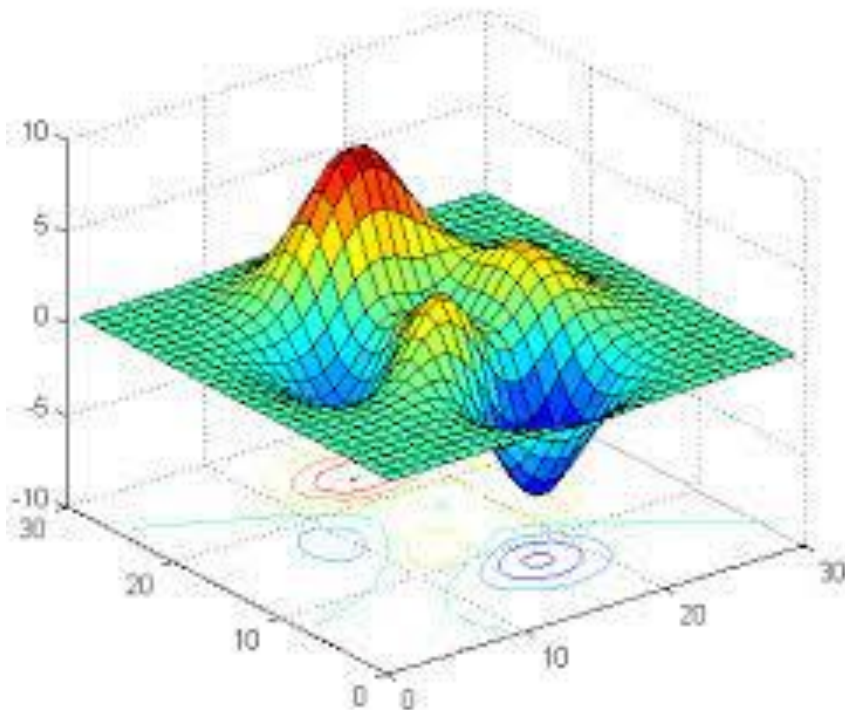
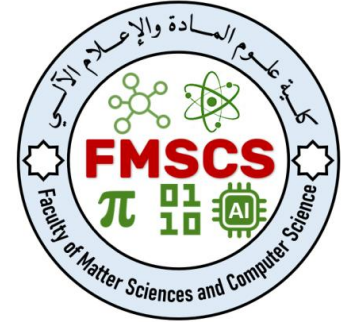




Khemis Miliana University
Faculty of Sciences of Matter and Computer Science
Department of Physics



Numerical Methods & Scientific Programming

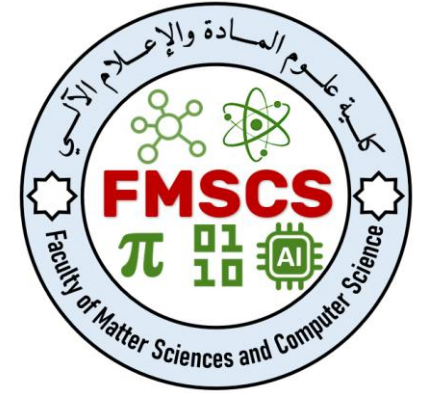
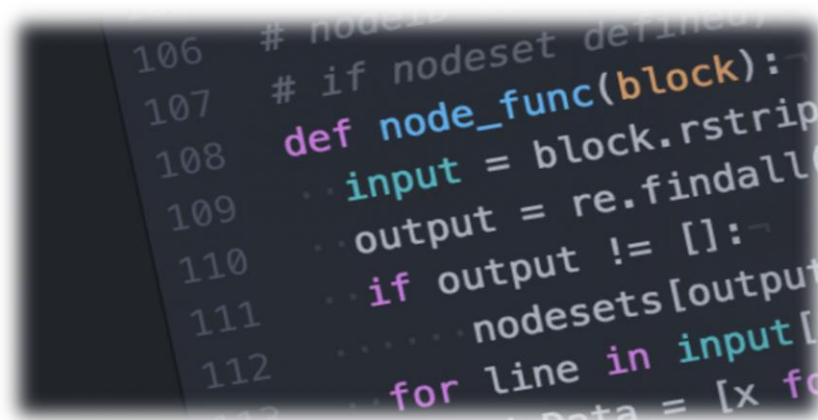
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Content of the program

- Chapter 01: *Initiation to a programming language (Python)*
 - *Hands-on-Python; Basics of Python*
- Chapter 02: *Numerical Integration*
 - *Trapezoidal rule; Simpson's method*
- Chapter 03: *Numerical Solution of equations*
 - *Bisection method; Newton's Method*
- Chapter 04: *Numerical resolution of differential equations*
 - *Euler's method; Runge-Kutta method*
- Chapter 05: *Numerical resolution of linear equations system*
 - *Gauss method, Gauss-Seidel method*



Hands-on Python

An open-source programming language



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Chapter 01: Initiation to a programming language

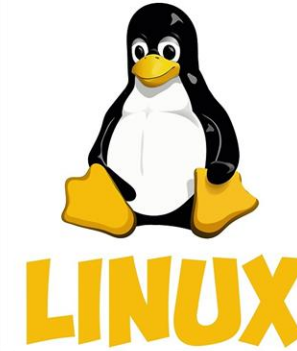
Outline

- What is Python?
- Why Python?
- How to work with Python?
- Getting started with Python: Installation and first steps
- *The basics of Python*
- *Python for computational and numerical physics*

