

December 2024

B.Tech. (IT/CSE/CE/AI&ML/DS)
(Third Semester)

Data Structures and Algorithms (PCC-CS-301)

Time : 3 Hours]

[Maximum Marks : 75

4. Write and Explain the algorithm to sort the given data using Merge Sort. Apply the merge sort on the following data to show the sorting process step-by-step :
87, 88, 25, 11, 22, 56, 99, 66, 77, 33.

Also analyze the time and space complexity.

15

5. (a) Explain operations of a stack with an example. 5

- (b) Write an algorithm to convert infix to postfix for $a + b * (c^d - e)^{(f + g * h)} - i$. 10

6. (a) What do you mean by Depth First Search (DFS) and Breadth First Search (BFS) ? Compare them. 10

- (b) Explain hashing, hash table and a hash function. Explain with an example. 5

7. (a) Write an algorithm to perform insertion and deletion in the circular queue. 10

- (b) What do you mean by priority queue ? Explain the different applications of priority queue. 5

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any four questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other.

Part A

1. (a) Consider the following function, 1.5

```
int unknown(int n) {
```

```
    int i, j, k = 0;
```

```
    for (i = n/2; i <= n; i++)
```

```
        for (j = 2; j <= n; j = j * 2)
```

```
            k = k + n/2;
```

```
    return k;
```

```
}
```

What is the time complexity of the function ?

- (b) In quick sort, for sorting n elements, the $(n/4)$ th smallest element is selected as a pivot using an $O(n)$ time algorithm. What is the worst-case time complexity of the quick sort ? 1.5
- (c) What is the disadvantage of simple queue over circular queue in array implementation of queue ? 1.5
- (d) What are AVL Trees ? How are they different from Binary Search Tree ? 1.5
- (e) Define complete graph and strongly connected graph. 1.5
- (f) Give adjacency list and adjacency matrix representations of a graph data structure. 1.5
- (g) Give one advantage and one disadvantage of using Binary Search over Linear Search. 1.5
- (h) The in-order and pre-order traversal of a binary tree are **d b e a f c g** and **a b d e c f g**, respectively. What is the post-order traversal of the binary tree ? 1.5

- (i) What do you mean by minimum spanning tree ? 1.5
- (j) The keys 12, 18, 13, 2, 3, 23, 5 and 15 are inserted into an initially empty hash table of length 10 using open addressing with hash function $h(k) = k \bmod 10$ and linear probing. What is the resultant hash table ? 1.5

Part B

2. (a) Given an array $\text{arr}[1 \dots 10][1 \dots 15]$ with a base value of 100 and the size of each element is 1 Byte in memory find the address of $\text{arr}[8][6]$ with the help of column-major order (CMO). 10
- (b) Define ADT (Abstract Data Type). Mention the features of ADT. 5
3. (a) Inspect, why we need an Asymptotic notation ? Explain the different Asymptotic notations with definition and example. 5
- (b) Write an algorithm to delete all occurrences of a given key in a linked list. 10

December 2023
B.Tech. - III SEMESTER
Data Structure & Algorithms (PCC-CS-301)

Max. Marks:75

Time: 3 Hours

- Instructions:**
1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.
 2. Answer any four questions from Part -B in detail.
 3. Different sub-parts of a question are to be attempted adjacent to each other.

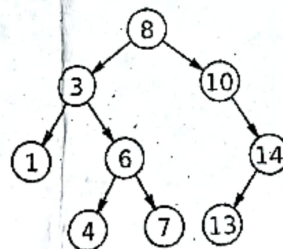
PART -A

Q1 (a) Define Time-Space tradeoff. (1.5)

(b) Compute the time complexity of the following code: (1.5)

```
main() {
    while (n>1) {
        n = n/2;
    } }
```

- (c) Differentiate between linear search and binary search. In what scenario linear search perform better than binary search? (1.5)
- (d) Write an algorithm for push operation of stack. (1.5)
- (e) Discuss the importance of priority queue. (1.5)
- (f) Compare the time complexity of insertion and deletion operation of queue when it is implemented with arrays and linked list. (1.5)
- (g) Find out the in-order, pre-order and post-order traversal of the following binary search tree. (1.5)



- (h) What do you mean by threaded binary search tree. (1.5)
- (i) Compare time and space complexities of following sorting algorithms: Quick Sort, Merge Sort and Heap Sort. (1.5)
- (j) What is hashing? Why it is important. (1.5)

PART -B

Q2 (a) Explain asymptotic notations in detail. Arrange the following functions in increasing order of their asymptotic Complexity: (10)

