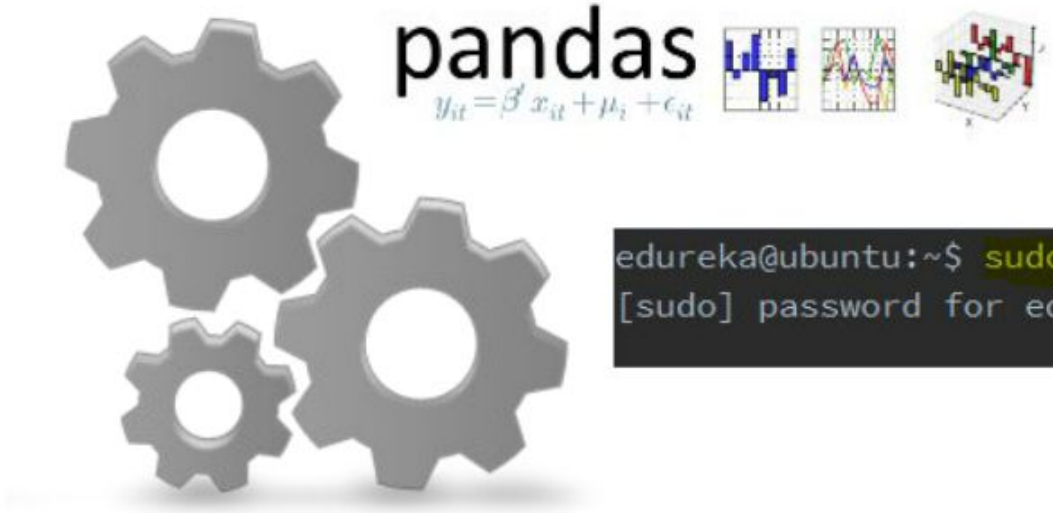
Installing pandas




```
edureka@ubuntu:~$ sudo apt-get install python-pandas
[sudo] password for edureka:
```

pandas

→ pandas is an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language

→ It is built on top of NumPy, SciPy, to some extent matplotlib

→ pandas is well suited for many different kinds of data:

» Tabular data with heterogeneously-typed columns, as in an SQL table or Excel spreadsheet

» Ordered and unordered (not necessarily fixed-frequency) time series data

» Arbitrary matrix data (homogeneously typed or heterogeneous) with row and column labels

» Any other form of observational/statistical data sets. The data actually need not be labeled at all to be placed into a pandas data structure

pandas

→ Purpose

- » Analyzing data
- » Cleaning data
- » Munging data
- » Modeling data
- » Organizing the results of the analysis into a form which is suitable for plotting or tabular display

Refer - https://pypi.python.org/pypi/pandas/0.13.0/

pandas - Data Structure Types

→ Primary Data Structures of pandas:

» Series (1-dimensional) – It is one-dimensional labelled array capable of holding any data type
» The basic method to create a Series is to call:

```
>>> import pandas

>>> dataFrame = pandas.Series(data = d, index=index)
```

» DataFrame (2-dimensional) – It is a 2-dimensional labelled data structure with columns of potentially different types capable of holding
» The basic method to create a DataFrame is to call:

```
>>> import pandas

>>> dataFrame = pandas.DataFrame(data = d, index=index)
```

Note: d and index can be any Dict of 1D ndarrays, lists, dicts, or Series etc

pandas - Series

→ Series

» One-dimensional array like object containing data and labels (or index)

```
>>> import pandas as pd
>>> series = pd.Series(list('98765'))
>>> series
0    9
1    8
2    7
3    6
4    5
dtype: object
```

```
>>> import pandas as pd
>>> series = pd.Series(tuple('abcdef'))
>>> series
0    a
1    b
2    c
3    d
4    e
5    f
dtype: object
```

pandas - Traversing Series

→ Working with Index:

» Index in a series can be specified and using the index we can fetch its corresponding value

```
>>> import pandas as pd
>>> series= pd.Series([9,8,7,6], index = ['*', '**', '***', '****'])
>>> series
*       9
**      8
***     7
****    6
dtype: int64
>>> # Fetching value with index '****'
>>> series['****']
6
```

» Multiple values can be fetched with multiple indexes

```
>>> series[ ['*', '***']]
*      9
***    7
dtype: int64
```

pandas - Traversing Series (Contd.)

