid_index

DataFrame.**last_valid_index**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return index for last non-NA/null value.

Returns

scalar, tuple, or None

Notes

This API only works with PySpark >= 3.0.

Examples

Support for DataFrame

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3, None],
...                     'b': [1.0, 2.0, 3.0, None],
...                     'c': [100, 200, 400, None]},
...                     index=['Q', 'W', 'E', 'R'])
>>> kdf
     a    b      c
Q  1.0  1.0  100.0
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  NaN  NaN    NaN
```

```
>>> kdf.last_valid_index()
'E'
```

Support for MultiIndex columns

```
>>> kdf.columns = pd.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> kdf
     a    b      c
     x    y      z
Q  1.0  1.0  100.0
W  2.0  2.0  200.0
E  3.0  3.0  400.0
R  NaN  NaN    NaN
```

```
>>> kdf.last_valid_index()
'E'
```

Support for Series.

```
>>> s = ks.Series([1, 2, 3, None, None], index=[100, 200, 300, 400, 500])
>>> s
100    1.0
200    2.0
300    3.0
400    NaN
```

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```
500    NaN
dtype: float64
```

```
>>> s.last_valid_index()
300
```

Support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 2, 0, 1, 2, 0, 1, 2]])
>>> s = ks.Series([250, 1.5, 320, 1, 0.3, None, None, None, None], index=midx)
>>> s
lama    speed     250.0
        weight      1.5
        length    320.0
cow     speed       1.0
        weight      0.3
        length      NaN
falcon  speed       NaN
        weight      NaN
        length      NaN
dtype: float64
```

```
>>> s.last_valid_index()
('cow', 'weight')
```

3.4.13 Serialization / IO / Conversion

DataFrame.from_records(data[, index, ...])	Convert structured or record ndarray to DataFrame.
DataFrame.info([verbose, buf, max_cols, ...])	Print a concise summary of a DataFrame.
DataFrame.to_table(name[, format, mode, ...])	Write the DataFrame into a Spark table.
DataFrame.to_delta(path[, mode, ...])	Write the DataFrame out as a Delta Lake table.
DataFrame.to_parquet(path[, mode, ...])	Write the DataFrame out as a Parquet file or directory.
DataFrame.to_spark_io([path, format, mode, ...])	Write the DataFrame out to a Spark data source.
DataFrame.to_csv([path, sep, na_rep, ...])	Write object to a comma-separated values (csv) file.
DataFrame.to_pandas()	Return a pandas DataFrame.
DataFrame.to_html([buf, columns, col_space, ...])	Render a DataFrame as an HTML table.
DataFrame.to_numpy()	A NumPy ndarray representing the values in this DataFrame or Series.
DataFrame.to_koalas([index_col])	Converts the existing DataFrame into a Koalas DataFrame.
DataFrame.to_spark([index_col])	Spark related features.
DataFrame.to_string([buf, columns, ...])	Render a DataFrame to a console-friendly tabular output.
DataFrame.to_json([path, compression, ...])	Convert the object to a JSON string.
DataFrame.to_dict([orient, into])	Convert the DataFrame to a dictionary.
DataFrame.to_excel(excel_writer[, ...])	Write object to an Excel sheet.

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DataFrame.to_clipboard([excel, sep])	Copy object to the system clipboard.
DataFrame.to_markdown([buf, mode])	Print Series or DataFrame in Markdown-friendly format.
DataFrame.to_records([index, column_dtypes, ...])	Convert DataFrame to a NumPy record array.
DataFrame.to_latex([buf, columns, ...])	Render an object to a LaTeX tabular environment table.
DataFrame.style	Property returning a Styler object containing methods for building a styled HTML representation for the DataFrame.

databricks.koalas.DataFrame.from_records

static DataFrame.**from_records**(*data: Union[numpy.array, List[tuple], dict, pandas.core.frame.DataFrame]*, *index: Union[str, list, numpy.array] = None*, *exclude: list = None*, *columns: list = None*, *coerce_float: bool = False*, *nrows: int = None*) → databricks.koalas.frame.DataFrame

Convert structured or record ndarray to DataFrame.

Parameters

data [ndarray (structured dtype), list of tuples, dict, or DataFrame]

index [string, list of fields, array-like] Field of array to use as the index, alternately a specific set of input labels to use

exclude [sequence, default None] Columns or fields to exclude

columns [sequence, default None] Column names to use. If the passed data do not have names associated with them, this argument provides names for the columns. Otherwise this argument indicates the order of the columns in the result (any names not found in the data will become all-NA columns)

coerce_float [boolean, default False] Attempt to convert values of non-string, non-numeric objects (like decimal.Decimal) to floating point, useful for SQL result sets

nrows [int, default None] Number of rows to read if data is an iterator

Returns

df [DataFrame]

Examples

Use dict as input

```
>>> ks.DataFrame.from_records({'A': [1, 2, 3]})
   A
0  1
1  2
2  3
```

Use list of tuples as input

```
>>> ks.DataFrame.from_records([(1, 2), (3, 4)])
   0  1
0  1  2
1  3  4
```

Use NumPy array as input

```
>>> ks.DataFrame.from_records(np.eye(3))
     0    1    2
0  1.0  0.0  0.0
1  0.0  1.0  0.0
2  0.0  0.0  1.0
```

databricks.koalas.DataFrame.info

DataFrame.**info**(*verbose=None*, *buf=None*, *max_cols=None*, *null_counts=None*) → None

Print a concise summary of a DataFrame.

This method prints information about a DataFrame including the index dtype and column dtypes, non-null values and memory usage.

Parameters

verbose [bool, optional] Whether to print the full summary.

buf [writable buffer, defaults to sys.stdout] Where to send the output. By default, the output is printed to sys.stdout. Pass a writable buffer if you need to further process the output.

max_cols [int, optional] When to switch from the verbose to the truncated output. If the DataFrame has more than *max_cols* columns, the truncated output is used.

null_counts [bool, optional] Whether to show the non-null counts.

Returns

None This method prints a summary of a DataFrame and returns None.

See also:

DataFrame.describe Generate descriptive statistics of DataFrame columns.

Examples

```
>>> int_values = [1, 2, 3, 4, 5]
>>> text_values = ['alpha', 'beta', 'gamma', 'delta', 'epsilon']
>>> float_values = [0.0, 0.25, 0.5, 0.75, 1.0]
>>> df = ks.DataFrame(
...     {"int_col": int_values, "text_col": text_values, "float_col": float_
↪values},
...     columns=['int_col', 'text_col', 'float_col'])
>>> df
   int_col text_col  float_col
0        1    alpha       0.00
1        2     beta       0.25
2        3    gamma       0.50
3        4    delta       0.75
4        5  epsilon       1.00
```

Prints information of all columns:

```
>>> df.info(verbose=True)
<class 'databricks.koalas.frame.DataFrame'>
Index: 5 entries, 0 to 4
Data columns (total 3 columns):
 #   Column     Non-Null Count  Dtype
---  ------     --------------  -----
 0   int_col    5 non-null      int64
 1   text_col   5 non-null      object
 2   float_col  5 non-null      float64
dtypes: float64(1), int64(1), object(1)
```

Prints a summary of columns count and its dtypes but not per column information:

```
>>> df.info(verbose=False)
<class 'databricks.koalas.frame.DataFrame'>
Index: 5 entries, 0 to 4
Columns: 3 entries, int_col to float_col
dtypes: float64(1), int64(1), object(1)
```

Pipe output of DataFrame.info to buffer instead of sys.stdout, get buffer content and writes to a text file:

```
>>> import io
>>> buffer = io.StringIO()
>>> df.info(buf=buffer)
>>> s = buffer.getvalue()
>>> with open('%s/info.txt' % path, "w",
...           encoding="utf-8") as f:
...     _ = f.write(s)
>>> with open('%s/info.txt' % path) as f:
...     f.readlines()
["<class 'databricks.koalas.frame.DataFrame'>\n",
'Index: 5 entries, 0 to 4\n',
'Data columns (total 3 columns):\n',
' #   Column     Non-Null Count  Dtype  \n',
'---  ------     --------------  -----  \n',
' 0   int_col    5 non-null      int64  \n',
' 1   text_col   5 non-null      object \n',
' 2   float_col  5 non-null      float64\n',
'dtypes: float64(1), int64(1), object(1)']
```

databricks.koalas.DataFrame.to_pandas

DataFrame.**to_pandas**() → pandas.core.frame.DataFrame

Return a pandas DataFrame.

Note: This method should only be used if the resulting pandas DataFrame is expected to be small, as all the data is loaded into the driver's memory.

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'])
>>> df.to_pandas()
   dogs  cats
0   0.2   0.3
1   0.0   0.6
2   0.6   0.0
3   0.2   0.1
```

databricks.koalas.DataFrame.to_numpy

DataFrame.**to_numpy**() → numpy.ndarray

A NumPy ndarray representing the values in this DataFrame or Series.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

Examples

```
>>> ks.DataFrame({"A": [1, 2], "B": [3, 4]}).to_numpy()
array([[1, 3],
       [2, 4]])
```

With heterogeneous data, the lowest common type will have to be used.

```
>>> ks.DataFrame({"A": [1, 2], "B": [3.0, 4.5]}).to_numpy()
array([[1. , 3. ],
       [2. , 4.5]])
```

For a mix of numeric and non-numeric types, the output array will have object dtype.

```
>>> df = ks.DataFrame({"A": [1, 2], "B": [3.0, 4.5], "C": pd.date_range('2000',␣
↪periods=2)})
>>> df.to_numpy()
array([[1, 3.0, Timestamp('2000-01-01 00:00:00')],
       [2, 4.5, Timestamp('2000-01-02 00:00:00')]], dtype=object)
```

For Series,

```
>>> ks.Series(['a', 'b', 'a']).to_numpy()
array(['a', 'b', 'a'], dtype=object)
```

databricks.koalas.DataFrame.to_koalas

DataFrame.**to_koalas**(*index_col: Union[str, List[str], None] = None*) → databricks.koalas.frame.DataFrame

Converts the existing DataFrame into a Koalas DataFrame.

This method is monkey-patched into Spark's DataFrame and can be used to convert a Spark DataFrame into a Koalas DataFrame. If running on an existing Koalas DataFrame, the method returns itself.

If a Koalas DataFrame is converted to a Spark DataFrame and then back to Koalas, it will lose the index information and the original index will be turned into a normal column.

Parameters

index_col: str or list of str, optional, default: None Index column of table in Spark.

See also:

DataFrame.to_spark

Examples

```
>>> df = ks.DataFrame({'col1': [1, 2], 'col2': [3, 4]}, columns=['col1', 'col2'])
>>> df
   col1  col2
0     1     3
1     2     4
```

```
>>> spark_df = df.to_spark()
>>> spark_df
DataFrame[col1: bigint, col2: bigint]
```

```
>>> kdf = spark_df.to_koalas()
>>> kdf
   col1  col2
0     1     3
1     2     4
```

We can specify the index columns.

```
>>> kdf = spark_df.to_koalas(index_col='col1')
>>> kdf
      col2
col1
1        3
2        4
```

Calling to_koalas on a Koalas DataFrame simply returns itself.

```
>>> df.to_koalas()
   col1  col2
0     1     3
1     2     4
```

databricks.koalas.DataFrame.to_spark

DataFrame.**to_spark**(*index_col: Union[str, List[str], None] = None*) → pyspark.sql.dataframe.DataFrame

Spark related features. Usually, the features here are missing in pandas but Spark has it.

databricks.koalas.DataFrame.to_string

DataFrame.**to_string**(*buf=None*, *columns=None*, *col_space=None*, *header=True*, *index=True*, *na_rep='NaN'*, *formatters=None*, *float_format=None*, *sparsify=None*, *index_names=True*, *justify=None*, *max_rows=None*, *max_cols=None*, *show_dimensions=False*, *decimal='.'*, *line_width=None*) → Optional[str]

Render a DataFrame to a console-friendly tabular output.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory. If the input is large, set max_rows parameter.

Parameters

buf [StringIO-like, optional] Buffer to write to.

columns [sequence, optional, default None] The subset of columns to write. Writes all columns by default.

col_space [int, optional] The minimum width of each column.

header [bool, optional] Write out the column names. If a list of strings is given, it is assumed to be aliases for the column names

index [bool, optional, default True] Whether to print index (row) labels.

na_rep [str, optional, default 'NaN'] String representation of NAN to use.

formatters [list or dict of one-param. functions, optional] Formatter functions to apply to columns' elements by position or name. The result of each function must be a unicode string. List must be of length equal to the number of columns.

float_format [one-parameter function, optional, default None] Formatter function to apply to columns' elements if they are floats. The result of this function must be a unicode string.

sparsify [bool, optional, default True] Set to False for a DataFrame with a hierarchical index to print every multiindex key at each row.

index_names [bool, optional, default True] Prints the names of the indexes.

justify [str, default None] How to justify the column labels. If None uses the option from the print configuration (controlled by set_option), 'right' out of the box. Valid values are

- left
- right
- center
- justify
- justify-all
- start
- end

- inherit
- match-parent
- initial
- unset.

max_rows [int, optional] Maximum number of rows to display in the console.

max_cols [int, optional] Maximum number of columns to display in the console.

show_dimensions [bool, default False] Display DataFrame dimensions (number of rows by number of columns).

decimal [str, default '.'] Character recognized as decimal separator, e.g. ',' in Europe.

line_width [int, optional] Width to wrap a line in characters.

Returns

str (or unicode, depending on data and options) String representation of the dataframe.

See also:

to_html Convert DataFrame to HTML.

Examples

```
>>> df = ks.DataFrame({'col1': [1, 2, 3], 'col2': [4, 5, 6]}, columns=['col1',
↪'col2'])
>>> print(df.to_string())
   col1  col2
0     1     4
1     2     5
2     3     6
```

```
>>> print(df.to_string(max_rows=2))
   col1  col2
0     1     4
1     2     5
```

databricks.koalas.DataFrame.to_dict

DataFrame.**to_dict**(*orient='dict'*, *into=<class 'dict'>*) → Union[List, collections.abc.Mapping]

Convert the DataFrame to a dictionary.

The type of the key-value pairs can be customized with the parameters (see below).

Note: This method should only be used if the resulting pandas DataFrame is expected to be small, as all the data is loaded into the driver's memory.

Parameters

orient [str {'dict', 'list', 'series', 'split', 'records', 'index'}] Determines the type of the values of the dictionary.

- 'dict' (default) : dict like {column -> {index -> value}}
- 'list' : dict like {column -> [values]}
- 'series' : dict like {column -> Series(values)}
- 'split' : dict like {'index' -> [index], 'columns' -> [columns], 'data' -> [values]}
- 'records' : list like [{column -> value}, ... , {column -> value}]
- 'index' : dict like {index -> {column -> value}}

Abbreviations are allowed. *s* indicates *series* and *sp* indicates *split*.

into [class, default dict] The collections.abc.Mapping subclass used for all Mappings in the return value. Can be the actual class or an empty instance of the mapping type you want. If you want a collections.defaultdict, you must pass it initialized.

Returns

dict, list or collections.abc.Mapping Return a collections.abc.Mapping object representing the DataFrame. The resulting transformation depends on the *orient* parameter.

Examples

```
>>> df = ks.DataFrame({'col1': [1, 2],
...                    'col2': [0.5, 0.75]},
...                   index=['row1', 'row2'],
...                   columns=['col1', 'col2'])
>>> df
      col1  col2
row1     1  0.50
row2     2  0.75
```

```
>>> df_dict = df.to_dict()
>>> sorted([(key, sorted(values.items())) for key, values in df_dict.items()])
[('col1', [('row1', 1), ('row2', 2)]), ('col2', [('row1', 0.5), ('row2', 0.75)])]
```

You can specify the return orientation.

```
>>> df_dict = df.to_dict('series')
>>> sorted(df_dict.items())
[('col1', row1    1
row2    2
Name: col1, dtype: int64), ('col2', row1    0.50
row2    0.75
Name: col2, dtype: float64)]
```

```
>>> df_dict = df.to_dict('split')
>>> sorted(df_dict.items())
[('columns', ['col1', 'col2']), ('data', [[1..., 0.75]]), ('index', ['row1', 'row2
↪'])]
```

```
>>> df_dict = df.to_dict('records')
>>> [sorted(values.items()) for values in df_dict]
[[('col1', 1...), ('col2', 0.5)], [('col1', 2...), ('col2', 0.75)]]
```

```
>>> df_dict = df.to_dict('index')
>>> sorted([(key, sorted(values.items())) for key, values in df_dict.items()])
[('row1', [('col1', 1), ('col2', 0.5)]), ('row2', [('col1', 2), ('col2', 0.75)])]
```

You can also specify the mapping type.

```
>>> from collections import OrderedDict, defaultdict
>>> df.to_dict(into=OrderedDict)
OrderedDict([('col1', OrderedDict([('row1', 1), ('row2', 2)])), ('col2',␣
↪OrderedDict([('row1', 0.5), ('row2', 0.75)]))])
```

If you want a *defaultdict*, you need to initialize it:

```
>>> dd = defaultdict(list)
>>> df.to_dict('records', into=dd)
[defaultdict(<class 'list'>, {'col..., 'col...}), defaultdict(<class 'list'>, {
↪'col..., 'col...})]
```

databricks.koalas.DataFrame.to_markdown

DataFrame.**to_markdown**(*buf=None*, *mode=None*) → str

Print Series or DataFrame in Markdown-friendly format.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory.

Parameters

buf [writable buffer, defaults to sys.stdout] Where to send the output. By default, the output is printed to sys.stdout. Pass a writable buffer if you need to further process the output.

mode [str, optional] Mode in which file is opened.

****kwargs** These parameters will be passed to *tabulate*.

Returns

str Series or DataFrame in Markdown-friendly format.

Examples

```
>>> kser = ks.Series(["elk", "pig", "dog", "quetzal"], name="animal")
>>> print(kser.to_markdown())
|    | animal   |
|---:|:---------|
|  0 | elk      |
|  1 | pig      |
|  2 | dog      |
|  3 | quetzal  |
```

```
>>> kdf = ks.DataFrame(
...     data={"animal_1": ["elk", "pig"], "animal_2": ["dog", "quetzal"]}
... )
```

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```
>>> print(kdf.to_markdown())
|    | animal_1   | animal_2   |
|---:|:-----------|:-----------|
|  0 | elk        | dog        |
|  1 | pig        | quetzal    |
```

databricks.koalas.DataFrame.to_records

DataFrame.**to_records**(*index=True*, *column_dtypes=None*, *index_dtypes=None*) → numpy.recarray

Convert DataFrame to a NumPy record array.

Index will be included as the first field of the record array if requested.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Parameters

index [bool, default True] Include index in resulting record array, stored in 'index' field or using the index label, if set.

column_dtypes [str, type, dict, default None] If a string or type, the data type to store all columns. If a dictionary, a mapping of column names and indices (zero-indexed) to specific data types.

index_dtypes [str, type, dict, default None] If a string or type, the data type to store all index levels. If a dictionary, a mapping of index level names and indices (zero-indexed) to specific data types. This mapping is applied only if *index=True*.

Returns

numpy.recarray NumPy ndarray with the DataFrame labels as fields and each row of the DataFrame as entries.

See also:

DataFrame.from_records Convert structured or record ndarray to DataFrame.

numpy.recarray An ndarray that allows field access using attributes, analogous to typed columns in a spreadsheet.

Examples

```
>>> df = ks.DataFrame({'A': [1, 2], 'B': [0.5, 0.75]},
...                   index=['a', 'b'])
>>> df
   A     B
a  1  0.50
b  2  0.75
```

```
>>> df.to_records()
rec.array([('a', 1, 0.5 ), ('b', 2, 0.75)],
          dtype=[('index', 'O'), ('A', '<i8'), ('B', '<f8')])
```

The index can be excluded from the record array:

```
>>> df.to_records(index=False)
rec.array([(1, 0.5 ), (2, 0.75)],
          dtype=[('A', '<i8'), ('B', '<f8')])
```

Specification of dtype for columns is new in pandas 0.24.0. Data types can be specified for the columns:

```
>>> df.to_records(column_dtypes={"A": "int32"})
rec.array([('a', 1, 0.5 ), ('b', 2, 0.75)],
          dtype=[('index', 'O'), ('A', '<i4'), ('B', '<f8')])
```

Specification of dtype for index is new in pandas 0.24.0. Data types can also be specified for the index:

```
>>> df.to_records(index_dtypes="<S2")
rec.array([(b'a', 1, 0.5 ), (b'b', 2, 0.75)],
          dtype=[('index', 'S2'), ('A', '<i8'), ('B', '<f8')])
```

databricks.koalas.DataFrame.to_latex

DataFrame.**to_latex**(*buf=None*, *columns=None*, *col_space=None*, *header=True*, *index=True*, *na_rep='NaN'*, *formatters=None*, *float_format=None*, *sparsify=None*, *index_names=True*, *bold_rows=False*, *column_format=None*, *longtable=None*, *escape=None*, *encoding=None*, *decimal='.'*, *multicolumn=None*, *multicolumn_format=None*, *multirow=None*) → Optional[str]

Render an object to a LaTeX tabular environment table.

Render an object to a tabular environment table. You can splice this into a LaTeX document. Requires usepackage{booktabs}.

Note: This method should only be used if the resulting pandas object is expected to be small, as all the data is loaded into the driver's memory. If the input is large, consider alternative formats.

Parameters

buf [file descriptor or None] Buffer to write to. If None, the output is returned as a string.

columns [list of label, optional] The subset of columns to write. Writes all columns by default.

col_space [int, optional] The minimum width of each column.

header [bool or list of str, default True] Write out the column names. If a list of strings is given, it is assumed to be aliases for the column names.

index [bool, default True] Write row names (index).

na_rep [str, default 'NaN'] Missing data representation.

formatters [list of functions or dict of {str: function}, optional] Formatter functions to apply to columns' elements by position or name. The result of each function must be a unicode string. List must be of length equal to the number of columns.

float_format [str, optional] Format string for floating point numbers.

sparsify [bool, optional] Set to False for a DataFrame with a hierarchical index to print every multiindex key at each row. By default, the value will be read from the config module.

index_names [bool, default True] Prints the names of the indexes.

bold_rows [bool, default False] Make the row labels bold in the output.

column_format [str, optional] The columns format as specified in LaTeX table format e.g. 'rcl' for 3 columns. By default, 'l' will be used for all columns except columns of numbers, which default to 'r'.

longtable [bool, optional] By default, the value will be read from the pandas config module. Use a longtable environment instead of tabular. Requires adding a usepackage{longtable} to your LaTeX preamble.

escape [bool, optional] By default, the value will be read from the pandas config module. When set to False prevents from escaping latex special characters in column names.

encoding [str, optional] A string representing the encoding to use in the output file, defaults to 'ascii' on Python 2 and 'utf-8' on Python 3.

decimal [str, default '.'] Character recognized as decimal separator, e.g. ',' in Europe.

multicolumn [bool, default True] Use multicolumn to enhance MultiIndex columns. The default will be read from the config module.

multicolumn_format [str, default 'l'] The alignment for multicolumns, similar to column_format The default will be read from the config module.

multirow [bool, default False] Use multirow to enhance MultiIndex rows. Requires adding a usepackage{multirow} to your LaTeX preamble. Will print centered labels (instead of top-aligned) across the contained rows, separating groups via clines. The default will be read from the pandas config module.

Returns

str or None If buf is None, returns the resulting LateX format as a string. Otherwise returns None.

See also:

DataFrame.to_string Render a DataFrame to a console-friendly tabular output.

DataFrame.to_html Render a DataFrame as an HTML table.

Examples

```
>>> df = ks.DataFrame({'name': ['Raphael', 'Donatello'],
...                    'mask': ['red', 'purple'],
...                    'weapon': ['sai', 'bo staff']},
...                   columns=['name', 'mask', 'weapon'])
>>> df.to_latex(index=False)
'\\begin{tabular}{lll}\n\\toprule\n name & mask & weapon
\\\\\n\\midrule\n Raphael & red & sai \\\\\n Donatello &
purple & bo staff \\\\\n\\bottomrule\n\\end{tabular}\n'
```

databricks.koalas.DataFrame.style

property DataFrame.**style**

Property returning a Styler object containing methods for building a styled HTML representation for the DataFrame.

Note: currently it collects top 1000 rows and return its pandas *pandas.io.formats.style.Styler* instance.

Examples

```
>>> ks.range(1001).style
<pandas.io.formats.style.Styler object at ...>
```

3.4.14 Spark-related

`DataFrame.spark` provides features that does not exist in pandas but in Spark. These can be accessed by `DataFrame.spark.<function/property>`.

DataFrame.spark.schema([index_col])	Returns the underlying Spark schema.
DataFrame.spark.print_schema([index_col])	Prints out the underlying Spark schema in the tree format.
DataFrame.spark.frame([index_col])	Return the current DataFrame as a Spark DataFrame.
DataFrame.spark.cache()	Yields and caches the current DataFrame.
DataFrame.spark.persist([storage_level])	Yields and caches the current DataFrame with a specific StorageLevel.
DataFrame.spark.hint(name, *parameters)	Specifies some hint on the current DataFrame.
DataFrame.spark.to_table(name[, format, ...])	Write the DataFrame into a Spark table.
DataFrame.spark.to_spark_io([path, format, ...])	Write the DataFrame out to a Spark data source.
DataFrame.spark.explain([extended, mode])	Prints the underlying (logical and physical) Spark plans to the console for debugging purpose.
DataFrame.spark.apply(func[, index_col])	Applies a function that takes and returns a Spark DataFrame.
DataFrame.spark.repartition(num_partitions)	Returns a new DataFrame partitioned by the given partitioning expressions.
DataFrame.spark.coalesce(num_partitions)	Returns a new DataFrame that has exactly *num_partitions* partitions.
DataFrame.spark.checkpoint([eager])	Returns a checkpointed version of this DataFrame.
DataFrame.spark.local_checkpoint([eager])	Returns a locally checkpointed version of this DataFrame.

databricks.koalas.DataFrame.spark.schema

spark.**schema**(*index_col: Union[str, List[str], None] = None*) → pyspark.sql.types.StructType
Returns the underlying Spark schema.

Parameters

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

Returns

pyspark.sql.types.StructType The underlying Spark schema.

Examples

```
>>> df = ks.DataFrame({'a': list('abc'),
...                    'b': list(range(1, 4)),
...                    'c': np.arange(3, 6).astype('i1'),
...                    'd': np.arange(4.0, 7.0, dtype='float64'),
...                    'e': [True, False, True],
...                    'f': pd.date_range('20130101', periods=3)},
...                   columns=['a', 'b', 'c', 'd', 'e', 'f'])
>>> df.spark.schema().simpleString()
'struct<a:string,b:bigint,c:tinyint,d:double,e:boolean,f:timestamp>'
>>> df.spark.schema(index_col='index').simpleString()
'struct<index:bigint,a:string,b:bigint,c:tinyint,d:double,e:boolean,f:timestamp>'
```

databricks.koalas.DataFrame.spark.print_schema

spark.**print_schema**(*index_col: Union[str, List[str], None] = None*) → None
Prints out the underlying Spark schema in the tree format.

Parameters

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

Returns

None

Examples

```
>>> df = ks.DataFrame({'a': list('abc'),
...                    'b': list(range(1, 4)),
...                    'c': np.arange(3, 6).astype('i1'),
...                    'd': np.arange(4.0, 7.0, dtype='float64'),
...                    'e': [True, False, True],
...                    'f': pd.date_range('20130101', periods=3)},
...                   columns=['a', 'b', 'c', 'd', 'e', 'f'])
>>> df.spark.print_schema()
root
 |-- a: string (nullable = false)
```

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```
 |-- b: long (nullable = false)
 |-- c: byte (nullable = false)
 |-- d: double (nullable = false)
 |-- e: boolean (nullable = false)
 |-- f: timestamp (nullable = false)
>>> df.spark.print_schema(index_col='index')
root
 |-- index: long (nullable = false)
 |-- a: string (nullable = false)
 |-- b: long (nullable = false)
 |-- c: byte (nullable = false)
 |-- d: double (nullable = false)
 |-- e: boolean (nullable = false)
 |-- f: timestamp (nullable = false)
```

databricks.koalas.DataFrame.spark.frame

`spark.frame`(*index_col: Union[str, List[str], None] = None*) → pyspark.sql.dataframe.DataFrame

Return the current DataFrame as a Spark DataFrame. `DataFrame.spark.frame()` is an alias of `DataFrame.to_spark()`.

Parameters

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

See also:

`DataFrame.to_spark`

`DataFrame.to_koalas`

`DataFrame.spark.frame`

Examples

By default, this method loses the index as below.

```
>>> df = ks.DataFrame({'a': [1, 2, 3], 'b': [4, 5, 6], 'c': [7, 8, 9]})
>>> df.to_spark().show()
+---+---+---+
|  a|  b|  c|
+---+---+---+
|  1|  4|  7|
|  2|  5|  8|
|  3|  6|  9|
+---+---+---+
```

```
>>> df = ks.DataFrame({'a': [1, 2, 3], 'b': [4, 5, 6], 'c': [7, 8, 9]})
>>> df.spark.frame().show()
+---+---+---+
|  a|  b|  c|
+---+---+---+
|  1|  4|  7|
```

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```
|  2|  5|  8|
|  3|  6|  9|
+---+---+---+
```

If *index_col* is set, it keeps the index column as specified.

```
>>> df.to_spark(index_col="index").show()
+-----+---+---+---+
|index|  a|  b|  c|
+-----+---+---+---+
|    0|  1|  4|  7|
|    1|  2|  5|  8|
|    2|  3|  6|  9|
+-----+---+---+---+
```

Keeping index column is useful when you want to call some Spark APIs and convert it back to Koalas DataFrame without creating a default index, which can affect performance.

```
>>> spark_df = df.to_spark(index_col="index")
>>> spark_df = spark_df.filter("a == 2")
>>> spark_df.to_koalas(index_col="index")
       a  b  c
index
1      2  5  8
```

In case of multi-index, specify a list to *index_col*.

```
>>> new_df = df.set_index("a", append=True)
>>> new_spark_df = new_df.to_spark(index_col=["index_1", "index_2"])
>>> new_spark_df.show()
+-------+-------+---+---+
|index_1|index_2|  b|  c|
+-------+-------+---+---+
|      0|      1|  4|  7|
|      1|      2|  5|  8|
|      2|      3|  6|  9|
+-------+-------+---+---+
```

Likewise, can be converted to back to Koalas DataFrame.

```
>>> new_spark_df.to_koalas(
...     index_col=["index_1", "index_2"])
                   b  c
index_1 index_2
0       1          4  7
1       2          5  8
2       3          6  9
```

databricks.koalas.DataFrame.spark.cache

spark.**cache**() → CachedDataFrame

Yields and caches the current DataFrame.

The Koalas DataFrame is yielded as a protected resource and its corresponding data is cached which gets uncached after execution goes of the context.

If you want to specify the StorageLevel manually, use `DataFrame.spark.persist()`

See also:

DataFrame.spark.persist

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'])
>>> df
   dogs  cats
0   0.2   0.3
1   0.0   0.6
2   0.6   0.0
3   0.2   0.1
```

```
>>> with df.spark.cache() as cached_df:
...     print(cached_df.count())
...
dogs    4
cats    4
dtype: int64
```

```
>>> df = df.spark.cache()
>>> df.to_pandas().mean(axis=1)
0    0.25
1    0.30
2    0.30
3    0.15
dtype: float64
```

To uncache the dataframe, use *unpersist* function

```
>>> df.spark.unpersist()
```

databricks.koalas.DataFrame.spark.persist

spark.**persist**(*storage_level: pyspark.storagelevel.StorageLevel = StorageLevel(True, True, False, False, 1)*) → CachedDataFrame

Yields and caches the current DataFrame with a specific StorageLevel. If a StogeLevel is not given, the *MEMORY_AND_DISK* level is used by default like PySpark.

The Koalas DataFrame is yielded as a protected resource and its corresponding data is cached which gets uncached after execution goes of the context.

See also:

DataFrame.spark.cache

Examples

```
>>> import pyspark
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'])
>>> df
   dogs  cats
0   0.2   0.3
1   0.0   0.6
2   0.6   0.0
3   0.2   0.1
```

Set the StorageLevel to *MEMORY_ONLY*.

```
>>> with df.spark.persist(pyspark.StorageLevel.MEMORY_ONLY) as cached_df:
...     print(cached_df.spark.storage_level)
...     print(cached_df.count())
...
Memory Serialized 1x Replicated
dogs    4
cats    4
dtype: int64
```

Set the StorageLevel to *DISK_ONLY*.

```
>>> with df.spark.persist(pyspark.StorageLevel.DISK_ONLY) as cached_df:
...     print(cached_df.spark.storage_level)
...     print(cached_df.count())
...
Disk Serialized 1x Replicated
dogs    4
cats    4
dtype: int64
```

If a StorageLevel is not given, it uses *MEMORY_AND_DISK* by default.

```
>>> with df.spark.persist() as cached_df:
...     print(cached_df.spark.storage_level)
...     print(cached_df.count())
...
Disk Memory Serialized 1x Replicated
dogs    4
cats    4
dtype: int64
```

```
>>> df = df.spark.persist()
>>> df.to_pandas().mean(axis=1)
0    0.25
1    0.30
2    0.30
3    0.15
dtype: float64
```

To uncache the dataframe, use *unpersist* function

```
>>> df.spark.unpersist()
```

databricks.koalas.DataFrame.spark.hint

`spark.hint`(*name: str*, **parameters*) → ks.DataFrame

Specifies some hint on the current DataFrame.

Parameters

name [A name of the hint.]

parameters [Optional parameters.]

Returns

ret [DataFrame with the hint.]

See also:

broadcast Marks a DataFrame as small enough for use in broadcast joins.

Examples

```
>>> df1 = ks.DataFrame({'lkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [1, 2, 3, 5]},
...                    columns=['lkey', 'value']).set_index('lkey')
>>> df2 = ks.DataFrame({'rkey': ['foo', 'bar', 'baz', 'foo'],
...                     'value': [5, 6, 7, 8]},
...                    columns=['rkey', 'value']).set_index('rkey')
>>> merged = df1.merge(df2.spark.hint("broadcast"), left_index=True, right_
↪index=True)
>>> merged.spark.explain()
== Physical Plan ==
...
...BroadcastHashJoin...
...
```

databricks.koalas.DataFrame.spark.to_table

`spark.to_table`(*name: str*, *format: Optional[str] = None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame into a Spark table. `DataFrame.spark.to_table()` is an alias of `DataFrame.to_table()`.

Parameters

name [str, required] Table name in Spark.

format [string, optional] Specifies the output data source format. Some common ones are:

- 'delta'
- 'parquet'
- 'orc'
- 'json'

- 'csv'

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'}, default] 'overwrite'. Specifies the behavior of the save operation when the table exists already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional, default None] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options Additional options passed directly to Spark.

Returns

None

See also:

read_table

DataFrame.to_spark_io

DataFrame.spark.to_spark_io

DataFrame.to_parquet

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

```
>>> df.to_table('%s.my_table' % db, partition_cols='date')
```

databricks.koalas.DataFrame.spark.to_spark_io

spark.**to_spark_io**(*path: Optional[str] = None*, *format: Optional[str] = None*, *mode: str = 'overwrite'*, *partition_cols: Union[str, List[str], None] = None*, *index_col: Union[str, List[str], None] = None*, ***options*) → None

Write the DataFrame out to a Spark data source. `DataFrame.spark.to_spark_io()` is an alias of `DataFrame.to_spark_io()`.

Parameters

path [string, optional] Path to the data source.

format [string, optional] Specifies the output data source format. Some common ones are:

- 'delta'
- 'parquet'
- 'orc'
- 'json'
- 'csv'

mode [str {'append', 'overwrite', 'ignore', 'error', 'errorifexists'}, default] 'overwrite'. Specifies the behavior of the save operation when data already.

- 'append': Append the new data to existing data.
- 'overwrite': Overwrite existing data.
- 'ignore': Silently ignore this operation if data already exists.
- 'error' or 'errorifexists': Throw an exception if data already exists.

partition_cols [str or list of str, optional] Names of partitioning columns

index_col: str or list of str, optional, default: None Column names to be used in Spark to represent Koalas' index. The index name in Koalas is ignored. By default, the index is always lost.

options [dict] All other options passed directly into Spark's data source.

Returns

None

See also:

read_spark_io

DataFrame.to_delta

DataFrame.to_parquet

DataFrame.to_table

DataFrame.to_spark_io

DataFrame.spark.to_spark_io

Examples

```
>>> df = ks.DataFrame(dict(
...    date=list(pd.date_range('2012-1-1 12:00:00', periods=3, freq='M')),
...    country=['KR', 'US', 'JP'],
...    code=[1, 2 ,3]), columns=['date', 'country', 'code'])
>>> df
                 date country  code
0 2012-01-31 12:00:00      KR     1
1 2012-02-29 12:00:00      US     2
2 2012-03-31 12:00:00      JP     3
```

```
>>> df.to_spark_io(path='%s/to_spark_io/foo.json' % path, format='json')
```

databricks.koalas.DataFrame.spark.explain

spark.**explain**(*extended: Optional[bool] = None*, *mode: Optional[str] = None*) → None

Prints the underlying (logical and physical) Spark plans to the console for debugging purpose.

Parameters

extended [boolean, default `False`.] If `False`, prints only the physical plan.

mode [string, default `None`.] The expected output format of plans.

Returns

None

Examples

```
>>> df = ks.DataFrame({'id': range(10)})
>>> df.spark.explain()
== Physical Plan ==
...
```

```
>>> df.spark.explain(True)
== Parsed Logical Plan ==
...
== Analyzed Logical Plan ==
...
== Optimized Logical Plan ==
...
== Physical Plan ==
...
```

```
>>> df.spark.explain("extended")
== Parsed Logical Plan ==
...
== Analyzed Logical Plan ==
...
== Optimized Logical Plan ==
...
== Physical Plan ==
...
```

```
>>> df.spark.explain(mode="extended")
== Parsed Logical Plan ==
...
== Analyzed Logical Plan ==
...
== Optimized Logical Plan ==
...
== Physical Plan ==
...
```

databricks.koalas.DataFrame.spark.apply

spark.**apply**(*func*, *index_col: Union[str, List[str], None] = None*) → ks.DataFrame

Applies a function that takes and returns a Spark DataFrame. It allows natively apply a Spark function and column APIs with the Spark column internally used in Series or Index.

Note: set *index_col* and keep the column named as so in the output Spark DataFrame to avoid using the default index to prevent performance penalty. If you omit *index_col*, it will use default index which is potentially expensive in general.

Note: it will lose column labels. This is a synonym of `func(kdf.to_spark(index_col)).to_koalas(index_col)`.

Parameters

func [function] Function to apply the function against the data by using Spark DataFrame.

Returns

DataFrame

Raises

ValueError [If the output from the function is not a Spark DataFrame.]

Examples

```
>>> kdf = ks.DataFrame({"a": [1, 2, 3], "b": [4, 5, 6]}, columns=["a", "b"])
>>> kdf
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> kdf.spark.apply(
...     lambda sdf: sdf.selectExpr("a + b as c", "index"), index_col="index")
...
       c
index
0      5
1      7
2      9
```

The case below ends up with using the default index, which should be avoided if possible.

```
>>> kdf.spark.apply(lambda sdf: sdf.groupby("a").count().sort("a"))
   a  count
0  1      1
1  2      1
2  3      1
```

databricks.koalas.DataFrame.spark.repartition

spark.**repartition**(*num_partitions: int*) → ks.DataFrame

Returns a new DataFrame partitioned by the given partitioning expressions. The resulting DataFrame is hash partitioned.

Parameters

num_partitions [int] The target number of partitions.

Returns

DataFrame

Examples

```
>>> kdf = ks.DataFrame({"age": [5, 5, 2, 2],
...                     "name": ["Bob", "Bob", "Alice", "Alice"]}).set_index("age")
>>> kdf.sort_index()
      name
age
2    Alice
2    Alice
5      Bob
5      Bob
>>> new_kdf = kdf.spark.repartition(7)
>>> new_kdf.to_spark().rdd.getNumPartitions()
7
>>> new_kdf.sort_index()
      name
age
2    Alice
2    Alice
5      Bob
5      Bob
```

databricks.koalas.DataFrame.spark.coalesce

spark.**coalesce**(*num_partitions: int*) → ks.DataFrame

Returns a new DataFrame that has exactly *num_partitions* partitions.

Note: This operation results in a narrow dependency, e.g. if you go from 1000 partitions to 100 partitions, there will not be a shuffle, instead each of the 100 new partitions will claim 10 of the current partitions. If a larger number of partitions is requested, it will stay at the current number of partitions. However, if you're doing a drastic coalesce, e.g. to num_partitions = 1, this may result in your computation taking place on fewer nodes than you like (e.g. one node in the case of num_partitions = 1). To avoid this, you can call repartition(). This will add a shuffle step, but means the current upstream partitions will be executed in parallel (per whatever the current partitioning is).

Parameters

num_partitions [int] The target number of partitions.

Returns

DataFrame

Examples

```
>>> kdf = ks.DataFrame({"age": [5, 5, 2, 2],
...                     "name": ["Bob", "Bob", "Alice", "Alice"]}).set_index("age")
>>> kdf.sort_index()
      name
age
2    Alice
2    Alice
5      Bob
5      Bob
>>> new_kdf = kdf.spark.coalesce(1)
>>> new_kdf.to_spark().rdd.getNumPartitions()
1
>>> new_kdf.sort_index()
      name
age
2    Alice
2    Alice
5      Bob
5      Bob
```

databricks.koalas.DataFrame.spark.checkpoint

`spark.`**`checkpoint`**(*eager: bool = True*) → ks.DataFrame

Returns a checkpointed version of this DataFrame.

Checkpointing can be used to truncate the logical plan of this DataFrame, which is especially useful in iterative algorithms where the plan may grow exponentially. It will be saved to files inside the checkpoint directory set with *SparkContext.setCheckpointDir*.

Parameters

eager [bool] Whether to checkpoint this DataFrame immediately

Returns

DataFrame

Examples

```
>>> kdf = ks.DataFrame({"a": ["a", "b", "c"]})
>>> kdf
   a
0  a
1  b
2  c
>>> new_kdf = kdf.spark.checkpoint()
>>> new_kdf
   a
0  a
1  b
2  c
```

databricks.koalas.DataFrame.spark.local_checkpoint

spark.**local_checkpoint**(*eager: bool = True*) → ks.DataFrame
Returns a locally checkpointed version of this DataFrame.

Checkpointing can be used to truncate the logical plan of this DataFrame, which is especially useful in iterative algorithms where the plan may grow exponentially. Local checkpoints are stored in the executors using the caching subsystem and therefore they are not reliable.

Parameters

eager [bool] Whether to locally checkpoint this DataFrame immediately

Returns

DataFrame

Examples

```
>>> kdf = ks.DataFrame({"a": ["a", "b", "c"]})
>>> kdf
   a
0  a
1  b
2  c
>>> new_kdf = kdf.spark.local_checkpoint()
>>> new_kdf
   a
0  a
1  b
2  c
```

3.4.15 Plotting

`DataFrame.plot` is both a callable method and a namespace attribute for specific plotting methods of the form `DataFrame.plot.<kind>`.

DataFrame.plot	alias of `databricks.koalas.plot.core.KoalasPlotAccessor`
DataFrame.plot.area([x, y, stacked])	Draw a stacked area plot.
DataFrame.plot.barh([x, y])	Make a horizontal bar plot.
DataFrame.plot.bar([x, y])	Vertical bar plot.
DataFrame.plot.hist([bins])	Draw one histogram of the DataFrame's columns.
DataFrame.plot.line([x, y])	Plot DataFrame/Series as lines.
DataFrame.plot.pie([y])	Generate a pie plot.
DataFrame.plot.scatter(x, y[, s, c])	Create a scatter plot with varying marker point size and color.
DataFrame.plot.density([bw_method, ind])	Generate Kernel Density Estimate plot using Gaussian kernels.
DataFrame.hist([bins])	Draw one histogram of the DataFrame's columns.
DataFrame.kde([bw_method, ind])	Generate Kernel Density Estimate plot using Gaussian kernels.

databricks.koalas.DataFrame.plot

databricks.koalas.DataFrame.**plot**
alias of databricks.koalas.plot.core.KoalasPlotAccessor

databricks.koalas.DataFrame.plot.area

plot.**area**(*x=None*, *y=None*, *stacked=True*, ***kwds*)
Draw a stacked area plot.

An area plot displays quantitative data visually. This function wraps the matplotlib area function.

Parameters

x [label or position, optional] Coordinates for the X axis. By default uses the index.

y [label or position, optional] Column to plot. By default uses all columns.

stacked [bool, default True] Area plots are stacked by default. Set to False to create a unstacked plot.

****kwds** [optional] Additional keyword arguments are documented in DataFrame.plot().

Returns

axes [matplotlib.axes.Axes or numpy.ndarray] Return an ndarray when subplots=True. Return an custom object when backend!=matplotlib.

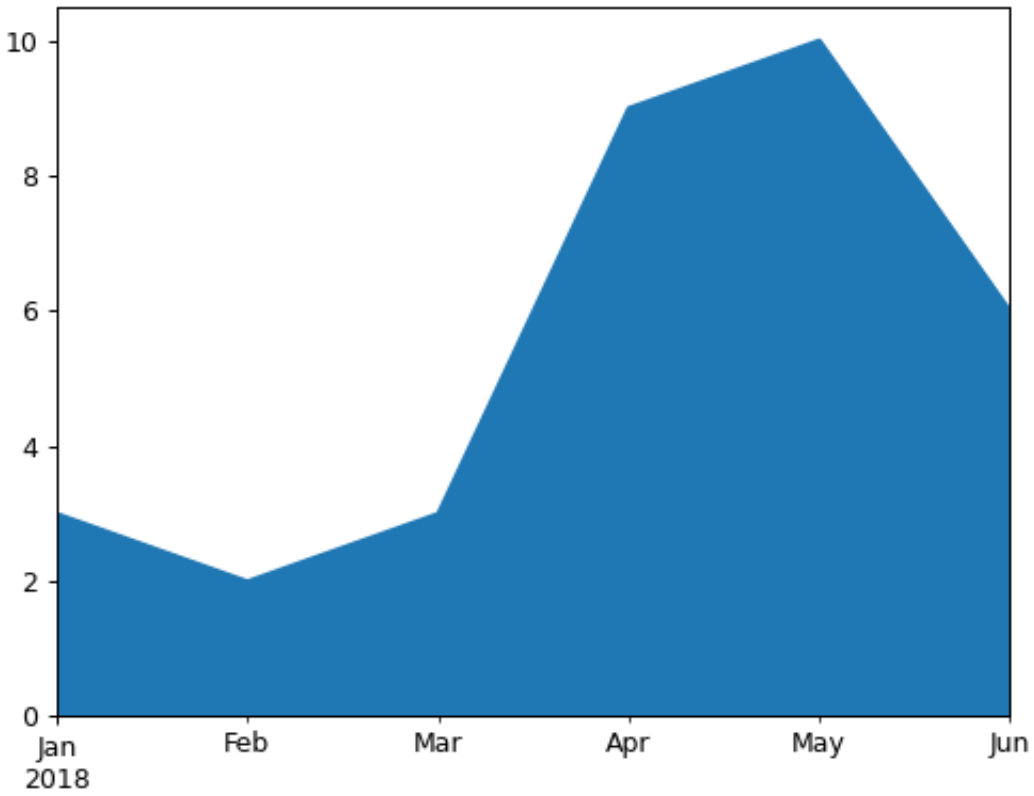
Examples

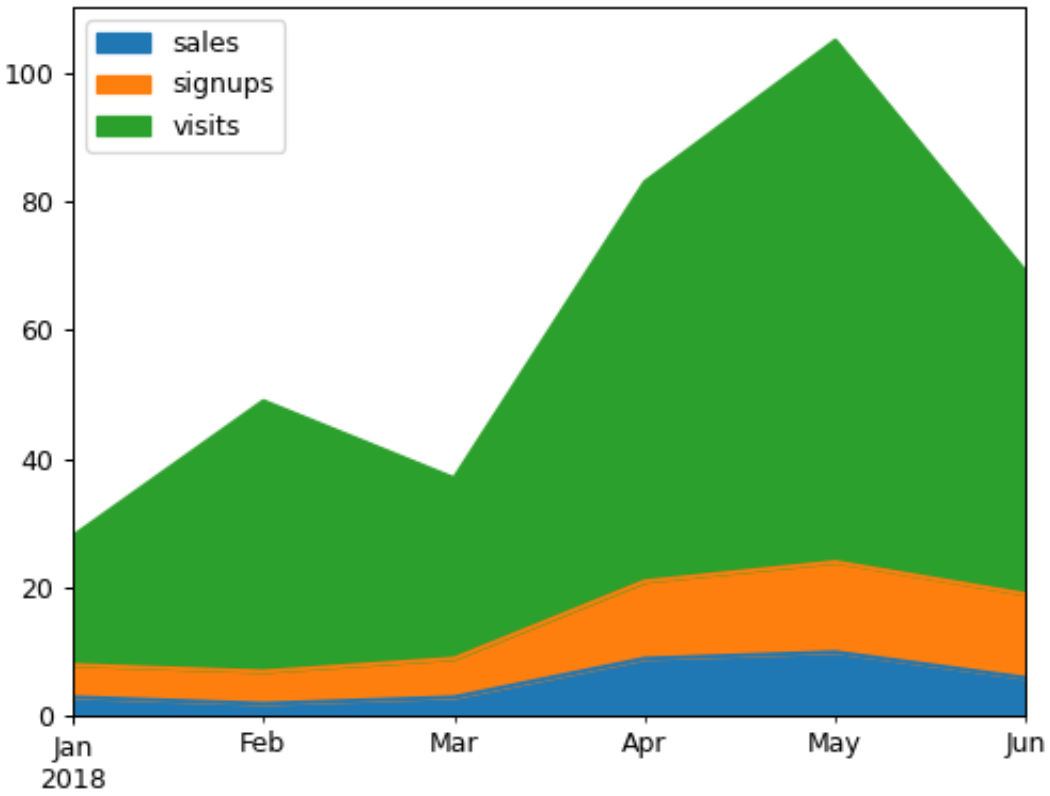
For Series

```
>>> df = ks.DataFrame({
...     'sales': [3, 2, 3, 9, 10, 6],
...     'signups': [5, 5, 6, 12, 14, 13],
...     'visits': [20, 42, 28, 62, 81, 50],
... }, index=pd.date_range(start='2018/01/01', end='2018/07/01',
...                        freq='M'))
>>> plot = df.sales.plot.area()
```

For DataFrame

```
>>> df = ks.DataFrame({
...     'sales': [3, 2, 3, 9, 10, 6],
...     'signups': [5, 5, 6, 12, 14, 13],
...     'visits': [20, 42, 28, 62, 81, 50],
... }, index=pd.date_range(start='2018/01/01', end='2018/07/01',
...                        freq='M'))
>>> plot = df.plot.area()
```


10
8
6
4
2
0
Jan
2018
Feb
Mar
Apr
May
Jun


sales
signups
visits
100
80
60
40
20
0
Jan
2018
Feb
Mar
Apr
May
Jun

databricks.koalas.DataFrame.plot.barh

plot.**barh**(*x=None*, *y=None*, ***kwargs*)

Make a horizontal bar plot.

A horizontal bar plot is a plot that presents quantitative data with rectangular bars with lengths proportional to the values that they represent. A bar plot shows comparisons among discrete categories. One axis of the plot shows the specific categories being compared, and the other axis represents a measured value.

Parameters

x [label or position, default DataFrame.index] Column to be used for categories.

y [label or position, default All numeric columns in dataframe] Columns to be plotted from the DataFrame.

****kwds** Keyword arguments to pass on to *databricks.koalas.DataFrame.plot()* or *databricks.koalas.Series.plot()*.

Returns

matplotlib.axes.Axes or numpy.ndarray of them

See also:

matplotlib.axes.Axes.bar Plot a vertical bar plot using matplotlib.

