


VIT[®]

 Vellore Institute of Technology
(Deemed to be University under section 3 of the UGC Act, 1956)
Final Assessment Test – May 2024

 Course: **CBS1003 - Data Structures and Algorithms**

 Class NBR(s): **3597/3598**

 Slot: **D2**

 Time: **Three Hours**

 Max. Marks: **100**

- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

Answer any TEN Questions
(10 X 10 = 100 Marks)

1. a) Find the Asymptotic complexity for the function by using Recursive Tree [5]
Method, where $T(n) = 2T(n/4) + \sqrt{n}$
- b) Compute the time complexity of the program by showing all the steps [5]
involved.

```

For(i=0; i<n; i++)
{
  Key=A[i];
  J=i-1;
  While(J>=0 && A[J]>k)
  {
    A[J+1]=A[J];
    J=J-1;
  }
  A[J+1]=Key;
}

```
2. a) The following piece of code determines whether all the elements in a given [5]
array are distinct. Assume it takes an array A [0...n - 1] as input and returns
"true" if all the elements in A are distinct and "false" otherwise.

```

for i ← 0 to n - 2 {
  for j ← i + 1 to n - 1 {
    if A[i] == A[j] {
      return false }
    }
  }
  return true

```

Identify the basic operation and calculate the worst case time complexity of this algorithm.
- b) Write the algorithm for quick sort and calculate the best case time complexity [5]
of the algorithm.
3. Consider a job scheduling application which schedules a variety of jobs in a queue [5]
according to their priority. Always the job with high priority is scheduled first.
Write the Algorithm to implement Enqueue() and Dequeue() operations of the
priority job scheduler which takes input as job and its priority.

Sample Input:

consider the following list of jobs and their priority(1-High and 5-Low)

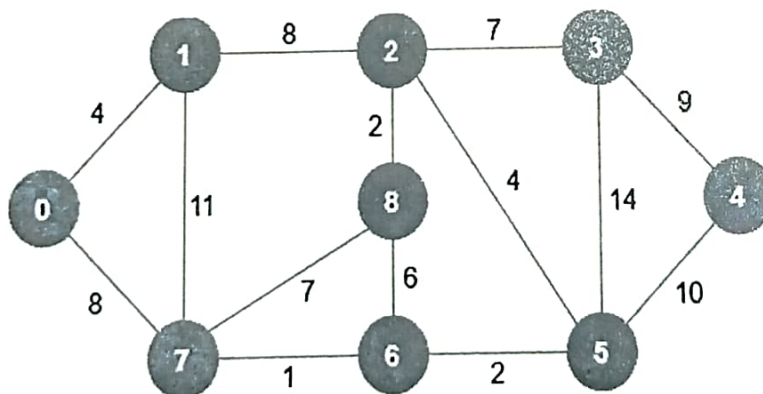
Job	X	Y	Z	A	B
Priority	3	2	1	5	4

Sample Output:

Job Scheduler schedule the jobs in the following order

Z Y X B A

4. Suppose there are two singly linked lists both of which intersect at some point and become a single linked list. The head or start pointers of both the lists are known, but the intersecting node is not known. Also, the number of nodes in each of the lists before they intersect is unknown and may be different in each list. Write the Algorithm for finding the merging point and Display the values in each list. Give the pictorial representation for the given scenario using the value list1 contains 8 elements and list 2 contains 4 elements.
5. Consider the expression: $(A*(B+C))*(B+X/Y)$. Write a suitable algorithm that makes use of stack to convert it to a postfix expression. Apply your algorithm to convert the given expression to postfix. (Note: Step by step conversion should be demonstrated).
6. Construct an AVL tree using the following keys: 25, 35, 47, 57 and 80. Give the pictorial representation for the single and double rotation after inserting every node in the tree. After constructing the tree with the given elements. Then perform the following operations on the AVL tree:
- Search for the key 47,
Delete the key 35,
And insert the key 18.
- Show the tree after each operation. Explain how the AVL tree maintains its balance during these operations.
7. Write an algorithm for Insertion and Deletion in B-Tree. Construct the B-tree for the given values 100, 150, 200, 187, 90, 50, 250, 125, 45 and 37 and Delete the element 150 and 200. Give the pictorial representation after insertion and deletion operation in the tree. Provide the steps in constructing B-tree.
8. Discuss and Demonstrate how Dijkstra's algorithm can be applied to the following scenario: Imagine you are a food delivery person in a city with 9 locations. The locations are connected by roads with different travel times. You need to deliver a food from location 0 to location 4 as quickly as possible. The travel times between locations are shown in the graph below:



9. i. Perform Breadth First Search (BFS) from the source node "2" using the above given graph. Illustrate the algorithm with step by step procedure. [5]
- ii. Perform Depth First Search (DFS) from the source node "4" using the above given graph. Illustrate the algorithm with step by step procedure. [5]

10. Assume you are given an array of integers representing the ages of people in a group: [25, 32, 40, 19, 60, 55, 22]. You need to sort this array in descending order using heap sort with a max heap. Additionally, after sorting the array, two new people join the group with ages 35 and 18. You need to insert these two new ages into the sorted array while maintaining the sorted order. [5]
- How would you perform heap sort on the given array using a max heap? Illustrate and write the pseudocode. [5]
 - How would you insert the two new ages into the sorted array while maintaining the sorted order? Illustrate and Write the algorithm. [5]
11. Insert the keys 83, 29, 16, 52, 34, 5, 28, 61, 77, 100, 93 into the Hash Table of size 12 using the First Hash function as $h_1(k) = k \bmod 12$ and second hash function as $h_2(k) = 1 + (k \bmod 10)$. Give the pictorial representation of the hash table for both the hash function and use the collision resolution technique to solve the collision problem.
12. Explain the Sequential and Index based file organization in detail and suggest the application of each method.

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