INDIAN INSTITUTE OF INFORMATION TECHNOLOGY SRI CITY, CHITTOOR

DATA STRUCTURES AND ALGORITHMS-S2023 -- ENDSEM Exam-- (**Max Marks = 21)**

Roll Number:	**Name:**	**Section:**

Signature of the **Invigilator**:

--Multiple Choice Questions--

1. Select the fastest algorithm from given options for sorting small arrays?(A) Insertion Sort (B) Merge Sort (C) Heap Sort (D) Quick Sort [ ]
2. A simple open addressing method that handles collisions by placing the colliding item in the next available table cell is (A) Quadratic Probing (B) Separate Chaining (C) Double Hashing (D) None of the given [ ]
3. In a full binary tree if there are L leaves, then total number of nodes N are? (A) N=2*L (B) N=L-1 (C) N=2*L-1 (D) N=2^L [ ]

4. Average time complexity of quicksort is (A)O(log n) (B) O(n) (C) O(1) (D) O(n log n) [ ]
5. Consider the two statements. S1: Quicksort is an in place algorithm. S2: Quicksort is a stable algorithm. (A) Both are true (B) Both are false (C) S1 is true, but S2 is false (D) S1 is false, but S2 is true. [ ]
6. For which of the following best, average and worst case time complexities are same (A) quicksort (B) mergesort (C)Both choices A and B are correct (D) neither A is correct nor B is correct [ ]

7. Which of the following sorting algorithm has the running time that is least dependant on the initial ordering of the input? (A) Insertion sort (B) Quick sort (C) Merge sort (D) Selection sort [ ]
8. For merging two sorted lists of size m and n into sorted list of size m+n, we require comparisons of(A) O(m) (B) O(n) (C)O(m+n) (D) O(logm + logn) [ ]
9. The minimum number of comparisons for a particular record among 32 sorted records through binary search method will be:
(A)16 (B)5 (C)8 (D)2 [ ]

—End of MCQ—

--Descriptive Questions--

10. Consider an initially empty binary search tree. Perform the following operations sequentially on the tree and draw the resultant tree at the end of each operation.

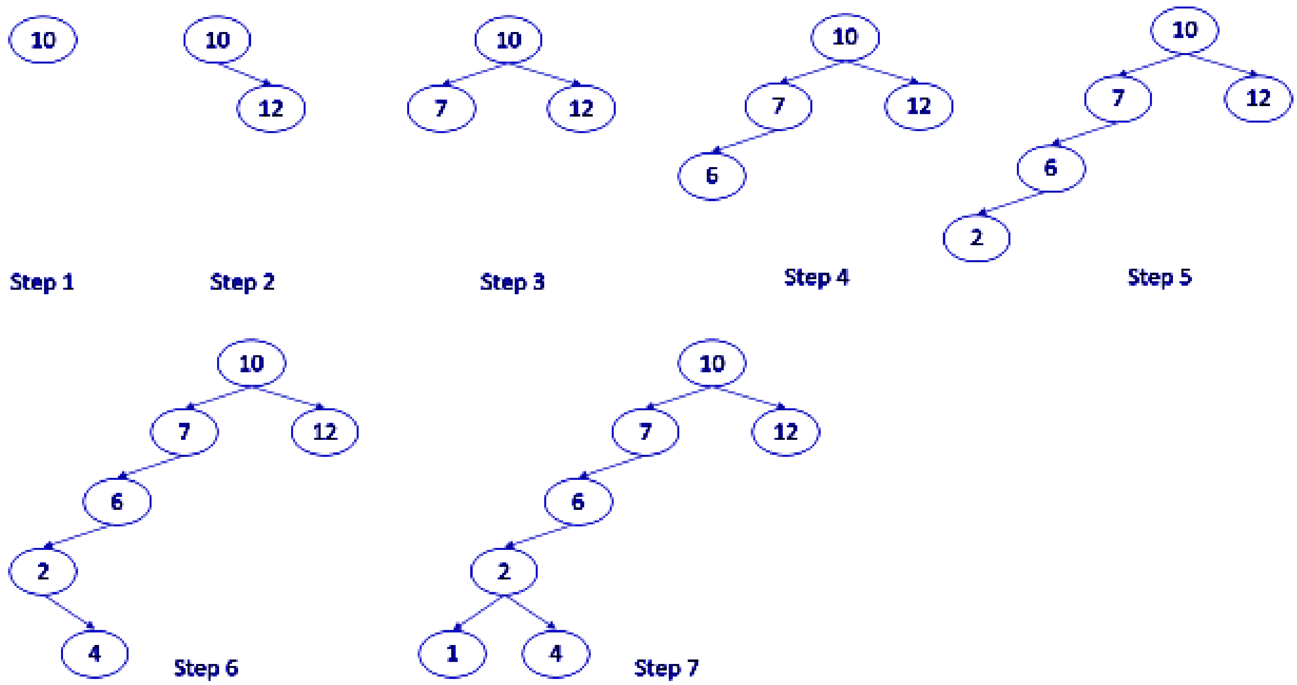
i) Insert 10, 12, 7, 6, 2, 4, 1 **[2M]**
ii) Delete 12 **[1M]**
iii) Delete 10 **[1M]**

