

Software Engineering Lab

Spring 2024

Assignment-4: NumPy and its Applications

Learning objectives:

NumPy stands for *Numerical Python*. NumPy is a Python library used for working with arrays. It also has functions for working in domain of linear algebra, fourier transform, and matrices. NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object and tools for working with these arrays. It is the fundamental package for scientific computing with Python.

Install Dependencies:

Before its application, ensure the following:

NumPy

```
pip install numpy
import numpy as np
```

OpenCV

```
pip install opencv-python
import cv2
img = cv2.imread('image.png', cv2.IMREAD_COLOR )
cv2.imshow('OUTPUT', img)
```

Matplot Library

```
pip install matplotlib
import matplotlib.pyplot as plt
```

Check time for execution

```
import time
seconds = time.time()
```

Once you install the requisite packages, do the following tasks.

1. Write a program to load a .csv file as a NumPy 1-D array. Find the maximum and minimum elements in the array.
[Hint: For the data, use the .csv file “Book1 .csv”](#)
2. For the Numpy 1-D array as obtained in Q.1, sort the elements in ascending order.
3. For the sorted Numpy 1-D array as obtained in Q.2, reverse the array and print.
4. Write a program to load three .csv files (Book1.csv, Book2.csv, and Book3.csv) as a list of Numpy 1-D arrays. Print the means of all arrays as a list.
5. Write a program to read an image, store the image in NumPy 3-D array. For the image, consider a .PNG. Display the image. Let the image stored in the NumPy array be X.
[Hint: Use OpenCV to work with image.](#)

6. Write a program to convert a color image (say a . PNG) into a grescale image. Let the greysacle image stored in the Numpy 2-D array be X. Display the grayscale iamge on the screen.
Hint: Greyscale value of a pixel is the mean of three RGB values of that pixel.
7. Let Y be the transpose matrix of X. Write a program to obtain $Z = X \times Y$.
8. **For the problem in Q. 7, write your program without using NumPy library. Compare the computation times doing the same with NumPy and basic programming in Python.**
9. Plot the pixel intensity histogram of the grescale image stored in X.
Hint: Use matplotlib to plot the histogram.
10. Create a black rectangle at the position [(40,100) top right, (70, 200) bottom left] in the grayscale image. Display the image.
11. Using the grayscale image stored in X, transform it into the binarized image with thresholds: [50, 70, 100, 150]. Let the binarized images are stored in Z50, Z70, Z100, and Z150, respectively.
Hint: Binarizing is thresholding each pixel value, i.e., if pixel>threshold, then 1 else 0.
12. Consider the color image stored in a .png. Create a filter of $\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}$, and multiply this filter to each pixel value in the image. Display the image after filtering.

Hint:

Links to the data for this assignment are given below. Additionally, you may run your programs with other appropriate data (optional).

[Book1.csv](#)

[Book2.csv](#)

[Book3.csv](#)

[a.png](#)

Evaluation:

- For Q. 1-4: 5 marks each. For Q. 5-12, 10 marks each.
- There will be no credit for a null submission (containg code for each task) to Moodle server.
- All programs should be well commented.
- **The submission deadline: 13.02.2024, 12:00 hours (according to the Moodle server time)**

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