→ Series is like a fixed-length, ordered dictionary

```
>>> import pandas as pd
>>> series = pd.Series(range(5), index = list('xyzxy'))
>>> series
x    0
y    1
z    2
x    3
y    4
dtype: int64
```

→ Unlike dictionary, index items don't have to be unique

```
>>> # Fetching the values with index x
>>> series['x']
x    0
x    3
dtype: int64
>>> # Fetching the value at index [x, 1]
>>> series['x'][1]
3
```

pandas - Incomplete Data in Series

→ Data can be filtered using conditions.

→ pandas can accommodate incomplete data. Incomplete data is replaced with "NaN" and "NaN" value is not an issue in arithmetic operations. Unlike in NumPy ndarray, data is automatically aligned

```
>>> import pandas as pd
>>> series = pd.Series({1:10, 2:20, 3:30}, index = [1,2,3,4])
>>> series
1    10
2    20
3    30
4   NaN
dtype: float64
```

→ We can use numpy-operations on data for filtering

```
>>> series * 4
1     40
2     80
3    120
4    NaN
dtype: float64
```

pandas - DataFrame

→ DataFrame

» Spreadsheet-like data structure containing an ordered collection of columns
» Has both row and column index

→ DataFrame Creation

» Creation with dictionary of equal-length lists

```
>>> import pandas as pd
>>> data = {'Country': ['US','US','INDIA','INDIA'],
...         'Year': [2012,2013,2012,2013],
...         'Population': [20, 27, 30, 35] }
...
>>> dataFrame = pd.DataFrame(data)
>>> dataFrame
  Country  Population  Year
0      US          20  2012
1      US          27  2013
2   INDIA          30  2012
3   INDIA          35  2013

[4 rows x 3 columns]
```

pandas - DataFrame using dicts

→ Creation with dict of dicts

```
>>> import pandas as pd
>>> data = { 'US': {2012:30, 2013:35},
...          'INDIA': {2012:20, 2013:27, 2014:28}}
...
>>> dataFrame = pd.DataFrame(data)
>>> dataFrame
      INDIA  US
2012     20  30
2013     27  35
2014     28 NaN

[3 rows x 2 columns]
```

→ Note: Incomplete data is filled with 'NaN' values

pandas - DataFrame

→ Columns can be retrieved as Series

» dict notation
» attribute notation

→ Rows can be retrieved by position or by name (using ix attribute)

```
>>> dataFrame['Country']
0       US
1       US
2    INDIA
3    INDIA
Name: Country, dtype: object
>>> dataFrame.describe()
       Population         Year
count    4.000000      4.00000
mean    28.000000   2012.50000
std      6.271629      0.57735
min     20.000000   2012.00000
25%     25.250000   2012.00000
50%     28.500000   2012.50000
75%     31.250000   2013.00000
max     35.000000   2013.00000

[8 rows x 2 columns]
```

pandas - DataFrame

→ New Columns can be added by computation or direct assignment

```
>>> dataFrame
  Country  Population  Year
0      US          20  2012
1      US          27  2013
2   INDIA          30  2012
3   INDIA          35  2013

[4 rows x 3 columns]
>>> # Adding a new column
>>> dataFrame['newCol'] = dataFrame['Population'] * 2
>>> dataFrame
  Country  Population  Year  newCol
0      US          20  2012      40
1      US          27  2013      54
2   INDIA          30  2012      60
3   INDIA          35  2013      70

[4 rows x 4 columns]
```

pandas - DataFrame

→ Functions on DataFrame

» We can apply functions like sum(), mean(), max(), head(), count(), tail() etc on DataFrame

```
>>> dataFrame
      INDIA  US
2012     20  30
2013     27  35
2014     28 NaN

[3 rows x 2 columns]
>>> # Calling sum()
>>> dataFrame.sum()
INDIA    75
US       65
dtype: float64
>>> # Calling mean()
>>> dataFrame.mean()
INDIA    25.0
US       32.5
dtype: float64
```

pandas - DataFrame

» describe() functions will give the summary of DataFrame

```
>>> # Calling describe()
>>> dataFrame.describe()
           INDIA         US
count   3.000000   2.000000
mean   25.000000  32.500000
std     4.358899   3.535534
min    20.000000  30.000000
25%    23.500000  31.250000
50%    27.000000  32.500000
75%    27.500000  33.750000
max    28.000000  35.000000

[8 rows x 2 columns]
```

pandas - Data Loading

→ pandas supports several ways to handle data loading

→ Text file data

- » read_csv
- » read_table

→ Structured data (JSON, XML, HTML)