Examples

For Series:

```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> plot = df.val.plot.barh()
```

For DataFrame:

```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> ax = df.plot.barh(x='lab', y='val')
```

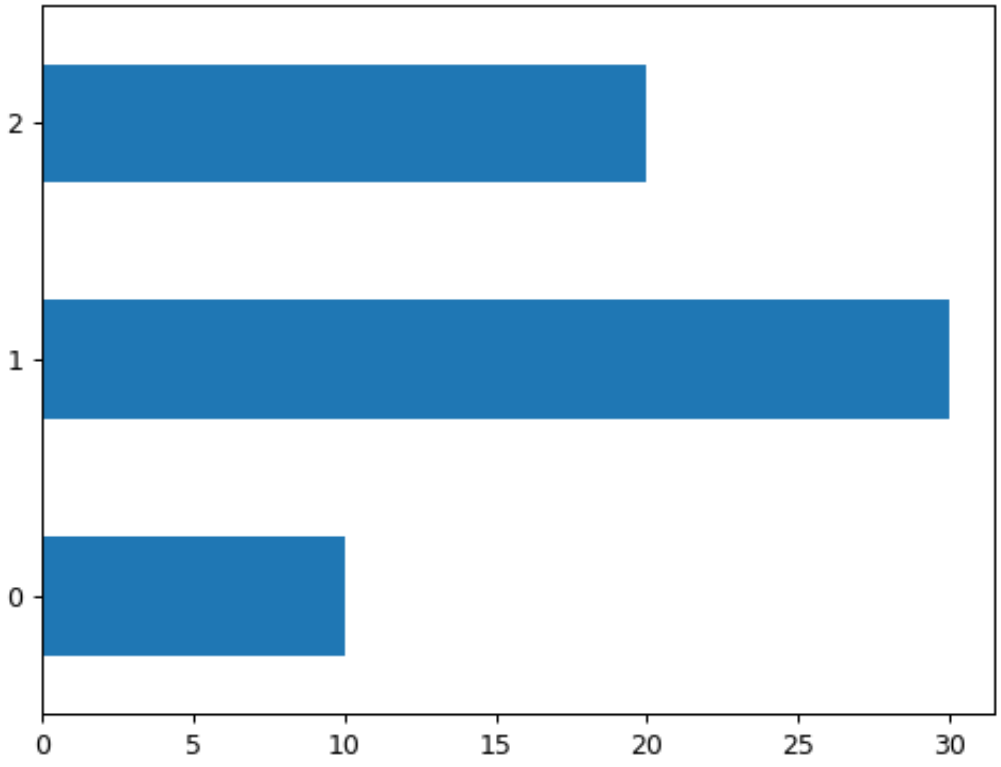
Plot a whole DataFrame to a horizontal bar plot

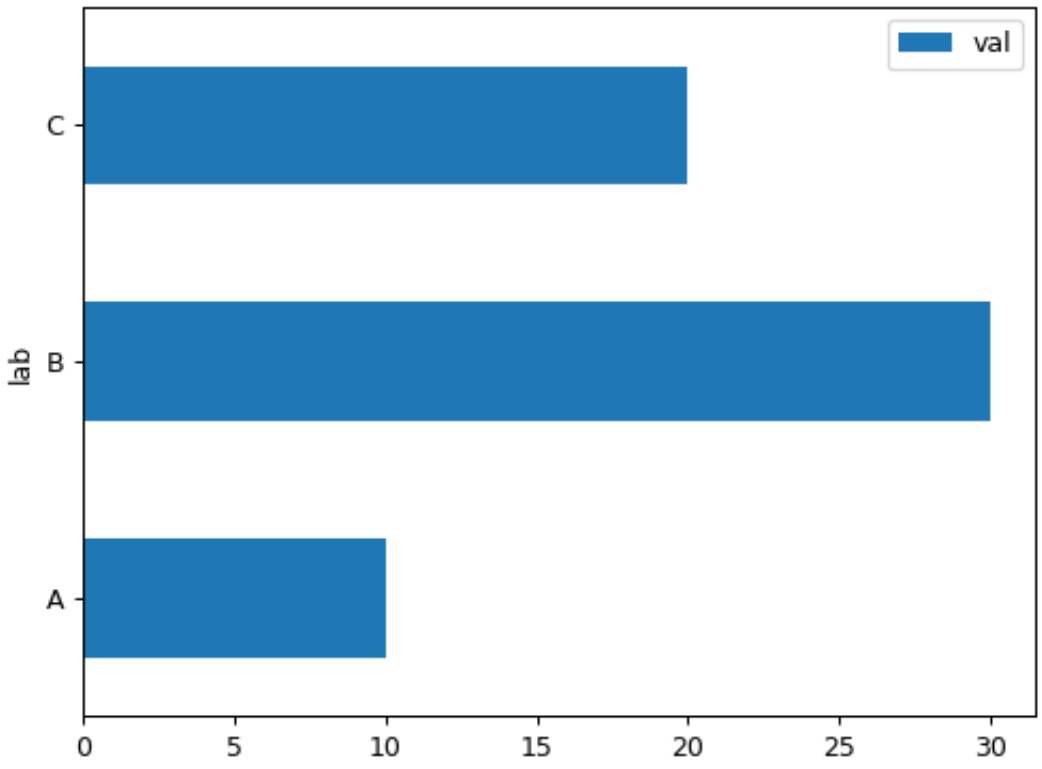
```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh()
```

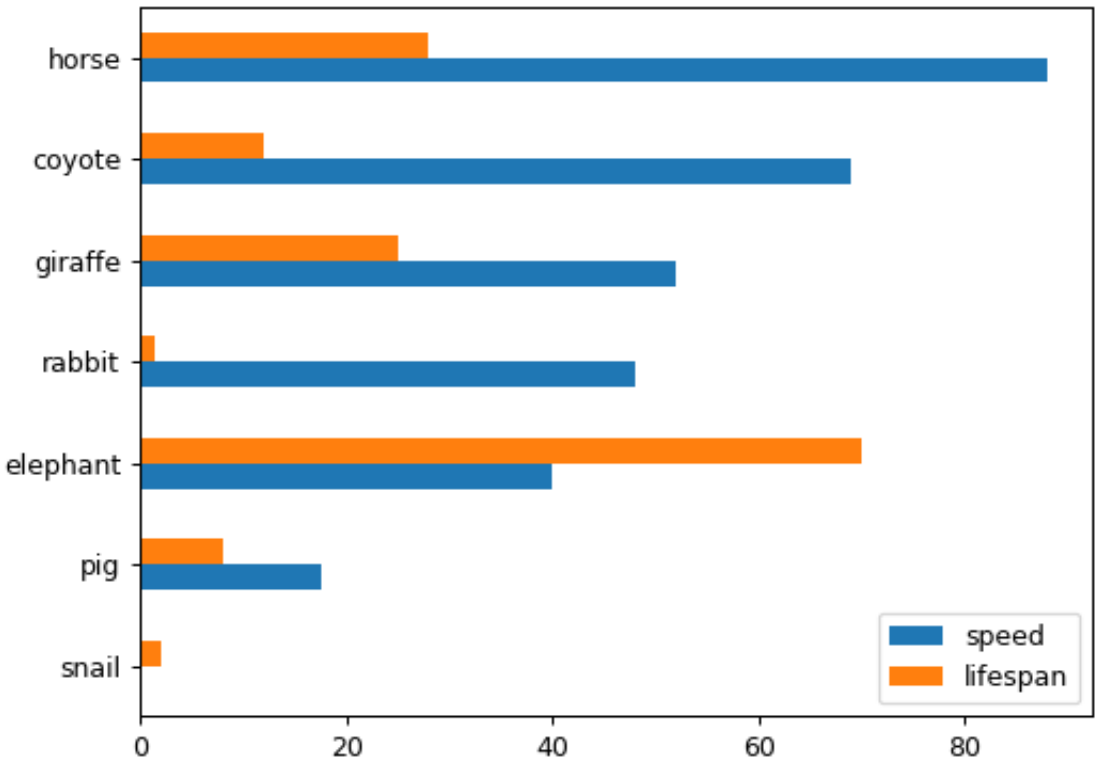
Plot a column of the DataFrame to a horizontal bar plot

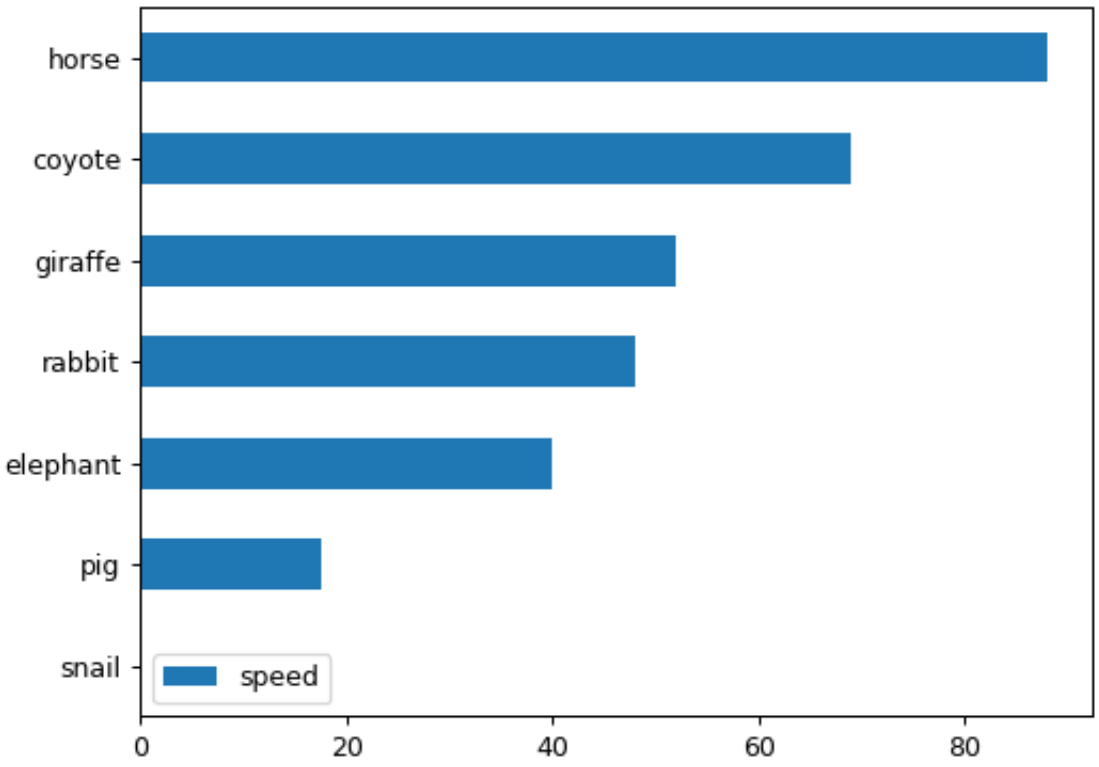
```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh(y='speed')
```

Plot DataFrame versus the desired column

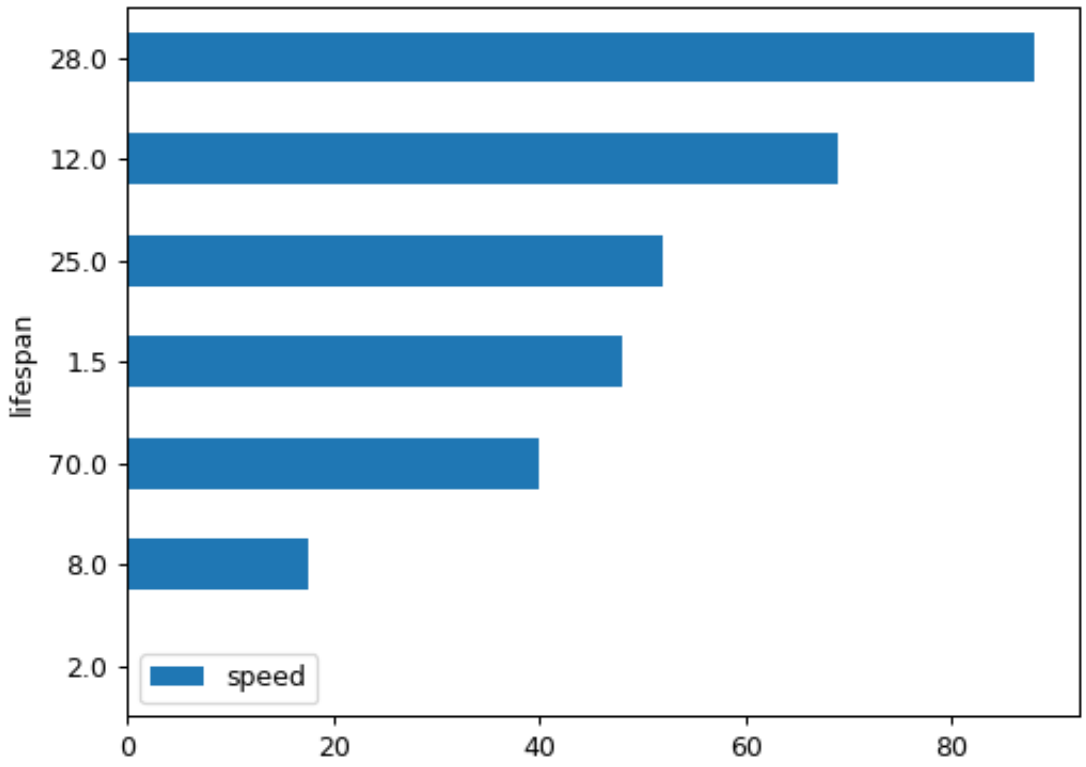

2
1
0
0
5
10
15
20
25
30


val
C
B
A
lab
0
5
10
15
20
25
30


horse
coyote
giraffe
rabbit
elephant
pig
snail
0
20
40
60
80
speed
lifespan


horse
coyote
giraffe
rabbit
elephant
pig
snail
speed
0
20
40
60
80

```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.barh(x='lifespan')
```



databricks.koalas.DataFrame.plot.bar

`plot.bar(x=None, y=None, **kwds)`

Vertical bar plot.

Parameters

x [label or position, optional] Allows plotting of one column versus another. If not specified, the index of the DataFrame is used.

y [label or position, optional] Allows plotting of one column versus another. If not specified, all numerical columns are used.

****kwds** [optional] Additional keyword arguments are documented in `Koalas.Series.plot()` or `Koalas.DataFrame.plot()`.

Returns

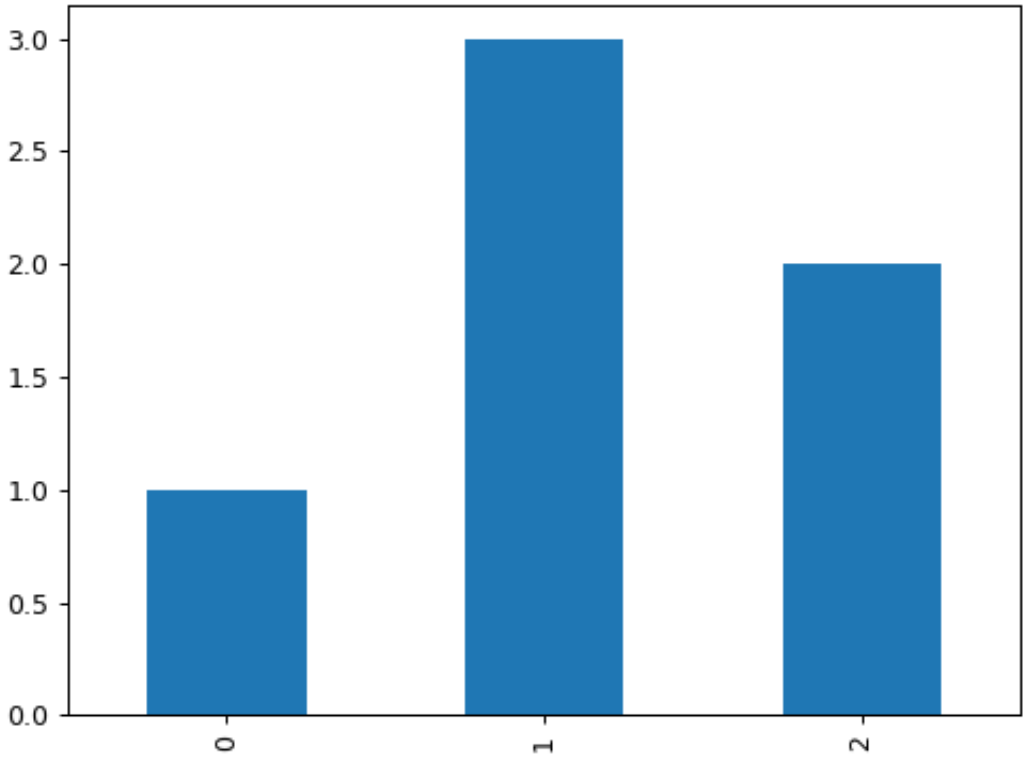
axes [matplotlib.axes.Axes or numpy.ndarray] Return an ndarray when subplots=True. Return an custom object when backend!=matplotlib.

Examples

Basic plot.

For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.bar()
```



For DataFrame:

```
>>> df = ks.DataFrame({'lab': ['A', 'B', 'C'], 'val': [10, 30, 20]})
>>> ax = df.plot.bar(x='lab', y='val', rot=0)
```

Plot a whole dataframe to a bar plot. Each column is assigned a distinct color, and each row is nested in a group along the horizontal axis.

```
>>> speed = [0.1, 17.5, 40, 48, 52, 69, 88]
>>> lifespan = [2, 8, 70, 1.5, 25, 12, 28]
>>> index = ['snail', 'pig', 'elephant',
...          'rabbit', 'giraffe', 'coyote', 'horse']
```

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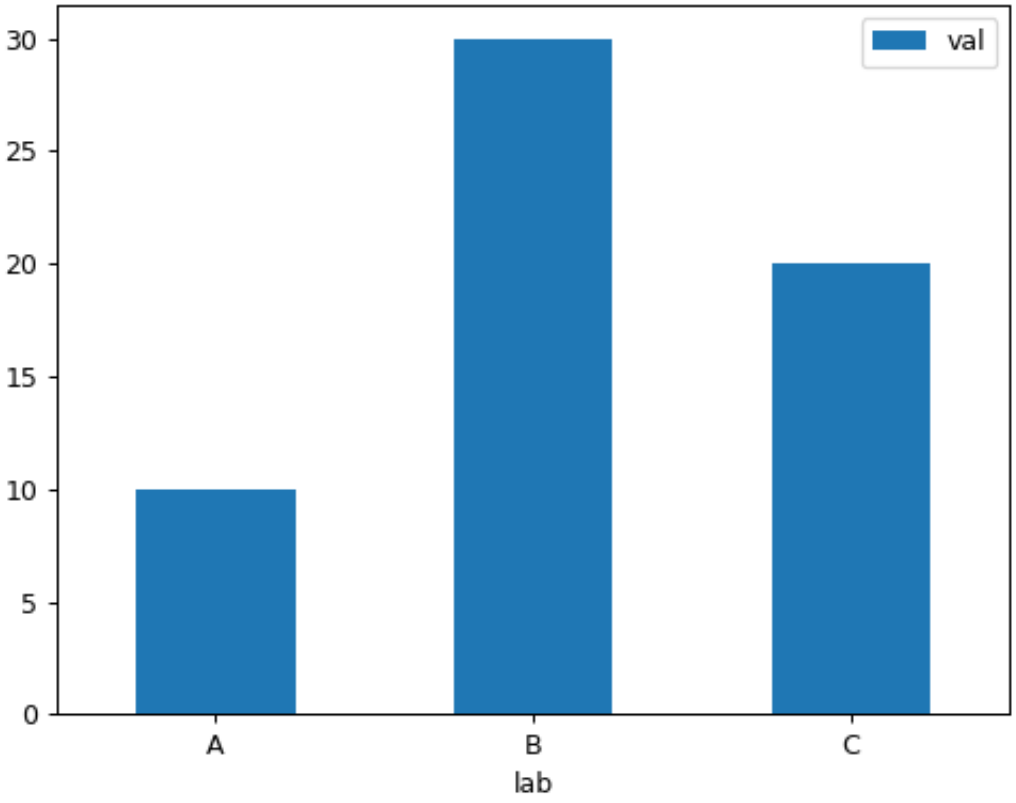
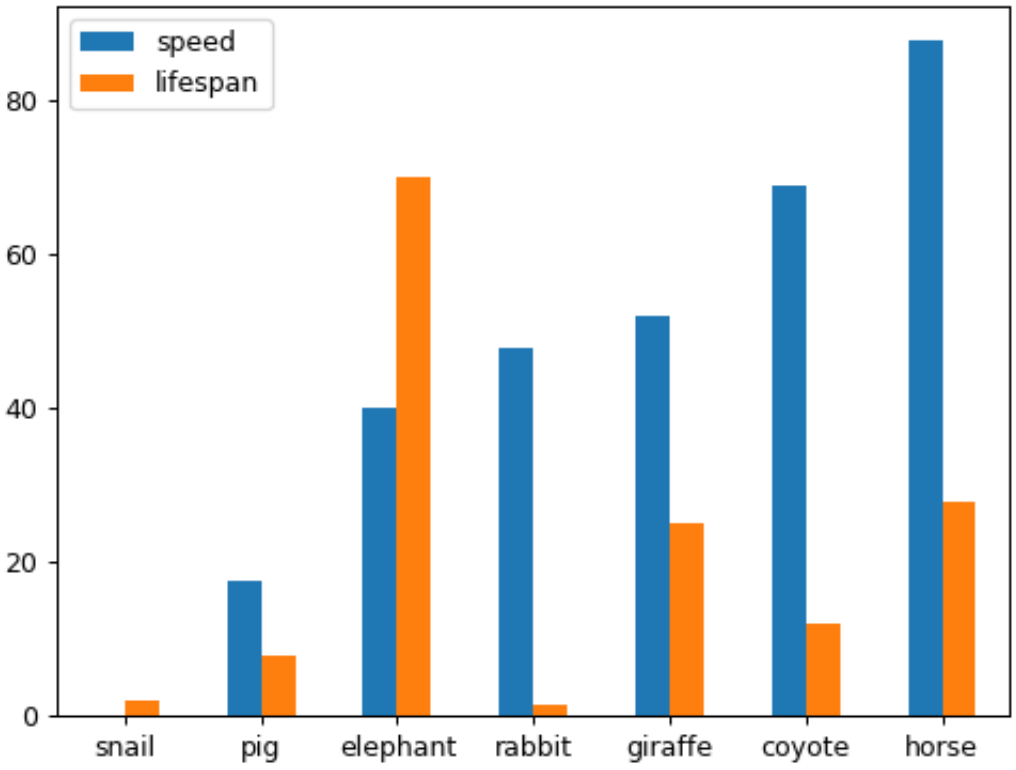

val
30
25
20
15
10
5
0
A
B
C
lab

(continued from previous page)

```
>>> df = ks.DataFrame({'speed': speed,
...                    'lifespan': lifespan}, index=index)
>>> ax = df.plot.bar(rot=0)
```



Instead of nesting, the figure can be split by column with `subplots=True`. In this case, a `numpy.ndarray` of `matplotlib.axes.Axes` are returned.

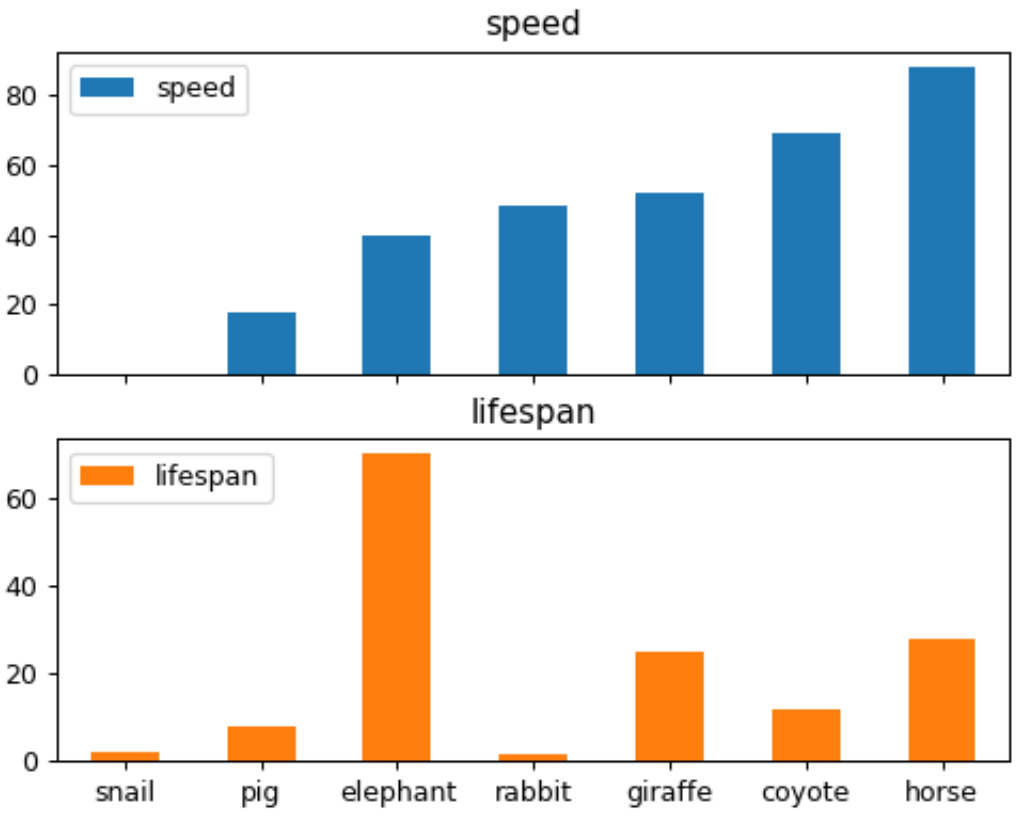
```
>>> axes = df.plot.bar(rot=0, subplots=True)
>>> axes[1].legend(loc=2)
```

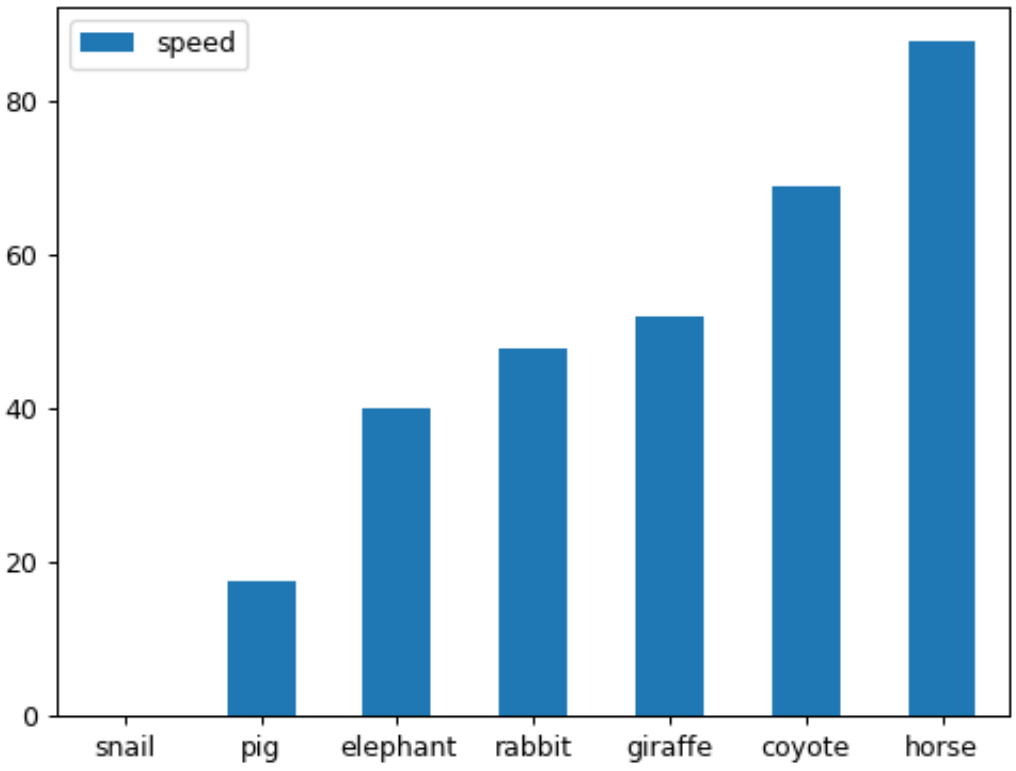
Plot a single column.

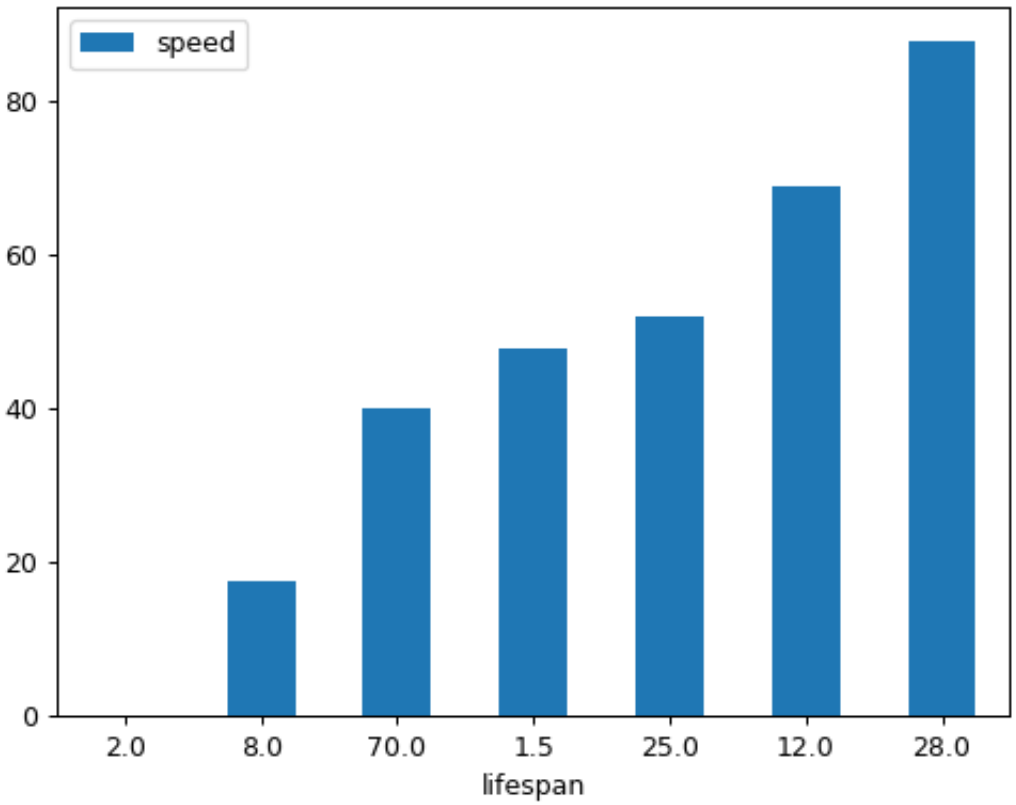
```
>>> ax = df.plot.bar(y='speed', rot=0)
```

Plot only selected categories for the DataFrame.

```
>>> ax = df.plot.bar(x='lifespan', rot=0)
```


speed
speed
80
60
40
20
0
lifespan
lifespan
60
40
20
0
snail
pig
elephant
rabbit
giraffe
coyote
horse


speed
80
60
40
20
0
snail
pig
elephant
rabbit
giraffe
coyote
horse


speed
80
60
40
20
0
2.0
8.0
70.0
1.5
25.0
12.0
28.0
lifespan

databricks.koalas.DataFrame.plot.hist

`plot.hist(bins=10, **kwds)`

Draw one histogram of the DataFrame's columns. A histogram is a representation of the distribution of data. This function calls `matplotlib.pyplot.hist()` or `plotting.backend.plot()`, on each series in the DataFrame, resulting in one histogram per column.

Parameters

bins [integer or sequence, default 10] Number of histogram bins to be used. If an integer is given, bins + 1 bin edges are calculated and returned. If bins is a sequence, gives bin edges, including left edge of first bin and right edge of last bin. In this case, bins is returned unmodified.

****kwds** All other plotting keyword arguments to be passed to `matplotlib.pyplot.hist()` Koalas.Series.plot.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

Basic plot.

For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.hist()
```

For DataFrame:

```
>>> df = pd.DataFrame(
...     np.random.randint(1, 7, 6000),
...     columns=['one'])
>>> df['two'] = df['one'] + np.random.randint(1, 7, 6000)
>>> df = ks.from_pandas(df)
>>> ax = df.plot.hist(bins=12, alpha=0.5)
```

databricks.koalas.DataFrame.plot.line

`plot.line(x=None, y=None, **kwargs)`

Plot DataFrame/Series as lines.

This function is useful to plot lines using Series's values as coordinates.

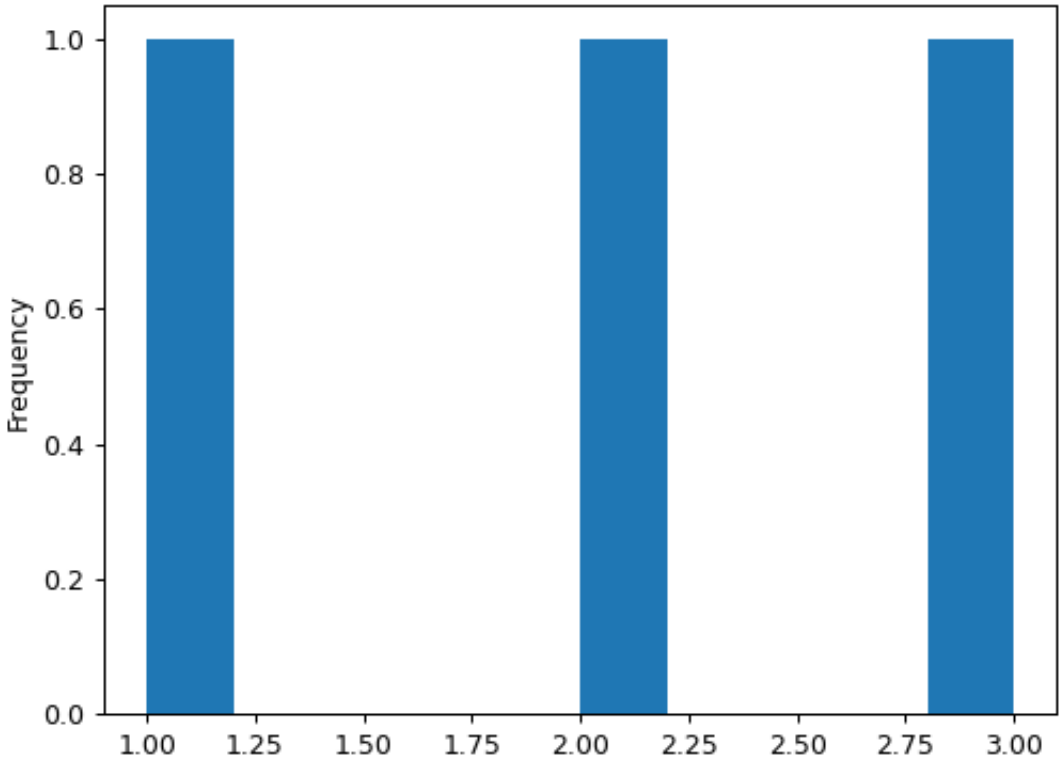
Parameters

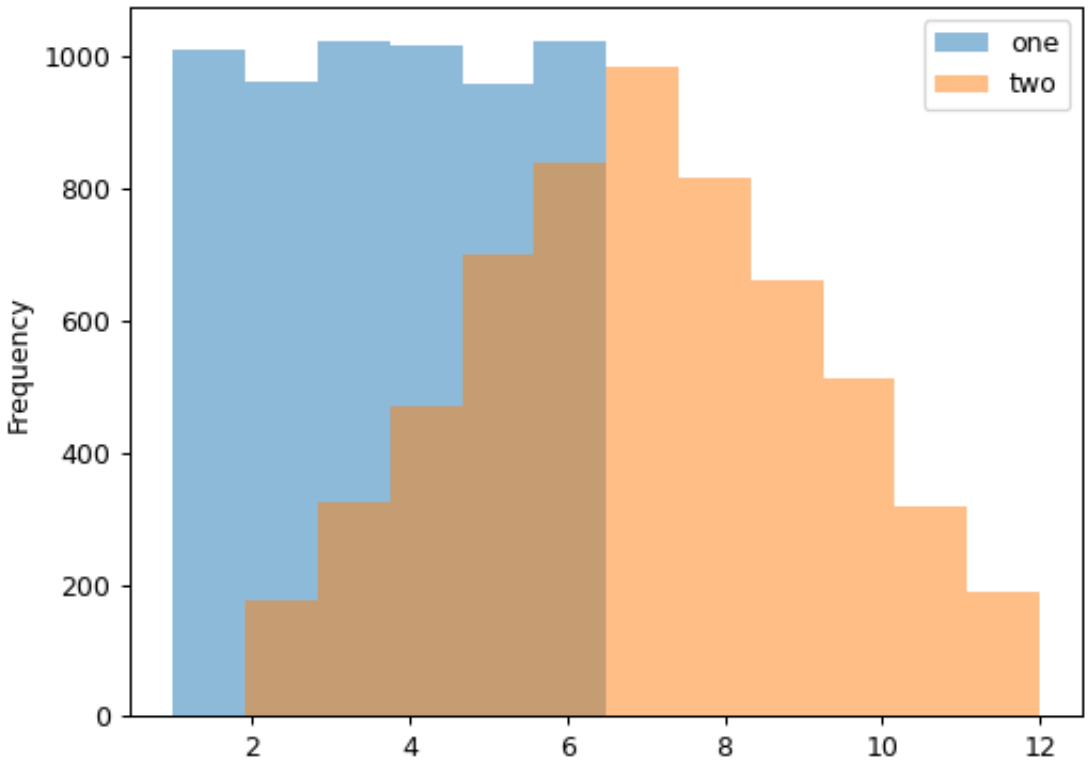
x [int or str, optional] Columns to use for the horizontal axis. Either the location or the label of the columns to be used. By default, it will use the DataFrame indices.

y [int, str, or list of them, optional] The values to be plotted. Either the location or the label of the columns to be used. By default, it will use the remaining DataFrame numeric columns.

****kwds** Keyword arguments to pass on to `Series.plot()` or `DataFrame.plot()`.

Returns


Frequency
1.0
0.8
0.6
0.4
0.2
0.0
1.00
1.25
1.50
1.75
2.00
2.25
2.50
2.75
3.00


one
two
Frequency
0
200
400
600
800
1000
2
4
6
8
10
12

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

See also:

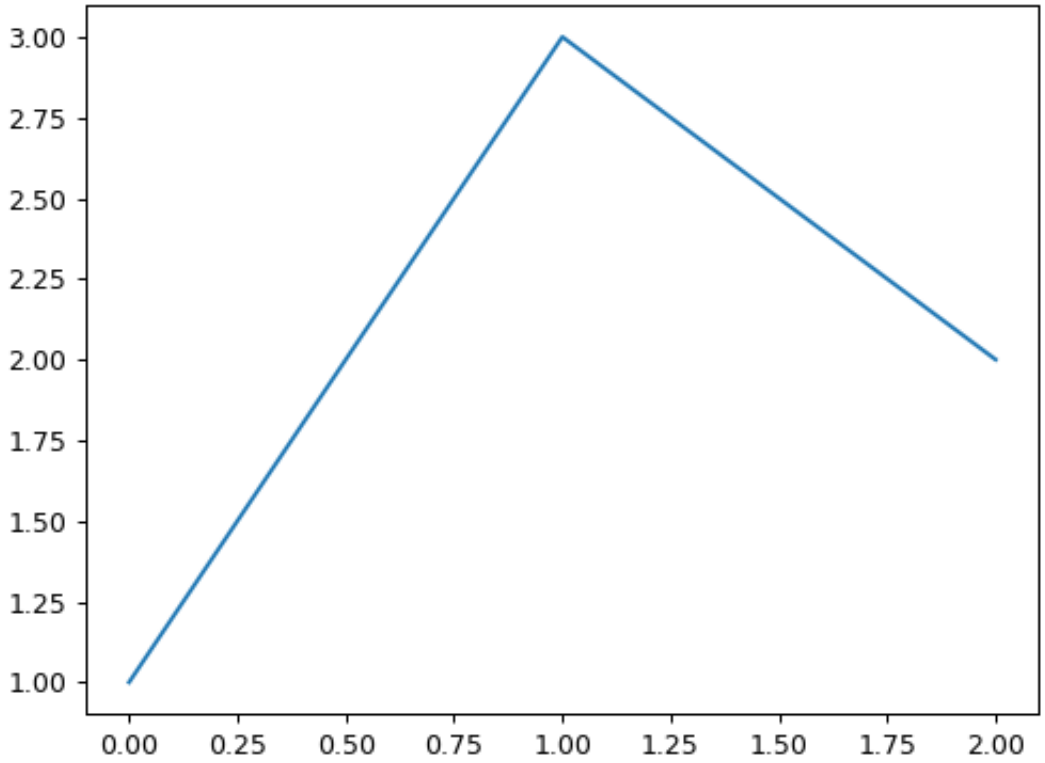
`matplotlib.pyplot.plot` Plot y versus x as lines and/or markers.

Examples

Basic plot.

For Series:

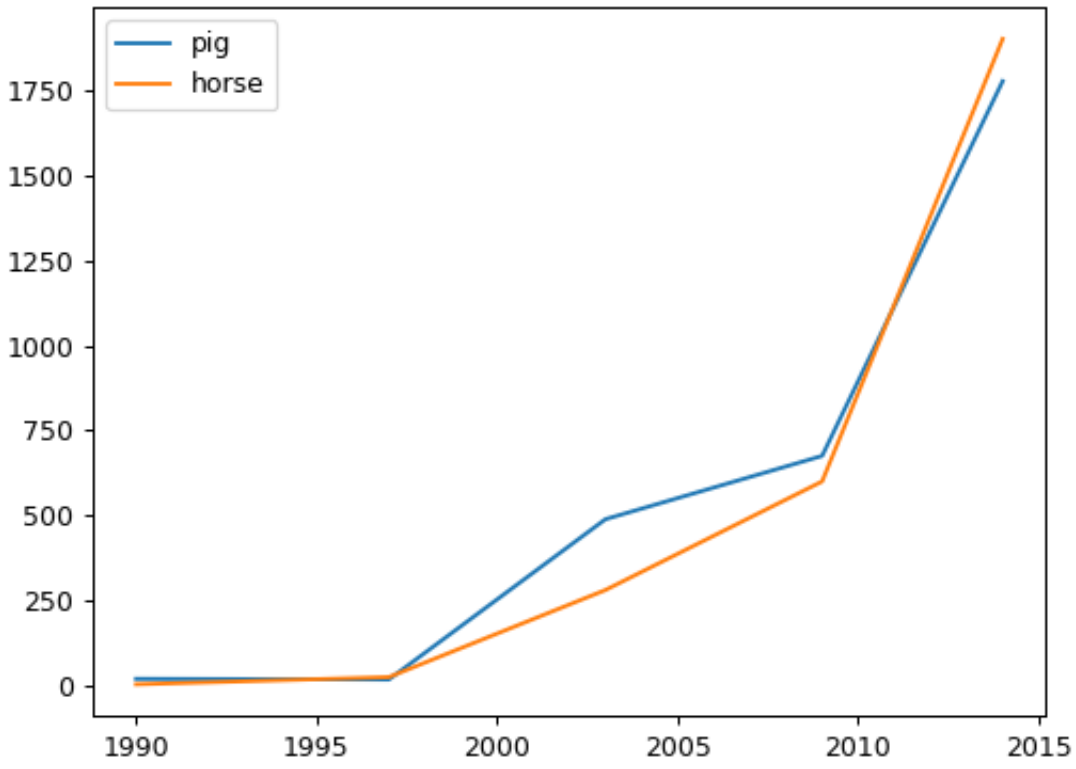
```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.line()
```



For DataFrame:

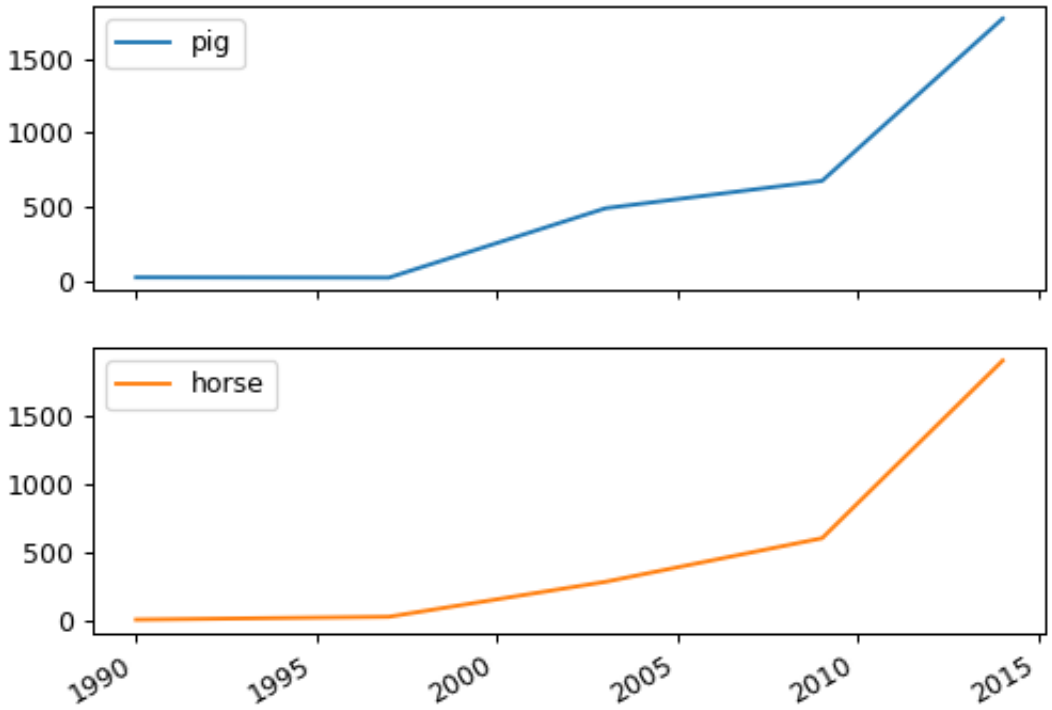
The following example shows the populations for some animals over the years.

```
>>> df = ks.DataFrame({'pig': [20, 18, 489, 675, 1776],
...                    'horse': [4, 25, 281, 600, 1900]},
...                   index=[1990, 1997, 2003, 2009, 2014])
>>> lines = df.plot.line()
```


pig
horse
1750
1500
1250
1000
750
500
250
0
1990
1995
2000
2005
2010
2015

An example with subplots, so an array of axes is returned.

```
>>> axes = df.plot.line(subplots=True)
>>> type(axes)
<class 'numpy.ndarray'>
```



The following example shows the relationship between both populations.

```
>>> lines = df.plot.line(x='pig', y='horse')
```

databricks.koalas.DataFrame.plot.pie

`plot.pie(y=None, **kwds)`

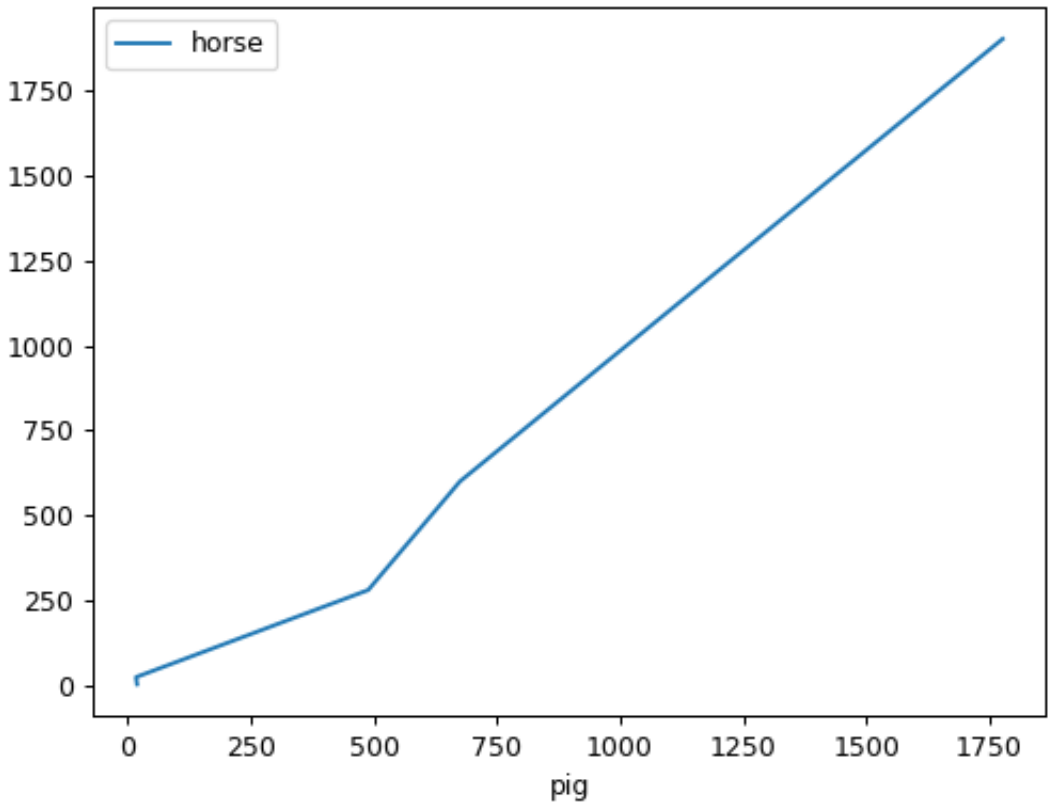
Generate a pie plot.

A pie plot is a proportional representation of the numerical data in a column. This function wraps `matplotlib.pyplot.pie()` for the specified column. If no column reference is passed and `subplots=True` a pie plot is drawn for each numerical column independently.

Parameters

y [int or label, optional] Label or position of the column to plot. If not provided, `subplots=True` argument must be passed.

****kwds** Keyword arguments to pass on to `Koalas.Series.plot()`.


horse
1750
1500
1250
1000
750
500
250
0
0
250
500
750
1000
1250
1500
1750
pig

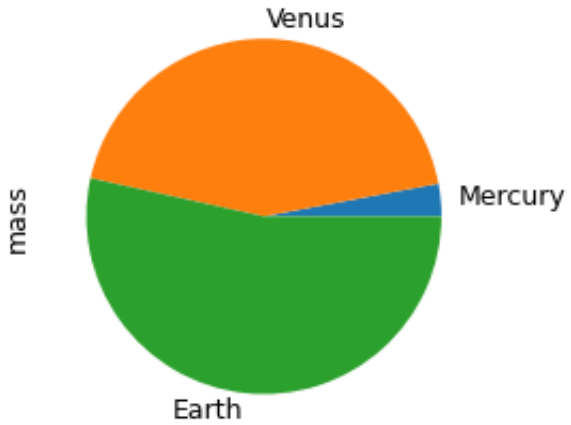
Returns

matplotlib.axes.Axes or np.ndarray of them A NumPy array is returned when *subplots* is True.

Examples

For Series:

```
>>> df = ks.DataFrame({'mass': [0.330, 4.87, 5.97],
...                    'radius': [2439.7, 6051.8, 6378.1]},
...                   index=['Mercury', 'Venus', 'Earth'])
>>> plot = df.mass.plot.pie(subplots=True, figsize=(6, 3))
```



For DataFrame:

```
>>> plot = df.plot.pie(y='mass', figsize=(5, 5))
```

databricks.koalas.DataFrame.plot.scatter

`plot.`**`scatter`**(*x*, *y*, *s=None*, *c=None*, ***kwds*)

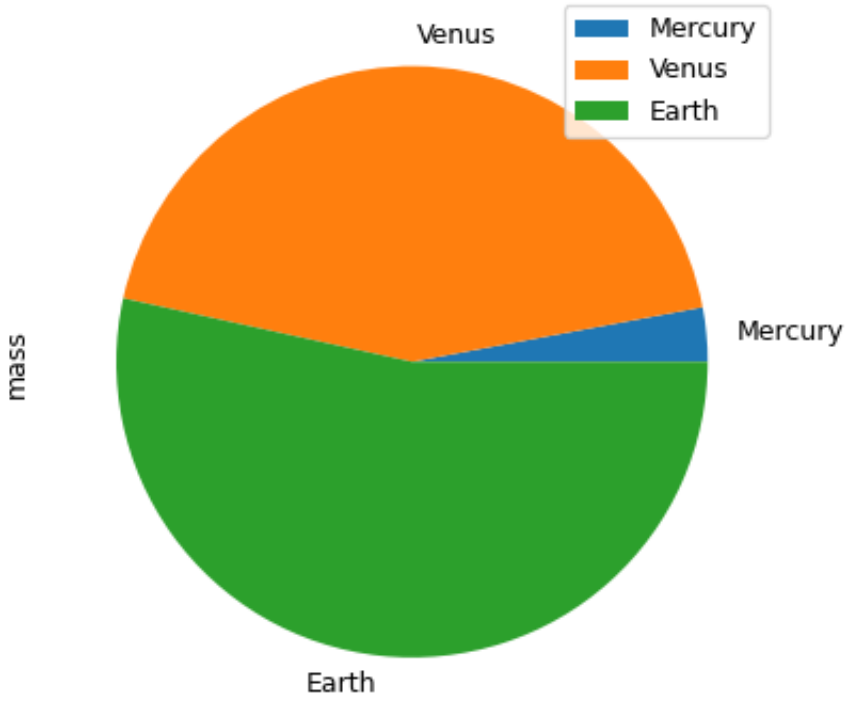
Create a scatter plot with varying marker point size and color.

The coordinates of each point are defined by two dataframe columns and filled circles are used to represent each point. This kind of plot is useful to see complex correlations between two variables. Points could be for instance natural 2D coordinates like longitude and latitude in a map or, in general, any pair of metrics that can be plotted against each other.

Parameters

x [int or str] The column name or column position to be used as horizontal coordinates for each point.

y [int or str] The column name or column position to be used as vertical coordinates for each point.


