

How to install Python3

For Windows 🪟

- Download the latest Python release installer for your OS from [here](#)
- Launch the installer
- **Pay Attention to select add Python to path**
- Wait until it's done 😊



For macOS

You've two alternatives:

1. Proceed as indicated with windows (but obviously download the installer for mac)
2. If you've brew installed just open a terminal and write "*brew install python3*"

For Linux

Python3 should be already available on most Linux of distribution, in the rare case you don't have it you can install it by writing on a terminal "*sudo /name of the packet manager/ install python3*" (For example in Ubuntu "*sudo apt-get install python3*")

ReadyCheck

In any case to check Python wheter has been correctly installed open a terminal and type "*python3*" you should see something like this

```
matteo@matteo-desktop ~-> python3
Python 3.6.8 (default, Aug 20 2019, 17:12:48)
[GCC 8.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

How to install VS Code

Go on the [VS Code website](#) and follow the installation guide for your OS

Optional

In the *Extensions* tab (on the left side) search for "python" and install the extension

How to launch a Python script

Launching a Python script is quite easy, these are the steps to follow:

1. Open a new terminal (Command line for Windows)
2. Navigate to the folder , "*cd name of the folder*" to open a folder , "*dir*" to list the file in the folder ("*ls*" for MacOS and Linux)
3. type "*python /name of the file.py*"

For the rest of the course we will always launch our Python scripts in this way

Exercise 0

Before anything you want to define the "main" as you would do in C. In Python we can do this like it's shown below

```
if __name__=="__main__":  
    #This is the main  
    pass
```

Remember that in Python indentation take places of the bracket, we will see going on with the exercise what this means

Main example

Print

Printing in python is really easy, you've just to type

```
print ("what you want to print")
```

An example is shown below

```
if __name__=="__main__":  
    #This is the main  
    print ("Sentence to print")
```

Exercise 1

Now try to write and launch your Python script and print some words/sentences, you will see that contrarily to C python will print the content of each *print()* in a new line

Print with Python

Print with placeholder

In a lot of case you want to print things like

```
the average of the values is: 5.4
```

In general you would like to print a string and the value of a variable or multiple variable. There a lot of way to print in Python, we will see just 2 of them.

First Method

The first method consists in using placeholder with "%" like you would do in C, there are different type of plceholder, you will mainly use the following:

- %s to print string
- %d to print integer
- %f to print float
- %e to print in exponential form

Special cases

In case of floating point number you can specify the number of digits after the comma by writing "`%.nf`" where `n` is the number of digits so for example if we want to have 3 digits we would write "`%.3f`". This method will work also with "`%s`" but in that case the number will specify the number of **characters** that will be used (including the "."). If you want to specify multiple variable you will write

```
print(" %s  %d %f" %(a,b,c))
```

Second method

The second method use the letter "f", in this case the placeholder is the same for every type of variable and is "*{variable}*", so the example we saw before would become:

```
print(f"My name is {myname}")
```

In this case if we want to print multiple variable we would write:

```
print(f"{a} {b} {c}")
```

Special cases

With this method you can also specify the total number of digits by writing "`{:.n}`" where *n* is the **total** number of digits so if for example we want to write pi with 3 decimal digits we would write

```
pi=3.15169265  
print(f"{pi:.4}").
```

Exercise 2

Now try to use both this method to write a Python script that give as output your name, your age and your birthday in this way:

```
My name is Python and I'm 28 years old, I was born the 20/02/1991
```


Exercise 3

Math operators

In python we can use a lot of mathematical operators let's check which they are ➡

- "+" plus
- "-" minus
- "/" slash
- "//" double-slash
- "*" asterisk
- "%" percent
- "<" less-than
- ">" greater-than
- "<=" less-than-equal
- ">=" greater-than-equal
- "==" equals

To try to understand what they do let's write a python script with one operation for each of them, something like the one below:

