Introduction to Data Science – Week 11

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COURSE 55793

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Last Week Recap

Classes

List comprehension

Map, Filter and Lambda

This Week

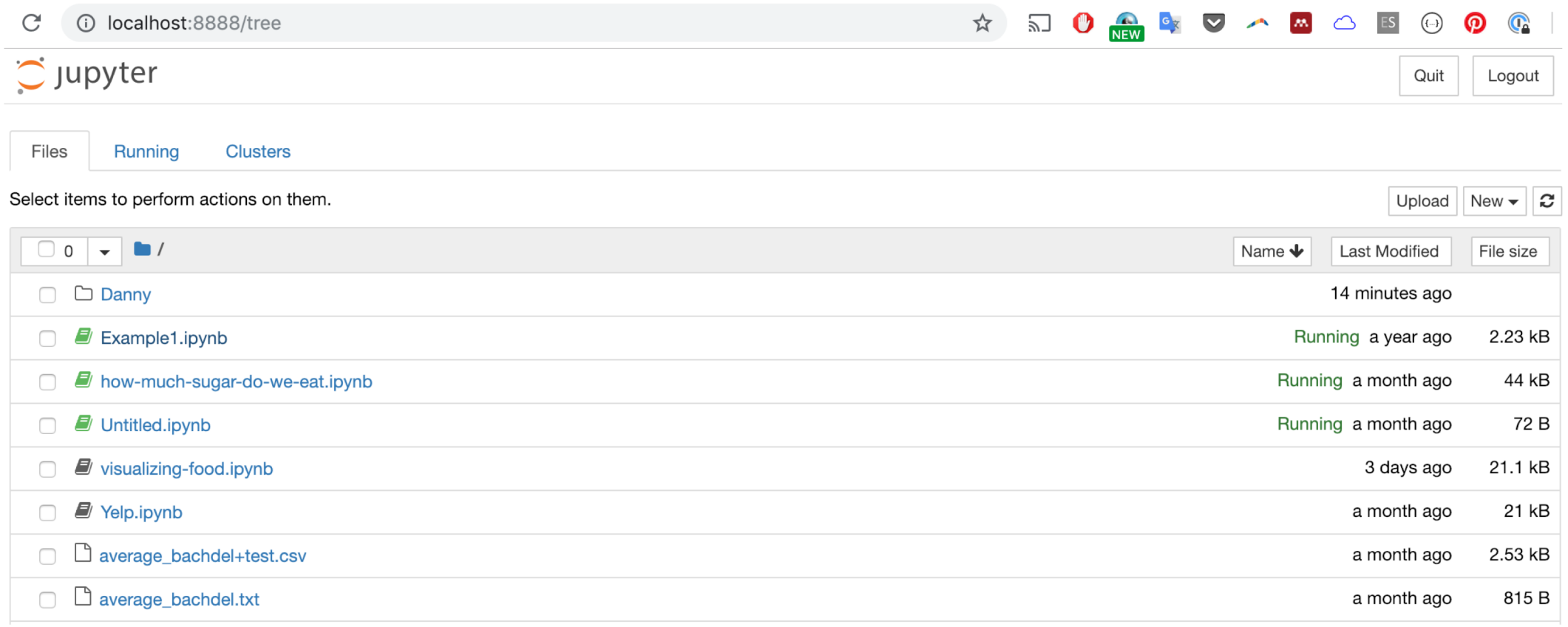
Jupyter notebook

Introduction to Numpy

Introduction to Pandas

(SQL type of thinking)