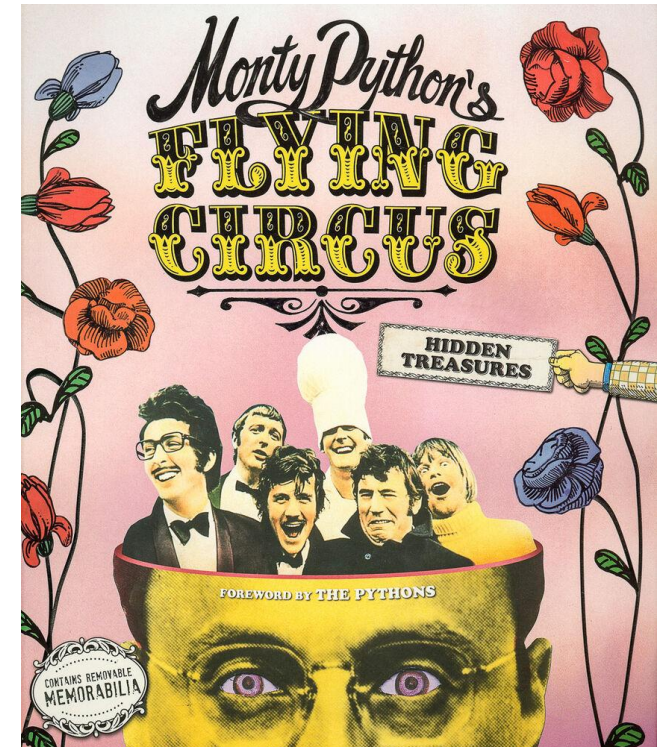


What is Python?

python



- Python is a general-purpose, high-level, interpreted language known for its ease of use, extensive libraries and tools, and code readability;
- Created and developed by Guido VAN ROSSUM (NL) since 80's. First release was in 1991 (Python0.90);
- It was designed to work initially only on linux-like platform, but fortunately since 2019 it could be supported by Windows (8, 10, 11);
- The name Python comes from an old BBC television comedy sketch series called Monty Python's Flying Circus.



What is Python?

The Zen of Python: Guiding principles for writing computer programs

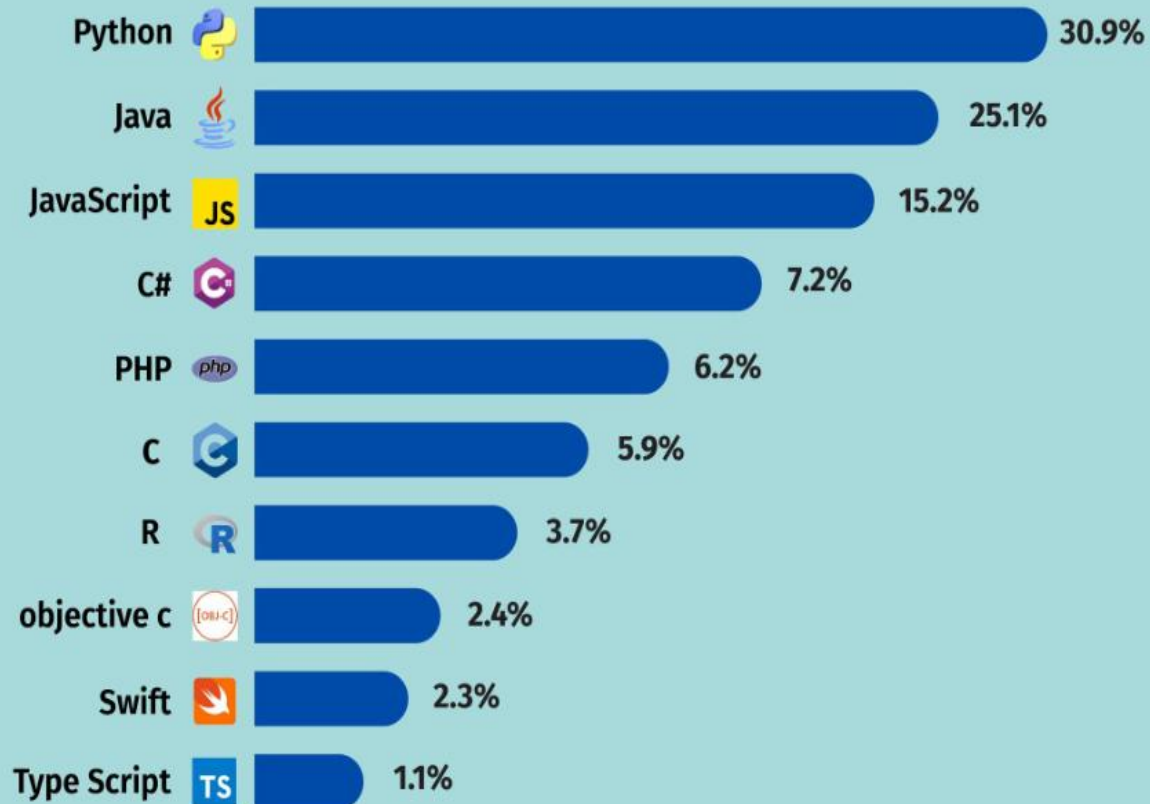
- Beautiful is better than ugly.
- Explicit is better than implicit.
- Simple is better than complex.
- Complex is better than complicated.
- Flat is better than nested.
- Sparse is better than dense.
- Readability counts.
- Special cases aren't special enough to break the rules.
- Although practicality beats purity.
- Errors should never pass silently.
- Unless explicitly silenced.
- In the face of ambiguity, refuse the temptation to guess.
- There should be one-- and preferably only one --obvious way to do it.
- Although that way may not be obvious at first unless you're Dutch.
- Now is better than never.
- Although never is often better than right now.
- If the implementation is hard to explain, it's a bad idea.
- If the implementation is easy to explain, it may be a good idea.
- Namespaces are one honking great idea – let's do more of those!

Why Python?