```
if __name__=="__main__":  
    print (f"2+3={2+3}")
```

2+3=5

Exercise 4

Ask user input

The function to ask inputs from user in Python is simply "*input()*". For example:

```
number=input(" Please write a number")
```

That is quite easy so let's try to write a script that ask the user his name and his age and his height and reply something like:

```
So you're Mt. Everest you're 60000 years old and you're tall 8848 m...
```

How to work on files

Reading and writing file in Python is really easy, the function you need are the following:

```
open()  
read()  
readline()  
write()  
close()
```

Open a file

open()

this function returns an object of the type file

```
#Open file in reading mode
f=open('myFile.txt')

#Open file in writing mode
f=open('myFile.txt', 'w')

#Open file in append mode
f=open('myFile.txt', 'a')
```

Read a file

read()

this function return the whole content of the file as a string

```
#Open and read the content of the file "myFile.txt"  
f=open('myFile.txt')  
fileContent=f.read()
```

Read a line

readline()

this function return one line of the file as a string

```
#Open the file "myFile.txt" and read one line  
f=open('myFile.txt')  
fileLine=f.readline()
```

Write a file

write()

this function write on a file

```
#Open the file "myFile.txt" and write one line  
f=open('myFile.txt','w')  
f.write('line to write')
```


Close a file

close()

this function closes the file

```
#Open the file "myFile.txt", write one line and close the file  
f=open('myFile.txt','w')  
f.write('line to write')  
f.close()
```

Exercise 5

As exercise create 2 file: "original.txt" with some random content and an empty file called "copy.txt", then write a python script to open the first file, shows its content on the terminal and write the content of "original.txt" in "copy.txt" but add at the beginning "the content of the original file is:". So the result should look like this.

original.txt

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua."

copyt.txt

"The content of the original file is:

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua."

If-elif-else

The easiest way to show how *if-elif-else* works is by making an example. So let's see a script that asks to the user two number and tells if the first is greater, smaller or equal to the second

```
if __name__=="__main__":  
    #Receive two number as input  
    a=int(input('Write a number\n'))  
    b=int(input('Write another number\n'))  
    #First case a>b  
    if a>b:  
        print(f"{a} is greater than {b}")  
    #Second case a<b  
    elif a<b:  
        print(f"{a} is smaller than {b}")  
    #All the other case  
    else:  
        print(f"{a} equals {b}")
```

Exercise 6

We can annidate multiple *if-elif-else* just remember to use the correct indentation, most code editors will do it for you but pay attention to it. You can create complex condition with "and" and "or".

As exercise write a script that takes as input a number and chech whether it's a multiple of 2 and 3.

List, for-loop, while-loop

As you've seen in the slides in python the "array" type is called "list" and there it has some particular function related to it:

List functions 1/3

- *list[i]*
Return the i-th element of the list
- *list.append(x)*
Add an item to the end of the list.
- *list.insert(i, x)*
Insert an item at a given position. The first argument is the index of the element before which to insert

List functions 2/3

- *list.remove(x)*

Remove the first item from the list whose value is x. It is an error if there is no such item.

- *list.pop([i])*

Remove the item at the given position in the list, and return it. If no index is specified, a.pop() removes and returns the last item in the list.

List functions 3/3

- *list.index(x)*
Return the index in the list of the first item whose value is x. It is an error if there is no such item.
- *list.count(x)*
Return the number of times x appears in the list.
- *len(list)*
Return the number of element in the list

 **Remember that list in python start at 0**

How to use the lists?

The easiest way to show how the *for-loop* and the *while-loop* works is by making an example. So let's see a script that creates a list with some number and calculates their sum and their product:

For-loop

```
if __name__=="__main__":  
    numbers=[1,2,3,4,5]  
    list_len=len(numbers)  
  
