Independent Study Proposal Document

Title: Algorithmic Problem Solving

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INTRODUCTION

This study will primarily emphasize on the implementation and practical applications to a wide variety of problems. The intended goal of the study is to analyse and gain insights into the algorithms required to solve 'hard' / complex problems. The various data structures and algorithms used to solve them and possible improvements in their space and time complexities.

PLANNED WORK

Solve a complex / 'hard' problems every week from online sources from such as LeetCode, HackerRank, CodeChef among others. Analyse the running time and space complexity of the different algorithms and possible optimisations. By the end of the study, we plan to complete at least 30-40 such problems.

With the problems, we aim to cover some of the following topics/algorithms among others,

- River Search Problem
- K-Server Problem
- Tiling rectangles
- Markov Chains
- Edmond-Karp Algorithm
- Dynamic Programming
- Bloom Filters
- Range Trees
- Fractional Cascading
- B/B+ Trees
- Huffman Coding
- Fibonacci Heap
- Boggle
- Graph Bridges
- Treaps

- Cache Oblivious Algorithms
- Hamiltonian Test Algorithms
- Pattern Matching algorithms like
    - Kasai's Algorithm
    - Bitmap Algorithm
    - Backward Non-deterministic Algorithms
    - Boyer Moore Algorithm
    - Backword oracle matching
    - Two way string matching
    - Z-functions
- Lyndon factorization
- Manacher's Algorithm
- Jaro Winkler Distance
- Suffix Trees
- Ternary Search Trees
- Sequential Pattern mining
- Pollard'd rho algorithm
- Catalan Number
- Interval Trees
- Heuristic Algorithms
- Chinese Remainder Theorm
- Blocking flows
- Frog in Maze
- Prime Miller Rabin
- Tries
- Van Emde Boas Queues
- Lucas Algorithm
- Segmented Sieve
- Minimum MST Graph
- Graph Search
- Eulerian Path
- Indexed Trees
- Convex Hull
- Binary Exponentiation
- Sorted Subsegments
- Automation Search
- Baeza Yates Gonnet
- Line Intersection
- Range Minimum Query
- Lowest Common Ancestor
- Euler Function
- Wu Manber
- Psuedo Isomorphic Substrings
- Hadlock's Algorithm
- Guassian Elimination
- Jhonson's Algorithm
- Aho Corasick
- Sentence Parsing Algorithms
- Wilson's Theorem

SCHEDULE

There will be scheduled meetings with the faculty sponsor in order to discuss the progress, challenges and any other difficulties. All the deliverables would be due by Reading Day / week 16 before Final Exams.

DELIVERABLES

The deliverables of the project include,

- A comprehensive final report of all the problems, including but not limited to
    o The problem
    o Intuition / Design / Approach
    o Implementation(s)
    o Time / Storage Analysis

EVALUATION

The course evaluation is based on the quality of the submitted problems, their implementation, explanations and the final report.