Venus
Mercury
Venus
Earth
Mercury
mass
Earth

s [scalar or array_like, optional]

c [str, int or array_like, optional]

****kwds: Optional** Keyword arguments to pass on to *databricks.koalas.DataFrame.plot()*.

Returns

axes [`matplotlib.axes.Axes`] Return an custom object when `backend!=matplotlib`.

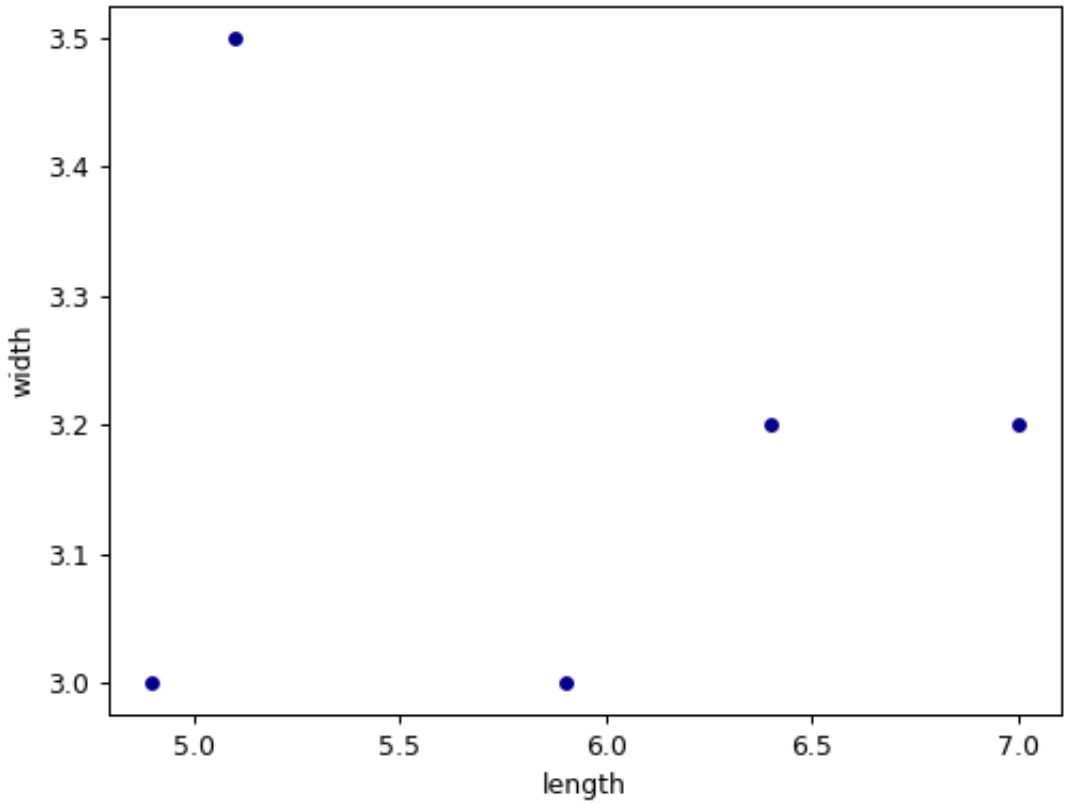
See also:

`matplotlib.pyplot.scatter` Scatter plot using multiple input data formats.

Examples

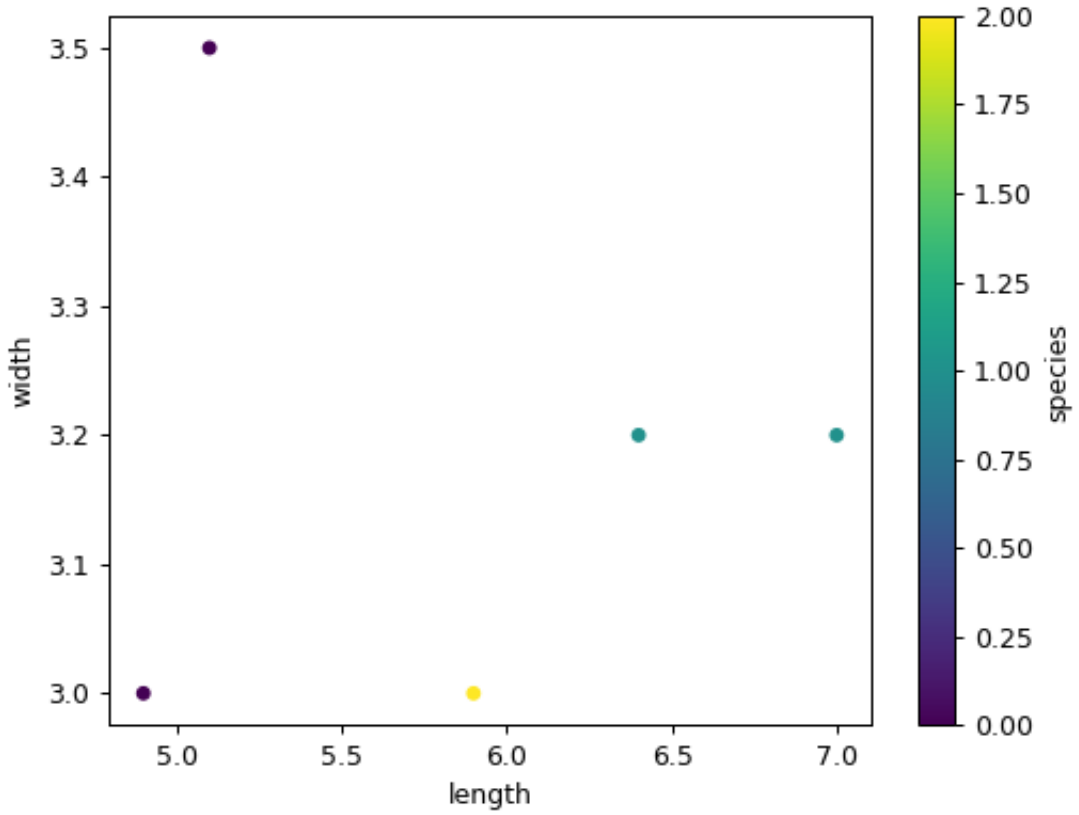
Let's see how to draw a scatter plot using coordinates from the values in a DataFrame's columns.

```
>>> df = ks.DataFrame([[5.1, 3.5, 0], [4.9, 3.0, 0], [7.0, 3.2, 1],
...                    [6.4, 3.2, 1], [5.9, 3.0, 2]],
...                   columns=['length', 'width', 'species'])
>>> ax1 = df.plot.scatter(x='length',
...                       y='width',
...                       c='DarkBlue')
```



And now with the color determined by a column as well.

```
>>> ax2 = df.plot.scatter(x='length',
...                       y='width',
...                       c='species',
...                       colormap='viridis')
```



databricks.koalas.DataFrame.plot.density

`plot.`**`density`**(*bw_method=None*, *ind=None*, ***kwargs*)

Generate Kernel Density Estimate plot using Gaussian kernels.

Parameters

bw_method [scalar] The method used to calculate the estimator bandwidth. See KernelDensity in PySpark for more information.

ind [NumPy array or integer, optional] Evaluation points for the estimated PDF. If None (default), 1000 equally spaced points are used. If *ind* is a NumPy array, the KDE is evaluated at the points passed. If *ind* is an integer, *ind* number of equally spaced points are used.

****kwargs** [optional] Keyword arguments to pass on to `Koalas.Series.plot()`.

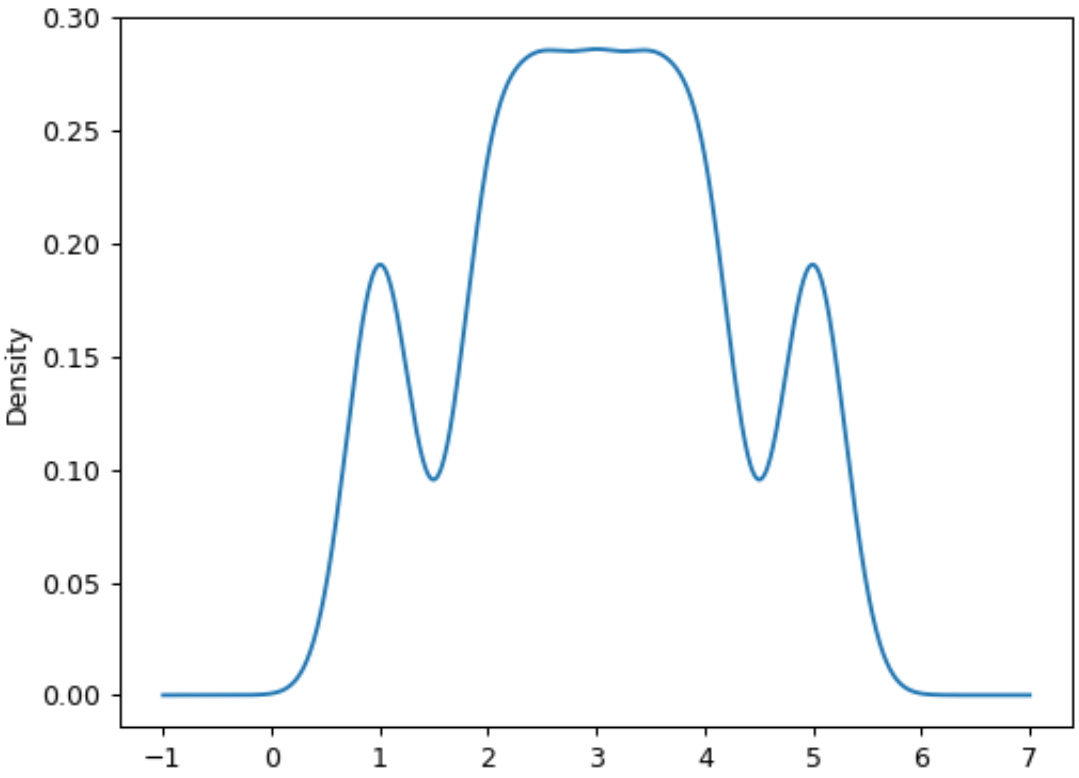
Returns

axes [matplotlib.axes.Axes or numpy.ndarray] Return an ndarray when subplots=True. Return an custom object when backend!=matplotlib.

Examples

A scalar bandwidth should be specified. Using a small bandwidth value can lead to over-fitting, while using a large bandwidth value may result in under-fitting:

```
>>> s = ks.Series([1, 2, 2.5, 3, 3.5, 4, 5])
>>> ax = s.plot.kde(bw_method=0.3)
```



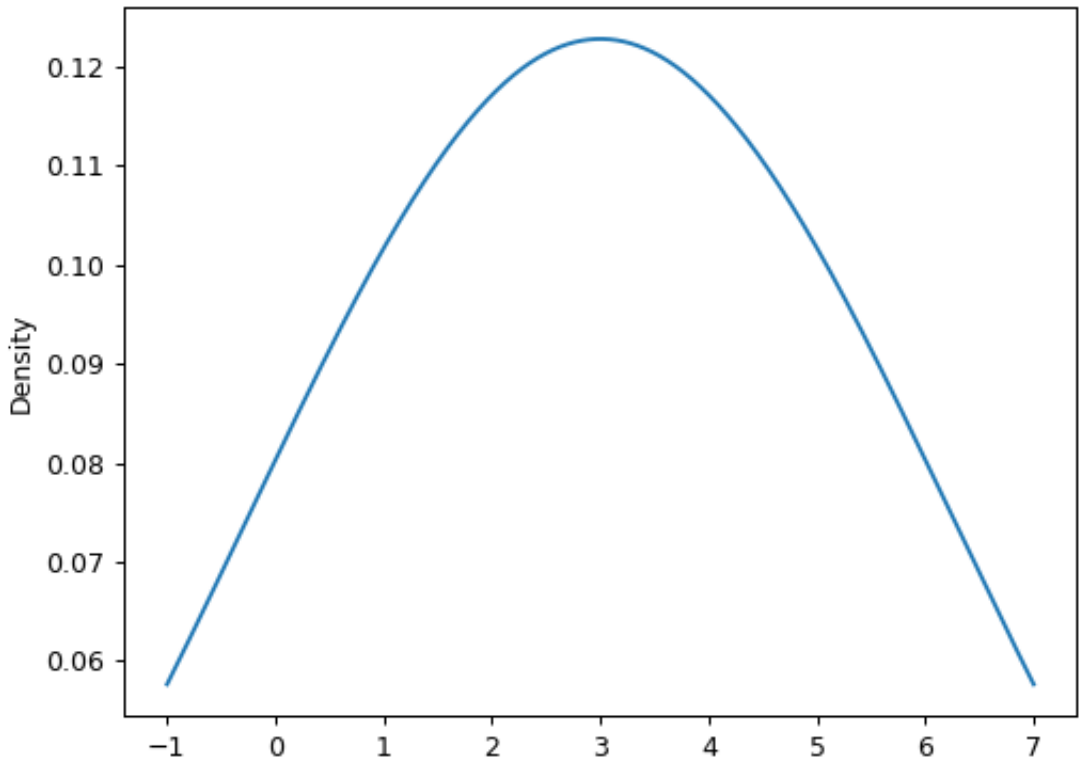

```
>>> ax = s.plot.kde(bw_method=3)
```

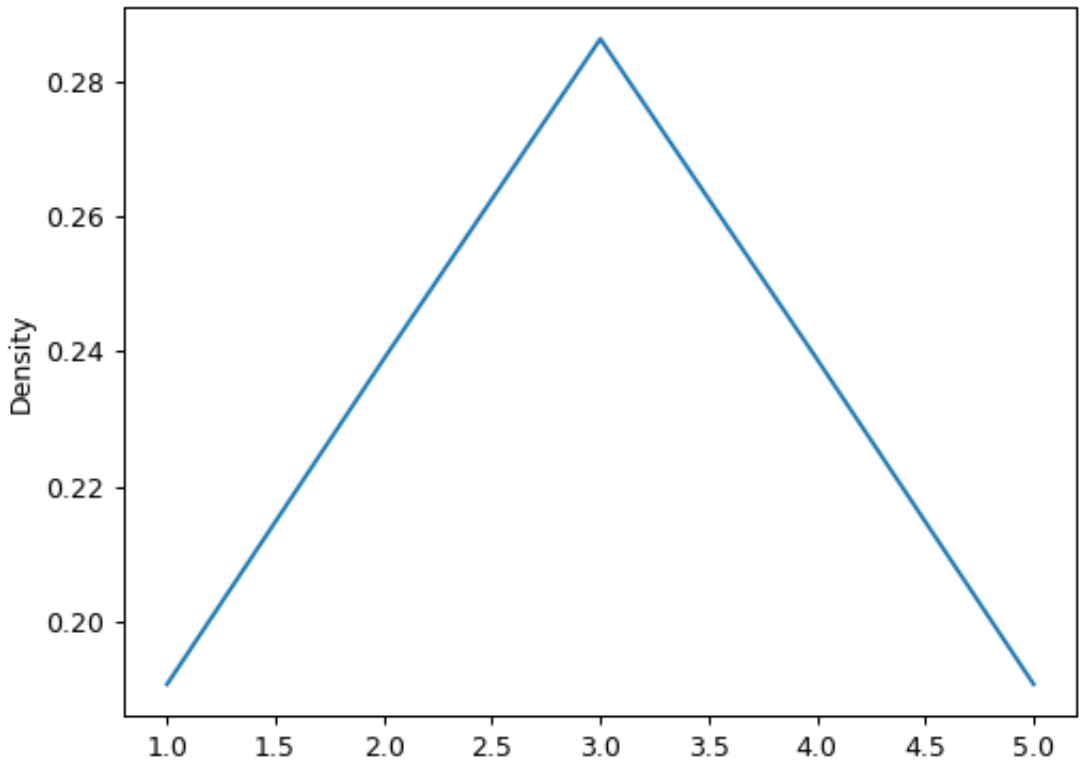
The *ind* parameter determines the evaluation points for the plot of the estimated KDF:

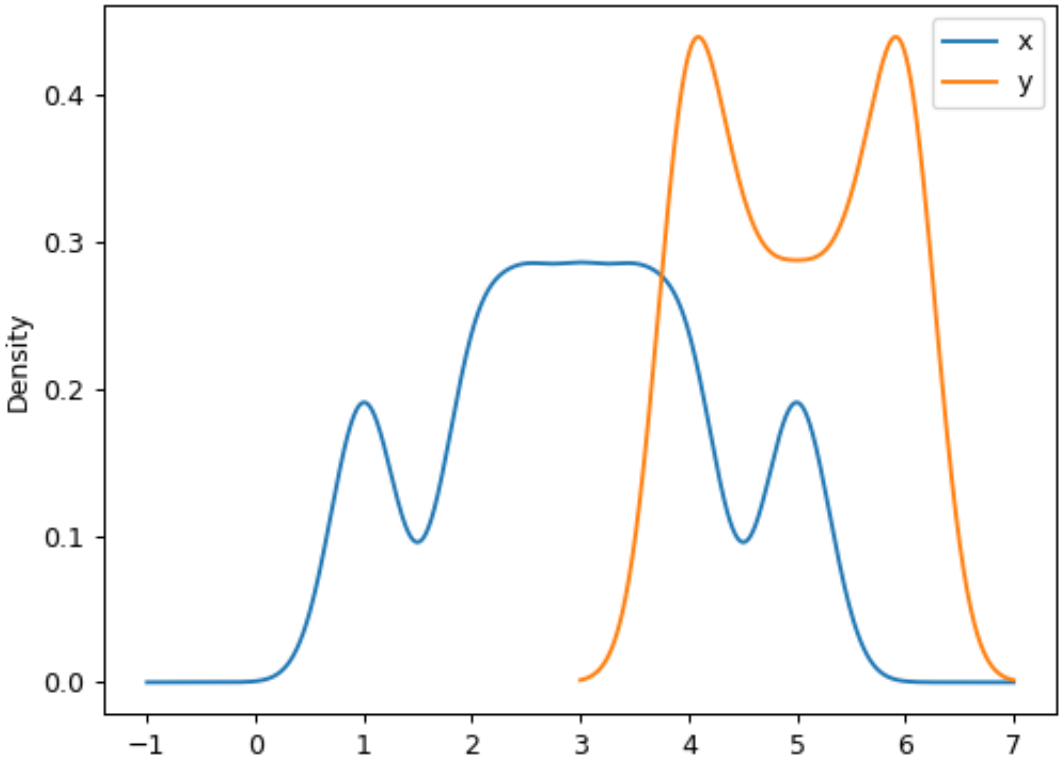
```
>>> ax = s.plot.kde(ind=[1, 2, 3, 4, 5], bw_method=0.3)
```

For DataFrame, it works in the same way as Series:

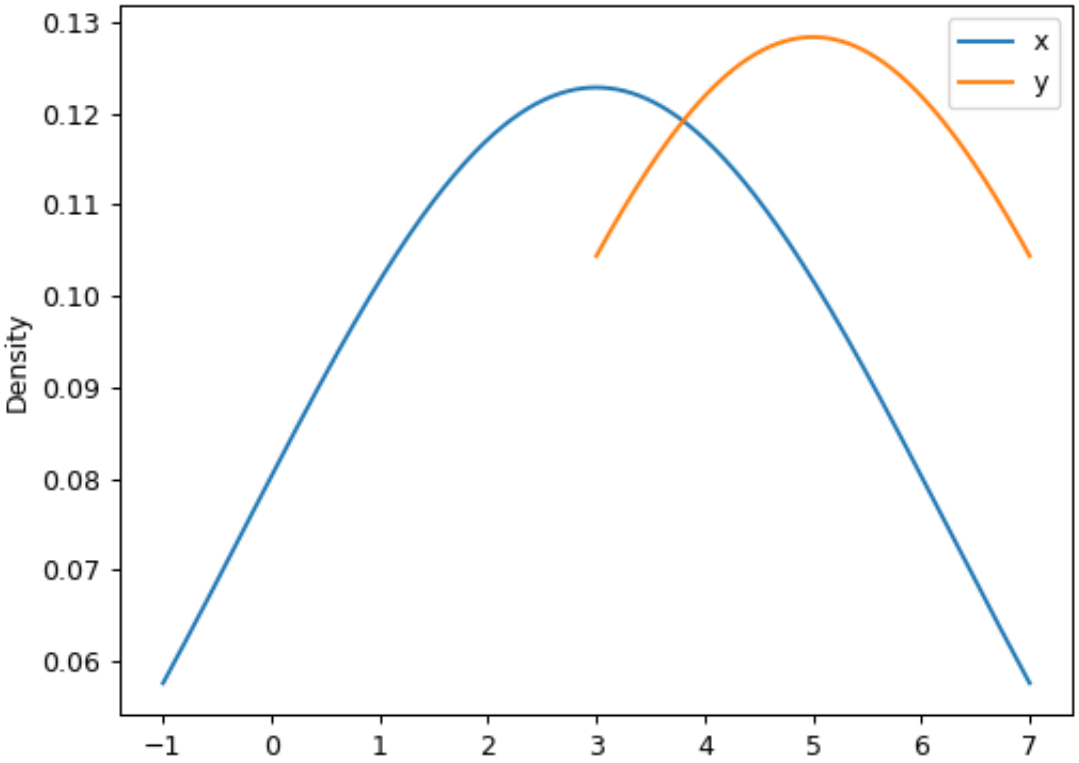
```
>>> df = ks.DataFrame({
...     'x': [1, 2, 2.5, 3, 3.5, 4, 5],
...     'y': [4, 4, 4.5, 5, 5.5, 6, 6],
... })
>>> ax = df.plot.kde(bw_method=0.3)
```


Density
0.12
0.11
0.10
0.09
0.08
0.07
0.06
−1
0
1
2
3
4
5
6
7


0.28
0.26
0.24
0.22
0.20
Density
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


x
y
Density
0.4
0.3
0.2
0.1
0.0
−1
0
1
2
3
4
5
6
7

```
>>> ax = df.plot.kde(bw_method=3)
```




```
>>> ax = df.plot.kde(ind=[1, 2, 3, 4, 5, 6], bw_method=0.3)
```

databricks.koalas.DataFrame.hist

DataFrame.**hist**(*bins=10*, ***kwds*) → matplotlib.axes._axes.Axes

Draw one histogram of the DataFrame's columns. A histogram is a representation of the distribution of data. This function calls `matplotlib.pyplot.hist()` or `plotting.backend.plot()`, on each series in the DataFrame, resulting in one histogram per column.

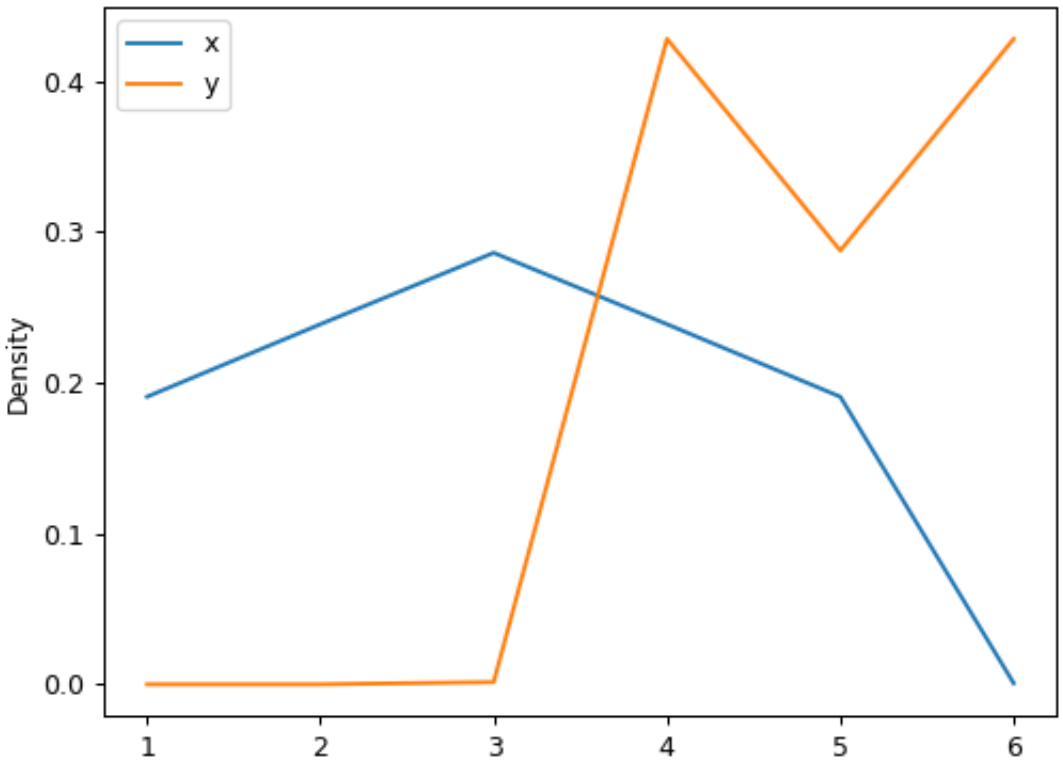
Parameters

bins [integer or sequence, default 10] Number of histogram bins to be used. If an integer is given, bins + 1 bin edges are calculated and returned. If bins is a sequence, gives bin edges, including left edge of first bin and right edge of last bin. In this case, bins is returned unmodified.

****kwds** All other plotting keyword arguments to be passed to `matplotlib.pyplot.hist()` Koalas.Series.plot.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

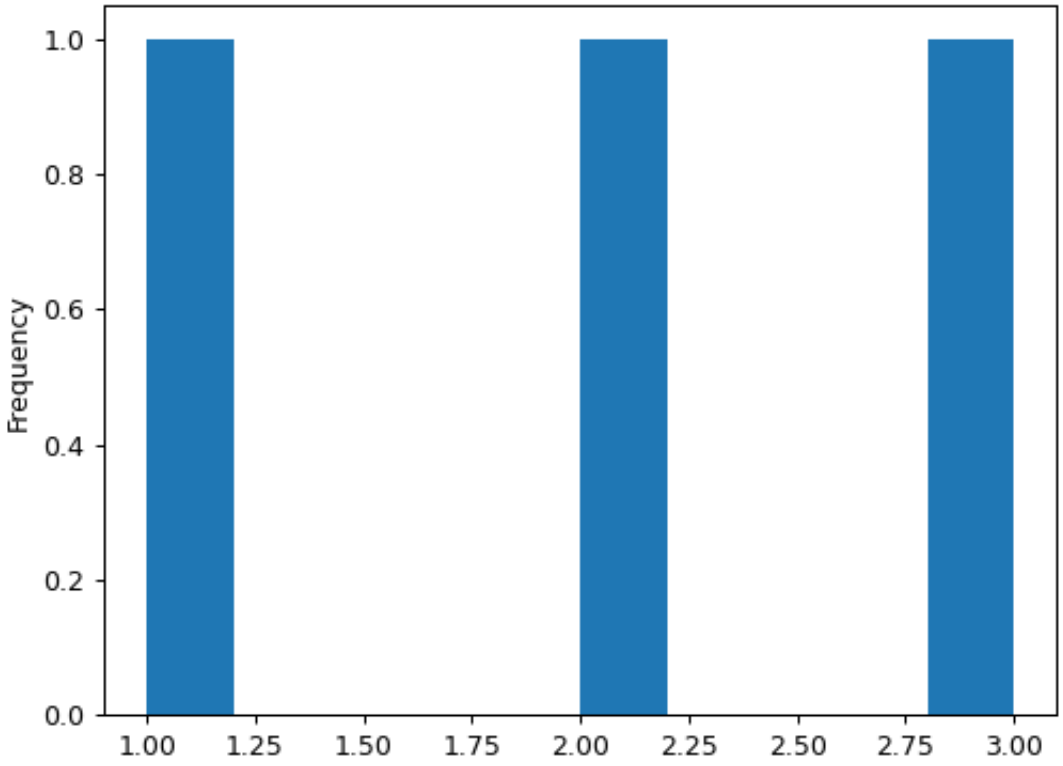

x
y
Density
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
6

Examples

Basic plot.

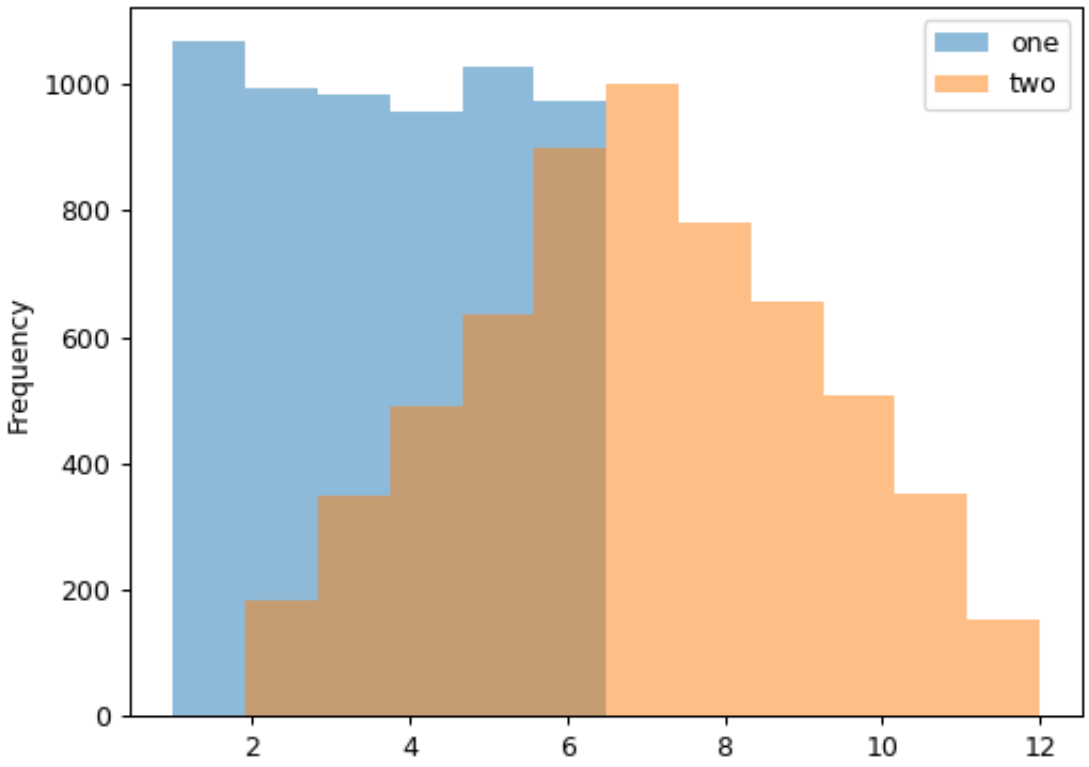
For Series:

```
>>> s = ks.Series([1, 3, 2])
>>> ax = s.plot.hist()
```



For DataFrame:

```
>>> df = pd.DataFrame(
...     np.random.randint(1, 7, 6000),
...     columns=['one'])
>>> df['two'] = df['one'] + np.random.randint(1, 7, 6000)
>>> df = ks.from_pandas(df)
>>> ax = df.plot.hist(bins=12, alpha=0.5)
```


one
two
Frequency
0
200
400
600
800
1000
2
4
6
8
10
12

databricks.koalas.DataFrame.kde

DataFrame.**kde**(*bw_method=None*, *ind=None*, ***kwds*) → matplotlib.axes._axes.Axes

Generate Kernel Density Estimate plot using Gaussian kernels.

Parameters

bw_method [scalar] The method used to calculate the estimator bandwidth. See KernelDensity in PySpark for more information.

ind [NumPy array or integer, optional] Evaluation points for the estimated PDF. If None (default), 1000 equally spaced points are used. If *ind* is a NumPy array, the KDE is evaluated at the points passed. If *ind* is an integer, *ind* number of equally spaced points are used.

****kwargs** [optional] Keyword arguments to pass on to `Koalas.Series.plot()`.

Returns

axes [`matplotlib.axes.Axes` or `numpy.ndarray`] Return an ndarray when `subplots=True`. Return an custom object when `backend!=matplotlib`.

Examples

A scalar bandwidth should be specified. Using a small bandwidth value can lead to over-fitting, while using a large bandwidth value may result in under-fitting:

```
>>> s = ks.Series([1, 2, 2.5, 3, 3.5, 4, 5])
>>> ax = s.plot.kde(bw_method=0.3)
```

```
>>> ax = s.plot.kde(bw_method=3)
```

The *ind* parameter determines the evaluation points for the plot of the estimated KDF:

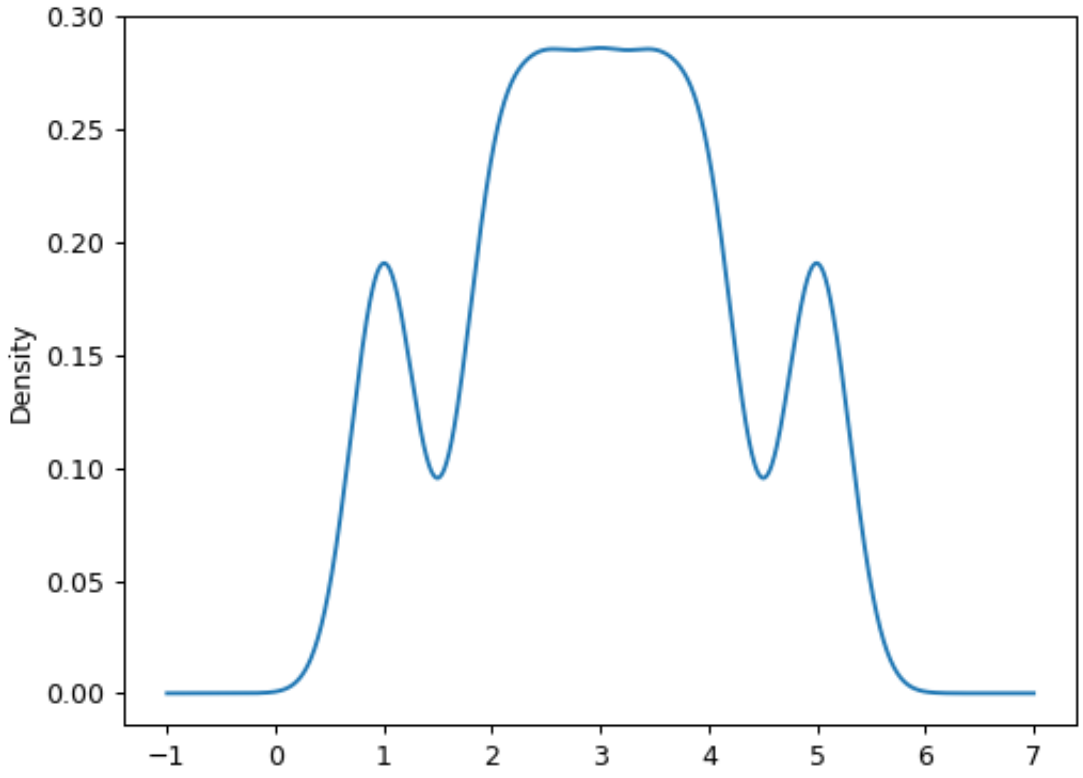
```
>>> ax = s.plot.kde(ind=[1, 2, 3, 4, 5], bw_method=0.3)
```

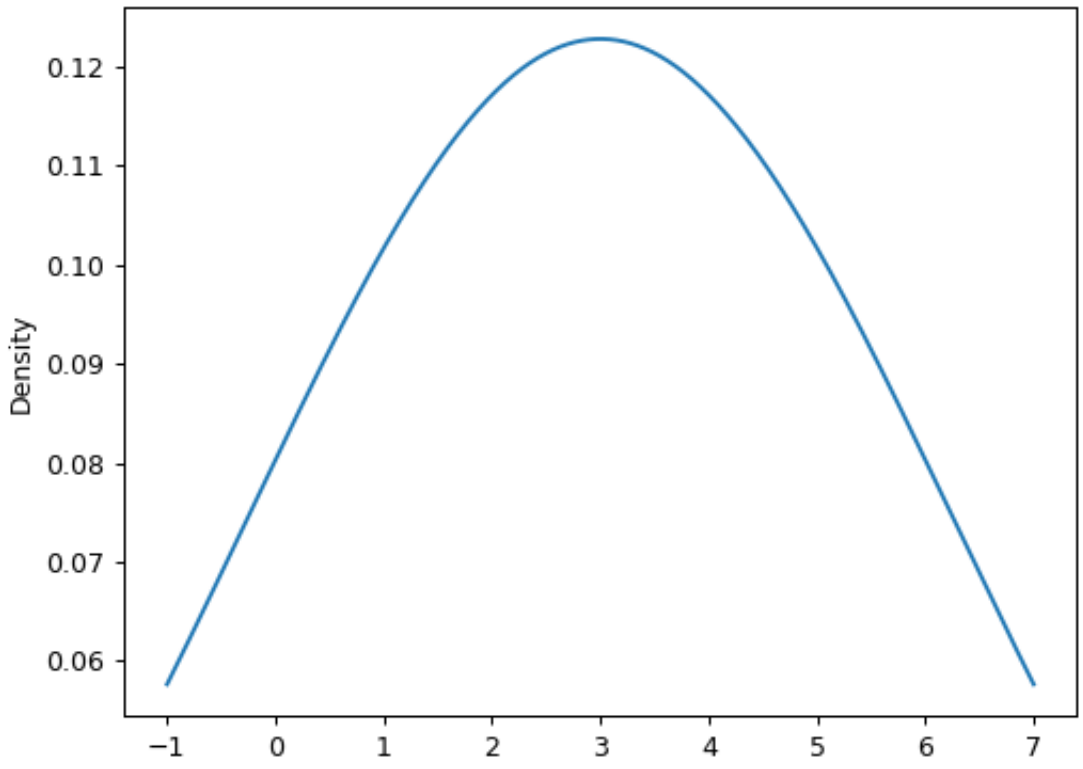
For DataFrame, it works in the same way as Series:

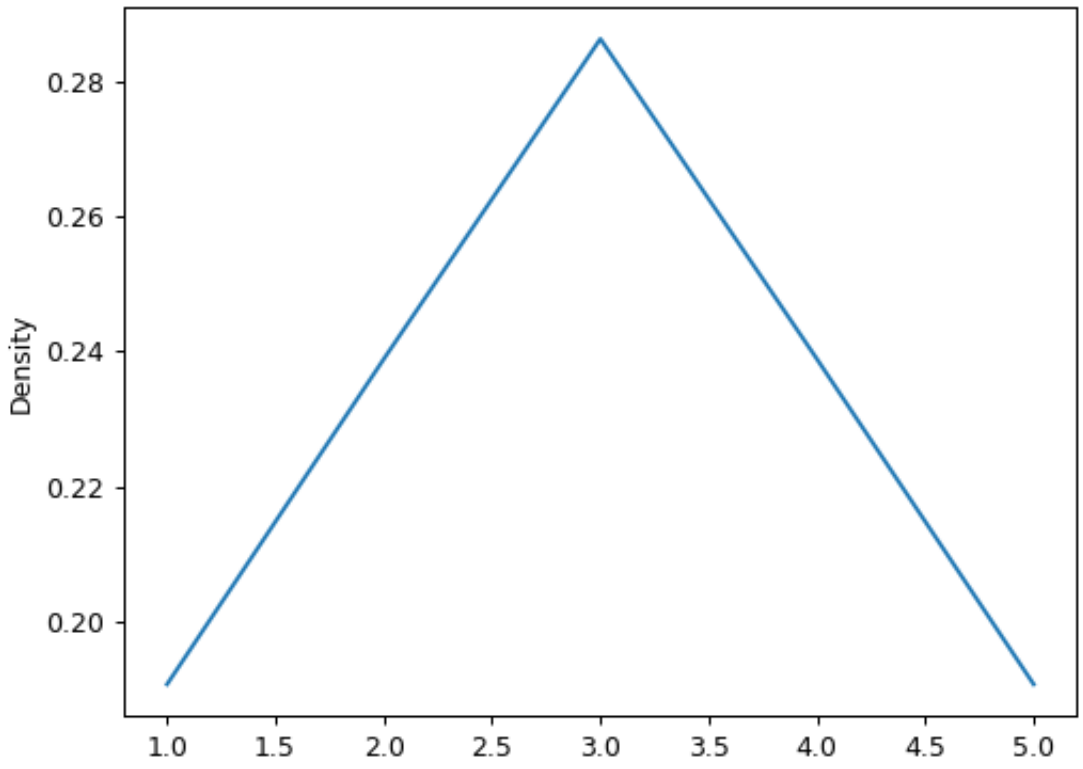
```
>>> df = ks.DataFrame({
...     'x': [1, 2, 2.5, 3, 3.5, 4, 5],
...     'y': [4, 4, 4.5, 5, 5.5, 6, 6],
... })
>>> ax = df.plot.kde(bw_method=0.3)
```

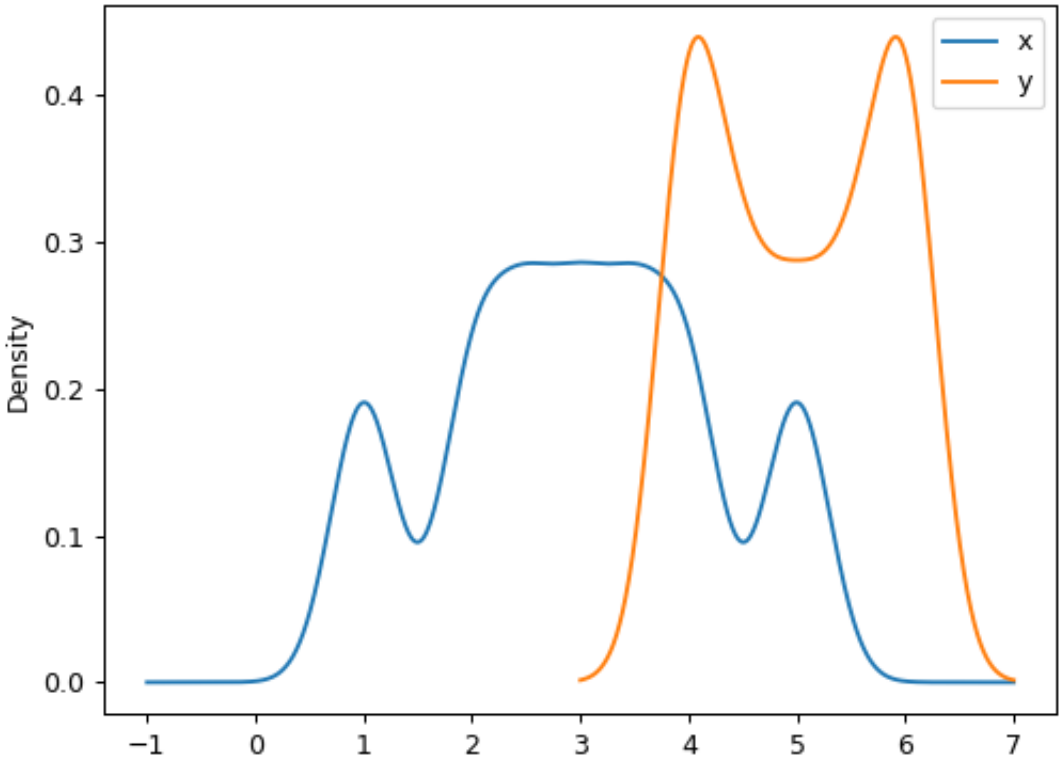
```
>>> ax = df.plot.kde(bw_method=3)
```

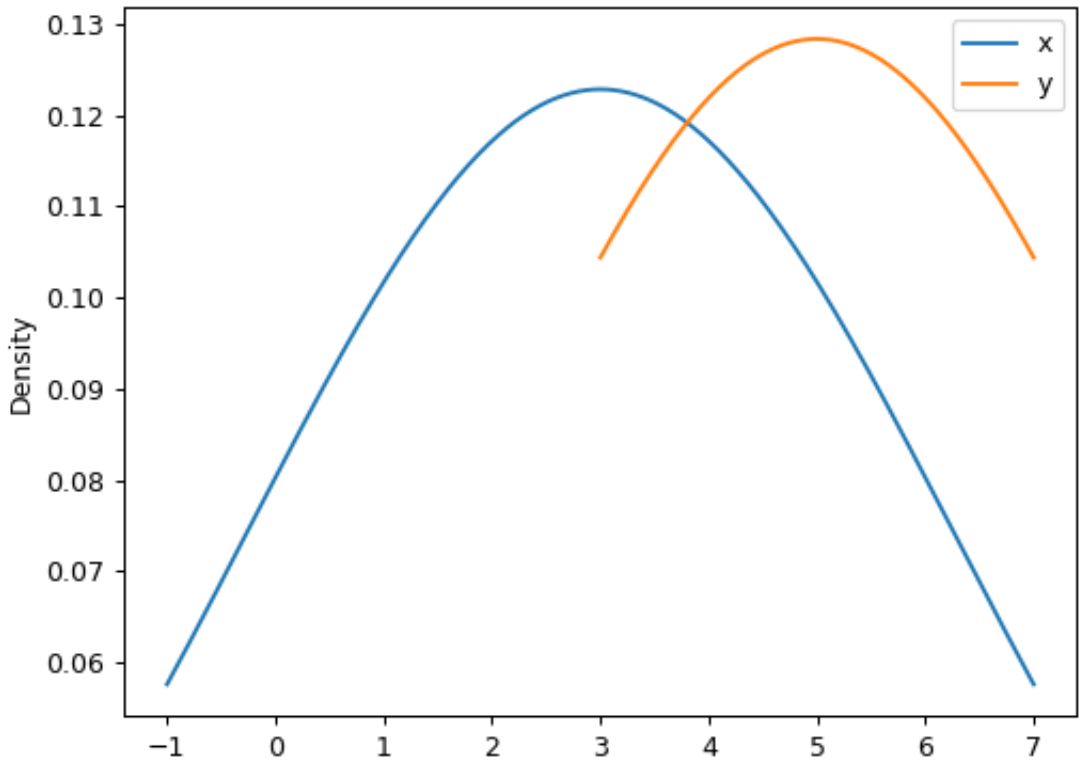
```
>>> ax = df.plot.kde(ind=[1, 2, 3, 4, 5, 6], bw_method=0.3)
```

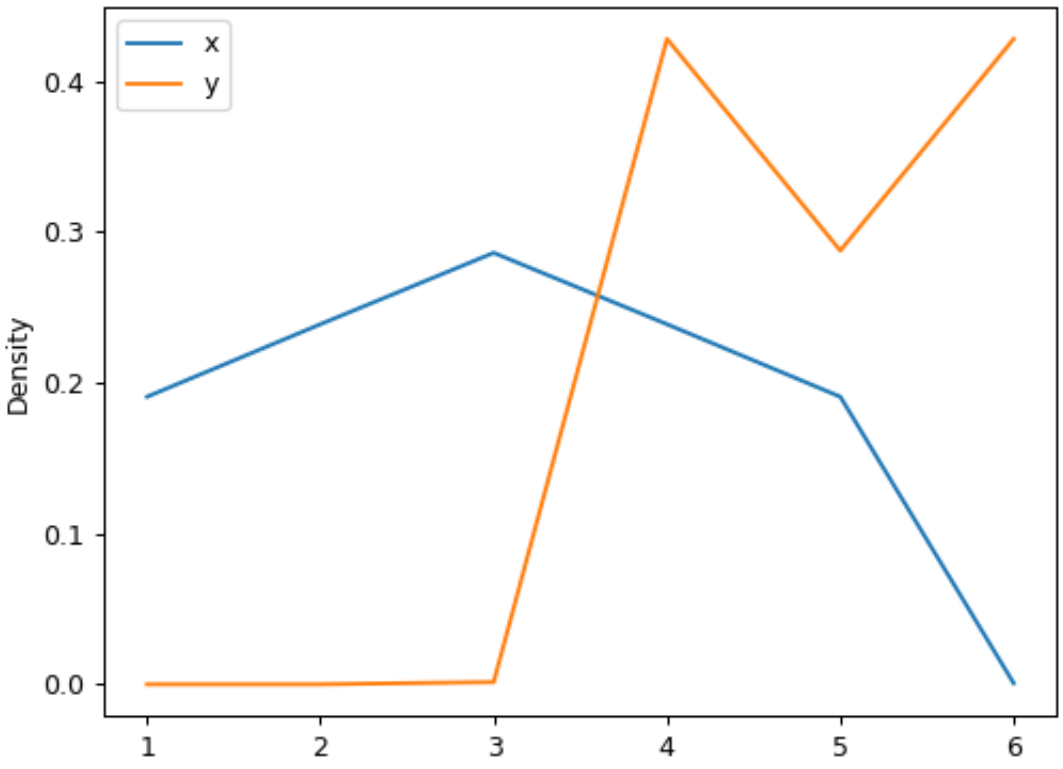

0.30
0.25
0.20
0.15
0.10
0.05
0.00
Density
−1
0
1
2
3
4
5
6
7


0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7


Density
0.28
0.26
0.24
0.22
0.20
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0


x
y
Density
0.0
0.1
0.2
0.3
0.4
−1
0
1
2
3
4
5
6
7


0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
Density
−1
0
1
2
3
4
5
6
7
x
y


x
y
Density
0.0
0.1
0.2
0.3
0.4
1
2
3
4
5
6

3.4.16 Koalas-specific

`DataFrame.koalas` provides Koalas-specific features that exists only in Koalas. These can be accessed by `DataFrame.koalas.<function/property>`.

DataFrame.koalas.attach_id_column(id_type, ...)	Attach a column to be used as identifier of rows similar to the default index.
DataFrame.koalas.apply_batch(func[, args])	Apply a function that takes pandas DataFrame and outputs pandas DataFrame.
DataFrame.koalas.transform_batch(func, ...)	Transform chunks with a function that takes pandas DataFrame and outputs pandas DataFrame.

databricks.koalas.DataFrame.koalas.attach_id_column

koalas.**attach_id_column**(*id_type: str*, *column: Union[Any, Tuple]*) → DataFrame

Attach a column to be used as identifier of rows similar to the default index.

See also Default Index type.

Parameters

id_type [string] The id type.

- 'sequence' : a sequence that increases one by one.

  Note: this uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

- 'distributed-sequence' : a sequence that increases one by one, by group-by and group-map approach in a distributed manner.
- 'distributed' : a monotonically increasing sequence simply by using PySpark's monotonically_increasing_id function in a fully distributed manner.

column [string or tuple of string] The column name.

Returns

DataFrame The DataFrame attached the column.

Examples

```
>>> df = ks.DataFrame({"x": ['a', 'b', 'c']})
>>> df.koalas.attach_id_column(id_type="sequence", column="id")
   x  id
0  a   0
1  b   1
2  c   2
```

```
>>> df.koalas.attach_id_column(id_type="distributed-sequence", column=0)
   x  0
0  a  0
1  b  1
2  c  2
```

```
>>> df.koalas.attach_id_column(id_type="distributed", column=0.0)
...
   x  0.0
0  a  ...
1  b  ...
2  c  ...
```

For multi-index columns:

```
>>> df = ks.DataFrame({("x", "y"): ['a', 'b', 'c']})
>>> df.koalas.attach_id_column(id_type="sequence", column=("id-x", "id-y"))
   x id-x
   y id-y
0  a    0
1  b    1
2  c    2
```

```
>>> df.koalas.attach_id_column(id_type="distributed-sequence", column=(0, 1.0))
   x   0
   y 1.0
0  a   0
1  b   1
2  c   2
```

databricks.koalas.DataFrame.koalas.apply_batch

koalas.**apply_batch**(*func*, *args=()*, ***kwds*) → DataFrame

Apply a function that takes pandas DataFrame and outputs pandas DataFrame. The pandas DataFrame given to the function is of a batch used internally.

See also Transform and apply a function.

Note: the *func* is unable to access to the whole input frame. Koalas internally splits the input series into multiple batches and calls *func* with each batch multiple times. Therefore, operations such as global aggregations are impossible. See the example below.

```
>>> # This case does not return the length of whole frame but of the batch␣
↪internally
... # used.
... def length(pdf) -> ks.DataFrame[int]:
...     return pd.DataFrame([len(pdf)])
...
>>> df = ks.DataFrame({'A': range(1000)})
>>> df.koalas.apply_batch(length)
    c0
0   83
1   83
2   83
...
10  83
11  83
```

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when

the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def plus_one(x) -> ks.DataFrame[float, float]:
...     return x + 1
```

If the return type is specified, the output column names become *c0, c1, c2 ... cn*. These names are positionally mapped to the returned DataFrame in `func`.

To specify the column names, you can assign them in a pandas friendly style as below:

```
>>> def plus_one(x) -> ks.DataFrame["a": float, "b": float]:
...     return x + 1
```

```
>>> pdf = pd.DataFrame({'a': [1, 2, 3], 'b': [3, 4, 5]})
>>> def plus_one(x) -> ks.DataFrame[zip(pdf.dtypes, pdf.columns)]:
...     return x + 1
```

Parameters

func [function] Function to apply to each pandas frame.

args [tuple] Positional arguments to pass to *func* in addition to the array/series.

****kwds** Additional keyword arguments to pass as keywords arguments to *func*.

Returns

DataFrame

See also:

`DataFrame.apply` For row/columnwise operations.

`DataFrame.applymap` For elementwise operations.

`DataFrame.aggregate` Only perform aggregating type operations.

`DataFrame.transform` Only perform transforming type operations.

`Series.koalas.transform_batch` transform the search as each pandas chunks.

Examples

```
>>> df = ks.DataFrame([(1, 2), (3, 4), (5, 6)], columns=['A', 'B'])
>>> df
   A  B
0  1  2
1  3  4
2  5  6
```

```
>>> def query_func(pdf) -> ks.DataFrame[int, int]:
...     return pdf.query('A == 1')
>>> df.koalas.apply_batch(query_func)
   c0  c1
0   1   2
```

```
>>> def query_func(pdf) -> ks.DataFrame["A": int, "B": int]:
...     return pdf.query('A == 1')
>>> df.koalas.apply_batch(query_func)
   A  B
0  1  2
```

You can also omit the type hints so Koalas infers the return schema as below:

```
>>> df.koalas.apply_batch(lambda pdf: pdf.query('A == 1'))
   A  B
0  1  2
```

You can also specify extra arguments.

