Indian Institute of Technology, Jodhpur

Bridge Course on DSA

(Session: 2022-23)

Assignment 3

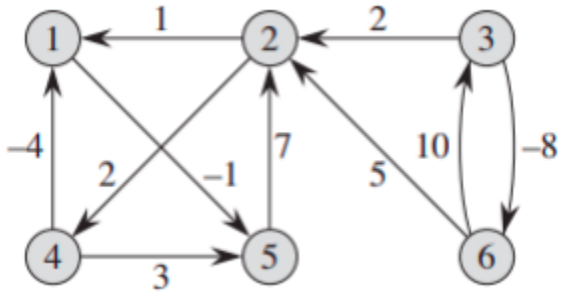
Instructions:

- The score points are assigned to the respective question
- You are required to attempt all the questions
- Answers need to be succinct and in your own words
- Verbosity is undesirable
- Please submit the solution within the provided deadline
- Plagiarism will not be tolerated. If plagiarism is detected, zero marks will be awarded for the entire assignment.

1. Write a program to implement:
    a. Prim's algorithm
    b. Kruskal's algorithm.
2. Write a program to find the weight of the minimum spanning tree given the graph.
3. You are given N cities, and the ith city contains a[i] blocks. If you want to build a road between ith and jth cities ($i \neq j$), then the number of blocks needed is gcd(a[i], a[j]). Here, gcd is the greatest common divisor. You have to build roads so that anyone can go from one city to another in precisely one way, not more than one way between two cities. You have to maximize the total number of blocks used to build roads. Print a maximum number of blocks used to build roads so that the provided condition is satisfied.
4. Let's consider some weird countries with N cities and M bidirectional roads of 3 types. It's weird because of some unusual rules about using these roads: men can use roads of types 1 and 3 only, and women can use roads of types 2 and 3 only. Please answer the following very interesting question: What is the maximum number of roads it's possible to destroy so that the country will still be connected for both men and women? A connected country is a country where it's possible to travel from any city to any other using existing roads.
5. Implement the following in AVL Tree & Red Black Tree
    a. Insertion
    b. Deletion
    c. Search

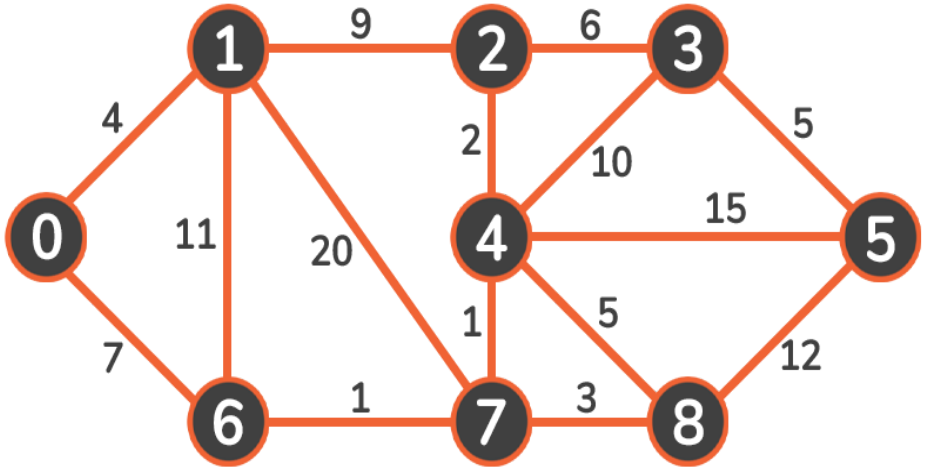
Section 2:

1. Apply the dijkstra algorithm to the directed, weighted graph shown in the following picture.Display the D(k) matrix that is produced after each round of the outer loop. **(Write the code for the same).**

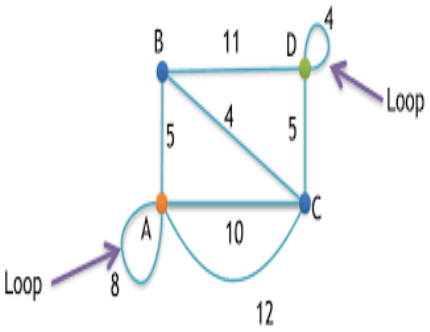


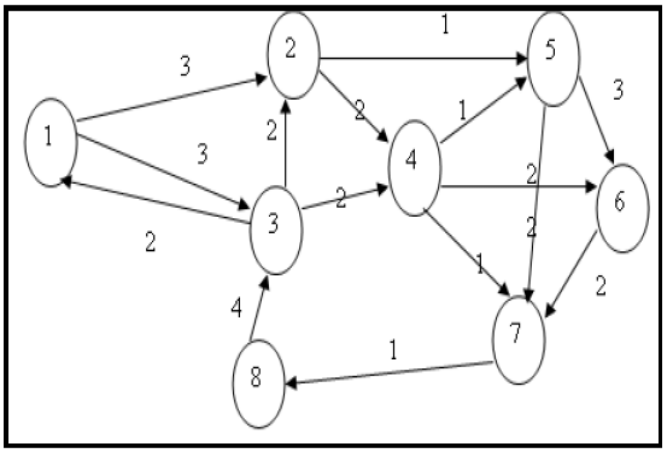
2. Implement Dijkstra algorithm for the below graph. **(Write the code)**.

   After that Suppose we switch Dijkstra's algorithm's while loop from while Q≠ ϕ to while |Q| > 1. This modification makes the while loop run |V| -1 times rather than |V| times. Is the suggested algorithm accurate? (why or why not) **Write code for the same.**



3. Take a look at the two undirected graphs g1 on the left and g2 on the right, respectively:





Implement given parts using dijkstra algorithm: **(Write the code for the same)**

A. Will we explore the full graph for graph g1 starting at node 0? List the nodes that have been visited, the shortest total distance that is now known for each node, and the best route that has been discovered so far to each node at the conclusion of each loop iteration.

B. Will we begin our search for node 0 in graph g2's full graph? At the conclusion of the procedure, list the shortest total distance currently known for each node and the best route to each node that has been discovered thus far.

4. Write Code for following scenario using dijkstra algorithm.In India, there are several cities. One of them is the capital. Cities are connected to each other by straight roads. Each year, only one person from each city has the opportunity to work in the capital. Prime Minister holds an annual contest. The rules are as follows:

1. The contestants will start running from their city. (at the same time)
2. Entry to the capital will only be allowed for a fixed time from the moment they all start operating.
3. Anyone who can enter the capital during this fixed time will certainly be allowed to work there.

Considering connections and distances between cities and capitals, the goal was to write a program to find out how many candidates could work in the capital. When designing the program, you can assume that applicants will find a route to the capital before the entrances close, if at all.