

Plan of Action (POA) – SoS Advanced Algorithms in CP

Y Harsha Vardhan

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Personal Information

Name: Harsha Vardhan

Mentor: Rishi Kalra (+1 Senior)

Duration: 2 Months (8 Weeks)

Objective: Master advanced algorithms, strengthen problem-solving skill, and prepare for 1900+ rating on Codeforces/ICPC.

Phase 1: Foundations & Intermediate Topics (Weeks 1-4)

Goal: Revise core concepts, solidify graph/tree algorithms, and explore lighter advanced techniques.

Week 1: Core Refresher

- **Topics:**

- Sorting (Merge/Quick)
- Binary Search
- Prefix Sums
- Greedy Algorithms
- Basic DP (Knapsack)

- **Practice:**

- 15+ problems (Codeforces)
- Focus on time complexity analysis

- **Additional:** Implement custom sorting comparators and a DP template

Week 2-3: Graphs & Trees

- **Topics:**

- BFS/DFS
- Dijkstra
- DSU
- SCCs (Kosaraju/Tarjan)
- LCA (Binary Lifting)
- Tree DP

- **Practice:**

- 20+ problems (e.g., shortest paths, cycle detection, subtree queries)

- **Additional:**

- GitHub repo with Dijkstra + Binary Lifting implementations
- Explanations for SCCs and Tree DP (for midterm report)

Week 4: Light Advanced Algorithms

- **Topics (Any 2-3):**

- Mo's Algorithm
- KMP/Z Algorithm
- Manacher's
- Sweep Line

- **Practice:**

- 10 problems (e.g., range queries, string matching)

- **Additional:** Mo's Algorithm template and problem notes

Midterm Report (End of Week 4)

- List of covered topics with use-cases

- Links to solved problems (Codeforces)

- Written explanations of:

1. **Dijkstra's Algorithm** (with a graph example)
2. **Binary Lifting** (LCA queries visualized)

Phase 2: Advanced Topics & Specialization (Weeks 5-8)

Goal: Tackle advanced data structures, string algorithms, and a self-chosen "boss" algorithm.

Week 5: Fenwick & Segment Trees

- **Topics:**
 - Point/Range queries
 - Lazy Propagation
 - Persistent ST
- **Practice:**
 - 10 problems (e.g., range updates, RMQ)
- **Additional:** Segment Tree with Lazy Propagation template

Week 6: FFT/NTT

- **Topics:**
 - Polynomial multiplication
 - FFT/NTT applications
- **Practice:**
 - 2-3 convolution problems (e.g., Codeforces FFT-themed)
- **Additional:** Notes on FFT intuition and NTT implementation

Week 7: String Algorithms

- **Topics:**
 - Suffix Array (Kasai's)
 - Ukkonen's Algorithm (Suffix Tree)
- **Practice:**
 - 5 problems (e.g., pattern matching, longest common substring)
- **Additional:** Suffix Array + LCP implementation

Week 8: Boss Algorithm (Self-Chosen)

- **Options:**

- Heavy-Light Decomposition
- Centroid Decomp
- Li Chao Tree

- **Tasks:**

- Study, implement, and solve 1-2 problems
- Prepare a **5-10 minute presentation video**

Final Report (End of Week 8)

- Full list of topics covered (basic → advanced)
- Problem solutions with reflections on challenges
- Detailed explanations of:
 1. **FFT/NTT** (polynomial multiplication intuition)
 2. **Suffix Array** (construction and applications)
 3. **Boss Algorithm** (e.g., HLD with diagrams)
- GitHub Repo with all templates
- Presentation video (link)

Additional Commitments

- **Time Investment:** 2-3 hours/day (theory + practice)
- **Resources:** CP Handbook, CP-Algorithms, Codeforces EDU
- **Flexibility:** Adjust timelines if stuck (e.g., extend graph week)
- **Mentor Support:** Regular check-ins for doubts and progress updates

Sign-Off

I'll adhere to this plan while remaining open to feedback and adjustments.
Looking forward to your guidance!

Student Signature: 

Date: 18/5/25