```
>>> def calculation(pdf, y, z) -> ks.DataFrame[int, int]:
...     return pdf ** y + z
>>> df.koalas.apply_batch(calculation, args=(10,), z=20)
        c0        c1
0       21      1044
1    59069   1048596
2  9765645  60466196
```

You can also use `np.ufunc` and built-in functions as input.

```
>>> df.koalas.apply_batch(np.add, args=(10,))
    A   B
0  11  12
1  13  14
2  15  16
```

```
>>> (df * -1).koalas.apply_batch(abs)
   A  B
0  1  2
1  3  4
2  5  6
```

databricks.koalas.DataFrame.koalas.transform_batch

koalas.**transform_batch**(*func*, **args*, ***kwargs*) → Union[DataFrame, Series]

Transform chunks with a function that takes pandas DataFrame and outputs pandas DataFrame. The pandas DataFrame given to the function is of a batch used internally. The length of each input and output should be the same.

See also Transform and apply a function.

Note: the *func* is unable to access to the whole input frame. Koalas internally splits the input series into multiple batches and calls *func* with each batch multiple times. Therefore, operations such as global aggregations are impossible. See the example below.

```
>>> # This case does not return the length of whole frame but of the batch␣
↪internally
... # used.
... def length(pdf) -> ks.DataFrame[int]:
...     return pd.DataFrame([len(pdf)] * len(pdf))
```

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```
...
>>> df = ks.DataFrame({'A': range(1000)})
>>> df.koalas.transform_batch(length)
    c0
0   83
1   83
2   83
...
```

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def plus_one(x) -> ks.DataFrame[float, float]:
...     return x + 1
```

If the return type is specified, the output column names become *c0, c1, c2 ... cn*. These names are positionally mapped to the returned DataFrame in `func`.

To specify the column names, you can assign them in a pandas friendly style as below:

```
>>> def plus_one(x) -> ks.DataFrame['a': float, 'b': float]:
...     return x + 1
```

```
>>> pdf = pd.DataFrame({'a': [1, 2, 3], 'b': [3, 4, 5]})
>>> def plus_one(x) -> ks.DataFrame[zip(pdf.dtypes, pdf.columns)]:
...     return x + 1
```

Parameters

func [function] Function to transform each pandas frame.

***args** Positional arguments to pass to func.

****kwargs** Keyword arguments to pass to func.

Returns

DataFrame or Series

See also:

`DataFrame.koalas.apply_batch` For row/columnwise operations.

`Series.koalas.transform_batch` transform the search as each pandas chunks.

Examples

```
>>> df = ks.DataFrame([(1, 2), (3, 4), (5, 6)], columns=['A', 'B'])
>>> df
   A  B
0  1  2
1  3  4
2  5  6
```

```
>>> def plus_one_func(pdf) -> ks.DataFrame[int, int]:
...     return pdf + 1
>>> df.koalas.transform_batch(plus_one_func)
   c0  c1
0   2   3
1   4   5
2   6   7
```

```
>>> def plus_one_func(pdf) -> ks.DataFrame['A': int, 'B': int]:
...     return pdf + 1
>>> df.koalas.transform_batch(plus_one_func)
   A  B
0  2  3
1  4  5
2  6  7
```

```
>>> def plus_one_func(pdf) -> ks.Series[int]:
...     return pdf.B + 1
>>> df.koalas.transform_batch(plus_one_func)
0    3
1    5
2    7
dtype: int64
```

You can also omit the type hints so Koalas infers the return schema as below:

```
>>> df.koalas.transform_batch(lambda pdf: pdf + 1)
   A  B
0  2  3
1  4  5
2  6  7
```

```
>>> (df * -1).koalas.transform_batch(abs)
   A  B
0  1  2
1  3  4
2  5  6
```

Note that you should not transform the index. The index information will not change.

```
>>> df.koalas.transform_batch(lambda pdf: pdf.B + 1)
0    3
1    5
2    7
Name: B, dtype: int64
```

You can also specify extra arguments as below.

```
>>> df.koalas.transform_batch(lambda pdf, a, b, c: pdf.B + a + b + c, 1, 2, c=3)
0     8
1    10
2    12
Name: B, dtype: int64
```

3.5 Index objects

3.5.1 Index

Index	Koalas Index that corresponds to pandas Index logically.

databricks.koalas.Index

class databricks.koalas.**Index**

Koalas Index that corresponds to pandas Index logically. This might hold Spark Column internally.

Variables

- **_kdf** – The parent dataframe
- **_scol** – Spark Column instance

Parameters

data [DataFrame or list] Index can be created by DataFrame or list

dtype [dtype, default None] Data type to force. Only a single dtype is allowed. If None, infer

name [name of index, hashable]

See also:

MultiIndex A multi-level, or hierarchical, Index.

Examples

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[1, 2, 3]).index
Int64Index([1, 2, 3], dtype='int64')
```

```
>>> ks.DataFrame({'a': [1, 2, 3]}, index=list('abc')).index
Index(['a', 'b', 'c'], dtype='object')
```

```
>>> Index([1, 2, 3])
Int64Index([1, 2, 3], dtype='int64')
```

```
>>> Index(list('abc'))
Index(['a', 'b', 'c'], dtype='object')
```

__init__(**args*, ***kwargs*)

Initialize self. See help(type(self)) for accurate signature.

Methods

__init__(*args, **kwargs)	Initialize self.
all([axis])	Return whether all elements are True.
any([axis])	Return whether any element is True.
append(other)	Append a collection of Index options together.
argmax()	Return a maximum argument indexer.
argmin()	Return a minimum argument indexer.
asof(label)	Return the label from the index, or, if not present, the previous one.
astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.
copy([name, deep])	Make a copy of this object.
delete(loc)	Make new Index with passed location(-s) deleted.
difference(other[, sort])	Return a new Index with elements from the index that are not in *other*.
drop(labels)	Make new Index with passed list of labels deleted.
drop_duplicates()	Return Index with duplicate values removed.
droplevel(level)	Return index with requested level(s) removed.
dropna()	Return Index or MultiIndex without NA/NaN values
equals(other)	Determine if two Index objects contain the same elements.
fillna(value)	Fill NA/NaN values with the specified value.
get_level_values(level)	Return Index if a valid level is given.
holds_integer()	Whether the type is an integer type.
identical(other)	Similar to equals, but check that other comparable attributes are also equal.
insert(loc, item)	Make new Index inserting new item at location.
intersection(other)	Form the intersection of two Index objects.
is_boolean()	Return if the current index type is a boolean type.
is_categorical()	Return if the current index type is a categorical type.
is_floating()	Return if the current index type is a floating type.
is_integer()	Return if the current index type is a integer type.
is_interval()	Return if the current index type is an interval type.
is_numeric()	Return if the current index type is a numeric type.
is_object()	Return if the current index type is a object type.
is_type_compatible(kind)	Whether the index type is compatible with the provided type.
isin(values)	Check whether *values* are contained in Series or Index.
isna()	Detect existing (non-missing) values.
isnull()	Detect existing (non-missing) values.
item()	Return the first element of the underlying data as a python scalar.
max()	Return the maximum value of the Index.
min()	Return the minimum value of the Index.
notna()	Detect existing (non-missing) values.
notnull()	Detect existing (non-missing) values.
nunique([dropna, approx, rsd])	Return number of unique elements in the object.
rename(name[, inplace])	Alter Index or MultiIndex name.
repeat(repeats)	Repeat elements of a Index/MultiIndex.
set_names(names[, level, inplace])	Set Index or MultiIndex name.

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shift([periods, fill_value])	Shift Series/Index by desired number of periods.
sort(*args, **kwargs)	Use sort_values instead.
sort_values([ascending])	Return a sorted copy of the index.
symmetric_difference(other[, result_name, sort])	Compute the symmetric difference of two Index objects.
take(indices)	Return the elements in the given *positional* indices along an axis.
toPandas()	Return a pandas Index.
to_frame([index, name])	Create a DataFrame with a column containing the Index.
to_list()	Return a list of the values.
to_numpy([dtype, copy])	A NumPy ndarray representing the values in this Index or MultiIndex.
to_pandas()	Return a pandas Index.
to_series([name])	Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.
tolist()	Return a list of the values.
transpose()	Return the transpose, For index, It will be index itself.
union(other[, sort])	Form the union of two Index objects.
unique([level])	Return unique values in the index.
value_counts([normalize, sort, ascending, ...])	Return a Series containing counts of unique values.
view()	this is defined as a copy with the same identity

Attributes

T	Return the transpose, For index, It will be index itself.
asi8	Integer representation of the values.
dtype	Return the dtype object of the underlying data.
empty	Returns true if the current object is empty.
has_duplicates	If index has duplicates, return True, otherwise False.
hasnans	Return True if it has any missing values.
inferred_type	Return a string of the type inferred from the values.
is_all_dates	Return if all data types of the index are datetime.
is_monotonic	Return boolean if values in the object are monotonically increasing.
is_monotonic_decreasing	Return boolean if values in the object are monotonically decreasing.
is_monotonic_increasing	Return boolean if values in the object are monotonically increasing.
is_unique	Return if the index has unique values.
name	Return name of the Index.
names	Return names of the Index.
ndim	Return an int representing the number of array dimensions.
nlevels	Number of levels in Index & MultiIndex.
shape	Return a tuple of the shape of the underlying data.

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size	Return an int representing the number of elements in this object.
spark_column	Spark Column object representing the Series/Index.
spark_type	Returns the data type as defined by Spark, as a Spark DataType object.
values	Return an array representing the data in the Index.

Properties

Index.is_monotonic	Return boolean if values in the object are monotonically increasing.
Index.is_monotonic_increasing	Return boolean if values in the object are monotonically increasing.
Index.is_monotonic_decreasing	Return boolean if values in the object are monotonically decreasing.
Index.is_unique	Return if the index has unique values.
Index.has_duplicates	If index has duplicates, return True, otherwise False.
Index.hasnans	Return True if it has any missing values.
Index.dtype	Return the dtype object of the underlying data.
Index.inferred_type	Return a string of the type inferred from the values.
Index.is_all_dates	Return if all data types of the index are datetime.
Index.shape	Return a tuple of the shape of the underlying data.
Index.name	Return name of the Index.
Index.names	Return names of the Index.
Index.ndim	Return an int representing the number of array dimensions.
Index.size	Return an int representing the number of elements in this object.
Index.nlevels	Number of levels in Index & MultiIndex.
Index.empty	Returns true if the current object is empty.
Index.T	Return the transpose, For index, It will be index itself.
Index.values	Return an array representing the data in the Index.

databricks.koalas.Index.is_monotonic

property Index.**is_monotonic**

Return boolean if values in the object are monotonically increasing.

Note: the current implementation of is_monotonic requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['1/1/2018', '3/1/2018', '4/1/2018'])
>>> ser.is_monotonic
True
```

```
>>> df = ks.DataFrame({'dates': [None, '1/1/2018', '2/1/2018', '3/1/2018']})
>>> df.dates.is_monotonic
False
```

```
>>> df.index.is_monotonic
True
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic
False
```

```
>>> ser.index.is_monotonic
True
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic
True
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'a'), ('z', 'b'), ('y', 'c'), ('y', 'd'), ('x', 'e')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
```

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```
>>> midx.is_monotonic
False
```

databricks.koalas.Index.is_monotonic_increasing

property Index.**is_monotonic_increasing**

Return boolean if values in the object are monotonically increasing.

Note: the current implementation of is_monotonic requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['1/1/2018', '3/1/2018', '4/1/2018'])
>>> ser.is_monotonic
True
```

```
>>> df = ks.DataFrame({'dates': [None, '1/1/2018', '2/1/2018', '3/1/2018']})
>>> df.dates.is_monotonic
False
```

```
>>> df.index.is_monotonic
True
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic
False
```

```
>>> ser.index.is_monotonic
True
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic
True
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'a'), ('z', 'b'), ('y', 'c'), ('y', 'd'), ('x', 'e')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
>>> midx.is_monotonic
False
```

databricks.koalas.Index.is_monotonic_decreasing

property Index.**is_monotonic_decreasing**

Return boolean if values in the object are monotonically decreasing.

Note: the current implementation of is_monotonic_decreasing requires to shuffle and aggregate multiple times to check the order locally and globally, which is potentially expensive. In case of multi-index, all data are transferred to single node which can easily cause out-of-memory error currently.

Returns

is_monotonic [bool]

Examples

```
>>> ser = ks.Series(['4/1/2018', '3/1/2018', '1/1/2018'])
>>> ser.is_monotonic_decreasing
True
```

```
>>> df = ks.DataFrame({'dates': [None, '3/1/2018', '2/1/2018', '1/1/2018']})
>>> df.dates.is_monotonic_decreasing
False
```

```
>>> df.index.is_monotonic_decreasing
False
```

```
>>> ser = ks.Series([1])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser = ks.Series([])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser.rename("a").to_frame().set_index("a").index.is_monotonic_decreasing
True
```

```
>>> ser = ks.Series([5, 4, 3, 2, 1], index=[1, 2, 3, 4, 5])
>>> ser.is_monotonic_decreasing
True
```

```
>>> ser.index.is_monotonic_decreasing
False
```

Support for MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples(
... [('x', 'a'), ('x', 'b'), ('y', 'c'), ('y', 'd'), ('z', 'e')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('z', 'e')],
           )
>>> midx.is_monotonic_decreasing
False
```

```
>>> midx = ks.MultiIndex.from_tuples(
... [('z', 'e'), ('z', 'd'), ('y', 'c'), ('y', 'b'), ('x', 'a')])
>>> midx
MultiIndex([('z', 'a'),
            ('z', 'b'),
            ('y', 'c'),
            ('y', 'd'),
            ('x', 'e')],
           )
>>> midx.is_monotonic_decreasing
True
```

databricks.koalas.Index.is_unique

property Index.**is_unique**

Return if the index has unique values.

Examples

```
>>> idx = ks.Index([1, 5, 7, 7])
>>> idx.is_unique
False
```

```
>>> idx = ks.Index([1, 5, 7])
>>> idx.is_unique
True
```

```
>>> idx = ks.Index(["Watermelon", "Orange", "Apple",
...                 "Watermelon"])
>>> idx.is_unique
False
```

```
>>> idx = ks.Index(["Orange", "Apple",
...                 "Watermelon"])
>>> idx.is_unique
True
```

databricks.koalas.Index.has_duplicates

property Index.**has_duplicates**

If index has duplicates, return True, otherwise False.

Examples

```
>>> idx = ks.Index([1, 5, 7, 7])
>>> idx.has_duplicates
True
```

```
>>> idx = ks.Index([1, 5, 7])
>>> idx.has_duplicates
False
```

```
>>> idx = ks.Index(["Watermelon", "Orange", "Apple",
...                 "Watermelon"])
>>> idx.has_duplicates
True
```

```
>>> idx = ks.Index(["Orange", "Apple",
...                 "Watermelon"])
>>> idx.has_duplicates
False
```

databricks.koalas.Index.hasnans

property Index.**hasnans**

Return True if it has any missing values. Otherwise, it returns False.

```
>>> ks.DataFrame({}, index=list('abc')).index.hasnans
False
```

```
>>> ks.Series(['a', None]).hasnans
True
```

```
>>> ks.Series([1.0, 2.0, np.nan]).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).hasnans
False
```

```
>>> (ks.Series([1.0, 2.0, np.nan]) + 1).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).rename("a").to_frame().set_index("a").index.hasnans
False
```

databricks.koalas.Index.dtype

property Index.**dtype**

Return the dtype object of the underlying data.

Examples

```
>>> s = ks.Series([1, 2, 3])
>>> s.dtype
dtype('int64')
```

```
>>> s = ks.Series(list('abc'))
>>> s.dtype
dtype('O')
```

```
>>> s = ks.Series(pd.date_range('20130101', periods=3))
>>> s.dtype
dtype('<M8[ns]')
```

```
>>> s.rename("a").to_frame().set_index("a").index.dtype
dtype('<M8[ns]')
```

databricks.koalas.Index.inferred_type

property Index.**inferred_type**
Return a string of the type inferred from the values.

Examples

```
>>> from datetime import datetime
>>> ks.Index([1, 2, 3]).inferred_type
'integer'
```

```
>>> ks.Index([1.0, 2.0, 3.0]).inferred_type
'floating'
```

```
>>> ks.Index(['a', 'b', 'c']).inferred_type
'string'
```

```
>>> ks.Index([True, False, True, False]).inferred_type
'boolean'
```

databricks.koalas.Index.is_all_dates

property Index.**is_all_dates**
Return if all data types of the index are datetime. remember that since Koalas does not support multiple data types in an index, so it returns True if any type of data is datetime.

Examples

```
>>> from datetime import datetime
```

```
>>> idx = ks.Index([datetime(2019, 1, 1, 0, 0, 0), datetime(2019, 2, 3, 0, 0, 0)])
>>> idx
DatetimeIndex(['2019-01-01', '2019-02-03'], dtype='datetime64[ns]', freq=None)
```

```
>>> idx.is_all_dates
True
```

```
>>> idx = ks.Index([datetime(2019, 1, 1, 0, 0, 0), None])
>>> idx
DatetimeIndex(['2019-01-01', 'NaT'], dtype='datetime64[ns]', freq=None)
```

```
>>> idx.is_all_dates
True
```

```
>>> idx = ks.Index([0, 1, 2])
>>> idx
Int64Index([0, 1, 2], dtype='int64')
```

```
>>> idx.is_all_dates
False
```

databricks.koalas.Index.shape

property Index.**shape**
Return a tuple of the shape of the underlying data.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
>>> idx.shape
(3,)
```

```
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
>>> midx.shape
(3,)
```

databricks.koalas.Index.name

property Index.**name**
Return name of the Index.

databricks.koalas.Index.names

property Index.**names**
Return names of the Index.

databricks.koalas.Index.ndim

property Index.**ndim**
Return an int representing the number of array dimensions.

Return 1 for Series / Index / MultiIndex.

Examples

For Series

```
>>> s = ks.Series([None, 1, 2, 3, 4], index=[4, 5, 2, 1, 8])
>>> s.ndim
1
```

For Index

```
>>> s.index.ndim
1
```

For MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index.ndim
1
```

databricks.koalas.Index.size

property Index.**size**

Return an int representing the number of elements in this object.

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'],
...                   index=list('abcd'))
>>> df.index.size
4
```

```
>>> df.set_index('dogs', append=True).index.size
4
```

databricks.koalas.Index.nlevels

property Index.**nlevels**

Number of levels in Index & MultiIndex.

Examples

```
>>> kdf = ks.DataFrame({"a": [1, 2, 3]}, index=pd.Index(['a', 'b', 'c'], name="idx
↪"))
>>> kdf.index.nlevels
1
```

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3]}, index=[list('abc'), list('def')])
>>> kdf.index.nlevels
2
```

databricks.koalas.Index.empty

property Index.**empty**

Returns true if the current object is empty. Otherwise, returns false.

```
>>> ks.range(10).id.empty
False
```

```
>>> ks.range(0).id.empty
True
```

```
>>> ks.DataFrame({}, index=list('abc')).index.empty
False
```

databricks.koalas.Index.T

property Index.**T**

Return the transpose, For index, It will be index itself.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
```

```
>>> idx.transpose()
Index(['a', 'b', 'c'], dtype='object')
```

For MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

```
>>> midx.transpose()
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

databricks.koalas.Index.values

property Index.**values**

Return an array representing the data in the Index.

Warning: We recommend using *Index.to_numpy()* instead.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

Examples

```
>>> ks.Series([1, 2, 3, 4]).index.values
array([0, 1, 2, 3])
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[[1, 2, 3], [4, 5, 6]]).index.
↪values
array([(1, 4), (2, 5), (3, 6)], dtype=object)
```

Modifying and computations

Index.all([axis])	Return whether all elements are True.
Index.any([axis])	Return whether any element is True.
Index.argmin()	Return a minimum argument indexer.
Index.argmax()	Return a maximum argument indexer.
Index.copy([name, deep])	Make a copy of this object.
Index.delete(loc)	Make new Index with passed location(-s) deleted.
Index.equals(other)	Determine if two Index objects contain the same elements.
Index.identical(other)	Similar to equals, but check that other comparable attributes are also equal.
Index.insert(loc, item)	Make new Index inserting new item at location.
Index.is_boolean()	Return if the current index type is a boolean type.
Index.is_categorical()	Return if the current index type is a categorical type.
Index.is_floating()	Return if the current index type is a floating type.
Index.is_integer()	Return if the current index type is a integer type.

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Index.is_interval()	Return if the current index type is an interval type.
Index.is_numeric()	Return if the current index type is a numeric type.
Index.is_object()	Return if the current index type is a object type.
Index.drop(labels)	Make new Index with passed list of labels deleted.
Index.drop_duplicates()	Return Index with duplicate values removed.
Index.min()	Return the minimum value of the Index.
Index.max()	Return the maximum value of the Index.
Index.rename(name[, inplace])	Alter Index or MultiIndex name.
Index.repeat(repeats)	Repeat elements of a Index/MultiIndex.
Index.take(indices)	Return the elements in the given *positional* indices along an axis.
Index.unique([level])	Return unique values in the index.
Index.nunique([dropna, approx, rsd])	Return number of unique elements in the object.
Index.value_counts([normalize, sort, . . .])	Return a Series containing counts of unique values.

databricks.koalas.Index.all

Index.**all**(*axis: Union[int, str] = 0*) → bool

Return whether all elements are True.

Returns True unless there at least one element within a series that is False or equivalent (e.g. zero or empty)

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Examples

```
>>> ks.Series([True, True]).all()
True
```

```
>>> ks.Series([True, False]).all()
False
```

```
>>> ks.Series([0, 1]).all()
False
```

```
>>> ks.Series([1, 2, 3]).all()
True
```

```
>>> ks.Series([True, True, None]).all()
True
```

```
>>> ks.Series([True, False, None]).all()
False
```

```
>>> ks.Series([]).all()
True
```

```
>>> ks.Series([np.nan]).all()
True
```

```
>>> df = ks.Series([True, False, None]).rename("a").to_frame()
>>> df.set_index("a").index.all()
False
```

databricks.koalas.Index.any

Index.**any**(*axis: Union[int, str] = 0*) → bool

Return whether any element is True.

Returns False unless there at least one element within a series that is True or equivalent (e.g. non-zero or non-empty).

Parameters

axis [{0 or 'index'}, default 0] Indicate which axis or axes should be reduced.

- 0 / 'index' : reduce the index, return a Series whose index is the original column labels.

Examples

```
>>> ks.Series([False, False]).any()
False
```

```
>>> ks.Series([True, False]).any()
True
```

```
>>> ks.Series([0, 0]).any()
False
```

```
>>> ks.Series([0, 1, 2]).any()
True
```

```
>>> ks.Series([False, False, None]).any()
False
```

```
>>> ks.Series([True, False, None]).any()
True
```

```
>>> ks.Series([]).any()
False
```

```
>>> ks.Series([np.nan]).any()
False
```

```
>>> df = ks.Series([True, False, None]).rename("a").to_frame()
>>> df.set_index("a").index.any()
True
```

databricks.koalas.Index.argmin

Index.**argmin**() → int

Return a minimum argument indexer.

Parameters

skipna [bool, default True]

Returns

minimum argument indexer

Examples

```
>>> kidx = ks.Index([10, 9, 8, 7, 100, 5, 4, 3, 100, 3])
>>> kidx
Int64Index([10, 9, 8, 7, 100, 5, 4, 3, 100, 3], dtype='int64')
```

```
>>> kidx.argmin()
7
```

databricks.koalas.Index.argmax

Index.**argmax**() → int

Return a maximum argument indexer.

Parameters

skipna [bool, default True]

Returns

maximum argument indexer

Examples

```
>>> kidx = ks.Index([10, 9, 8, 7, 100, 5, 4, 3, 100, 3])
>>> kidx
Int64Index([10, 9, 8, 7, 100, 5, 4, 3, 100, 3], dtype='int64')
```

```
>>> kidx.argmax()
4
```

databricks.koalas.Index.copy

Index.**copy**(*name=None*, *deep=None*) → databricks.koalas.indexes.Index
Make a copy of this object. name sets those attributes on the new object.

Parameters

name [string, optional] to set name of index

deep [None] this parameter is not supported but just dummy parameter to match pandas.

Examples

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df
            max_speed  shield
cobra               1       2
viper               4       5
sidewinder          7       8
>>> df.index
Index(['cobra', 'viper', 'sidewinder'], dtype='object')
```

Copy index

```
>>> df.index.copy()
Index(['cobra', 'viper', 'sidewinder'], dtype='object')
```

Copy index with name

```
>>> df.index.copy(name='snake')
Index(['cobra', 'viper', 'sidewinder'], dtype='object', name='snake')
```

databricks.koalas.Index.delete

Index.**delete**(*loc*) → databricks.koalas.indexes.Index
Make new Index with passed location(-s) deleted.

Note: this API can be pretty expensive since it is based on a global sequence internally.

Returns

new_index [Index]

Examples

```
>>> kidx = ks.Index([10, 10, 9, 8, 4, 2, 4, 4, 2, 2, 10, 10])
>>> kidx
Int64Index([10, 10, 9, 8, 4, 2, 4, 4, 2, 2, 10, 10], dtype='int64')
```

```
>>> kidx.delete(0).sort_values()
Int64Index([2, 2, 2, 4, 4, 4, 8, 9, 10, 10, 10], dtype='int64')
```

```
>>> kidx.delete([0, 1, 2, 3, 10, 11]).sort_values()
Int64Index([2, 2, 2, 4, 4, 4], dtype='int64')
```

MultiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2), ('c', 'z',␣
↪3)])
>>> kidx
MultiIndex([('a', 'x', 1),
            ('b', 'y', 2),
            ('c', 'z', 3)],
           )
```

```
>>> kidx.delete([0, 2]).sort_values()
MultiIndex([('b', 'y', 2)],
           )
```

databricks.koalas.Index.equals

Index.**equals**(*other*) → bool

Determine if two Index objects contain the same elements.

Returns

bool True if "other" is an Index and it has the same elements as calling index; False otherwise.

Examples

```
>>> from databricks.koalas.config import option_context
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx.name = "name"
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx.names = ("nameA", "nameB")
```

For Index

```
>>> idx.equals(idx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.equals(ks.Index(['a', 'b', 'c']))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.equals(ks.Index(['b', 'b', 'a']))
False
```

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```
>>> idx.equals(midx)
False
```

For MultiIndex

```
>>> midx.equals(midx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.equals(ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z
↪')]))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.equals(ks.MultiIndex.from_tuples([('c', 'z'), ('b', 'y'), ('a', 'x
↪')]))
False
>>> midx.equals(idx)
False
```

databricks.koalas.Index.identical

`Index.`**`identical`**(*other*) → bool

Similar to equals, but check that other comparable attributes are also equal.

Returns

bool If two Index objects have equal elements and same type True, otherwise False.

Examples

```
>>> from databricks.koalas.config import option_context
>>> idx = ks.Index(['a', 'b', 'c'])
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
```

For Index

```
>>> idx.identical(idx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.identical(ks.Index(['a', 'b', 'c']))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.identical(ks.Index(['b', 'b', 'a']))
False
>>> idx.identical(midx)
False
```

For MultiIndex

```
>>> midx.identical(midx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.identical(ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z
↪')]))
True
```

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```
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.identical(ks.MultiIndex.from_tuples([('c', 'z'), ('b', 'y'), ('a', 'x
↪')]))
False
>>> midx.identical(idx)
False
```

databricks.koalas.Index.insert

`Index.insert` (*loc: int*, *item*) → databricks.koalas.indexes.Index

Make new Index inserting new item at location.

Follows Python list.append semantics for negative values.

Parameters

loc [int]

item [object]

Returns

new_index [Index]

Examples

```
>>> kidx = ks.Index([1, 2, 3, 4, 5])
>>> kidx.insert(3, 100)
Int64Index([1, 2, 3, 100, 4, 5], dtype='int64')
```

For negative values

```
>>> kidx = ks.Index([1, 2, 3, 4, 5])
>>> kidx.insert(-3, 100)
Int64Index([1, 2, 100, 3, 4, 5], dtype='int64')
```

databricks.koalas.Index.is_boolean

`Index.is_boolean` () → bool

Return if the current index type is a boolean type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[True]).index.is_boolean()
True
```

databricks.koalas.Index.is_categorical

Index.**is_categorical**() → bool
Return if the current index type is a categorical type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[1]).index.is_categorical()
False
```

databricks.koalas.Index.is_floating

Index.**is_floating**() → bool
Return if the current index type is a floating type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[1]).index.is_floating()
False
```

databricks.koalas.Index.is_integer

Index.**is_integer**() → bool
Return if the current index type is a integer type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[1]).index.is_integer()
True
```

databricks.koalas.Index.is_interval

Index.**is_interval**() → bool
Return if the current index type is an interval type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[1]).index.is_interval()
False
```

databricks.koalas.Index.is_numeric

Index.**is_numeric**() → bool
Return if the current index type is a numeric type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=[1]).index.is_numeric()
True
```

databricks.koalas.Index.is_object

Index.**is_object**() → bool
Return if the current index type is a object type.

Examples

```
>>> ks.DataFrame({'a': [1]}, index=["a"]).index.is_object()
True
```

databricks.koalas.Index.drop

Index.**drop**(*labels*) → databricks.koalas.indexes.Index
Make new Index with passed list of labels deleted.

Parameters

labels [array-like]

Returns

dropped [Index]

Examples

```
>>> index = ks.Index([1, 2, 3])
>>> index
Int64Index([1, 2, 3], dtype='int64')
```

```
>>> index.drop([1])
Int64Index([2, 3], dtype='int64')
```

databricks.koalas.Index.drop_duplicates

Index.**drop_duplicates**() → databricks.koalas.indexes.Index
Return Index with duplicate values removed.

Returns

deduplicated [Index]

See also:

Series.drop_duplicates Equivalent method on Series.

DataFrame.drop_duplicates Equivalent method on DataFrame.

Examples

Generate an pandas.Index with duplicate values.

```
>>> idx = ks.Index(['lama', 'cow', 'lama', 'beetle', 'lama', 'hippo'])
```

```
>>> idx.drop_duplicates().sort_values()
Index(['beetle', 'cow', 'hippo', 'lama'], dtype='object')
```

databricks.koalas.Index.min

Index.**min**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], . . .]]
Return the minimum value of the Index.

Returns

scalar Minimum value.

See also:

Index.max Return the maximum value of the object.

Series.min Return the minimum value in a Series.

DataFrame.min Return the minimum values in a DataFrame.

Examples

```
>>> idx = ks.Index([3, 2, 1])
>>> idx.min()
1
```

```
>>> idx = ks.Index(['c', 'b', 'a'])
>>> idx.min()
'a'
```

For a MultiIndex, the maximum is determined lexicographically.

```
>>> idx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2)])
>>> idx.min()
('a', 'x', 1)
```

databricks.koalas.Index.max

Index.**max**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return the maximum value of the Index.

Returns

scalar Maximum value.

See also:

Index.min Return the minimum value in an Index.

Series.max Return the maximum value in a Series.

DataFrame.max Return the maximum values in a DataFrame.

Examples

```
>>> idx = ks.Index([3, 2, 1])
>>> idx.max()
3
```

```
>>> idx = ks.Index(['c', 'b', 'a'])
>>> idx.max()
'c'
```

For a MultiIndex, the maximum is determined lexicographically.

```
>>> idx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2)])
>>> idx.max()
('b', 'y', 2)
```

databricks.koalas.Index.rename

Index.**rename**(*name: Union[Any, Tuple, List[Union[Any, Tuple]]]*, *inplace: bool = False*) → Optional[databricks.koalas.indexes.Index]

Alter Index or MultiIndex name. Able to set new names without level. Defaults to returning new index.

Parameters

name [label or list of labels] Name(s) to set.

inplace [boolean, default False] Modifies the object directly, instead of creating a new Index or MultiIndex.

Returns

Index or MultiIndex The same type as the caller or None if inplace is True.

Examples

```
>>> df = ks.DataFrame({'a': ['A', 'C'], 'b': ['A', 'B']}, columns=['a', 'b'])
>>> df.index.rename("c")
Int64Index([0, 1], dtype='int64', name='c')
```

```
>>> df.set_index("a", inplace=True)
>>> df.index.rename("d")
Index(['A', 'C'], dtype='object', name='d')
```

You can also change the index name in place.

```
>>> df.index.rename("e", inplace=True)
>>> df.index
Index(['A', 'C'], dtype='object', name='e')
```

```
>>> df
   b
e
A  A
C  B
```

Support for MultiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y')])
>>> kidx.names = ['hello', 'koalas']
>>> kidx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['hello', 'koalas'])
```

```
>>> kidx.rename(['aloha', 'databricks'])
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['aloha', 'databricks'])
```

databricks.koalas.Index.repeat

`Index.`**`repeat`**(*repeats: int*) → databricks.koalas.indexes.Index

Repeat elements of a Index/MultiIndex.

Returns a new Index/MultiIndex where each element of the current Index/MultiIndex is repeated consecutively a given number of times.

Parameters

repeats [int] The number of repetitions for each element. This should be a non-negative integer. Repeating 0 times will return an empty Index.

Returns

repeated_index [Index/MultiIndex] Newly created Index/MultiIndex with repeated elements.

See also:

Series.repeat Equivalent function for Series.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
>>> idx.repeat(2)
Index(['a', 'b', 'c', 'a', 'b', 'c'], dtype='object')
```

For MultiIndex,

```
>>> midx = ks.MultiIndex.from_tuples([('x', 'a'), ('x', 'b'), ('y', 'c')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c')],
           )
>>> midx.repeat(2)
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('x', 'a'),
            ('x', 'b'),
            ('y', 'c')],
           )
>>> midx.repeat(0)
MultiIndex([], )
```

databricks.koalas.Index.take

`Index.take`(*indices*) → Union[Series, Index]

Return the elements in the given *positional* indices along an axis.

This means that we are not indexing according to actual values in the index attribute of the object. We are indexing according to the actual position of the element in the object.

Parameters

indices [array-like] An array of ints indicating which positions to take.

Returns

taken [same type as caller] An array-like containing the elements taken from the object.

See also:

DataFrame.loc Select a subset of a DataFrame by labels.

DataFrame.iloc Select a subset of a DataFrame by positions.

numpy.take Take elements from an array along an axis.

Examples

Series

```
>>> kser = ks.Series([100, 200, 300, 400, 500])
>>> kser
0    100
1    200
2    300
3    400
4    500
dtype: int64
```

```
>>> kser.take([0, 2, 4]).sort_index()
0    100
2    300
4    500
dtype: int64
```

Index

```
>>> kidx = ks.Index([100, 200, 300, 400, 500])
>>> kidx
Int64Index([100, 200, 300, 400, 500], dtype='int64')
```

```
>>> kidx.take([0, 2, 4]).sort_values()
Int64Index([100, 300, 500], dtype='int64')
```

MultiIndex

```
>>> kmidx = ks.MultiIndex.from_tuples([("x", "a"), ("x", "b"), ("x", "c")])
>>> kmidx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('x', 'c')],
           )
```

```
>>> kmidx.take([0, 2])
MultiIndex([('x', 'a'),
            ('x', 'c')],
           )
```

databricks.koalas.Index.unique

`Index.`**`unique`**(*level=None*) → databricks.koalas.indexes.Index

Return unique values in the index.

Be aware the order of unique values might be different than pandas.Index.unique

Parameters

level [int or str, optional, default is None]

Returns

Index without duplicates

See also:

Series.unique

groupby.SeriesGroupBy.unique

Examples

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[1, 1, 3]).index.unique().sort_
↪values()
Int64Index([1, 3], dtype='int64')
```

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=['d', 'e', 'e']).index.unique().
↪sort_values()
Index(['d', 'e'], dtype='object')
```

MultiIndex

```
>>> ks.MultiIndex.from_tuples([("A", "X"), ("A", "Y"), ("A", "X")]).unique()
...
MultiIndex([('A', 'X'),
            ('A', 'Y')],
           )
```

databricks.koalas.Index.nunique

`Index.`**`nunique`**(*dropna: bool = True*, *approx: bool = False*, *rsd: float = 0.05*) → int

Return number of unique elements in the object. Excludes NA values by default.

Parameters

dropna [bool, default True] Don't include NaN in the count.

approx: bool, default False If False, will use the exact algorithm and return the exact number of unique. If True, it uses the HyperLogLog approximate algorithm, which is significantly faster for large amount of data. Note: This parameter is specific to Koalas and is not found in pandas.

rsd: float, default 0.05 Maximum estimation error allowed in the HyperLogLog algorithm. Note: Just like `approx` this parameter is specific to Koalas.

Returns

int

See also:

DataFrame.nunique Method nunique for DataFrame.

Series.count Count non-NA/null observations in the Series.

Examples

```
>>> ks.Series([1, 2, 3, np.nan]).nunique()
3
```

```
>>> ks.Series([1, 2, 3, np.nan]).nunique(dropna=False)
4
```

On big data, we recommend using the approximate algorithm to speed up this function. The result will be very close to the exact unique count.

```
>>> ks.Series([1, 2, 3, np.nan]).nunique(approx=True)
3
```

```
>>> idx = ks.Index([1, 1, 2, None])
>>> idx
Float64Index([1.0, 1.0, 2.0, nan], dtype='float64')
```

```
>>> idx.nunique()
2
```

```
>>> idx.nunique(dropna=False)
3
```

databricks.koalas.Index.value_counts

Index.**value_counts**(*normalize=False*, *sort=True*, *ascending=False*, *bins=None*, *dropna=True*) → Series

Return a Series containing counts of unique values. The resulting object will be in descending order so that the first element is the most frequently-occurring element. Excludes NA values by default.

Parameters

normalize [boolean, default False] If True then the object returned will contain the relative frequencies of the unique values.

sort [boolean, default True] Sort by values.

ascending [boolean, default False] Sort in ascending order.

bins [Not Yet Supported]

dropna [boolean, default True] Don't include counts of NaN.

Returns

counts [Series]

See also:

Series.count Number of non-NA elements in a Series.

Examples

For Series

```
>>> df = ks.DataFrame({'x':[0, 0, 1, 1, 1, np.nan]})
>>> df.x.value_counts()
1.0    3
0.0    2
Name: x, dtype: int64
```

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> df.x.value_counts(normalize=True)
1.0    0.6
0.0    0.4
Name: x, dtype: float64
```

dropna With *dropna* set to *False* we can also see NaN index values.

```
>>> df.x.value_counts(dropna=False)
1.0    3
0.0    2
NaN    1
Name: x, dtype: int64
```

For Index

```
>>> idx = ks.Index([3, 1, 2, 3, 4, np.nan])
>>> idx
Float64Index([3.0, 1.0, 2.0, 3.0, 4.0, nan], dtype='float64')
```

```
>>> idx.value_counts().sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

sort

With *sort* set to *False*, the result wouldn't be sorted by number of count.

```
>>> idx.value_counts(sort=True).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

normalize

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> idx.value_counts(normalize=True).sort_index()
1.0    0.2
2.0    0.2
3.0    0.4
```

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```
4.0    0.2
dtype: float64
```

dropna

With *dropna* set to *False* we can also see NaN index values.

```
>>> idx.value_counts(dropna=False).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
NaN    1
dtype: int64
```

For MultiIndex.

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index
MultiIndex([(  'lama', 'weight'),
            (  'lama', 'weight'),
            (  'lama', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon', 'weight'),
            ('falcon', 'length'),
            ('falcon', 'length')],
           )
```

```
>>> s.index.value_counts().sort_index()
(cow, length)       1
(cow, weight)       2
(falcon, length)    2
(falcon, weight)    1
(lama, weight)      3
dtype: int64
```

```
>>> s.index.value_counts(normalize=True).sort_index()
(cow, length)       0.111111
(cow, weight)       0.222222
(falcon, length)    0.222222
(falcon, weight)    0.111111
(lama, weight)      0.333333
dtype: float64
```

If Index has name, keep the name up.

```
>>> idx = ks.Index([0, 0, 0, 1, 1, 2, 3], name='koalas')
>>> idx.value_counts().sort_index()
0    3
1    2
```

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```
2    1
3    1
Name: koalas, dtype: int64
```

Compatibility with MultiIndex

Index.set_names(names[, level, inplace])	Set Index or MultiIndex name.

databricks.koalas.Index.set_names

Index.**set_names**(*names*, *level=None*, *inplace=False*) → Optional[databricks.koalas.indexes.Index]

Set Index or MultiIndex name. Able to set new names partially and by level.

Parameters

names [label or list of label] Name(s) to set.

level [int, label or list of int or label, optional] If the index is a MultiIndex, level(s) to set (None for all levels). Otherwise level must be None.

inplace [bool, default False] Modifies the object directly, instead of creating a new Index or MultiIndex.

Returns

Index The same type as the caller or None if inplace is True.

See also:

Index.rename Able to set new names without level.

Examples

```
>>> idx = ks.Index([1, 2, 3, 4])
>>> idx
Int64Index([1, 2, 3, 4], dtype='int64')
```

```
>>> idx.set_names('quarter')
Int64Index([1, 2, 3, 4], dtype='int64', name='quarter')
```

For MultiIndex

```
>>> idx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y')])
>>> idx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           )
```

```
>>> idx.set_names(['kind', 'year'], inplace=True)
>>> idx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['kind', 'year'])
```

```
>>> idx.set_names('species', level=0)
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['species', 'year'])
```

Compatibility with MultiIndex

Index.droplevel(level)	Return index with requested level(s) removed.

databricks.koalas.Index.droplevel

Index.**droplevel**(*level*) → databricks.koalas.indexes.Index

Return index with requested level(s) removed. If resulting index has only 1 level left, the result will be of Index type, not MultiIndex.

Parameters

level [int, str, tuple, or list-like, default 0] If a string is given, must be the name of a level If list-like, elements must be names or indexes of levels.

Returns

Index or MultiIndex

Examples

```
>>> midx = ks.DataFrame({'a': ['a', 'b']}, index=[['a', 'x'], ['b', 'y'], [1,␣
↪2]]).index
>>> midx
MultiIndex([('a', 'b', 1),
            ('x', 'y', 2)],
           )
>>> midx.droplevel([0, 1])
Int64Index([1, 2], dtype='int64')
>>> midx.droplevel(0)
MultiIndex([('b', 1),
            ('y', 2)],
           )
>>> midx.names = [("a", "b"), "b", "c"]
>>> midx.droplevel([('a', 'b')])
MultiIndex([('b', 1),
            ('y', 2)],
           names=['b', 'c'])
```

Missing Values

Index.fillna(value)	Fill NA/NaN values with the specified value.
Index.dropna()	Return Index or MultiIndex without NA/NaN values
Index.isna()	Detect existing (non-missing) values.
Index.notna()	Detect existing (non-missing) values.

databricks.koalas.Index.fillna

Index.**fillna**(*value: Union[int, float, str, bytes, decimal.Decimal, datetime.date, None]*) → databricks.koalas.indexes.Index

Fill NA/NaN values with the specified value.

Parameters

value [scalar] Scalar value to use to fill holes (e.g. 0). This value cannot be a list-likes.

Returns

Index : filled with value

Examples

```
>>> ki = ks.DataFrame({'a': ['a', 'b', 'c']}, index=[1, 2, None]).index
>>> ki
Float64Index([1.0, 2.0, nan], dtype='float64')
```

```
>>> ki.fillna(0)
Float64Index([1.0, 2.0, 0.0], dtype='float64')
```

databricks.koalas.Index.dropna

Index.**dropna**() → databricks.koalas.indexes.Index

Return Index or MultiIndex without NA/NaN values

Examples

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', None],
...                   columns=['max_speed', 'shield'])
>>> df
       max_speed  shield
cobra          1       2
viper          4       5
NaN            7       8
```

```
>>> df.index.dropna()
Index(['cobra', 'viper'], dtype='object')
```

Also support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       [None, 'weight', 'length']],
...                      [[0, 1, 1, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 1, 0, 1, 2, 1, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, None],
...               index=midx)
>>> s
lama    NaN        45.0
cow     weight    200.0
        weight      1.2
        NaN        30.0
        weight    250.0
        length      1.5
falcon  weight    320.0
        weight      1.0
        length      NaN
dtype: float64
```

```
>>> s.index.dropna()
MultiIndex([(   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon', 'weight'),
            ('falcon', 'weight'),
            ('falcon', 'length')],
           )
```

databricks.koalas.Index.isna

`Index.isna()` → Union[Series, Index]

Detect existing (non-missing) values.

Return a boolean same-sized object indicating if the values are NA. NA values, such as None or numpy.NaN, gets mapped to True values. Everything else gets mapped to False values. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True).

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser.isna()
0    False
1    False
2     True
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.isna()
Index([False, False, True], dtype='object', name='a')
```

databricks.koalas.Index.notna

Index.**notna**() → Union[Series, Index]

Detect existing (non-missing) values. Return a boolean same-sized object indicating if the values are not NA. Non-missing values get mapped to True. Characters such as empty strings '' or numpy.inf are not considered NA values (unless you set pandas.options.mode.use_inf_as_na = True). NA values, such as None or numpy.NaN, get mapped to False values.

Returns

Series or Index [Mask of bool values for each element in Series] that indicates whether an element is not an NA value.

Examples

Show which entries in a Series are not NA.

```
>>> ser = ks.Series([5, 6, np.NaN])
>>> ser
0    5.0
1    6.0
2    NaN
dtype: float64
```

```
>>> ser.notna()
0     True
1     True
2    False
dtype: bool
```

```
>>> ser.rename("a").to_frame().set_index("a").index.notna()
Index([True, True, False], dtype='object', name='a')
```

Conversion

Index.astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.
Index.item()	Return the first element of the underlying data as a python scalar.
Index.to_list()	Return a list of the values.
Index.to_series([name])	Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.
Index.to_frame([index, name])	Create a DataFrame with a column containing the Index.
Index.view()	this is defined as a copy with the same identity
Index.to_numpy([dtype, copy])	A NumPy ndarray representing the values in this Index or MultiIndex.

databricks.koalas.Index.astype

`Index.astype`(*dtype*) → Union[Index, Series]

Cast a Koalas object to a specified dtype `dtype`.

Parameters

dtype [data type] Use a numpy.dtype or Python type to cast entire pandas object to the same type.

Returns

casted [same type as caller]

See also:

to_datetime Convert argument to datetime.

Examples

```
>>> ser = ks.Series([1, 2], dtype='int32')
>>> ser
0    1
1    2
dtype: int32
```

```
>>> ser.astype('int64')
0    1
1    2
dtype: int64
```

```
>>> ser.rename("a").to_frame().set_index("a").index.astype('int64')
Int64Index([1, 2], dtype='int64', name='a')
```

databricks.koalas.Index.item

`Index.item`() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return the first element of the underlying data as a python scalar.

Returns

scalar The first element of Index.

Raises

ValueError If the data is not length-1.

Examples

```
>>> kidx = ks.Index([10])
>>> kidx.item()
10
```

databricks.koalas.Index.to_list

Index.**to_list**() → List

Return a list of the values.

These are each a scalar type, which is a Python scalar (for str, int, float) or a pandas scalar (for Timestamp/Timedelta/Interval/Period)

Note: This method should only be used if the resulting list is expected to be small, as all the data is loaded into the driver's memory.

Examples

Index

```
>>> idx = ks.Index([1, 2, 3, 4, 5])
>>> idx.to_list()
[1, 2, 3, 4, 5]
```

MultiIndex

```
>>> tuples = [(1, 'red'), (1, 'blue'), (2, 'red'), (2, 'green')]
>>> midx = ks.MultiIndex.from_tuples(tuples)
>>> midx.to_list()
[(1, 'red'), (1, 'blue'), (2, 'red'), (2, 'green')]
```

databricks.koalas.Index.to_series

Index.**to_series**(*name: Union[Any, Tuple] = None*) → databricks.koalas.series.Series

Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.

Parameters

name [string, optional] name of resulting Series. If None, defaults to name of original index

Returns

Series [dtype will be based on the type of the Index values.]

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'],
...                   index=list('abcd'))
>>> df['dogs'].index.to_series()
a    a
b    b
c    c
d    d
dtype: object
```

databricks.koalas.Index.to_frame

Index.**to_frame**(*index=True*, *name=None*) → databricks.koalas.frame.DataFrame

Create a DataFrame with a column containing the Index.

Parameters

index [boolean, default True] Set the index of the returned DataFrame as the original Index.

name [object, default None] The passed name should substitute for the index name (if it has one).

Returns

DataFrame DataFrame containing the original Index data.

See also:

Index.to_series Convert an Index to a Series.

Series.to_frame Convert Series to DataFrame.

Examples

```
>>> idx = ks.Index(['Ant', 'Bear', 'Cow'], name='animal')
>>> idx.to_frame()
       animal
animal
Ant       Ant
Bear     Bear
Cow       Cow
```

By default, the original Index is reused. To enforce a new Index:

```
>>> idx.to_frame(index=False)
  animal
0    Ant
1   Bear
2    Cow
```

To override the name of the resulting column, specify *name*:

```
>>> idx.to_frame(name='zoo')
          zoo
animal
Ant       Ant
Bear     Bear
Cow       Cow
```

databricks.koalas.Index.view

`Index.view()` → databricks.koalas.indexes.Index
this is defined as a copy with the same identity

databricks.koalas.Index.to_numpy

`Index.to_numpy`(*dtype=None*, *copy=False*) → numpy.ndarray
A NumPy ndarray representing the values in this Index or MultiIndex.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Parameters

dtype [str or numpy.dtype, optional] The dtype to pass to `numpy.asarray()`

copy [bool, default False] Whether to ensure that the returned value is a not a view on another array. Note that `copy=False` does not *ensure* that `to_numpy()` is no-copy. Rather, `copy=True` ensure that a copy is made, even if not strictly necessary.

Returns

numpy.ndarray

Examples

```
>>> ks.Series([1, 2, 3, 4]).index.to_numpy()
array([0, 1, 2, 3])
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[[1, 2, 3], [4, 5, 6]]).index.to_
↪numpy()
array([(1, 4), (2, 5), (3, 6)], dtype=object)
```

3.5.2 Spark-related

`Index.spark` provides features that does not exist in pandas but in Spark. These can be accessed by `Index.spark.<function/property>`.

Index.spark.data_type	Returns the data type as defined by Spark, as a Spark DataType object.
Index.spark.column	Spark Column object representing the Series/Index.

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Index.spark.transform(func)	Applies a function that takes and returns a Spark column.

databricks.koalas.Index.spark.data_type

property spark.**data_type**

Returns the data type as defined by Spark, as a Spark DataType object.

databricks.koalas.Index.spark.column

property spark.**column**

Spark Column object representing the Series/Index.

Note: This Spark Column object is strictly stick to its base DataFrame the Series/Index was derived from.

databricks.koalas.Index.spark.transform

spark.**transform**(*func*) → ks.Index

Applies a function that takes and returns a Spark column. It allows to natively apply a Spark function and column APIs with the Spark column internally used in Series or Index. The output length of the Spark column should be same as input's.

Note: It requires to have the same input and output length; therefore, the aggregate Spark functions such as count does not work.

Parameters

func [function] Function to use for transforming the data by using Spark columns.

Returns

Series or Index

Raises

ValueError [If the output from the function is not a Spark column.]

Examples

```
>>> from pyspark.sql.functions import log
>>> df = ks.DataFrame({"a": [1, 2, 3], "b": [4, 5, 6]}, columns=["a", "b"])
>>> df
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> df.a.spark.transform(lambda c: log(c))
0    0.000000
1    0.693147
2    1.098612
Name: a, dtype: float64
```

```
>>> df.index.spark.transform(lambda c: c + 10)
Int64Index([10, 11, 12], dtype='int64')
```

```
>>> df.a.spark.transform(lambda c: c + df.b.spark.column)
0    5
1    7
2    9
Name: a, dtype: int64
```

Sorting

Index.sort_values([ascending])	Return a sorted copy of the index.

databricks.koalas.Index.sort_values

Index.**sort_values**(*ascending=True*) → databricks.koalas.indexes.Index

Return a sorted copy of the index.

Note: This method is not supported for pandas when index has NaN value. pandas raises unexpected TypeError, but we support treating NaN as the smallest value.

Parameters

ascending [bool, default True] Should the index values be sorted in an ascending order.

Returns

sorted_index [ks.Index or ks.MultiIndex] Sorted copy of the index.

See also:

Series.sort_values Sort values of a Series.

DataFrame.sort_values Sort values in a DataFrame.

Examples

```
>>> idx = ks.Index([10, 100, 1, 1000])
>>> idx
Int64Index([10, 100, 1, 1000], dtype='int64')
```

Sort values in ascending order (default behavior).

