**HW4**

**Question 1 (25 Points)**: Write a Java program that will take a directed graph as input (say G) and reverse the original graph (say G'). Then, determine the maximum in-degree and maximum out-degree. For example, see Fig 1(b), which is the reversed version of Fig. 1(a). In Fig 1(b), Node-0 has the maximum indegree (3) and Node-4 and Node-5 have the maximum out-degree (2).

**Question 2 (25 Points)**: Apply prims algorithm on the graph given below to find the MST. Start the algorithm from node F. To earn full points, you must do the followings:

1. Draw the MST. Clearly level the nodes and edges

Diagram

Description automatically generated

II. Show the final state of the following table. Check the slides taught in the class for reference.

|  |  |  |
| --- | --- | --- |
| **Node** | **Cost** | **Prev** |
| A | 8 | E |
| B | 4 | A |
| C | 2 | F |
| D | 7 | C |
| E | 1 | G |
| F | 0 | NULL |
| G | 2 | H |
| H | 4 | C |
| I | 9 | D |

**Question 3 (25 Points)**: The mayor of Christchurch takes a mega project to build roads among eight towns. The streets cost $5000 per mile, and the mayor wants to minimize the cost but must connect all towns. The following graph shows the geographical location of these towns and the length of roads (in mile). For example, the road length between C and F is 42 miles.

• What is the minimum length of the roads that connect all the towns? Show the updated graph that connect all the towns with minimum cost. **The minimum length to connect all the town is 115 miles.**

Text, letter

Description automatically generated

• What is the total cost of the project?

**Total Cost: 115 miles \* $5000/mile = $575,000**

**Question 4 (25 Points):** A networking company uses a compression technique to encode the message before transmitting over the network. The message contains the following characters with their frequency. Assume that initially (before encoding) all characters require 3 bits to represent (a = 000, b = 001…). If the compression technique used is Huffman Coding,

1. How these bits will be represented (show the tree)?

Diagram

Description automatically generated

1. Determine how many bits will be saved in the message?

**133 bits**

1. Decode this message according to the Huffman tree you have constructed: **1011011010.**

**FFFE**