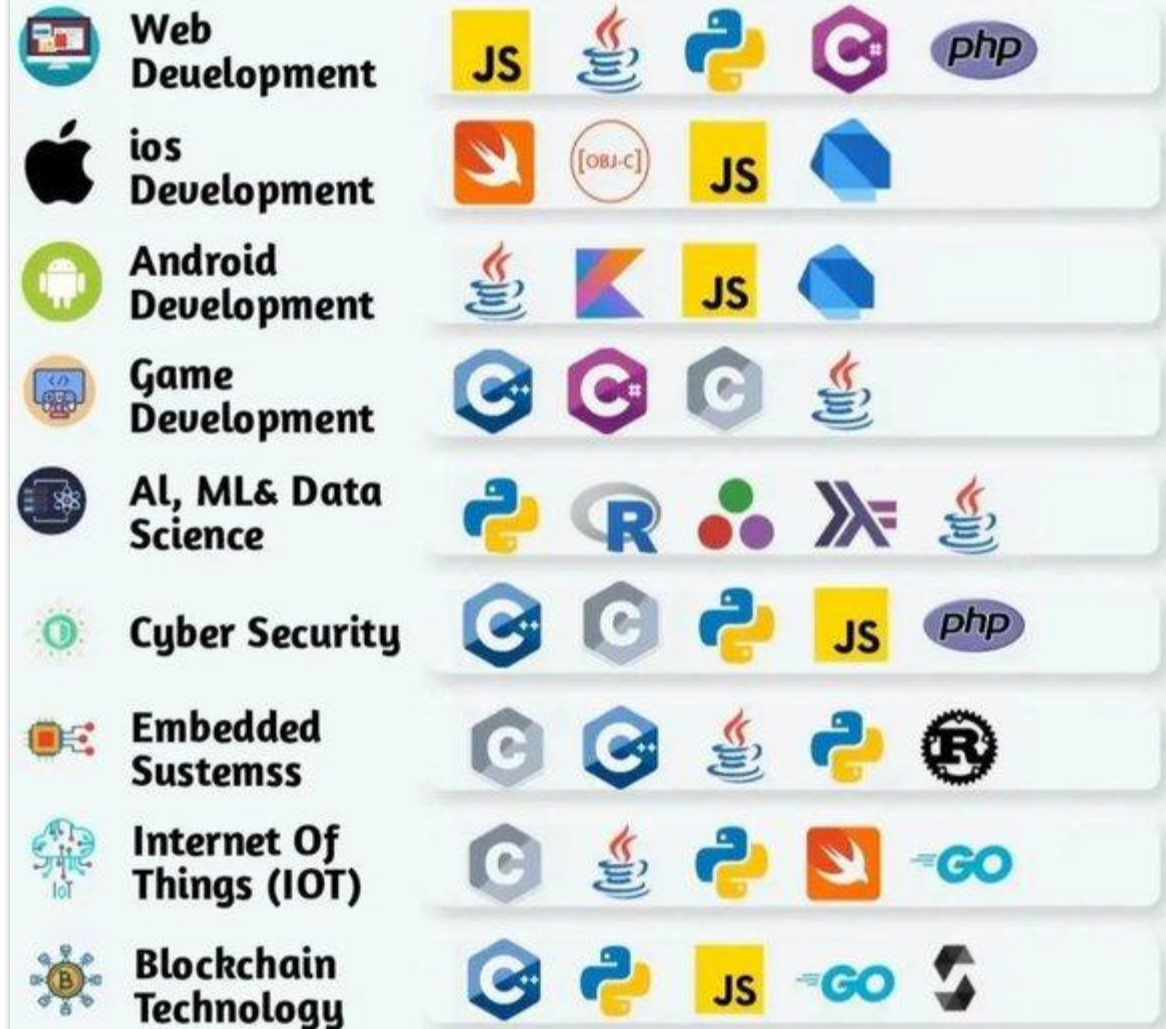
- It is easy to learn: shorter time is required than many other languages;
- It is easy to use for writing new software : codes could be written faster with Python;
- It is easy to obtain, install and deploy : it is free, open and multiplatform;
- Python can handle complex algorithms and is excellent for data automation, making it a natural fit for Machine Learning (ML).
- Being open-source, it has support from a large community of Python users committed to making it better and more efficient.

Why Python?

Most Popular Programming Languages of 2025!



PROGRAMMING LANGUAGES USED IN DIFFERENT DOMAINSS



How to work with Python?

- The terminal (interpreting line by line)

```
a = 1
b = 2
c = a + b
print('a + b is', c)
```

cmd Select Command Prompt

C:\Users\saber>_

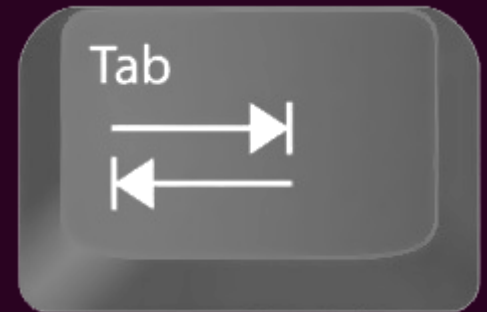


How to work with Python?

- The interactive terminal **IP[y]:**

```
q1_spending = 50
q2_spending = 60
total_spending = q1_spending + q2_spending
print('total spending is ', total_spending)
```

```
(base) saber@saber-X1:~$
```



How to work with Python?

- Text editor



```
File Edit View Selection Find Packages Help

my_code.py

1  a = 1
2  b = 2
3  c = a + b
4  print('a + b is ', c)
5
```

C:\> Command Prompt

C:\Users\saber\Documents>

How to work with Python?

- Integrated Development Environment (IDE): Jupyter



Code



6. Using Modules to Load Data

Can we use a module to load the data into python and avoid all the code we used earlier? The answer is YES! We can use `pandas`. Pandas is like having MS EXCEL in python, but just more powerful. Here is an example.

```
In [ ]: ▶ # Importing the module
import pandas as pd

# Loading the data
data = pd.read_csv('house_prices.csv')

# Displaying the data
data.head(5)
```