```
>>> idx.sort_values()
Int64Index([1, 10, 100, 1000], dtype='int64')
```

Sort values in descending order.

```
>>> idx.sort_values(ascending=False)
Int64Index([1000, 100, 10, 1], dtype='int64')
```

Support for MultiIndex.

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('c', 'y', 2), ('b', 'z',␣
↪3)])
>>> kidx
MultiIndex([('a', 'x', 1),
            ('c', 'y', 2),
            ('b', 'z', 3)],
           )
```

```
>>> kidx.sort_values()
MultiIndex([('a', 'x', 1),
            ('b', 'z', 3),
            ('c', 'y', 2)],
           )
```

```
>>> kidx.sort_values(ascending=False)
MultiIndex([('c', 'y', 2),
            ('b', 'z', 3),
            ('a', 'x', 1)],
           )
```

Time-specific operations

Index.shift([periods, fill_value])	Shift Series/Index by desired number of periods.

databricks.koalas.Index.shift

Index.**shift**(*periods=1*, *fill_value=None*) → Union[Series, Index]

Shift Series/Index by desired number of periods.

Note: the current implementation of shift uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Parameters

periods [int] Number of periods to shift. Can be positive or negative.

fill_value [object, optional] The scalar value to use for newly introduced missing values. The default depends on the dtype of self. For numeric data, np.nan is used.

Returns

Copy of input Series/Index, shifted.

Examples

```
>>> df = ks.DataFrame({'Col1': [10, 20, 15, 30, 45],
...                    'Col2': [13, 23, 18, 33, 48],
...                    'Col3': [17, 27, 22, 37, 52]},
...                   columns=['Col1', 'Col2', 'Col3'])
```

```
>>> df.Col1.shift(periods=3)
0     NaN
1     NaN
2     NaN
3    10.0
4    20.0
Name: Col1, dtype: float64
```

```
>>> df.Col2.shift(periods=3, fill_value=0)
0     0
1     0
2     0
3    13
4    23
Name: Col2, dtype: int64
```

```
>>> df.index.shift(periods=3, fill_value=0)
Int64Index([0, 0, 0, 0, 1], dtype='int64')
```

Combining / joining / set operations

Index.append(other)	Append a collection of Index options together.
Index.intersection(other)	Form the intersection of two Index objects.
Index.union(other[, sort])	Form the union of two Index objects.
Index.difference(other[, sort])	Return a new Index with elements from the index that are not in *other*.
Index.symmetric_difference(other[, ...])	Compute the symmetric difference of two Index objects.

databricks.koalas.Index.append

Index.**append**(*other: databricks.koalas.indexes.Index*) → databricks.koalas.indexes.Index
Append a collection of Index options together.

Parameters

other [Index]

Returns

appended [Index]

Examples

```
>>> kidx = ks.Index([10, 5, 0, 5, 10, 5, 0, 10])
>>> kidx
Int64Index([10, 5, 0, 5, 10, 5, 0, 10], dtype='int64')
```

```
>>> kidx.append(kidx)
Int64Index([10, 5, 0, 5, 10, 5, 0, 10, 10, 5, 0, 5, 10, 5, 0, 10], dtype='int64')
```

Support for MiltiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y')])
>>> kidx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           )
```

```
>>> kidx.append(kidx)
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('a', 'x'),
            ('b', 'y')],
           )
```

databricks.koalas.Index.intersection

Index.**intersection**(*other*) → databricks.koalas.indexes.Index
Form the intersection of two Index objects.

This returns a new Index with elements common to the index and *other*.

Parameters

other [Index or array-like]

Returns

intersection [Index]

Examples

```
>>> idx1 = ks.Index([1, 2, 3, 4])
>>> idx2 = ks.Index([3, 4, 5, 6])
>>> idx1.intersection(idx2).sort_values()
Int64Index([3, 4], dtype='int64')
```

databricks.koalas.Index.union

`Index.`**`union`**(*other*, *sort=None*) → databricks.koalas.indexes.Index

Form the union of two Index objects.

Parameters

other [Index or array-like]

sort [bool or None, default None] Whether to sort the resulting Index.

Returns

union [Index]

Examples

Index

```
>>> idx1 = ks.Index([1, 2, 3, 4])
>>> idx2 = ks.Index([3, 4, 5, 6])
>>> idx1.union(idx2).sort_values()
Int64Index([1, 2, 3, 4, 5, 6], dtype='int64')
```

MultiIndex

```
>>> midx1 = ks.MultiIndex.from_tuples([("x", "a"), ("x", "b"), ("x", "c"), ("x",
↪"d")])
>>> midx2 = ks.MultiIndex.from_tuples([("x", "c"), ("x", "d"), ("x", "e"), ("x",
↪"f")])
>>> midx1.union(midx2).sort_values()
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('x', 'c'),
            ('x', 'd'),
            ('x', 'e'),
            ('x', 'f')],
           )
```

databricks.koalas.Index.difference

Index.**difference**(*other*, *sort=None*) → databricks.koalas.indexes.Index

Return a new Index with elements from the index that are not in *other*.

This is the set difference of two Index objects.

Parameters

other [Index or array-like]

sort [True or None, default None] Whether to sort the resulting index. * True : Attempt to sort the result. * None : Do not sort the result.

Returns

difference [Index]

Examples

```
>>> idx1 = ks.Index([2, 1, 3, 4])
>>> idx2 = ks.Index([3, 4, 5, 6])
>>> idx1.difference(idx2, sort=True)
Int64Index([1, 2], dtype='int64')
```

MultiIndex

```
>>> midx1 = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2), ('c', 'z',␣
↪3)])
>>> midx2 = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'z', 2), ('k', 'z',␣
↪3)])
>>> midx1.difference(midx2)
MultiIndex([('b', 'y', 2),
            ('c', 'z', 3)],
           )
```

databricks.koalas.Index.symmetric_difference

Index.**symmetric_difference**(*other*, *result_name=None*, *sort=None*) → databricks.koalas.indexes.Index

Compute the symmetric difference of two Index objects.

Parameters

other [Index or array-like]

result_name [str]

sort [True or None, default None] Whether to sort the resulting index. * True : Attempt to sort the result. * None : Do not sort the result.

Returns

symmetric_difference [Index]

Notes

`symmetric_difference` contains elements that appear in either `idx1` or `idx2` but not both. Equivalent to the Index created by `idx1.difference(idx2) | idx2.difference(idx1)` with duplicates dropped.

Examples

```
>>> s1 = ks.Series([1, 2, 3, 4], index=[1, 2, 3, 4])
>>> s2 = ks.Series([1, 2, 3, 4], index=[2, 3, 4, 5])
```

```
>>> s1.index.symmetric_difference(s2.index)
Int64Index([5, 1], dtype='int64')
```

You can set name of result Index.

```
>>> s1.index.symmetric_difference(s2.index, result_name='koalas')
Int64Index([5, 1], dtype='int64', name='koalas')
```

You can set sort to *True*, if you want to sort the resulting index.

```
>>> s1.index.symmetric_difference(s2.index, sort=True)
Int64Index([1, 5], dtype='int64')
```

You can also use the ^ operator:

```
>>> s1.index ^ s2.index
Int64Index([5, 1], dtype='int64')
```

Selecting

Index.asof(label)	Return the label from the index, or, if not present, the previous one.
Index.isin(values)	Check whether *values* are contained in Series or Index.

databricks.koalas.Index.asof

Index.**asof**(*label*) → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None]

Return the label from the index, or, if not present, the previous one.

Assuming that the index is sorted, return the passed index label if it is in the index, or return the previous index label if the passed one is not in the index.

Note: This API is dependent on *Index.is_monotonic_increasing()* which can be expensive.

Parameters

label [object] The label up to which the method returns the latest index label.

Returns

object The passed label if it is in the index. The previous label if the passed label is not in the sorted index or *NaN* if there is no such label.

Examples

Index.asof returns the latest index label up to the passed label.

```
>>> idx = ks.Index(['2013-12-31', '2014-01-02', '2014-01-03'])
>>> idx.asof('2014-01-01')
'2013-12-31'
```

If the label is in the index, the method returns the passed label.

```
>>> idx.asof('2014-01-02')
'2014-01-02'
```

If all of the labels in the index are later than the passed label, NaN is returned.

```
>>> idx.asof('1999-01-02')
nan
```

databricks.koalas.Index.isin

`Index.`**`isin`**`(`*values*`)` → Union[Series, Index]

Check whether *values* are contained in Series or Index.

Return a boolean Series or Index showing whether each element in the Series matches an element in the passed sequence of *values* exactly.

Parameters

values [list or set] The sequence of values to test.

Returns

isin [Series (bool dtype) or Index (bool dtype)]

Examples

```
>>> s = ks.Series(['lama', 'cow', 'lama', 'beetle', 'lama',
...                'hippo'], name='animal')
>>> s.isin(['cow', 'lama'])
0     True
1     True
2     True
3    False
4     True
5    False
Name: animal, dtype: bool
```

Passing a single string as `s.isin('lama')` will raise an error. Use a list of one element instead:

```
>>> s.isin(['lama'])
0     True
1    False
```

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```
2     True
3    False
4     True
5    False
Name: animal, dtype: bool
```

```
>>> s.rename("a").to_frame().set_index("a").index.isin(['lama'])
Index([True, False, True, False, True, False], dtype='object', name='a')
```

3.5.3 MultiIndex

MultiIndex	Koalas MultiIndex that corresponds to pandas MultiIndex logically.

databricks.koalas.MultiIndex

class databricks.koalas.**MultiIndex**

Koalas MultiIndex that corresponds to pandas MultiIndex logically. This might hold Spark Column internally.

Variables

- **_kdf** – The parent dataframe
- **_scol** – Spark Column instance

See also:

Index A single-level Index.

Examples

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[[1, 2, 3], [4, 5, 6]]).index
MultiIndex([(1, 4),
            (2, 5),
            (3, 6)],
           )
```

```
>>> ks.DataFrame({'a': [1, 2, 3]}, index=[list('abc'), list('def')]).index
MultiIndex([('a', 'd'),
            ('b', 'e'),
            ('c', 'f')],
           )
```

__init__(**args*, ***kwargs*)

Initialize self. See help(type(self)) for accurate signature.

Methods

__init__(*args, **kwargs)	Initialize self.
all(*args, **kwargs)	Return whether all elements are True.
any(*args, **kwargs)	Return whether any element is True.
append(other)	Append a collection of Index options together.
argmax()	Return a maximum argument indexer.
argmin()	Return a minimum argument indexer.
asof(label)	Return the label from the index, or, if not present, the previous one.
astype(dtype)	Cast a Koalas object to a specified dtype dtype.
copy([deep])	Make a copy of this object.
delete(loc)	Make new Index with passed location(-s) deleted.
difference(other[, sort])	Return a new Index with elements from the index that are not in *other*.
drop(codes[, level])	Make new MultiIndex with passed list of labels deleted
drop_duplicates()	Return Index with duplicate values removed.
droplevel(level)	Return index with requested level(s) removed.
dropna()	Return Index or MultiIndex without NA/NaN values
equals(other)	Determine if two Index objects contain the same elements.
fillna(value)	Fill NA/NaN values with the specified value.
from_arrays(arrays[, sortorder, names])	Convert arrays to MultiIndex.
from_frame(df[, names])	Make a MultiIndex from a DataFrame.
from_product(iterables[, sortorder, names])	Make a MultiIndex from the cartesian product of multiple iterables.
from_tuples(tuples[, sortorder, names])	Convert list of tuples to MultiIndex.
get_level_values(level)	Return vector of label values for requested level, equal to the length of the index.
holds_integer()	Whether the type is an integer type.
identical(other)	Similar to equals, but check that other comparable attributes are also equal.
insert(loc, item)	Make new MultiIndex inserting new item at location.
intersection(other)	Form the intersection of two Index objects.
is_boolean()	Return if the current index type is a boolean type.
is_categorical()	Return if the current index type is a categorical type.
is_floating()	Return if the current index type is a floating type.
is_integer()	Return if the current index type is a integer type.
is_interval()	Return if the current index type is an interval type.
is_numeric()	Return if the current index type is a numeric type.
is_object()	Return if the current index type is a object type.
is_type_compatible(kind)	Whether the index type is compatible with the provided type.
isin(values)	Check whether *values* are contained in Series or Index.
isna()	Detect existing (non-missing) values.
isnull()	Detect existing (non-missing) values.
item()	Return the first element of the underlying data as a python tuple.
max()	Return the maximum value of the Index.

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min()	Return the minimum value of the Index.
notna()	Detect existing (non-missing) values.
notnull()	Detect existing (non-missing) values.
nunique([dropna])	Return number of unique elements in the object.
rename(name[, inplace])	Alter Index or MultiIndex name.
repeat(repeats)	Repeat elements of a Index/MultiIndex.
set_names(names[, level, inplace])	Set Index or MultiIndex name.
shift([periods, fill_value])	Shift Series/Index by desired number of periods.
sort(*args, **kwargs)	Use sort_values instead.
sort_values([ascending])	Return a sorted copy of the index.
swaplevel([i, j])	Swap level i with level j.
symmetric_difference(other[, result_name, sort])	Compute the symmetric difference of two MultiIndex objects.
take(indices)	Return the elements in the given *positional* indices along an axis.
toPandas()	Return a pandas MultiIndex.
to_frame([index, name])	Create a DataFrame with the levels of the MultiIndex as columns.
to_list()	Return a list of the values.
to_numpy([dtype, copy])	A NumPy ndarray representing the values in this Index or MultiIndex.
to_pandas()	Return a pandas MultiIndex.
to_series([name])	Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.
tolist()	Return a list of the values.
transpose()	Return the transpose, For index, It will be index itself.
union(other[, sort])	Form the union of two Index objects.
unique([level])	Return unique values in the index.
value_counts([normalize, sort, ascending, ...])	Return a Series containing counts of unique values.
view()	this is defined as a copy with the same identity

Attributes

T	Return the transpose, For index, It will be index itself.
asi8	Integer representation of the values.
dtype	Return the dtype object of the underlying data.
empty	Returns true if the current object is empty.
has_duplicates	If index has duplicates, return True, otherwise False.
hasnans	Return True if it has any missing values.
inferred_type	Return a string of the type inferred from the values.
is_all_dates	is_all_dates always returns False for MultiIndex
is_monotonic	Return boolean if values in the object are monotonically increasing.
is_monotonic_decreasing	Return boolean if values in the object are monotonically decreasing.

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is_monotonic_increasing	Return boolean if values in the object are monotonically increasing.
is_unique	Return if the index has unique values.
levshape	A tuple with the length of each level.
name	Return name of the Index.
names	Return names of the Index.
ndim	Return an int representing the number of array dimensions.
nlevels	Number of levels in Index & MultiIndex.
shape	Return a tuple of the shape of the underlying data.
size	Return an int representing the number of elements in this object.
spark_column	Spark Column object representing the Series/Index.
spark_type	Returns the data type as defined by Spark, as a Spark DataType object.
values	Return an array representing the data in the Index.

MultiIndex Constructors

MultiIndex.from_arrays(arrays[, sortorder, ...])	Convert arrays to MultiIndex.
MultiIndex.from_tuples(tuples[, sortorder, ...])	Convert list of tuples to MultiIndex.
MultiIndex.from_product(iterables[, ...])	Make a MultiIndex from the cartesian product of multiple iterables.
MultiIndex.from_frame(df[, names])	Make a MultiIndex from a DataFrame.

databricks.koalas.MultiIndex.from_arrays

static MultiIndex.**from_arrays**(*arrays*, *sortorder=None*, *names=None*) → databricks.koalas.indexes.MultiIndex

Convert arrays to MultiIndex.

Parameters

arrays: list / sequence of array-likes Each array-like gives one level's value for each data point. len(arrays) is the number of levels.

sortorder: int or None Level of sortedness (must be lexicographically sorted by that level).

names: list / sequence of str, optional Names for the levels in the index.

Returns

index: MultiIndex

Examples

```
>>> arrays = [[1, 1, 2, 2], ['red', 'blue', 'red', 'blue']]
>>> ks.MultiIndex.from_arrays(arrays, names=('number', 'color'))
MultiIndex([(1,  'red'),
            (1, 'blue'),
            (2,  'red'),
            (2, 'blue')],
           names=['number', 'color'])
```

databricks.koalas.MultiIndex.from_tuples

static MultiIndex.**from_tuples**(*tuples*, *sortorder=None*, *names=None*) → databricks.koalas.indexes.MultiIndex

Convert list of tuples to MultiIndex.

Parameters

tuples [list / sequence of tuple-likes] Each tuple is the index of one row/column.

sortorder [int or None] Level of sortedness (must be lexicographically sorted by that level).

names [list / sequence of str, optional] Names for the levels in the index.

Returns

index [MultiIndex]

Examples

```
>>> tuples = [(1, 'red'), (1, 'blue'),
...           (2, 'red'), (2, 'blue')]
>>> ks.MultiIndex.from_tuples(tuples, names=('number', 'color'))
MultiIndex([(1,  'red'),
            (1, 'blue'),
            (2,  'red'),
            (2, 'blue')],
           names=['number', 'color'])
```

databricks.koalas.MultiIndex.from_product

static MultiIndex.**from_product**(*iterables*, *sortorder=None*, *names=None*) → databricks.koalas.indexes.MultiIndex

Make a MultiIndex from the cartesian product of multiple iterables.

Parameters

iterables [list / sequence of iterables] Each iterable has unique labels for each level of the index.

sortorder [int or None] Level of sortedness (must be lexicographically sorted by that level).

names [list / sequence of str, optional] Names for the levels in the index.

Returns

index [MultiIndex]

See also:

MultiIndex.from_arrays Convert list of arrays to MultiIndex.

MultiIndex.from_tuples Convert list of tuples to MultiIndex.

Examples

```
>>> numbers = [0, 1, 2]
>>> colors = ['green', 'purple']
>>> ks.MultiIndex.from_product([numbers, colors],
...                            names=['number', 'color'])
MultiIndex([(0,  'green'),
            (0, 'purple'),
            (1,  'green'),
            (1, 'purple'),
            (2,  'green'),
            (2, 'purple')],
           names=['number', 'color'])
```

databricks.koalas.MultiIndex.from_frame

static MultiIndex.**from_frame**(*df*, *names=None*) → databricks.koalas.indexes.MultiIndex

Make a MultiIndex from a DataFrame.

Parameters

df [DataFrame] DataFrame to be converted to MultiIndex.

names [list-like, optional] If no names are provided, use the column names, or tuple of column names if the columns is a MultiIndex. If a sequence, overwrite names with the given sequence.

Returns

MultiIndex The MultiIndex representation of the given DataFrame.

See also:

MultiIndex.from_arrays Convert list of arrays to MultiIndex.

MultiIndex.from_tuples Convert list of tuples to MultiIndex.

MultiIndex.from_product Make a MultiIndex from cartesian product of iterables.

Examples

```
>>> df = ks.DataFrame([['HI', 'Temp'], ['HI', 'Precip'],
...                    ['NJ', 'Temp'], ['NJ', 'Precip']],
...                   columns=['a', 'b'])
>>> df
      a       b
0    HI    Temp
1    HI  Precip
2    NJ    Temp
3    NJ  Precip
```

```
>>> ks.MultiIndex.from_frame(df)
MultiIndex([('HI',   'Temp'),
            ('HI', 'Precip'),
            ('NJ',   'Temp'),
            ('NJ', 'Precip')],
           names=['a', 'b'])
```

Using explicit names, instead of the column names

```
>>> ks.MultiIndex.from_frame(df, names=['state', 'observation'])
MultiIndex([('HI',   'Temp'),
            ('HI', 'Precip'),
            ('NJ',   'Temp'),
            ('NJ', 'Precip')],
           names=['state', 'observation'])
```

MultiIndex Properties

MultiIndex.has_duplicates	If index has duplicates, return True, otherwise False.
MultiIndex.hasnans	Return True if it has any missing values.
MultiIndex.inferred_type	Return a string of the type inferred from the values.
MultiIndex.is_all_dates	is_all_dates always returns False for MultiIndex
MultiIndex.shape	Return a tuple of the shape of the underlying data.
MultiIndex.names	Return names of the Index.
MultiIndex.ndim	Return an int representing the number of array dimensions.
MultiIndex.empty	Returns true if the current object is empty.
MultiIndex.T	Return the transpose, For index, It will be index itself.
MultiIndex.size	Return an int representing the number of elements in this object.
MultiIndex.nlevels	Number of levels in Index & MultiIndex.
MultiIndex.levshape	A tuple with the length of each level.
MultiIndex.values	Return an array representing the data in the Index.

databricks.koalas.MultiIndex.has_duplicates

property MultiIndex.**has_duplicates**

If index has duplicates, return True, otherwise False.

Examples

```
>>> idx = ks.Index([1, 5, 7, 7])
>>> idx.has_duplicates
True
```

```
>>> idx = ks.Index([1, 5, 7])
>>> idx.has_duplicates
False
```

```
>>> idx = ks.Index(["Watermelon", "Orange", "Apple",
...                 "Watermelon"])
>>> idx.has_duplicates
True
```

```
>>> idx = ks.Index(["Orange", "Apple",
...                 "Watermelon"])
>>> idx.has_duplicates
False
```

databricks.koalas.MultiIndex.hasnans

property MultiIndex.**hasnans**

Return True if it has any missing values. Otherwise, it returns False.

```
>>> ks.DataFrame({}, index=list('abc')).index.hasnans
False
```

```
>>> ks.Series(['a', None]).hasnans
True
```

```
>>> ks.Series([1.0, 2.0, np.nan]).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).hasnans
False
```

```
>>> (ks.Series([1.0, 2.0, np.nan]) + 1).hasnans
True
```

```
>>> ks.Series([1, 2, 3]).rename("a").to_frame().set_index("a").index.hasnans
False
```

databricks.koalas.MultiIndex.inferred_type

property MultiIndex.**inferred_type**

Return a string of the type inferred from the values.

databricks.koalas.MultiIndex.is_all_dates

property MultiIndex.**is_all_dates**

is_all_dates always returns False for MultiIndex

Examples

```
>>> from datetime import datetime
```

```
>>> idx = ks.MultiIndex.from_tuples(
...     [(datetime(2019, 1, 1, 0, 0, 0), datetime(2019, 1, 1, 0, 0, 0)),
...      (datetime(2019, 1, 1, 0, 0, 0), datetime(2019, 1, 1, 0, 0, 0))])
>>> idx
MultiIndex([('2019-01-01', '2019-01-01'),
            ('2019-01-01', '2019-01-01')],
           )
```

```
>>> idx.is_all_dates
False
```

databricks.koalas.MultiIndex.shape

property MultiIndex.**shape**
Return a tuple of the shape of the underlying data.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
>>> idx.shape
(3,)
```

```
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
>>> midx.shape
(3,)
```

databricks.koalas.MultiIndex.names

property MultiIndex.**names**
Return names of the Index.

databricks.koalas.MultiIndex.ndim

property MultiIndex.**ndim**

Return an int representing the number of array dimensions.

Return 1 for Series / Index / MultiIndex.

Examples

For Series

```
>>> s = ks.Series([None, 1, 2, 3, 4], index=[4, 5, 2, 1, 8])
>>> s.ndim
1
```

For Index

```
>>> s.index.ndim
1
```

For MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index.ndim
1
```

databricks.koalas.MultiIndex.empty

property MultiIndex.**empty**

Returns true if the current object is empty. Otherwise, returns false.

```
>>> ks.range(10).id.empty
False
```

```
>>> ks.range(0).id.empty
True
```

```
>>> ks.DataFrame({}, index=list('abc')).index.empty
False
```

databricks.koalas.MultiIndex.T

property MultiIndex.**T**

Return the transpose, For index, It will be index itself.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
```

```
>>> idx.transpose()
Index(['a', 'b', 'c'], dtype='object')
```

For MultiIndex

```
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

```
>>> midx.transpose()
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

databricks.koalas.MultiIndex.size

property MultiIndex.**size**

Return an int representing the number of elements in this object.

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'],
...                   index=list('abcd'))
>>> df.index.size
4
```

```
>>> df.set_index('dogs', append=True).index.size
4
```

databricks.koalas.MultiIndex.nlevels

property MultiIndex.**nlevels**
Number of levels in Index & MultiIndex.

Examples

```
>>> kdf = ks.DataFrame({"a": [1, 2, 3]}, index=pd.Index(['a', 'b', 'c'], name="idx
↪"))
>>> kdf.index.nlevels
1
```

```
>>> kdf = ks.DataFrame({'a': [1, 2, 3]}, index=[list('abc'), list('def')])
>>> kdf.index.nlevels
2
```

databricks.koalas.MultiIndex.levshape

property MultiIndex.**levshape**
A tuple with the length of each level.

Examples

```
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

```
>>> midx.levshape
(3, 3)
```

databricks.koalas.MultiIndex.values

property MultiIndex.**values**
Return an array representing the data in the Index.

Warning: We recommend using *Index.to_numpy()* instead.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Returns

numpy.ndarray

Examples

```
>>> ks.Series([1, 2, 3, 4]).index.values
array([0, 1, 2, 3])
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[[1, 2, 3], [4, 5, 6]]).index.
↪values
array([(1, 4), (2, 5), (3, 6)], dtype=object)
```

MultiIndex components

MultiIndex.swaplevel([i, j])	Swap level i with level j.

databricks.koalas.MultiIndex.swaplevel

MultiIndex.**swaplevel**(*i=- 2*, *j=- 1*) → databricks.koalas.indexes.MultiIndex

Swap level i with level j. Calling this method does not change the ordering of the values.

Parameters

i [int, str, default -2] First level of index to be swapped. Can pass level name as string. Type of parameters can be mixed.

j [int, str, default -1] Second level of index to be swapped. Can pass level name as string. Type of parameters can be mixed.

Returns

MultiIndex A new MultiIndex.

Examples

```
>>> midx = ks.MultiIndex.from_arrays([['a', 'b'], [1, 2]], names = ['word',
↪'number'])
>>> midx
MultiIndex([('a', 1),
            ('b', 2)],
           names=['word', 'number'])
```

```
>>> midx.swaplevel(0, 1)
MultiIndex([(1, 'a'),
            (2, 'b')],
           names=['number', 'word'])
```

```
>>> midx.swaplevel('number', 'word')
MultiIndex([(1, 'a'),
            (2, 'b')],
           names=['number', 'word'])
```

MultiIndex components

MultiIndex.droplevel(level)	Return index with requested level(s) removed.

databricks.koalas.MultiIndex.droplevel

MultiIndex.**droplevel**(*level*) → databricks.koalas.indexes.Index

Return index with requested level(s) removed. If resulting index has only 1 level left, the result will be of Index type, not MultiIndex.

Parameters

level [int, str, tuple, or list-like, default 0] If a string is given, must be the name of a level If list-like, elements must be names or indexes of levels.

Returns

Index or MultiIndex

Examples

```
>>> midx = ks.DataFrame({'a': ['a', 'b']}, index=[['a', 'x'], ['b', 'y'], [1,␣
↪2]]).index
>>> midx
MultiIndex([('a', 'b', 1),
            ('x', 'y', 2)],
           )
>>> midx.droplevel([0, 1])
Int64Index([1, 2], dtype='int64')
>>> midx.droplevel(0)
MultiIndex([('b', 1),
            ('y', 2)],
           )
>>> midx.names = [("a", "b"), "b", "c"]
>>> midx.droplevel([('a', 'b')])
MultiIndex([('b', 1),
            ('y', 2)],
           names=['b', 'c'])
```

MultiIndex Missing Values

MultiIndex.fillna(value)	Fill NA/NaN values with the specified value.
MultiIndex.dropna()	Return Index or MultiIndex without NA/NaN values

databricks.koalas.MultiIndex.fillna

MultiIndex.**fillna**(*value: Union[int, float, str, bytes, decimal.Decimal, datetime.date, None]*) → databricks.koalas.indexes.Index

Fill NA/NaN values with the specified value.

Parameters

value [scalar] Scalar value to use to fill holes (e.g. 0). This value cannot be a list-likes.

Returns

Index : filled with value

Examples

```
>>> ki = ks.DataFrame({'a': ['a', 'b', 'c']}, index=[1, 2, None]).index
>>> ki
Float64Index([1.0, 2.0, nan], dtype='float64')
```

```
>>> ki.fillna(0)
Float64Index([1.0, 2.0, 0.0], dtype='float64')
```

databricks.koalas.MultiIndex.dropna

MultiIndex.**dropna**() → databricks.koalas.indexes.Index

Return Index or MultiIndex without NA/NaN values

Examples

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', None],
...                   columns=['max_speed', 'shield'])
>>> df
       max_speed  shield
cobra          1       2
viper          4       5
NaN            7       8
```

```
>>> df.index.dropna()
Index(['cobra', 'viper'], dtype='object')
```

Also support for MultiIndex

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       [None, 'weight', 'length']],
...                      [[0, 1, 1, 1, 1, 1, 2, 2, 2],
...                       [0, 1, 1, 0, 1, 2, 1, 1, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, None],
...               index=midx)
>>> s
lama    NaN        45.0
cow     weight    200.0
```

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```
        weight      1.2
        NaN        30.0
        weight    250.0
        length      1.5
falcon  weight    320.0
        weight      1.0
        length      NaN
dtype: float64
```

```
>>> s.index.dropna()
MultiIndex([(   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon', 'weight'),
            ('falcon', 'weight'),
            ('falcon', 'length')],
           )
```

MultiIndex Modifying and computations

MultiIndex.equals(other)	Determine if two Index objects contain the same elements.
MultiIndex.identical(other)	Similar to equals, but check that other comparable attributes are also equal.
MultiIndex.insert(loc, item)	Make new MultiIndex inserting new item at location.
MultiIndex.drop(codes[, level])	Make new MultiIndex with passed list of labels deleted
MultiIndex.copy([deep])	Make a copy of this object.
MultiIndex.delete(loc)	Make new Index with passed location(-s) deleted.
MultiIndex.rename(name[, inplace])	Alter Index or MultiIndex name.
MultiIndex.repeat(repeats)	Repeat elements of a Index/MultiIndex.
MultiIndex.take(indices)	Return the elements in the given *positional* indices along an axis.
MultiIndex.unique([level])	Return unique values in the index.
MultiIndex.min()	Return the minimum value of the Index.
MultiIndex.max()	Return the maximum value of the Index.
MultiIndex.value_counts([normalize, sort, ...])	Return a Series containing counts of unique values.

databricks.koalas.MultiIndex.equals

MultiIndex.**equals**(*other*) → bool

Determine if two Index objects contain the same elements.

Returns

bool True if "other" is an Index and it has the same elements as calling index; False otherwise.

Examples

```
>>> from databricks.koalas.config import option_context
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx.name = "name"
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> midx.names = ("nameA", "nameB")
```

For Index

```
>>> idx.equals(idx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.equals(ks.Index(['a', 'b', 'c']))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.equals(ks.Index(['b', 'b', 'a']))
False
>>> idx.equals(midx)
False
```

For MultiIndex

```
>>> midx.equals(midx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.equals(ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z
↪')]))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.equals(ks.MultiIndex.from_tuples([('c', 'z'), ('b', 'y'), ('a', 'x
↪')]))
False
>>> midx.equals(idx)
False
```

databricks.koalas.MultiIndex.identical

`MultiIndex.`**`identical`**(*other*) → bool

Similar to equals, but check that other comparable attributes are also equal.

Returns

bool If two Index objects have equal elements and same type True, otherwise False.

Examples

```
>>> from databricks.koalas.config import option_context
>>> idx = ks.Index(['a', 'b', 'c'])
>>> midx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
```

For Index

```
>>> idx.identical(idx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.identical(ks.Index(['a', 'b', 'c']))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     idx.identical(ks.Index(['b', 'b', 'a']))
False
>>> idx.identical(midx)
False
```

For MultiIndex

```
>>> midx.identical(midx)
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.identical(ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z
↪')]))
True
>>> with option_context('compute.ops_on_diff_frames', True):
...     midx.identical(ks.MultiIndex.from_tuples([('c', 'z'), ('b', 'y'), ('a', 'x
↪')]))
False
>>> midx.identical(idx)
False
```

databricks.koalas.MultiIndex.insert

`MultiIndex.`**`insert`**(*loc: int*, *item*) → databricks.koalas.indexes.Index

Make new MultiIndex inserting new item at location.

Follows Python list.append semantics for negative values.

Parameters

loc [int]

item [object]

Returns

new_index [MultiIndex]

Examples

```
>>> kmidx = ks.MultiIndex.from_tuples([("a", "x"), ("b", "y"), ("c", "z")])
>>> kmidx.insert(3, ("h", "j"))
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z'),
            ('h', 'j')],
           )
```

For negative values

```
>>> kmidx.insert(-2, ("h", "j"))
MultiIndex([('a', 'x'),
            ('h', 'j'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

databricks.koalas.MultiIndex.drop

MultiIndex.**drop**(*codes*, *level=None*) → databricks.koalas.indexes.MultiIndex

Make new MultiIndex with passed list of labels deleted

Parameters

codes [array-like] Must be a list of tuples

level [int or level name, default None]

Returns

dropped [MultiIndex]

Examples

```
>>> index = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y'), ('c', 'z')])
>>> index
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('c', 'z')],
           )
```

```
>>> index.drop(['a'])
MultiIndex([('b', 'y'),
            ('c', 'z')],
           )
```

```
>>> index.drop(['x', 'y'], level=1)
MultiIndex([('c', 'z')],
           )
```

databricks.koalas.MultiIndex.copy

MultiIndex.**copy**(*deep=None*) → databricks.koalas.indexes.MultiIndex

Make a copy of this object.

Parameters

deep [None] this parameter is not supported but just dummy parameter to match pandas.

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'],
...                   index=[list('abcd'), list('efgh')])
>>> df['dogs'].index
MultiIndex([('a', 'e'),
            ('b', 'f'),
            ('c', 'g'),
            ('d', 'h')],
           )
```

Copy index

```
>>> df.index.copy()
MultiIndex([('a', 'e'),
            ('b', 'f'),
            ('c', 'g'),
            ('d', 'h')],
           )
```

databricks.koalas.MultiIndex.delete

`MultiIndex.delete(loc)` → databricks.koalas.indexes.Index

Make new Index with passed location(-s) deleted.

Note: this API can be pretty expensive since it is based on a global sequence internally.

Returns

new_index [Index]

Examples

```
>>> kidx = ks.Index([10, 10, 9, 8, 4, 2, 4, 4, 2, 2, 10, 10])
>>> kidx
Int64Index([10, 10, 9, 8, 4, 2, 4, 4, 2, 2, 10, 10], dtype='int64')
```

```
>>> kidx.delete(0).sort_values()
Int64Index([2, 2, 2, 4, 4, 4, 8, 9, 10, 10, 10], dtype='int64')
```

```
>>> kidx.delete([0, 1, 2, 3, 10, 11]).sort_values()
Int64Index([2, 2, 2, 4, 4, 4], dtype='int64')
```

MultiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2), ('c', 'z',␣
↪3)])
>>> kidx
MultiIndex([('a', 'x', 1),
            ('b', 'y', 2),
```

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```
            ('c', 'z', 3)],
           )
```

```
>>> kidx.delete([0, 2]).sort_values()
MultiIndex([('b', 'y', 2)],
           )
```

databricks.koalas.MultiIndex.rename

MultiIndex.**rename**(*name: Union[Any, Tuple, List[Union[Any, Tuple]]]*, *inplace: bool = False*) → Optional[databricks.koalas.indexes.Index]

Alter Index or MultiIndex name. Able to set new names without level. Defaults to returning new index.

Parameters

name [label or list of labels] Name(s) to set.

inplace [boolean, default False] Modifies the object directly, instead of creating a new Index or MultiIndex.

Returns

Index or MultiIndex The same type as the caller or None if inplace is True.

Examples

```
>>> df = ks.DataFrame({'a': ['A', 'C'], 'b': ['A', 'B']}, columns=['a', 'b'])
>>> df.index.rename("c")
Int64Index([0, 1], dtype='int64', name='c')
```

```
>>> df.set_index("a", inplace=True)
>>> df.index.rename("d")
Index(['A', 'C'], dtype='object', name='d')
```

You can also change the index name in place.

```
>>> df.index.rename("e", inplace=True)
>>> df.index
Index(['A', 'C'], dtype='object', name='e')
```

```
>>> df
   b
e
A  A
C  B
```

Support for MultiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y')])
>>> kidx.names = ['hello', 'koalas']
>>> kidx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['hello', 'koalas'])
```

```
>>> kidx.rename(['aloha', 'databricks'])
MultiIndex([('a', 'x'),
            ('b', 'y')],
           names=['aloha', 'databricks'])
```

databricks.koalas.MultiIndex.repeat

`MultiIndex.`**`repeat`**(*repeats: int*) → databricks.koalas.indexes.Index

Repeat elements of a Index/MultiIndex.

Returns a new Index/MultiIndex where each element of the current Index/MultiIndex is repeated consecutively a given number of times.

Parameters

repeats [int] The number of repetitions for each element. This should be a non-negative integer. Repeating 0 times will return an empty Index.

Returns

repeated_index [Index/MultiIndex] Newly created Index/MultiIndex with repeated elements.

See also:

Series.repeat Equivalent function for Series.

Examples

```
>>> idx = ks.Index(['a', 'b', 'c'])
>>> idx
Index(['a', 'b', 'c'], dtype='object')
>>> idx.repeat(2)
Index(['a', 'b', 'c', 'a', 'b', 'c'], dtype='object')
```

For MultiIndex,

```
>>> midx = ks.MultiIndex.from_tuples([('x', 'a'), ('x', 'b'), ('y', 'c')])
>>> midx
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c')],
           )
>>> midx.repeat(2)
MultiIndex([('x', 'a'),
            ('x', 'b'),
            ('y', 'c'),
            ('x', 'a'),
            ('x', 'b'),
            ('y', 'c')],
           )
>>> midx.repeat(0)
MultiIndex([], )
```

databricks.koalas.MultiIndex.take

MultiIndex.**take**(*indices*) → Union[Series, Index]

Return the elements in the given *positional* indices along an axis.

This means that we are not indexing according to actual values in the index attribute of the object. We are indexing according to the actual position of the element in the object.

Parameters

indices [array-like] An array of ints indicating which positions to take.

Returns

taken [same type as caller] An array-like containing the elements taken from the object.

See also:

DataFrame.loc Select a subset of a DataFrame by labels.

DataFrame.iloc Select a subset of a DataFrame by positions.

numpy.take Take elements from an array along an axis.

Examples

Series

```
>>> kser = ks.Series([100, 200, 300, 400, 500])
>>> kser
0    100
1    200
2    300
3    400
4    500
dtype: int64
```

```
>>> kser.take([0, 2, 4]).sort_index()
0    100
2    300
4    500
dtype: int64
```

Index

```
>>> kidx = ks.Index([100, 200, 300, 400, 500])
>>> kidx
Int64Index([100, 200, 300, 400, 500], dtype='int64')
```

```
>>> kidx.take([0, 2, 4]).sort_values()
Int64Index([100, 300, 500], dtype='int64')
```

MultiIndex

```
>>> kmidx = ks.MultiIndex.from_tuples([("x", "a"), ("x", "b"), ("x", "c")])
>>> kmidx
MultiIndex([('x', 'a'),
            ('x', 'b'),
```

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```
            ('x', 'c')],
           )
```

```
>>> kmidx.take([0, 2])
MultiIndex([('x', 'a'),
            ('x', 'c')],
           )
```

databricks.koalas.MultiIndex.unique

`MultiIndex.`**`unique`**(*level=None*) → databricks.koalas.indexes.Index

Return unique values in the index.

Be aware the order of unique values might be different than pandas.Index.unique

Parameters

level [int or str, optional, default is None]

Returns

Index without duplicates

See also:

Series.unique

groupby.SeriesGroupBy.unique

Examples

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[1, 1, 3]).index.unique().sort_
↪values()
Int64Index([1, 3], dtype='int64')
```

```
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=['d', 'e', 'e']).index.unique().
↪sort_values()
Index(['d', 'e'], dtype='object')
```

MultiIndex

```
>>> ks.MultiIndex.from_tuples([("A", "X"), ("A", "Y"), ("A", "X")]).unique()
...
MultiIndex([('A', 'X'),
            ('A', 'Y')],
           )
```

databricks.koalas.MultiIndex.min

MultiIndex.**min**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return the minimum value of the Index.

Returns

scalar Minimum value.

See also:

Index.max Return the maximum value of the object.

Series.min Return the minimum value in a Series.

DataFrame.min Return the minimum values in a DataFrame.

Examples

```
>>> idx = ks.Index([3, 2, 1])
>>> idx.min()
1
```

```
>>> idx = ks.Index(['c', 'b', 'a'])
>>> idx.min()
'a'
```

For a MultiIndex, the maximum is determined lexicographically.

```
>>> idx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2)])
>>> idx.min()
('a', 'x', 1)
```

databricks.koalas.MultiIndex.max

MultiIndex.**max**() → Union[int, float, str, bytes, decimal.Decimal, datetime.date, None, Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]]

Return the maximum value of the Index.

Returns

scalar Maximum value.

See also:

Index.min Return the minimum value in an Index.

Series.max Return the maximum value in a Series.

DataFrame.max Return the maximum values in a DataFrame.

Examples

```
>>> idx = ks.Index([3, 2, 1])
>>> idx.max()
3
```

```
>>> idx = ks.Index(['c', 'b', 'a'])
>>> idx.max()
'c'
```

For a MultiIndex, the maximum is determined lexicographically.

```
>>> idx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2)])
>>> idx.max()
('b', 'y', 2)
```

databricks.koalas.MultiIndex.value_counts

MultiIndex.**value_counts**(*normalize=False*, *sort=True*, *ascending=False*, *bins=None*, *dropna=True*)
→ databricks.koalas.series.Series

Return a Series containing counts of unique values. The resulting object will be in descending order so that the first element is the most frequently-occurring element. Excludes NA values by default.

Parameters

normalize [boolean, default False] If True then the object returned will contain the relative frequencies of the unique values.

sort [boolean, default True] Sort by values.

ascending [boolean, default False] Sort in ascending order.

bins [Not Yet Supported]

dropna [boolean, default True] Don't include counts of NaN.

Returns

counts [Series]

See also:

Series.count Number of non-NA elements in a Series.

Examples

For Series

```
>>> df = ks.DataFrame({'x':[0, 0, 1, 1, 1, np.nan]})
>>> df.x.value_counts()
1.0    3
0.0    2
Name: x, dtype: int64
```

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> df.x.value_counts(normalize=True)
1.0    0.6
0.0    0.4
Name: x, dtype: float64
```

dropna With *dropna* set to *False* we can also see NaN index values.

```
>>> df.x.value_counts(dropna=False)
1.0    3
0.0    2
NaN    1
Name: x, dtype: int64
```

For Index

```
>>> idx = ks.Index([3, 1, 2, 3, 4, np.nan])
>>> idx
Float64Index([3.0, 1.0, 2.0, 3.0, 4.0, nan], dtype='float64')
```

```
>>> idx.value_counts().sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

sort

With *sort* set to *False*, the result wouldn't be sorted by number of count.

```
>>> idx.value_counts(sort=True).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
dtype: int64
```

normalize

With *normalize* set to *True*, returns the relative frequency by dividing all values by the sum of values.

```
>>> idx.value_counts(normalize=True).sort_index()
1.0    0.2
2.0    0.2
3.0    0.4
4.0    0.2
dtype: float64
```

dropna

With *dropna* set to *False* we can also see NaN index values.

```
>>> idx.value_counts(dropna=False).sort_index()
1.0    1
2.0    1
3.0    2
4.0    1
```

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```
NaN    1
dtype: int64
```

For MultiIndex.

```
>>> midx = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                       ['speed', 'weight', 'length']],
...                      [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                       [1, 1, 1, 1, 1, 2, 1, 2, 2]])
>>> s = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3], index=midx)
>>> s.index
MultiIndex([(  'lama', 'weight'),
            (  'lama', 'weight'),
            (  'lama', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'weight'),
            (   'cow', 'length'),
            ('falcon', 'weight'),
            ('falcon', 'length'),
            ('falcon', 'length')],
           )
```

```
>>> s.index.value_counts().sort_index()
(cow, length)       1
(cow, weight)       2
(falcon, length)    2
(falcon, weight)    1
(lama, weight)      3
dtype: int64
```

```
>>> s.index.value_counts(normalize=True).sort_index()
(cow, length)       0.111111
(cow, weight)       0.222222
(falcon, length)    0.222222
(falcon, weight)    0.111111
(lama, weight)      0.333333
dtype: float64
```

If Index has name, keep the name up.

```
>>> idx = ks.Index([0, 0, 0, 1, 1, 2, 3], name='koalas')
>>> idx.value_counts().sort_index()
0    3
1    2
2    1
3    1
Name: koalas, dtype: int64
```

MultiIndex Combining / joining / set operations

MultiIndex.append(other)	Append a collection of Index options together.
MultiIndex.intersection(other)	Form the intersection of two Index objects.
MultiIndex.union(other[, sort])	Form the union of two Index objects.
MultiIndex.difference(other[, sort])	Return a new Index with elements from the index that are not in *other*.
MultiIndex.symmetric_difference(other[, ...])	Compute the symmetric difference of two MultiIndex objects.

databricks.koalas.MultiIndex.append

MultiIndex.**append**(*other: databricks.koalas.indexes.Index*) → databricks.koalas.indexes.Index

Append a collection of Index options together.

Parameters

other [Index]

Returns

appended [Index]

Examples

```
>>> kidx = ks.Index([10, 5, 0, 5, 10, 5, 0, 10])
>>> kidx
Int64Index([10, 5, 0, 5, 10, 5, 0, 10], dtype='int64')
```

```
>>> kidx.append(kidx)
Int64Index([10, 5, 0, 5, 10, 5, 0, 10, 10, 5, 0, 5, 10, 5, 0, 10], dtype='int64')
```

Support for MiltiIndex

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x'), ('b', 'y')])
>>> kidx
MultiIndex([('a', 'x'),
            ('b', 'y')],
           )
```

```
>>> kidx.append(kidx)
MultiIndex([('a', 'x'),
            ('b', 'y'),
            ('a', 'x'),
            ('b', 'y')],
           )
```

databricks.koalas.MultiIndex.intersection

MultiIndex.**intersection**(*other*) → databricks.koalas.indexes.MultiIndex

Form the intersection of two Index objects.

This returns a new Index with elements common to the index and *other*.

Parameters

other [Index or array-like]

Returns

intersection [MultiIndex]

Examples

```
>>> midx1 = ks.MultiIndex.from_tuples([("a", "x"), ("b", "y"), ("c", "z")])
>>> midx2 = ks.MultiIndex.from_tuples([("c", "z"), ("d", "w")])
>>> midx1.intersection(midx2).sort_values()
MultiIndex([('c', 'z')],
           )
```

databricks.koalas.MultiIndex.union

MultiIndex.**union**(*other*, *sort=None*) → databricks.koalas.indexes.Index

Form the union of two Index objects.

Parameters

other [Index or array-like]

sort [bool or None, default None] Whether to sort the resulting Index.

Returns

union [Index]

Examples

Index

```
>>> idx1 = ks.Index([1, 2, 3, 4])
>>> idx2 = ks.Index([3, 4, 5, 6])
>>> idx1.union(idx2).sort_values()
Int64Index([1, 2, 3, 4, 5, 6], dtype='int64')
```

MultiIndex

```
>>> midx1 = ks.MultiIndex.from_tuples([("x", "a"), ("x", "b"), ("x", "c"), ("x",
↪"d")])
>>> midx2 = ks.MultiIndex.from_tuples([("x", "c"), ("x", "d"), ("x", "e"), ("x",
↪"f")])
>>> midx1.union(midx2).sort_values()
MultiIndex([('x', 'a'),
            ('x', 'b'),
```

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```
            ('x', 'c'),
            ('x', 'd'),
            ('x', 'e'),
            ('x', 'f')],
           )
```

databricks.koalas.MultiIndex.difference

MultiIndex.**difference**(*other*, *sort=None*) → databricks.koalas.indexes.Index

Return a new Index with elements from the index that are not in *other*.

This is the set difference of two Index objects.

Parameters

other [Index or array-like]

sort [True or None, default None] Whether to sort the resulting index. * True : Attempt to sort the result. * None : Do not sort the result.

Returns

difference [Index]

Examples

```
>>> idx1 = ks.Index([2, 1, 3, 4])
>>> idx2 = ks.Index([3, 4, 5, 6])
>>> idx1.difference(idx2, sort=True)
Int64Index([1, 2], dtype='int64')
```

MultiIndex

```
>>> midx1 = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'y', 2), ('c', 'z',␣
↪3)])
>>> midx2 = ks.MultiIndex.from_tuples([('a', 'x', 1), ('b', 'z', 2), ('k', 'z',␣
↪3)])
>>> midx1.difference(midx2)
MultiIndex([('b', 'y', 2),
            ('c', 'z', 3)],
           )
```

databricks.koalas.MultiIndex.symmetric_difference

MultiIndex.**symmetric_difference**(*other*, *result_name=None*, *sort=None*) → databricks.koalas.indexes.MultiIndex

Compute the symmetric difference of two MultiIndex objects.

Parameters

other [Index or array-like]

result_name [list]

sort [True or None, default None] Whether to sort the resulting index. * True : Attempt to sort the result. * None : Do not sort the result.

Returns

symmetric_difference [MiltiIndex]

Notes

`symmetric_difference` contains elements that appear in either `idx1` or `idx2` but not both. Equivalent to the Index created by `idx1.difference(idx2) | idx2.difference(idx1)` with duplicates dropped.

Examples

```
>>> midx1 = pd.MultiIndex([['lama', 'cow', 'falcon'],
...                        ['speed', 'weight', 'length']],
...                       [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                        [0, 0, 0, 0, 1, 2, 0, 1, 2]])
>>> midx2 = pd.MultiIndex([['koalas', 'cow', 'falcon'],
...                        ['speed', 'weight', 'length']],
...                       [[0, 0, 0, 1, 1, 1, 2, 2, 2],
...                        [0, 0, 0, 0, 1, 2, 0, 1, 2]])
>>> s1 = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...                index=midx1)
>>> s2 = ks.Series([45, 200, 1.2, 30, 250, 1.5, 320, 1, 0.3],
...               index=midx2)
```

```
>>> s1.index.symmetric_difference(s2.index)
MultiIndex([('koalas', 'speed'),
            ( 'lama', 'speed')],
           )
```

You can set names of result Index.

```
>>> s1.index.symmetric_difference(s2.index, result_name=['a', 'b'])
MultiIndex([('koalas', 'speed'),
            ( 'lama', 'speed')],
           names=['a', 'b'])
```

You can set sort to *True*, if you want to sort the resulting index.

