CS 4783/5783
Fall 2022
Assignment 0 – Python Fundamentals
Due: 09/02/2022 11:59 pm

Guidelines:

The goal of this assignment is to provide a refresher with python programming and the associated libraries that we will be using in this course such as NumPy and Matlplotlib. **There will be two parts to this assignment, for a total of 30 points.**

You will need to submit your code as a IPython notebook as demonstrated in class. It must be stored in a GitHub repository that you will need to create for this course. The submission will be on Canvas and will be just the link to the notebook on the GitHub repository containing your solution.

Problem 1

In this part of the assignment, you will work with file I/O operations, dictionaries, Numpy arrays and visualization with Matplotlib. You will write a simple Python script that will read a file named `test.txt`. You can hard code this into your program for convenience. A sample file is given on Canvas for your reference. Your program should read a text file and print a histogram of the letters present in the document. The code must have the histogram as both a dictionary, where the keys are letters and the values are the corresponding frequencies, as well as a Numpy array, where each index corresponds to a letter in alphabetical order. For example, the letter 'a' corresponds to index 0, 'b' to index 1, etc.

An example of a histogram for a line is given below:

```
Input: The quick brown fox jumps over the lazy dog
Output: {'a': 1, 'b': 1, 'c': 1, 'd': 1, 'e': 3, 'f': 1,
'g': 1, 'h': 2,
'i': 1, 'j': 1, 'k': 1, 'l': 1, 'm': 1, 'n': 1, 'o': 4,
'p': 1, 'q': 1, 'r':
2, 's': 1, 't': 2, 'u': 2, 'v': 1, 'w': 1, 'x': 1, 'y':
1, 'z': 1}
```

Given the computed histogram, create two bar graphs. In the first, the frequencies should be normalized i.e., the frequencies will sum to 1. In the second, they should be unnormalized. Make sure to generate titles appropriately for the graph and the axes. Display the plots to the user along with printing the histogram(s).

Problem 2

In this part of the assignment, you will be working with arrays using NumPy. You will be working with an image (test.png) that was provided on Canvas for convenience. You can read the image using OpenCV (installed by default on Colab) as follows.

```
import cv2
img = cv2.imread('input.png')
```

Perform the following operations:

1. For each pixel in the image, i.e., every element in the array `img`, compute the Euclidean distance to the following points [255, 0, 0], [0, 255, 0] and [0, 0, 255]. Once computed, set the value of the pixel to the point with the least distance. Save the image as `output1.png`
2. Set the pixels that fall within a square (whose sides are of length 50) at the center of the image to be [0,0,0]. Save the image as `output2.png`.

Problem 3

In this part of the assignment, you will be using NumPy to solve the following word problem. Specifically, you can use the LinAlg package from Numpy to solve the system of equations.

```
Problem statement:
You and a friend go to buy tacos. You get three soft tacos and three burritos and your total bill is $11.25. Your friend's bill is $10.00 for four soft tacos and two burritos. How much do soft tacos cost? How much do burritos cost?
```