Python Basic Course

Part II

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Outline

- Part I: introduction and basics
  - What is Python
  - Tools and “hello world”
  - Basic syntax and data types
    - assignments, types and operators
    - conditional blocks and loops
- Part II: architecture
  - Functions
  - Scope
  - Built-ins
  - Modules
- Part IV: manipulating data
  - List operations
  - String operations
  - Dealing bad data
  - Reading and writing files
- Part VI: Pandas
  - Series and Dataframes
  - Common operations
  - How to read documentation

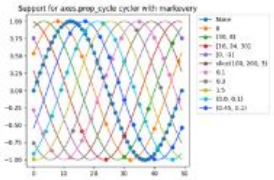
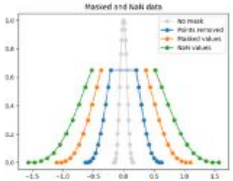
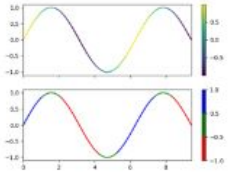
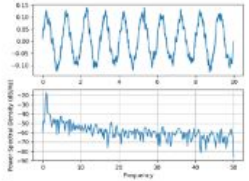
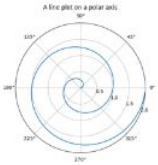
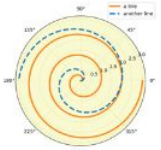
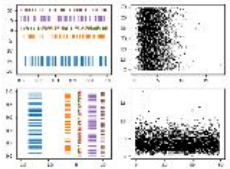
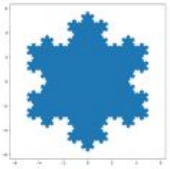
Pandas

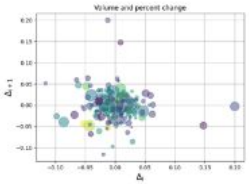
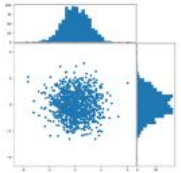
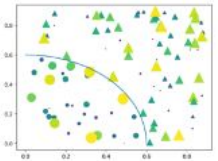
➔ *What is Pandas?*

- Pandas is a “fast, powerful, flexible and easy to use open source data analysis and manipulation tool, built on top of the Python programming language”
- Offers data structures and operations for manipulating numerical tables in form of arrays and matrices, and time series to some extent.
- Pandas *does not* marry entirely the Python philosophy: often requires working with indexes to iterate over data structures and adopting an “old-fashioned” mindset.
- The name is derived from the term "panel data", an econometrics term for data sets that include observations over multiple time periods for the same individuals.

Pandas

➔ *What is Pandas?*

Pandas

➔ *How to install Pandas?*

- Being an extra Python library, it needs to be installed.
- The Python Package Manager can be used for this in nearly all environments:

```
$ pip install pandas
```

- In Repl.it, it is automatically installed, so you don’t have to worry about it.

Pandas

➔ *How to use Pandas?*

- As any other library, Pandas needs to be imported before you can use it
- You import libraries exactly as you import modules:

```
import pandas
```

- You will usually see it imported in a renamed way, for brevity when using it

```
import pandas as pd
```

Pandas

➔ *Other libraries involved*

- Numpy (Numerical Python) is another very common library used together with Pandas:

```
import pandas as pd
import numpy as np
```

- Matplotlib is instead a library for plotting, and in particular the pyplot module is very commonly used:

```
import matplotlib.pyplot as plt
```