```
>>> s1.index.symmetric_difference(s2.index, sort=True)
MultiIndex([('koalas', 'speed'),
            ( 'lama', 'speed')],
           )
```

You can also use the ^ operator:

```
>>> s1.index ^ s2.index
MultiIndex([('koalas', 'speed'),
            ( 'lama', 'speed')],
           )
```

MultiIndex Conversion

MultiIndex.astype(dtype)	Cast a Koalas object to a specified dtype `dtype`.
MultiIndex.item()	Return the first element of the underlying data as a python tuple.
MultiIndex.to_list()	Return a list of the values.
MultiIndex.to_series([name])	Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.
MultiIndex.to_frame([index, name])	Create a DataFrame with the levels of the MultiIndex as columns.
MultiIndex.view()	this is defined as a copy with the same identity
MultiIndex.to_numpy([dtype, copy])	A NumPy ndarray representing the values in this Index or MultiIndex.

databricks.koalas.MultiIndex.astype

`MultiIndex.`**`astype`**(*dtype*) → Union[Index, Series]

Cast a Koalas object to a specified dtype `dtype`.

Parameters

dtype [data type] Use a numpy.dtype or Python type to cast entire pandas object to the same type.

Returns

casted [same type as caller]

See also:

to_datetime Convert argument to datetime.

Examples

```
>>> ser = ks.Series([1, 2], dtype='int32')
>>> ser
0    1
1    2
dtype: int32
```

```
>>> ser.astype('int64')
0    1
1    2
dtype: int64
```

```
>>> ser.rename("a").to_frame().set_index("a").index.astype('int64')
Int64Index([1, 2], dtype='int64', name='a')
```

databricks.koalas.MultiIndex.item

MultiIndex.**item**() → Tuple[Union[int, float, str, bytes, decimal.Decimal, datetime.date, None], ...]

Return the first element of the underlying data as a python tuple.

Returns

tuple The first element of MultiIndex.

Raises

ValueError If the data is not length-1.

Examples

```
>>> kmidx = ks.MultiIndex.from_tuples([('a', 'x')])
>>> kmidx.item()
('a', 'x')
```

databricks.koalas.MultiIndex.to_list

MultiIndex.**to_list**() → List

Return a list of the values.

These are each a scalar type, which is a Python scalar (for str, int, float) or a pandas scalar (for Timestamp/Timedelta/Interval/Period)

Note: This method should only be used if the resulting list is expected to be small, as all the data is loaded into the driver's memory.

Examples

Index

```
>>> idx = ks.Index([1, 2, 3, 4, 5])
>>> idx.to_list()
[1, 2, 3, 4, 5]
```

MultiIndex

```
>>> tuples = [(1, 'red'), (1, 'blue'), (2, 'red'), (2, 'green')]
>>> midx = ks.MultiIndex.from_tuples(tuples)
>>> midx.to_list()
[(1, 'red'), (1, 'blue'), (2, 'red'), (2, 'green')]
```

databricks.koalas.MultiIndex.to_series

MultiIndex.**to_series**(*name: Union[Any, Tuple] = None*) → databricks.koalas.series.Series

Create a Series with both index and values equal to the index keys useful with map for returning an indexer based on an index.

Parameters

name [string, optional] name of resulting Series. If None, defaults to name of original index

Returns

Series [dtype will be based on the type of the Index values.]

Examples

```
>>> df = ks.DataFrame([(.2, .3), (.0, .6), (.6, .0), (.2, .1)],
...                   columns=['dogs', 'cats'],
...                   index=list('abcd'))
>>> df['dogs'].index.to_series()
a    a
b    b
c    c
d    d
dtype: object
```

databricks.koalas.MultiIndex.to_frame

MultiIndex.**to_frame**(*index=True*, *name=None*) → databricks.koalas.frame.DataFrame

Create a DataFrame with the levels of the MultiIndex as columns. Column ordering is determined by the DataFrame constructor with data as a dict.

Parameters

index [boolean, default True] Set the index of the returned DataFrame as the original MultiIndex.

name [list / sequence of strings, optional] The passed names should substitute index level names.

Returns

DataFrame [a DataFrame containing the original MultiIndex data.]

See also:

DataFrame

Examples

```
>>> tuples = [(1, 'red'), (1, 'blue'),
...           (2, 'red'), (2, 'blue')]
>>> idx = ks.MultiIndex.from_tuples(tuples, names=('number', 'color'))
>>> idx
MultiIndex([(1,  'red'),
            (1, 'blue'),
            (2,  'red'),
            (2, 'blue')],
           names=['number', 'color'])
>>> idx.to_frame()
              number color
number color
1      red         1   red
       blue        1  blue
2      red         2   red
       blue        2  blue
```

By default, the original Index is reused. To enforce a new Index:

```
>>> idx.to_frame(index=False)
   number color
0       1   red
1       1  blue
2       2   red
3       2  blue
```

To override the name of the resulting column, specify *name*:

```
>>> idx.to_frame(name=['n', 'c'])
                n     c
number color
1      red      1   red
       blue     1  blue
2      red      2   red
       blue     2  blue
```

databricks.koalas.MultiIndex.view

`MultiIndex.`**`view`**`()` → databricks.koalas.indexes.Index
this is defined as a copy with the same identity

databricks.koalas.MultiIndex.to_numpy

`MultiIndex.`**`to_numpy`**(*dtype=None*, *copy=False*) → numpy.ndarray
A NumPy ndarray representing the values in this Index or MultiIndex.

Note: This method should only be used if the resulting NumPy ndarray is expected to be small, as all the data is loaded into the driver's memory.

Parameters

dtype [str or numpy.dtype, optional] The dtype to pass to `numpy.asarray()`

copy [bool, default False] Whether to ensure that the returned value is a not a view on another array. Note that `copy=False` does not *ensure* that `to_numpy()` is no-copy. Rather, `copy=True` ensure that a copy is made, even if not strictly necessary.

Returns

numpy.ndarray

Examples

```
>>> ks.Series([1, 2, 3, 4]).index.to_numpy()
array([0, 1, 2, 3])
>>> ks.DataFrame({'a': ['a', 'b', 'c']}, index=[[1, 2, 3], [4, 5, 6]]).index.to_
↪numpy()
array([(1, 4), (2, 5), (3, 6)], dtype=object)
```

3.5.4 MultiIndex Spark-related

`MultiIndex.spark` provides features that does not exist in pandas but in Spark. These can be accessed by `MultiIndex.spark.<function/property>`.

MultiIndex.spark.data_type	Returns the data type as defined by Spark, as a Spark DataType object.
MultiIndex.spark.column	Spark Column object representing the Series/Index.
MultiIndex.spark.transform(func)	Applies a function that takes and returns a Spark column.

databricks.koalas.MultiIndex.spark.data_type

property spark.**data_type**
Returns the data type as defined by Spark, as a Spark DataType object.

databricks.koalas.MultiIndex.spark.column

property spark.**column**
Spark Column object representing the Series/Index.

Note: This Spark Column object is strictly stick to its base DataFrame the Series/Index was derived from.

databricks.koalas.MultiIndex.spark.transform

spark.**transform**(*func*) → ks.Index

Applies a function that takes and returns a Spark column. It allows to natively apply a Spark function and column APIs with the Spark column internally used in Series or Index. The output length of the Spark column should be same as input's.

Note: It requires to have the same input and output length; therefore, the aggregate Spark functions such as count does not work.

Parameters

func [function] Function to use for transforming the data by using Spark columns.

Returns

Series or Index

Raises

ValueError [If the output from the function is not a Spark column.]

Examples

```
>>> from pyspark.sql.functions import log
>>> df = ks.DataFrame({"a": [1, 2, 3], "b": [4, 5, 6]}, columns=["a", "b"])
>>> df
   a  b
0  1  4
1  2  5
2  3  6
```

```
>>> df.a.spark.transform(lambda c: log(c))
0    0.000000
1    0.693147
2    1.098612
Name: a, dtype: float64
```

```
>>> df.index.spark.transform(lambda c: c + 10)
Int64Index([10, 11, 12], dtype='int64')
```

```
>>> df.a.spark.transform(lambda c: c + df.b.spark.column)
0    5
1    7
2    9
Name: a, dtype: int64
```

MultiIndex Sorting

MultiIndex.sort_values([ascending])	Return a sorted copy of the index.

databricks.koalas.MultiIndex.sort_values

MultiIndex.**sort_values**(*ascending=True*) → databricks.koalas.indexes.Index

Return a sorted copy of the index.

Note: This method is not supported for pandas when index has NaN value. pandas raises unexpected TypeError, but we support treating NaN as the smallest value.

Parameters

ascending [bool, default True] Should the index values be sorted in an ascending order.

Returns

sorted_index [ks.Index or ks.MultiIndex] Sorted copy of the index.

See also:

Series.sort_values Sort values of a Series.

DataFrame.sort_values Sort values in a DataFrame.

Examples

```
>>> idx = ks.Index([10, 100, 1, 1000])
>>> idx
Int64Index([10, 100, 1, 1000], dtype='int64')
```

Sort values in ascending order (default behavior).

```
>>> idx.sort_values()
Int64Index([1, 10, 100, 1000], dtype='int64')
```

Sort values in descending order.

```
>>> idx.sort_values(ascending=False)
Int64Index([1000, 100, 10, 1], dtype='int64')
```

Support for MultiIndex.

```
>>> kidx = ks.MultiIndex.from_tuples([('a', 'x', 1), ('c', 'y', 2), ('b', 'z',␣
↪3)])
>>> kidx
MultiIndex([('a', 'x', 1),
            ('c', 'y', 2),
            ('b', 'z', 3)],
           )
```

```
>>> kidx.sort_values()
MultiIndex([('a', 'x', 1),
            ('b', 'z', 3),
            ('c', 'y', 2)],
           )
```

```
>>> kidx.sort_values(ascending=False)
MultiIndex([('c', 'y', 2),
            ('b', 'z', 3),
            ('a', 'x', 1)],
           )
```

3.6 Window

Rolling objects are returned by `.rolling` calls: `koalas.DataFrame.rolling()`, `koalas.Series.rolling()`, etc. Expanding objects are returned by `.expanding` calls: `koalas.DataFrame.expanding()`, `koalas.Series.expanding()`, etc.

3.6.1 Standard moving window functions

Rolling.count()	The rolling count of any non-NaN observations inside the window.
Rolling.sum()	Calculate rolling summation of given DataFrame or Series.
Rolling.min()	Calculate the rolling minimum.
Rolling.max()	Calculate the rolling maximum.
Rolling.mean()	Calculate the rolling mean of the values.

databricks.koalas.window.Rolling.count

Rolling.**count**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

The rolling count of any non-NaN observations inside the window.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series.expanding [Calling object with Series data.]

DataFrame.expanding [Calling object with DataFrames.]

Series.count [Count of the full Series.]

DataFrame.count [Count of the full DataFrame.]

Examples

```
>>> s = ks.Series([2, 3, float("nan"), 10])
>>> s.rolling(1).count()
0    1.0
1    1.0
2    0.0
3    1.0
dtype: float64
```

```
>>> s.rolling(3).count()
0    1.0
1    2.0
2    2.0
3    2.0
dtype: float64
```

```
>>> s.to_frame().rolling(1).count()
     0
0  1.0
1  1.0
2  0.0
3  1.0
```

```
>>> s.to_frame().rolling(3).count()
     0
0  1.0
1  2.0
2  2.0
3  2.0
```

databricks.koalas.window.Rolling.sum

`Rolling.sum()` → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate rolling summation of given DataFrame or Series.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Same type as the input, with the same index, containing the rolling summation.

See also:

`Series.expanding` Calling object with Series data.

`DataFrame.expanding` Calling object with DataFrames.

`Series.sum` Reducing sum for Series.

`DataFrame.sum` Reducing sum for DataFrame.

Examples

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s
0    4
1    3
2    5
3    2
4    6
dtype: int64
```

```
>>> s.rolling(2).sum()
0    NaN
1    7.0
2    8.0
3    7.0
4    8.0
dtype: float64
```

```
>>> s.rolling(3).sum()
0     NaN
1     NaN
2    12.0
3    10.0
4    13.0
dtype: float64
```

For DataFrame, each rolling summation is computed column-wise.

```
>>> df = ks.DataFrame({"A": s.to_numpy(), "B": s.to_numpy() ** 2})
>>> df
   A   B
0  4  16
1  3   9
2  5  25
3  2   4
4  6  36
```

```
>>> df.rolling(2).sum()
     A     B
0  NaN   NaN
1  7.0  25.0
2  8.0  34.0
3  7.0  29.0
4  8.0  40.0
```

```
>>> df.rolling(3).sum()
      A     B
0   NaN   NaN
1   NaN   NaN
2  12.0  50.0
3  10.0  38.0
4  13.0  65.0
```

databricks.koalas.window.Rolling.min

Rolling.**min**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]
Calculate the rolling minimum.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Returned object type is determined by the caller of the rolling calculation.

See also:

Series.rolling Calling object with a Series.

DataFrame.rolling Calling object with a DataFrame.

Series.min Similar method for Series.

DataFrame.min Similar method for DataFrame.

Examples

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s
0    4
1    3
2    5
3    2
4    6
dtype: int64
```

```
>>> s.rolling(2).min()
0    NaN
1    3.0
2    3.0
3    2.0
4    2.0
dtype: float64
```

```
>>> s.rolling(3).min()
0    NaN
1    NaN
2    3.0
3    2.0
4    2.0
dtype: float64
```

For DataFrame, each rolling minimum is computed column-wise.

```
>>> df = ks.DataFrame({"A": s.to_numpy(), "B": s.to_numpy() ** 2})
>>> df
   A   B
0  4  16
1  3   9
2  5  25
3  2   4
4  6  36
```

```
>>> df.rolling(2).min()
     A    B
0  NaN  NaN
1  3.0  9.0
2  3.0  9.0
3  2.0  4.0
4  2.0  4.0
```

```
>>> df.rolling(3).min()
     A    B
0  NaN  NaN
1  NaN  NaN
2  3.0  9.0
3  2.0  4.0
4  2.0  4.0
```

databricks.koalas.window.Rolling.max

Rolling.**max**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate the rolling maximum.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Return type is determined by the caller.

See also:

Series.rolling Series rolling.

DataFrame.rolling DataFrame rolling.

Series.max Similar method for Series.

DataFrame.max Similar method for DataFrame.

Examples

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s
0    4
1    3
2    5
3    2
4    6
dtype: int64
```

```
>>> s.rolling(2).max()
0    NaN
1    4.0
2    5.0
3    5.0
4    6.0
dtype: float64
```

```
>>> s.rolling(3).max()
0    NaN
1    NaN
2    5.0
3    5.0
4    6.0
dtype: float64
```

For DataFrame, each rolling maximum is computed column-wise.

```
>>> df = ks.DataFrame({"A": s.to_numpy(), "B": s.to_numpy() ** 2})
>>> df
   A   B
0  4  16
1  3   9
2  5  25
3  2   4
4  6  36
```

```
>>> df.rolling(2).max()
     A     B
0  NaN   NaN
1  4.0  16.0
2  5.0  25.0
3  5.0  25.0
4  6.0  36.0
```

```
>>> df.rolling(3).max()
     A     B
0  NaN   NaN
1  NaN   NaN
2  5.0  25.0
3  5.0  25.0
4  6.0  36.0
```

databricks.koalas.window.Rolling.mean

Rolling.**mean**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate the rolling mean of the values.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Returned object type is determined by the caller of the rolling calculation.

See also:

Series.rolling Calling object with Series data.

DataFrame.rolling Calling object with DataFrames.

Series.mean Equivalent method for Series.

DataFrame.mean Equivalent method for DataFrame.

Examples

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s
0    4
1    3
2    5
3    2
4    6
dtype: int64
```

```
>>> s.rolling(2).mean()
0    NaN
1    3.5
2    4.0
3    3.5
4    4.0
dtype: float64
```

```
>>> s.rolling(3).mean()
0         NaN
1         NaN
2    4.000000
3    3.333333
4    4.333333
dtype: float64
```

For DataFrame, each rolling mean is computed column-wise.

```
>>> df = ks.DataFrame({"A": s.to_numpy(), "B": s.to_numpy() ** 2})
>>> df
   A   B
0  4  16
1  3   9
2  5  25
3  2   4
4  6  36
```

```
>>> df.rolling(2).mean()
     A     B
0  NaN   NaN
1  3.5  12.5
2  4.0  17.0
3  3.5  14.5
4  4.0  20.0
```

```
>>> df.rolling(3).mean()
          A          B
0       NaN        NaN
1       NaN        NaN
2  4.000000  16.666667
3  3.333333  12.666667
4  4.333333  21.666667
```

3.6.2 Standard expanding window functions

Expanding.count()	The expanding count of any non-NaN observations inside the window.
Expanding.sum()	Calculate expanding summation of given DataFrame or Series.
Expanding.min()	Calculate the expanding minimum.
Expanding.max()	Calculate the expanding maximum.
Expanding.mean()	Calculate the expanding mean of the values.

databricks.koalas.window.Expanding.count

Expanding.**count**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

The expanding count of any non-NaN observations inside the window.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Returned object type is determined by the caller of the expanding calculation.

See also:

Series.expanding Calling object with Series data.

DataFrame.expanding Calling object with DataFrames.

Series.count Count of the full Series.

DataFrame.count Count of the full DataFrame.

Examples

```
>>> s = ks.Series([2, 3, float("nan"), 10])
>>> s.expanding().count()
0    1.0
1    2.0
2    2.0
3    3.0
dtype: float64
```

```
>>> s.to_frame().expanding().count()
     0
0  1.0
1  2.0
2  2.0
3  3.0
```

databricks.koalas.window.Expanding.sum

Expanding.**sum**() → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate expanding summation of given DataFrame or Series.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Same type as the input, with the same index, containing the expanding summation.

See also:

Series.expanding Calling object with Series data.

DataFrame.expanding Calling object with DataFrames.

Series.sum Reducing sum for Series.

DataFrame.sum Reducing sum for DataFrame.

Examples

```
>>> s = ks.Series([1, 2, 3, 4, 5])
>>> s
0    1
1    2
2    3
3    4
4    5
dtype: int64
```

```
>>> s.expanding(3).sum()
0     NaN
1     NaN
2     6.0
3    10.0
4    15.0
dtype: float64
```

For DataFrame, each expanding summation is computed column-wise.

```
>>> df = ks.DataFrame({"A": s.to_numpy(), "B": s.to_numpy() ** 2})
>>> df
   A   B
0  1   1
1  2   4
2  3   9
3  4  16
4  5  25
```

```
>>> df.expanding(3).sum()
      A     B
0   NaN   NaN
1   NaN   NaN
2   6.0  14.0
3  10.0  30.0
4  15.0  55.0
```

databricks.koalas.window.Expanding.min

`Expanding.min()` → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate the expanding minimum.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Returned object type is determined by the caller of the expanding calculation.

See also:

Series.expanding Calling object with a Series.

DataFrame.expanding Calling object with a DataFrame.

Series.min Similar method for Series.

DataFrame.min Similar method for DataFrame.

Examples

Performing a expanding minimum with a window size of 3.

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s.expanding(3).min()
0    NaN
1    NaN
2    3.0
3    2.0
4    2.0
dtype: float64
```

databricks.koalas.window.Expanding.max

`Expanding.max()` → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate the expanding maximum.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Return type is determined by the caller.

See also:

Series.expanding Calling object with Series data.

DataFrame.expanding Calling object with DataFrames.

Series.max Similar method for Series.

DataFrame.max Similar method for DataFrame.

Examples

Performing a expanding minimum with a window size of 3.

```
>>> s = ks.Series([4, 3, 5, 2, 6])
>>> s.expanding(3).max()
0    NaN
1    NaN
2    5.0
3    5.0
```

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```
4    6.0
dtype: float64
```

databricks.koalas.window.Expanding.mean

`Expanding.`**`mean`**`()` → Union[databricks.koalas.series.Series, databricks.koalas.frame.DataFrame]

Calculate the expanding mean of the values.

Note: the current implementation of this API uses Spark's Window without specifying partition specification. This leads to move all data into single partition in single machine and could cause serious performance degradation. Avoid this method against very large dataset.

Returns

Series or DataFrame Returned object type is determined by the caller of the expanding calculation.

See also:

`Series.expanding` Calling object with Series data.

`DataFrame.expanding` Calling object with DataFrames.

`Series.mean` Equivalent method for Series.

`DataFrame.mean` Equivalent method for DataFrame.

Examples

The below examples will show expanding mean calculations with window sizes of two and three, respectively.

```
>>> s = ks.Series([1, 2, 3, 4])
>>> s.expanding(2).mean()
0    NaN
1    1.5
2    2.0
3    2.5
dtype: float64
```

```
>>> s.expanding(3).mean()
0    NaN
1    NaN
2    2.0
3    2.5
dtype: float64
```

3.7 GroupBy

GroupBy objects are returned by groupby calls: *DataFrame.groupby()*, *Series.groupby()*, etc.

3.7.1 Indexing, iteration

GroupBy.get_group(name)	Construct DataFrame from group with provided name.

databricks.koalas.groupby.GroupBy.get_group

GroupBy.**get_group**(*name*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Construct DataFrame from group with provided name.

Parameters

name [object] The name of the group to get as a DataFrame.

Returns

group [same type as obj]

Examples

```
>>> kdf = ks.DataFrame([('falcon', 'bird', 389.0),
...                     ('parrot', 'bird', 24.0),
...                     ('lion', 'mammal', 80.5),
...                     ('monkey', 'mammal', np.nan)],
...                    columns=['name', 'class', 'max_speed'],
...                    index=[0, 2, 3, 1])
>>> kdf
     name   class  max_speed
0  falcon    bird      389.0
2  parrot    bird       24.0
3    lion  mammal       80.5
1  monkey  mammal        NaN
```

```
>>> kdf.groupby("class").get_group("bird").sort_index()
     name class  max_speed
0  falcon  bird      389.0
2  parrot  bird       24.0
```

```
>>> kdf.groupby("class").get_group("mammal").sort_index()
     name   class  max_speed
1  monkey  mammal        NaN
3    lion  mammal       80.5
```

3.7.2 Function application

GroupBy.apply(func, *args, **kwargs)	Apply function *func* group-wise and combine the results together.
GroupBy.transform(func, *args, **kwargs)	Apply function column-by-column to the GroupBy object.

databricks.koalas.groupby.GroupBy.apply

GroupBy.**apply**(*func*, **args*, ***kwargs*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Apply function *func* group-wise and combine the results together.

The function passed to *apply* must take a DataFrame as its first argument and return a DataFrame. *apply* will then take care of combining the results back together into a single dataframe. *apply* is therefore a highly flexible grouping method.

While *apply* is a very flexible method, its downside is that using it can be quite a bit slower than using more specific methods like *agg* or *transform*. Koalas offers a wide range of method that will be much faster than using *apply* for their specific purposes, so try to use them before reaching for *apply*.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def pandas_div(x) -> ks.DataFrame[float, float]:
...     return x[['B', 'C']] / x[['B', 'C']]
```

If the return type is specified, the output column names become *c0, c1, c2 ... cn*. These names are positionally mapped to the returned DataFrame in `func`.

To specify the column names, you can assign them in a pandas friendly style as below:

```
>>> def pandas_div(x) -> ks.DataFrame["a": float, "b": float]:
...     return x[['B', 'C']] / x[['B', 'C']]
```

```
>>> pdf = pd.DataFrame({'B': [1.], 'C': [3.]})
>>> def plus_one(x) -> ks.DataFrame[zip(pdf.columns, pdf.dtypes)]:
...     return x[['B', 'C']] / x[['B', 'C']]
```

Note: the dataframe within `func` is actually a pandas dataframe. Therefore, any pandas APIs within this function is allowed.

Parameters

func [callable] A callable that takes a DataFrame as its first argument, and returns a dataframe.

***args** Positional arguments to pass to func.

****kwargs** Keyword arguments to pass to func.

Returns

applied [DataFrame or Series]

See also:

aggregate Apply aggregate function to the GroupBy object.

DataFrame.apply Apply a function to a DataFrame.

Series.apply Apply a function to a Series.

Examples

```
>>> df = ks.DataFrame({'A': 'a a b'.split(),
...                    'B': [1, 2, 3],
...                    'C': [4, 6, 5]}, columns=['A', 'B', 'C'])
>>> g = df.groupby('A')
```

Notice that g has two groups, a and b. Calling *apply* in various ways, we can get different grouping results:

Below the functions passed to *apply* takes a DataFrame as its argument and returns a DataFrame. *apply* combines the result for each group together into a new DataFrame:

```
>>> def plus_min(x):
...     return x + x.min()
>>> g.apply(plus_min).sort_index()
    A  B   C
0  aa  2   8
1  aa  3  10
2  bb  6  10
```

```
>>> g.apply(sum).sort_index()
    A  B   C
A
a  aa  3  10
b   b  3   5
```

```
>>> g.apply(len).sort_index()
A
a    2
b    1
dtype: int64
```

You can specify the type hint and prevent schema inference for better performance.

```
>>> def pandas_div(x) -> ks.DataFrame[float, float]:
...     return x[['B', 'C']] / x[['B', 'C']]
>>> g.apply(pandas_div).sort_index()
    c0   c1
0  1.0  1.0
1  1.0  1.0
2  1.0  1.0
```

In case of Series, it works as below.

```
>>> def plus_max(x) -> ks.Series[np.int]:
...     return x + x.max()
```

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```
>>> df.B.groupby(df.A).apply(plus_max).sort_index()
0    6
1    3
2    4
Name: B, dtype: int64
```

```
>>> def plus_min(x):
...     return x + x.min()
>>> df.B.groupby(df.A).apply(plus_min).sort_index()
0    2
1    3
2    6
Name: B, dtype: int64
```

You can also return a scalar value as a aggregated value of the group:

```
>>> def plus_length(x) -> np.int:
...     return len(x)
>>> df.B.groupby(df.A).apply(plus_length).sort_index()
0    1
1    2
Name: B, dtype: int64
```

The extra arguments to the function can be passed as below.

```
>>> def calculation(x, y, z) -> np.int:
...     return len(x) + y * z
>>> df.B.groupby(df.A).apply(calculation, 5, z=10).sort_index()
0    51
1    52
Name: B, dtype: int64
```

databricks.koalas.groupby.GroupBy.transform

GroupBy.**transform**(*func*, **args*, ***kwargs*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Apply function column-by-column to the GroupBy object.

The function passed to *transform* must take a Series as its first argument and return a Series. The given function is executed for each series in each grouped data.

While *transform* is a very flexible method, its downside is that using it can be quite a bit slower than using more specific methods like *agg* or *transform*. Koalas offers a wide range of method that will be much faster than using *transform* for their specific purposes, so try to use them before reaching for *transform*.

Note: this API executes the function once to infer the type which is potentially expensive, for instance, when the dataset is created after aggregations or sorting.

To avoid this, specify return type in `func`, for instance, as below:

```
>>> def convert_to_string(x) -> ks.Series[str]:
...     return x.apply("a string {}".format)
```

Note: the series within `func` is actually a pandas series. Therefore, any pandas APIs within this function is allowed.

Parameters

func [callable] A callable that takes a Series as its first argument, and returns a Series.

***args** Positional arguments to pass to func.

****kwargs** Keyword arguments to pass to func.

Returns

applied [DataFrame]

See also:

`aggregate` Apply aggregate function to the GroupBy object.

`Series.apply` Apply a function to a Series.

Examples

```
>>> df = ks.DataFrame({'A': [0, 0, 1],
...                    'B': [1, 2, 3],
...                    'C': [4, 6, 5]}, columns=['A', 'B', 'C'])
```

```
>>> g = df.groupby('A')
```

Notice that `g` has two groups, `0` and `1`. Calling *transform* in various ways, we can get different grouping results: Below the functions passed to *transform* takes a Series as its argument and returns a Series. *transform* applies the function on each series in each grouped data, and combine them into a new DataFrame:

```
>>> def convert_to_string(x) -> ks.Series[str]:
...     return x.apply("a string {}".format)
>>> g.transform(convert_to_string)
            B           C
0  a string 1  a string 4
1  a string 2  a string 6
2  a string 3  a string 5
```

```
>>> def plus_max(x) -> ks.Series[np.int]:
...     return x + x.max()
>>> g.transform(plus_max)
   B   C
0  3  10
1  4  12
2  6  10
```

You can omit the type hint and let Koalas infer its type.

```
>>> def plus_min(x):
...     return x + x.min()
>>> g.transform(plus_min)
   B   C
```

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```
0  2   8
1  3  10
2  6  10
```

In case of Series, it works as below.

```
>>> df.B.groupby(df.A).transform(plus_max)
0    3
1    4
2    6
Name: B, dtype: int64
```

```
>>> (df * -1).B.groupby(df.A).transform(abs)
0    1
1    2
2    3
Name: B, dtype: int64
```

You can also specify extra arguments to pass to the function.

```
>>> def calculation(x, y, z) -> ks.Series[np.int]:
...     return x + x.min() + y + z
>>> g.transform(calculation, 5, z=20)
    B   C
0  27  33
1  28  35
2  31  35
```

The following methods are available only for *DataFrameGroupBy* objects.

DataFrameGroupBy.agg([func_or_funcs])	Aggregate using one or more operations over the specified axis.
DataFrameGroupBy.aggregate([func_or_funcs])	Aggregate using one or more operations over the specified axis.

databricks.koalas.groupby.DataFrameGroupBy.agg

DataFrameGroupBy.**agg**(*func_or_funcs=None*, **args*, ***kwargs*) → databricks.koalas.frame.DataFrame

Aggregate using one or more operations over the specified axis.

Parameters

func_or_funcs [dict, str or list] a dict mapping from column name (string) to aggregate functions (string or list of strings).

Returns

Series or DataFrame The return can be:

- Series : when DataFrame.agg is called with a single function
- DataFrame : when DataFrame.agg is called with several functions

Return Series or DataFrame.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 2],
...                    'B': [1, 2, 3, 4],
...                    'C': [0.362, 0.227, 1.267, -0.562]},
...                   columns=['A', 'B', 'C'])
```

```
>>> df
   A  B      C
0  1  1  0.362
1  1  2  0.227
2  2  3  1.267
3  2  4 -0.562
```

Different aggregations per column

```
>>> aggregated = df.groupby('A').agg({'B': 'min', 'C': 'sum'})
>>> aggregated[['B', 'C']].sort_index()
   B      C
A
1  1  0.589
2  3  0.705
```

```
>>> aggregated = df.groupby('A').agg({'B': ['min', 'max']})
>>> aggregated.sort_index()
     B
   min  max
A
1    1    2
2    3    4
```

```
>>> aggregated = df.groupby('A').agg('min')
>>> aggregated.sort_index()
     B      C
A
1    1  0.227
2    3 -0.562
```

```
>>> aggregated = df.groupby('A').agg(['min', 'max'])
>>> aggregated.sort_index()
     B           C
   min  max    min    max
A
1    1    2  0.227  0.362
2    3    4 -0.562  1.267
```

To control the output names with different aggregations per column, Koalas also supports 'named aggregation' or nested renaming in .agg. It can also be used when applying multiple aggregation functions to specific columns.

```
>>> aggregated = df.groupby('A').agg(b_max=ks.NamedAgg(column='B', aggfunc='max'))
>>> aggregated.sort_index()
     b_max
A
1        2
2        4
```

```
>>> aggregated = df.groupby('A').agg(b_max=('B', 'max'), b_min=('B', 'min'))
>>> aggregated.sort_index()
     b_max   b_min
A
1        2       1
2        4       3
```

```
>>> aggregated = df.groupby('A').agg(b_max=('B', 'max'), c_min=('C', 'min'))
>>> aggregated.sort_index()
     b_max   c_min
A
1        2   0.227
2        4  -0.562
```

databricks.koalas.groupby.DataFrameGroupBy.aggregate

DataFrameGroupBy.**aggregate**(*func_or_funcs=None*, **args*, ***kwargs*) → databricks.koalas.frame.DataFrame

Aggregate using one or more operations over the specified axis.

Parameters

func_or_funcs [dict, str or list] a dict mapping from column name (string) to aggregate functions (string or list of strings).

Returns

Series or DataFrame The return can be:

- Series : when DataFrame.agg is called with a single function
- DataFrame : when DataFrame.agg is called with several functions

Return Series or DataFrame.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Notes

agg is an alias for *aggregate*. Use the alias.

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 2],
...                    'B': [1, 2, 3, 4],
...                    'C': [0.362, 0.227, 1.267, -0.562]},
...                   columns=['A', 'B', 'C'])
```

```
>>> df
   A  B      C
0  1  1  0.362
1  1  2  0.227
2  2  3  1.267
3  2  4 -0.562
```

Different aggregations per column

```
>>> aggregated = df.groupby('A').agg({'B': 'min', 'C': 'sum'})
>>> aggregated[['B', 'C']].sort_index()
   B      C
A
1  1  0.589
2  3  0.705
```

```
>>> aggregated = df.groupby('A').agg({'B': ['min', 'max']})
>>> aggregated.sort_index()
     B
   min  max
A
1    1    2
2    3    4
```

```
>>> aggregated = df.groupby('A').agg('min')
>>> aggregated.sort_index()
     B      C
A
1    1  0.227
2    3 -0.562
```

```
>>> aggregated = df.groupby('A').agg(['min', 'max'])
>>> aggregated.sort_index()
     B           C
   min  max    min    max
A
1    1    2  0.227  0.362
2    3    4 -0.562  1.267
```

To control the output names with different aggregations per column, Koalas also supports 'named aggregation' or nested renaming in .agg. It can also be used when applying multiple aggregation functions to specific columns.

```
>>> aggregated = df.groupby('A').agg(b_max=ks.NamedAgg(column='B', aggfunc='max'))
>>> aggregated.sort_index()
   b_max
A
1      2
2      4
```

```
>>> aggregated = df.groupby('A').agg(b_max=('B', 'max'), b_min=('B', 'min'))
>>> aggregated.sort_index()
   b_max   b_min
A
1      2       1
2      4       3
```

```
>>> aggregated = df.groupby('A').agg(b_max=('B', 'max'), c_min=('C', 'min'))
>>> aggregated.sort_index()
   b_max   c_min
A
1      2   0.227
2      4  -0.562
```

3.7.3 Computations / Descriptive Stats

GroupBy.all()	Returns True if all values in the group are truthful, else False.
GroupBy.any()	Returns True if any value in the group is truthful, else False.
GroupBy.count()	Compute count of group, excluding missing values.
GroupBy.cumcount([ascending])	Number each item in each group from 0 to the length of that group - 1.
GroupBy.cummax()	Cumulative max for each group.
GroupBy.cummin()	Cumulative min for each group.
GroupBy.cumprod()	Cumulative product for each group.
GroupBy.cumsum()	Cumulative sum for each group.
GroupBy.filter(func)	Return a copy of a DataFrame excluding elements from groups that do not satisfy the boolean criterion specified by func.
GroupBy.first()	Compute first of group values.
GroupBy.last()	Compute last of group values.
GroupBy.max()	Compute max of group values.
GroupBy.mean()	Compute mean of groups, excluding missing values.
GroupBy.median([numeric_only, accuracy])	Compute median of groups, excluding missing values.
GroupBy.min()	Compute min of group values.
GroupBy.rank([method, ascending])	Provide the rank of values within each group.
GroupBy.std()	Compute standard deviation of groups, excluding missing values.
GroupBy.sum()	Compute sum of group values
GroupBy.var()	Compute variance of groups, excluding missing values.
GroupBy.nunique([dropna])	Return DataFrame with number of distinct observations per group for each column.
GroupBy.size()	Compute group sizes.

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GroupBy.diff([periods])	First discrete difference of element.
GroupBy.idxmax([skipna])	Return index of first occurrence of maximum over requested axis in group.
GroupBy.idxmin([skipna])	Return index of first occurrence of minimum over requested axis in group.
GroupBy.fillna([value, method, axis, ...])	Fill NA/NaN values in group.
GroupBy.bfill([limit])	Synonym for *DataFrame.fillna()* with `method=`bfill`.
GroupBy.ffill([limit])	Synonym for *DataFrame.fillna()* with `method=`ffill`.
GroupBy.head([n])	Return first n rows of each group.
GroupBy.backfill([limit])	Synonym for *DataFrame.fillna()* with `method=`bfill`.
GroupBy.shift([periods, fill_value])	Shift each group by periods observations.
GroupBy.tail([n])	Return last n rows of each group.

databricks.koalas.groupby.GroupBy.all

GroupBy.**all**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Returns True if all values in the group are truthful, else False.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 2, 3, 3, 4, 4, 5, 5],
...                    'B': [True, True, True, False, False,
...                          False, None, True, None, False]},
...                   columns=['A', 'B'])
>>> df
   A      B
0  1   True
1  1   True
2  2   True
3  2  False
4  3  False
5  3  False
6  4   None
7  4   True
8  5   None
9  5  False
```

```
>>> df.groupby('A').all().sort_index()
       B
A
1   True
2  False
3  False
```

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```
4   True
5  False
```

databricks.koalas.groupby.GroupBy.any

GroupBy.**any**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Returns True if any value in the group is truthful, else False.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 2, 3, 3, 4, 4, 5, 5],
...                    'B': [True, True, True, False, False,
...                          False, None, True, None, False]},
...                   columns=['A', 'B'])
>>> df
   A      B
0  1   True
1  1   True
2  2   True
3  2  False
4  3  False
5  3  False
6  4   None
7  4   True
8  5   None
9  5  False
```

```
>>> df.groupby('A').any().sort_index()
       B
A
1   True
2   True
3  False
4   True
5  False
```

databricks.koalas.groupby.GroupBy.count

GroupBy.**count**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Compute count of group, excluding missing values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 1, 2],
...                    'B': [np.nan, 2, 3, 4, 5],
...                    'C': [1, 2, 1, 1, 2]}, columns=['A', 'B', 'C'])
>>> df.groupby('A').count().sort_index()
   B  C
A
1  2  3
2  2  2
```

databricks.koalas.groupby.GroupBy.cumcount

GroupBy.**cumcount**(*ascending=True*) → databricks.koalas.series.Series

Number each item in each group from 0 to the length of that group - 1.

Essentially this is equivalent to

```
self.apply(lambda x: pd.Series(np.arange(len(x)), x.index))
```

Parameters

ascending [bool, default True] If False, number in reverse, from length of group - 1 to 0.

Returns

Series Sequence number of each element within each group.

Examples

```
>>> df = ks.DataFrame([['a'], ['a'], ['a'], ['b'], ['b'], ['a']],
...                   columns=['A'])
>>> df
   A
0  a
1  a
2  a
3  b
4  b
5  a
>>> df.groupby('A').cumcount().sort_index()
0    0
1    1
2    2
3    0
4    1
5    3
dtype: int64
>>> df.groupby('A').cumcount(ascending=False).sort_index()
0    3
1    2
2    1
3    1
4    0
5    0
dtype: int64
```

databricks.koalas.groupby.GroupBy.cummax

GroupBy.**cummax**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Cumulative max for each group.

Returns

Series or DataFrame

See also:

Series.cummax

DataFrame.cummax

Examples

```
>>> df = ks.DataFrame(
...     [[1, None, 4], [1, 0.1, 3], [1, 20.0, 2], [4, 10.0, 1]],
...     columns=list('ABC'))
>>> df
   A     B  C
0  1   NaN  4
1  1   0.1  3
2  1  20.0  2
3  4  10.0  1
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.groupby("A").cummax().sort_index()
      B  C
0   NaN  4
1   0.1  4
2  20.0  4
3  10.0  1
```

It works as below in Series.

```
>>> df.C.groupby(df.A).cummax().sort_index()
0    4
1    4
2    4
3    1
Name: C, dtype: int64
```

databricks.koalas.groupby.GroupBy.cummin

GroupBy.**cummin**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Cumulative min for each group.

Returns

Series or DataFrame

See also:

Series.cummin

DataFrame.cummin

Examples

```
>>> df = ks.DataFrame(
...     [[1, None, 4], [1, 0.1, 3], [1, 20.0, 2], [4, 10.0, 1]],
...     columns=list('ABC'))
>>> df
   A     B  C
0  1   NaN  4
1  1   0.1  3
2  1  20.0  2
3  4  10.0  1
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.groupby("A").cummin().sort_index()
      B  C
0   NaN  4
1   0.1  3
2   0.1  2
3  10.0  1
```

It works as below in Series.

```
>>> df.B.groupby(df.A).cummin().sort_index()
0     NaN
1     0.1
2     0.1
3    10.0
Name: B, dtype: float64
```

databricks.koalas.groupby.GroupBy.cumprod

GroupBy.**cumprod**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Cumulative product for each group.

Returns

Series or DataFrame

See also:

Series.cumprod

DataFrame.cumprod

Examples

```
>>> df = ks.DataFrame(
...     [[1, None, 4], [1, 0.1, 3], [1, 20.0, 2], [4, 10.0, 1]],
...     columns=list('ABC'))
>>> df
   A     B  C
0  1   NaN  4
1  1   0.1  3
2  1  20.0  2
3  4  10.0  1
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.groupby("A").cumprod().sort_index()
      B   C
0   NaN   4
1   0.1  12
2   2.0  24
3  10.0   1
```

It works as below in Series.

```
>>> df.B.groupby(df.A).cumprod().sort_index()
0     NaN
1     0.1
2     2.0
3    10.0
Name: B, dtype: float64
```

databricks.koalas.groupby.GroupBy.cumsum

GroupBy.**cumsum**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Cumulative sum for each group.

Returns

Series or DataFrame

See also:

Series.cumsum

DataFrame.cumsum

Examples

```
>>> df = ks.DataFrame(
...     [[1, None, 4], [1, 0.1, 3], [1, 20.0, 2], [4, 10.0, 1]],
...     columns=list('ABC'))
>>> df
   A     B  C
0  1   NaN  4
1  1   0.1  3
2  1  20.0  2
3  4  10.0  1
```

By default, iterates over rows and finds the sum in each column.

```
>>> df.groupby("A").cumsum().sort_index()
      B  C
0   NaN  4
1   0.1  7
2  20.1  9
3  10.0  1
```

It works as below in Series.

```
>>> df.B.groupby(df.A).cumsum().sort_index()
0     NaN
1     0.1
2    20.1
3    10.0
Name: B, dtype: float64
```

databricks.koalas.groupby.GroupBy.filter

GroupBy.**filter**(*func*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Return a copy of a DataFrame excluding elements from groups that do not satisfy the boolean criterion specified by func.

Parameters

f [function] Function to apply to each subframe. Should return True or False.

dropna [Drop groups that do not pass the filter. True by default;] if False, groups that evaluate False are filled with NaNs.

Returns

filtered [DataFrame or Series]

Notes

Each subframe is endowed the attribute 'name' in case you need to know which group you are working on.

Examples

```
>>> df = ks.DataFrame({'A' : ['foo', 'bar', 'foo', 'bar',
...                           'foo', 'bar'],
...                    'B' : [1, 2, 3, 4, 5, 6],
...                    'C' : [2.0, 5., 8., 1., 2., 9.]}, columns=['A', 'B', 'C'])
>>> grouped = df.groupby('A')
>>> grouped.filter(lambda x: x['B'].mean() > 3.)
     A  B    C
1  bar  2  5.0
3  bar  4  1.0
5  bar  6  9.0
```

```
>>> df.B.groupby(df.A).filter(lambda x: x.mean() > 3.)
1    2
3    4
```

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```
5    6
Name: B, dtype: int64
```

databricks.koalas.groupby.GroupBy.first

GroupBy.**first**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute first of group values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.last

GroupBy.**last**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute last of group values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.max

GroupBy.**max**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute max of group values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.mean

GroupBy.**mean**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute mean of groups, excluding missing values.

Returns

koalas.Series or koalas.DataFrame

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 1, 2, 1, 2],
...                    'B': [np.nan, 2, 3, 4, 5],
...                    'C': [1, 2, 1, 1, 2]}, columns=['A', 'B', 'C'])
```

Groupby one column and return the mean of the remaining columns in each group.

```
>>> df.groupby('A').mean().sort_index()
     B         C
A
1  3.0  1.333333
2  4.0  1.500000
```

databricks.koalas.groupby.GroupBy.median

GroupBy.**median**(*numeric_only=True*, *accuracy=10000*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Compute median of groups, excluding missing values.

For multiple groupings, the result index will be a MultiIndex

---

Note: Unlike pandas', the median in Koalas is an approximated median based upon approximate percentile computation because computing median across a large dataset is extremely expensive.

Parameters

numeric_only [bool, default True] Include only float, int, boolean columns. False is not supported. This parameter is mainly for pandas compatibility.

Returns

Series or DataFrame Median of values within each group.

Examples

```
>>> kdf = ks.DataFrame({'a': [1., 1., 1., 1., 2., 2., 2., 3., 3., 3.],
...                     'b': [2., 3., 1., 4., 6., 9., 8., 10., 7., 5.],
...                     'c': [3., 5., 2., 5., 1., 2., 6., 4., 3., 6.]},
...                    columns=['a', 'b', 'c'],
...                    index=[7, 2, 4, 1, 3, 4, 9, 10, 5, 6])
>>> kdf
      a     b    c
7   1.0   2.0  3.0
2   1.0   3.0  5.0
4   1.0   1.0  2.0
1   1.0   4.0  5.0
3   2.0   6.0  1.0
4   2.0   9.0  2.0
9   2.0   8.0  6.0
10  3.0  10.0  4.0
5   3.0   7.0  3.0
6   3.0   5.0  6.0
```

DataFrameGroupBy

```
>>> kdf.groupby('a').median().sort_index()
       b    c
a
1.0  2.0  3.0
2.0  8.0  2.0
3.0  7.0  4.0
```

SeriesGroupBy

```
>>> kdf.groupby('a')['b'].median().sort_index()
a
1.0    2.0
2.0    8.0
3.0    7.0
Name: b, dtype: float64
```

databricks.koalas.groupby.GroupBy.min

GroupBy.**min**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Compute min of group values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.rank

GroupBy.**rank**(*method='average'*, *ascending=True*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Provide the rank of values within each group.

Parameters

method [{'average', 'min', 'max', 'first', 'dense'}, default 'average']

- average: average rank of group
- min: lowest rank in group
- max: highest rank in group
- first: ranks assigned in order they appear in the array
- dense: like 'min', but rank always increases by 1 between groups

ascending [boolean, default True] False for ranks by high (1) to low (N)

Returns

DataFrame with ranking of values within each group

Examples

```
>>> df = ks.DataFrame({
...     'a': [1, 1, 1, 2, 2, 2, 3, 3, 3],
...     'b': [1, 2, 2, 2, 3, 3, 3, 4, 4]}, columns=['a', 'b'])
>>> df
   a  b
0  1  1
1  1  2
2  1  2
3  2  2
4  2  3
5  2  3
6  3  3
7  3  4
8  3  4
```

```
>>> df.groupby("a").rank().sort_index()
     b
0  1.0
1  2.5
2  2.5
3  1.0
4  2.5
5  2.5
6  1.0
7  2.5
8  2.5
```

```
>>> df.b.groupby(df.a).rank(method='max').sort_index()
0    1.0
1    3.0
2    3.0
3    1.0
4    3.0
5    3.0
6    1.0
7    3.0
8    3.0
Name: b, dtype: float64
```

databricks.koalas.groupby.GroupBy.std

GroupBy.**std**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Compute standard deviation of groups, excluding missing values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.sum

GroupBy.**sum**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute sum of group values

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.var

GroupBy.**var**() → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Compute variance of groups, excluding missing values.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

databricks.koalas.groupby.GroupBy.nunique

GroupBy.**nunique**(*dropna=True*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]
Return DataFrame with number of distinct observations per group for each column.

Parameters

dropna [boolean, default True] Don't include NaN in the counts.

Returns

nunique [DataFrame or Series]

Examples

```
>>> df = ks.DataFrame({'id': ['spam', 'egg', 'egg', 'spam',
...                           'ham', 'ham'],
...                    'value1': [1, 5, 5, 2, 5, 5],
...                    'value2': list('abbaxy')}, columns=['id', 'value1', 'value2
↪'])
>>> df
     id  value1 value2
0  spam       1      a
1   egg       5      b
2   egg       5      b
3  spam       2      a
4   ham       5      x
5   ham       5      y
```

```
>>> df.groupby('id').nunique().sort_index()
      value1  value2
id
egg        1       1
```

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```
ham        1       2
spam       2       1
```

```
>>> df.groupby('id')['value1'].nunique().sort_index()
id
egg     1
ham     1
spam    2
Name: value1, dtype: int64
```

databricks.koalas.groupby.GroupBy.size

GroupBy.**size**() → databricks.koalas.series.Series

Compute group sizes.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 2, 3, 3, 3],
...                    'B': [1, 1, 2, 3, 3, 3]},
...                   columns=['A', 'B'])
>>> df
   A  B
0  1  1
1  2  1
2  2  2
3  3  3
4  3  3
5  3  3
```

```
>>> df.groupby('A').size().sort_index()
A
1    1
2    2
3    3
dtype: int64
```

```
>>> df.groupby(['A', 'B']).size().sort_index()
A  B
1  1    1
2  1    1
   2    1
3  3    3
dtype: int64
```

For Series,

```
>>> df.B.groupby(df.A).size().sort_index()
A
1    1
2    2
3    3
Name: B, dtype: int64
```

```
>>> df.groupby(df.A).B.size().sort_index()
A
1    1
2    2
3    3
Name: B, dtype: int64
```

databricks.koalas.groupby.GroupBy.diff

GroupBy.**diff**(*periods=1*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

First discrete difference of element.

Calculates the difference of a DataFrame element compared with another element in the DataFrame group (default is the element in the same column of the previous row).

Parameters

periods [int, default 1] Periods to shift for calculating difference, accepts negative values.

Returns

diffed [DataFrame or Series]

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'a': [1, 2, 3, 4, 5, 6],
...                    'b': [1, 1, 2, 3, 5, 8],
...                    'c': [1, 4, 9, 16, 25, 36]}, columns=['a', 'b', 'c'])
>>> df
   a  b   c
0  1  1   1
1  2  1   4
2  3  2   9
3  4  3  16
4  5  5  25
5  6  8  36
```

```
>>> df.groupby(['b']).diff().sort_index()
     a    c
0  NaN  NaN
1  1.0  3.0
2  NaN  NaN
3  NaN  NaN
```

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```
4  NaN  NaN
5  NaN  NaN
```

Difference with previous column in a group.

```
>>> df.groupby(['b'])['a'].diff().sort_index()
0    NaN
1    1.0
2    NaN
3    NaN
4    NaN
5    NaN
Name: a, dtype: float64
```

databricks.koalas.groupby.GroupBy.idxmax

GroupBy.**idxmax**(*skipna=True*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Return index of first occurrence of maximum over requested axis in group. NA/null values are excluded.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

See also:

Series.idxmax

DataFrame.idxmax

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 2, 2, 3],
...                    'b': [1, 2, 3, 4, 5],
...                    'c': [5, 4, 3, 2, 1]}, columns=['a', 'b', 'c'])
```

```
>>> df.groupby(['a'])['b'].idxmax().sort_index()
a
1  1
2  3
3  4
Name: b, dtype: int64
```

```
>>> df.groupby(['a']).idxmax().sort_index()
   b  c
a
1  1  0
2  3  2
3  4  4
```

databricks.koalas.groupby.GroupBy.idxmin

GroupBy.**idxmin**(*skipna=True*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Return index of first occurrence of minimum over requested axis in group. NA/null values are excluded.

Parameters

skipna [boolean, default True] Exclude NA/null values. If an entire row/column is NA, the result will be NA.

See also:

Series.idxmin

DataFrame.idxmin

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 2, 2, 3],
...                    'b': [1, 2, 3, 4, 5],
...                    'c': [5, 4, 3, 2, 1]}, columns=['a', 'b', 'c'])
```

```
>>> df.groupby(['a'])['b'].idxmin().sort_index()
a
1    0
2    2
3    4
Name: b, dtype: int64
```

```
>>> df.groupby(['a']).idxmin().sort_index()
   b  c
a
1  0  1
2  2  3
3  4  4
```

databricks.koalas.groupby.GroupBy.fillna

GroupBy.**fillna**(*value=None*, *method=None*, *axis=None*, *inplace=False*, *limit=None*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Fill NA/NaN values in group.

Parameters

value [scalar, dict, Series] Value to use to fill holes. alternately a dict/Series of values specifying which value to use for each column. DataFrame is not supported.

method [{'backfill', 'bfill', 'pad', 'ffill', None}, default None] Method to use for filling holes in reindexed Series pad / ffill: propagate last valid observation forward to next valid backfill / bfill: use NEXT valid observation to fill gap

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame DataFrame with NA entries filled.

Examples

```
>>> df = ks.DataFrame({
...     'A': [1, 1, 2, 2],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> df
   A    B    C  D
0  1  2.0  NaN  0
1  1  4.0  NaN  1
2  2  NaN  NaN  5
3  2  3.0  1.0  4
```

We can also propagate non-null values forward or backward in group.

```
>>> df.groupby(['A'])['B'].fillna(method='ffill').sort_index()
0    2.0
1    4.0
2    NaN
3    3.0
Name: B, dtype: float64
```

```
>>> df.groupby(['A']).fillna(method='bfill').sort_index()
     B    C  D
0  2.0  NaN  0
1  4.0  NaN  1
2  3.0  1.0  5
3  3.0  1.0  4
```

databricks.koalas.groupby.GroupBy.bfill

`GroupBy.`**`bfill`**(*limit=None*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Synonym for *DataFrame.fillna()* with `method=`bfill``.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame DataFrame with NA entries filled.

Examples

```
>>> df = ks.DataFrame({
...     'A': [1, 1, 2, 2],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> df
   A    B    C  D
0  1  2.0  NaN  0
1  1  4.0  NaN  1
2  2  NaN  NaN  5
3  2  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> df.groupby(['A']).bfill().sort_index()
     B    C  D
0  2.0  NaN  0
1  4.0  NaN  1
2  3.0  1.0  5
3  3.0  1.0  4
```

databricks.koalas.groupby.GroupBy.ffill

`GroupBy.`**`ffill`**(*limit=None*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Synonym for *DataFrame.fillna()* with `method=`ffill`.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame DataFrame with NA entries filled.

Examples

```
>>> df = ks.DataFrame({
...     'A': [1, 1, 2, 2],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> df
   A    B    C  D
0  1  2.0  NaN  0
1  1  4.0  NaN  1
2  2  NaN  NaN  5
3  2  3.0  1.0  4
```

Propagate non-null values forward.

```
>>> df.groupby(['A']).ffill().sort_index()
     B    C  D
0  2.0  NaN  0
1  4.0  NaN  1
2  NaN  NaN  5
3  3.0  1.0  4
```

databricks.koalas.groupby.GroupBy.head

`GroupBy.`**`head`**`(n=5)` → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Return first n rows of each group.

