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Thapar Institute of Engineering & Technology, Patiala

Department of Computer Science and Engineering

END Semester Test

B. E. (Second Year): Semester-I (2024-25)(Minor CSE)

Course Code: UCM004

Course Name: Data Structures

20 Dec, 2024

Time: 9.00-12 Noon

M. Marks: 40

Name of Faculty: Dr. Rajendra Ku. Roul

(Note: Answer any 5 questions. Write all sub-parts of a question together. Assume any missing value suitably. All the symbols and notations used here have their usual meaning.)

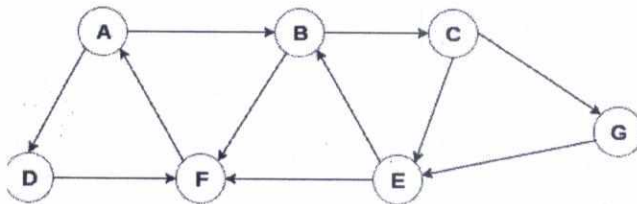
Q1. a) Consider an empty binary search tree (BST). You have asked to add all the 12 months of a year one by one in a sequence to the empty BST starting from 'Jan'. Delete 'Feb' and then 'Mar' from the BST. (Note: consider only the first three letters of a month and the first character is capital letter for all the months.) Show the final tree after inserting all the 12 months and then two more trees after deleting 'Feb' and 'Mar' from the BST. (4M, CLO3, BL2)

b) Inorder Traversal: [5, 10, 12, 15, 20, 22, 25, 30, 35, 40, 45]

Postorder Traversal: [5, 12, 10, 22, 20, 15, 35, 45, 40, 30, 25]

Consider the above traversals of a binary search tree (BST). Construct such BST by showing the intermediate steps. (4M, CLO3, BL2)

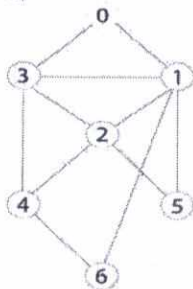
Q2. a) Consider the following graph $G(V, E)$. Show the adjacency list and adjacency matrix of G . Run the Breadth First Search (BFS) algorithm on it by considering 'A' as the source node. Show the content of the queue at each step along with the generated BFS Tree. (Note: To make the answer unique, you are strongly advised to consider the adjacency list in an alphabetical order.) (4M, CLO4, BL1)



b) Consider the following elements of an unsorted array and you have asked to sort them using merge sort. Clearly show the steps to sort the array element. (4M, CLO2, BL1)

13, 20, 10, 15, 6, 30, 27, 14, 43, 29

Q3. a) Consider the following graph $G(V, E)$. Show the adjacency list of G . Run the Depth First Search (DFS) algorithm on it starting from the node '0' by showing the content of the stack along with the starting and finishing time at each node. Finally, show the generated DFS Tree. (Note: To make the answer unique, you are strongly advised to consider the adjacency list in a sequencing order.) (4M, CLO3, BL3)



b) Consider the following elements and sort them using quick sort by selecting 10 as the pivot element. Show all the intermediate steps till 10 get its fix position in the array.

13, 20, 4, 15, 6, 30, 27, 14, 43, 29, 10 (4M, CLO2, BL2)

Q4. a) Discuss different advantages and disadvantages of a linked list over array? Give suitable examples to support your answers. (2M, CLO1, BL4)

b) Write algorithms to implement the following on Binary search tree. (6M, CLO3, BL2)

i) Finding minimum and maximum element in a BST.

ii) Finding successor of a node in a BST.

iii) Finding inorder traversal of nodes in a BST.

Q5. a) Explain with example how can you implement a stack using two queues. (4M, CLO1, BL2)

b) Assume that stack **A** has been given to you and has four entries: a, b, c, d (with **a** on the top). An entry popped out of stack **A** can be printed immediately or pushed to stack **B**. An entry popped out of stack **B** can only be printed. In this arrangement, how many permutations of a, b, c, and d are *not* possible? List all those permutations. (4M, CLO1, BL2)

a
b
c
d
A

Q6 a) Given the following weighted graph, find the shortest path from vertex A to all other vertices using Dijkstra's Algorithm. Provide the shortest distance to each vertex and the corresponding path. Show the content of the queue at each stage used for the above problem. (4M, CLO1, BL2)

Graph Details:

Vertices: A, B, C, D, E

Edges with weights:

A → B: 4

A → C: 2

B → C: 1

B → D: 5

C → D: 8

C → E: 10

D → E: 2

b) Given the in-order traversal: [10, 15, 20, 25, 30, 35, 40, 45, 50, 55], (4M, CLO3, BL2)

i) Construct a BST from the given traversal.

ii) Find the post order traversal of the BST.
