Atal Bihari Vajpayee Indian Institute of Information Technology & Management

Minor Examination

Sub: Design and Analysis of Algorithms   **Course Code: CS203**

Time: 2 Hours   **Date: 27/Sept/2023**   **Max. Marks: 30**

Note: Attempt all questions and answer them appropriately.

No doubts will be cleared during examination.

1. Let $f(n)$ and $g(n)$ be asymptotically nonnegative functions. Using the basic definition of , Θ-notation, prove that $\max(f(n), g(n)) = \Theta(f(n) + g(n))$.   [2]

2. Is the array with values {23, 17, 14, 6, 13, 10, 1, 5, 7, 12} a max heap?   [2]

3. Show that the worst-case running time of MAX-HEAPIFY on a heap of size n is $\Omega(\log n)$. (Hint: For a heap with n nodes, give node values that cause MAXHEAPIFY to be called recursively at every node on a simple path from the root down to a leaf.)   [4]

4. Illustrate the operation of MAX-HEAP-INSERT (A, 10) on the heap
   $$A = \{15, 13, 9, 5, 12, 8, 7, 4, 0, 6, 2, 1\}$$ [4]

5. Write pseudocode for the procedures HEAP-MINIMUM, HEAP-EXTRACT-MIN, HEAP-DECREASE-KEY, and MIN-HEAP-INSERT that implement a min-priority queue with a min-heap.   [4]

6. Give an adjacency-list representation for a complete binary tree on 7 vertices. Give an equivalent adjacency-matrix representation. Assume that vertices are numbered from 1 to 7 as in a binary heap.   [4]

7. Suppose that we represent the graph $G = (V, E)$ as an adjacency matrix. Give a simple implementation of Prim's algorithm for this case that runs in $O(V^2)$ time.   [5]

8. Construct the minimum spanning tree (MST) for the given graph using Kruskal's Algorithm. And write the complexity.   [5]