Data Science

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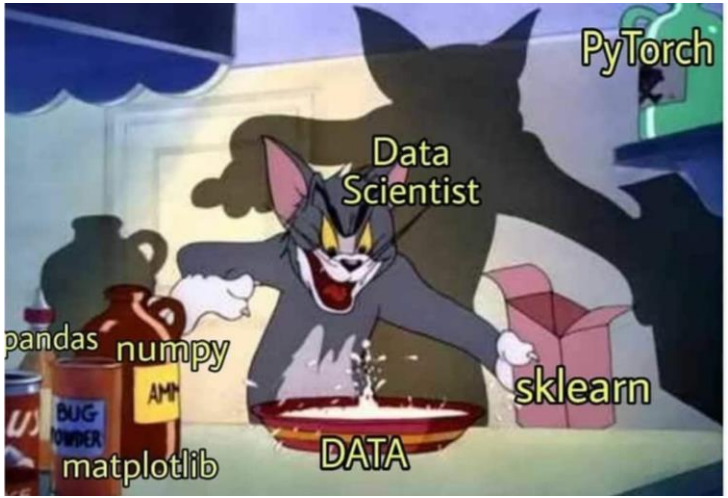
Introduction

Data Science

A Data Scientist helps companies with data-driven decisions, to make their business better.

Data Science is a combination of multiple disciplines that uses statistics, data analysis, and machine learning to analyze data and to extract knowledge and insights from it.

Data Science is about data gathering, finding patterns in data, data analysis, make future predictions and decision-making.



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Numpy

Introduction

NumPy stands for Numerical Python.

NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices.

NumPy aims to provide an array object that is up to 50x faster than lists. Arrays are very frequently used in data science. The array object in NumPy is called ndarray.

Numpy documentation: https://numpy.org/doc/

Import

```
import numpy as np
```

Arrays

Create

```
arr0 = np.array(1)
arr1 = np.array([1, 2, 3])
arr2 = np.array([[1, 2, 3], [2, 3, 4]])
arr3 = np.array([[[1, 2, 3], [2, 3, 4]], [[3, 4, 5], [4, 5, 6]]])
print(arr2.ndim)
```

Slice

```
arr = np.array([[1, 2, 3, 4, 5], [6, 7, 8, 9, 10]])
print(arr[1, 5], arr[1, 1:4], arr[0:2, 1:4])
```

Data Types

Check

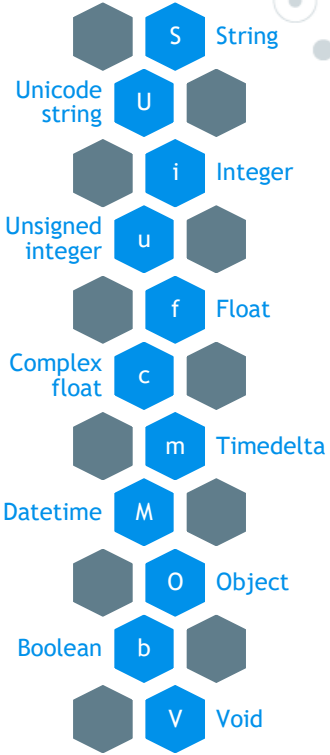
```
arr = np.array([1, 2, 3, 4])
print(arr.dtype)
```

Define

```
arr = np.array([1, 2, 3, 4], dtype = 'S')
print(arr.dtype)
```

Convert

```
arr = np.array([1, 2, 3, 4])
newArr = arr.astype('S')
print(arr.dtype, newArr.dtype)
```



Copy and View

Copy is a new array, and view is just a view of the original array.

```
arr = np.array([1, 2, 3, 4, 5])
viewArr = arr.view()
copyArr = arr.copy()
arr[0] = 10
print(viewArr, copyArr)
print(viewArr.base, copyArr.base)
```

Shape

Shape

```
arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8]])
print(arr.shape)
```

Reshape

```
arr = np.array([1, 2, 3, 4, 5, 6, 7, 8])
print(arr.reshape(2, 4))
print(arr.reshape(2, 2, -1))
```

Flatten

```
arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8]])
print(arr.reshape(-1))
```

Loops

Iterating arrays

```
arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8]])
for x in arr:
    print(x)
for x in np.nditer(arr):
    print(x)
for x in np.nditer(arr[:, ::2]):
    print(x)
for x in np.ndenumerate(arr):
    print(x)
```

Joins and Splits

Joining arrays

```
arr1, arr2 = np.array([[1, 2], [3, 4]]), np.array([[5, 6], [7, 8]])
print(np.concatenate((arr1, arr2)))
print(np.concatenate((arr1, arr2), axis = 1))
print(np.stack((arr1, arr2), axis = 1))
```

