[Total No. of Questions - 9] [Total No. of Printed Pages - 3]

Dec-24-0311 (CBCS)

CS-301 (Data Structures) [CSE, IT]

B.Tech. 3rd

Time : 3 Hours

Max. Marks : 60

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Each question carries 10 marks. Attempt one question each from section A, B, C & D. Section E is compulsory and carries 20 marks.

SECTION - A

1. (a) How do you analyze complexity of an algorithm? Explain various notations used to define various complexities of algorithm. (5)

   (b) Provide the increasing order of asymptotic complexity of functions f1, f2, f3 and f4:

   $f1(n) = 2n$; $f2(n) = n^2$; $f3(n) = n \log_2 n$; $f4(n) = 5^n$. (5)

2. Let $A = a_1, a_2, \ldots, a_n$ and $B = b_1, b_2, \ldots, b_n$ be two arrays of integers of same size and let x be another integer. Write an efficient algorithm to decide if $x = a_i + b_j$ for some i and j. If yes, then delete both a_i and b_j for their respective arrays. Otherwise, insert a value in either of A or B at the kth position (can take input from user) where $k < n$ such that $x = a_i + b_j$ (Your algorithm should handle both the cases also, make functions for both and call). What is the complexity of your full algorithm? (10)

SECTION - B

3. What is a linked list? How can it be used to implement a stack? Is it possible to perform a binary search on a linked list with 'n'

sorted numbers? If no, then why and if yes, then how can it be done and what will be the complexity of your algorithm? (10)

4. What are the merits and demerits of a linear queue over a circular queue? Write algorithms for insertion and deletion in a LINEAR queue implemented using an array. (10)

SECTION - C

5. What is an AVL tree and why do we need it when we already have a binary search tree? Create an AVL tree from following elements in order one by one.

   64, 1, 14, 26, 13, 110, 98, 85, 81 (10)

6. Draw the binary tree T with node labels a, b, c, d, e, f and g for which the inorder and postorder traversals result in the following sequences.

   Inorder : K, G , D, L, H, M , B, A, E, C

   Preorder: A, B, D, G , K, H, L, M , C , E (10)

SECTION - D

7. Write an algorithm for Selection Sort to sort given elements in the ascending order, where instead of a minimum number, a maximum number is selected each time and placed in appropriate place. What is its complexity for both worst and average case? Also, sort the following numbers in increasing order using your algorithm:

   65 70 75 80 85 60 55 50 45 (10)

8. Consider a hash table of size seven, with starting index zero, and a hash function (3x + 4) mod 7. Assuming the hash table is initially empty, what will be the contents of table when the sequence 1, 2, 3, 8, 9, 10 is inserted into the table using open addressing? (10)

SECTION - E (Compulsory)

9. Write short note on any 5 of the following:

I. In which of the cases, Quick sort performs similar to Insertion sort in terms of time complexity?

II. How will you count total number of nodes in a binary tree?

III. Insert the following keys 15, 32, 20, 9, 3, 25, 12, 1, one by one into an empty Max Heap and show the Max Heap after each insertion. At last delete a root and show the final result.

IV. Why you prefer to insert a deleted node at the front of an AVAIL list and not at the middle or end part of it?

V. How is a two-dimensional array stored in a memory?

VI. Asymptotic Notation. (5×4=20)