Pandas

➔ *The Jupyter Notebooks*

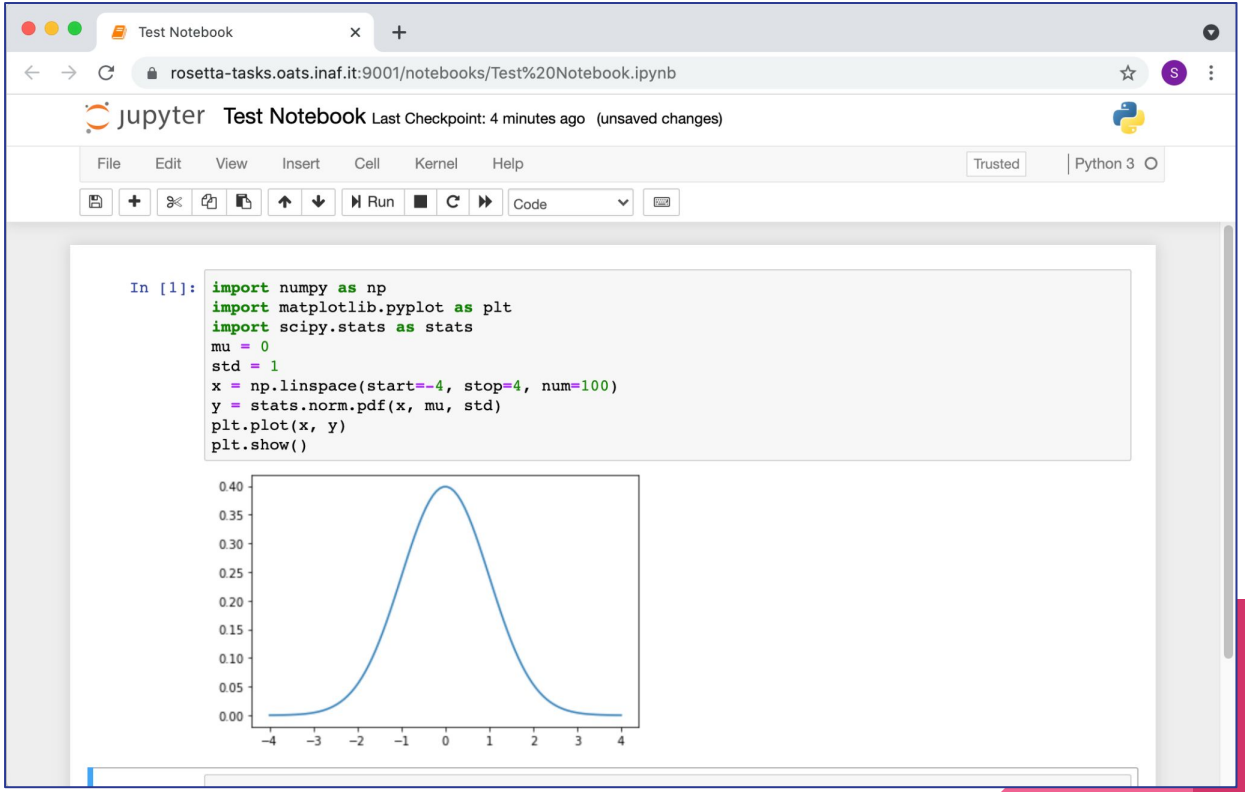
- Pandas has a strong interactive component and for interactive analysis gives it best when used with the Jupyter Notebooks
- These are computational graphical environments which wrap a Python interpreter
- Several services derived from this approach, as Google Colab or Kaggle Notebooks.
- Installing and using the Jupyter engine in your environment it is not covered here, but just for reference:

```
$ pip install notebook
$ jupyter notebook
```

..and then open your browser on localhost:8888

Pandas

➔ *The Jupyter Notebooks*



Pandas

➔ *Series*

- Pandas Series are one of the most basic data types. You can think of them as Python lists, but provide much more features.

```
series = pd.Series([4,5,6])
print(series[0])
```

```
4
```

Pandas

➔ *Series*

- Series have an index to speed up data access. By defaults, it is just composed by the positions of the elements

```
series = pd.Series([4,5,6])
print(series)
```

```
0    4
1    5
2    6
dtype: int64
```

Pandas

➔ *Series*

- Series have an index to speed up data access. By defaults, it is just composed by the positions of the elements

```
series = pd.Series([4,5,6])
print(series)
```

Index

```
0    4
1    5
2    6
dtype: int64
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
```

```
a    4
b    5
c    6
dtype: int64
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
print(series[0])
```

```
4
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
print(series['a'])
```

```
4
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
print(series.iloc[0])
```

```
4
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
print(series.loc['a'])
```

```
4
```

