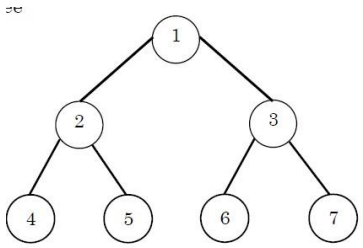
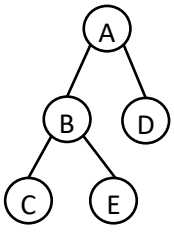
AV121 – Data Structures and Algorithms
Practice Questions

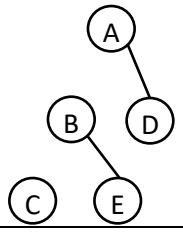
Part 1

Questions in this part carry 1 mark each. Explain your answer if you would like to.

Note 1: For the quiz, if your answer is wrong and there's no explanation, you get no credit. However, if you gave an explanation and it points in the right direction, you will get partial credit even if the final answer is wrong.

Note 2: Part 1 of the Quiz 2 question paper will contain 5 questions of this type (Total: 5 marks)

1.1	What is the post-order traversal for the tree given below?  	(1 mark)
1.2	Which of the following statement is false? (A) A tree with n nodes has (n-1) edges. (B) A labeled rooted binary tree can be uniquely constructed given its postorder and preorder traversal results. (C) A complete binary tree with n internal nodes has (n+1) leaves. (D) The maximum number of nodes in a binary tree of height h is (2^(h+1) -1).	(1 mark)
1.3	Write down the pre-order traversal sequence for the tree shown below:  	(1 mark)

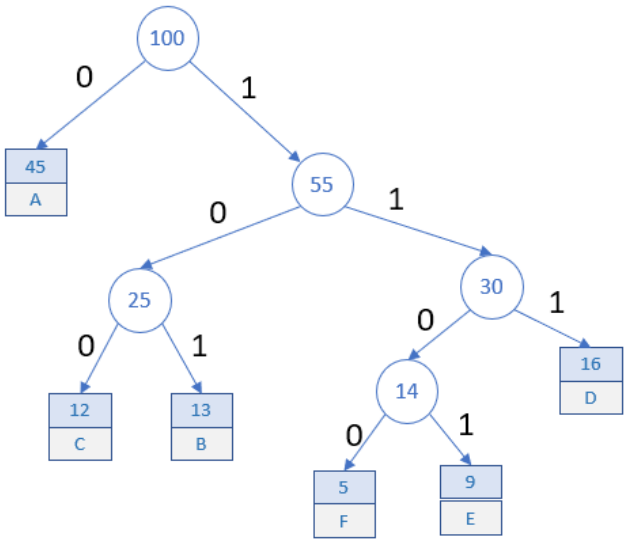
1.4	State whether the following statement is true or false: "A binary search tree containing integers can be uniquely reconstructed if its pre-order traversal is given to you."	(1 mark)
1.5	Suppose the numbers 40, 60, 50, 33 are inserted in order into an empty binary search tree. Show the 4 stages.	(1 mark)
1.6	Which of the following statements is true: A. All AVL Trees are binary search trees B. All Red-Black Trees are binary search trees C. All binary search trees are AVL Trees D. Both A&B E. All of the above	(1 mark)
1.7	Search operation in a binary search tree always completes in O(log n) time: True False Can't say	(1 mark)
1.8	Search operation in a Red-Black tree always completes in O(log n) time: True False Can't say	(1 mark)
1.9	"In a Red-Black Tree, path from the root to the farthest leaf is no more than twice as long as the path from the root to the nearest leaf." Select the most suitable answer that applies to the above statement from the options below: A. True B. False C. Can't say	(1 mark)
1.10	Which of the following statements about Red-Black trees is false: Every node is either red or black A red node can have only red children A black node cannot have black children Every path from the root to any leaf node must contain the same number of black nodes	(1 mark)
1.11	How many connected components are there in the graph shown below?  	(1 mark)