    ##For-loop for the sum  
    #set sum to 0  
    sum_of_numbers=0  
    for i in range(list_len):  
        #takes the previous value of the sum and add the number at the place i  
        sum_of_numbers=sum_of_numbers+numbers[i]  
        #the more "pythonic" way to do it is  
        #sum_of_numbers+=numbers[i]  
    print(f"The sum of the numbers in the list is {sum_of_numbers}")
```

While-loop

```
if __name__=="__main__":  
    numbers=[1,2,3,4,5]  
    list_len=len(numbers)  
    #set counter to 0 and product to 1  
    i=0  
    product_of_numbers=1  
    while i<list_len:  
        #Multiply the old value for the number at place i  
        product_of_numbers=product_of_numbers*numbers[i]  
        #the more "pythonic" way to do it is  
        #product_of_numbers*=numbers[i]  
        #Update counter  
        i=i+1  
    print(f"The product of the numbers in the list is {product_of_numbers}")
```

For in the "pythonic" way

There is another method to write the *for-loop* that is a little easier that is: `for item in list:`

Using this method for the previous example it becomes

```
if __name__=="__main__":  
    numbers=[1,2,3,4,5]  
    sum_of_numbers=0  
    for item in numbers:  
        sum_of_numbers+=item
```

Exercise 7

As exercise write a script to calculate the average, the max and the min of a list of number

Dictionaries

An really useful datatype of python is "dict". Dictionaries are collections of couples of key/value, key are of type string and they are unique for each dict, the value of a dict can be of whatever type :int,float,string,list or even other dict. Let's see an example of dict and what function can be used on a dict.

```
if __name__=="__main__":
    config={
        "lastUpdate": "2020-7-25-22:46",
        "devicesList": [
            {
                "deviceID": "BOX1_A_FAN_1",
                "availableResources": "Fan",
                "IP": "192.168.1.254",
                "port": 49160,
                "endPoints": {
                    "REST": "http://192.168.1.254:49160/greenhouse/box_1/actuators/fan",
                    "MQTT": "greenhouse/box_1/actuators/fan"
                },
                "insertTimestamp": 1595709994.0579066
            }
        ]
    }
```

Exercise 8

As exercise write a script that ask as input the data needed to fill the dict defined below and print the dict as output

```
personal_data={  
    "projectName": "",  
        "company": "",  
        "deviceList": [  
            {  
                "deviceID": ""  
                "deviceName": ""  
                "deviceType": ""  
            }  
        ]  
}
```

JSON files

For all the course we will use *.json* files a json is essentially a dictionary saved on a file, it is easy for humans to read and write. It is easy for machines to parse and generate. Python has a module (i.e. library) called *json* that contains all the functions we need to read and write json files.

The functions we will use are

json.load(fp)

the output is a dictionary that filled with the content of from the file pointer fp (fp is the result of the function open("<name_of_the_file>.json")). What we will usually write is

```
dictionaryName=json.load(open("<name_of_the_file>.json"))
```

json.dump(d,fp)

this is used to write the dictionary *d* on the file pointer fp. What we usually write could be

```
json.dump(dictionaryName, open("<name_of_the_file>.json", "w"))
```

json.loads(myString)

this will return a dictionary obtained by converting the string *myString*. We will use this function later in the course

json.dump(d)

this will return a string by converting the dictionary *d*. Also this function will be useful later in the course

Exercise 9

As exercise try to save the variable *personal_data* from the exercise 8 into a json file

Functions

Functions are useful to repeat the same operation multiple times without writing the same code multiple times. Let's see an example of a function

```
def useless_function(argument):  
    argument_v2=argument+argument  
    return argument_v2  
if __name__=="__main__":  
    y=useless_function("IoT")  
    print(y)  
    z=useless_function([1,2,3])  
    print(z)
```

Exercise 10

As we see in this example we don't need to specify the type of the input of the function, python will understand it by itself (by the way this is a special case due to the fact that int, string and list all support the operator "+" in does **not** work)

As exercise write 4 function to: add, subtract, multiply and divide two given numbers and print the result