Splitting arrays

```
arr = np.array([[1, 2, 3, 4], [5, 6, 7, 8], [9, 10, 11, 12], [13, 14, 15, 16]])
print(np.array_split(arr, 2))
print(np.array_split(arr, 3))
print(np.array_split(arr, 6))
print(np.array_split(arr, 2, axis = 1))
```

Sort

Sorting arrays

```
arr = np.array([[1, 3], [2, 4], [6, 4], [4, 0]])
print(np.sort(arr))
```

Search Sorted

```
arr = np.array([1, 3, 2, 4, 6, 4, 4, 0])
print(np.searchsorted(arr, 3))
print(np.searchsorted(arr, 5))
```

Search and Filter

Searching arrays

```
arr = np.array([[1, 3], [2, 4], [6, 4], [4, 0]])
print(np.where(arr == 4))
print(np.where(arr % 2 == 0))
```

Filtering arrays

```
arr = np.array([1, 3, 2, 4, 6, 4, 4, 0])
print(arr[arr % 2 == 0])
```

Random Numbers

Generate Random Number

```
print(np.random.rand())
print(np.random.rand(2, 3))
print(np.random.randint(50, 100))
print(np.random.randint(50, 100, size = (2, 3)))
```

Generate Random Number From Array

```
print(np.random.choice([3, 5, 7, 9]))
print(np.random.choice([3, 5, 7, 9], size = (2, 3)))
print(np.random.choice([3, 5, 7, 9], p = [0.1, 0.3, 0.6, 0.0]))
```

Universal Functions

Converting iterative statements into a vector based operation is called vectorization.

It is faster as modern CPUs are optimized for such operations.

ufuncs are used to implement vectorization in NumPy.

```
x, y = [1, 2, 3, 4], [5, 6, 7, 8]
print(np.add(x, y))
```

Some useful ufuncs

```
add()  subtract()  multiply()  divide()  power()  mod()  abs()
sum()  cumsum()  prod()  cumprod()  diff()
```

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Pandas

Introduction

Pandas is a Python library used for working with data sets.

It has functions for analyzing, cleaning, exploring, and manipulating data.

It allows us to analyze big data and make conclusions based on statistical theories.

It can clean messy data sets, and make them readable and relevant.

Pandas documentation: http://pandas.pydata.org/pandas-docs/stable/

Import

```
import pandas as pd
```

Series

A column in a table

```
calories = [420, 380, 390]
s = pd.Series(calories)
print(s)
print(s[0])
calories = {'day1': 420, 'day2': 380, 'day3': 390}
s = pd.Series(calories)
print(s['day2'])
print(s.loc['day2'])
```

DataFrames

A table with rows and columns

```
data = {'calories': [420, 380, 390], 'duration': [50, 40, 45]}
df = pd.DataFrame(data)
print(df['calories'])
print(df[['calories']])
print(df.loc[0])
print(df.loc[[0, 2]])
df = pd.DataFrame(data, index = ['day1', 'day2', 'day3'])
print(df.loc['day2'])
print(df.iloc[1])
```

Read and Write

Read files

```
df = pd.read_csv('data.csv')
df = pd.read_excel('data.xlsx')
df = pd.read_json('data.json')
```

Write files

```
df.to_csv('data.csv')
df.to_excel('data.xlsx')
df.to_json('data.json')
```

Analyze

```
df = pd.DataFrame({'calories': [420, 380, 390], 'duration': [50, 50, 45]})
```

View

```
print(df.head())
print(df.tail())
print(df.index)
print(df.columns)
print(df['duration'].value_counts())
```

Information

```
print(df.info())
print(df.describe())
```

Sort and Filter

```
data = {'calories': [420, 380, 390], 'duration': [50, 40, -45]}
df = pd.DataFrame(data, index = ['day2', 'day3', 'day1'])
```

Sort

```
print(df.sort_index())
print(df.sort_values(by = 'calories'))
```

Filter

```
df[df['duration'] > 0]
df[df < 0] = -df
```

Operations

```
df = pd.DataFrame({'calories': [420, 380, 390], 'duration': [50, 40, 45]})
```

Stats

```
print(df.sum())
print(df.sum(axis = 1))
print(df.mean())
print(df.max())
print(df.min())
```

Apply

```
print(df.apply(np.cumsum))
print(df.apply(lambda x: x.max() - x.min(), axis = 1))
print(df['calories'].apply(lambda x: x * 2))
```

Data Cleaning

The data set contains some empty cells: row 18, 22, and 28.

`isna()` `dropna()` `fillna()`

The data set contains wrong format: row 26.

`dtype` `astype()` `to_numeric()` `to_datetime()`

The data set contains wrong data: row 7.

`loc[]` `iloc[]`

The data set contains duplicates: row 11 and 12.