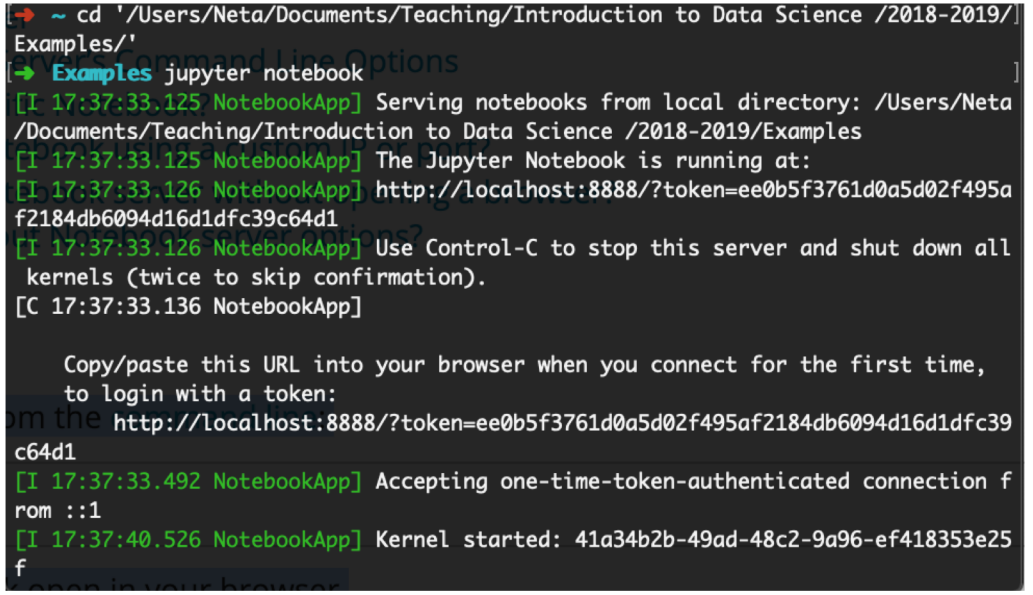
Jupyter Notebook



How to use Jupyter Notebook

To start the notebook server from the command line:

1. Open the command line
2. By using ‘cd’, go to your local directory where your files are (or found in a subdirectory)
3. Enter ‘jupyter notebook’ in the command line
4. You should see the notebook open in your browser



Optionally, you can open Jupyter Notebook from the Anaconda navigator

How to install

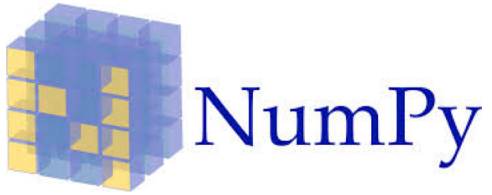
For Anaconda users, pandas is already installed so no need to do anything further.

For Python users (make sure to install all of its dependencies like numpy, scipy and matplotlib)

pip install pandas

pip install jupyter-notebook

Detour: numpy library



Numpy is the core library for scientific computing in Python.

It provides a high-performance multidimensional array object, and tools for working with these arrays.

Compared with lists, working with numpy is more compact, has faster access in reading and writing items, being more convenient and more efficient. However, there are also more constrains.

It also comes with many functions that manipulate arrays (and matrixes), and make mathematical calculations on arrays.