Pandas

➔ *Series*

- However, other types of indexes are possible, for example based on letters, or dates and time. They are more complex to deal with.

```
series = pd.Series([4,5,6])
series.index = ['a','b','c']
print(series.loc['a'])
```

```
4
```

Pandas

➜ *Series*

- Both Series and their indexes supports being iterated on, and allow to be more pythonic in some contexts:

```
series = pd.Series([4,5,6])
for item in series:
    print(item)
```

```
4
5
6
```

Pandas

➜ *Series*

- Both Series and their indexes supports being iterated on, and allow to be more pythonic in some contexts:

```
series = pd.Series([4,5,6])
for index_item in series.index:
    print(index_item)
```

```
0
1
2
```

Pandas

➔ *Series*

- Several functions are ready to be applied to the series, unlike the Python lists. Mean, min, max etc. are just some examples of them.

```
series = pd.Series([4,5,6])
print(series.mean())
```

```
5.0
```

Pandas

➔ *Series*

- Several functions are ready to be applied to the series, unlike the Python lists. Mean, min, max etc. are just some examples of them.

```
series = pd.Series([4,5,6])
print(series.max())
```

```
6.0
```

Pandas

➜ *DataFrames*

- DataFrames are basically matices. They support multiple axes, indexes, and labels for columns.

```
df = pd.DataFrame([[4,40],[5,50],[6,60]])
print(df)
```

```
   0   1
0  4  40
1  5  50
2  6  60
```

Pandas

➜ *DataFrames*

- DataFrames are basically matices. They support multiple axes, indexes, and labels for columns.

```
df = pd.DataFrame([[4,40],[5,50],[6,60]])
print(df)
```

Pandas

➔ *DataFrames*

- If accessing them by “position”, they return a column which is returned as as Series which “inherits” the index

```
df = pd.DataFrame([[4,40],[5,50],[6,60]])
print(df[1])
```

```
0    40
1    50
2    60
Name: 1, dtype: int64
```

Pandas

➔ *DataFrames*

- If accessing them by “position”, they return a column which is returned as as Series which “inherits” the index

```
df = pd.DataFrame([[4,40],[5,50],[6,60]])
type(df[1])
```

```
pandas.core.series.Series
```

Pandas

➜ *DataFrames*

- Data frames supports changing not only the index but also the column labels:

```
df = pd.DataFrame([[4,40],[5,50],[6,60]])
df.index = ['a','b','c']
df.columns = ['Rome', 'Venice']
print(df)
```

```
   Rome  Venice
a     4      40
b     5      50
c     6      60
```

Pandas

➜ *DataFrames*

- DataFrames can also be created directly from Python dictionaries, but remember that you will not have any order guaranteed in the columns!

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df)
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

Pandas

➜ *DataFrames*

- DataFrames can also be created directly from Python dictionaries, but remember that you will not have any order guaranteed in the columns!

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df)
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

Pandas

➜ *DataFrames*

- DataFrames can also be created directly from Python dictionaries, but remember that you will not have any order guaranteed in the columns!

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df)
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

Pandas

➜ *DataFrames*

- At this point you can access the columns using their label in the square brackets notation. Keep in mind that for the Series, this was instead accessing the “rows”.

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df['Venice'])
```

```
0    40
1    50
2    60
Name: Venice, dtype: int64
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

Pandas

➜ *DataFrames*

- This mode still gives you a Series:

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
type(df['Venice'])
```

```
pandas.core.series.Series
```

	Rome	Venice
0	4	40
1	5	50
2	6	60

Pandas

➜ *DataFrames*

- In order to instead get another DataFrame for a specific column (or more), you can use the filter() function, or a bi-dimensional iloc() not covered here.

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df.filter(['Venice']))
```

```
   Rome  Venice
0     4      40
1     5      50
2     6      60
```

```
   Venice
0      40
1      50
2      60
```

Pandas

➜ *DataFrames*

- In order to instead get another DataFrame for a specific column (or more), you can use the filter() function, or a bi-dimensional iloc() not covered here.