7. Plotting Data Loaded Using `pandas`

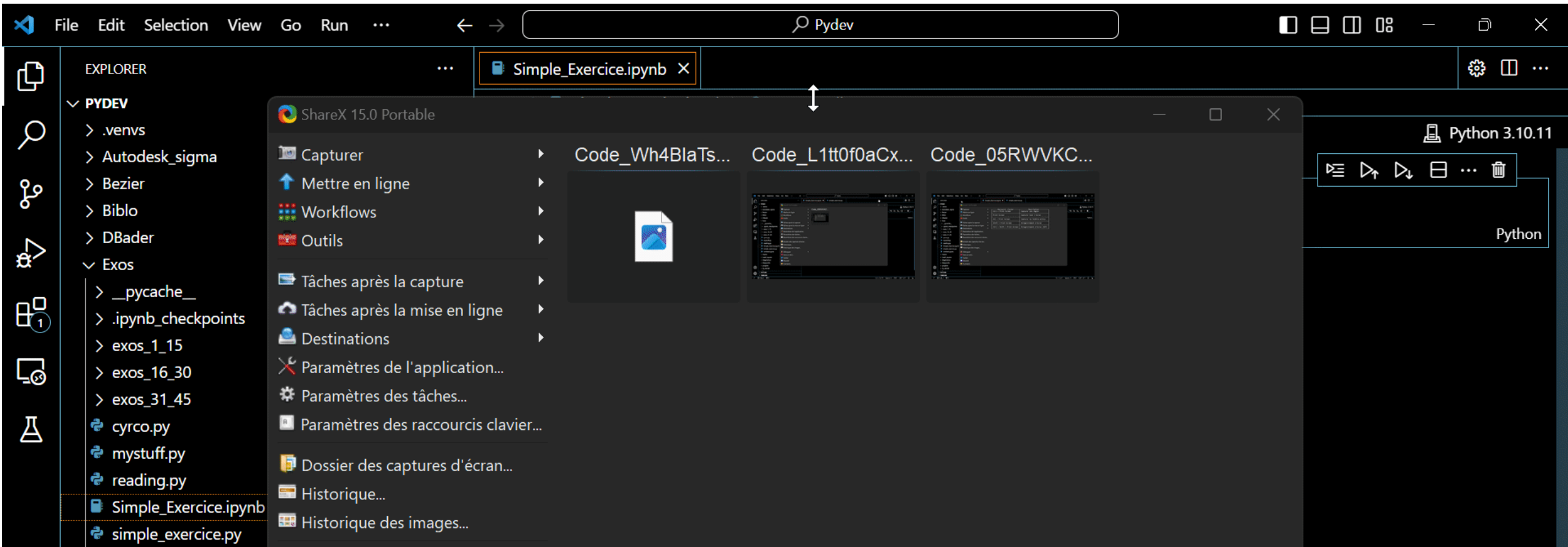
Plotting this data is very simple. Just pick which columns to plot.

```
In [ ]: ▶ plt.scatter(data['Rooms'], data['Price'])
plt.xlabel('Number of rooms')
plt.ylabel('Price')
plt.show()
```

How to work with Python?

