School of Computing and Information Technology

ASSIGNMENT 3
(Individual)

CSIT113 – Problem Solving

Session 3, July -- September 2023

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Total No of Questions:	Seven (7) questions
Total Marks:	100 marks
Weightage:	8% of total subject mark

Objective

In this assignment, students are assessed on the understanding of the materials from Unit 8 to Unit 10 in the lecture notes. Students are required to apply the appropriate strategies and methods discussed in these units for each of the problems stated in the questions in this assignment.
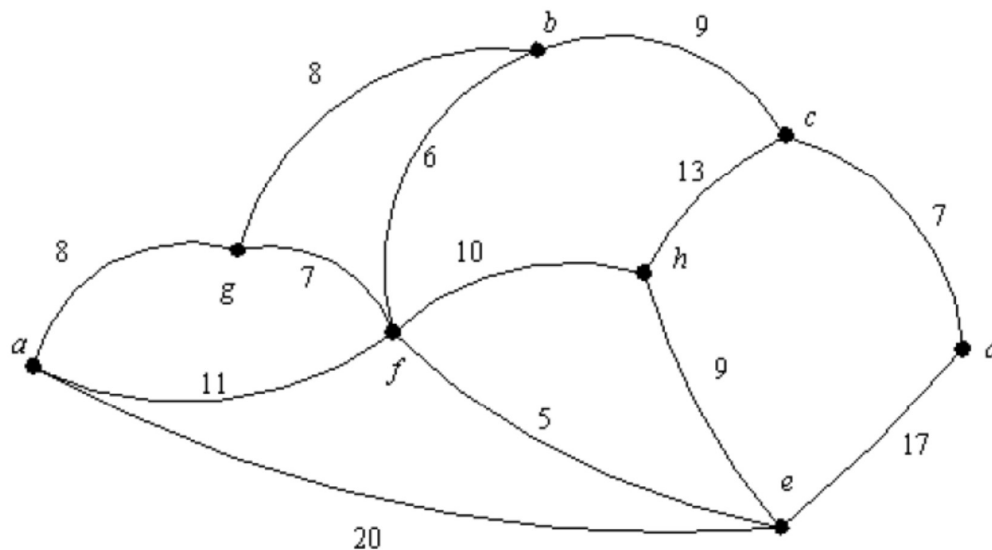
Question 1 [15 marks]:

The costs for all the possible options to construct the roads for connecting a pair of cities is shown in the following table:

Pair of cities	Cost
(A, B)	2
(B, C)	3
(C, D)	2
(C, E)	7
(A, C)	4
(A, F)	3
(B, E)	5
(F, D)	6
(E, D)	7

Draw a graph to model the problem and then use *Kruskal*'s algorithm to find the roads to be constructed such that all the cities are connected and the total cost is minimum. You must show the sequence of edges added when you apply the algorithm and the minimum cost for constructing all the roads.

Question 2 [10 marks]:

Start from vertex e, find a minimum spanning tree of the following graph using *Prim*'s algorithm:

Show the minimum weight and the sequence of edges added.

Question 3 [15 marks]:

The lengths of all the roads connecting a pair of cities is shown in the following table:

Pair of cities	Length (km)
(A, B)	2
(B, C)	3
(C, D)	2
(C, E)	7
(A, C)	4
(A, F)	3
(B, E)	5
(F, D)	6
(E, D)	7

Draw a graph to model the problem and apply a suitable algorithm to find a shortest path from city C to each of the remaining cities. You must show all the steps in finding these paths step-by-step using a table.

Question 4 [20 marks]:

We want to assign 4 people to 4 jobs so that the total cost of the assignment is as small as possible. The constraint to the problem is that each job is assigned to only one person, and each person is assigned with only one job. The table gives the cost of a person completing a particular job.

Person \ Job	1	2	3	4
A	9	5	4	5
B	4	3	5	6
C	3	1	3	2
D	2	4	2	6

Using branch-and-bound algorithm, assign the four jobs to the 4 people such that the total cost of the assignment is optimal. Your state-space tree must include node numbers to show the order that you draw the nodes.

Question 5 [20 marks]:

Apply backtracking to find a subset of numbers with sum 25 from the numbers the following sequence:

8	10	12	14	16

You must show the state-space tree in the process of applying backtracking and state the reason for your conclusion clearly.

Question 6 [10 marks]:

(a) Construct a binary search tree (BST) built from inserting the numbers given below. The numbers are to be inserted from left to right.

56, 14, 58, 57, 15, 13, 56, 19, 20, 18, 17

(b) Draw the resultant BST after deleting 14 from the BST constructed in Q6a).

Question 7 [10 marks]:

List the order in which the vertices of the graph shown in Figure 1 are visited when the following methods are applied with the start vertex = a:

       (a) the breath-first-search
       (b) depth-first-search

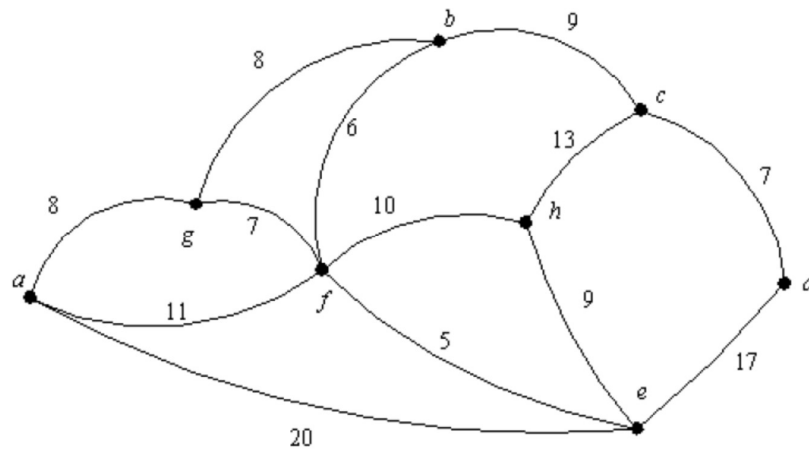Assume that the vertices are listed in increasing order in each adjacency list.

Figure 1