

# Python Cheatsheed

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# Fundamentals

## Data types

Name	Data type	Description
string	'str'	sequence of characters
integer	1	integers numbers
float	0.1	decimals numbers
complex	1j	imaginary numbers
boolean	True/False	logical values
list	[a, b, ...]	mutable ordered sequence
tuple	(a, b, ...)	immutable ordered sequence
range	range(init, fin, step)	immutable ordered sequence
dictionary	{key=value, ...}	mutable unordered mapping
set	{x, ...}	mutable unordered set
frozenset	frozenset({x, ...})	immutable unordered set
byte		
bytearray		
memoryview		

## Data conversion

	convert in string data type
int()	convert in integer data type
float()	convert in float data type
bool()	convert in bool data type
list()	convert in list data type
dict()	convert in dict data type
set()	convert in set data type

## Generic operations

len(x)	variable length
min(x), max(x)	min/max value
sorted(x)	sort a list
enumerate(x, ...)	iterator
zip(x)	iterator on tuple
all(x)	true if all are true
any(x)	true if at least one is true

## Sting operations

s1 + s2	concatenation
s * int	multiplication
s[i]	indexing
s.index()	??
s.find()	??
s.strip()	remove white spaces
s.lower()	lowercase
s.upper()	uppercase
s.split([sep])	creates string array of words
s.join(seq)	creates string array of words
s.find('string')	match string in string
s.replace('old', 'new')	replace string

## List operations

l.append(x)	append a element
l.extend(x)	append as sequence of elements
l.insert(i,x)	insert variable at i position
l.remove(x)	remove value x
l.pop([i])	remove and return item at index i
l.sort()	sort
l.revert()	reverse sort

## Dictionaries operations

d[key] = value	assign value to a key
d.clear()	clear dictionary
d.update(d2)	??
d.key()	??
d.values()	??
d.items()	??
d.pop(key[default])	??
d.popitem()	??
d.get(key[default])	??
d.setdefault(key[default])	??

## Sets operations

s.update(s2)	??
s.copy()	??
s.add(key)	??
s.remove(key)	??
s.discard(key)	??
s.clear()	??
s.pop()	??

# Operators

## Arithmetic operators

+, -, *, /	basic operations
%	module
**	exponential
//	floor

## Logic operators

==	equal
!=	not equal
<, >	strict inequality
<=, >=	inequality

## Boolean operators

x and y	and operator
x or y	or operator
not x	not operator

## Assignment operators

=	value assignment
+=, -=, *=, /=, **=, //=	arithmetic assignment

## Other operators

x is y	true if x is y
x is not y	true if x is not y
x in y	true x is in y sequence
x not in y	true x is not in y sequence

## Indexing

x[i]	list i-th element
x[init_val:fin_val]	list slicing

## Loops/Conditions

### if/elif/else

```

if condition:
    ...
elif condition:
    ...
else:
    default

```

### while

```

while condition:
    ...

```

### for

```

\for condition:
    ...

```

break	end the loop
Keywords: continue	continue the loop
\t	tab

## Functions

```

# function definition
def fun_name(param, *args, param=default, **kwargs):
    # function body
    ...
    return x      # value to return

```

```

# function call
a = fun_name(arg_1, ..., arg_n))

```

## Input/Output

```
print(x)          print function
x = input("string: ")  input function
```

```
Keywords: \n  newline
          \s  space
          \t  tab
```

## Filesystem

```
f = open("file", "mode", encoding="enc")
f.write(text)
f.writelines(list of lines)
f.read()
f.readlines()
f.readline()
f.close()
mode:
- r: read
- a: append
- w: write
- x: create
enc:
- utf8
```

open file  
writing  
writing  
reading chars  
reading lines  
next line  
close file

- ascii  
- latin1

```
# open file
with open("file", "mode") as f:
    for line in f:
        ...
```

## Error Handling

```
raise ExcClass()
try:
    <code>
except Exception as exc:
    <error>
```

# Common Modules

## Math

```
import math

# absolute value
abs()

# round value
round()

# sine
sin()

# cosine
cos()

# tangent
tan()

# square root
sqrt()

# logarithm
log()

# ceil
ceil()

# floor
floor()
```