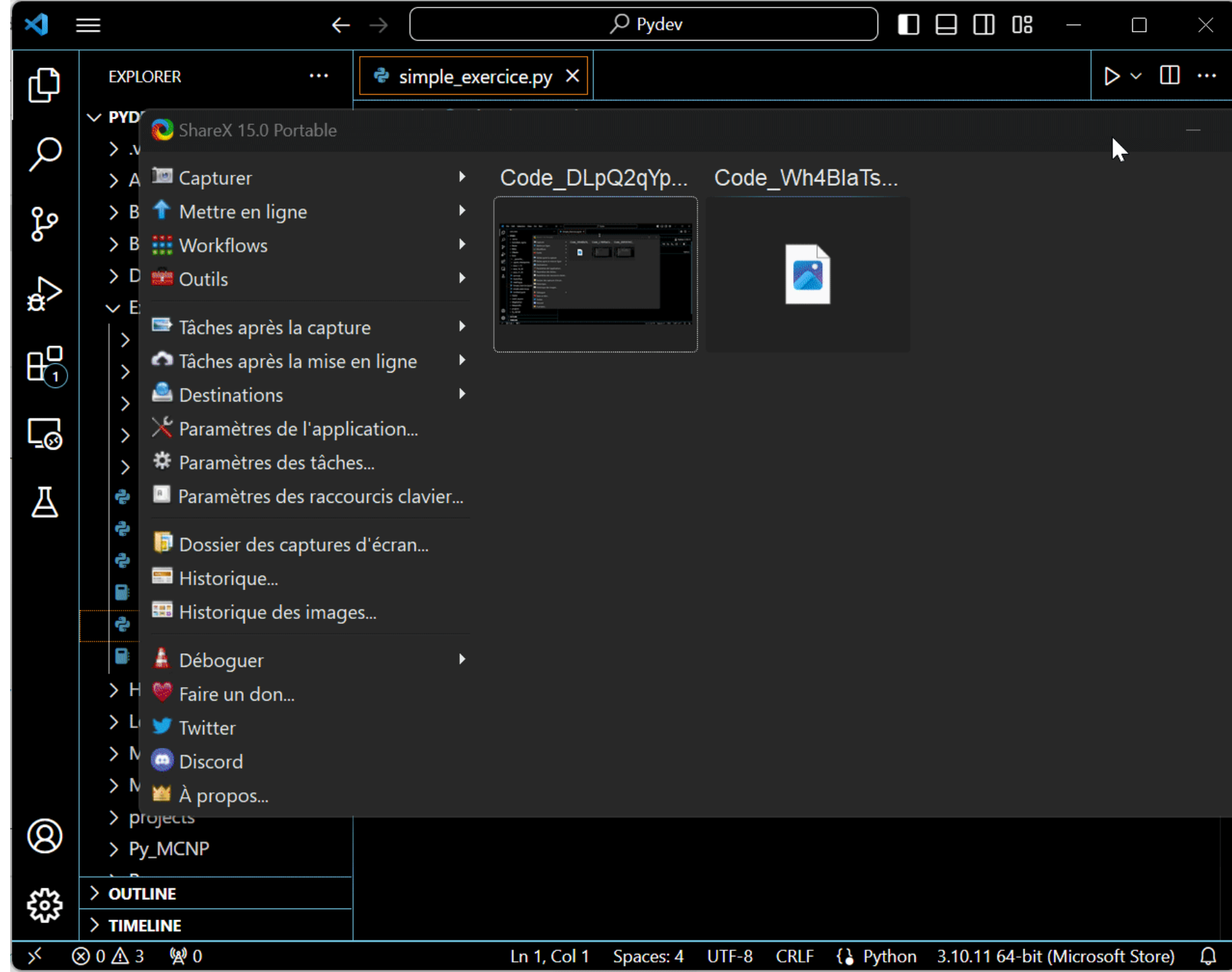


- Integrated Development Environment (IDE): Vscode



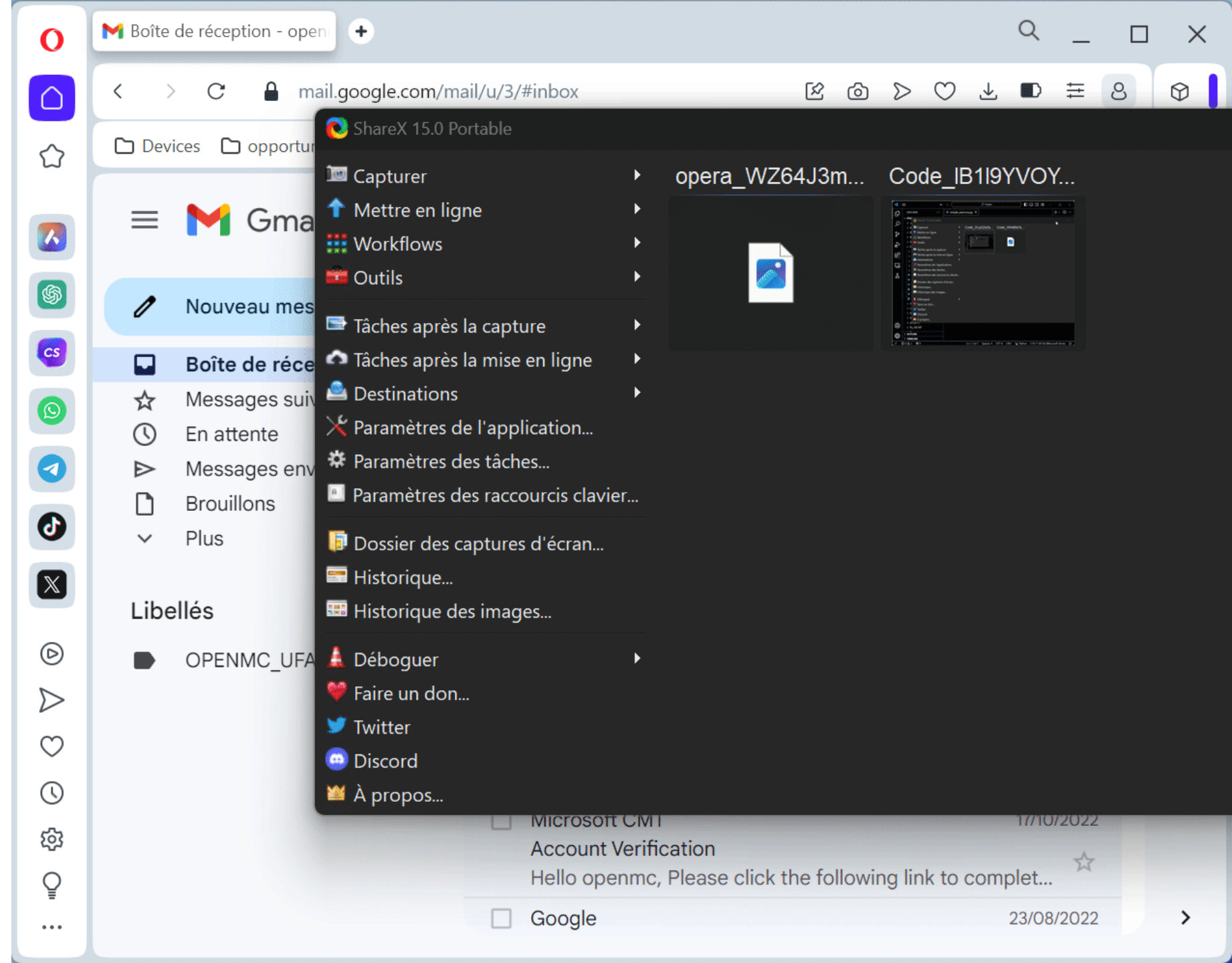
How to work with Python?

- Integrated Development Environment (IDE): Vscode



How to work with Python?

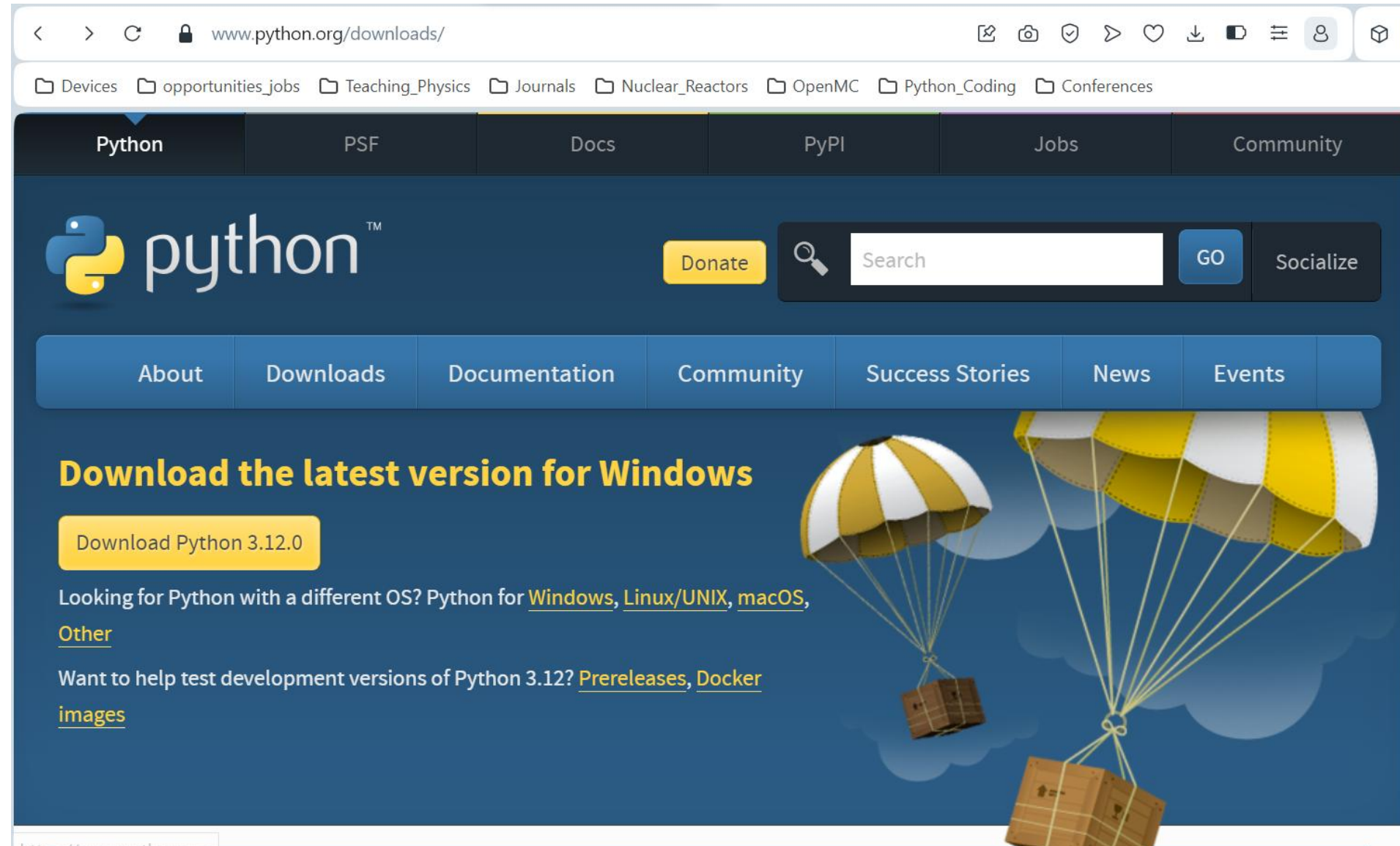
- Integrated Development Environment (IDE): googlecolab



