CSE 3500 – Algorithms and Complexity
Homework 5

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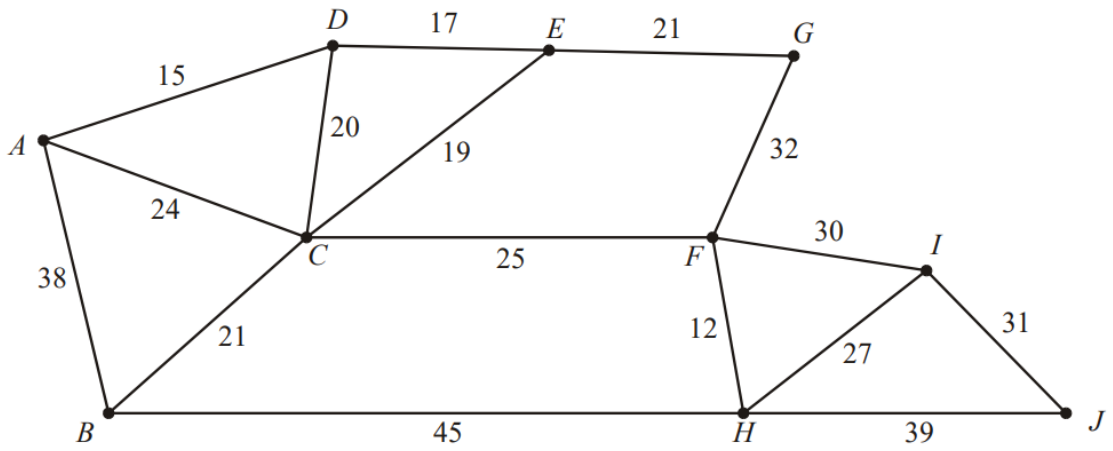
1. (40 points) Minimum spanning tree

1. In the diagram, we have 10 cities, and the distances between them are measured in kilometers. Our objective is to establish an electricity network that delivers power to these cities while minimizing the cost of the wires required for the connection.
To achieve this, we need to find a minimum spanning tree for the city shown in the diagram. The process should clearly illustrate the order in which you selected the edges for your tree. You should accomplish this using:



Find a minimum spanning tree for the network in the diagram above, showing clearly the order in which you selected the edges for your tree, using:
(i) Kruskal's algorithm,
(ii) Prim's algorithm, starting from A

2. Can Prim's and Kruskal's algorithm yield different minimum spanning trees? Explain why or why not.

3. Can Prim's algorithm produce the correct Minimum Spanning Tree (MST) when negative edge weights are present? Explain the reasoning behind your answer.

4. Can Kruskal's algorithm produce the correct Minimum Spanning Tree (MST) when negative edge weights are present? Explain the reasoning behind your answer.

2.(40 points) Huffman Code

A file contains the following characters with the frequencies as shown.

Characters	Frequencies
a	10
e	15
i	12
o	3
u	5
s	13
t	1

1. If you used fixed-length code to encode the message, how many bits do you need per character?

2. If you used fixed-length code to encode the message, how many bits do you need to encode this message?

3. Create a Huffman encoding tree for the given file. Follow the algorithm taught in class precisely to obtain identical codes.

4. What are the codes for each character after using Huffman coding? Fill the table.

Character	Code	Number of Bits
a		
e		
i		
o		
u		
s		
t		

5. What is the average number of bits per character after using Huffman coding?

6. how many bits do you need to encode the file if Huffman codes are used?

7. Encode the following word using Huffman codes
   Outset

8. Decode the following codes:
   11111011100011001
   01001100010
   0110111
   101110111000

3. (10 points) Huffman Code

Under a Huffman coding of *n* symbols with frequencies *f1, f2, ..., fn*, what is the longest a codeword could possibly be? Give an example set of frequencies that would produce this case.