[Show trees for the insertion and deletion. Incorrect trees will get zero marks, and all sub questions are interrelated, wrong answer in any predecessor will lead to no mark in successor questions ***(for e.g. wrong answer for i will not get mark for ii and iii)***]

10. Answer.

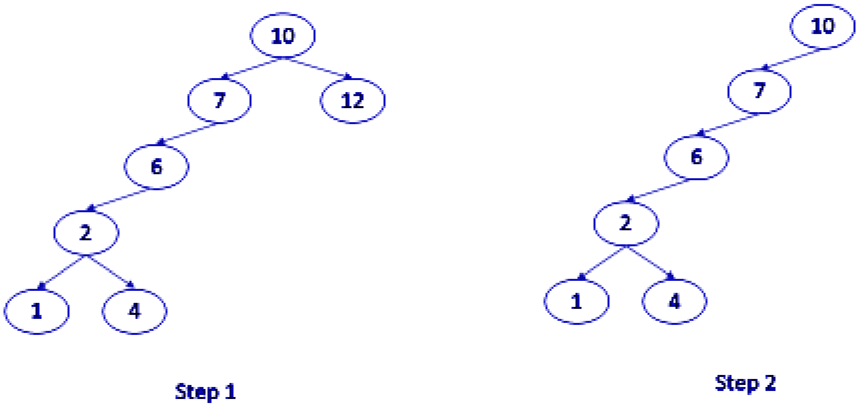
i)

Question 10: i) Answer for insertion



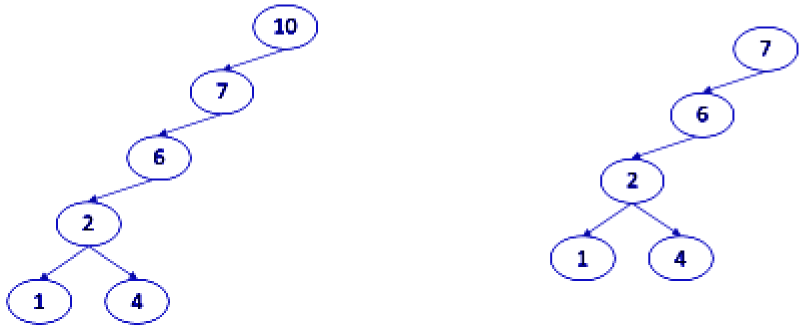
ii)

Question 10: ii) Answer for deletion of 12



iii)

Question 10: iii) Answer for deletion of 10



Step 1

Step 2

11. Progressively insert the elements 1, 2, 3, 4, 5, 6, 7, 8 in to a Max-Heap. Assume that the Max-Heap is represented as an array where the root is at index 1. You need to show the array representation after each insertion. Unnecessary scribblings may attract negative marks. [4 Marks]

11. Answer.
After each insertion the array representation of the max-heap is shown (as a row).

1							
2	1						
3	1	2					
4	3	2	1				
5	4	2	1	3			
6	4	5	1	3	2		
7	4	6	1	3	2	5	
8	7	6	4	3	2	5	1

Roll Number:	**Name:**	**Section:**

12. (i)Consider the following sequence of elements in an array:{35, 18, 7, 12, 5, 23, 16, 3 }. If we perform Bubble sort on the array, how many passes are required? Show the results after each pass. How many swapping and comparison are needed to sort the array [2 Marks]
(ii)Consider the modified merge sort where we divide the array into 5 equal sub arrays instead of 2(as in standard merge sort).What is the time complexity if modified merge sort? Is there any improvement over standard merge sort? [2 Marks]

12. Answer.

(i)
Pass 1: 18 7 12 5 23 16 3 35
Pass 2: 7 12 5 18 16 3 23 35
Pass 3: 7 5 12 16 3 18 23 35
Pass 4: 5 7 12 3 16 18 23 35
Pass 5: 5 7 3 12 16 18 23 35
Pass 6: 5 3 7 12 16 18 23 35
Pass 7: 3 5 7 12 16 18 23 35

Total no. of Pass= 7
Total no. of comparison=28
Total no. of swaps=20

(ii)
The array is divided into 5 parts and all parts are equal so the recurrence relation will be

5T(n/5) + n

On solving this will be O(nlogn).which is asymptotically equal to merge sort.

It would be the same as the time complexity when we are dividing the problem in two halves every time, only the base of log changes to 5.

Space for Rough work

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