Python for Data Analysis.
ESILV 2023–2024
[Practical work 2: NumPy]

NumPy

Exercise 1 [NumPy initialization arrays]

1. Use this line of code to create a NumPy array. Display its dimension and type.
   np.array([[1,2,3],[4,5,6],[7,8,9]])

2. Create a 1-dimensional array of zeros

3. Create a 2-dimensional array of zeros and visualize its length using different functions. See its size, dimensions and types.

4. What are the "*zeros_like*" and "*empty*" functions for? Explain.

5. What are the *'linespace'* and *'arange* functions for? Explain.

6. Use the "*random*" function to create a 1D and 2Darray array. Check their dimensions using the functions seen previously.

Exercise 2 [Mathematic operations]

1. Create a NumPy array, representing the sinus of another array. Do the same for cosines and logarithm. Save each result in a variable.
2. Use sinus and cosine array, to compute those functions:
   *f(x) = sinx * cosx*
   *f(x) = cosx**2 - sinx**2*
   How about this one:
   $sin(x)^2 + cos(x)^2$
   What are your remarks concerning the last one?

3. Add a constant *C = 1.5 to* every element of the sinus array.

4. Explore the *'dot'* and *'@'* functions. What are they used for?

Exercise 3 [I/O operations using NumPy]

1. Create a random multi-dimensional array (or use one that has already been created) and save it as a text file. Now, save this array as a NumPy object (.npy extension)
2. Read those files again using *open()* function.

3. Try to read it again, using NumPy function *'loadtxt'*. Explain the difference between them.

Exercise 4 [Use Case, Mona Lisa]

Loading Mona Lisa data

1. Load ‘monalisa.txt’ file as a NumPy array and explore it. (Dimensions, values, types, etc.)

2. Show the portrait of the Mona Lisa. To do this import matplotlib using this command:
   import matplotlib.pyplot as plt
   Then use *‘imshow’* command to display it.

3. Use the ‘cmap’ parameter to display it in black & white.

4. Load ‘monalisa.npy’ file as a NumPy array, display it and explore it. (Dimensions, values, types, etc.) Why do you think the second photo is better?

Slicing – Using monalisa.npy

5. Crop the image to show only Mona Lisa's head

6. Pixelize Mona Lisa's image on 3 different levels, and explain the result

7. Rotate the Mona Lisa 90°

8. Display the reflection of the Mona Lisa

9. Hide Mona Lisa's face using a white box. Replace the white box with a randomly generated box

Transformation - Use the monlisa.txt file

10. Create a filter on the image to have a darker Mona Lisa

11. Create a vertical gradient from right to left allowing the image to be darker on the left

12. Create a horizontal gradient that will make the Mona Lisa darker on top