

B.Tech 4th Semester Exam., 2019

DATA STRUCTURES

Time : 3 hours

Full Marks : 70

Instructions:

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct answer of the following
(any seven) : 2×7=14

- (a) Which of the following best describes an array?
 - (i) A data structure that shows a hierarchical behaviour
 - (ii) Container of objects of similar types
 - (iii) Container of objects of mixed types
 - (iv) All of the above

(b) The process of removing an element from stack is called

- (i) create
- (ii) push
- (iii) evaluation
- (iv) pop

(c) In a stack, if a user tries to remove an element from empty stack it is called

- (i) underflow
- (ii) empty collection
- (iii) overflow
- (iv) garbage collection

(d) A linear collection of data elements where the linear node is given by means of pointer is called

- (i) linked list
- (ii) node list
- (iii) primitive list
- (iv) None of the above

- (e) What would be the asymptotic time complexity to add a node at the end of singly linked list, if the pointer is initially pointing to the head of the list?
- (i) $O(1)$
 - (ii) $O(n)$
 - (iii) $\Theta(n)$
 - (iv) $\Theta(1)$
- (f) With what data structure can a priority queue be implemented?
- (i) Array
 - (ii) List
 - (iii) Heap
 - (iv) All of the above
- (g) What is the functionality of the following piece of code?
- ```

Public void fun (int x)
{
 q1.offer (x);
}

```
- (i) Perform **push()** with **push** as the costlier operation
  - (ii) Perform **push()** with **pop** as the costlier operation

- (iii) Perform **pop()** with **push** as the costlier operation
  - (iv) Perform **pop()** with **pop** as the costlier operation
- (h) In a max-heap, element with the greatest key is always in which of the following nodes?
- (i) Leaf node
  - (ii) First node of left subtree
  - (iii) Root node
  - (iv) First node of right subtree
- (i) What is the specialty about the in-order traversal of a binary search tree?
- (i) It traverses in a non-increasing order
  - (ii) It traverses in an increasing order
  - (iii) It traverses in a random fashion
  - (iv) None of the above
- (j) Which of the following is not an application of priority queue?
- (i) Huffman codes
  - (ii) Interrupt handling in operating system
  - (iii) Undo operation in text editors
  - (iv) Bayesian spam filter

2. (a) Explain array implementation of priority queues and list implementations of priority queues. 7
- (b) Differentiate between row major and column major array index notations. How is index calculated in both? Explain your answer by using the example of an integer array  $\text{int } a[10]$  and the element  $a[2][5]$  is to be accessed. 7
3. (a) What is doubly linked list? What are its applications? Explain how an element can be deleted from the list using appropriate pseudocode. 7
- (b) Consider two strings  $X = x_1, x_2, \dots, x_n$  and  $Y = y_1, y_2, \dots, y_m$ , where  $x_i, 1 \leq i \leq n$  and  $y_j, 1 \leq j \leq m$  are the members of finite set symbols. Write an algorithm to generate a string by taking 1 element from each list. When any one string is exhausted, the output string should store rest of the elements of other string. 7
4. (a) What do you understand by 'garbage'? Explain how garbage collection method is used for allocating and freeing memory storage. 7

- (b) Suppose the following eight numbers are inserted in order into an empty binary search tree :  
 $T : 50, 33, 44, 22, 77, 35, 60, 40$   
 Draw the tree T. 7
5. (a) Discuss pre-order and post-order tree traversal techniques. Write the pseudocode for these two traversal methods. 7
- (b) Write the algorithms for insertion sort and merge sort with examples and discuss their complexities. 7
6. (a) Write an algorithm to perform breadth first search (BFS). Compare the BFS and DFS search techniques. 7
- (b) Explain the working of merge sort on the following data :  
 $\{10, 15, 0, 17, 20, 25, 30, 16, 70, 6\}$   
 Show all intermediate steps. Also, mention its time complexity. 7
7. (a) What is meant by a spanning tree of a graph? Give an algorithm to find a spanning tree. What is the complexity of your algorithm? 7
- (b) What do you mean by tree traversal? Give a recursive algorithm for tree traversal. Determine the complexity of your algorithm. 7

8. (a) Algorithm A requires  $n^2$  days and algorithm B requires  $n^3$  sec to solve a problem. Which algorithm would you prefer for a problem instance with  $n = 10^6$ ? 7

(b) Assume the recurrence relation

$$T(N) = 2T(N/2) + N, N \geq 2$$

with boundary condition  $T(1) = 0$ . What is the time complexity? 7

9. Write short notes on the following :  $3\frac{1}{2} \times 4 = 14$

(a) Hashing methods

(b) Height balanced tree

(c) Operation in circular queue

(d) AVL tree

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