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
type(df.filter(['Venice']))
```

```
pandas.core.frame.DataFrame
```

	Rome	Venice
0	4	40
1	5	50
2	6	60

Pandas

➔ *DataFrames*

- To access a row of a DataFrame, you can use the loc and/or iloc functions, which access “by row”, exactly as for the Series… and returns a Series, in “horizontal”.

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
print(df.loc[0])
```

```
Rome       4
Venice    40
Name: 0, dtype: int64
```

	Rome	Venice
0	4	40
1	5	50
2	6	60

Pandas

➜ *DataFrames*

- To access a row of a DataFrame, you can use the loc and/or iloc functions, which access “by row”, exactly as for the Series… and returns a Series, in “horizontal”.

```
df = pd.DataFrame({'Rome': [4,5,6],
                   'Venice':[40,50,60]})
type(df.loc[0])
```

```
pandas.core.series.Series
```

	Rome	Venice
0	4	40
1	5	50
2	6	60

Pandas

➔ *DataFrames*

- You can also “elect” a data frame column as its index:

```
df = pd.DataFrame({'Quarter': ['q1','q2','q3'],
                   'Rome': [4,5,6],
                   'Venice': [40,50,60]})
df.set_index('Quarter', inplace=True)
print(df)
```

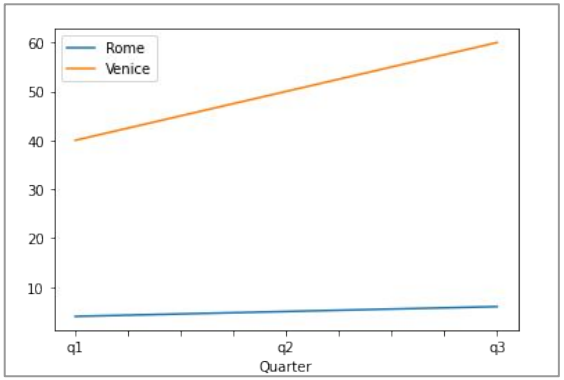
```
         Rome  Venice
Quarter
q1          4      40
q2          5      50
q3          6      60
```

Pandas

➔ *DataFrames*

- ..and you can plot DataFrames, as the Series and other Pandas data structures.

```
df = pd.DataFrame({'Quarter': ['q1','q2','q3'],
                   'Rome': [4,5,6],
                   'Venice': [40,50,60]})
df.set_index('Quarter', inplace=True)
plt.plot(df)
plt.show()
```