`duplicated()` `drop_duplicates()`

	Duration	Date	Pulse	Maxpulse	Calories
0	60	'2020/12/01'	110	130	409.1
1	60	'2020/12/02'	117	145	479.0
2	60	'2020/12/03'	103	135	340.0
3	45	'2020/12/04'	109	175	282.4
4	45	'2020/12/05'	117	148	406.0
5	60	'2020/12/06'	102	127	300.0
6	60	'2020/12/07'	110	136	374.0
7	450	'2020/12/08'	104	134	253.3
8	30	'2020/12/09'	109	133	195.1
9	60	'2020/12/10'	98	124	269.0
10	60	'2020/12/11'	103	147	329.3
11	60	'2020/12/12'	100	120	250.7
12	60	'2020/12/12'	100	120	250.7
13	60	'2020/12/13'	106	128	345.3
14	60	'2020/12/14'	104	132	379.3
15	60	'2020/12/15'	98	123	275.0
16	60	'2020/12/16'	98	120	215.2
17	60	'2020/12/17'	100	120	300.0
18	45	'2020/12/18'	90	112	NaN
19	60	'2020/12/19'	103	123	323.0
20	45	'2020/12/20'	97	125	243.0
21	60	'2020/12/21'	108	131	364.2
22	45	NaN	100	119	282.0
23	60	'2020/12/23'	130	101	300.0
24	45	'2020/12/24'	105	132	246.0
25	60	'2020/12/25'	102	126	334.5
26	60	2020/12/26	100	120	250.0
27	60	'2020/12/27'	92	118	241.0

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Matplotlib

Introduction

Matplotlib is a graph plotting library in python that serves as a visualization utility.

Matplotlib is mostly written in python, a few segments are written in C, Objective-C and Javascript for Platform compatibility.

Most of the Matplotlib utilities lies under the pyplot submodule, and are usually imported under the plt alias.

Matplotlib documentation: https://matplotlib.org/stable/

Import

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

Plotting

```
xpoints = np.array([0, 10, 8])
ypoints = np.array([0, 15, 4])
```

Plotting x and y points

```
plt.plot(xpoints, ypoints)
plt.show()
```

Plotting without line

```
plt.plot(xpoints, ypoints, 'o')
plt.show()
```

Markers and Line

fmt parameter

```
xpoints = np.array([0, 10, 8])
ypoints = np.array([0, 15, 4])
marker, line, color = '*', '--', 'g'
plt.plot(xpoints, ypoints, f'{marker}{line}{color}')
plt.show
```

fmt reference

Marker: o * . , x X + P s D d p h H v ^ < > 1 2 3 4 | _

Line: - : -- -.

Color: r g b c m y k w

Markers and Line

Multiple Lines

```
y1 = np.array([3, 8, 1, 10])
y2 = np.array([6, 2, 7, 11])
plt.plot(y1, marker = '', linestyle = ':', color = '#4CAF50')
plt.plot(y2, 'o-.r', markersize = 9, linewidth = 3)
plt.show()
```

Text

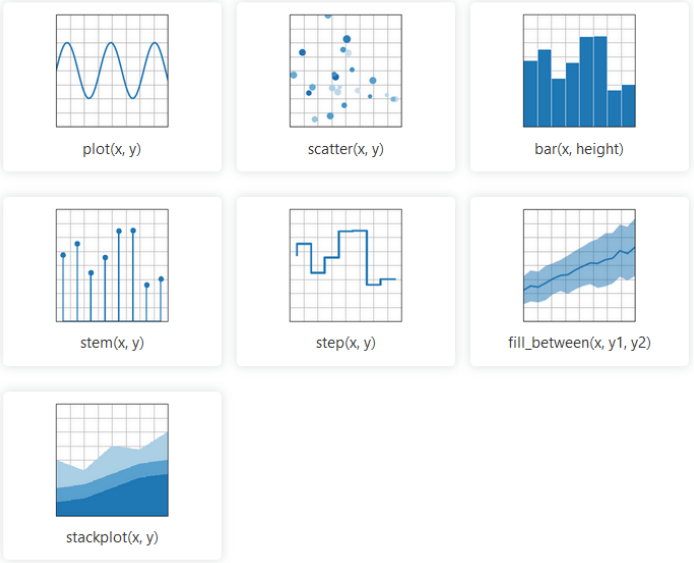
Title and labels

```
x = np.array([80, 85, 90, 95, 100, 105, 110, 115, 120, 125])
y = np.array([240, 255, 259, 265, 270, 290, 305, 306, 325, 330])
titleFont = {'family': 'Trebuchet MS', 'color': '#0091EA', 'size': 14}
labelFont = {'family': 'Consolas', 'color': 'black', 'size': 11}
plt.plot(x, y)
plt.title('Sports Watch Data', titleFont)
plt.xlabel('Average Pulse', labelFont)
plt.ylabel('Calorie Burnage', labelFont)
plt.show()
```

Plot Types

Documentation

https://matplotlib.org/stable/plot_types/index.html



Thanks!

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