National Institute of Technology Mizoram

Mid – Semester Examination, Odd Semester (2022-23)

Advanced Data Structures (CSL 1704)

7th Semester | **Full Marks: 30 marks** | **Duration: 1:30 hours**

Answer all 3 (Three) Questions. All Questions Carry Same Marks

(3 * 10 = 30 Marks)

19/30

upper lower

1. a) Define O, θ, and Ω asymptotic notations. [6]

   b) Prove that $o(g(n)) \cap \omega(g(n))$ is the empty set. 5 X [4]

(OR)

   c) Explain why the statement, "The running time of algorithm A is at least $O(n^2)$" is meaningless. [6]

   d) Suppose algorithms A and B are solving a same problem. When will you say that the algorithm A is better than the algorithm B. [4]

2. a) Write pseudocode for the procedures HEAP-MINIMUM, HEAP-EXTRACT-MIN, and MIN-HEAP-INSERT that implement a min-priority queue with a min-heap. [10]

(OR)

   b) Differentiate between a Splay tree and a B-tree. [4]

   c) Write pseudocode for insertion and deletion operations of a Trie. [6]

3. a) Suppose that a node x is inserted into a red-black tree with RB-INSERT and then is immediately deleted with RB-DELETE. Is the resulting red-black tree the same as the initial red-black tree? Justify your answer. [6]

   b) List out the properties of red-black tree. [4]

(OR)

   c) Show the AVL tree that result after successively inserting the keys 41; 38; 31; 12; 19; 8 into an initially empty AVL tree. [4]

   d) Explain the pseudocode of deleting an element from an AVL tree [6]

~~~~~~ Best of Luck ~~~~~~
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National Institute of Technology Mizoram

End – Semester Examination, Odd Semester (2022-23)

Advanced Data Structures (CSL 1704)

7th Semester, B.Tech | **Maximim Mark: 50** | **Time: 3 hrs**

Answer all 5 (Five) Questions. All Questions Carry Same Marks

(5 * 10 = 50 Marks)

1. What are the disadvantages of reference count garbage collection method? Explain how Mark and sweep garbage collection method resolve these issues. [4 + 6]

2. Consider the following sorting algorithms: Insertion sort, Bubble sort, Heap Sort, Merge Sort and Quick Sort. Which of them are stable? Justify your answer. [10]

3. Decide whether you think the following statement is true or false. If it is true, give an explanation. If it is false, give a counterexample. [5 + 5]

i. Let G be an arbitrary connected, undirected graph with a distinct cost c(e) on every edge e. Suppose e* is the cheapest edge in G; that is, c(e*) < c(e) for every edge e ≠ e*. Then there is a minimum spanning tree T of G that contains the edge e*. True

ii. Suppose we are given an instance of the Minimum Spanning Tree Problem on a graph G, with edge costs that are all positive and distinct. Let T be a minimum spanning tree for this instance. Now suppose we replace each edge cost c by its square, c^2, thereby creating a new instance of the problem with the same graph but different costs. Then T must still be a minimum spanning tree for this new instance. True

4. Given a sequence of n numbers a1, a2, a3, ..., an, derive an algorithm for finding a contiguous subsequence ai, ..., aj for which the sum of elements in the subsequence is maximum. Also, show the step-by-step working of the algorithm by using an example. {Example: for sequence [-2, 11, -4, 13, -5, 2], the maximum sum is 20 given by the subsequence [11, -4, 13]}. [10]

5. What is a skip list? Explain the pseudocode of inserting an element in a skip list. [3 + 7]

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Set - A

1. Insert the following keys successively into an initially empty red-black tree. Show a step-by-step procedure.

72, 56, 47, 36, 9 [4]

2. Explain the pseudocode for inserting a node z from a Binary Search Tree T with examples. [4]

Set - B

1. Insert the following keys successively into an initially empty AVL tree. Show a step-by-step procedure. [4]

72, 56, 47, 36, 9

2. Explain the pseudocode for deleting a node z from a Binary Search Tree T. [4]

Set - C

1. Insert the following keys successively into an initially empty red-black tree. Show a step-by-step procedure. [4]

7, 5, 4, 3, 9

2. If a node in a binary search tree has two children, then show that its successor has no left child and its predecessor has no right child. [4]