Total No. of Questions : 10] [Total No. of Printed Pages : 6

Roll No. ....

CS/IT–305(N)

B. E. (Third Semester) EXAMINATION, June, 2010

(New Scheme)

(Common for CS and IT Engg. Branch)

DATA STRUCTURES

Time : Three Hours

Maximum Marks : 100

Minimum Pass Marks : 35

Note : The paper consists of ten questions. Each question has an alternative question (marked using OR) and you need to answer only one of the two questions connected by OR. For every algorithmic problem, try to find the most time efficient solution.

1. (a) Describe the difference between an abstract data type specification and implementation. 4

(b) An abstract data type for a 24-hour clock has operations to set the time, read the time and advance the time by one second. Provide a specification for the abstract data type. 6

(c) Give the solutions for the following recurrences : 5, 5

(i) $T(n) = T(n-1) + 1/n$

(ii) $T(n) = 2\,T(n/2) + n \log n$

Or

2. (a) Explain why recursion can lead to highly inefficient programs when used to solve certain classes of problems. Suggest at least *two* solutions for the same. 6, 4,

(b) You are developing a divide-and-conquer algorithm which must have asymptotic complexity $O(n \log n)$ to be of practical use. Moreover, you have decided to divive the problem into 3 sub-problems of size $n = 4$ each, where n is the size of the original problem. Using this strategy is it possible to achieve the desired complexity ? If so, what is the most number of steps (as a function of n) that may be used for dividing up the original problem and combining the solutions of the sub-problems ? Explain. 10

3. (a) Write an algorithm that swaps (interchanges) two nodes in a linked list storing integers. The two integers which are to be swapped are passed as parameters for swap operation and the algorithm also checks for error conditions. 6

(b) For a double ended circular queue (i.e. Deque) implemented using an array, give algorithms for : 5, 5, 4

(i) isDQEmpty-returns true if deque is empty.

(ii) isDQFull-return true if deque is full.

(iii) insertFront-insert an element in the front of the deque. The algorithms should also check error conditions if applicable.

Or

4. (a) Consider a multi-array organization of a doubly linked list storing integers (key value) as ahead. The header

of the list is pointing at index 5. For proper insertions and deletions, another linked list of un-allocated node is also to be maintained whose header points to index 10. Show both the lists in this configuration : 6

index	key	prev	next
1	12	8	7
2		NIL	6
3	4	5	11
4	10	7	12
5	2	NIL	3
6		NIL	NIL
7	7	1	4
8	14	11	1
9	21	12	NIL
10		NIL	2
11	3	3	8
12	13	4	9

(b) In the previous question, update both the lists when :

(i) key 7 is deleted

(ii) a new key = 26 is inserted in the end of the integer list 2, 2

(c) Give an interface definition for an abstract data type 'Queue'. The queue is to be implemented in an array in a circular fashion. Give algotithms for each function defined in the interface of the queue. 10

5. (a) Add the following list of numbers sequentially to an initially empty binary Max-heap : 8

12, 5, 15, 9, 13, 7, 15, 10, 3, 20, 4

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(b) For the heap in the previous problem, show the resulting heap after deleting the first four max elements. 4

(c) The preorder and in-order traversals of a binary tree are given below. Draw the binary tree. 8

Preorder : J C B A D E F I G H

Inorder : A B C E D F J G I H

Or

6. (a) Determine and explain if the folowing binary tree is (i) Heap (ii) BST (iii) Height-balanced tree (iv) Complete binary tree (v) Full binary tree. 10

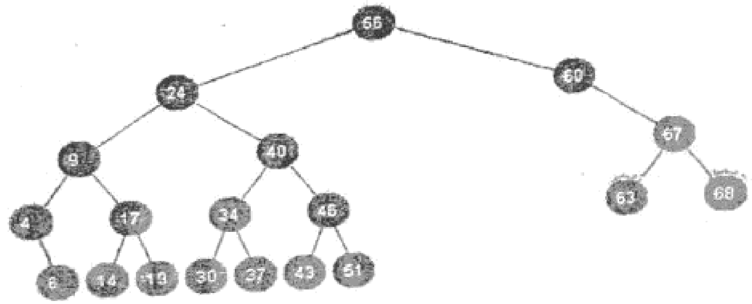

Fig. 1

(b) Insert 44, 47 and 48 into the following AVL tree sequentially. Show the result of this insertion. Also compute the balance factors for all the nodes of the resulting AVL tree. 5, 5

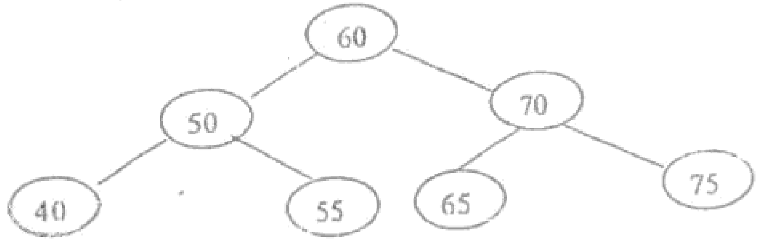

Fig. 2

7. (a) In what order are the vertices visited using DFS starting from vertex A in the following undirected graph ? Where a choice exists, use alphabetical order. What if you use BFS ? 5, 5

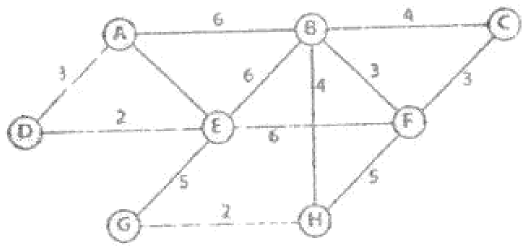

Fig. 3

(b) How long does it take to determine if an undirected graph contains a vertex that is connected to no other vertices. 5, 5

(i) if you use an adjacency matrix

(ii) if you use adjacency lists.

Or

8. (a) Let graph G = (V, E) be a directed graph and vertices start, goal to be in V. Assuming all edges in E are of non-negative weight, describe an efficient algorithm for finding the longest acyclic path from start to goal. 10

(b) For the undirected graph (Q. 7 (a)), compute its spanning tree by showing the steps (in sequence) using : 5, 5

(i) Prim's algorithm

(ii) Kruskal's algorithm

9. (a) Explain what is meant by the terms closed bucket, collision and load factor in the context of hash tables. 6

(b) The integers 5, 26, 22, 41, 18, 16, 4, 13 are to be stored in a closed bucket hash table of length 13 : 4

(i) Suggest a suitable hash function.

(ii) State, with reasons, where each of the above integers would be stored in the table, assuming the order of insertion is from left to right. 4

(iii) Describe an algorithm to check whether a given integer is in the table. Show how your algorithm would successfully determine whether the integer 31 is in the table. 6

Or

10. (a) Describe how a new integer could be inserted into a sequence of sorted integers (so that the resulting sequence is also sorted) in each of the following cases :

(i) The sequence is stored in an array. 3

(ii) The sequence is stored in a linked list. 3

(iii) Compare the efficiency of (i) and (ii). 2

(b) Give the time complexity of various sorting/searching algorithms as per the table given below : 12

Name of the algorithm	Best case	Average case	Worse case
Binary search			
Linear search			
Insertion sort			
Bubble sort			
Radix sort			
Quick sort			
Merge sort			
Heap sort			