Getting started with Python: Installation and first steps

For windows users:

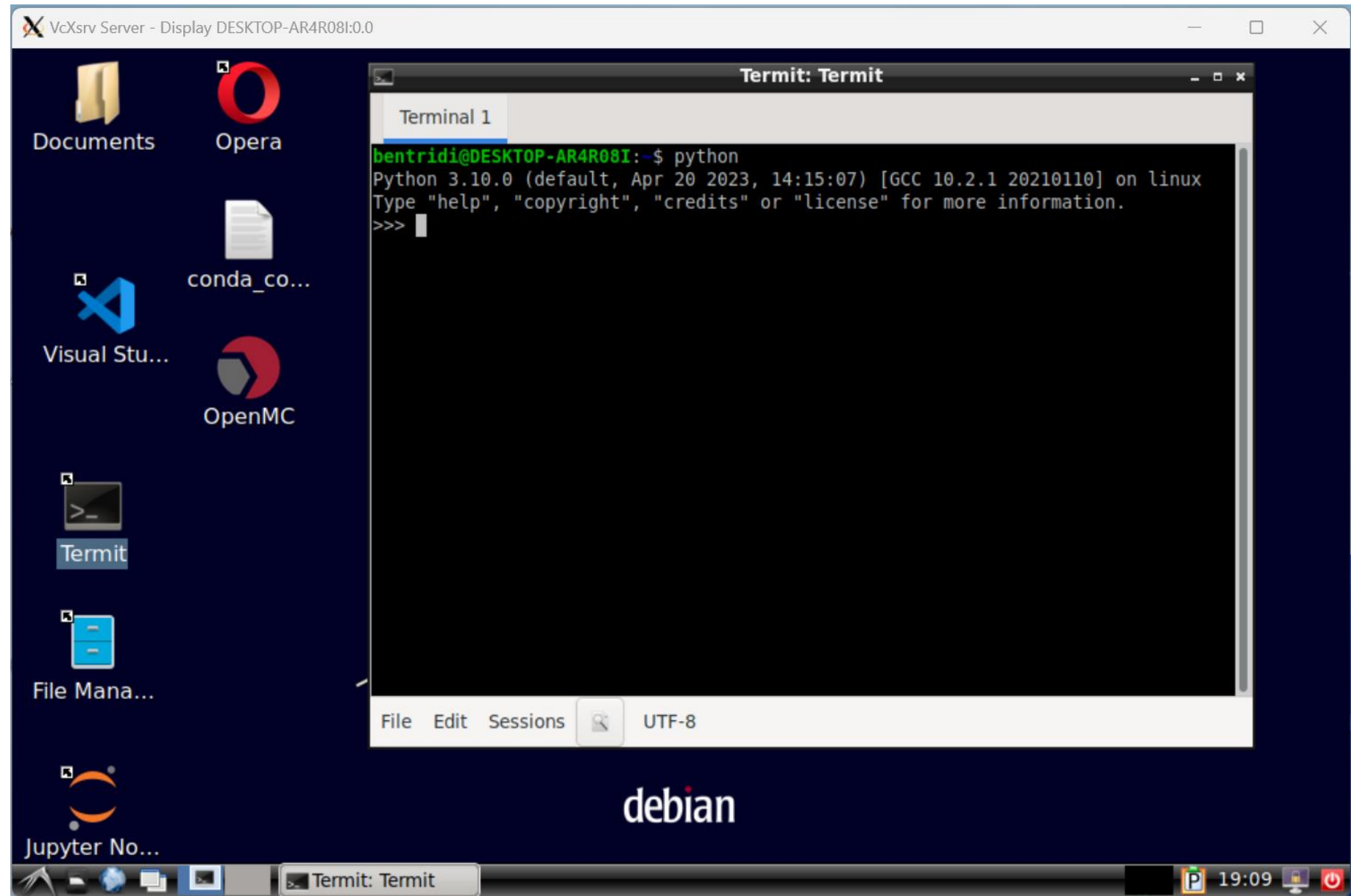
- Download the installer the given release of Python



