INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, NAGPUR
Department of Computer Science & Engineering
CSL 205: Design and Analysis of Algorithms

Date: May 04, 2022 (Wed.)

End Semester Exam
Duration: 3-hour | Semester – IV CSE | Max. Marks: 50

Important Instructions:

- This is a closed book, closed notes examination.
- Write proper comments before writing any algorithms.
- Make suitable assumption wherever necessary.
- All the questions are compulsory. This question paper comprises total 05 questions.

Q.1 (a) Solve the following recurrence using substitution method: (5M) (CO1)

$T(n)=2T(n/2)+\log(n)$ where $T(1)=2$

Provide the suitable asymptotic bound.

Q.1 (b) What is the necessity of Amortized analysis? Illustrate the working of aggregate analysis method for incrementing a k-bit binary counter. Compare the amortized cost with the worst-case time complexity for binary incrementation problem. (5M) (CO1)

Q.2 (a) Propose a suitable algorithm for finding the second smallest element in an array of *n* integer based on divide and conquer method. Analyze and comment on the time complexity of this algorithm. (5M) (CO2)

Q.2 (b) What is the solution generated by the algorithm job sequencing with deadline when n=7, (p1,p2,.....p7) = (3,5,20,18,1,6,30), and (d1,d2,....,d7) = (1,3,4,3,2,1,2)? Also, list the underlying greedy based formulation for the same. (5M) (CO2)

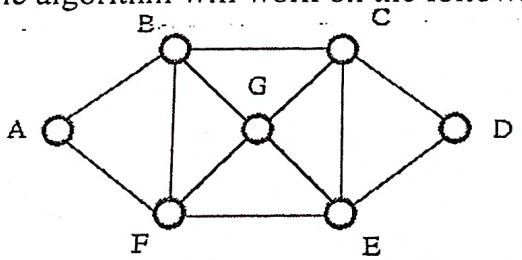
Q.3 (a) Longest palindrome subsequence (LPS) in a given string can be illustrated with the help of following example: (5M) (CO3, CO4)

Input: BBABCBCAB, LPS: BABCBAB, length (LPS): 07

How dynamic programming can be formulated for solving the above optimization problem? Propose the dynamic programming formalized algorithm along with the underlying time and space complexity.

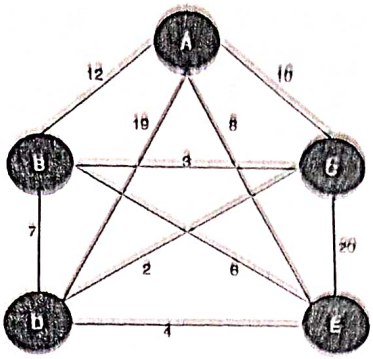
Q.3 (b) Compute an optimal parenthesization of a matrix-chain product whose sequence of dimensions is {5; 10; 3; 12; 5; 50; 6}. Mention each and every step clearly. (5M) (CO3, CO4)

Q.4 (a) Hamiltonian cycle is a cycle in a connected graph that visits each vertex exactly once. Propose a backtracking approach for detecting only one Hamiltonian cycle present in the given graph, if any. How the algorithm will work on the following graph? (5M) (CO3, CO4)



Q.4 (b) Consider $w = \{3, 5, 7, 10, 12, 15, 18, 20\}$ and $m = 30$. Find all the possible subsets of w that sum to m using backtracking approach. Draw the state space tree for the same. Backtracking at various nodes should be clearly reflected in the solution space tree. (5M) (CO3 CO4

Q.5 (a) Approximation algorithm produce the suboptimal solution for an optimization problem. Propose a *twice-around-the-tree* approximation algorithm for the travelling salesman problem. Apply the approximate algorithm on the following connected graph with vertex *A* as source vertex. Also, comment on the worst case of this approximate algorithm along with the approximation ratio. (5M (CO CO4



Q.5 (b) Decision and optimization problem can be used interchangeably. Prove the same using the following three problems by proposing their decision and optimization versions: (5M) (CO3, CO4)

1. Knapsack problem
2. Graph coloring problem
3. ~~Travelling salesman problem~~

Paper Setter

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Moderator

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