Returns

DataFrame or Series

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 1, 2, 2, 2, 3, 3, 3],
...                    'b': [2, 3, 1, 4, 6, 9, 8, 10, 7, 5],
...                    'c': [3, 5, 2, 5, 1, 2, 6, 4, 3, 6]},
...                   columns=['a', 'b', 'c'],
...                   index=[7, 2, 4, 1, 3, 4, 9, 10, 5, 6])
>>> df
    a   b  c
7   1   2  3
2   1   3  5
4   1   1  2
1   1   4  5
3   2   6  1
4   2   9  2
9   2   8  6
10  3  10  4
5   3   7  3
6   3   5  6
```

```
>>> df.groupby('a').head(2).sort_index()
    a   b  c
2   1   3  5
3   2   6  1
4   2   9  2
5   3   7  3
7   1   2  3
10  3  10  4
```

```
>>> df.groupby('a')['b'].head(2).sort_index()
2      3
3      6
4      9
5      7
7      2
10    10
Name: b, dtype: int64
```

databricks.koalas.groupby.GroupBy.backfill

GroupBy.**backfill**(*limit=None*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Synonym for *DataFrame.fillna()* with `method=`bfill`.

Parameters

axis [{0 or *index*}] 1 and *columns* are not supported.

inplace [boolean, default False] Fill in place (do not create a new object)

limit [int, default None] If method is specified, this is the maximum number of consecutive NaN values to forward/backward fill. In other words, if there is a gap with more than this number of consecutive NaNs, it will only be partially filled. If method is not specified, this is the maximum number of entries along the entire axis where NaNs will be filled. Must be greater than 0 if not None

Returns

DataFrame DataFrame with NA entries filled.

Examples

```
>>> df = ks.DataFrame({
...     'A': [1, 1, 2, 2],
...     'B': [2, 4, None, 3],
...     'C': [None, None, None, 1],
...     'D': [0, 1, 5, 4]
...     },
...     columns=['A', 'B', 'C', 'D'])
>>> df
   A    B    C  D
0  1  2.0  NaN  0
1  1  4.0  NaN  1
2  2  NaN  NaN  5
3  2  3.0  1.0  4
```

Propagate non-null values backward.

```
>>> df.groupby(['A']).bfill().sort_index()
     B    C  D
0  2.0  NaN  0
1  4.0  NaN  1
2  3.0  1.0  5
3  3.0  1.0  4
```

databricks.koalas.groupby.GroupBy.shift

GroupBy.**shift**(*periods=1*, *fill_value=None*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Shift each group by periods observations.

Parameters

periods [integer, default 1] number of periods to shift

fill_value [optional]

Returns

Series or DataFrame Object shifted within each group.

Examples

```
>>> df = ks.DataFrame({
...     'a': [1, 1, 1, 2, 2, 2, 3, 3, 3],
...     'b': [1, 2, 2, 2, 3, 3, 3, 4, 4]}, columns=['a', 'b'])
>>> df
   a  b
0  1  1
1  1  2
2  1  2
3  2  2
4  2  3
5  2  3
6  3  3
7  3  4
8  3  4
```

```
>>> df.groupby('a').shift().sort_index()
     b
0  NaN
1  1.0
2  2.0
3  NaN
4  2.0
5  3.0
6  NaN
7  3.0
8  4.0
```

```
>>> df.groupby('a').shift(periods=-1, fill_value=0).sort_index()
   b
0  2
```

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```
1  2
2  0
3  3
4  3
5  0
6  4
7  4
8  0
```

databricks.koalas.groupby.GroupBy.tail

GroupBy.**tail**(*n=5*) → Union[databricks.koalas.frame.DataFrame, databricks.koalas.series.Series]

Return last n rows of each group.

Similar to *.apply(lambda x: x.tail(n))*, but it returns a subset of rows from the original DataFrame with original index and order preserved (*as_index* flag is ignored).

Does not work for negative values of n.

Returns

DataFrame or Series

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 1, 2, 2, 2, 3, 3, 3],
...                    'b': [2, 3, 1, 4, 6, 9, 8, 10, 7, 5],
...                    'c': [3, 5, 2, 5, 1, 2, 6, 4, 3, 6]},
...                   columns=['a', 'b', 'c'],
...                   index=[7, 2, 4, 1, 3, 4, 9, 10, 5, 6])
>>> df
    a   b  c
7   1   2  3
2   1   3  5
4   1   1  2
1   1   4  5
3   2   6  1
4   2   9  2
9   2   8  6
10  3  10  4
5   3   7  3
6   3   5  6
```

```
>>> df.groupby('a').tail(2).sort_index()
   a  b  c
1  1  4  5
4  2  9  2
4  1  1  2
5  3  7  3
6  3  5  6
9  2  8  6
```

```
>>> df.groupby('a')['b'].tail(2).sort_index()
1    4
```

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```
4    9
4    1
5    7
6    5
9    8
Name: b, dtype: int64
```

The following methods are available only for *DataFrameGroupBy* objects.

DataFrameGroupBy.describe()	Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN values.

databricks.koalas.groupby.DataFrameGroupBy.describe

DataFrameGroupBy.**describe**() → databricks.koalas.frame.DataFrame

Generate descriptive statistics that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN values.

Analyzes both numeric and object series, as well as DataFrame column sets of mixed data types. The output will vary depending on what is provided. Refer to the notes below for more detail.

Note: Unlike pandas, the percentiles in Koalas are based upon approximate percentile computation because computing percentiles across a large dataset is extremely expensive.

Returns

DataFrame Summary statistics of the DataFrame provided.

See also:

DataFrame.count

DataFrame.max

DataFrame.min

DataFrame.mean

DataFrame.std

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 3], 'b': [4, 5, 6], 'c': [7, 8, 9]})
>>> df
   a  b  c
0  1  4  7
1  1  5  8
2  3  6  9
```

Describing a DataFrame. By default only numeric fields are returned.

```
>>> described = df.groupby('a').describe()
>>> described.sort_index()
      b                                                 c
  count mean       std min 25% 50% 75% max count mean       std min 25% 50% 75%␣
↪max
a
1   2.0  4.5  0.707107 4.0 4.0 4.0 5.0 5.0   2.0  7.5  0.707107 7.0 7.0 7.0 8.0 8.
↪0
3   1.0  6.0       NaN 6.0 6.0 6.0 6.0 6.0   1.0  9.0       NaN 9.0 9.0 9.0 9.0 9.
↪0
```

The following methods are available only for *SeriesGroupBy* objects.

SeriesGroupBy.nsmallest([n])	Return the first n rows ordered by columns in ascending order in group.
SeriesGroupBy.nlargest([n])	Return the first n rows ordered by columns in descending order in group.
SeriesGroupBy.value_counts([sort, ...])	Compute group sizes.
SeriesGroupBy.unique()	Return unique values in group.

databricks.koalas.groupby.SeriesGroupBy.nsmallest

SeriesGroupBy.**nsmallest**(*n=5*) → databricks.koalas.series.Series

Return the first n rows ordered by columns in ascending order in group.

Return the first n rows with the smallest values in columns, in ascending order. The columns that are not specified are returned as well, but not used for ordering.

Parameters

n [int] Number of items to retrieve.

See also:

databricks.koalas.Series.nsmallest

databricks.koalas.DataFrame.nsmallest

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 2, 2, 2, 3, 3, 3],
...                    'b': [1, 2, 2, 2, 3, 3, 3, 4, 4]}, columns=['a', 'b'])
```

```
>>> df.groupby(['a'])['b'].nsmallest(1).sort_index()
a
1  0    1
2  3    2
3  6    3
Name: b, dtype: int64
```

databricks.koalas.groupby.SeriesGroupBy.nlargest

SeriesGroupBy.**nlargest**(*n=5*) → databricks.koalas.series.Series

Return the first n rows ordered by columns in descending order in group.

Return the first n rows with the smallest values in columns, in descending order. The columns that are not specified are returned as well, but not used for ordering.

Parameters

n [int] Number of items to retrieve.

See also:

databricks.koalas.Series.nlargest

databricks.koalas.DataFrame.nlargest

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 2, 2, 2, 3, 3, 3],
...                    'b': [1, 2, 2, 2, 3, 3, 3, 4, 4]}, columns=['a', 'b'])
```

```
>>> df.groupby(['a'])['b'].nlargest(1).sort_index()
a
1  1    2
2  4    3
3  7    4
Name: b, dtype: int64
```

databricks.koalas.groupby.SeriesGroupBy.value_counts

SeriesGroupBy.**value_counts**(*sort=None*, *ascending=None*, *dropna=True*) → databricks.koalas.series.Series

Compute group sizes.

Parameters

sort [boolean, default None] Sort by frequencies.

ascending [boolean, default False] Sort in ascending order.

dropna [boolean, default True] Don't include counts of NaN.

See also:

databricks.koalas.Series.groupby

databricks.koalas.DataFrame.groupby

Examples

```
>>> df = ks.DataFrame({'A': [1, 2, 2, 3, 3, 3],
...                    'B': [1, 1, 2, 3, 3, 3]},
...                   columns=['A', 'B'])
>>> df
   A  B
0  1  1
1  2  1
2  2  2
3  3  3
4  3  3
5  3  3
```

```
>>> df.groupby('A')['B'].value_counts().sort_index()
A  B
1  1    1
2  1    1
   2    1
3  3    3
Name: B, dtype: int64
```

databricks.koalas.groupby.SeriesGroupBy.unique

SeriesGroupBy.**unique**() → databricks.koalas.series.Series

Return unique values in group.

Uniques are returned in order of unknown. It does NOT sort.

See also:

databricks.koalas.Series.unique

databricks.koalas.Index.unique

Examples

```
>>> df = ks.DataFrame({'a': [1, 1, 1, 2, 2, 2, 3, 3, 3],
...                    'b': [1, 2, 2, 2, 3, 3, 3, 4, 4]}, columns=['a', 'b'])
```

```
>>> df.groupby(['a'])['b'].unique().sort_index()
a
1    [1, 2]
2    [2, 3]
3    [3, 4]
Name: b, dtype: object
```

3.8 Machine Learning utilities

3.8.1 MLflow

Arbitrary MLflow models can be used with Koalas Dataframes, provided they implement the 'pyfunc' flavor. This is the case for most frameworks supported by MLflow (scikit-learn, pytorch, tensorflow, ...). See comprehensive examples in *load_model()* for more information.

Note: The MLflow package must be installed in order to use this module. If MLflow is not installed in your environment already, you can install it with the following command:

pip install koalas[mlflow]

PythonModelWrapper(model_uri, return_type_hint)	A wrapper around MLflow's Python object model.
load_model(model_uri[, predict_type])	Loads an MLflow model into an wrapper that can be used both for pandas and Koalas DataFrame.

databricks.koalas.mlflow.PythonModelWrapper

class databricks.koalas.mlflow.**PythonModelWrapper**(*model_uri*, *return_type_hint*)

A wrapper around MLflow's Python object model.

This wrapper acts as a predictor on koalas

__init__(*model_uri*, *return_type_hint*)

Initialize self. See help(type(self)) for accurate signature.

Methods

__init__(model_uri, return_type_hint)	Initialize self.
predict(data)	Returns a prediction on the data.

databricks.koalas.mlflow.load_model

databricks.koalas.mlflow.**load_model**(*model_uri*, *predict_type='infer'*) → *databricks.koalas.mlflow.PythonModelWrapper*

Loads an MLflow model into an wrapper that can be used both for pandas and Koalas DataFrame.

Parameters

model_uri [str] URI pointing to the model. See MLflow documentation for more details.

predict_type [a python basic type, a numpy basic type, a Spark type or 'infer'.] This is the return type that is expected when calling the predict function of the model. If 'infer' is specified, the wrapper will attempt to determine automatically the return type based on the model type.

Returns

PythonModelWrapper A wrapper around MLflow PythonModel objects. This wrapper is expected to adhere to the interface of mlflow.pyfunc.PythonModel.

Notes

Currently, the model prediction can only be merged back with the existing dataframe. Other columns have to be manually joined. For example, this code will not work:

```
>>> df = ks.DataFrame({"x1": [2.0], "x2": [3.0], "z": [-1]})
>>> features = df[["x1", "x2"]]
>>> y = model.predict(features)
>>> # Works:
>>> features["y"] = y
>>> # Will fail with a message about dataframes not aligned.
>>> df["y"] = y
```

A current workaround is to use the .merge() function, using the feature values as merging keys.

```
>>> features['y'] = y
>>> everything = df.merge(features, on=['x1', 'x2'])
>>> everything
    x1   x2  z         y
0  2.0  3.0 -1  1.376932
```

Examples

Here is a full example that creates a model with scikit-learn and saves the model with MLflow. The model is then loaded as a predictor that can be applied on a Koalas Dataframe.

We first initialize our MLflow environment:

```
>>> from mlflow.tracking import MlflowClient, set_tracking_uri
>>> import mlflow.sklearn
>>> from tempfile import mkdtemp
>>> d = mkdtemp("koalas_mlflow")
>>> set_tracking_uri("file:%s"%d)
>>> client = MlflowClient()
>>> exp = mlflow.create_experiment("my_experiment")
>>> mlflow.set_experiment("my_experiment")
```

We aim at learning this numerical function using a simple linear regressor.

```
>>> from sklearn.linear_model import LinearRegression
>>> train = pd.DataFrame({"x1": np.arange(8), "x2": np.arange(8)**2,
...                       "y": np.log(2 + np.arange(8))})
>>> train_x = train[["x1", "x2"]]
>>> train_y = train[["y"]]
>>> with mlflow.start_run():
...     lr = LinearRegression()
...     lr.fit(train_x, train_y)
...     mlflow.sklearn.log_model(lr, "model")
LinearRegression(...)
```

Now that our model is logged using MLflow, we load it back and apply it on a Koalas dataframe:

```
>>> from databricks.koalas.mlflow import load_model
>>> run_info = client.list_run_infos(exp)[-1]
>>> model = load_model("runs:/{run_id}/model".format(run_id=run_info.run_uuid))
>>> prediction_df = ks.DataFrame({"x1": [2.0], "x2": [4.0]})
```

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```
>>> prediction_df["prediction"] = model.predict(prediction_df)
>>> prediction_df
    x1   x2  prediction
0  2.0  4.0    1.355551
```

The model also works on pandas DataFrames as expected:

```
>>> model.predict(prediction_df[["x1", "x2"]].to_pandas())
array([[1.35555142]])
```

3.9 Extensions

3.9.1 Accessors

Accessors can be written and registered with Koalas Dataframes, Series, and Index objects. Accessors allow developers to extend the functionality of Koalas objects seamlessly by writing arbitrary classes and methods which are then wrapped in one of the following decorators.

register_dataframe_accessor(name)	Register a custom accessor with a DataFrame
register_series_accessor(name)	Register a custom accessor with a Series object
register_index_accessor(name)	Register a custom accessor with an Index

databricks.koalas.extensions.register_dataframe_accessor

databricks.koalas.extensions.**register_dataframe_accessor**(*name*)

Register a custom accessor with a DataFrame

Parameters

name [str] name used when calling the accessor after its registered

Returns

callable A class decorator.

See also:

register_series_accessor Register a custom accessor on Series objects

register_index_accessor Register a custom accessor on Index objects

Notes

When accessed, your accessor will be initialiazed with the Koalas object the user is interacting with. The accessor's init method should always ingest the object being accessed. See the examples for the init signature.

In the pandas API, if data passed to your accessor has an incorrect dtype, it's recommended to raise an `AttributeError` for consistency purposes. In Koalas, `ValueError` is more frequently used to annotate when a value's datatype is unexpected for a given method/function.

Ultimately, you can structure this however you like, but Koalas would likely do something like this:

```
>>> ks.Series(['a', 'b']).dt
...
Traceback (most recent call last):
    ...
ValueError: Cannot call DatetimeMethods on type StringType
```

Examples

In your library code:

```
from databricks.koalas.extensions import register_dataframe_accessor

@register_dataframe_accessor("geo")
class GeoAccessor:

    def __init__(self, koalas_obj):
        self._obj = koalas_obj
        # other constructor logic

    @property
    def center(self):
        # return the geographic center point of this DataFrame
        lat = self._obj.latitude
        lon = self._obj.longitude
        return (float(lon.mean()), float(lat.mean()))

    def plot(self):
        # plot this array's data on a map
        pass
```

Then, in an ipython session:

```
>>> ## Import if the accessor is in the other file.
>>> # from my_ext_lib import GeoAccessor
>>> kdf = ks.DataFrame({"longitude": np.linspace(0,10),
...                     "latitude": np.linspace(0, 20)})
>>> kdf.geo.center
(5.0, 10.0)

>>> kdf.geo.plot()
```

databricks.koalas.extensions.register_series_accessor

databricks.koalas.extensions.**register_series_accessor**(*name*)

Register a custom accessor with a Series object

Parameters

name [str] name used when calling the accessor after its registered

Returns

callable A class decorator.

See also:

register_dataframe_accessor Register a custom accessor on DataFrame objects

register_index_accessor Register a custom accessor on Index objects

Notes

When accessed, your accessor will be initialiazed with the Koalas object the user is interacting with. The code signature must be:

```
def __init__(self, koalas_obj):
    # constructor logic
...
```

In the pandas API, if data passed to your accessor has an incorrect dtype, it's recommended to raise an `AttributeError` for consistency purposes. In Koalas, `ValueError` is more frequently used to annotate when a value's datatype is unexpected for a given method/function.

Ultimately, you can structure this however you like, but Koalas would likely do something like this:

```
>>> ks.Series(['a', 'b']).dt
...
Traceback (most recent call last):
    ...
ValueError: Cannot call DatetimeMethods on type StringType
```

Examples

In your library code:

```
from databricks.koalas.extensions import register_series_accessor

@register_series_accessor("geo")
class GeoAccessor:

    def __init__(self, koalas_obj):
        self._obj = koalas_obj

    @property
    def is_valid(self):
        # boolean check to see if series contains valid geometry
        return True
```

Then, in an ipython session:

```
>>> ## Import if the accessor is in the other file.
>>> # from my_ext_lib import GeoAccessor
>>> kdf = ks.DataFrame({"longitude": np.linspace(0,10),
...                     "latitude": np.linspace(0, 20)})
>>> kdf.longitude.geo.is_valid
True
```

databricks.koalas.extensions.register_index_accessor

databricks.koalas.extensions.**register_index_accessor**(*name*)

Register a custom accessor with an Index

Parameters

name [str] name used when calling the accessor after its registered

Returns

callable A class decorator.

See also:

register_dataframe_accessor Register a custom accessor on DataFrame objects

register_series_accessor Register a custom accessor on Series objects

Notes

When accessed, your accessor will be initialiazed with the Koalas object the user is interacting with. The code signature must be:

```
def __init__(self, koalas_obj):
    # constructor logic
...
```

In the pandas API, if data passed to your accessor has an incorrect dtype, it's recommended to raise an `AttributeError` for consistency purposes. In Koalas, `ValueError` is more frequently used to annotate when a value's datatype is unexpected for a given method/function.

Ultimately, you can structure this however you like, but Koalas would likely do something like this:

```
>>> ks.Series(['a', 'b']).dt
...
Traceback (most recent call last):
    ...
ValueError: Cannot call DatetimeMethods on type StringType
```

Examples

In your library code:

```
from databricks.koalas.extensions import register_index_accessor

@register_index_accessor("foo")
class CustomAccessor:

    def __init__(self, koalas_obj):
        self._obj = koalas_obj
        self.item = "baz"

    @property
    def bar(self):
        # return item value
        return self.item
```

Then, in an ipython session:

```
>>> ## Import if the accessor is in the other file.
>>> # from my_ext_lib import CustomAccessor
>>> kdf = ks.DataFrame({"longitude": np.linspace(0,10),
...                     "latitude": np.linspace(0, 20)})
>>> kdf.index.foo.bar
'baz'
```

CHAPTER

FOUR

DEVELOPMENT

4.1 Contributing Guide

Table of contents:

4.1.1 Types of Contributions

The largest amount of work consists simply of implementing the pandas API using Spark's built-in functions, which is usually straightforward. But there are many different forms of contributions in addition to writing code:

1. Use the project and provide feedback, by creating new tickets or commenting on existing relevant tickets.
2. Review existing pull requests.
3. Improve the project's documentation.
4. Write blog posts or tutorial articles evangelizing Koalas and help new users learn Koalas.
5. Give a talk about Koalas at your local meetup or a conference.

4.1.2 Step-by-step Guide For Code Contributions

1. Read and understand the *Design Principles* for the project. Contributions should follow these principles.
2. Signaling your work: If you are working on something, comment on the relevant ticket that you are doing so to avoid multiple people taking on the same work at the same time. It is also a good practice to signal that your work has stalled or you have moved on and want somebody else to take over.
3. Understand what the functionality is in pandas or in Spark.
4. Implement the functionality, with test cases providing close to 100% statement coverage. Document the functionality.
5. Run existing and new test cases to make sure they still pass. Also run *dev/reformat* script to reformat Python files by using Black, and run the linter *dev/lint-python*.
6. Build the docs (*make html* in *docs* directory) and verify the docs related to your change look OK.
7. Submit a pull request, and be responsive to code review feedback from other community members.

That's it. Your contribution, once merged, will be available in the next release.

4.1.3 Environment Setup

Conda

If you are using Conda, the Koalas installation and development environment are as follows.

```
# Python 3.6+ is required
conda create --name koalas-dev-env python=3.6
conda activate koalas-dev-env
conda install -c conda-forge pyspark=2.4
conda install -c conda-forge --yes --file requirements-dev.txt
pip install -e .  # installs koalas from current checkout
```

Once setup, make sure you switch to *koalas-dev-env* before development:

```
conda activate koalas-dev-env
```

pip

With Python 3.6+, pip can be used as below to install and set up the development environment.

```
pip install pyspark==2.4
pip install -r requirements-dev.txt
pip install -e .  # installs koalas from current checkout
```

4.1.4 Running Tests

There is a script *./dev/pytest* which is exactly same as *pytest* but with some default settings to run Koalas tests easily.

To run all the tests, similar to our CI pipeline:

```
# Run all unittest and doctest
./dev/pytest
```

To run a specific test file:

```
# Run unittest
./dev/pytest -k test_dataframe.py

# Run doctest
./dev/pytest -k series.py --doctest-modules databricks
```

To run a specific doctest/unittest:

```
# Run unittest
./dev/pytest -k "DataFrameTest and test_Dataframe"

# Run doctest
./dev/pytest -k DataFrame.corr --doctest-modules databricks
```

Note that *-k* is used for simplicity although it takes an expression. You can use *–verbose* to check what to filter. See *pytest –help* for more details.

4.1.5 Building Documentation

To build documentation via Sphinx:

```
cd docs && make clean html
```

It generates HTMLs under *docs/build/html* directory. Open *docs/build/html/index.html* to check if documentation is built properly.

4.1.6 Coding Conventions

We follow PEP 8 with one exception: lines can be up to 100 characters in length, not 79.

4.1.7 Doctest Conventions

When writing doctests, usually the doctests in pandas are converted into Koalas to make sure the same codes work in Koalas. In general, doctests should be grouped logically by separating a newline.

For instance, the first block is for the statements for preparation, the second block is for using the function with a specific argument, and third block is for another argument. As a example, please refer DataFrame.rsub in pandas.

These blocks should be consistently separated in Koalas, and more doctests should be added if the coverage of the doctests or the number of examples to show is not enough even though they are different from pandas'.

4.1.8 Release Guide

Release Cadence

In general, minor releases occur about every month. Therefore, Koalas 1.4.0 would generally be released about a month after 1.3.0. Maintenance releases happen as needed in between minor releases. Major releases do not happen according to a fixed schedule The chart below is the expected release dates of minor releases.

Date	Version
01/15 2020	1.6.0

Release Instructions

Only project maintainers can do the following to publish a release.

1. Make sure version is set correctly in *databricks/koalas/version.py*.
2. Make sure the build is green.
3. Create a new release on GitHub. Tag it as the same version as the setup.py. If the version is "0.1.0", tag the commit as "v0.1.0".
4. Upload the package to PyPi:

```
rm -rf dist/koalas*
python setup.py sdist bdist_wheel
export package_version=$(python setup.py --version)
echo $package_version

python3 -m pip install --user --upgrade twine

# for test
python3 -m twine upload --repository-url https://test.pypi.org/legacy/ dist/
↪koalas-$package_version-py3-none-any.whl dist/koalas-$package_version.tar.
↪gz

# for release
python3 -m twine upload --repository-url https://upload.pypi.org/legacy/␣
↪dist/koalas-$package_version-py3-none-any.whl dist/koalas-$package_version.
↪tar.gz
```

5. Verify the uploaded package can be installed and executed. One unofficial tip is to run the doctests of Koalas within a Python interpreter after installing it.

```
import os

from pytest import main
import databricks

test_path = os.path.abspath(os.path.dirname(databricks.__file__))
main(['-k', '-to_delta -read_delta', '--verbose', '--showlocals', '--doctest-
↪modules', test_path])
```

Note that this way might require additional settings, for instance, environment variables.

4.2 Design Principles

This section outlines design principles guiding the Koalas project.

4.2.1 Be Pythonic

Koalas targets Python data scientists. We want to stick to the convention that users are already familiar with as much as possible. Here are some examples:

- Function names and parameters use snake_case, rather than CamelCase. This is different from PySpark's design. For example, Koalas has *to_pandas()*, whereas PySpark has *toPandas()* for converting a DataFrame into a pandas DataFrame. In limited cases, to maintain compatibility with Spark, we also provide Spark's variant as an alias.
- Koalas respects to the largest extent the conventions of the Python numerical ecosystem, and allows the use of NumPy types, etc. that can be supported by Spark.
- Koalas docs' style and infrastructure simply follow rest of the PyData projects'.

4.2.2 Unify small data (pandas) API and big data (Spark) API, but pandas first

The Koalas DataFrame is meant to provide the best of pandas and Spark under a single API, with easy and clear conversions between each API when necessary. When Spark and pandas have similar APIs with subtle differences, the principle is to honor the contract of the pandas API first.

There are different classes of functions:

1. Functions that are found in both Spark and pandas under the same name (*count*, *dtypes*, *head*). The return value is the same as the return type in pandas (and not Spark's).
2. Functions that are found in Spark but that have a clear equivalent in pandas, e.g. *alias* and *rename*. These functions will be implemented as the alias of the pandas function, but should be marked that they are aliases of the same functions. They are provided so that existing users of PySpark can get the benefits of Koalas without having to adapt their code.
3. Functions that are only found in pandas. When these functions are appropriate for distributed datasets, they should become available in Koalas.
4. Functions that are only found in Spark that are essential to controlling the distributed nature of the computations, e.g. *cache*. These functions should be available in Koalas.

We are still debating whether data transformation functions only available in Spark should be added to Koalas, e.g. *select*. We would love to hear your feedback on that.

4.2.3 Return Koalas data structure for big data, and pandas data structure for small data

Often developers face the question whether a particular function should return a Koalas DataFrame/Series, or a pandas DataFrame/Series. The principle is: if the returned object can be large, use a Koalas DataFrame/Series. If the data is bound to be small, use a pandas DataFrame/Series. For example, *DataFrame.dtypes* return a pandas Series, because the number of columns in a DataFrame is bounded and small, whereas *DataFrame.head()* or *Series.unique()* returns a Koalas DataFrame/Series, because the resulting object can be large.

4.2.4 Provide discoverable APIs for common data science tasks

At the risk of overgeneralization, there are two API design approaches: the first focuses on providing APIs for common tasks; the second starts with abstractions, and enable users to accomplish their tasks by composing primitives. While the world is not black and white, pandas takes more of the former approach, while Spark has taken more of the later.

One example is value count (count by some key column), one of the most common operations in data science. pandas *DataFrame.value_count* returns the result in sorted order, which in 90% of the cases is what users prefer when exploring data, whereas Spark's does not sort, which is more desirable when building data pipelines, as users can accomplish the pandas behavior by adding an explicit *orderBy*.

Similar to pandas, Koalas should also lean more towards the former, providing discoverable APIs for common data science tasks. In most cases, this principle is well taken care of by simply implementing pandas' APIs. However, there will be circumstances in which pandas' APIs don't address a specific need, e.g. plotting for big data.

4.2.5 Provide well documented APIs, with examples

All functions and parameters should be documented. Most functions should be documented with examples, because those are the easiest to understand than a blob of text explaining what the function does.

A recommended way to add documentation is to start with the docstring of the corresponding function in PySpark or pandas, and adapt it for Koalas. If you are adding a new function, also add it to the API reference doc index page in *docs/source/reference* directory. The examples in docstring also improve our test coverage.

4.2.6 Guardrails to prevent users from shooting themselves in the foot

Certain operations in pandas are prohibitively expensive as data scales, and we don't want to give users the illusion that they can rely on such operations in Koalas. That is to say, methods implemented in Koalas should be safe to perform by default on large datasets. As a result, the following capabilities are not implemented in Koalas:

1. Capabilities that are fundamentally not parallelizable: e.g. imperatively looping over each element
2. Capabilities that require materializing the entire working set in a single node's memory. This is why we do not implement pandas.DataFrame.to_xarray. Another example is the *_repr_html_* call caps the total number of records shown to a maximum of 1000, to prevent users from blowing up their driver node simply by typing the name of the DataFrame in a notebook.

A few exceptions, however, exist. One common pattern with "big data science" is that while the initial dataset is large, the working set becomes smaller as the analysis goes deeper. For example, data scientists often perform aggregation on datasets and want to then convert the aggregated dataset to some local data structure. To help data scientists, we offer the following:

- `DataFrame.to_pandas()`: returns a pandas DataFrame, koalas only
- `DataFrame.to_numpy()`: returns a numpy array, works with both pandas and Koalas

Note that it is clear from the names that these functions return some local data structure that would require materializing data in a single node's memory. For these functions, we also explicitly document them with a warning note that the resulting data structure must be small.

4.2.7 Be a lean API layer and move fast

Koalas is designed as an API overlay layer on top of Spark. The project should be lightweight, and most functions should be implemented as wrappers around Spark or pandas - the Koalas library is designed to be used only in the Spark's driver side in general. Koalas does not accept heavyweight implementations, e.g. execution engine changes.

This approach enables us to move fast. For the considerable future, we aim to be making monthly releases. If we find a critical bug, we will be making a new release as soon as the bug fix is available.

4.2.8 High test coverage

Koalas should be well tested. The project tracks its test coverage with over 90% across the entire codebase, and close to 100% for critical parts. Pull requests will not be accepted unless they have close to 100% statement coverage from the codecov report.

CHAPTER

FIVE

RELEASE NOTES

5.1 Version 1.5.0

5.1.1 Index operations support

We improved Index operations support (#1944, #1955).

Here are some examples:

- Before

```
>>> kidx = ks.Index([1, 2, 3, 4, 5])
>>> kidx + kidx
Int64Index([2, 4, 6, 8, 10], dtype='int64')
>>> kidx + kidx + kidx
Traceback (most recent call last):
...
AssertionError: args should be single DataFrame or single/multiple Series
```

```
>>> ks.Index([1, 2, 3, 4, 5]) + ks.Index([6, 7, 8, 9, 10])
Traceback (most recent call last):
...
AssertionError: args should be single DataFrame or single/multiple Series
```

- After

```
>>> kidx = ks.Index([1, 2, 3, 4, 5])
>>> kidx + kidx + kidx
Int64Index([3, 6, 9, 12, 15], dtype='int64')
```

```
>>> ks.options.compute.ops_on_diff_frames = True
>>> ks.Index([1, 2, 3, 4, 5]) + ks.Index([6, 7, 8, 9, 10])
Int64Index([7, 9, 13, 11, 15], dtype='int64')
```

5.1.2 Other new features and improvements

We added the following new features:

DataFrame:

- `swaplevel` (#1928)
- `swapaxes` (#1946)
- `dot` (#1945)
- `itertuples` (#1960)

Series:

- `swaplevel` (#1919)
- `swapaxes` (#1954)

Index:

- `to_list` (#1948)

MultiIndex:

- `to_list` (#1948)

GroupBy: - `tail` (#1949) - `median` (#1957)

5.1.3 Other improvements and bug fixes

- Support DataFrame parameter in Series.dot (#1931)
- Add a best practice for checkpointing. (#1930)
- Remove implicit switch-ons of "compute.ops_on_diff_frames" (#1953)
- Fix Series._to_internal_pandas and introduce Index._to_internal_pandas. (#1952)
- Fix first/last_valid_index to support empty column DataFrame. (#1923)
- Use pandas' transpose when the data is expected to be small. (#1932)
- Fix tail to use the resolved copy (#1942)
- Avoid unneeded reset_index in DataFrameGroupBy.describe. (#1951)
- TypeError when Index.name / Series.name is not a hashable type (#1883)
- Adjust data column names before attaching default index. (#1947)
- Add plotly into the optional dependency in Koalas (#1939)
- Add plotly backend test cases (#1938)
- Don't pass stacked in plotly area chart (#1934)
- Set upperbound of matplotlib to avoid failure on Ubuntu (#1959)
- Fix GroupBy.descirbe for multi-index columns. (#1922)
- Upgrade pandas version in CI (#1961)
- Compare Series from the same anchor (#1956)
- Add videos from Data+AI Summit 2020 EUROPE. (#1963)

- Set PYARROW_IGNORE_TIMEZONE for binder. (#1965)

5.2 Version 1.4.0

5.2.1 Better type support

We improved the type mapping between pandas and Koalas (#1870, #1903). We added more types or string expressions to specify the data type or fixed mismatches between pandas and Koalas.

Here are some examples:

- Added `np.float32` and `"float32"` (matched to `FloatType`)

```
>>> ks.Series([10]).astype(np.float32)
0    10.0
dtype: float32

>>> ks.Series([10]).astype("float32")
0    10.0
dtype: float32
```

- Added `np.datetime64` and `"datetime64[ns]"` (matched to `TimestampType`)

```
>>> ks.Series(["2020-10-26"]).astype(np.datetime64)
0   2020-10-26
dtype: datetime64[ns]

>>> ks.Series(["2020-10-26"]).astype("datetime64[ns]")
0   2020-10-26
dtype: datetime64[ns]
```

- Fixed `np.int` to match `LongType`, not `IntegerType`.

```
>>> pd.Series([100]).astype(np.int)
0    100.0
dtype: int64

>>> ks.Series([100]).astype(np.int)
0    100.0
dtype: int32  # This fixed to `int64` now.
```

- Fixed `np.float` to match `DoubleType`, not `FloatType`.

```
>>> pd.Series([100]).astype(np.float)
0    100.0
dtype: float64

>>> ks.Series([100]).astype(np.float)
0    100.0
dtype: float32  # This fixed to `float64` now.
```

We also added a document which describes supported/unsupported pandas data types or data type mapping between pandas data types and PySpark data types. See: Type Support In Koalas.

5.2.2 Return type annotations for major Koalas objects

To improve Koala's auto-completion in various editors and avoid misuse of APIs, we added return type annotations to major Koalas objects. These objects include DataFrame, Series, Index, GroupBy, Window objects, etc. (#1852, #1857, #1859, #1863, #1871, #1882, #1884, #1889, #1892, #1894, #1898, #1899, #1900, #1902).

The return type annotations help auto-completion libraries, such as Jedi, to infer the actual data type and provide proper suggestions:

- Before

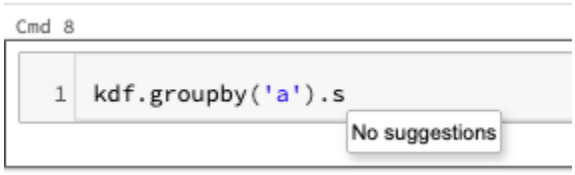

Fig. 1: Before

- After

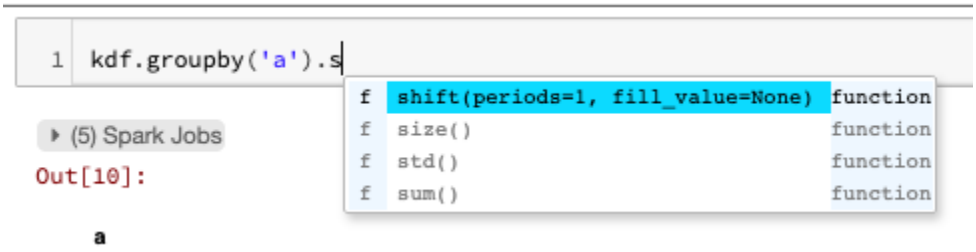

Fig. 2: After

It also helps mypy enable static analysis over the method body.

5.2.3 pandas 1.1.4 support

We verified the behaviors of pandas 1.1.4 in Koalas.

As pandas 1.1.4 introduced a behavior change related to `MultiIndex.is_monotonic` (`MultiIndex.is_monotonic_increasing`) and `MultiIndex.is_monotonic_decreasing` (pandas-dev/pandas#37220), Koalas also changes the behavior (#1881).

5.2.4 Other new features and improvements

We added the following new features:

DataFrame:

- `__neg__` (#1847)
- `rename_axis` (#1843)
- `spark.repartition` (#1864)
- `spark.coalesce` (#1873)

- `spark.checkpoint` (#1877)
- `spark.local_checkpoint` (#1878)
- `reindex_like` (#1880)

Series:

- `rename_axis` (#1843)
- `compare` (#1802)
- `reindex_like` (#1880)

Index:

- `intersection` (#1747)

MultiIndex:

- `intersection` (#1747)

5.2.5 Other improvements and bug fixes

- Use SF.repeat in series.str.repeat (#1844)
- Remove warning when use cache in the context manager (#1848)
- Support a non-string name in Series' boxplot (#1849)
- Calculate fliers correctly in Series.plot.box (#1846)
- Show type name rather than type class in error messages (#1851)
- Fix DataFrame.spark.hint to reflect internal changes. (#1865)
- DataFrame.reindex supports named columns index (#1876)
- Separate InternalFrame.index_map into index_spark_column_names and index_names. (#1879)
- Fix DataFrame.xs to handle internal changes properly. (#1896)
- Explicitly disallow empty list as index_spark_colum_names and index_names. (#1895)
- Use nullable inferred schema in function apply (#1897)
- Introduce InternalFrame.index_level. (#1890)
- Remove InternalFrame.index_map. (#1901)
- Force to use the Spark's system default precision and scale when inferred data type contains DecimalType. (#1904)
- Upgrade PyArrow from 1.0.1 to 2.0.0 in CI (#1860)
- Fix read_excel to support squeeze argument. (#1905)
- Fix to_csv to avoid duplicated option 'path' for DataFrameWriter. (#1912)

5.3 Version 1.3.0

5.3.1 pandas 1.1 support

We verified the behaviors of pandas 1.1 in Koalas. Koalas now supports pandas 1.1 officially (#1688, #1822, #1829).

5.3.2 Support for non-string names

Now we support for non-string names (#1784). Previously names in Koalas, e.g., `df.columns`, `df.colums.names`, `df.index.names`, needed to be a string or a tuple of string, but it should allow other data types which are supported by Spark.

Before:

```
>>> kdf = ks.DataFrame([[1, 'x'], [2, 'y'], [3, 'z']])
>>> kdf.columns
Index(['0', '1'], dtype='object')
```

After:

```
>>> kdf = ks.DataFrame([[1, 'x'], [2, 'y'], [3, 'z']])
>>> kdf.columns
Int64Index([0, 1], dtype='int64')
```

5.3.3 Improve `distributed-sequence` default index

The performance is improved when creating a `distributed-sequence` as a default index type by avoiding the interaction between Python and JVM (#1699).

5.3.4 Standardize binary operations between int and str columns

Make behaviors of binary operations (`+`, `-`, `*`, `/`, `//`, `%`) between `int` and `str` columns consistent with respective pandas behaviors (#1828).

It standardizes binary operations as follows:

- `+`: raise `TypeError` between int column and str column (or string literal)
- `*`: act as spark SQL `repeat` between int column(or int literal) and str columns; raise `TypeError` if a string literal is involved
- `-`, `/`, `//`, `%` (`modulo`) : raise `TypeError` if a str column (or string literal) is involved

5.3.5 Other new features and improvements

We added the following new features:

DataFrame:

- `product` (#1739)
- `from_dict` (#1778)
- `pad` (#1786)
- `backfill` (#1798)

Series:

- `reindex` (#1737)
- `explode` (#1777)
- `pad` (#1786)
- `argmin` (#1790)
- `argmax` (#1790)
- `argsort` (#1793)
- `backfill` (#1798)

Index:

- `inferred_type` (#1745)
- `item` (#1744)
- `is_unique` (#1766)
- `asi8` (#1764)
- `is_type_compatible` (#1765)
- `view` (#1788)
- `insert` (#1804)

MultiIndex:

- `inferred_type` (#1745)
- `item` (#1744)
- `is_unique` (#1766)
- `asi8` (#1764)
- `is_type_compatible` (#1765)
- `from_frame` (#1762)
- `view` (#1788)
- `insert` (#1804)

GroupBy:

- `get_group` (#1783)

5.3.6 Other improvements

- Fix DataFrame.mad to work properly (#1749)
- Fix Series name after binary operations. (#1753)
- Fix GroupBy.cum~ for matching with pandas' behavior (#1708)
- Fix cumprod to work properly with Integer columns. (#1750)
- Fix DataFrame.join for MultiIndex (#1771)
- Exception handling for from_frame properly (#1791)
- Fix iloc for slice(None, 0) (#1767)
- Fix Series.__repr__ when Series.name is None. (#1796)
- DataFrame.reindex supports koalas Index parameter (#1741)
- Fix Series.fillna with inplace=True on non-nullable column. (#1809)
- Input check in various APIs (#1808, #1810, #1811, #1812, #1813, #1814, #1816, #1824)
- Fix to_list work properly in pandas==0.23 (#1823)
- Fix Series.astype to work properly (#1818)
- Frame.groupby supports dropna (#1815)

5.4 Version 1.2.0

5.4.1 Non-named Series support

Now we added support for non-named Series (#1712). Previously Koalas automatically named a Series `"0"` if no name is specified or `None` is set to the name, whereas pandas allows a Series without the name.

For example:

```
>>> ks.__version__
'1.1.0'
>>> kser = ks.Series([1, 2, 3])
>>> kser
0    1
1    2
2    3
Name: 0, dtype: int64
>>> kser.name = None
>>> kser
0    1
1    2
2    3
Name: 0, dtype: int64
```

Now the Series will be non-named.

```
>>> ks.__version__
'1.2.0'
>>> ks.Series([1, 2, 3])
0    1
```

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```
1    2
2    3
dtype: int64
>>> kser = ks.Series([1, 2, 3], name="a")
>>> kser.name = None
>>> kser
0    1
1    2
2    3
dtype: int64
```

5.4.2 More stable "distributed-sequence" default index

Previously "distributed-sequence" default index had sometimes produced wrong values or even raised an exception. For example, the codes below:

```
>>> from databricks import koalas as ks
>>> ks.options.compute.default_index_type = 'distributed-sequence'
>>> ks.range(10).reset_index()
```

did not work as below:

```
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
  ...
pyspark.sql.utils.PythonException:
  An exception was thrown from the Python worker. Please see the stack trace below.
Traceback (most recent call last):
  ...
  File "/.../koalas/databricks/koalas/internal.py", line 620, in offset
    current_partition_offset = sums[id.iloc[0]]
KeyError: 103
```

We investigated and made the default index type more stable (#1701). Now it unlikely causes such situations and it is stable enough.

5.4.3 Improve testing infrastructure

We changed the testing infrastructure to use pandas' testing utils for exact check (#1722). Now it compares even index/column types and names so that we will be able to follow pandas more strictly.

5.4.4 Other new features and improvements

We added the following new features:

DataFrame:

- `last_valid_index` (#1705)

Series:

- `product` (#1677)
- `last_valid_index` (#1705)

GroupBy:

- `cumcount` (#1702)

5.4.5 Other improvements

- Refine Spark I/O. (#1667)
- Set `partitionBy` explicitly in `to_parquet`.
- Add `mode` and `partition_cols` to `to_csv` and `to_json`.
- Fix type hints to use `Optional`.
- Make read_excel read from DFS if the underlying Spark is 3.0.0 or above. (#1678, #1693, #1694, #1692)
- Support callable instances to apply as a function, and fix groupby.apply to keep the index when possible (#1686)
- Bug fixing for hasnans when non-DoubleType. (#1681)
- Support axis=1 for DataFrame.dropna(). (#1689)
- Allow assining index as a column (#1696)
- Try to read pandas metadata in read_parquet if index_col is None. (#1695)
- Include pandas Index object in dataframe indexing options (#1698)
- Unified `PlotAccessor` for DataFrame and Series (#1662)
- Fix SeriesGroupBy.nsmallest/nlargest. (#1713)
- Fix DataFrame.size to consider its number of columns. (#1715)
- Fix first_valid_index() for Empty object (#1704)
- Fix index name when groupby.apply returns a single row. (#1719)
- Support subtraction of date/timestamp with literals. (#1721)
- DataFrame.reindex(fill_value) does not fill existing NaN values (#1723)

5.5 Version 1.1.0

5.5.1 API extensions

We added support for API extensions (#1617).

You can register your custom accessors to `DataFrame`, `Seires`, and `Index`.

For example, in your library code:

```
from databricks.koalas.extensions import register_dataframe_accessor

@register_dataframe_accessor("geo")
class GeoAccessor:

    def __init__(self, koalas_obj):
        self._obj = koalas_obj
        # other constructor logic
```

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```
    @property
    def center(self):
        # return the geographic center point of this DataFrame
        lat = self._obj.latitude
        lon = self._obj.longitude
        return (float(lon.mean()), float(lat.mean()))

    def plot(self):
        # plot this array's data on a map
        pass
    ...
```

Then, in a session:

```
>>> from my_ext_lib import GeoAccessor
>>> kdf = ks.DataFrame({"longitude": np.linspace(0,10),
...                     "latitude": np.linspace(0, 20)})
>>> kdf.geo.center
    (5.0, 10.0)

>>> kdf.geo.plot()
...
```

See also: https://koalas.readthedocs.io/en/latest/reference/extensions.html

5.5.2 Plotting backend

We introduced `plotting.backend` configuration (#1639).

Plotly (>=4.8) or other libraries that pandas supports can be used as a plotting backend if they are installed in the environment.

```
>>> kdf = ks.DataFrame([[1, 2, 3, 4], [5, 6, 7, 8]], columns=["A", "B", "C", "D"])
>>> kdf.plot(title="Example Figure")  # defaults to backend="matplotlib"
```

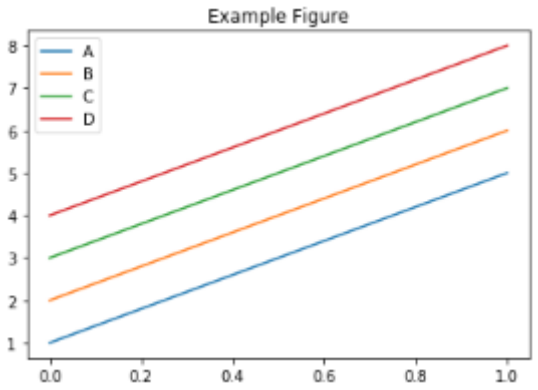

Fig. 3: image

```
>>> fig = kdf.plot(backend="plotly", title="Example Figure", height=500, width=500)
>>> ## same as:
>>> # ks.options.plotting.backend = "plotly"
```

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```
>>> # fig = kdf.plot(title="Example Figure", height=500, width=500)
>>> fig.show()
```

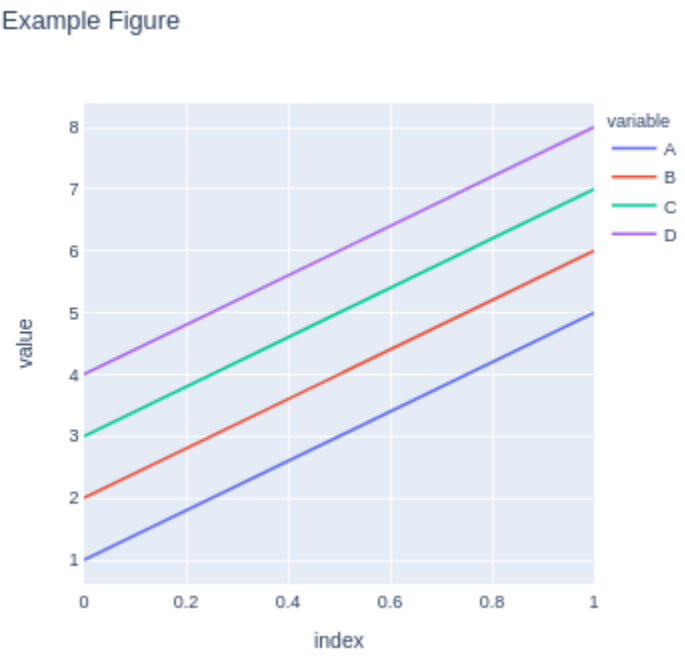

Fig. 4: image

Each backend returns the figure in their own format, allowing for further editing or customization if required.

```
>>> fig.update_layout(template="plotly_dark")
>>> fig.show()
```

5.5.3 Koalas accessor

We introduced `koalas` accessor and some methods specific to Koalas (#1613, #1628).

`DataFrame.apply_batch`, `DataFrame.transform_batch`, and `Series.transform_batch` are deprecated and moved to `koalas` accessor.

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pdf):
...     return pdf + 1  # should always return the same length as input.
...
>>> kdf.koalas.transform_batch(pandas_plus)
   a  b
0  2  5
1  3  6
2  4  7
```

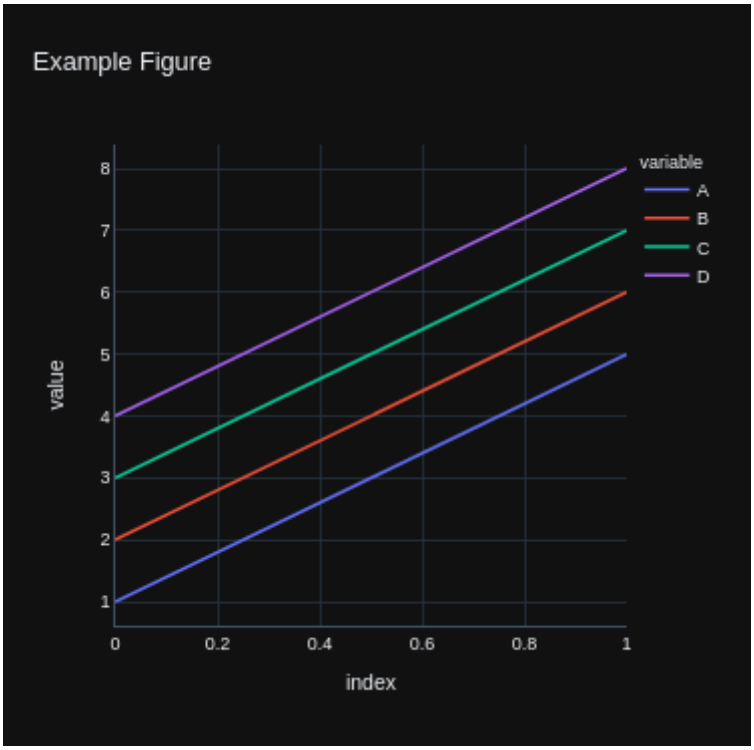

Fig. 5: image

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_filter(pdf):
...     return pdf[pdf.a > 1]  # allow arbitrary length
...
>>> kdf.koalas.apply_batch(pandas_filter)
   a  b
1  2  5
2  3  6
```

or

```
>>> kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
>>> def pandas_plus(pser):
...     return pser + 1  # should always return the same length as input.
...
>>> kdf.a.koalas.transform_batch(pandas_plus)
0    2
1    3
2    4
Name: a, dtype: int64
```

See also: https://koalas.readthedocs.io/en/latest/user_guide/transform_apply.html

5.5.4 Other new features and improvements

We added the following new features:

DataFrame:

- `tail` (#1632)
- `droplevel` (#1622)

Series:

- `iteritems` (#1603)
- `items` (#1603)
- `tail` (#1632)
- `droplevel` (#1630)

5.5.5 Other improvements

- Simplify Series.to_frame. (#1624)
- Make Window functions create a new DataFrame. (#1623)
- Fix Series._with_new_scol to use alias. (#1634)
- Refine concat to handle the same anchor DataFrames properly. (#1627)
- Add sort parameter to concat. (#1636)
- Enable to assign list. (#1644)
- Use SPARK_INDEX_NAME_FORMAT in combine_frames to avoid ambiguity. (#1650)
- Rename spark columns only when index=False. (#1649)
- read_csv: Implement reading of number of rows (#1656)
- Fixed ks.Index.to_series() to work properly with name paramter (#1643)
- Fix fillna to handle "ffill" and "bfill" properly. (#1654)

5.6 Version 1.0.1

5.6.1 Critical bug fix

We fixed a critical bug introduced in Koalas 1.0.0 (#1609).

If we call `DataFrame.rename` with `columns` parameter after some operations on the DataFrame, the operations will be lost:

```
>>> kdf = ks.DataFrame([[1, 2, 3, 4], [5, 6, 7, 8]], columns=["A", "B", "C", "D"])
>>> kdf1 = kdf + 1
>>> kdf1
   A  B  C  D
0  2  3  4  5
1  6  7  8  9
>>> kdf1.rename(columns={"A": "aa", "B": "bb"})
   aa  bb  C  D
```

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```
0   1   2  3  4
1   5   6  7  8
```

This should be:

```
>>> pdf1.rename(columns={"A": "aa", "B": "bb"})
   aa  bb  C  D
0   2   3  4  5
1   6   7  8  9
```

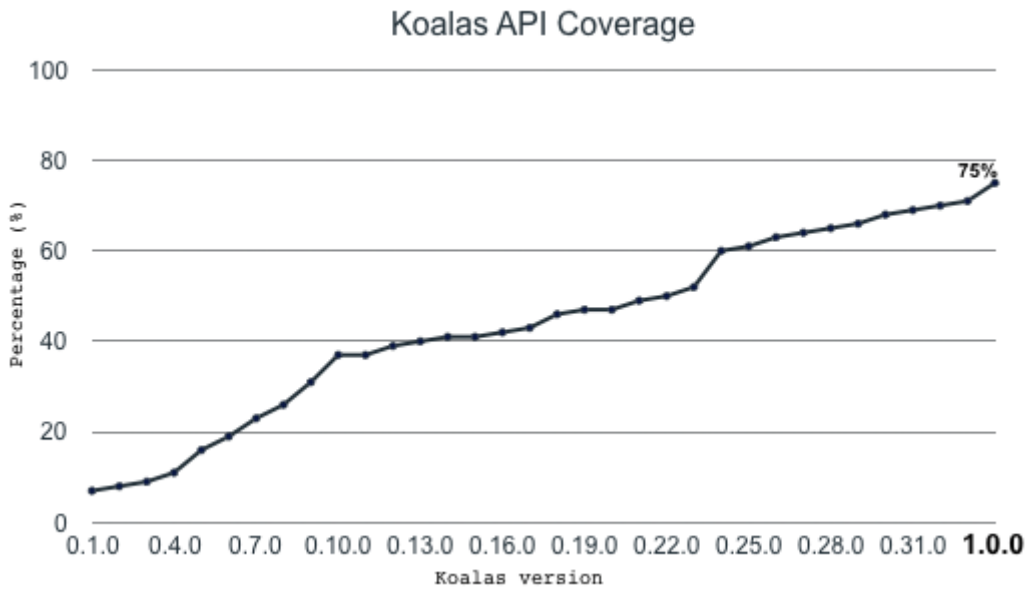
5.6.2 Other improvements

- Clean up InternalFrame and around anchor. (#1601)
- Fixing DataFrame.iteritems to return generator (#1602)
- Clean up groupby to use the anchor. (#1610)

5.7 Version 1.0.0

5.7.1 Better pandas API coverage

We implemented many APIs and features equivalent with pandas such as plotting, grouping, windowing, I/O, and transformation, and now Koalas reaches the pandas API coverage close to 80% in Koalas 1.0.0.



