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Roll No.										

Paper Code: CS-501

B. TECH.
FIFTH SEMESTER EXAMINATION, 2016-2017
DESIGN AND ANALYSIS OF ALGORITHMS

[Time: 3 Hours] [Total Marks: 100]

Note: Attempt ***ALL*** questions. Assume suitable data, if required. All question carry equal marks.

1. Attempt any *five* parts of the following: - **(4x5= 20)**

(a) Is $2^{n+1} = O^{(2n)}$? Is $2^{2n} = O^{(2n)}$? Justify your answer.
(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.

2. Attempt any *two* parts of the following: - **(10x2= 20)**

(a) Let P be a shortest path from some vertex s to some other vertex *s* 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.

3. Attempt any *two* parts of the following: - **(10x2= 20)**

(a) Let $n = 2^k-1$. An array A[*1...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 *BitLookup*(i,j) which returns j^{th} bit of *A[i]*. Each *BitLookup(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.)

4. Attempt any *two* parts of the following: - **(10x2= 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.

5. Attempt any *two* parts of the following: - **(10x2= 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 randomized version of the quick sort algorithm improves the worst case behavior of the quick sort algorithm.