# COMPETATIVE CODING

# BASIC OF COMPETATIVE PROGRAMMING

## INTRODUCTION TO COMPETITIVE PROGRAMMING

Why Competitive Programming?, How To Approach A Problem In Contest, Various Types Of Errors

**BASICS OF RECURSION**

Introduction to Recursion, Recursion and PMI, Fibonacci Number, Recursion and Arrays

## TIME AND SPACE COMPLEXITY ANALYSIS

Order Complexity Analysis, Theoretical Analysis, Linear Search time complexity, Insertion Sort time complexity, Selection Sort time complexity, Theoretical Analysis - Recursive Algorithms, Merge Sort Time complexity, Fibonacci Time Complexity Analysis, Space Complexity Analysis, Merge Sort Space Complexity Analysis, Fibonacci Space Complexity Analysis, Kadane's Algorithm

**LANGUAGE TOOLS**

STL - Data Structures, STL - Functions, Hussain Set, Voters List, Permutation & Palindrome

**SEARCHING & SORTING APPLICATIONS**

Aggressive Cows, Inversion Count

# BASIC PROBLEM SOLVING USING CP

## TWO POINTERS AND SLIDING WINDOW

Working of two-pointers and sliding window technique, Intuition behind Two Sum Problem Max sum of k consecutive elements and Longest Substring with At Most Two Distinct Characters

## GREEDY ALGORITHMS

Introduction to Greedy Algorithms, Greedy Vs DP, Logic building for the problems like Fraction Knapsack and Activity Selection etc.

## SORTING

Introduction to Sorting Algorithms, working of Sorting algorithms like Merge Sort, Quick Sort

Counting Sort etc and A problem based on Quickselect Algorithm

## BINARY SEARCH

Binary Search and its implementation details, problems based on search on answer and problems based on search on input.

# APPLICATION OF RECURSION

## ADVANCED RECURSION

Generating all subsets and all Permutations using recursion and Logic building of Combination sum Problem

## BACKTRACKING

Introduction to Backtracking Algorithms, Recursion vs Backtracking and Logic behind popular problems like Rat in a Maze,N-Queens

# BIT MANIPULATION AND NUMBER THEORY

## BIT MANIPULATION

All basic bitwise operators like (OR, AND, NOT, XOR, Left Shift and Right Shift) and properties of each of these operators Common operations done using these operators(like Set ith bit, Count Set Bits)

## NUMBER THEORY-I

Checking whether a number is prime or not in sqrt(n) time Sieve algorithm, Segmented Sieve problem’s solution, Euclid’s algorithm, What are LDEs and how to solve them using Extended and Euclid’s algo

## NUMBER THEORY-II

Modular Arithmetic Properties, How to find Modular Inverse, How to find number of solutions of LDEs and Euler’s Totient Function

## NUMBER THEORY-III

Exponentiation and Modular Exponentiation Matrix Exponentiation, How to find Nth term of a recurrence relation using Matrix Exponentiation and How to find Nth term of Fibonacci Series

## NUMBER THEORY-IV

Non-Deterministic Primality Tests, Fermat's Theorem, Miller Rabin Test and its Deterministic Version, Wilson's Theorem and Chinese Remainder Theorem

# DYNAMIC PORGRAMMING AND DISJOINT SETS

## DYNAMIC PROGRAMMING 1

Basics of Dynamic Programming(Introduction, Need) and Memoization vs Tabulation Method

Optimization of recurrence relation (overlapping subproblem) into DP- Solution 2-dimensional DP Solution

## DYNAMIC PROGRAMMING II

The intuition behind problems like LCS, LIS(How to build logic), Further Optimization of Dynamic

Programming Solution using Segment tree or binary search Multidimensional(3D,4D) Dp Solution Conversion of DP-State into DP-Transition and vice-versa

## DYNAMIC PROGRAMMING III

Algorithms based on Tree DP including Binary Lifting, Re-rooting(In-Out) DP, Algorithms based on Graph DP and Algorithms based on Digit DP

## DISJOINT SET

Introduction to Disjoint Set Data-Structure, need and Applications of DSU, find and Union Operation and union by Rank and Path Compression Technique

# TREES

## TREE-I

Introduction to Trees(different terminologies related to tree, need of non-linear data structure, applications), various Tree Traversal Techniques, N-ary vs Binary Tree and Concepts based on n-ary tree

## TREE-II

Introduction to Euler’s Tour, Technique(Construction and Properties), Introduction to Mo’s algorithm, Problems based on Tree Queries like Subtree Queries and Path Queries

# GRAPHS

## GRAPH-I

Introduction and Basic terminologies of Graph, DFS and BFS, Finding Path Between Two Nodes, Detecting Cycle in Graph and Topological Sorting

## GRAPH-II

Minimum Spanning Trees, Kruskal Algorithm Prims Algorithm, Explaining Dijkstra Algorithm, Bellman-Ford Algorithm and Floyd Warshall Algorithm

## GRAPH-III

Bipartite Graph Test, Introduction & Applications of SCC, Tarjan's Algorithm for SCC and articulation points and Bridges-what are they how to find them

# COMBINATORICS

## COMBINATORICS-I

Introduction to Combinatorics, revising Permutation and Combination, Combinatorics-nCr, nPr and Binomial coefficient etc

## COMBINATORICS-II

Catalan Number, Inclusion-exclusion, PigeonHole Principle and Application of Combinatorics Technique

# GEOMETRY

## GEOMETRY-I

Introduction to Computational Geometry, Distance of a Point from a Line,Collinear Points, Intersection of Two line segment and Circle line intersection

**GEOMETRY-II**

Area of Polygon, Convex Hull- Algorithm & Applications

**GAME THEORY**

Game theory-game states, Nim game and Sprague-Grundy theorem

# STRINGS

## STRINGS-I

Strings Data Structure and their huge, Importance in CP Pattern Matching basics, Rabin-Karp

Algorithm, Longest Prefix Suffix explanation and KMP & Z-Algorithm

**STRINGS-II**

Manchester Algorithm and Introduction to Suffix Array, LCP Array

# TRIES

Introduction to Trie Data Structure, Search, Insert & Deletion using Trie and Applications of Trie Data Structure

# RANGE QUERY

## RANGE QUERY-I

Introduction to Range Query Data Structure Segment Tree i) Explaining use case ii) Showing implementation range query, point update, range update(Lazy Propagation)

## RANGE QUERY-II

Fenwick Tree i) Explaining use case ii) Showing implementation range query, point update, range update Sqrt Decomposition i) Explanation, Implementation Mo’s Algorithm i) Online Query ii) Offline Query

# BIT MASKING

Introduction to Bit Masking Its Usage(related to Dp) and Representing subsets, DP+Bitmasking Problems