Getting started with Python: Installation and first steps

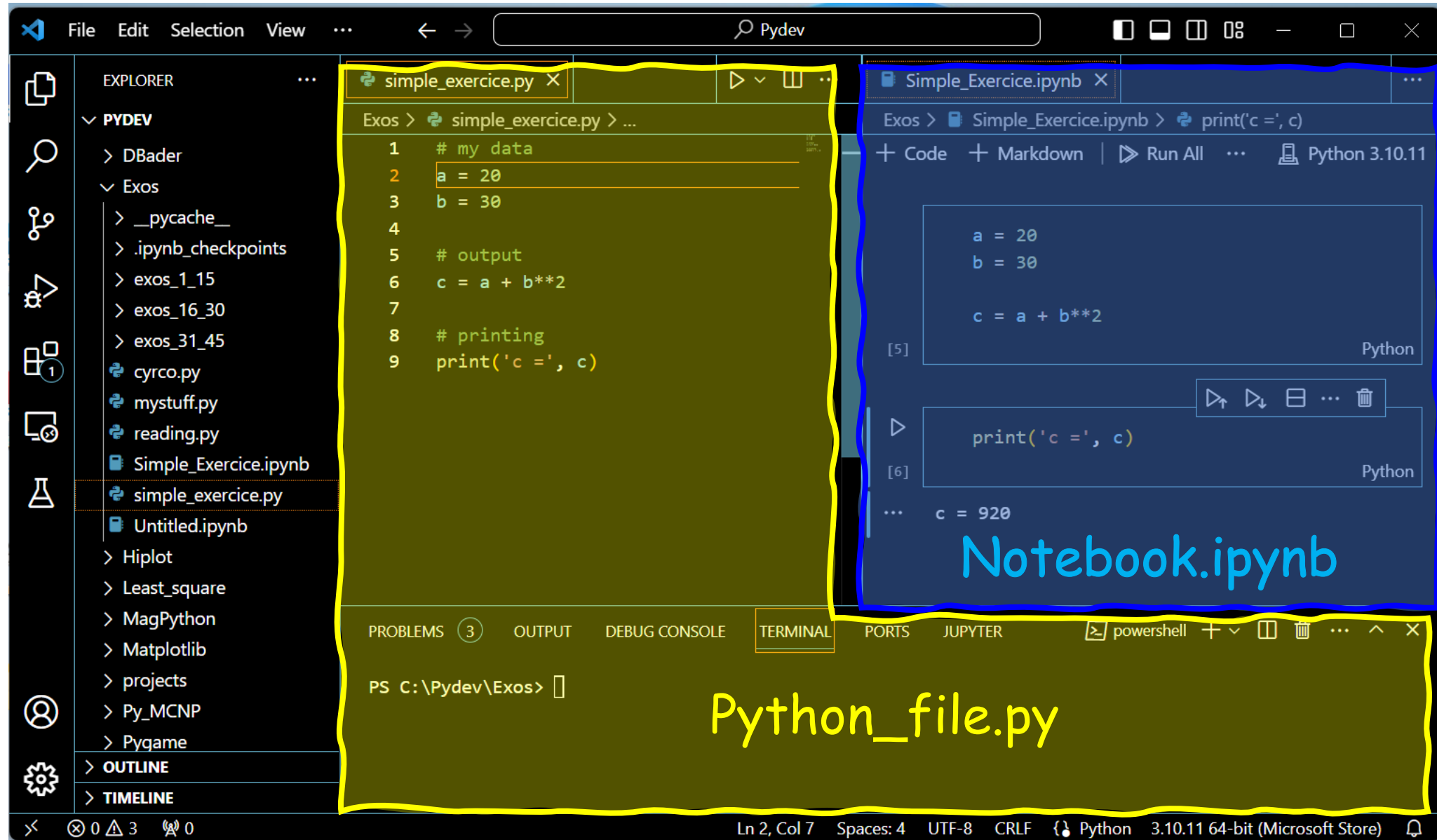
For Linux users:

- The Python is already available with the most used Linux distribution: Ubuntu, Debian, Suse, ...



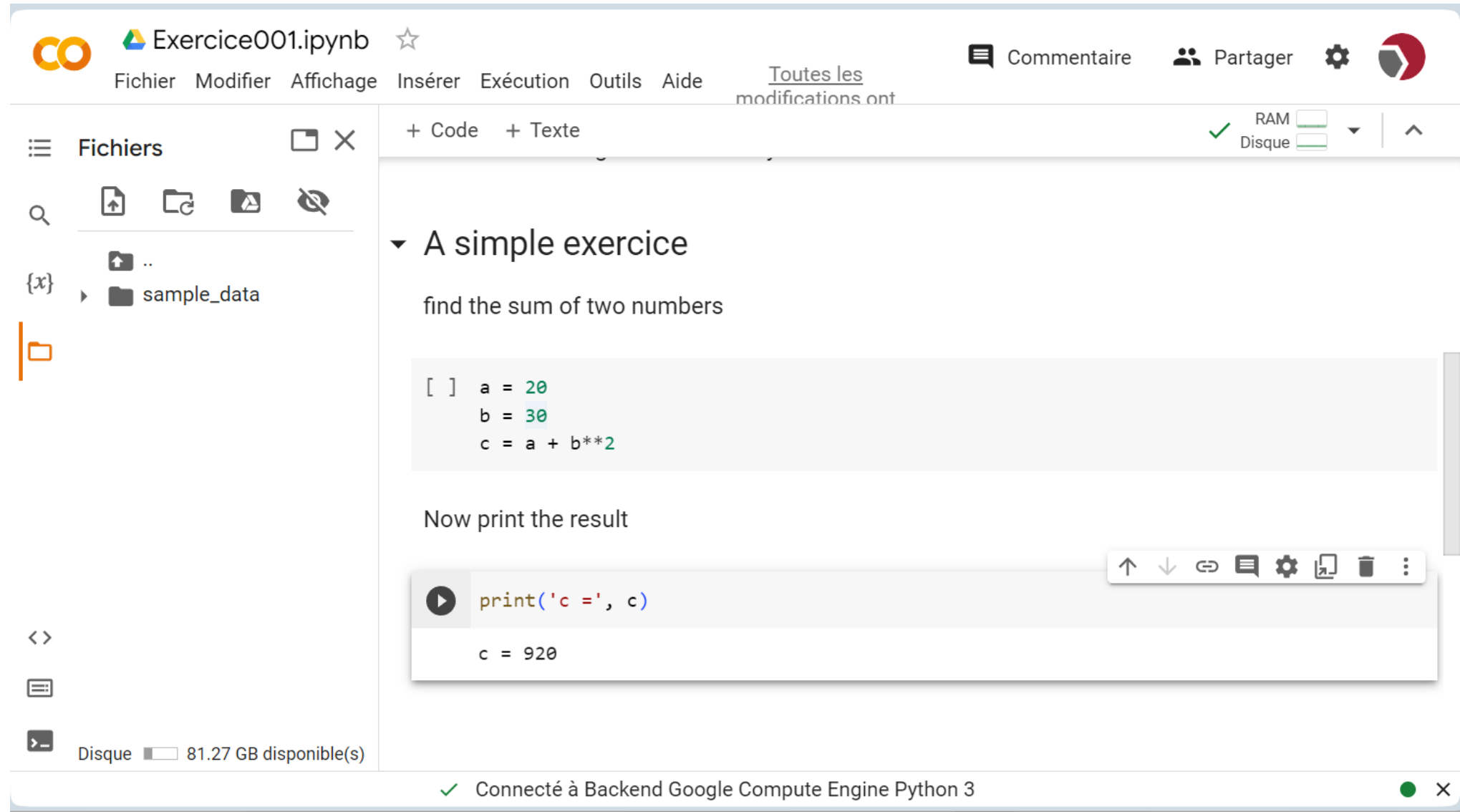
Getting started with Python: Installation and first steps