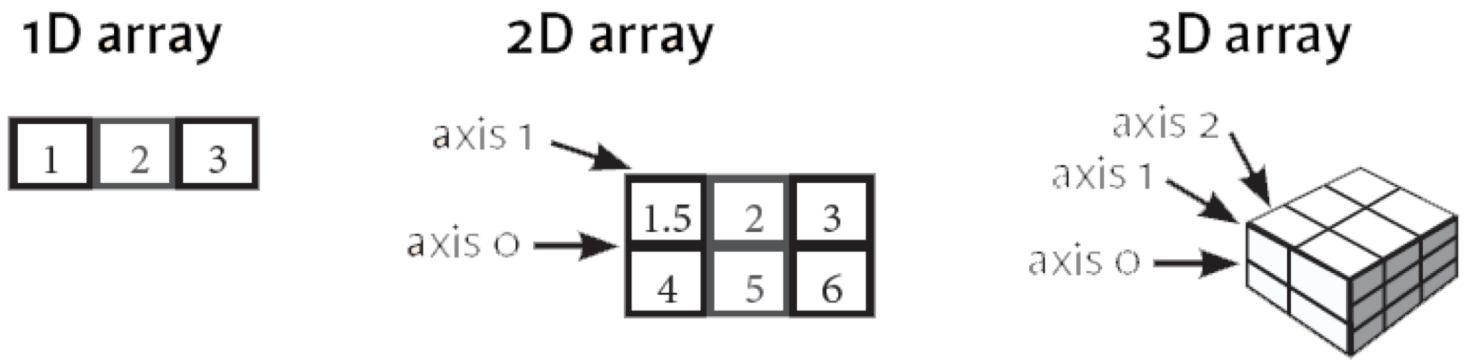
Numpy array

The basic object that we would work with is an array.

NumPy's array class is called ndarray. It is also known by the alias array.

A numpy array is a grid of values, all of the same type (dtype), and is indexed by a tuple of nonnegative integers.

The number of dimensions is the *rank* of the array; the *shape* of an array is a tuple of integers giving the size of the array along each dimension

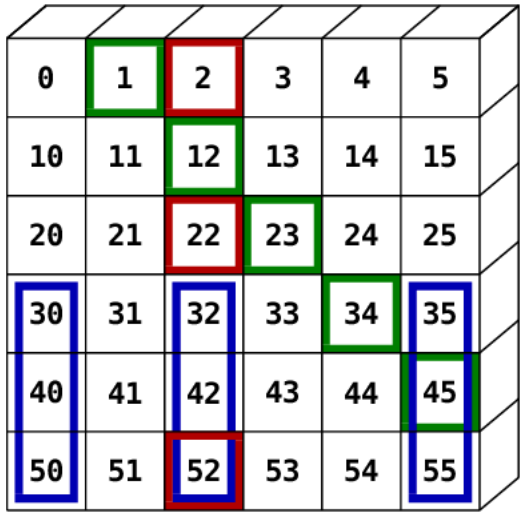


Slicing and indexing an array

```
>>> a[(0,1,2,3,4), (1,2,3,4,5)]
array([1, 12, 23, 34, 45])

>>> a[3:, [0,2,5]]
array([[30, 32, 35],
       [40, 42, 45],
       [50, 52, 55]])

>>> mask = np.array([1,0,1,0,0,1], dtype=bool)
>>> a[mask, 2]
array([2, 22, 52])
```



Operations on arrays (to name a few)

Sum()

Count()

Mean()

Std()

Floor()

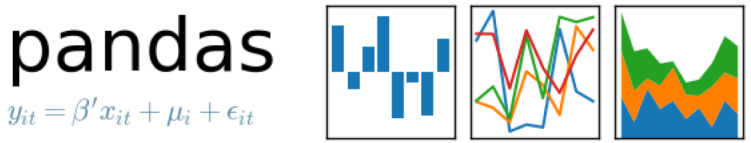
Random()

Max()

Min()

Cumsum()

Pandas library



Pandas (derived from the word Panel Data) is probably the most popular library for data manipulation and analysis in Python.

Key Features:

- Fast and efficient DataFrame object with default and customized indexing, and label
- Label-based slicing, indexing, subsetting, and filtering
- Tools for loading data from different file formats like txt, csv, excel
- Integrated handling of missing data
- Integrated data manipulation like reshape and pivot, merging and joining
- Group by data for aggregation and transformations
- Time Series functionality
- Built-in plotting with matplotlib
- Based on Numpy

Pandas Series object

Series is an object which is similar to list. Unlike list, it has associated index with each element (values).