Pandas

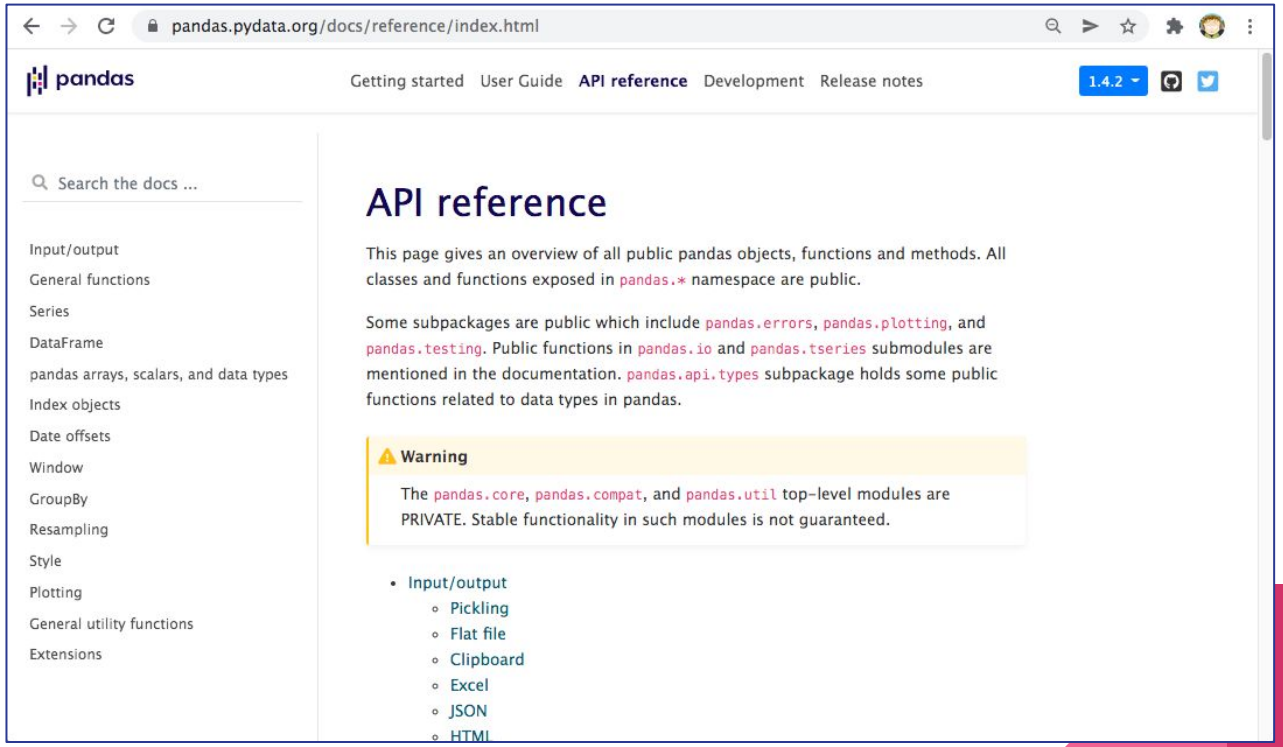
➔ *How to read the documentation*

- There are loads of operations which can be done on pandas objects.
- While classic (textbook-like) documentation is always useful, there is another type of documentation that is good to know how to read:

  → the API reference documentation.
- API stands for the Application Programming Interface.
- When you use Pandas, you use its API!

