Department of Computer Science & Engineering
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Basics of NumPy

Instructions:

- Solve the problems using "Jupyter Notebook" linked to "Anaconda Navigator".
- For each problem, create a "Markdown" window, mention the problem you have asked to solve followed by "Code" window containing your program and output of the program.
- As comments as much as you can.
- Upload the .ipynb file. Give the name of your file as **A6-<RollNo>.ipynb.** You have to upload only one file in this lab.

Time: 2 hours Full Marks: 100

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`"
   [5 points]

2. For the Numpy 1-D array as obtained in Q.1, sort the elements in ascending order.
   [5 points]

3. For the sorted Numpy 1-D array as obtained in Q.2, reverse the array and print.
   [5 points]

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 Points]

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.
   [10 points]

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.
   [10 points]

7. Let Y be the transpose matrix of X. Write a program to obtain Z = X×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.**
   [10 points]

9. Plot the pixel intensity histogram of the grayscale image stored in X.
   Hint: Use matplotlib to plot the histogram.

[10 points]

10. Create a black rectangle at the position [(40,100) top right, (70, 200) bottom left] in the grayscale image. Display the image.

[10 points]

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.

[15 points]

12. Consider the color image stored in `a.png`. Create a filter of [[-1,-1,-1][0,0,0][1,1,1]], and multiply this filter to each pixel value in the image. Display the image after filtering.

[15 points]

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**

Install dependencies:

Before its application, ensure the following:

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()
```

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