SVKM'S NMIMS

MUKESH PATEL SCHOOL OF TECHNOLOGY MANAGEMENT& ENGINEERING/

SCHOOL OF TECHNOLOGY MANAGEMENT

Academic Year: 2023-2024

Program/s: BTech/ MBA Tech/ BTech-Integrated — Year: II/IV Semester: IV/VIII

Stream/s: CE/CS/Computer

Subject: Design and Analysis of Algorithms — Time: 3 hrs (10:00am to 1:00pm)

Date: 1 / 7 / 2024 — No. of Pages: 03

Marks: 100

Re-Examination (2022-23)

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover of the Answer Book, which is provided for their use.

1) Question No. _1___ is compulsory.
2) Out of remaining questions, attempt any __4___ questions.
3) **In all ___5_ questions to be attempted.**
4) All questions carry equal marks.
5) **Answer to each new question to be started on a fresh page.**
6) **Figures in brackets on the right hand side indicate full marks.**
7) **Assume Suitable data if necessary.**

Q1		Answer briefly:	[20]
CO-1; SO-1; BL-4	a.	Differentiate between NP complete and NP hard problems. What are the primary reasons, programs utilize memory space for?	[5]
CO-2; SO-1; BL-2	b.	Explain the working principle of Divide and Conquer algorithmic paradigm. Further, when employing the Divide and Conquer technique to solve a problem, if the sizes of the two sub problems are roughly equal, specify the recurrence relation that defines the time complexity.	[5]
CO-2; SO-6; BL-3	c.	Solve the following instance of "job scheduling with deadlines" problem: n = 7, profits $(p_1, p_2, p_3, p_4, p_5, p_6, p_7) = (3, 5, 20, 18, 1, 6, 30)$ and deadlines $(d_1, d_2, d_3, d_4, d_5, d_6, d_7) = (1, 4, 5, 4, 2, 1, 2)$. Schedule the jobs in such a way to get maximum profit.	[5]
CO-3; SO-2; BL-2	d.	The procedure BELLMAN-FORD relaxes edges, progressively decreasing an estimate v. d on the weight of a shortest path from the source s to each vertex $v \in V$ until it achieves the actual shortest path weight δ (s,v), explain the process of relaxation followed in Bellman Ford algorithm.	[5]
Q2	a. CO-1,2,4; SO-2; BL- 1,3	i)Write an algorithm for Quick sort that uses the principle of Divide and Conquer. Analyze it for its Worst-Case Time complexity. ii)Solve for the Time and Space Complexity of the Pseudocode of Adding two n*n Matrices.	[10]
	b. CO-1,4; SO-1; BL-1,3	With reference to Asymptotic Notations i) Specify the asymptotic analysis for the following algorithm control structures (i) Sequencing (ii) If- then (iii) For loop ii) If $f(n) = 3n^2 + n + 1$, solve for the Θ notation for f(n).	[10]