Once you have Python on your machine, it is recommended to choose the suitable editor for coding and programming (VSCODE or any other similar IDE editors)



Getting started with Python: Installation and first steps

It is also recommended to use Google.colab since no installation is required. You have access directly to a Linux platform with python already installed



The screenshot displays a Google Colab notebook titled "Exercice001.ipynb". The interface includes a top menu bar with options like "Fichier", "Modifier", "Affichage", "Insérer", "Exécution", "Outils", and "Aide". On the right, there are links for "Commentaire", "Partager", and a settings icon. Below the menu, a sidebar on the left shows a file explorer with a folder named "sample_data". The main area of the notebook contains a section titled "A simple exercice" with the instruction "find the sum of two numbers". Below this, a code cell is shown with the following Python code:

```
[ ] a = 20
    b = 30
    c = a + b**2
```

Following the code cell, the text "Now print the result" is displayed. Below this, another code cell is shown with the following Python code:

```
print('c =', c)
```

The output of the second code cell is displayed as:

```
c = 920
```

At the bottom of the interface, a status bar indicates "Connecté à Backend Google Compute Engine Python 3".

The basics of Python

- Some syntax rules
- Variables
- Data types I
- Formatting
- Data types II
- Operators
- User input
- Flow control: if - elif - else - for - while
- Functions
- Scope: Local and global variables
- Modules

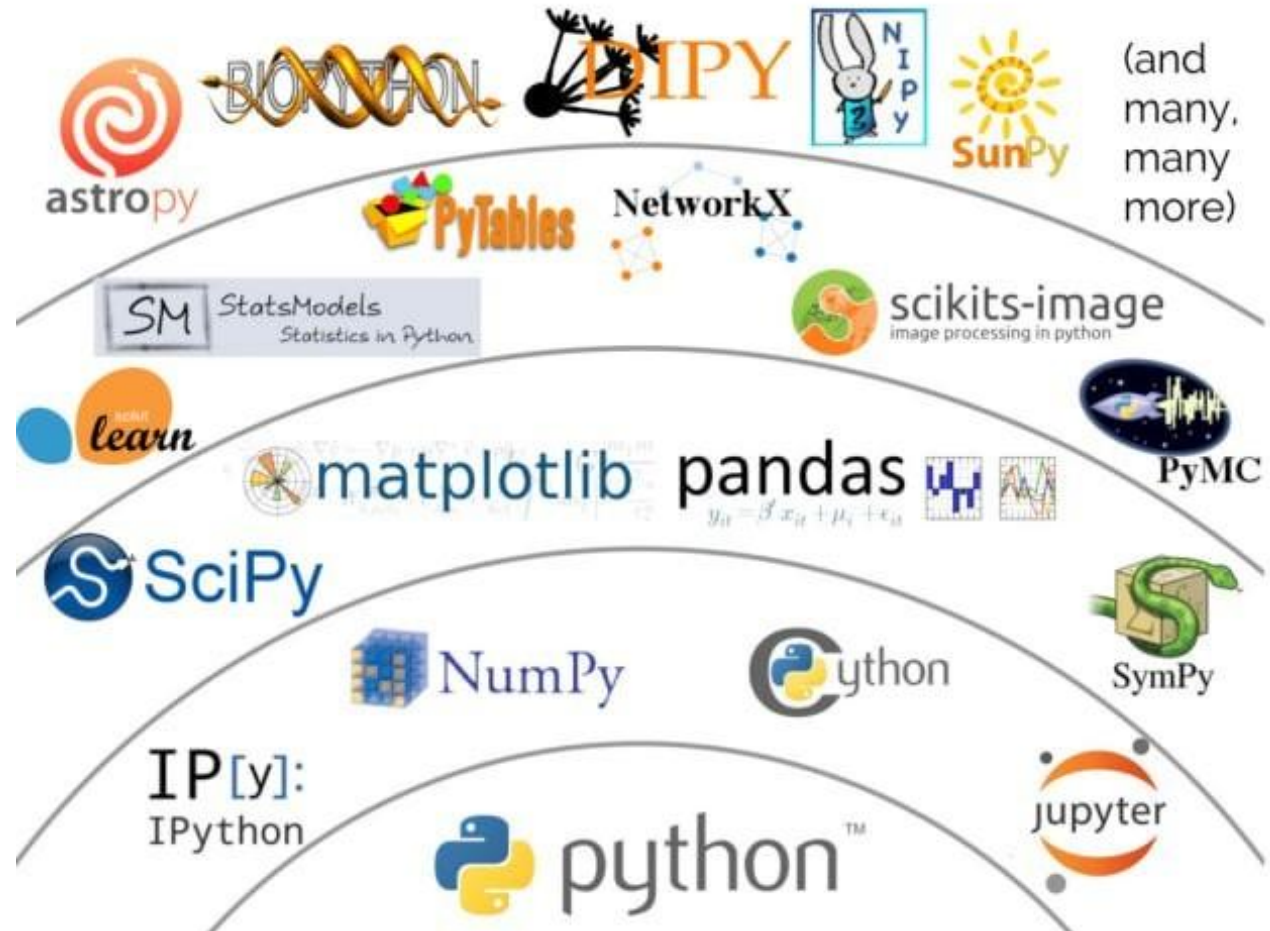


Modules and Libraries : The most used ones for computational physics

Your package



More than 130.000 existing libraries



PIP: Package Installer for Python

Your package



Matplotlib

You need just to type in a command line:

> *pip install <package_name>*

for example, to install numpy (numerical python), type:

> *pip install numpy*