Indian Institute of Engineering Science and Technology, Shibpur

B. Tech. Information Technology, 5th Semester Mid Semester Examinations, October 2021

Algorithms

IT-3104

Full Marks: 30 Answer any five questions Time: 45 Minutes

1. a) 3-D Maxima problem: Let a point p in 3-dimensional space be given by its integer coordinates, p = (p.x, p.y,p.z). A point p is said to be dominated by a point q if p.x<= q.x and p.y<=q.y and p.z<=q.z. Given a set of n points, P = {p_1, p_2, … , p_n} in 3-space a point is said to be maximal if it is not dominated by any other point in P. Write an algorithm to find the set of maximal points. [3]
   b) Find the time complexity of the algorithm given by you for the 3-D maxima problem. [3]

2. a) Let f and g be two functions that take nonnegative values, suppose that f=O(g). Show that g=Ω(f). [3]
   b) Suppose that f and g are two functions such that for some other function h, we have f = O(h) and g = O(h). Then f + g = O(h). [3]

3. a) "$T(n)=pn^2+qn+r$ is both $O(n^2)$ and $\Omega(n^2)$" – comment and explain whether this statement is correct. [3]
   b) If f= Θ(g) and g=Θ(h), then f=Θ(h). Prove it. [3]

4. a) State the *Merge* procedure used in *MergeSort*. [3]
   b) Analyse the running time of the *Merge* procedure. [3]

5. a) State the Master Theorem for determining the asymptotic growth rates of recurrence problems. [3]

   b) Solve the recurrence using Master Theorem: T(n) = T(2n/3) + 1. [3]

6. a) If G is an directed graph, the sum of the lengths of all the adjacency lists is |E|. Prove it. [3]
   b) Breadth-first search colors each vertex white, gray, or black. All vertices start out white and may later become gray and then black. Show with an example when i) a white vertex becomes black and ii) a white vertex becomes gray then black. [3]

7. a) In Depth-First-Search, what do you understand by the following? i) Back edge ii) forward edge iii) cross edge. Explain with illustrations. [3]
   b) Why the Minimum Spanning Tree of a graph may not be unique? Explain with example. [3]