Data Structures and Algorithms

Mock Minor 2

Semester: III **Division: D** **Course Code: 17ECSC204**

Date: 27 Oct 2018 **Time: 45 mins**

Note:

- All the questions are compulsory and carry 04 marks each

1. **Binary Tree and Binary Search Tree**

   You are given a binary tree (via a pointer to its root) with n nodes, which may or may not be a binary search tree. How much time is necessary and sufficient to check whether or not the tree satisfies the search tree property? 03 mins

   a. n^2 b. logn

   c. n d. nlogn

2. **Shortest Paths, Rules and Theories**

   Consider a directed graph with distinct and non-negative edge lengths and a source vertex s. Fix a destination vertex t and assume that the graph contains at least one s–t path. Which of the following statements are true? 07 mins

   a. There is a shortest s–t path with no repeated vertices. A simple or loop-less path.

   b. The minimum-length s-t path might have as many as n–1 edges, where n is the number of vertices

   c. The shortest s-t path must include the minimum-length edge of G

   d. The shortest s-t path must exclude the maximum-length edge of G

3. **Bubble Sort and Improvements**

   Apply Bubble sort for the input:

   E X A M P L E

   One way to make bubble sort efficient is by halting when you know no more swaps can happen in future iterations. For the considered example it happens for a certain iteration. When that happened, how many comparisons were made? 06 mins

   a. 3 b. 2

   c. 1 d. 4

4. **3-way-Merge Sort**

   Suppose that instead of dividing in half at each step of Merge Sort, you divide into thirds, sort each third, and finally combine all of them using a three-way merge subroutine. What is the overall asymptotic running time of this algorithm? (Hint: Note that the merge step can still be implemented in O(n) time.) 04 mins

   a. $n(\log(n))^2$ b. nlog(n)

   c. $n^3\log(n)$ d. n

5. **AVL Tree**

   Construct an AVL tree for the input: 15, 20, 24, 10, 13, 7, 30, 36, 25

   Considering single rotation count as 1 and double rotation count as 2, how many rotations happened while the tree was constructed for all the inputs? 08 mins

   a. 6 b. 9

   c. 8 d. 7

6. **Graph, In-degree and Out-degree**

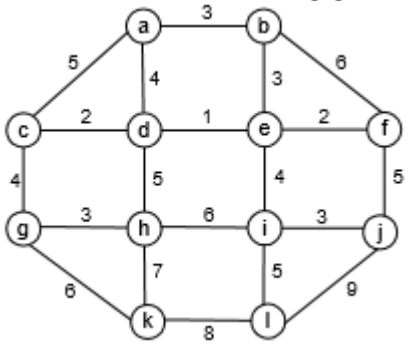
Given an adjacency-list representation of a directed graph, where each vertex maintains an array of its outgoing edges (but NOT its incoming edges), how long does it take in the worst case to compute the in-degree of a given vertex? If n and m are used to denote the number of vertices and edges, respectively of the given graph. Also, let k denote the maximum in-degree of a vertex. 05 mins

a. m b. m+n

c. m+k d. mn

7. **Prims Minimum Spanning Tree**

When you apply prim's algorithm for the following graph:



10 mins

How many edges will be there in the resulting minimum spanning tree?

a. 10 b. 11

c. 12 d. We cannot apply prims for the given graph

8. **Recurrence Relations**

What is the result obtained on solving the given recurrence relation?

$x(n) = 3x(n-1)$ for $n > 1$ and $x(1) = 4$ 05 mins

a. $4/3 * 3^n$ b. $3/4 * 3^n$

c. $4 * 3^n$ d. 3^{n-1}

9. **Merge Sort and Positions**

Here is an array of ten integers: 5 3 8 9 1 7 0 2 6 4

Suppose we run MergeSort on this array, what is the number in the 7th position of the partially sorted array after the outermost two recursive calls have completed (i.e., just before the very last Merge step)? (When we say "7th" position, we're counting positions starting at 1; for example, the input array has a "0" in its 7th position.) 04 mins

a. 6 b. 1

c. 2 d. 4

10. **Binary Trees and AVL Trees**

How many binary trees can be drawn with 5 nodes that satisfy the requirement of AVL tree? 08 mins

a. 4 b. 5

c. 6 d. 7

**** MAY THE FORCE BE WITH YOU ****