## Argumens Parser

```
import argparse

# create object
arg = argparse.ArgumentParser()

# add argument
arg.add_argument('-strink_arg_name', 'full_arg_name',
    ↳ required=True, help='description')

args = vars(arg.parse_args())
```

## Filesystem

```
from pathlib import Path

# creating path
address = Path('home', '...', 'file')
actual_path = Path.cwd()
home_path = Path.home()

# absolute path
address.is_absolute()

# get path parts
address.parent      # previous folder
address.name        # final position
address.stem        # home
address.drive
```

## File Management

### csv

```
import csv

# write
f = open('file.csv', 'w', newline = '')
f_csv = csv.writer(f, delimiter='\\t',
    ↳ lineterminator='\\n\\n')
f_csv.writerow(['elem_0', ..., 'elem_n'])
```

```
# write as dictionary
f = open('file.csv', 'w', newline = '')
f_csv = csv.DictWriter(f, ['key_0', ..., 'key_n'])
f_csv.writeheader()
f_csv.writerow({'key_0': value_0, ..., 'key_n':
    ↳ value_n})

# read
f = open('file.csv', 'r')
f_csv = csv.reader(f)
for row in f_csv:
    print('Row #' + str(f_csv.line_num) + ' ' +
        ↳ str(row))

# read dictionary
f = open('file.csv')

f_csv = csv.DictReader(f, ['key_0', ..., 'key_n'])
for row in f_csv:
    print(row['key_0'], ..., row['key_n'])

# close
f.close()
```

### json

```
import json

# write
json_write = {'key_0': value_0, ..., 'key_n':
    ↳ value_n}
stringOfJsonData = json.dumps(json_write)

# read
json_read = '{'key_0': value_0, ..., 'key_n':
    ↳ value_n}'
jsonDataAsPythonValue = json.loads(json_read)
print(jsonDataAsPythonValue)
```

## Regular Expression

```
# object
regex_obj = re.compile(r'string_to_match')

# find the first result
match = regex_obj.search(Text)
regex_obj.search.group()
regex_obj.search.groups()

# find all results and replace
match = regex_obj.findall(Text)

# censoring data
Censored_Text = regex_obj.sub(r'CENSORED', Text)
```

```
string_to_match:
string          specific string
(\\d\\D{1}) (\\w{2}\\W)
(...)          grouping
[]            create a character class
+            match one or more characters
*            match zero or more characters
?            match zero or one character
.            match any character except for newline
^string       start with
string&       end with
```

## Green thread process

Multi-threading (aka "Green thread process") is used in IO applications.

```
import threading

def fun_name(...):
    ...

# thread 1
t1 = threading.Thread(target=fun_name)
t1.daemon = True
t1.start()

# thread 2
t2 = threading.Thread(target=fun_name)
t2.daemon = True
t2.start()
```

## Multiprocessing

This method is the proper multi-threading.

```
import numpy as np
from numba import njit
from concurrent.futures import ThreadPoolExecutor

# function definition
def fun_name(...):
    ...

# multi-process function
multi_fun = njit(fun_name, nogil=True)

# process 1
with ThreadPoolExecutor(8) as ex:
    ex.map(multi_fun, range(100))

# process 2
with ThreadPoolExecutor(8) as ex:
    ex.map(multi_fun, range(10))
```

# Modules Management

## Virtual Environment

<code>python3 -m venv ws_name</code>	create virtual environment
<code>source ws_name/bin/activate</code>	activate virtual environment
<code>deactivate</code>	deactivate virtual environment

## Package Installer

### Basic commands

<code>pip3 list</code>	list of installed packages
<code>pip3 install</code>	install packages
<code>pip3 uninstall</code>	uninstall packages
<code>pip3 show</code>	info about package
<code>pip3 check</code>	verify dependencies
<code>pip3 search</code>	search PyPI for packages

## Python dependancies

<code>pip3 freeze &gt; deps.txt</code>	create list of dependencies
<code>pip3 install -r deps.txt</code>	install dependencies from list
<code>pip3 uninstall -r deps.txt</code>	uninstall dependencies from list

