CSE/PC/B/T/213/2021

B. E. COMPUTER SC. & ENGINEERING EXAMINATION, 2021

(2nd Year, 1st Semester)

DATA STRUCTURES AND ALGORITHMS

Time : Five hours **Full Marks : 100**

Answer all questions. Be brief and to the point in answering questions.

1. (a) Define Abstract Data Type. Explain with an example. Why is it called "abstract"?

4+1

(b) Show how the following integers will be inserted in a blank Binary Search Tree in the given sequence:

56, 12, 23, 20, 18, 78, 65, 86, 54, 8.

Now, show how the search process will work for searching the elements 8 and 100.

2+2

(c) Explain what you mean by Time Complexity and Space Complexity.

4

(d) What do you mean by non-linear recursion?

2

(e) Explain what you mean by collision in the context of Hashing.

2

(f) Why should the algorithms corresponding to the ADT operations be efficient?

3

2. Answer any two from the following:

(a) Write C language functions for *insert_after* and *delete_after* operations for a pointer-based Singly Linked List. You need to define the node type also. Hence write the C functions *enqueue* and *dequeue* for a Queue ADT implemented using the Circular Single Linked List with a Tail pointer.

4+2+4

(b) Explain what you mean by equality of two stacks. Write a commented C language function for checking whether two stacks are equal or not.

4+6

(c) Write a C language function to find the in-order predecessor of the root of a binary tree. Explain the special cases you have taken into account in the function. Write a C language function to right-rotate a binary tree. What is the utility of such rotation?

3+2+3+2

3. Answer any two from the following:

(a) Develop non-recursive and recursive Divide-and-Conquer algorithm for Binary Search. Explain the condition to be maintained for Binary Search to be applicable. What is the type of recursion used in your algorithm?

6+2+2

(b) Design a Greedy algorithm to find out Minimum Cost Spanning Tree of a given weighted Graph. Explain how the greedy strategy has been used in your algorithm. Analyze the time complexity of your algorithm.

4+3+3

(c) Develop a recursive algorithm to test whether a given Binary Tree is a Binary Search Tree. What change is to be made in the node structure of a BST to make it a Height Balanced Tree node? Explain.

6+4

4. Answer any two from the following:

(a) Discuss various Data Structures which can be used to represent Sparse Graphs. Explain the space overhead of each of the alternatives. Explain how you can represent the transitive closure matrix of a sparse graph efficiently.

4+3+3

(b) What data structure will you use for the evaluating postfix expressions? What are the errors you can detect in a postfix expression using your algorithm? Show how the following postfix expression will be evaluated step by step:

10 20 10 – 50 * + 17 / $, where $ is a sentinel.

3+3+4

(c) What are the data structures for representing Hash Tables? What is the utility of hashing in storing a large number of records in hard disks for access with minimum latency?

5+5

5. Answer any two from the following:

(a) In solving a problem, each data node has a structure containing some information field. The total number of bytes in the structure is 2096. You have a maximum of 20,000 such structures to process. The different options of data structures are Binary Search Tree and AVL Tree. Considering each pointer has 6 bytes, on an average what is the amount of main memory required and how much is the memory overhead if you want to process all 20,000 structures in memory for each data structure option? Explain situations, when you will select each data structure option.

6+4

(b) You have a very large number of very big records, each having a key field. But the total size of the records is such that they can fit in the main memory in an array. The application requires that the records to be sorted on the key values in the memory. Develop a scheme of storing the records in the memory, so that the time overhead due to data movement for sorting the records can be minimized. Considering an efficient sorting algorithm, what would be the amount of time saved in your scheme, given the size of a single record as *m* and the number of records as *n*.

6+4

(c) You are going to develop an application for COVID Patient Treatment Resource Help. Consider there are 10 hospitals with known number of initial COVID beds, 5 safe homes with known number of beds, 100 medicine suppliers, 12 ambulance agencies and 20 Oxygen vendors in a locality. Explain your choice of data structures and algorithms for the application.

4+6

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