5.7.2 Apache Spark 3.0

Apache Spark 3.0 is now supported in Koalas 1.0 (#1586, #1558). Koalas does not require any change to use Spark 3.0. Apache Spark has more than 3400 fixes landed in Spark 3.0 and Koalas shares the most of fixes in many other components.

It also brings the performance improvement in Koalas APIs that execute Python native functions internally via pandas UDFs, for example, `DataFrame.apply` and `DataFrame.apply_batch` (#1508).

5.7.3 Python 3.8

With Apache Spark 3.0, Koalas supports the latest Python 3.8 which has many significant improvements (#1587), see also Python 3.8.0 release notes.

5.7.4 Spark accessor

`spark` accessor was introduced from Koalas 1.0.0 in order for the Koalas users to leverage the existing PySpark APIs more easily (#1530). For example, you can apply the PySpark functions as below:

```
import databricks.koalas as ks
import pyspark.sql.functions as F

kss = ks.Series([1, 2, 3, 4])
kss.spark.apply(lambda s: F.collect_list(s))
```

5.7.5 Better type hint support

In the early versions, it was required to use Koalas instances as the return type hints for the functions that return a pandas instances, which looks slightly awkward.

```
def pandas_div(pdf) -> koalas.DataFrame[float, float]:
    # pdf is a pandas DataFrame,
    return pdf[['B', 'C']] / pdf[['B', 'C']]

df = ks.DataFrame({'A': ['a', 'a', 'b'], 'B': [1, 2, 3], 'C': [4, 6, 5]})
df.groupby('A').apply(pandas_div)
```

In Koalas 1.0.0 with Python 3.7+, you can also use pandas instances in the return type as below:

```
def pandas_div(pdf) -> pandas.DataFrame[float, float]:
    return pdf[['B', 'C']] / pdf[['B', 'C']]
```

In addition, the new type hinting is experimentally introduced in order to allow users to specify column names in the type hints as below (#1577):

```
def pandas_div(pdf) -> pandas.DataFrame['B': float, 'C': float]:
    return pdf[['B', 'C']] / pdf[['B', 'C']]
```

See also the guide in Koalas documentation (#1584) for more details.

5.7.6 Wider support of in-place update

Previously in-place updates happen only within each DataFrame or Series, but now the behavior follows pandas in-place updates and the update of one side also updates the other side (#1592).

For example, the following updates `kdf` as well.

```
kdf = ks.DataFrame({"x": [np.nan, 2, 3, 4, np.nan, 6]})
kser = kdf.x
kser.fillna(0, inplace=True)
```

```
kdf = ks.DataFrame({"x": [np.nan, 2, 3, 4, np.nan, 6]})
kser = kdf.x
kser.loc[2] = 30
```

```
kdf = ks.DataFrame({"x": [np.nan, 2, 3, 4, np.nan, 6]})
kser = kdf.x
kdf.loc[2, 'x'] = 30
```

If the DataFrame and Series are connected, the in-place updates update each other.

5.7.7 Less restriction on `compute.ops_on_diff_frames`

In Koalas 1.0.0, the restriction of `compute.ops_on_diff_frames` became much more loosened (#1522, #1554). For example, the operations such as below can be performed without enabling `compute.ops_on_diff_frames`, which can be expensive due to the shuffle under the hood.

```
df + df + df
df['foo'] = df['bar']['baz']
df[['x', 'y']] = df[['x', 'y']].fillna(0)
```

5.7.8 Other new features and improvements

DataFrame:

- `__bool__` (#1526)
- `explode` (#1507)
- `spark.apply` (#1536)
- `spark.schema` (#1530)
- `spark.print_schema` (#1530)
- `spark.frame` (#1530)
- `spark.cache` (#1530)
- `spark.persist` (#1530)
- `spark.hint` (#1530)
- `spark.to_table` (#1530)
- `spark.to_spark_io` (#1530)
- `spark.explain` (#1530)

- spark.apply (#1530)
- mad (#1538)
- __abs__ (#1561)

Series:

- item (#1502, #1518)
- divmod (#1397)
- rdivmod (#1397)
- unstack (#1501)
- mad (#1503)
- __bool__ (#1526)
- to_markdown (#1510)
- spark.apply (#1536)
- spark.data_type (#1530)
- spark.nullable (#1530)
- spark.column (#1530)
- spark.transform (#1530)
- filter (#1511)
- __abs__ (#1561)
- bfill (#1580)
- ffill (#1580)

Index:

- __bool__ (#1526)
- spark.data_type (#1530)
- spark.column (#1530)
- spark.transform (#1530)
- get_level_values (#1517)
- delete (#1165)
- __abs__ (#1561)
- holds_integer (#1547)

MultiIndex:

- __bool__ (#1526)
- spark.data_type (#1530)
- spark.column (#1530)
- spark.transform (#1530)
- get_level_values (#1517)
- delete (#1165

- `__abs__` (#1561)
- `holds_integer` (#1547)

Along with the following improvements:

- Fix Series.clip not to create a new DataFrame. (#1525)
- Fix combine_first to support tupled names. (#1534)
- Add Spark accessors to usage logging. (#1540)
- Implements multi-index support in Dataframe.filter (#1512)
- Fix Series.fillna to avoid Spark jobs. (#1550)
- Support DataFrame.spark.explain(extended: str) case. (#1563)
- Support Series as repeats in Series.repeat. (#1573)
- Fix fillna to handle NaN properly. (#1572)
- Fix DataFrame.replace to avoid creating a new Spark DataFrame. (#1575)
- Cache an internal pandas object to avoid run twice in Jupyter. (#1564)
- Fix Series.div when div/floordiv np.inf by zero (#1463)
- Fix Series.unstack to support non-numeric type and keep the names (#1527)
- Fix hasnans to follow the modified column. (#1532)
- Fix explode to use internal methods. (#1538)
- Fix RollingGroupby and ExpandingGroupby to handle agg_columns. (#1546)
- Fix reindex not to update internal. (#1582)

5.7.9 Backward Compatibility

- Remove the deprecated pandas_wraps (#1529)
- Remove compute function. (#1531)

5.8 Version 0.33.0

5.8.1 `apply` and `transform` Improvements

We added supports to have positional/keyword arguments for `apply`, `apply_batch`, `transform`, and `transform_batch` in `DataFrame`, `Series`, and `GroupBy`. (#1484, #1485, #1486)

```
>>> ks.range(10).apply(lambda a, b, c: a + b + c, args=(1,), c=3)
   id
0   4
1   5
2   6
3   7
4   8
5   9
6  10
7  11
```

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```
8  12
9  13
```

```
>>> ks.range(10).transform_batch(lambda pdf, a, b, c: pdf.id + a + b + c, 1, 2, c=3)
0     6
1     7
2     8
3     9
4    10
5    11
6    12
7    13
8    14
9    15
Name: id, dtype: int64
```

```
>>> kdf = ks.DataFrame(
...     {"a": [1, 2, 3, 4, 5, 6], "b": [1, 1, 2, 3, 5, 8], "c": [1, 4, 9, 16, 25, 36]},
...     columns=["a", "b", "c"])
>>> kdf.groupby(["a", "b"]).apply(lambda x, y, z: x + x.min() + y + z, 1, z=2)
    a   b   c
0   5   5   5
1   7   5  11
2   9   7  21
3  11   9  35
4  13  13  53
5  15  19  75
```

5.8.2 Spark Schema

We add `spark_schema` and `print_schema` to know the underlying Spark Schema. (#1446)

```
>>> kdf = ks.DataFrame({'a': list('abc'),
...                     'b': list(range(1, 4)),
...                     'c': np.arange(3, 6).astype('i1'),
...                     'd': np.arange(4.0, 7.0, dtype='float64'),
...                     'e': [True, False, True],
...                     'f': pd.date_range('20130101', periods=3)},
...                    columns=['a', 'b', 'c', 'd', 'e', 'f'])

>>> # Print the schema out in Spark's DDL formatted string
>>> kdf.spark_schema().simpleString()
'struct<a:string,b:bigint,c:tinyint,d:double,e:boolean,f:timestamp>'
>>> kdf.spark_schema(index_col='index').simpleString()
'struct<index:bigint,a:string,b:bigint,c:tinyint,d:double,e:boolean,f:timestamp>'

>>> # Print out the schema as same as DataFrame.printSchema()
>>> kdf.print_schema()
root
 |-- a: string (nullable = false)
 |-- b: long (nullable = false)
 |-- c: byte (nullable = false)
 |-- d: double (nullable = false)
 |-- e: boolean (nullable = false)
```

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```
 |-- f: timestamp (nullable = false)

>>> kdf.print_schema(index_col='index')
root
 |-- index: long (nullable = false)
 |-- a: string (nullable = false)
 |-- b: long (nullable = false)
 |-- c: byte (nullable = false)
 |-- d: double (nullable = false)
 |-- e: boolean (nullable = false)
 |-- f: timestamp (nullable = false)
```

5.8.3 GroupBy Improvements

We fixed many bugs of `GroupBy` as listed below.

- Fix groupby when as_index=False. (#1457)
- Make groupby.apply in pandas<0.25 run the function only once per group. (#1462)
- Fix Series.groupby on the Series from different DataFrames. (#1460)
- Fix GroupBy.head to recognize agg_columns. (#1474)
- Fix GroupBy.filter to follow complex group keys. (#1471)
- Fix GroupBy.transform to follow complex group keys. (#1472)
- Fix GroupBy.apply to follow complex group keys. (#1473)
- Fix GroupBy.fillna to use GroupBy._apply_series_op. (#1481)
- Fix GroupBy.filter and apply to handle agg_columns. (#1480)
- Fix GroupBy apply, filter, and head to ignore temp columns when ops from different DataFrames. (#1488)
- Fix GroupBy functions which need natural orderings to follow the order when opts from different DataFrames. (#1490)

5.8.4 Other new features and improvements

We added the following new feature:

SeriesGroupBy:

- `filter` (#1483)

5.8.5 Other improvements

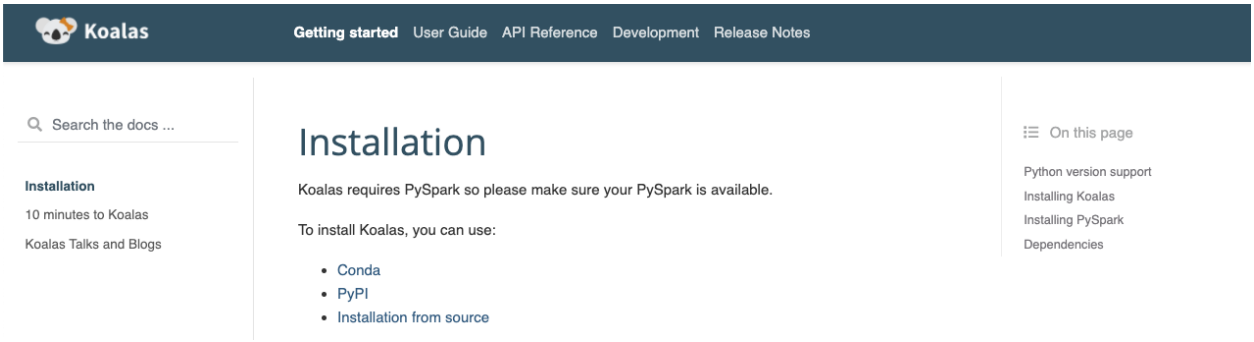
- dtype for DateType should be np.dtype("object"). (#1447)
- Make reset_index disallow the same name but allow it when drop=True. (#1455)
- Fix named aggregation for MultiIndex (#1435)
- Raise ValueError that is not raised now (#1461)
- Fix get dummies when uses the prefix parameter whose type is dict (#1478)

- Simplify DataFrame.columns setter. (#1489)

5.9 Version 0.32.0

5.9.1 Koalas documentation redesign

Koalas documentation was redesigned with a better theme, pydata-sphinx-theme. Please check the new Koalas documentation site out.



5.9.2 `transform_batch` and `apply_batch`

We added the APIs that enable you to directly transform and apply a function against Koalas Series or DataFrame. `map_in_pandas` is deprecated and now renamed to `apply_batch`.

```
import databricks.koalas as ks
kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
def pandas_plus(pdf):
    return pdf + 1  # should always return the same length as input.

kdf.transform_batch(pandas_plus)
```

```
import databricks.koalas as ks
kdf = ks.DataFrame({'a': [1,2,3], 'b':[4,5,6]})
def pandas_plus(pdf):
    return pdf[pdf.a > 1]  # allow arbitrary length

kdf.apply_batch(pandas_plus)
```

Please also check Transform and apply a function in Koalas documentation.

5.9.3 Other new features and improvements

We added the following new feature:

DataFrame:

- `truncate` (#1408)
- `hint` (#1415)

SeriesGroupBy:

- `unique` (#1426)

Index:

- `spark_column` (#1438)

Series:

- `spark_column` (#1438)

MultiIndex:

- `spark_column` (#1438)

5.9.4 Other improvements

- Fix from_pandas to handle the same index name as a column name. (#1419)
- Add documentation about non-Koalas APIs (#1420)
- Hot-fixing the lack of keyword argument 'deep' for DataFrame.copy() (#1423)
- Fix Series.div when divide by zero (#1412)
- Support expand parameter if n is a positive integer in Series.str.split/rsplit. (#1432)
- Make Series.astype(bool) follow the concept of "truthy" and "falsey". (#1431)
- Fix incompatible behaviour with pandas for floordiv with np.nan (#1429)
- Use mapInPandas for apply_batch API in Spark 3.0 (#1440)
- Use F.datediff() for subtraction of dates as a workaround. (#1439)

5.10 Version 0.31.0

5.10.1 PyArrow>=0.15 support is back

We added PyArrow>=0.15 support back (#1110).

Note that, when working with `pyarrow>=0.15` and `pyspark<3.0`, Koalas will set an environment variable `ARROW_PRE_0_15_IPC_FORMAT=1` if it does not exist, as per the instruction in SPARK-29367, but it will NOT work if there is a Spark context already launched. In that case, you have to manage the environment variable by yourselves.

5.10.2 Spark specific improvements

Broadcast hint

We added `broadcast` function in namespace.py (#1360).

We can use it with `merge`, `join`, and `update` which invoke join operation in Spark when you know one of the DataFrame is small enough to fit in memory, and we can expect much more performant than shuffle-based joins.

For example,

```
>>> merged = df1.merge(ks.broadcast(df2), left_on='lkey', right_on='rkey')
>>> merged.explain()
== Physical Plan ==
...
...BroadcastHashJoin...
...
```

persist function and storage level

We added `persist` function to specify the storage level when caching (#1381), and also, we added `storage_level` property to check the current storage level (#1385).

```
>>> with df.cache() as cached_df:
...     print(cached_df.storage_level)
...
Disk Memory Deserialized 1x Replicated

>>> with df.persist(pyspark.StorageLevel.MEMORY_ONLY) as cached_df:
...     print(cached_df.storage_level)
...
Memory Serialized 1x Replicated
```

5.10.3 Other new features and improvements

We added the following new feature:

DataFrame:

- `to_markdown` (#1377)
- `squeeze` (#1389)

Series:

- `squeeze` (#1389)
- `asof` (#1366)

5.10.4 Other improvements

- Add a way to specify index column in I/O APIs (#1379)
- Fix `iloc.__setitem__` with the other Series from the same DataFrame. (#1388)
- Add support Series from different DataFrames for `loc/iloc.__setitem__`. (#1391)
- Refine `__setitem__` for loc/iloc with DataFrame. (#1394)
- Help misuse of options argument. (#1402)
- Add blog posts in Koalas documentation (#1406)
- Fix mod & rmod for matching with pandas. (#1399)

5.11 Version 0.30.0

5.11.1 Slice column selection support in loc

We continue to improve `loc` indexer and added the slice column selection support (#1351).

```
>>> from databricks import koalas as ks
>>> df = ks.DataFrame({'a':list('abcdefghij'), 'b':list('abcdefghij'), 'c': range(10)}
↪)
>>> df.loc[:, "b":"c"]
   b  c
0  a  0
1  b  1
2  c  2
3  d  3
4  e  4
5  f  5
6  g  6
7  h  7
8  i  8
9  j  9
```

5.11.2 Slice row selection support in loc for multi-index

We also added the support of slice as row selection in `loc` indexer for multi-index (#1344).

```
>>> from databricks import koalas as ks
>>> import pandas as pd
>>> df = ks.DataFrame({'a': range(3)}, index=pd.MultiIndex.from_tuples([("a", "b"), (
↪"a", "c"), ("b", "d")]))
>>> df.loc[("a", "c"): "b"]
     a
a c  1
b d  2
```

5.11.3 Slice row selection support in iloc

We continued to improve `iloc` indexer to support iterable indexes as row selection (#1338).

```
>>> from databricks import koalas as ks
>>> df = ks.DataFrame({'a':list('abcdefghij'), 'b':list('abcdefghij')})
>>> df.iloc[[-1, 1, 2, 3]]
   a  b
1  b  b
2  c  c
3  d  d
9  j  j
```

5.11.4 Support of setting values via loc and iloc at Series

Now, we added the basic support of setting values via `loc` and `iloc` at Series (#1367).

```
>>> from databricks import koalas as ks
>>> kser = ks.Series([1, 2, 3], index=["cobra", "viper", "sidewinder"])
>>> kser.loc[kser % 2 == 1] = -kser
>>> kser
cobra        -1
viper         2
sidewinder   -3
```

5.11.5 Other new features and improvements

We added the following new feature:

DataFrame:

- `take` (#1292)
- `eval` (#1359)

Series:

- `dot` (#1136)
- `take` (#1357)
- `combine_first` (#1290)

Index:

- `droplevel` (#1340)
- `union` (#1348)
- `take` (#1357)
- `asof` (#1350)

MultiIndex:

- `droplevel` (#1340)
- `unique` (#1342)
- `union` (#1348)

- `take` (#1357)

5.11.6 Other improvements

- Compute Index.is_monotonic/Index.is_monotonic_decreasing in a distributed manner (#1354)
- Fix SeriesGroupBy.apply() to respect various output (#1339)
- Add the support for operations between different DataFrames in groupby() (#1321)
- Explicitly don't support to disable numeric_only in stats APIs at DataFrame (#1343)
- Fix index operator against Series and Frame to use iloc conditionally (#1336)
- Make nunique in DataFrame to return a Koalas DataFrame instead of pandas' (#1347)
- Fix MultiIndex.drop() to follow renaming et al. (#1356)
- Add column axis in ks.concat (#1349)
- Fix iloc for Series when the series is modified. (#1368)
- Support MultiIndex for duplicated, drop_duplicates. (#1363)

5.12 Version 0.29.0

5.12.1 Slice support in `iloc`

We improved `iloc` indexer to support slice as row selection. (#1335)

For example,

```
>>> kdf = ks.DataFrame({'a':list('abcdefghij')})
>>> kdf
   a
0  a
1  b
2  c
3  d
4  e
5  f
6  g
7  h
8  i
9  j
>>> kdf.iloc[2:5]
   a
2  c
3  d
4  e
>>> kdf.iloc[2:-3:2]
   a
2  c
4  e
6  g
>>> kdf.iloc[5:]
   a
5  f
```

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```
6  g
7  h
8  i
9  j
>>> kdf.iloc[5:2]
Empty DataFrame
Columns: [a]
Index: []
```

5.12.2 Documentation

We added links to the previous talks in our document. (#1319)

You can see a lot of useful talks from the previous events and we will keep updated.

https://koalas.readthedocs.io/en/latest/getting_started/videos.html

5.12.3 Other new features and improvements

We added the following new feature:

DataFrame: - `stack` (#1329)

Series:

- `repeat` (#1328)

Index:

- `difference` (#1325)
- `repeat` (#1328)

MultiIndex:

- `difference` (#1325)
- `repeat` (#1328)

5.12.4 Other improvements

- DataFrame.pivot should preserve the original index names. (#1316)
- Fix _LocIndexerLike to handle a Series from index. (#1315)
- Support MultiIndex in DataFrame.unstack. (#1322)
- Support Spark UDT when converting from/to pandas DataFrame/Series. (#1324)
- Allow negative numbers for head. (#1330)
- Return a Koalas series instead of pandas' in stats APIs at Koalas DataFrame (#1333)

5.13 Version 0.28.0

5.13.1 pandas 1.0 support

We added pandas 1.0 support (#1197, #1299), and Koalas now can work with pandas 1.0.

5.13.2 map_in_pandas

We implemented `DataFrame.map_in_pandas` API (#1276) so Koalas can allow any arbitrary function with pandas DataFrame against Koalas DataFrame. See the example below:

```
>>> import databricks.koalas as ks
>>> df = ks.DataFrame({'A': range(2000), 'B': range(2000)})
>>> def query_func(pdf):
...     num = 1995
...     return pdf.query('A > @num')
...
>>> df.map_in_pandas(query_func)
        A     B
1996  1996  1996
1997  1997  1997
1998  1998  1998
1999  1999  1999
```

5.13.3 Standardize code style using Black

As a development only change, we added Black integration (#1301). Now, all code style is standardized automatically via running `./dev/reformat`, and the style is checked as a part of `./dev/lint-python`.

5.13.4 Other new features and improvements

We added the following new feature:

DataFrame:

- `query` (#1273)
- `unstack` (#1295)

5.13.5 Other improvements

- Fix `DataFrame.describe()` to support multi-index columns. (#1279)
- Add util function validate_bool_kwarg (#1281)
- Rename data columns prior to filter to make sure the column names are as expected. (#1283)
- Add an faq about Structured Streaming. (#1298)
- Let extra options have higher priority to allow workarounds (#1296)
- Implement 'keep' parameter for `drop_duplicates` (#1303)
- Add a note when type hint is provided to DataFrame.apply (#1310)

- Add a util method to verify temporary column names. (#1262)

5.14 Version 0.27.0

5.14.1 `head` ordering

Since Koalas doesn't guarantee the row ordering, `head` could return some rows from distributed partition and the result is not deterministic, which might confuse users.

We added a configuration `compute.ordered_head` (#1231), and if it is set to `True`, Koalas performs natural ordering beforehand and the result will be the same as pandas'. The default value is `False` because the ordering will cause a performance overhead.

```
>>> kdf = ks.DataFrame({'a': range(10)})
>>> pdf = kdf.to_pandas()
>>> pdf.head(3)
   a
0  0
1  1
2  2

>>> kdf.head(3)
   a
5  5
6  6
7  7
>>> kdf.head(3)
   a
0  0
1  1
2  2

>>> ks.options.compute.ordered_head = True
>>> kdf.head(3)
   a
0  0
1  1
2  2
>>> kdf.head(3)
   a
0  0
1  1
2  2
```

5.14.2 GitHub Actions

We started trying to use GitHub Actions for CI. (#1254, #1265, #1264, #1267, #1269)

5.14.3 Other new features and improvements

We added the following new feature:

DataFrame: - apply (#1259)

5.14.4 Other improvements

- Fix identical and equals for the comparison between the same object. (#1220)
- Select the series correctly in SeriesGroupBy APIs (#1224)
- Fixes `DataFrame/Series.clip` function to preserve its index. (#1232)
- Throw a better exception in `DataFrame.sort_values` when multi-index column is used (#1238)
- Fix `fillna` not to change index values. (#1241)
- Fix `DataFrame.__setitem__` with tuple-named Series. (#1245)
- Fix `corr` to support multi-index columns. (#1246)
- Fix output of `print()` matches with pandas of Series (#1250)
- Fix fillna to support partial column index for multi-index columns. (#1244)
- Add as_index check logic to groupby parameter (#1253)
- Raising NotImplementedError for elements that actually are not implemented. (#1256)
- Fix where to support multi-index columns. (#1249)

5.15 Version 0.26.0

5.15.1 `iat` indexer

We continued to improve indexers. Now, `iat` indexer is supported too (#1062).

```
>>> df = ks.DataFrame([[0, 2, 3], [0, 4, 1], [10, 20, 30]],
...                   columns=['A', 'B', 'C'])
>>> df
    A   B   C
0   0   2   3
1   0   4   1
2  10  20  30

>>> df.iat[1, 2]
1
```

5.15.2 Other new features and improvements

We added the following new features:

koalas.Index

- `equals` (#1216)
- `identical` (#1215)
- `is_all_dates` (#1205)
- `append` (#1163)
- `to_frame` (#1187)

koalas.MultiIndex:

- `equals` (#1216)
- `identical` (#1215)
- `swaplevel` (#1105)
- `is_all_dates` (#1205)
- `is_monotonic_increasing` (#1183)
- `is_monotonic_decreasing` (#1183)
- `append` (#1163)
- `to_frame` (#1187)

koalas.DataFrameGroupBy

- `describe` (#1168)

5.15.3 Other improvements

- Change default write mode to overwrite to be consistent with pandas (#1209)
- Prepare Spark 3 (#1211, #1181)
- Fix `DataFrame.idxmin/idxmax`. (#1198)
- Fix reset_index with the default index is "distributed-sequence". (#1193)
- Fix column name as a tuple in multi column index (#1191)
- Add favicon to doc (#1189)

5.16 Version 0.25.0

5.16.1 `loc` and `iloc` indexers improvement

We improved `loc` and `iloc` indexers. Now, `loc` can support scalar values as indexers (#1172).

```
>>> import databricks.koalas as ks
>>>
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df.loc['sidewinder']
max_speed    7
shield       8
Name: sidewinder, dtype: int64
>>> df.loc['sidewinder', 'max_speed']
7
```

In addition, Series derived from a different Frame can be used as indexers (#1155).

```
>>> import databricks.koalas as ks
>>>
>>> ks.options.compute.ops_on_diff_frames = True
>>>
>>> df1 = ks.DataFrame({'A': [0, 1, 2, 3, 4], 'B': [100, 200, 300, 400, 500]},
...                    index=[20, 10, 30, 0, 50])
>>> df2 = ks.DataFrame({'A': [0, -1, -2, -3, -4], 'B': [-100, -200, -300, -400, -500]}
↪,
...                    index=[20, 10, 30, 0, 50])
>>> df1.A.loc[df2.A > -3].sort_index()
10    1
20    0
30    2
```

Lastly, now `loc` uses its natural order according to index identically with pandas' when using the slice (#1159, #1174, #1179). See the example below.

```
>>> df = ks.DataFrame([[1, 2], [4, 5], [7, 8]],
...                   index=['cobra', 'viper', 'sidewinder'],
...                   columns=['max_speed', 'shield'])
>>> df.loc['cobra':'viper', 'max_speed']
cobra    1
viper    4
Name: max_speed, dtype: int64
```

5.16.2 Other new features and improvements

We added the following new features:

koalas.Series:

- `get` (#1153)

koalas.Index

- `drop` (#1117)
- `len` (#1161)
- `set_names` (#1134)
- `argmin` (#1162)
- `argmax` (#1162)

koalas.MultiIndex:

- `from_product` (#1144)
- `drop` (#1117)
- `len` (#1161)
- `set_names` (#1134)

5.16.3 Other improvements

- Add support `from_pandas` for Index/MultiIndex. (#1170)
- Add a hidden column `__natural_order__`. (#1146)
- Introduce `_LocIndexerLike` and consolidate some logic. (#1149)
- Refactor `LocIndexerLike.__getitem__`. (#1152)
- Remove sort in `GroupBy._reduce_for_stat_function`. (#1147)
- Randomize index in tests and fix some window-like functions. (#1151)
- Explicitly don't support `Index.duplicated` (#1131)
- Fix `DataFrame._repr_html_()`. (#1177)

5.17 Version 0.24.0

5.17.1 NumPy's universal function (ufunc) compatibility

We added the compatibility of NumPy ufunc (#1127). Virtually all ufunc compatibilities in Koalas DataFrame were implemented. See the example below:

```
>>> import databricks.koalas as ks
>>> import numpy as np
>>> kdf = ks.range(10)
>>> np.log(kdf)
         id
0       NaN
1  0.000000
2  0.693147
3  1.098612
4  1.386294
5  1.609438
6  1.791759
7  1.945910
8  2.079442
9  2.197225
```

5.17.2 Other new features and improvements

We added the following new features:

koalas:

- `to_numeric` (#1060)

koalas.DataFrame:

- `idxmax` (#1054)
- `idxmin` (#1054)
- `pct_change` (#1051)
- `info` (#1124)

koalas.Index

- `fillna` (#1102)
- `min` (#1114)
- `max` (#1114)
- `drop_duplicates` (#1121)
- `nunique` (#1132)
- `sort_values` (#1120)

koalas.MultiIndex:

- `levshape` (#1086)
- `min` (#1114)
- `max` (#1114)
- `sort_values` (#1120)

koalas.SeriesGroupBy

- `head` (#1050)

koalas.DataFrameGroupBy

- `head` (#1050)

5.17.3 Other improvements

- Setting index name / names for Series (#1079)
- disable 'str' for 'SeriesGroupBy', disable 'DataFrame' for 'GroupBy' (#1097)
- Support 'compute.ops_on_diff_frames' for NumPy ufunc compay in Series (#1128)
- Support arithmetic and comparison APIs on same DataFrames (#1129)
- Fix rename() for Index to support MultiIndex also (#1125)
- Set the upper-bound for pandas. (#1137)
- Fix _cum() for Series to work properly (#1113)
- Fix value_counts() to work properly when dropna is True (#1116, #1142)

5.18 Version 0.23.0

5.18.1 NumPy's universal function (ufunc) compatibility

We added the compatibility of NumPy ufunc (#1096, #1106). Virtually all ufunc compatibilities in Koalas Series were implemented. See the example below:

```
>>> import databricks.koalas as ks
>>> import numpy as np
>>> kdf = ks.range(10)
>>> kser = np.sqrt(kdf.id)
>>> type(kser)
<class 'databricks.koalas.series.Series'>
>>> kser
0    0.000000
1    1.000000
2    1.414214
3    1.732051
4    2.000000
5    2.236068
6    2.449490
7    2.645751
8    2.828427
9    3.000000
```

5.18.2 Other new features and improvements

We added the following new features:

koalas:

- `option_context` (#1077)

koalas.DataFrame:

- `where` (#1018)
- `mask` (#1018)
- `iterrows` (#1070)

koalas.Series:

- `pop` (#866)
- `first_valid_index` (#1092)
- `pct_change` (#1071)

koalas.Index

- `symmetric_difference` (#953, #1059)
- `to_numpy` (#1058)
- `transpose` (#1056)
- `T` (#1056)
- `dropna` (#938)
- `shape` (#1085)

- `value_counts` (#949)

koalas.MultiIndex:

- `symmetric_difference` (#953, #1059)
- `to_numpy` (#1058)
- `transpose` (#1056)
- `T` (#1056)
- `dropna` (#938)
- `shape` (#1085)
- `value_counts` (#949)

5.18.3 Other improvements

- Fix comparison operators to treat NULL as False (#1029)
- Make corr return koalas.DataFrame (#1069)
- Include link to Help Thirsty Koalas Fund (#1082)
- Add Null handling for different frames (#1083)
- Allow `Series.__getitem__` to take boolean Series (#1075)
- Produce correct output against multiIndex when 'compute.ops_on_diff_frames' is enabled (#1089)
- Fix idxmax() / idxmin() for Series work properly (#1078)

5.19 Version 0.22.0

5.19.1 Enable Arrow 0.15.1+

Apache Arrow 0.15.0 did not work well with PySpark 2.4 so it was disabled in the previous version. With Arrow 0.15.1, now it works in Koalas (#902).

5.19.2 Expanding and Rolling

We also added `expanding()` and `rolling()` APIs in all `groupby()`, Series and Frame (#985, #991, #990, #1015, #996, #1034, #1037)

- `min`
- `max`
- `sum`
- `mean`
- `std`
- `var`

5.19.3 Multi-index columns support

We continue improving multi-index columns support. We made the following APIs support multi-index columns:

- `median` (#995)
- `at` (#1049)

5.19.4 Documentation

We added "Best Practices" section in the documentation (#1041) so that Koalas users can read and follow. Please see https://koalas.readthedocs.io/en/latest/user_guide/best_practices.html

5.19.5 Other new features and improvements

We added the following new features:

koalas.DataFrame:

- `quantile` (#984)
- `explain` (#1042)

koalas.Series:

- `between` (#997)
- `update` (#923)
- `mask` (#1017)

koalas.MultiIndex:

- `from_tuples` (#970)
- `from_arrays` (#1001)

Along with the following improvements:

- Introduce column_scols in InternalFrame substitude for data_columns. (#956)
- Fix different index level assignment when 'compute.ops_on_diff_frames' is enabled (#1045)
- Fix Dataframe.melt function & Add doctest case for melt function (#987)
- Enable creating Index from list like 'Index([1, 2, 3])' (#986)
- Fix combine_frames to handle where the right hand side arguments are modified Series (#1020)
- `setup.py` should support Python 2 to show a proper error message. (#1027)
- Remove `Series.schema`. (#993)

5.20 Version 0.21.0

5.20.1 Multi-index columns support

We continue improving multi-index columns support. We made the following APIs support multi-index columns:

- `nunique` (#980)
- `to_csv` (#983)

5.20.2 Documentation

Now, we have installation guide, design principles and FAQ in our public documentation (#914, #944, #963, #964)

5.20.3 Other new features and improvements

We added the following new features:

koalas

- `merge` (#969)

koalas.DataFrame:

- `keys` (#937)
- `ndim` (#947)

koalas.Series:

- `keys` (#935)
- `mode` (#899)
- `truncate` (#928)
- `xs` (#921)
- `where` (#922)
- `first_valid_index` (#936)

koalas.Index:

- `copy` (#939)
- `unique` (#912)
- `ndim` (#947)
- `has_duplicates` (#946)
- `nlevels` (#945)

koalas.MultiIndex:

- `copy` (#939)
- `ndim` (#947)
- `has_duplicates` (#946)
- `nlevels` (#945)

koalas.Expanding

- `count` (#978)

Along with the following improvements:

- Fix passing options as keyword arguments (#968)
- Make is_monotonic~ work properly for index (#930)
- Fix Series.__getitem__ to work properly (#934)
- Fix reindex when all the given columns are included the existing columns (#975)
- Add datetime as the equivalent python type to TimestampType (#957)
- Fix is_unique to respect the current Spark column (#981)
- Fix bug when assign None to name as Index (#974)
- Use name_like_string instead of str directly. (#942, #950)

5.21 Version 0.20.0

5.21.1 Disable Arrow 0.15

Apache Arrow 0.15.0 was released on the 5th of October, 2019, which Koalas depends on to execute Pandas UDF, but the Spark community reports an issue with PyArrow 0.15.

We decided to set an upper bound for pyarrow version to avoid such issues until we are sure that Koalas works fine with it.

- Set an upper bound for pyarrow version. (#918)

5.21.2 Multi-index columns support

We continue improving multi-index columns support. We made the following APIs support multi-index columns:

- `pivot_table` (#908)
- `melt` (#920)

5.21.3 Other new features and improvements

We added the following new features:

koalas.DataFrame:

- `xs` (#892)

koalas.Series:

- `drop_duplicates` (#896)
- `replace` (#903)

koalas.GroupBy:

- `shift` (#910)

Along with the following improvements:

- Implement nested renaming for groupby agg (#904)
- Add 'index_col' parameter to DataFrame.to_spark (#906)
- Add more options to `read_csv` (#916)
- Add NamedAgg (#911)
- Enable DataFrame setting value as list of labels (#905)

5.22 Version 0.19.0

5.22.1 Koalas Logo

Now that we have an official logo!

We can see the cute logo in our documents as well.

5.22.2 Documentation

Also we improved the documentation: https://koalas.readthedocs.io/en/latest/

- Added the logo (#831)
- Added a Jupyter notebook for 10 min tutorial (#843)
- Added the tutorial to the documentation (#853)
- Add some examples for plot implementations in their docstrings (#847)
- Move contribution guide to the official documentation site (#841)

Binder integration for the 10 min tutorial

You can run a live Jupyter notebook for 10 min tutorial from .

5.22.3 Multi-index columns support

We continue improving multi-index columns support. We made the following APIs support multi-index columns:

- `transform` (#800)
- `round` (#802)
- `unique` (#809)
- `duplicated` (#803)
- `assign` (#811)
- `merge` (#825)
- `plot` (#830)
- `groupby` and its functions (#833)
- `update` (#848)
- `join` (#848)
- `drop_duplicate` (#856)
- `dtype` (#858)
- `filter` (#859)
- `dropna` (#857)
- `replace` (#860)

5.22.4 Plots

We also continue adding plot APIs as follows:

For DataFrame:

- `plot.kde()` (#784)

5.22.5 Other new features and improvements

We added the following new features:

koalas.DataFrame:

- `pop` (#791)
- `__iter__` (#836)
- `rename` (#806)
- `expanding` (#840)
- `rolling` (#840)

koalas.Series:

- `aggregate` (#816)
- `agg` (#816)
- `expanding` (#840)
- `rolling` (#840)
- `drop` (#829)
- `copy` (#869)

koalas.DataFrameGroupBy:

- `expanding` (#840)
- `rolling` (#840)

koalas.SeriesGroupBy:

- `expanding` (#840)
- `rolling` (#840)

Along with the following improvements:

- Add squeeze argument to read_csv (#812)
- Raise a more helpful error for duplicated columns in Join (#820)
- Issue with ks.merge to Series (#818)
- Fix `MultiIndex.to_pandas()` and `__repr__()`. (#832)
- Add unit and origin options for to_datetime (#839)
- Fix on wrong error raise in DataFrame.fillna (#844)
- Allow str and list in aggfunc in DataFrameGroupby.agg (#828)
- Add `index_col` argument to `to_koalas()`. (#863)

5.23 Version 0.18.0

5.23.1 Multi-index columns support

We continue improving multi-index columns support (#793, #776). We made the following APIs support multi-index columns:

- `applymap` (#793)
- `shift` (#793)
- `diff` (#793)
- `fillna` (#793)
- `rank` (#793)

Also, we can set tuple or None name for Series and Index. (#776)

```
>>> import databricks.koalas as ks
>>> kser = ks.Series([1, 2, 3])
>>> kser.name = ('a', 'b')
>>> kser
0    1
1    2
2    3
Name: (a, b), dtype: int64
```

5.23.2 Plots

We also continue adding plot APIs as follows:

For Series:

- `plot.kde()` (#767)

For DataFrame:

- `plot.hist()` (#780)

5.23.3 Options

In addition, we added the support for namespace-access in options (#785).

```
>>> import databricks.koalas as ks
>>> ks.options.display.max_rows
1000
>>> ks.options.display.max_rows = 10
>>> ks.options.display.max_rows
10
```

See also User Guide of our project docs.

5.23.4 Other new features and improvements

We added the following new features:

koalas.DataFrame:

- `aggregate` (#796)
- `agg` (#796)
- `items` (#787)

koalas.indexes.Index/MultiIndex

- `is_boolean` (#795)
- `is_categorical` (#795)
- `is_floating` (#795)
- `is_integer` (#795)
- `is_interval` (#795)
- `is_numeric` (#795)

- `is_object` (#795)

Along with the following improvements:

- Add `index_col` for `read_json` (#797)
- Add index_col for spark IO reads (#769, #775)
- Add "sep" parameter for read_csv (#777)
- Add axis parameter to dataframe.diff (#774)
- Add read_json and let to_json use spark.write.json (#753)
- Use spark.write.csv in to_csv of Series and DataFrame (#749)
- Handle TimestampType separately when convert to pandas' dtype. (#798)
- Fix `spark_df` when `set_index(.., drop=False)`. (#792)

5.23.5 Backward compatibility

- We removed some parameters in `DataFrame.to_csv` and `DataFrame.to_json` to allow distributed writing (#749, #753)

5.24 Version 0.17.0

5.24.1 Options

We started using options to configure the Koalas' behavior. Now we have the following options:

- `display.max_rows` (#714, #742)
- `compute.max_rows` (#721, #736)
- `compute.shortcut_limit` (#717)
- `compute.ops_on_diff_frames` (#725)
- `compute.default_index_type` (#723)
- `plotting.max_rows` (#728)
- `plotting.sample_ratio` (#737)

We can also see the list and their descriptions in the User Guide of our project docs.

5.24.2 Plots

We continue adding plot APIs as follows:

For Series:

- `plot.area()` (#704)

For DataFrame:

- `plot.line()` (#686)
- `plot.bar()` (#695)
- `plot.barh()` (#698)

- `plot.pie()` (#703)
- `plot.area()` (#696)
- `plot.scatter()` (#719)

5.24.3 Multi-index columns support

We also continue improving multi-index columns support. We made the following APIs support multi-index columns:

- `koalas.concat()` (#680)
- `koalas.get_dummies()` (#695)
- `DataFrame.pivot_table()` (#635)

5.24.4 Other new features and improvements

We added the following new features:

koalas:

- `read_sql_table()` (#741)
- `read_sql_query()` (#741)
- `read_sql()` (#741)

koalas.DataFrame:

- `style` (#712)

Along with the following improvements:

- `GroupBy.apply` should return Koalas DataFrame instead of pandas DataFrame (#731)
- Fix `rpow` and `rfloordiv` to use proper operators in Series (#735)
- Fix `rpow` and `rfloordiv` to use proper operators in DataFrame (#740)
- Add schema inference support at DataFrame.transform (#732)
- Add `Option` class to support type check and value check in options (#739)
- Added missing tests (#687, #692, #694, #709, #711, #730, #729, #733, #734)

5.24.5 Backward compatibility

- We renamed two of the default index names from `one-by-one` and `distributed-one-by-one` to `sequence` and `distributed-sequence` respectively. (#679)
- We moved the configuration for enabling operations on different DataFrames from the environment variable to the option. (#725)
- We moved the configuration for the default index from the environment variable to the option. (#723)

5.25 Version 0.16.0

Firstly, we introduced new mode to enable operations on different DataFrames (#633). This mode can be enabled by setting `OPS_ON_DIFF_FRAMES` environment variable is set to `true` as below:

```
>>> import databricks.koalas as ks
>>>
>>> kdf1 = ks.range(5)
>>> kdf2 = ks.DataFrame({'id': [5, 4, 3]})
>>> (kdf1 - kdf2).sort_index()
    id
0 -5.0
1 -3.0
2 -1.0
3  NaN
4  NaN
```

```
>>> import databricks.koalas as ks
>>>
>>> kdf = ks.range(5)
>>> kdf['new_col'] = ks.Series([1, 2, 3, 4])
>>> kdf
   id  new_col
0   0      1.0
1   1      2.0
3   3      4.0
2   2      3.0
4   4      NaN
```

Secondly, we also introduced default index and disallowed Koalas DataFrame with no index internally (#639)(#655). For example, if you create Koalas DataFrame from Spark DataFrame, the default index is used. The default index implementation can be configured by setting `DEFAULT_INDEX` as one of three types:

- (default) `one-by-one`: It implements a one-by-one sequence by Window function without specifying partition. This index type should be avoided when the data is large.

  ```
  >>> ks.range(3)
     id
  0   0
  1   1
  2   2
  ```

- `distributed-one-by-one`: It implements a one-by-one sequence by group-by and group-map approach. It still generates a one-by-one sequential index globally. If the default index must be a one-by-one sequence in a large dataset, this index can be used.

  ```
  >>> ks.range(3)
     id
  0   0
  1   1
  2   2
  ```

- `distributed`: It implements a monotonically increasing sequence simply by using Spark's `monotonically_increasing_id` function. If the index does not have to be a one-by-one sequence, this index can be used. Performance-wise, this index almost does not have any penalty comparing to other index types.

```
>>> ks.range(3)
              id
25769803776    0
60129542144    1
94489280512    2
```

Thirdly, we implemented many plot APIs in Series as follows:

- plot.pie() (#669)
- plot.area() (#670)
- plot.line() (#671)
- plot.barh() (#673)

See the example below:

```
import databricks.koalas as ks

ks.range(10).to_pandas().id.plot.pie()
```

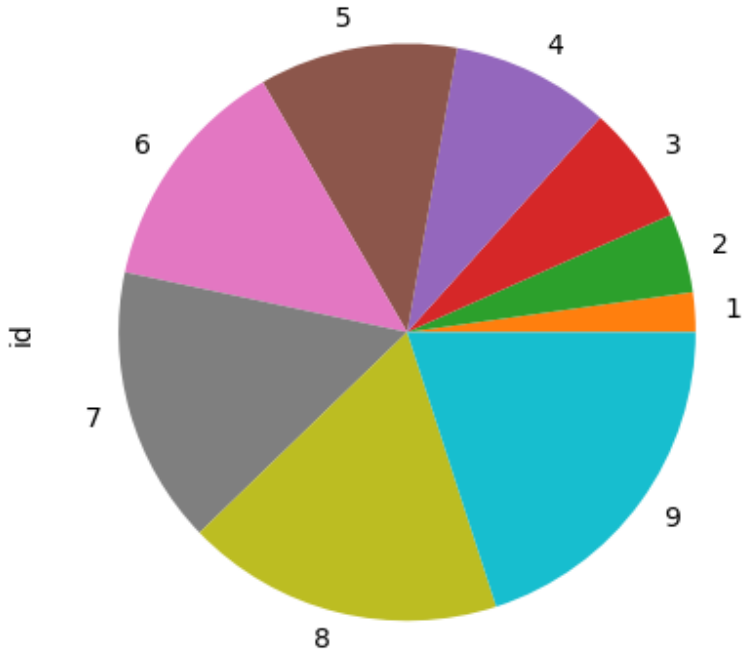

Fig. 6: image

Fourthly, we rapidly improved multi-index columns support continuously. Now multi-index columns are supported in multiple APIs:

- `DataFrame.sort_index()` (#637)
- `GroupBy.diff()` (#653)
- `GroupBy.rank()` (#653)
- `Series.any()` (#652)
- `Series.all()` (#652)
- `DataFrame.any()` (#652)
- `DataFrame.all()` (#652)
- `DataFrame.assign()` (#657)
- `DataFrame.drop()` (#658)
- `DataFrame.reindex()` (#659)
- `Series.quantile()` (#663)
- `Series,transform()` (#663)
- `DataFrame.select_dtypes()` (#662)
- `DataFrame.transpose()` (#664).

Lastly we added new functionalities, especially for groupby-related functionalities, in the past weeks. We added the following features:

koalas.DataFrame

- duplicated() (#569)
- fillna() (#640)
- bfill() (#640)
- pad() (#640)
- ffill() (#640)

koalas.groupby.GroupBy:

- diff() (#622)
- nunique() (#617)
- nlargest() (#654)
- nsmallest() (#654)
- idxmax() (#649)
- idxmin() (#649)

Along with the following improvements:

- Add a basic infrastructure for configurations. (#645)
- Always use `column_index`. (#648)
- Allow to omit type hint in GroupBy.transform, filter, apply (#646)

5.26 Version 0.15.0

We rapidly improved and added new functionalities, especially for groupby-related functionalities, in the past weeks. We also added the following features:

koalas.groupby.GroupBy:

- size() (#593)
- filter() (#614)
- cummax() (#610)
- cummin() (#610)
- cumsum() (#610)
- cumprod() (#610)
- rand() (#619)

koalas.groupby.SeriesGroupBy:

- apply() (#609)
- value_counts() (#613)

koalas.indexes.Index:

- size() (#623)

Along with the following improvements:

- Add multiple aggregations on a single column (#602)
- Add axis=columns to count, var, std, max, sum, min, kurtosis, skew and mean in DataFrame (#605)
- Add Spark DDL formatted string support in read_csv(names=...) (#604)
- Support names of index levels (#621, #629)
- Add as_index argument to groupby. (#627)
- Fix issues related to multi-index column access (#594, #597, #606, #611, #612, #620)

5.27 Version 0.14.0

We added a basic multi-index support in columns (#590) as below. pandas multi-index can be also mapped.

```
>>> import databricks.koalas as ks
>>> import numpy as np
>>>
>>> arrays = [np.array(['bar', 'bar', 'baz', 'baz', 'foo', 'foo', 'qux', 'qux']),
...           np.array(['one', 'two', 'one', 'two', 'one', 'two', 'one', 'two'])]
>>> kdf = ks.DataFrame(np.random.randn(3, 8), index=['A', 'B', 'C'], columns=arrays)
```

```
>>> kdf
        bar                 baz                 foo                 qux
        one       two       one       two       one       two       one       two
A -1.574777  0.805108  0.139748  1.287946 -1.782297 -0.152292  0.680594  1.419407
B  0.076886 -1.560807  0.403807 -0.715029  1.236899 -0.364483 -1.548554  0.076003
C -0.575168  0.061539 -2.083615 -0.816090 -1.267440  0.745949 -1.194421  0.468818
```

```
>>> kdf['bar']
        one       two
A -1.574777  0.805108
B  0.076886 -1.560807
C -0.575168  0.061539
```

```
>>> kdf['bar']['two']
A    0.805108
B   -1.560807
C    0.061539
Name: two, dtype: float64
```

In addition, we are triaging APIs to support and unsupport explicitly (#574)(#580). Some of pandas APIs would explicitly be unsupported according to Guardrails to prevent users from shooting themselves in the foot and based upon other justifications such as the cost of their operations.

We also added the following features:

koalas.DataFrame:

- ffill() (#571)
- bfill() (#570)
- filter() (#589)

koalas.Series:

- idxmax() (#587)
- idxmin() (#587)

koalas.indexes.Index:

- Index.rename() (#581)

koalas.groupby.GroupBy:

- apply() (#584)
- transform() (#585)

Along with the following improvements:

- pandas 0.25 support (#579)
- `method` and `limit` parameter support in `DataFrame.fillna()` (#565)
- Dots (`.`) in columns names are allowed (#490)
- Add support of level argument for DataFrame/Series.sort_index() (#583)

5.28 Version 0.13.0

We rapidly improved and added new functionalities in the past week. We also added the following features:

koalas.DataFrame:

- diff (#562)
- shift (#562)
- round (#537)

- rank (#546)
- any (#568)
- all (#568)

koalas.Series:

- diff (#564)
- quantile (#566)
- shift (#563)
- is_monotonic (#560)
- is_monotonic_increasing (#560)
- is_monotonic_decreasing (#560)
- round (#537)
- rank (#546)

5.29 Version 0.12.0

We rapidly improved and added new functionalities in the past week. We also added the following features:

koalas:

- isna (#548)
- isnull (#548)
- notna (#548)
- notnull (#548)

koalas.DataFrame:

- bool (#533)
- reindex (#493)
- pivot (#532)
- transform (#541)
- median (#544)
- cumprod (#545)

koalas.Series:

- cummax (#534)
- cummin (#534)
- cumsum (#534)
- bool (#533)
- median (#540)
- transpose (#543)
- T (#543)

- cumprod (#545)
- hasnans (#547)

Along with the following improvements:

- Fix DataFrame.replace to take `kdf.replace({0: 10, 1: 100})` (#527)

5.30 Version 0.11.0

We fixed a critical regression for pandas 0.23.x compatibility (#528, #529) Now, pandas 0.23.x support is back.

INDEX

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