$f_1(n) = n \cdot n^{1/2}$

$f_2(n) = 2^n$

$f_3(n) = n^3$

$f_4(n) = n \log_2 n$

(b) How to analyse an algorithm? Explain with example. (5)

- Q3 (a) Write an algorithm for linear search and binary search. Apply binary search on the following sorted array to search an element '40' and also analyze its worst case time complexity. (10)

10	20	25	36	40	43	49
----	----	----	----	----	----	----

- (b) Write ADT of Stack and Queue. (5)

- Q4 (a) Write an algorithm to evaluate postfix expression. Show step-by-step procedure for the evaluation of the following postfix expression. (10)

4	7	+	2	10	2	/	*	-	4	+
---	---	---	---	----	---	---	---	---	---	---

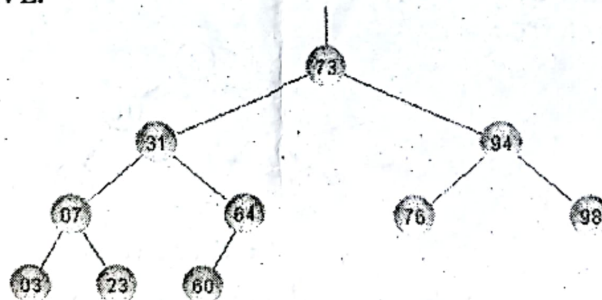
- (b) Define circular queue. List out the importance of circular queue over simple queue. (5)

- Q5 Explain the following operations on singly linked list with their worst case time complexities: (15)

- (a) Traversing
- (b) Insertion in middle
- (c) Deletion from end

- Q6 (a) What is Binary Search Tree (BST)? Write an algorithm to insert an element in a BST and also analyze its worst case time complexity. (10)

- (b) Is the given BST is AVL after inserting an element having value '02' ? If not, then make it AVL. (5)



- Q7 Write a short note on the following: (15)

- (a) Insertion sort
- (b) Collision Resolution Techniques
- (c) Breadth First Search

(2)

(5)

Data Structures and Algorithms (PCC-CS-301)

[Max. Marks : 25]

1. It is compulsory to answer all the questions (1 mark each) of Part-A in short.

2. Answer any three questions from Part-B in detail..

3. Different sub-parts of a question are to be attempted adjacent to each other.

PART-A

ABC x DEF = A / 9 x HxJ

4, 5, 2, 3, 1. The inorder traversal of the same tree is 8, 6, 9, 4, 7, 2, 5, 1, 3. The height of a tree is the length of the longest path from the root to any leaf. The height of the binary tree above is _____.? (1)

end of the function.

Post- 8 9 6 7 4 5 2 3 1
Two- 8 6 9 4 7 2 30 P.T.O.

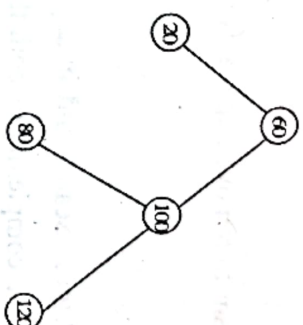
- ```

/* Link list node */
struct node{ int data; struct node* next;};

/* head_ref is a double pointer which points
to head (or start) pointer of linked list */
static void reverse(struct node** head_ref){
 struct node* prev = NULL;
 struct node* current = *head_ref;
 struct node* next;
 while (current != NULL) {
 next = current->next;
 current->next = prev;
 prev = current;
 current = next;
 }
}
/*ADD A STATEMENT HERE*/

```
- What should be added in place of "/\*ADD A STATEMENT HERE\*/", so that the function correctly reverses a linked list. (1)
- (c) What is a AVL Tree? (1)
- (d) What is priority Queue? (1)
- (e) How the selection of a particular data structure is done to solve a problem? (1)
- (f) What do you mean by best, average and worst case of an algorithm? (1)

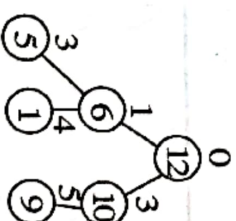
- (g) Consider the AVL tree. What will be tree after insertion of 70. (1)



- (h) Write selection sort algorithm. (1)
- (i) What do you mean by stack overflow? (1)
- (j) Write DFS technique steps. (1)

### PART-B

2. (a) Write short note on BST. (3)
- (b) Consider the below tree and show all the heap sort steps on this. (2)



- Q3 (a) What do you mean by Data Structure? Explain the types of data structure (3)