Assignment 5

Indian Institute of Technology, Roorkee
Programming Lab (CS-504)

Autumn Semester

Problem Statement 1

Given a word-sequence and line-width, i.e., max. number of characters that can be put in a line. Develop a greedy solution to put line-breaks in the given sequence in a way to have balanced lines. Assume that the length of each word is smaller than the line-width. What is the time complexity of your solution?

Trace out the solution for the following two examples using your solution and state the cost in terms of the time complexity.

a) Word-sequence: 'aaa bb cc ddddd'
Line-width: 6
b) Word-sequence: 'This is known as the word wrap problem'
Line-width: 10

Problem Statement 2

Due to the worsening flood situation in some north-eastern state in India, every single road connecting different villages in a district damaged completely. So the district administration decided to rebuild the roads and establish a connection between every village again that too withminimum cost. So write a programming code that calculates the minimum cost to reconnect all villages by rebuilding the roads. There are N number of villages in total. Input is in the form of two-dimensional array buildcost[N][N], where buildcost[i][j] represent the cost to rebuild road between village i and j (0 in the case when there is no road between the villages). Print the minimum cost to reconnect the villages. Analyze the time and space complexity.

Problem Statement 3

Seam carving is dynamic programming based image resizing algorithm. A seam is a connected path of low energy pixels in an image. It is an optimal 8-connected path of pixels on a single image from top to bottom or left to right, where optimality is defined by an image energy function. By repeatedly carving out or inserting seams in one direction, we can change the aspect ratio of an image. Seam carving produces aesthetically pleasing images as opposed to image cropping or simply removing the rows and columns. (ref "Seam carving for content-aware image resizing," Shai Avidan, Ariel Shamir)

Seam carving problem can be thought of as finding path of lowest energy in a 2D array. In this question, you will implement the Seam Carving algorithm in C++,

Python, or Matlab. Below is a given example API in Python. Image reading code and energy computation code are provided. You have to write the code for unimplemented functions.

```
from matplotlib import image
import numpy as np

img = image.imread("image_file")
img = img[:,:,0]

#image energy function using abs of gradients
def compute_energy(img: np.ndarray):
   gs = np.gradient(img,axis=1)
   gy = np.gradient(img, axis=0)
   energy = np.abs(gx) + np.abs(gy)
   return energy

def compute_cumulative_min_energy_vertical(energy):
   To be implemented

def compute_cumulative_min_energy_horizontal(energy):
   To be implemented

def compute_optimal_seam_vertical( cumulative_energy_v ):
   To be implemented

def compute_optimal_seam_horizontal( cumulative_energy_h):
   To be implemented

def remove_seam_vertical( img, seam_v ):
   To be implemented

def remove_seam_horizontal(img, seam_h ):
   To be implemented

def display_seam( img, seam):
   To be implemented
```