School of Computing and Information Technology

ASSIGNMENT 3
(Individual)

CSIT113 – Problem Solving

Session 1, January – March 2024

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Total No of Questions: Seven (7) questions

Total Marks: 100 marks

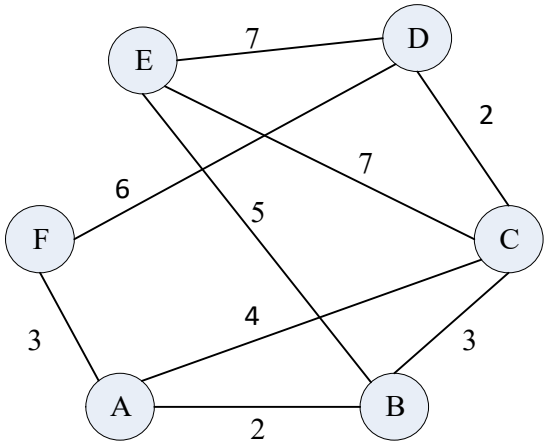
Weightage: 8% of total subject mark

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 [12 marks]:

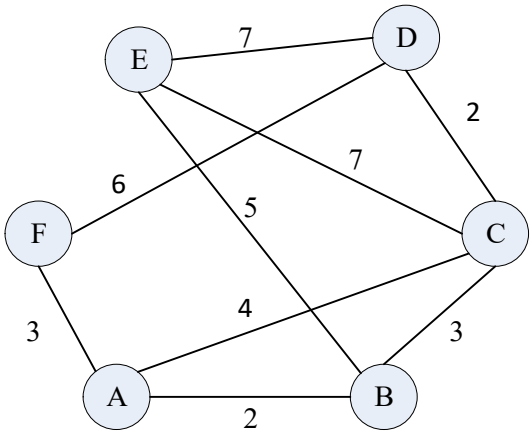
Use Dijkstra's algorithm to find the shortest paths from vertex E to all other vertices in the following graph:



Show the shortest path table and shortest path tree according to the example in the lecture note,

Question 2 [12 marks]:

Find a minimum spanning tree of the following graph using Prim's algorithm with starting vertex C and show the sequence of edges that are chosen when the algorithm is used, and the weight of the minimum spanning tree:



Question 3 [20 marks]:

A factory requires 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	10	6	5	6
B	5	4	6	7
C	4	2	4	3
D	3	5	3	7

Using branch-and-bound technique through **setting lower bound as the sum of the lowest cost values in each row**, to assign the four jobs to the four people such that the total cost of the assignment is optimal. Your state-space tree **must have the least number of nodes**. You **must indicate the sequence number of the nodes according to the order you draw the nodes**.

Question 4 [12 marks]:

Use the backtracking problem-solving technique to place 5 queens on a 5×5 board so that no two queens are in the same row, column, or diagonal, **by placing one queen on a column each time from left to right (first strategy)**. When a queen is placed in the board, **you are also required to consider the rows from top to bottom order (to be followed when have multiple choice)**. Show the state-space tree in applying the technique clearly with the order in which each node is created indicated

Question 5 [20 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.

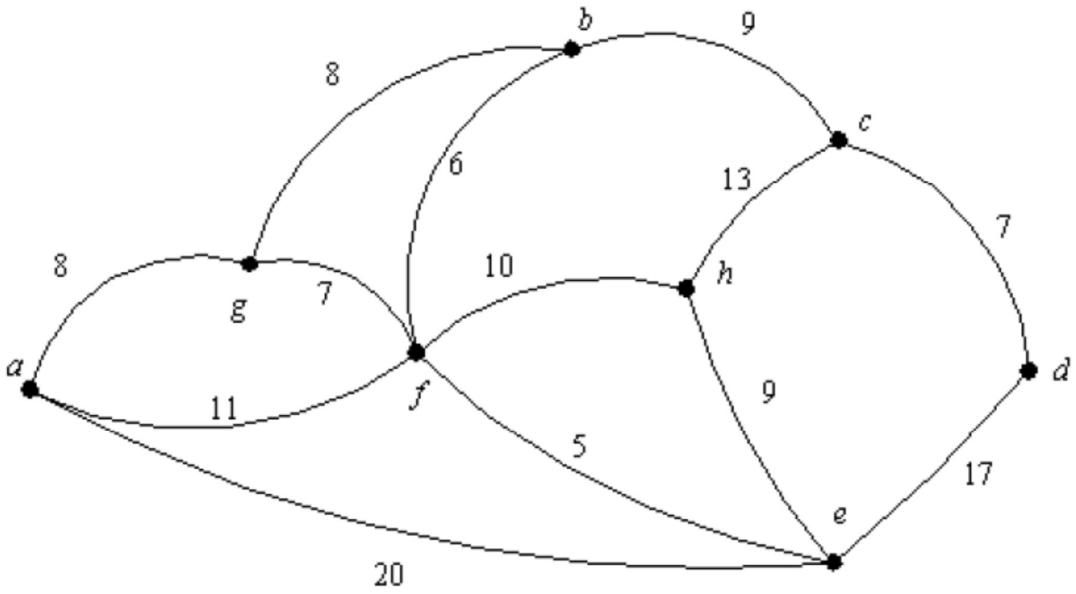
32, 22, 38, 34, 25, 23, 23, 29, 30, 28, 27