# Object Oriented Programming

## Introduction

### Principles

- Abstraction
- Encapsulation
- Inheritance
- Polimorphism

### Rules

- S
- O
- L
- I
- D

## Class

```
class ClassName:

    # Constructor
    def __init__(self, args):
        self.field = value

    # Method definition
    def method(self, args):
        ...

# Child class (Inheritance)
class ChildClassName(ClassName):

    # Static attribute (class attributes definition)
```

```
class_attribute = value

def __init__(self, args):
    super().__init__(self, args)
    self.field = value

    # modify class attribute
    ClassName.class_attribute = value

    # call class method
    ClassName.classmethod()

# Static method (class method definition)
@classmethod
def class_method(cls):
    cls.class_attribute = value
```

# Data Plotting

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

## Plot

```
fig, axes = plt.subplots(figsize=(12,6))
```

```
axes.plot(  
    x, y,  
    color='value',  
    linewidth=value,  
    marker='value',  
    markersize=value,  
    label='string'  
)
```

```
plt.show()
```

## Subplot

```
plot_obj = plt.subplots(nrows=nx, ncols=ny, figsize=(12,6))  
fig, (axes_0, ..., axes_n) = plot_obj
```

```
# subplot 0  
axes_0.plot(  
    x0, y0, ...  
)
```

```
...
```

```
# subplot n  
axes_n.plot(  
    xn, yn, ...  
)
```

```
plt.show()
```

## Scatter

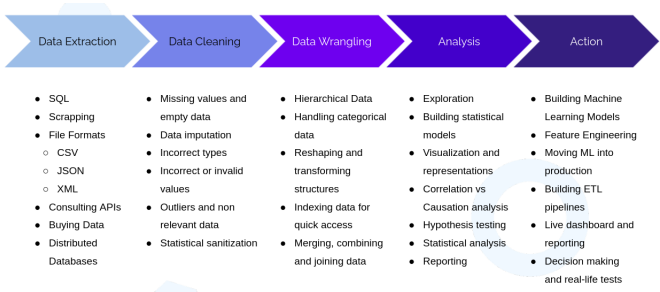
## Bar

## Histogram

## Kernel density estimator

# Data Analysis

## Introduction



Useful libraries:

- pandas

- numpy
- matplotlib
- scipy

## Read/Write files

```
df = pd.read_csv(csv_file_name)
df.to_csv('file_name.csv')
```

## DataFrame

```
# Create dataframe
df = pd.DataFrame({
```

```
    'col_1': value.index,
    'col_2': value,
    ...
})
```

```
# Analysis
df.info()           # info about dataset
df.description()    # statistical info about dataset
df.columns()        # dataframe columns
```

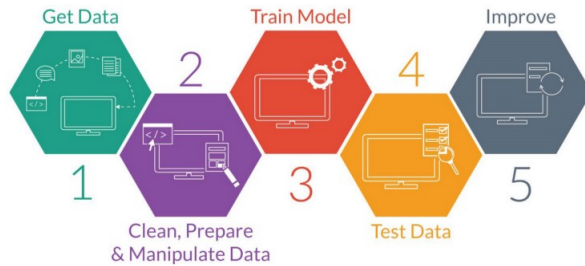
```
# Indexing
x = df.column_title # single column target
x = df[['column_title_1'], ...] # multiple columns target
```



# Machine Learning

## Introduction

Machine Learning (ML) is the set of practices that allow to obtain a prediction model from a set of input/output (dataset), in a process called training. Dataset is a collection of entries with a number of fields (features) that describe the data. The dataset is often divided in two pieces: training dataset and validation dataset.



## Steps

1. Formulating the problem
2. Framing the problem: identify which type of ML approaches (one or more) fits best the problem
3. Design the dataset

4. Training
5. Validating the model

## Problem Framing

- Supervised Learning: if data are labeled, so the output is a feature of the dataset; the goal is finding the relation between the features and the labels.
  - Classification: pick one of the N labels (binary, multi-class)
    - \* Logistic Regression
    - \* SVM (Support Vector Machine)
    - \* ANN
    - \* Decision Trees
    - \* Random Forest
  - Regression: predict numerical values
    - \* Linear Regression
    - \* Polynomial Regression
  - Deep Learning:
    - \* CNN
    - \* RNN

- Unsupervised Learning: if data are not labeled, so the output is not in the dataset; the goal is to identify meaningful patterns in the data and build its own labels (clusters).
  - Clustering: group similar data (K-Means, SVD, PCA)
  - Association: infer likely association patterns in data
  - Dimensionality Reduction
  - Anomaly Detection
- Reinforcement Learning: the model (agent) is set up and receives reward (reward function) when it performs the specified task.
  - Dynamic Programming
  - Monte Carlo methods

## Overfitting/Underfitting

Overfitting occurs when features are too much and the model obtained track very well the training data, which can be affected by noise, but does not pass validation. Underfitting occurs when features are not enough to fit a proper model, then is poor both in training and in validation.