- » It works fine with existing libraries

→ Excel (depends upon xlrd and openpyxl packages)

→ Database

- » pandas.io.sql module (read_frame)

pandas - Loading CSV data

→ pandas.read_csv will load the csv data

```
>>> from pandas import *
>>> # Reading csv file named custs
>>> data = read_csv('/home/edureka/Desktop/custs.csv')
```

Import pandas
data = pandas.read_csv("aapl_data.csv")

```
>>> data
       ID First Name   Last Name  Age                  Occupation
0  4000001   Kristina       Chung   55                       Pilot
1  4000002      Paige        Chen   74                     Teacher
2  4000003     Sherri      Melton   34                  Firefighter
3  4000004   Gretchen        Hill   66  Computer hardware engineer
4  4000005      Karen     Puckett   74                      Lawyer
5  4000006    Patrick        Song   42                  Veterinarian
6  4000007      Elsie    Hamilton   43                       Pilot
7  4000008      Hazel      Bender   63                   Carpenter
8  4000009    Malcolm      Wagner   39                      Artist
9  4000010    Dolores  McLaughlin   60                      Writer

[10 rows x 5 columns]
```

→ Data created above is a DataFrame

pandas - Loading CSV data

→ Using len on a DataFrame will give you the number of rows

```
>>> # Calling len()
>>> len(data)
10
```

→ We can get the column names using the columns property

```
>>> # Getting the column names
>>> data.columns
Index([u'ID', u'First Name', u'Last Name', u'Age', u'Occupation'], dtype='object')
```

pandas - Loading CSV data

→ Columns can be accessed in two ways

» The first is using the DataFrame like a dictionary with string keys. Multiple columns can be accessed by passing multiple column names

» >>>data["Open"]

» The second way to access columns is using the dot syntax. This only works if your column name could also be a Python variable name (i.e., no spaces), and if it doesn't collide with another DataFrame property or function name (e.g., count, sum)

» >>>data.Open

```
>>> data['ID']
0    4000001
1    4000002
2    4000003
3    4000004
4    4000005
5    4000006
6    4000007
7    4000008
8    4000009
9    4000010
Name: ID, dtype: int64
```

pandas - Functions

→ head() function lists the first 5 rows as default. If we want to display first n rows. Use .head(n)

```
>>> data.head(2)
        ID First Name Last Name  Age Occupation
0  4000001   Kristina     Chung   55      Pilot
1  4000002      Paige      Chen   74    Teacher

[2 rows x 5 columns]
```

→ head() function can be applied on columns also

```
>>> data.ID.head(2)
0    4000001
1    4000002
Name: ID, dtype: int64
```

→ We can use other functions like tail(), max(), min(), std(), mean() etc

```
>>> data.ID.max()
4000010
```

pandas - Accessing Rows

→ Accessing Individual Rows

» Sometimes you need to access individual rows in your DataFrame. The irow() function lets you grab the ith row from a DataFrame (starting from 0)

```
>>> data.irow(1)
ID             4000002
First Name       Paige
Last Name         Chen
Age                 74
Occupation     Teacher
Name: 1, dtype: object
```

```
>>> data.irow(2)
ID                4000003
First Name         Sherri
Last Name          Melton
Age                    34
Occupation     Firefighter
Name: 2, dtype: object
```

pandas - Accessing Rows

→ Filtering

» Selecting rows of interest from a DataFrame. In addition to strings, the dictionary syntax accepts things like this:
» We can apply filters again on Hi_Volume to filter further if Hi_Volume gives more than one row as output. Multiple conditions can also be checked at a time

```
>>> Volume = data[ data.ID == 4000002 ]
>>> Volume
        ID First Name Last Name  Age Occupation
1  4000002      Paige      Chen   74    Teacher

[1 rows x 5 columns]
```

```
>>> Volume = data[ data.Occupation == 'Writer' ]
>>> Volume
        ID First Name   Last Name  Age Occupation
9  4000010    Dolores  McLaughlin   60     Writer

[1 rows x 5 columns]
```

