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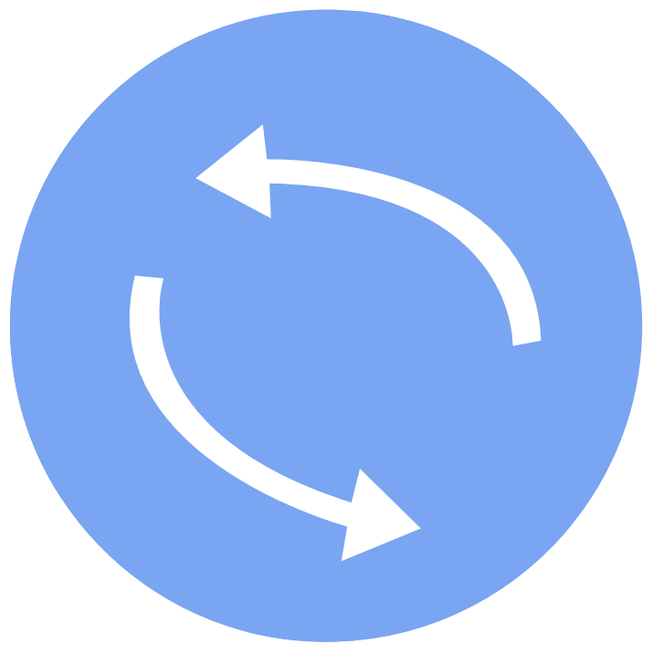
MCS-211

30 MOST REPEATED QUESTIONS



Curated List of 30 Questions that are seen to be repeated frequently in the examinations.

By **FarLearner.com**

MCS-211 Most Repeated Questions

1 . Write a mathematical definition of asymptotic notations (like Big Oh, Big Omega, or Big Theta) and show an example.

Dec 2021 Q1(a), Dec 2022 Q1(a), June 2023 Q1(b), Dec 2023 Q1(b), June 2025 Q1(f).

Answer : Big Omega (Ω) represents the asymptotic lower bound of a function.

Definition

A function f(n) = Ω(g(n)) if there exist positive constants c and n_0 such that :

$f(n) \geq c \cdot g(n)$ for all $n \geq n_0$

This means f(n) grows at least as fast as g(n) for large values of n.

Given :

$f(n) = 3n^3 + 2n^2 + 1$

$g(n) = 2n^2 + 3$

For large n, the dominant terms are

$f(n) \approx 3n^3$

$g(n) \approx 2n^2$

Now compare growth:

$3n^3 \geq c(2n^2)$

Divide by n^2

$3n \geq 2c$

Choose c = 1

Then

$3n \geq 2$

which is true for $n \geq 1$

Therefore

$f(n) = \Omega(g(n))$

2 . Apply Dijkstra's algorithm to find the shortest path from a starting vertex to all other vertices in a given graph.

Dec 2021 Q2(b), Dec 2022 Q2(b)(i), Dec 2023 Q4(a), June 2024 Q5(a), Dec 2024 Q4(a), June 2025 Q4(b).

Answer : Dijkstra's algorithm is used to find the shortest path from a source vertex to all other vertices in a weighted graph with non-negative weights.

Algorithm

Dijkstra(G, source)

1. for each vertex v
   dist[v] = ∞
2. dist[source] = 0
3. while unvisited vertices exist
4. u = vertex with minimum distance
5. mark u visited
6. for each neighbor v of u
7. if dist[u] + weight(u,v) < dist[v]
8. dist[v] = dist[u] + weight(u,v)

Working

- Start with the source vertex.
- Assign distance 0 to the source.
- Assign ∞ to other vertices.
- Update shortest distances step-by-step.
- Continue until all vertices are visited.

The result gives the minimum distance from the source node to all other nodes.

Time Complexity

Using adjacency matrix : $O(V^2)$

Using priority queue : O(ElogV)

3 . Explain the working principle of Floyd-Warshall's algorithm and apply it to a given graph to find the shortest paths matrix.

Dec 2021 Q5(a), June 2022 Q1(b), Dec 2022 Q4(c), Dec 2023 Q4(c), June 2024 Q5(b), Dec 2024 Q5(a), June 2025 Q1(h).

Answer : The All Pair Shortest Path (APSP) problem means finding the shortest path between every pair of vertices in a graph.

If a graph has n vertices, we must find the shortest distance between each pair (vi , vj).

This problem is commonly solved using the Floyd–Warshall Algorithm.

Floyd–Warshall Algorithm

The Floyd–Warshall algorithm is used to find the shortest paths between all pairs of vertices in a weighted graph.

It works using the dynamic programming technique.

The algorithm improves the shortest path by considering each vertex as an intermediate vertex.

MCS-211 Most Repeated Questions

4 . Explain the use of the master method. Write, interpret, and apply all the three cases to solve recurrence relations.

