VIT Vellore Institute of Technology

Reg. No. : 21BCE1808

46-50

Final Assessment Test (FAT) – November/December 2022

Programme	**B.Tech.**	Semester	**Fall Semester 2022-23**
Course Title	**DATA STRUCTURES AND ALGORITHMS**	Course Code	**BCSE202L**
Faculty Name	**Prof. M Suguna**	Slot	**D1+TD1**
		Class Nbr	**CH2022231001053**
Time	**3 Hours**	Max. Marks	**100**

SECTION A (10 X 10 Marks)

Answer All questions

1. (a). Is $2n^3+4n^2+5 = O(n^5)$? Justify your answer. (5 Marks) **[10]**
   (b). Give asymptotic upper and lower bounds for $T(n) = 2T(n/2)+n^3$. Assume that T(n) is constant for $n \leq 2$. Make your bounds as tight as possible, and justify your answer (5 Marks)

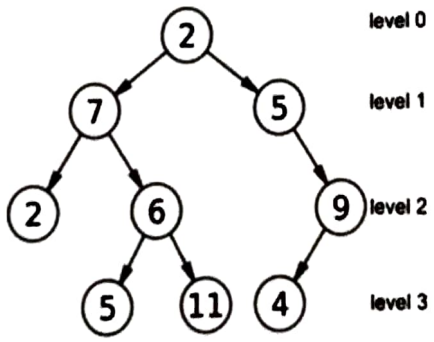
2. Consider two singly linked lists **L1** and **L2** of sizes **m** and **n** respectively. Let X and Y be two nodes in the list L1. Write an algorithm to remove the nodes X and Y from the list L1 and insert the node X before the first node in L2 and insert the node Y as the last node in L2. **For example, your algorithm produces output L1:** 9->10->12->13 and L2: 11-> 100 -> 101->102->103->14 if L1: 9->10->11->12->13->14, L2: 100->101->102->103, X=11 and Y=14. **[10]**

3. Let Q be a queue of integers of size n and let k be a given integer. Write an algorithm to reverse the order of the first k elements of Q , leaving the other elements in the same order. Your algorithm must use queue operations only. For example, your algorithm produces output Q :[50, 40, 30, 20, 10, 60, 70, 80, 90, 100] if Q : [10, 20, 30, 40, 50, 60, 70, 80, 90, 100], k = 5. **[10]**

4. **Nuts and Bolts problem**: You are given a collection of 'n' bolts of different widths and 'n' corresponding nuts. You are allowed to try a nut and bolt together, from which you can determine whether the nut is larger than the bolt, smaller than the bolt, or matches the bolt exactly. However, there is no way to compare two nuts together or two bolts together. The problem is to match each bolt to its corresponding nut. Write an algorithm to solve the Nuts and Bolts problem and also illustrate your algorithm for any sample input . **[10]**

5. Given a Binary Search Tree 'T', and two keys k1 and k2. Write an algorithm to print all keys of T in the range of k1 and k2. Illustrate your algorithm with a sample input. **[10]**

6. Write an algorithm to display the list of levels of a binary tree where these levels contain maximum number of nodes. For example, the following binary tree has maximum number of nodes at level-2 and level-3. **[10]**



Illustrate your algorithm with a sample input.

7. Consider a complete undirected graph $G = (V, E)$ with nodes $v_1, v_2, v_3, \ldots, v_n \in V$ and an edge $(v_i, v_j) \in E$ where $i = 1, 2, \ldots, n$ and $j = 1, 2, \ldots, n$. Derive a new graph $G^1 = (V, E^1)$ from G such that $(v_i, v_j) \in E^1$ where i is an even number and j is an odd number. The graph G^1 is a subgraph of the graph G. Write an algorithm to compute G^1 using adjacency matrix of G. For example, $G = (V, E)$ is a complete graph where $V = \{1, 2, 3, 4\}$. Your algorithm should produce a graph $G^1 = (V, E^1)$ where $V = \{1, 2, 3, 4\}$ and $E^1 = \{(2, 1), (4, 1), (2, 3), (4, 3)\}$ for the graph G. **[10]**

8. Let $G = (V, E)$ be any directed weighted graph, where $|E| = m$ denotes the number of edges, $|V| = n$ denotes the number of nodes. $w(u, v)$ denotes the weight associated with each edge in G. Assume s is the source node in G. Let p be a given positive integer. The length of a path is equal to the sum of weights of edges on the path. For given G and s, write an algorithm to check whether there is a shortest path from s to any other nodes in G, whose length is equal to p or not. Illustrate your algorithm with a sample input. **[10]**

9. Given values **{2341, 4234, 2839, 430, 22, 397, 3920}**, a hash table of size 7 and a hash function $h(x) = x \bmod 7$. Show the resultant table after inserting the values in the given order with each of the following collision strategies. **[10]**

   i) Linear probing (5marks)

   ii) Quadratic probing (5marks)

10. Build an AVL tree using the following keys A,B,C,D,E,F,G,H,I,J and K. After the insertion, delete two keys using LIFO (Last In First Out) order i.e., last inserted element should be deleted first. Illustrate the insertion and deletion procedure for the given keys. Write an algorithm for delete operation for the given case. **[10]**

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Final Assessment Test (FAT) - May 2024

Programme	**B.Tech.**	Semester	**WINTER SEMESTER 2023 - 24**
Course Title	**DATA STRUCTURES AND ALGORITHMS**	Course Code	**BCSE202L**
Faculty Name	**Prof. Om Kumar C U**	Slot	**E2+TE2**
		Class Nbr	**CH2023240502725**
Time	**3 Hours**	Max. Marks	**100**

General Instructions:

- Write only Register Number in the Question Paper where space is provided (right-side at the top) & do not write any other details.
- If any assumptions are required, assume the same and mention those assumptions in the answer script.

