

Introduction

Standard libraries

Python provide a lot of standard libraries that could be used in any python program without installing additional packages. For example, `math` and `random`.

You can read the corresponding references:

- Math: <https://docs.python.org/3/library/math.html>
- Random: <https://docs.python.org/3/library/random.html>

Import

To use the libraries, we need to first import them using `import`, For example:

```
In [1]: import math
a = 24
b = 36
print("GCD of", a, "and", b, "is", math.gcd(a, b))
```

GCD of 24 and 36 is 12

Import as

It is possible to rename the imported library for simplicity or in cash of variable name crashiing.

```
In [2]: import math as m
a = 24
b = 36
print("GCD of", a, "and", b, "is", m.gcd(a, b))
```

GCD of 24 and 36 is 12

Repository

Apart from the standard libraries, we can also make use of third party libraries. There are many choices that could ease our works.

Before we can use any 3rd party library, we have to install them.

- `pip` is a command line tools for installation of Python libraries.
- The library pages will usually show you the command for installation.

Libraries for data manipulation and visualization

NumPy

- The core library for multidimensional array for many other libraries.
- Especially useful for data science.

Matplotlib

- A plotting library, very useful for visualization.

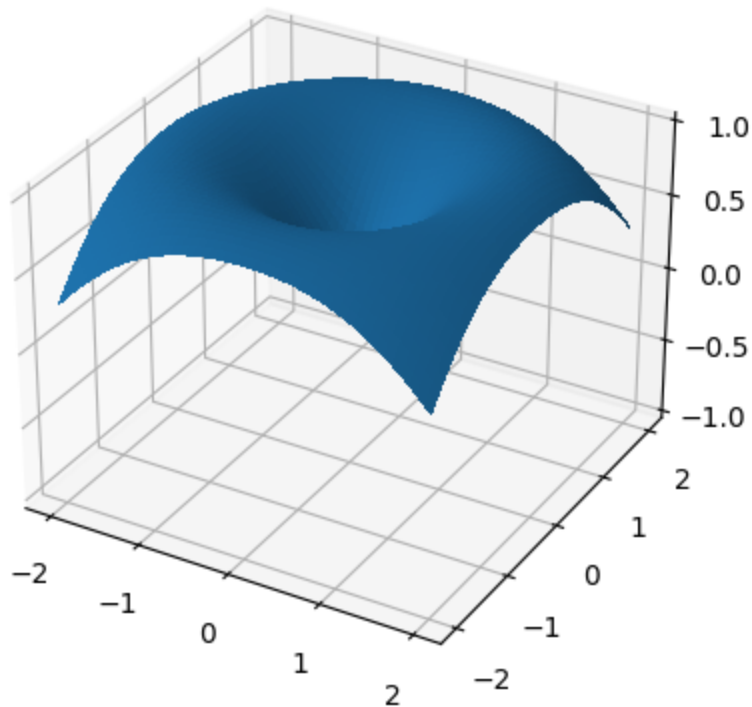
NumPy + Matplotlib example

The example below produces a 3D plot of $\sin\sqrt{x^2 + y^2}$.

```
In [3]: import matplotlib.pyplot as plt
import numpy as np

ax = plt.figure().add_subplot(111, projection='3d')
X, Y = np.meshgrid(np.linspace(-2, 2, 500), np.linspace(-2, 2, 500))
Z = np.sin(np.sqrt(X**2 + Y**2))

ax.plot_surface(X, Y, Z, antialiased=False)
ax.set_zlim(-1.01, 1.01)
plt.show()
```



Quick Quiz

For each of the following code segment, explain if the code is valid or not.

A:

```
import math as m
print(m.gcd(24, 36))
```

B:

```
import math
print(math.gcd(24, 36))
```

C:

```
import math
print(gcd(24, 36))
```

D:

```
import m as math
print(m.gcd(24, 36))
```

Demonstration 3-2

Using numpy and matplotlib, plot the graph of $\sin(x) + \cos(x)$ from $-\pi$ to π .

Necessary references:

- (NumPy) `linspace()` generate a set of points between two values as an array.
 - <https://numpy.org/doc/stable/reference/generated/numpy.linspace.html>
- (NumPy) `sin()` and `cos()` apply the corresponding function to an array (and return an array of result).
 - <https://numpy.org/doc/stable/reference/generated/numpy.sin.html>,
<https://numpy.org/doc/stable/reference/generated/numpy.cos.html>
- (Matplotlib) `plot()` plot x-y graph from an array of `x` values and an array of `y` values.
 - https://matplotlib.org/stable/api/_as_gen/matplotlib.pyplot.plot.html

Self-learning topics

Libraries

- Numpy
- Matplotlib

It is very common that we need to consult the documentations when we use third party libraries. Instead of summarizing the usage of these libraries, you will be redirected to their corresponding documentations.

NumPy

NumPy provides support of multi-dimensional array.

- [Installation](#)
- [Quickstart tutorial](#)

Matplotlib

Matplotlib provides support of plotting chart from data.

- [Installation](#)
- [Tutorials](#)

Self-evaluation exercises (3-2)

Quiz 3-2

1. When we create an array using `empty()` in NumPy, which parameter should we specify if we want to specify the data type of the values in the array?
2. The program below shows an attempt to create a plot with 4 data points. However, nothing is shown after running the program. Give one line of code that fix the code so that a plot is displayed when the program is executed.

```
import matplotlib.pyplot as plt

plt.plot([1, 2, 4, 7], [2, 5, 3, 6])
```

Exercise 3-2

Write a program that reads 2 integers, say, `a` and `b`, then produce a sequence of 9 evenly distributed values in the range of $[a, b]$, formatted as a 3 x 3 integer array (values should be floored/truncated). (Hint: use `linspace()`)

Sample input/output:

Input	Output
1	[[1 1 1]
2	[1 1 1]
	[1 1 2]]
1	[[1 2 3]
9	[4 5 6]
	[7 8 9]]
5	[[5 6 8]
20	[10 12 14]
	[16 18 20]]

Optional topics

- Standard libraries in Python
- Pandas

Further references

Visit the two related sections in the Python tutorial for a glance of the standard library provided by Python. It could be useful to know that these libraries exist.

- [10. Brief Tour of the Standard Library](#)
- [11. Brief Tour of the Standard Library — Part II](#)

Pandas

pandas is a data analysis and manipulation tool

- [Installation](#)
- [Tutorial](#)

Study the use of the library through the tutorial.