Printed Pages: 2
CS-501

B.Tech.Vth Sem. EXAM,2015-2016

Design and Analysis of Algorithms

Time: 3 hours
Maximum Marks: 100

Note:

1. You are required to attempt all the questions.
2. Your answers to each question should be precise and to the point.
3. Make suitable assumptions wherever necessary.

Q1: There are total **7** parts in this question. Answer any **FIVE** parts. $[5 \times 4 = 20]$

(a) Give asymptotically upper bound (O notation) for the recurrence $T(n) = 2T(\sqrt{n}) + \lg n$.

(b) If a dynamic-programming problem satisfies the optimal-substructure property, then a locally optimal solution is globally optimal. If this statement is True or False. Justify.

(c) Let be a directed graph with negative-weight edges, but no negative-weight cycles. Then, one can compute all shortest paths from a source $s \in V$ to all $v \in V$ faster than Bellman-Ford using the technique of reweighing. If this is True or False. Justify.

(d) There exists a comparison sort of 5 numbers that uses at most 6 comparisons in the worst case. True or False. Justify.

(e) Compare Merge, Quick and Bubble sorts in terms of their Best, Average and Worst time complexities. Answer this comparison in a tabular form.

(f) Can you site one application of Max Flow algorithm other than finding maximum flow in a flow network.

(g) Briefly explain how any comparison based sorting algorithm can be made to be stable, without affecting the running time by more than a constant factor.

Q2: There are total **3** parts in this question. Answer any **TWO** parts. $[2 \times 10 = 20]$

(a) Let P be a shortest path from some vertex s to some other vertex t in a graph. If the weight of each edge in the graph is increased by one, then will P will still be a shortest path from s to t. Explain.

(b) Suppose that all edges weights in a graph are integers in the range of 1 to $|V|$. How can you make Kruskal's algorithm to run fast.

(c) Develop an algorithm to calculate n^n where n is some positive integer.

Q3: There are total **3** parts in this question. Answer any **TWO** parts. $[2 \times 10 = 20]$

(a) Let $n = 2^k - 1$. An array $A[1 \ldots n]$ contains all integers from 0 to 1 except one. The elements of A are stored as k bit vectors. Assume that only operation we can use to examine the integers is $Bit_Lookup(i, j)$ which returns j^{th} bit of $A[i]$. Each $Bit_Lookup(i, j)$ operation takes constant time. Design a $O(n)$ time algorithm to find the missing integer.

(b) Prove that weighted graphic matroids exhibit the greedy choice property.

(c) What is the running time of the most efficient deterministic algorithm you know for finding the shortest path between two vertices in a directed graph, where the weights of all edges are equal? (Include the name of the algorithm.)

Q4: There are total **3** parts in this question. Answer any **TWO** parts. $[2 \times 10 = 20]$

(a) Write an efficient algorithm for finding the transitive closure of a weighted direct graph. Compare your choice of algorithm with naive approach for solving the problem.

(b) Write an efficient algorithm to decompose a directed graph into its strongly connected components.

(c) Suppose that all characters in a pattern P are different. Show how to accelerate the naive string matcher to run in $O(n)$ time on an n-character text T.

Q5: There are total **3** parts in this question. Answer any **TWO** parts. $[2 \times 10 = 20]$

(a) Show that problem of finding clique of an undirected graph is NP Complete. You may make suitable assumptions.

(b) Write an approximation algorithm to solve the vertex cover problem.

(c) How randomised version of the quick sort algorithm improves the worst case behaviour of the quick sort algorithm.