

Course/ Batch: BTech/ SCSET
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Course Type: Core
Course Name: Design and Analysis of Algorithms

Tutorial Assignment: Week 11

Tutorial title: Dynamic Programming

CO Mapping

Question no	CO1	CO2	CO3
Q1	✓	✓	✓
Q2	✓	✓	
Q3	✓	✓	
Q4	✓	✓	
Q5	✓	✓	✓

Q1. A hospital maintains a patient database that undergoes multiple stages of transformation before generating a final report. The data is processed in four steps, each represented as a matrix:

- Step 1: The raw patient data is stored in a structured format with 10 attributes (such as age, weight, and BP) and 5 key identifiers (like patient ID, admission date, etc.). (Matrix A1, size 10×5).
- Step 2: The data is mapped to a medical coding system that expands it into 20 different medical codes used for diagnosis and billing. (Matrix A2, size 5×20).
- Step 3: The coded data is passed through a risk prediction model, which reduces the dimensionality to 10 key risk indicators. (Matrix A3, size 20×10).
- Step 4: A final transformation prepares the data for report generation, reducing it to 5 key metrics used by doctors and insurance providers. (Matrix A4, size 10×5).

To ensure efficient processing, we need to determine the optimal order of matrix multiplications that minimizes the number of scalar computations required to transform the data through all stages. What is the minimum number of scalar multiplications required to compute the final processed output?

Q2. Compute the binomial coefficient $C(6,3)$ using dynamic programming based on Pascal's Identity.

Q3. Consider the dynamic programming approach to calculate the binomial coefficient $C(n, k)$ using Pascal's Identity. Which of the following statements is TRUE?

- (A) The base case for the recursion is $C(n, k) = 1$ if $n = k$ or $k = 0$.
- (B) The recurrence relation used is $C(n, k) = C(n + 1, k - 1) + C(n + 1, k)$.
- (C) The time complexity of the dynamic programming solution to calculate $C(n, k)$ is exponential in terms of n .
- (D) The dynamic programming approach avoids redundant calculations by storing the results of subproblems.

Q4. If you implement the bottom-up dynamic programming approach to find $C(n, k)$, approximately how many addition operations will be performed to fill the DP table?

- (A) $O(n)$
- (B) $O(k)$
- (C) $O(n \times k)$
- (D) $O(n + k)$

Q5. A logistics company manages four warehouses (labeled 1, 2, 3, and 4) and tracks the shipping costs between them. The table below shows the direct shipping costs (in dollars) between warehouses, where ∞ means no direct shipping route exists:

	1	2	3	4
1	0	8	∞	1
2	∞	0	1	∞
3	4	∞	0	∞
4	∞	2	9	0

To optimize shipping costs, the company applies the Floyd-Warshall algorithm to determine the minimum cost to transport goods from warehouse 4 to warehouse 3 after considering all possible routes. What is the lowest shipping cost?