Data Structures and Algorithms: Topic-wise Guide

Linear Data Structures

- Array
- Linked List (Singly, Doubly, Circular)
- Stack
- Queue
- Deque
- Priority Queue

Hashing

- Hash Table / Hash Map
- Hash Set
- Bloom Filter

Trees

- Binary Tree
- Binary Search Tree (BST)
- AVL Tree
- Red-Black Tree
- Segment Tree
- Fenwick Tree (Binary Indexed Tree)
- Trie
- B-Tree / B+ Tree

Heaps

- Min Heap
- Max Heap
- Heap Sort
- Priority Queue Implementation

Graphs

- Graph Representations (Adjacency List, Matrix)

- BFS
- DFS
- Topological Sort
- Dijkstra's Algorithm
- Bellman-Ford Algorithm
- Floyd-Warshall Algorithm
- Kruskal's Algorithm
- Prim's Algorithm
- Tarjan's Algorithm
- Kosaraju's Algorithm
- Disjoint Set (Union-Find)

Searching Algorithms

- Linear Search
- Binary Search
- Ternary Search
- Exponential Search
- Jump Search
- Interpolation Search

Sorting Algorithms

- Bubble Sort
- Selection Sort
- Insertion Sort
- Merge Sort
- Quick Sort
- Heap Sort
- Counting Sort
- Radix Sort
- Bucket Sort
- Shell Sort
- TimSort

Recursion and Backtracking

- Recursion Basics
- Backtracking (N-Queens, Sudoku Solver, Permutations, Subsets)

Greedy Algorithms

- Activity Selection
- Huffman Coding
- Fractional Knapsack
- Job Scheduling

Dynamic Programming

- Fibonacci Series
- 0/1 Knapsack
- Unbounded Knapsack
- Longest Common Subsequence (LCS)
- Longest Increasing Subsequence (LIS)
- Matrix Chain Multiplication
- Edit Distance
- Subset Sum
- Coin Change
- Bitmask DP
- DP on Trees
- DP on Graphs

Bit Manipulation

- Set/Clear/Toggle Bits
- XOR Tricks
- Count Set Bits
- Power of Two
- Subsets using Bitmask

String Algorithms

- String Matching (Naive, KMP, Rabin-Karp)
- Z-Algorithm
- Trie Operations

- Suffix Array
- Suffix Tree
- Manacher's Algorithm

Mathematical Algorithms

- Sieve of Eratosthenes
- GCD (Euclidean Algorithm)
- LCM
- Modular Arithmetic
- Modular Exponentiation
- Matrix Exponentiation
- Number Theoretic Transform (NTT)
- Combinatorics (nCr, Permutations)

Advanced Topics

- Segment Tree with Lazy Propagation
- Mo's Algorithm
- Heavy-Light Decomposition
- Centroid Decomposition
- K-D Tree
- LRU Cache (HashMap + LinkedList)

General Concepts

- Time and Space Complexity
- Big-O, Big-Theta, Big-Omega
- Amortized Analysis

Advanced Graph Algorithms

- Johnson's Algorithm
- A* Search Algorithm

Advanced Dynamic Programming

- Digit DP
- Knuth Optimization

- Divide and Conquer DP
- Slope Trick

Computational Geometry

- Convex Hull (Graham Scan / Jarvis March)
- Line Intersection
- Rotating Calipers

Number Theory

- Modular Inverse
- Chinese Remainder Theorem
- Euler's Totient Function
- Fermat's Little Theorem
- Miller-Rabin Primality Test

Problem Solving Patterns

- Sliding Window
- Two Pointers
- Monotonic Stack/Queue
- Difference Array
- Prefix Sum / Suffix Sum
- Binary Search on Answer
- Meet in the Middle

Practice Strategy

- Problem Solving Approach (Brute Force to Optimized)
- Debugging Techniques
- Using Competitive Programming Platforms (LeetCode, Codeforces, AtCoder)

System Design Related

- Caching Strategies (LRU, LFU)
- Bloom Filter in Systems
- Trie in Autocomplete/T9
- Hashing in Distributed Systems