(b) Draw the resultant BST after each following deletion from the BST constructed in Q3a) according to the order show:

i) 25 is deleted
ii) 38 is deleted

Question 6 [12 marks]:

Find a minimum spanning tree of the following graph using *Kruskal*'s algorithm:



Show the minimum weight and the sequence of edges added

Question 7 [12 marks]:

List the order in which the vertices of the graph shown in Figure 1 are visited when the depth-first-search algorithm is applied with the start vertex = 16. Assume that the vertices are listed in increasing order in each adjacency list.

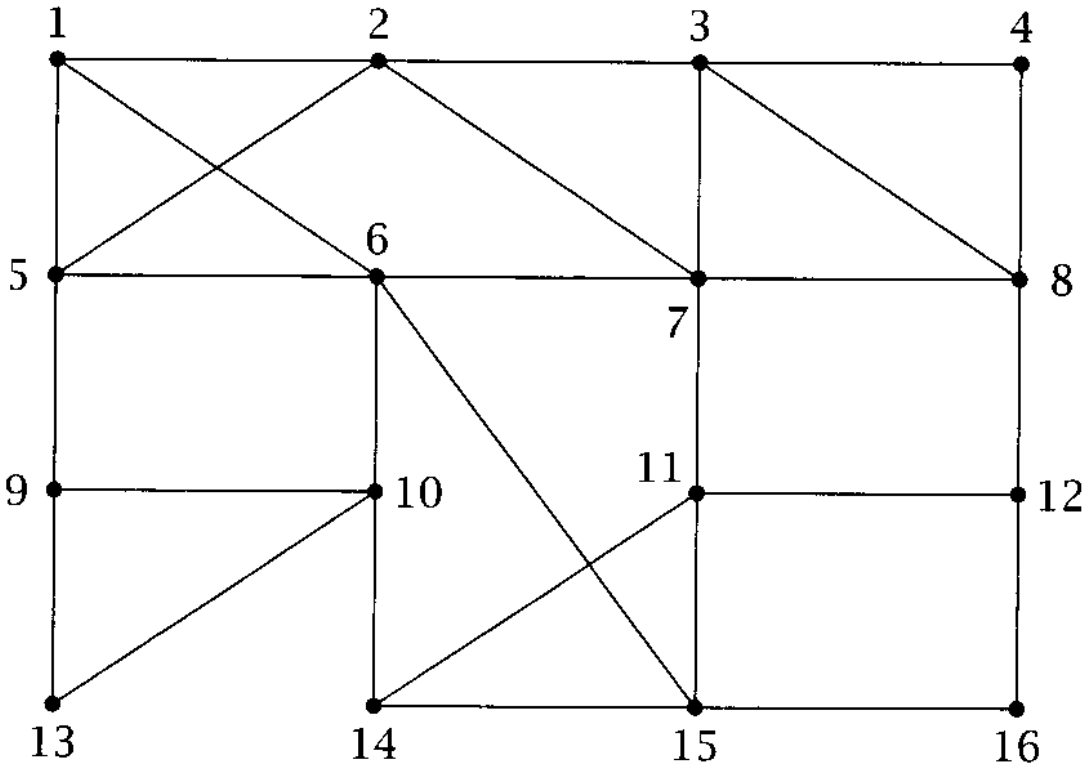


Figure 1