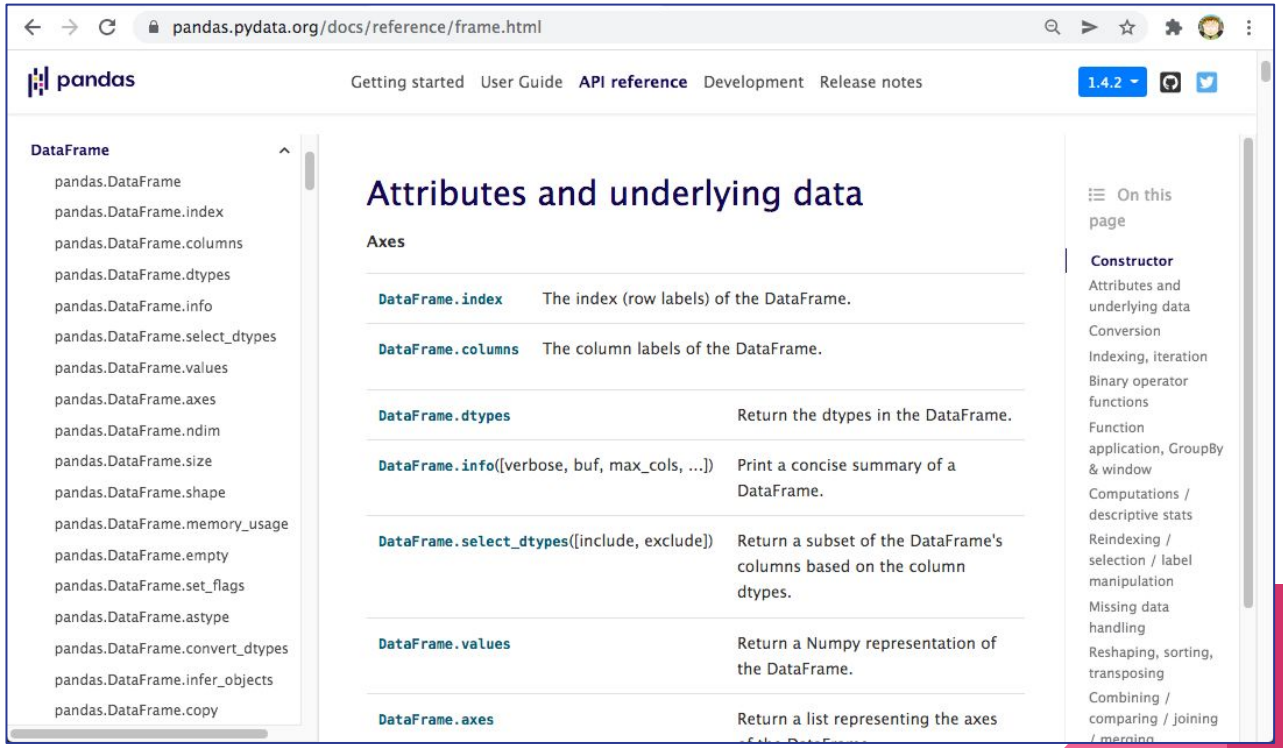
Pandas

➜ *How to read the documentation*



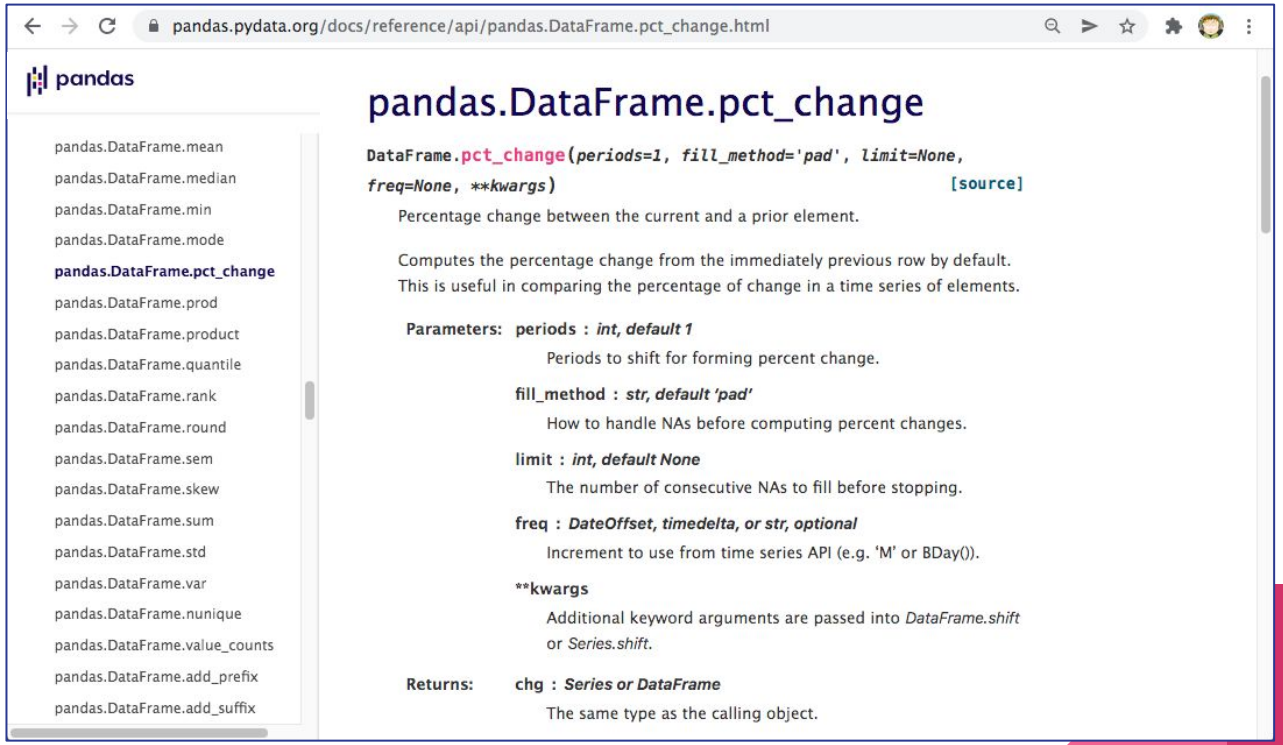
Pandas

➔ *How to read the documentation*



Pandas

➔ *How to read the documentation*



End of part IV

➔ *Questions?*

Next: exercise 4

Exercise 4

Let’s go through an example together

Try to execute the commands we will see by yourself

First, download the file below and upload it to your Repl.it:
https://sarusso.github.io/python_courses/time_series.csv