## Validation

# Computer Vision

## OpenCV

### Input/Output

```
import cv2

# Read
image_obj = cv2.imread(image_file.format, options)
'''
options:
- cv2.IMREAD_COLOR: read colors
- cv2.IMREAD_GRAYSCALE: read gray-scale
'''

h, w = image.shape[:2]    # image height and width

# Show
cv2.imshow('image_out_name', image_obj)
cv2.waitKey(option)
'''
options: if empty it close at key pressing, if not
↳ indicate the value in ms after which the picture
↳ is closed
'''

# Write
cv2.imwrite('image_file.format', image_obj)
```

### Manipulation

```
# Set colors
    # set color
    imag_obj[i, j] = color

    # read color
    (b, g, r) = image_obj[i, j]

# Cut
cut_image = image_obj[i, j]

# Resize
    # resize by width
    new_w = 300
    resize_ratio = new_w/w
```

```
dim = (new_w, int(h*resize_ratio))
resized_image = cv2.resize(image_obj,
    ↳ dim, interpolation=cv2.INTER_AREA)

# resize by percentage
resized_image = cv2.resize(image, (0, 0),
    ↳ fx=perc_x, fy=perc_y,
    ↳ interpolation=cv2.INTER_AREA)

# Reflection
flipped_x = cv2.flip(image_obj)
'''
option:
- 0: reflect around vertical axis
- 1: reflect around horizontal axis
'''

# Padding
pud_image = cv2.copyMakeBorder(image_obj, top_aug,
    ↳ bottom_aug, sx_aug, dx_aug, option)
'''
- cv2.BORDER_REPLICATE: the pixel at borders are
    ↳ replicated
- cv2.BORDER_REFLECT: the image is reflected at
    ↳ borders
- cv2.REFLECT_101: the image is reflected at borders
    ↳ without borders
- cv2.BORDER_WRAP: replicate image at borders
- cv2.BORDER_CONSTANT, value=color: fill with color
'''
```

### Drawing

```
# Creating
    # gray-scale image
    image_obj = np.zeros((x_size, y_size),
    ↳ dtype='data_type')

    # color image
    image_obj = np.zeros((x_size, y_size, 3),
    ↳ dtype='data_type')

# Figures
```

```
# Line
cv2.line(image_obj, init_point, fin_point, color,
    ↳ thickness=thick_value,
    ↳ lineType=cv2.line_type)

# Rectangle
cv2.rectangle(image_obj, init_point, fin_point,
    ↳ color, thickness=thick_value,
    ↳ lineType=cv2.line_type)

# Circle
cv2.circle(image_obj, (center_x, center_y),
    ↳ radius, color, thickness=thick_value,
    ↳ lineType=cv2.line_type)
'''
options:
- thick_value: value of thickness, if set to -1 it
    ↳ means solid
- line_type:
- cv2.LINE_AA: line AA
'''
```

### Transformations

```
# Translation
T = np.float32([[1, 0, x], [0, 1, y]])
image_translated = cv2.warpAffine(image_obj, T, (w,
    ↳ h))

# Rotation
# custom rotation
R = cv2.getRotationMatrix2D((x_center, y_center),
    ↳ angle, 1.0)
image_rotated = cv2.warpAffine(image_obj, R, (w, h))

# quarter rotation
image_rotated = cv2.rotate(image_obj, option)
'''
option:
- cv2.ROTATE_90_CLOCKWISE: -90°
- cv2.ROTATE_90_COUNTERCLOCKWISE: +90°
- cv2.ROTATE_180_CLOCKWISE: -180°
- cv2.ROTATE_90_COUNTERCLOCKWISE: +180°
'''
```