NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa, 403401
Programme Name: B.Tech.
End Semester Examinations, December-2022

Course Name: Data Structures
Date: 06/12/2022
Duration: 3 Hours

Course Code: CS201
Time: 02:00 PM-05:00 PM
Max. Marks: 100

ANSWER ALL QUESTIONS

1. Find minimal spanning tree for the graph shown in Fig1 using Prim's algorithm and derive its time complexity when Minheap is used. (10 Marks)
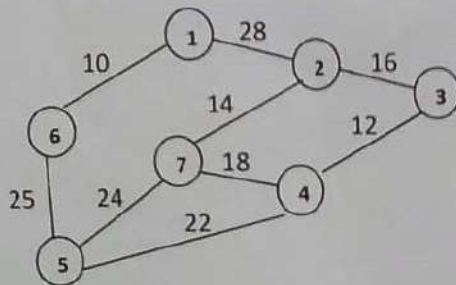

Fig1: Sample Graph

2. Write iterative and recursive algorithms for Maxheapify and derive space complexity respectively. (10 Marks)

3. Suppose we execute a Depth-first search on the graph shown in Fig2, which begins at some unknown vertex. Here, it is assumed that only a recursive call to visit a vertex is made if the vertex has not been visited earlier. Then find the maximum possible recursion depth (including the initial call). (10 Marks)
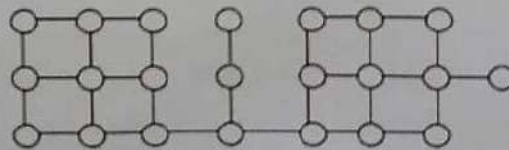

Fig2: Sample Graph

4. A list of n strings, each of length n, is sorted into lexicographic order using the merge-sort algorithm. Find the worst case running time of this computation.

(10 Marks)

5. Consider the depth-first-search of an undirected graph with 4 vertices P, Q, R and S. Let discovery time d(u) represent the time instant when the vertex u is first visited, and finish time f(u) represent the time instant when the vertex u is last visited. Given that (10 Marks)

   d(P) = 5 units f(P) = 12 units
   d(Q) = 6 units f(Q) = 10 units
   d(R) = 15 units f(R) = 22 units
   d(S) = 16 units f(S) = 20 units

   How many connected components are there in the graph and display them.

6. a) Insert the following elements in a binary search tree and balance it whenever it is required. 60, 30, 70, 20, 18, 25, 42, 56, 21 and 58 (4 Marks)
   b) What is an AVL Tree? Why we need to a binary tree which is height balanced? · (6 Marks)

7. a) Which data structure is used for Breadth First Traversal of a graph? (4 Marks)
   b) Write an algorithm for Breadth First Traversal. Explain its time and space complexity with respect to both adjacency list and adjacency matrix with proof. (6 Marks)

8. a) Evaluate the postfix expression for string = "100 200 + 2 / 5 * 7 +" and String = "2 3 1 * + 9 –" (4 Marks)
   b) Why and when Stack or Queue data structures are used instead of Arrays. (6 Marks)

9. a) Find time complexity using Master's theorem for the following recurrence relations (4 Marks)
   i) $T(n) = 2T(n/4)+n^{0.51}$
   ii) $T(n) = 2T(n/2)+n^{-1}$
   b) What is a Direct Address Table? What are its limitations? (6 Marks)

10. a) What is a collision? Explain collision resolving techniques. (6 Marks)
    b) A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown in Table1. How many different insertion sequences of the key values using the same hash function and linear probing will result in the hash table. (4 Marks)

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Table1: Sample Table