To access the index, use my_series.index

To access the values, use my_series.values

You can define a new series by using dictionary (where key is the index name and value is value)

```
>>> import pandas as pd
>>> my_series = pd.Series([5, 6, 7, 8, 9, 10])
>>> my_series
0     5
1     6
2     7
3     8
4     9
5    10
dtype: int64
```

```
>>> my_series2 = pd.Series(range(5, 11),
... index=['a', 'b', 'c', 'd', 'e', 'f'])
>>> my_series2
a     5
b     6
c     7
d     8
e     9
f    10
dtype: int64
```


Manipulating Series object

Can retrieve elements by their index

Make group assignment

Can filter and do math operations

```
>>> my_series2[0]
5
>>> my_series2[2:5]
c    7
d    8
e    9
dtype: int64
>>> my_series2[['a', 'f', 'c']]
a     5
f    10
c     7
dtype: int64
```

```
>>> my_series2 > 7
a    False
b    False
c    False
d     True
e     True
f     True
dtype: bool
>>> my_series2[my_series2 > 7] * 2
d    16
e    18
f    20
dtype: int64
```


Pandas DataFrame

Simply said, DataFrame is a table. It has rows and columns. Each column in a DataFrame is a Series object, rows consist of elements inside Series.

columns

Index column

rows

	Name	Team	Number	Position	Age	Height	Weight	College	Salary
0	Avery Bradley	Boston Celtics	0.0	PG	25.0	6-2	180.0	Texas	7730337.0
1	Jae Crowder	Boston Celtics	99.0	SF	25.0	6-6	235.0	Marquette	6796117.0
2	John Holland	Boston Celtics	30.0	SG	27.0	6-5	205.0	Boston University	NaN
3	R.J. Hunter	Boston Celtics	28.0	SG	22.0	6-5	185.0	Georgia State	1148640.0
4	Jonas Jerebko	Boston Celtics	8.0	PF	29.0	6-10	231.0	NaN	5000000.0

Creating a DataFrame object

From scratch:

- from Lists
- from dict of Lists
- from list of dicts
- from dict of series
- etc.

```
>>> data = {'Name':['Tom', 'Jack', 'Steve', 'Ricky'],'Age':[28,34,29,42]}
>>> df = pd.DataFrame(data, index=['rank1','rank2','rank3','rank4'])
>>> df
        Name  Age
rank1    Tom   28
rank2   Jack   34
rank3  Steve   29
rank4  Ricky   42
```


Reading and writing files

Reading from file:

pd.read_table('some_text_file.txt')

pd.read_csv('some_csv_file.csv')

Writing to file:

df.to_csv('sove_csv_file.csv')

Exploring a DataFrame

This is a small sample of things you can do

module/attribute	explanation
df.head()	Returns the 5 first rows of df
df.tail()	Returns the 5 last rows of df
df.shape	Returns a tuple representing the dimensionality of df (row, column)
df.columns	Names of columns
df.index	Df.Index values
df.info()	Returns the data type and number of entries (non-null) for each column in df
df.describe()	Returns a df that calculates count, mean, std, etc. for every number column
df.sum(axis=0)	Sums the values of a row (if axis=0) or columns (axis=1)
df.mean(axis=0)	Return the mean of the values for the requested axis
df.max(axis=0)	Return the maximum value for the requested axis

Selecting from a Dataframe

- Select a column by using a dot notation or the column label in bracket
- To select multiple columns insert a list column labels
- Use df.loc[rows filter, column labels]
- To select by index use df.iloc[]

```
>>> df.loc[df['Age'] > 30, ['Name', 'Age']]
        Name  Age
rank2   Jack   34
rank4  Ricky   42
```

```
>>> df.Name
rank1      Tom
rank2     Jack
rank3    Steve
rank4    Ricky
Name: Name, dtype: object
>>> df['Age']
rank1    28
rank2    34
rank3    29
rank4    42
Name: Age, dtype: int64
```


Rules for specifying multiple filter criteria in Pandas

use **&** instead of **and**

use **|** instead of **or**

add **parentheses** around each condition to specify evaluation order