Found in: Dec 2021 Q5(b), Dec 2022 Q1(c), June 2023 Q2(a), Dec 2023 Q5(vi), June 2025 Q5(b).

Answer : Use of Master Method

The Master Method is used to solve recurrence relations that arise in divide-and-conquer algorithms.

It is used for recurrences of the form:

$T(n)=aT(n/b)+f(n)$

Where:

- aaa = number of subproblems
- bbb = factor by which problem size is reduced
- f(n)f(n)f(n) = cost of dividing and combining

Case 1

If

$f(n)=O(n^{\log_b a-\epsilon})$

for some $\epsilon>0$

Then

$T(n)=\Theta(n^{\log_b a})$

5 . Define a fractional knapsack problem as an optimi211ation problem and write a greedy method/algorithm to find an optimal solution.

Dec 2021 Q3(b), June 2022 Q3(c), June 2023 Q5(v), Dec 2024 Q4(b), June 2025 Q4(a).

Answer : Fractional Knapsack Problem :

In the fractional knapsack problem, items can be divided into fractions to maximi211e the total profit within the knapsack capacity. This problem is solved using the Greedy Approach.

Steps

- Calculate profit/weight ratio for each item.
- Sort items by this ratio in descending order.
- Select items with the highest ratio first.
- If the knapsack has less capacity than the fraction of the next item.

Example :

Item Weight Profit

A 10 60

B 20 100

C 30 120

6 . Explain P, NP, NP-Hard, and NP-Complete classes of problems with appropriate examples, and differentiate between them.

Dec 2021 Q4(b), Dec 2023 Q1(g), June 2024 Q1(e), June 2025 Q1(d) and Q5(a).

Answer : These classes categori211e problems based on computational complexity.

1. Class P

P (Polynomial time) problems are those that can be solved in polynomial time by a deterministic algorithm.

Time complexity:

$O(n)$, $O(n^2)$, $O(n^3)$, etc.

Examples:

- Sorting
- Searching
- Minimum Spanning Tree
- Shortest Path (Dijkstra)

2. Class NP

NP (No ms are
proble nomial
time.

7 . Explain the quick sort algorithm using a divide and conquer approach, apply its partition procedure to an array, and analy211e its time complexity.

Found in: Dec 2021 Q1(b), Dec 2022 Q3(b), June 2023 Q3(b), June 2024 Q1(f), June 2025 Q2(b).

Answer : Quick Sort is a divide and conquer sorting algorithm.

Steps:

- Choose a pivot element.
- Partition the array into two parts:
  - elements smaller than pivot
  - elements greater than pivot
- Recursively sort the sub-arrays.

Algorithm

QuickSort(A, low, high)
1. if low < high
2. p = Partition(A, low, high)
3. QuickSort(A, low, p-1)
4. Quick

MCS-211 Most Repeated Questions

8 . What is an algorithm? Explain its desirable characteristics or building blocks with the help of an example.

Found in: June 2023 Q1(a), Dec 2023 Q2(a), June 2024 Q1(c), June 2025 Q1(a).

Answer : Algorithm:

An algorithm is a finite sequence of well-defined instructions used to solve a specific problem or perform a computation.

Desirable Characteristics :

- Input: An algorithm must have 211ero or more quantities provided to it externally.
- Output: At least one quantity or result must be produced as a final outcome.
- Definiteness: Each step or instruction in the algorithm must be clear, unambiguous, and precisely defined.
- Finiteness: The algorithm must terminate after a finite number of steps for any input.
- Effectiveness: Each operation must be basic enough to be performed exactly and in a finite amount of time.
- Con… …ths the alg… …com

9 . Write Prim's algorithm for finding a Minimum Spanning Tree, find its time complexity, and apply it to a given graph.

Found in: Dec 2022 Q1(d), Dec 2023 Q5(iv), June 2024 Q2(a), June 2025 Q3(b).

Answer : Prim's Algorithm : Prim's Algorithm is used to find the Minimum Spanning Tree (MST) of a weighted graph.

A Minimum Spanning Tree connects all vertices with minimum total edge weight and no cycles.

Steps

- Start with any vertex.
- Select the minimum weight edge connecting the tree to a new vertex.
- Add the new vertex to the tree.
- Repeat until all vertices are included.

Example diagram:

```
A ----- B
 \ /
  C
```

Prim's a… connect all vert…

Time Co…

$O(V^2)$

10 . Describe a task scheduling problem as an optimi211ation problem and apply the task scheduling algorithm to minimi211e time or maximi211e total profit.
Found in: Dec 2021 Q1(d), Dec 2022 Q5(a), Dec 2023 Q1(e).

Answer : The job scheduling with deadlines problem schedules jobs to maximize total profit.

Each job has:

- Deadline
- Profit
- Unit execution time

Given Data

Job	Deadline	Profit
1	2	60
2	3	50
3	4	70
4	3	80
5	4	75
6	2	30
7	4	40