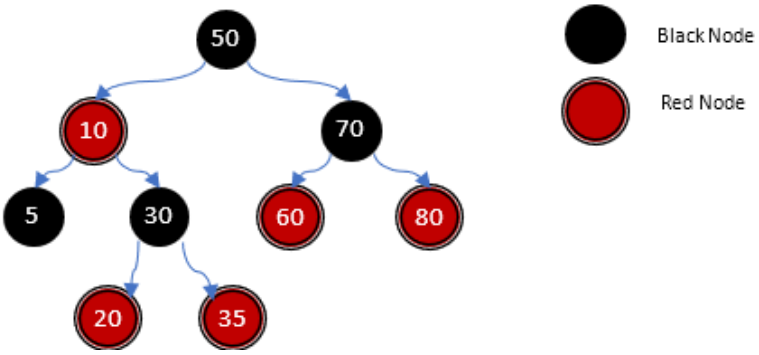
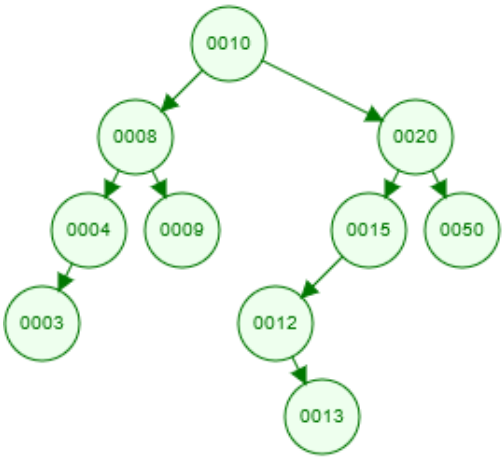
1.12	Height of a 2-3 tree is bounded by: A. O(log n) B. O(n) C. O(nlog n) D. None of the above	(1 mark)
1.13	2-3 Trees grow downwards from the root when new nodes are inserted: A. True B. False	(1 mark)
1.14	Which of the following statements are true? A. All trees are graphs B. All graphs are trees C. Both A and B D. None of the above	(1 mark)
1.15	State whether the following statement is true or false: "Depth-first search can be used to find out the shortest distance from a node to all other nodes in an unweighted graph."	(1 mark)
1.16	Depth-first search of any graph always generates a unique tree A. True B. False	(1 mark)
1.17	Breadth-first search can be used to find out the shortest distance from a node to all other nodes in an unweighted graph A. True B. False	(1 mark)
1.18	Which representation is better for representing a sparse graph? A. Adjacency Matrix B. Adjacency List	(1 mark)
1.19	State whether the following statement is true or false: "Dijkstra's Single Source Shortest Path algorithm is used to identify a minimum spanning tree on a graph."	(1 mark)
1.20	State whether the following statement is true or false: "Dijkstra's Single Source Shortest Path algorithm provides an exact solution to the Traveling Salesman Problem."	(1 mark)

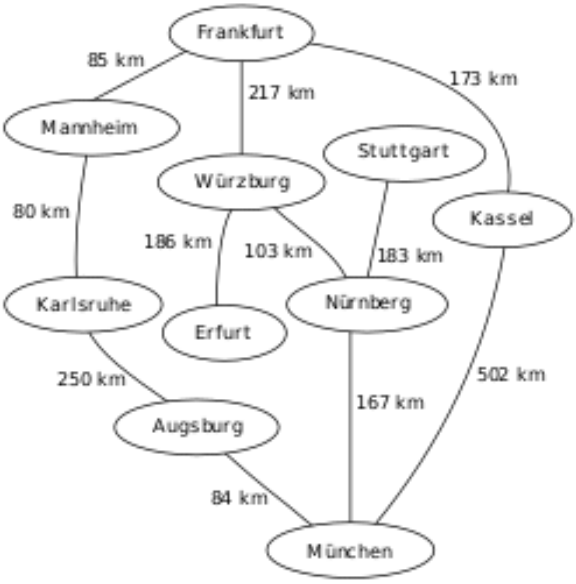
Part 2

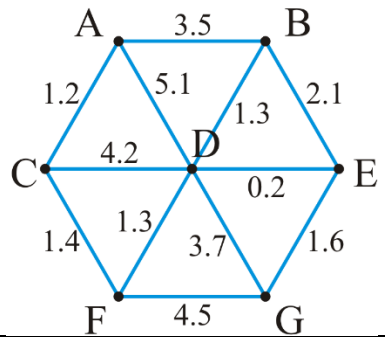
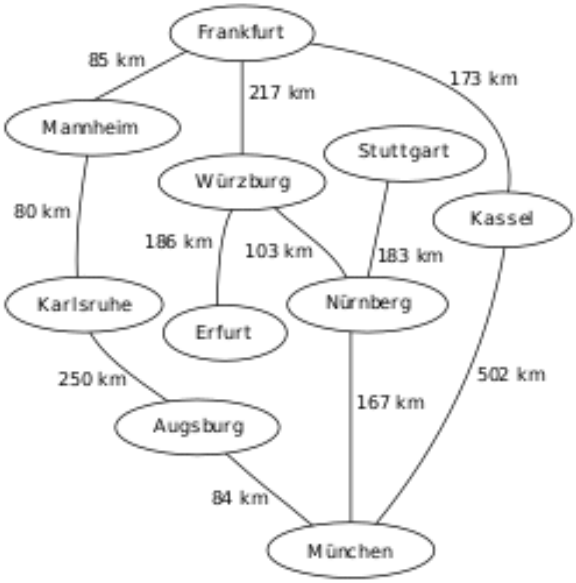
Questions in this part carry 2.5 marks each. Please give detailed answers.

