

Common to COMPUTER SCIENCE AND ENGINEERING and
INFORMATION TECHNOLOGY

THIRD SEMESTER (Regulations 2009)

CS9201 – DESIGN AND ANALYSIS OF ALGORITHMS

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. Obtain the relationship between $O(f(n))$ and $\Omega(g(n))$
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 $\Omega(n \lg n)$ comparisons. Determine the smallest possible depth of a leaf in a decision tree for a comparison sort.
5. Show that the 0/1 knapsack problem cannot be solved using greedy strategy.
6. Why do we need LUP decomposition instead of LU decomposition to solve equations.
7. Mention some applications that uses linear programming.
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. $T(n) = T(n/2) + T(n/4) + n$ (4)
 - c. $T(n) = T(n/3) + T(2n/3) + cn$, where 'c' is a constant and 'n' is the input size (4)
- ii. Write an algorithm to find the minimum and maximum using any strategy and analyse its time complexity (4)
12. a. Write the randomized quick sort algorithm and analyse its time complexity. (16)

(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. Using LUP decomposition determine the inverse of the following matrix (8)

$$\begin{matrix} 1 & 5 & 4 \\ 5 & 2 & 3 \\ 7 & 1 & 6 \end{matrix}$$

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 abaaababababbabbabaaab has this pattern in it by simulating the algorithm (8)

(OR)

- b. i. Write the simplex algorithm and prove that this algorithm produces a solution that is feasible and optimal if there exist a solution. (8)
 ii. Solve the following set of equations using Simplex algorithm (8)

Maximize $18x_1 + 12.5x_2$

Subject to

$$x_1 + x_2 \leq 20$$

$$x_1 \leq 12$$

$$x_2 \leq 16$$

$$x_1, x_2 \geq 0$$

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

(OR)

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

ababbabbab
 1 2 3 4 5 6 7 8 9 10
 0 0 2 2

Roll No.

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b) Explain class templates with an example.

15. a) Explain the various forms of inheritance.

(OR)

b) Explain how exception handling is achieved in C++?