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Section - I

Answer all questions (4 X 15 Marks = 60 Marks)

01. (i) Given an array of strings str, organize the strings into groups of anagrams. Write an algorithm to return the result in any order. For instance, if str[ ] = {"eat", "tea", "tan", "ate", "nat", "bat"}, the output should be {["bat"], ["nat", "tan"], ["ate", "eat", "tea"]}. Similarly, if str[ ] = {"cat", "dog", "tac", "god", "act"}, the output may be {["cat", "tac", "act"], ["dog", "god"]}. An anagram is a word or phrase formed by rearranging the letters of another word or phrase, typically using all the original letters exactly once. (8 Marks) **[15]**

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(ii) Given a sorted array A and a key. Write an algorithm to find the first starting and ending indices of the key in the array. If the key is not found, return [-1, -1]. For example, if A = [1, 2, 3, 3, 3, 4, 4, 5] and the key is 5, the algorithm should return [7, 7]. Similarly, if A = [1, 2, 3, 3, 3, 4, 4, 5] and the key is 3, the algorithm returns [2, 4]. (7 Marks)

7

02. Consider a linked list 'L' which is always of even size 'N'. Write an algorithm to swap the elements in odd positions with the elements in even position. For example if L= 10 -> 20 -> 30 -> 40 -> 50 -> 60 -> 70 -> 80, where N=8 then your algorithm should modify L as 20 -> 10 ->40 ->30 ->60 -> 50 ->80 -> 70. **[15]**

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Rubrics:

Algorithm (8 Marks) Illustration (7 Marks)

03. Given a Binary Search Tree (BST) and a positive integer k, write an algorithm that identifies if there are two nodes in the BST whose values add up to k. For example, if k is assumed to be 7 then there are two pairs (1,6), (2,5) that sum up to 7. **[15]**

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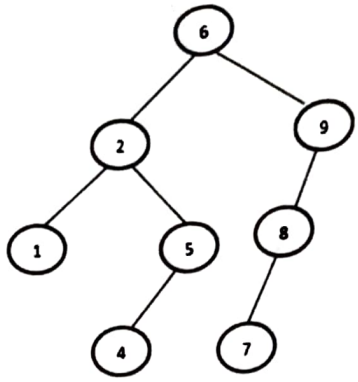


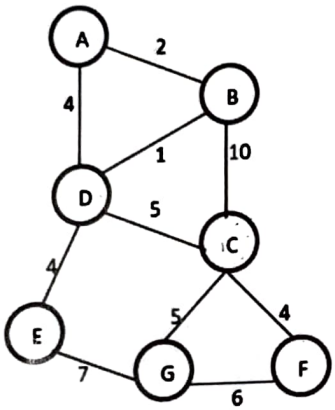
Rubrics:

Algorithm (8 Marks) Illustration (7 Marks)

04. (i) Use Dijkstra's algorithm to find the shortest path on the below graph between A and G. (8 Marks) [15]

(ii) Given a connected and weighted undirected graph, construct a minimum spanning tree out of it using Kruskal's Algorithm. (7 Marks)

(15)



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Section - II

Answer all questions (4 X 10 Marks = 40 Marks)

05. (i) Solve the recurrence relation $T(n) = n^{1/2} T(n^{1/2}) + n^{1/2}$ through substitution method. (5 Marks) [10]

(ii) Solve the recurrence relation $T(n) = 2T(n/2) + n^2$? (5 Marks)

(2)

06. As the Head of Operations managing runway operations at a busy international airport, develop an algorithm to determine the minimum number of runways required to prevent flight delays. The algorithm should analyze two floating-point arrays representing the arrival times AT[4] and departure times DT[4] of flights. It is assumed that there will be at least one and at most two flights with overlapping arrival and departure times. For example if the flights arrival and departure are : AT[4.00, 4.11, 4.05, 4.31], DT[4.10, 4.30, 4.25, 5.00], you would need a minimum of 2 runways to manage them without delays. [10]

(4)

Rubrics:

Algorithm (7 Marks) Illustration (3 Marks)

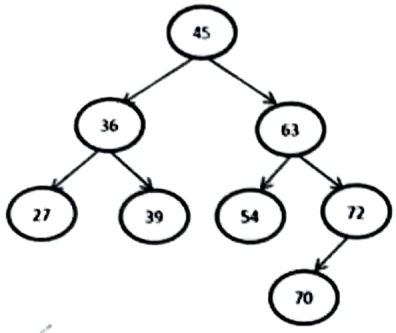
07. Consider a hash table of size = 11. Using double hashing, insert the keys 72, 27, 36, 24, 63, 81, 92, and 101 into the table. Consider $h_1 = (k \bmod 11)$ and $h_2 = (k \bmod 8)$. [10]

Rubrics:

Algorithm (5 Marks) Illustration (5 Marks)

(9)

08. Consider the AVL tree given below. **[10]**



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(i) Insert 18, 81, 15 and 1 in it. (5 Marks)

(ii) Delete nodes 39, 63, 15, and 1 from the AVL tree formed after solving the above question. (5 Marks)

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