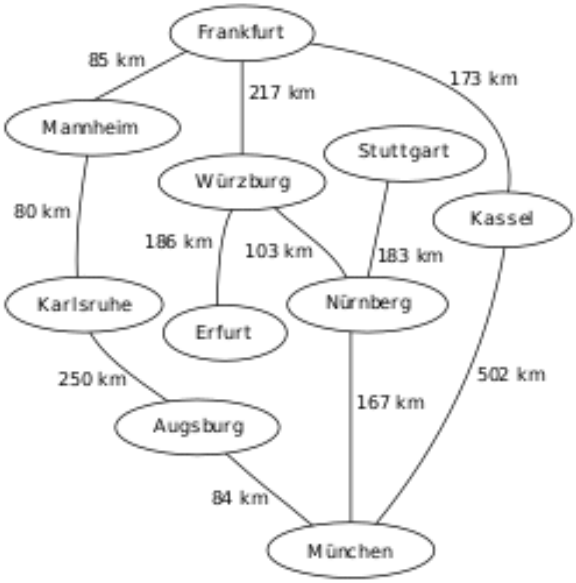
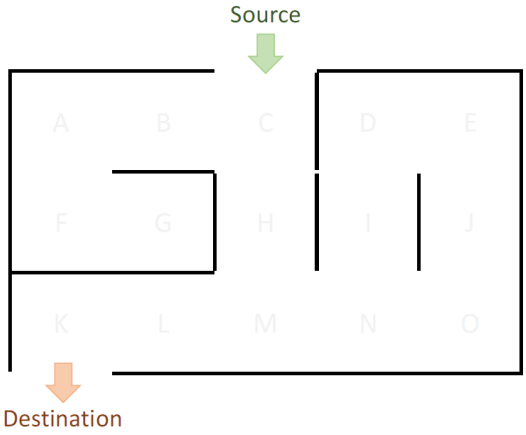
Note 3: Part 2 of the Quiz 2 question paper will contain 4 questions of this type (Total: 10 marks)

2.1	Construct an AVL tree from the following elements (in the order given below) 10, 30, 70, 90, 80, 6, 2 Show the tree after inserting each number. After inserting the last number, what is the height of the resulting AVL tree?	(2.5 marks)
2.2	Explain how Huffman coding is useful in representing data efficiently. Given the following Huffman Tree, decode the binary sequence: **001011101**  	(2.5 marks)
2.3	Insert the following numbers in to an AVL Tree 10, 25, 35, 45, 55, 75, 5, 4, 3, 2, 1 Show the tree structure and rotations after each insertion	(2.5 marks)

2.4	Given the following RB Tree:  Show the steps required in inserting the following numbers and the steps required (if any) to maintain the Red-Black tree rules: ○ Insert 1 ○ Insert 85 ○ Insert 6 Show the tree after each step.	(2.5 marks)
2.5	Delete the following elements from the BST below. Show the tree structure after each deletion: 10, 20, 8, 15, 3  	(2.5 marks)
2.6	Construct a 2-3 tree by inserting the following elements in the given order: 10, 20, 30, 40, 50	(2.5 marks)

2.7	Given the following mathematical expression: (4*8) + (8-4) ÷ (1 + (5*3)) • Construct the equivalent expression tree. • Write down the inorder, preorder and postorder traversals of the tree. • Which of the above traversals is the most suitable input to a computer that has a stack available for evaluation?	(2.5 marks)
2.8	Draw the graph, represented by the following information: Set of vertices, V = {A, B, C, D, E} Set of edges, E = {(A-B), (A-D), (B-C)} Carry out Breadth-First Search and Depth-First Search on this graph and draw the corresponding BFS Tree and DFS Tree. Are the BFS and DFS trees unique? **Note: If the starting point of BFS / DFS is not specified in the question, you are free to start at any node in the graph.**	(2.5 marks)
2.9	Carry out BFS on this graph, starting at Frankfurt:  	(2.5 marks)

2.10	Which technique will you use for planning a cable network, reaching all cities in a state? Explain how you will accomplish this task at the minimum cost possible.	(2.5 marks)
2.11	Identify a minimum spanning tree of this graph 	(2.5 marks)
2.12	Construction a minimum spanning tree of this graph using Prim's algorithm 	(2.5 marks)
2.13	Construction a minimum spanning tree of this graph using Kruskal's algorithm	(2.5 marks)

		
2.14	How can you make a computer systematically find a path through the given maze? Explain the algorithm and show the steps taken by the algorithm for solving the maze. 	(2.5 marks)
2.15	Carry out BFS on this unweighted undirected graph and identify the shortest path from G to all other nodes (In terms of number of edges traversed).