B.E. / B.Tech DEGREE END SEMESTER EXAMINATIONS APRIL/MAY 2012

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COMPUTER SCIENCE AND ENGINEERING

THIRD SEMESTER (Regulations 2009)

CS9201 – DESIGN AND ANALYSIS OF ALGORITHMS

(Common to IT)

Time: 3 Hrs Max Marks: 100

Answer All Questions

Part A (10 * 2 = 20 Marks)

1. Prove that O(g(n) + O (f(n) = O (max (f(n), g(n),)
2. If $f(n) = n^2 + 3 \lg n$ and $g(n) = n + \lg n$, determine whether f(n) = O(g(n)) or g(n) = O (f(n))?
3. Write an algorithm for performing counting sort.
4. Using the decision tree model prove that any comparison sort algorithm requires in the worst case Ω (n lg n) comparisons. Determine the smallest possible depth of a leaf in a decision tree for a comparison sort.
5. State the activity selection problem.
6. State any two properties of matrices.
7. Convert the following to duality representation

   Maximize $2x_1 + 5x_2$ subject to

   $x_1 + x_2 \leq 20$

   $2x_1 + 3x_2 \leq 10$

   $5x_1 + 3x_2 \leq 28$

   $x_1, x_2 \geq 0$
8. Write and determine the worst case complexity of simple string matching algorithm
9. Define NP completeness and NP hard.
10. Prove the polynomial reducible property of NP problems

Part B (5 * 16 = 80 Marks)

11\. i. Solve the following recurrence equation

   a. T(n) = T(n/2) + 1, where $n = 2^k$ for all $k \geq 0$ (4)

   b. T(n) = T(n/3) + T(2n/3) + cn, where 'c' is a constant and 'n' is the input size (4)

   ii. Write a randomized search algorithm and analyse its time complexity (8)

12\. a. i. Write an algorithm to select the i^{th} smallest number using a randomized algorithm. Show that the average complexity of this algorithm is linear in time (8)

   ii. Select the 4^{th} smallest from the list given by A = {3, 2, 9, 0, 7, 5, 4, 8, 6, 1} using the above algorithm (8)

(OR)

b. i. Write an algorithm to perform matrix chain multiplication using dynamic programming and analyze this algorithm for its time and space efficiency (8)

ii. Determine the optimal number of multiplications required and a way to multiply the chain of matrices given {30, 20, 10, 5, 20, 2} (8)

13. a. i. Write a non-recursive procedure to compute Huffman code and prove that the Huffman code is optimal and greedy (8)

ii. Using the greedy Huffman algorithm determine the huffman code given the following characters and their corresponding frequencies of occurrence (8)

a:2, b: 1, c:15, d: 9, e:10, f:6, g:5, h:4, i : 10, j:2

(OR)

b. i. Write an algorithm that solves a system of linear equation using LUP decomposition and analyse this algorithm for time and space complexity (8)

ii. Solve the following equation using LU decomposition (8)

$$\begin{aligned} x + 5y + 4z &= 12 \\ 2x + 3z &= 9 \\ 5x + 8y + 2z &= 5 \end{aligned}$$

14. a. i. Write the KMP algorithm to perform string matching and show that this algorithm is linear in time (8)

ii. Compute the Prefix function that is used by the KMP algorithm for the pattern given by

P = ababbabbab

And check whether the string given by abaaabababababbabbabaaab has this pattern in it by simulating the algorithm (8)

(OR)

b. Write the simplex algorithm and prove that this algorithm produces a solution that is feasible and optimal if there exist a solution. (16)

15. a. Write an algorithm to solve the Travelling salesman problem and prove that it is a 2 time approximation algorithm with an example (16)

(OR)

b. Prove that Vertex cover problem is NP – complete. Explain this with an example. (16)