Competitive Programming Study Plan

Overview

This study plan covers key algorithmic concepts and problems to prepare for competitive programming, focusing on Greedy Algorithms, Binary Search, Dynamic Programming, Frequency Counting, Sliding Window, and Advanced Greedy techniques. The plan spans five weeks, with specific problems and hybrid challenges to build proficiency.

1 Greedy Algorithms

Key Focus: Maximizing or minimizing choices optimally by making locally optimal decisions.

1.1 Relevant Problems

- **Activity Selection Problem:** Select the maximum number of non-overlapping activities.
- **Minimum Number of Coins (Unbounded Knapsack variant):** Minimize coins needed for a given amount.
- **Fractional Knapsack:** Maximize value within a weight constraint.
- **Gym Exercises (Problem 1):** Direct application of greedy choice for scheduling.

2 Binary Search + Simulation

Key Focus: Efficient searching and simulating scenarios to validate solutions.

2.1 Relevant Problems

- **Aggressive Cows:** Use binary search to maximize the minimum distance between cows.
- **Capacity to Ship Packages:** Find minimum capacity to ship packages within days.
- **Heroes vs. Villains (Problem 2):** Simulate battles after binary searching for optimal strength.

3 Dynamic Programming (DP) & Prefix/Suffix Arrays

Key Focus: Building optimal substructures and precomputing costs for efficiency.

3.1 Relevant Problems

- **Longest Increasing Subsequence (LIS):** Find the longest strictly increasing subsequence.
- **Minimum Changes to Mountain Array (Problem 4):** Minimize changes to form a mountain array.
- **Trapping Rain Water:** Use prefix/suffix arrays to compute trapped water volume.

4 Frequency Counting & GCD

Key Focus: Counting element frequencies and using GCD for divisibility constraints.

4.1 Relevant Problems

- **Find All Anagrams in a String:** Use sliding window with frequency counting.
- **Maximum Equal Pieces (Problem 5):** Use GCD of frequencies to maximize equal pieces.
- **Minimum Deletions to Make Character Frequencies Unique:** Adjust frequencies for uniqueness.

5 Sliding Window & Lexicographical Order

Key Focus: Optimizing window-based operations and lexicographical constraints.

5.1 Relevant Problems

- **Smallest Range Covering Elements from K Lists:** Find smallest range across lists.
- **Lexicographically Smallest Array (Problem 6):** Minimize array lexicographically with swaps.
- **Minimum Swaps to Group All 1s Together:** Optimize swaps using sliding window.

6 Advanced Greedy & Hashing

Key Focus: Building sequences under constraints using greedy and hashing techniques.

6.1 Relevant Problems

- **Task Scheduler:** Schedule tasks with cooling periods using frequency.
- **Restaurant Dishes (Problem 7):** Build exponential sequences with constraints.

- **Divide Array in Sets of K Consecutive Numbers:** Group numbers using greedy hashing.

7 Bonus: Infosys-Style Mixed Practice

Hybrid Problems:

- **Gym + Villains:** Combine greedy scheduling with binary search for optimal solutions.
- **Mountain + Digging:** Integrate Terrain Digging (Problem 3) with mountain array properties.

8 Study Plan

Week 1-2: Greedy + Binary Search Focus on Problems 1, 2, and 6. Practice Activity Selection, Aggressive Cows, and Lexicographically Smallest Array to master greedy choices and binary search techniques.

Week 3-4: DP + Frequency Counting Tackle Problems 3, 4, and 5. Solve Terrain Digging, Minimum Changes to Mountain Array, and Maximum Equal Pieces to build DP and GCD skills.

Week 5: Advanced Topics Work on Problem 7 and hybrid problems. Focus on Restaurant Dishes and mixed challenges like Gym + Villains to combine techniques.