Reading and Writing Data

- We'll see three commonly used file formats: csv, text file, and Excel.

```
# Reading
df=pd.read_csv('Data/mtcars.csv') # from csv
df=pd.read_csv('Data/mtcars.txt', sep='\t') # from text file
df=pd.read_excel('Data/mtcars.xlsx','Sheet2') # from Excel
# reading from multiple sheets of same Excel into different data frames
xlsx = pd.ExcelFile('file_name.xls')
sheet1_df = pd.read_excel(xlsx, 'Sheet1')
sheet2_df = pd.read_excel(xlsx, 'Sheet2')
```

```
# writing
# index = False parameter will not write the index values, default is True
df.to_csv('Data/mtcars_new.csv', index=False)
df.to_csv('Data/mtcars_new.txt', sep='\t', index=False)
df.to_excel('Data/mtcars_new.xlsx',sheet_name='Sheet1', index = False)
```

Basic Operations

- Convert string to date series

pd.to_datetime(pd.Series([‘2017-04-01’,‘2017-04-02’,‘2017-04-03’]))

- Rename a specific column name

df.rename(columns={‘old_columnname’:‘new_columnname’})

- Flag duplicates

df.duplicated()

- Drop duplicates

df = df.drop_duplicates()

Basic Operations

- Drop missing rows and columns having missing values

df.dropna()

- Replaces all missing values with 0 (or you can use any int or str)

df.fillna(value=0)

- Check missing value condition and return Boolean value of true or false for each cell

pd.isnull(df)

Viewing Data

- The Pandas dataframe comes with built-in functions to view the contained data.

Looking at the top n records default n value is 5 if not specified	df.head(n=2)
Looking at the bottom n records	df.tail()
Get column names	df.columns
Get column datatypes	df.dtypes
Get dataframe index	df.index
Get unique values	df[column_name].unique()
Get values	df.values
Sort DataFrame	df.sort_values(by =['Column1', 'Column2'], ascending=[True,True'])

Viewing Data

select/view by column name	df[column_name]
select/view by row number	df[0:3]
selection by index	df.loc[0:3] # index 0 to 3 df.loc[0:3,['column1', 'column2']] # index 0 to 3 for specific columns
selection by position	df.iloc[0:2] # using range, first 2 rows df.iloc[2,3,6] # specific position df.iloc[0:2,0:2] # first 2 rows and first 2 columns

Viewing Data

selection without it being in the index	print df.ix[1,1] # value from fist row and first column print df.ix[:,2] # all rows of column at 2nd position
Faster alternative to iloc to get scalar values	print df.iat[1,1]
Transpose DataFrame	df.T
Filter DataFrame based on value condition for one column	df[df['column_name'] > 7.5]
Filter DataFrame based on a value condition on one column	df[df['column_name'].isin(['condition_value1', 'condition_value2'])]
Filter based on multiple conditions on multiple columns using AND operator	df[(df['column1']>7.5) & (df['column2']>3)]
Filter based on multiple conditions on multiple columns using OR operator	df[(df['column1']>7.5) | (df['column2']>3)]

Merge/Join

- Pandas provide various facilities for easily combining together Series, DataFrame, and Panel objects with various kinds of set logic for the indexes and relational algebra functionality in the case of join merge-type operations

Viewing Data

- Concat or append operation

```
df = pd.concat([df_1, df_2])
print df_1.append(df_2)
```

- Join the two dataframes along columns

```
pd.concat([df_1, df_2], axis=1)
```

- Merge two dataframes

```
pd.merge(df_1, df_2, on=‘columnid')
```

Join

- Pandas offer SQL style merges as well.
- Left join two dataframes

```
print pd.merge(df_1, df_2, on=‘columnid', how='left')
```

- Merge while adding a suffix to duplicate column names of both table

```
print pd.merge(df_1, df_2, on='emp_id', how='left', suffixes=('_left', '_right'))
```

Join

- Inner Join - Inner join produces only the set of records that match in both Table A and Table B

pd.merge(df_1, df_2, on=‘emp_id’, how=‘inner’)

- Outer Join - Full outer join produces the set of all records in Table A and Table B, with matching records from both sides where available. If there is no match, the missing side will contain null

pd.merge(df_1, df_2, on='emp_id', how='outer')

Grouping

- Grouping involves 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