<table>
<tr><td rowspan="3">Q3</td><td>a.
CO-1;
SO-1;
BL-1,3</td><td>State the Master's Theorem for Dividing functions. Also Solve the following recurrence relation using Master's theorem-
$T(n) = \sqrt{2}T(n/2) + \log n$</td><td>[5]</td></tr>
<tr><td>b.
CO-3;
SO-1;
BL-2</td><td>What kind of problems can be solved using Backtracking Algorithmic Paradigm? Why is Backtracking algorithmic paradigm is not preferable over other algorithmic paradigms.</td><td>[5]</td></tr>
<tr><td>c.
CO-2;
SO-1;
BL-4</td><td>With reference to Divide and Conquer algorithmic paradigm
i) Use algorithmic explanation to show how Divide and Conquer technique can be used to find the minimum and maximum number from a given sequence of numbers.
ii) State the recurrence relation for MinMaxDAC() algorithm
iii) Using Divide and Conquer technique, generate a recursion tree to find the minimum and maximum elements in the given sequence:
42, 30, -12, -18, 20, 78, 18, 37, 55</td><td>[10]</td></tr>
<tr><td rowspan="2">Q4</td><td>a.
CO-3;
SO-6;
BL- 3</td><td>i) Solve the following 0/1 Knapsack instance for maximizing the Profit.
$N = 5$, $(W_1, W_2, W_3, W_4, W_5) = (2,3,5,7,1)$, $(P_1, P_2, P_3, P_4, P_5) = (10,5,15,7,6)$ and $M = 14$.
ii) Write down the Recurrence relation for solving the Multistage Graph problem by Backward Approach to find the cost of the minimum cost path between 2 vertices.</td><td>[10]</td></tr>
<tr><td>b.
CO-2;
SO-6;
BL-1,3</td><td>i) Differentiate between greedy and dynamic programming algorithmic paradigm.
ii) Considering the case of Greedy Fractional Knapsack. A thief is robbing a store and can carry a maximal weight of 16 kg into his knapsack. There are n items available in the store and weight of i^{th} item is w_i and its profit is p_i (shown in the table below). What items should the thief pick from the store to steal where maximizing the profit is the sole objective of the thief. Also solve for the total profit gained.
<table>
<tr><td>Object</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Profit</td><td>6</td><td>2</td><td>1</td><td>8</td><td>3</td><td>5</td></tr>
<tr><td>Weight (kg)</td><td>6</td><td>10</td><td>3</td><td>5</td><td>1</td><td>3</td></tr>
</table></td><td>[10]</td></tr>
<tr><td>Q5</td><td>a.
CO-1,4;
SO-2;
BL-1</td><td>Write individual Code Snippets that exhibit:
i) Constant Space complexity
ii) Linear Space Complexity
iii) Linear Time Complexity
iv) Quadratic Time Complexity</td><td>[10]</td></tr>
</table>

		v) Logarithmic Time Complexity	
	b. CO-3; SO-2; BL-1,3	i) With reference to Dynamic programming explain the following terms (i) Principle of optimality (ii) Memoization ii) Consider the following 3 matrices A: 10*100 B: 100*5 C: 5*50 Using Dynamic Programming approach, compute the correct order of Matrix multiplication (Matrix Chaining Multiplication), so as to reduce the computational complexity. Show all the computations involved.	[10]
Q6	a. CO-2; SO-1; BL- 1,3	A multinational corporation operates in multiple regions; each with its own set of departments generating large volumes of data includes 99, 27, 71, 199, and 259. The organization needs to merge these datasets efficiently what is the minimum time required to merge these datasets. i) Identifying the algorithm paradigm that should be used to solve the problem. ii) Solve for finding the minimum time required to merge these datasets. iii) Write a generic algorithm for the identified algorithmic paradigm.	[10]
	b. CO-3; SO-2; BL-1,6	With reference to Backtracking, answer the following questions i) Explain the concept of Bounding function in Backtracking algorithmic paradigm. ii) Explain the problem statement of sum of subset problem iii) Using Backtracking approach, generate a state-space tree to find the possible subset of X that sum to Y for the following instance of sum of subset problem X= {5,10,12,13,15,18} and Y= {30}.	[10]
Q7	a. CO-3; SO-2; BL-1,3	i) Write the Dynamic Programming Algorithm to find the Length of the Longest Common Subsequence (LCS). ii) Solve for finding out the similarity between the two strings by computing the length of the longest common subsequence (LCS) between them using Dynamic Programming, further print the longest common subsequence. String1 = "MZJAWXU" String2 = "XMJYAUZ"	[10]
	b. CO-1; SO-1; BL-3	Solve the recurrence relation using Recursion Tree method and Backward Substitution Method $T(n) = \begin{cases} c & n = 1 \\ 2T\left(\frac{n}{2}\right) + c & n > 1 \end{cases}$	[10]