Data Structure - LLDs - (1 Week)

List of data structures

- ❏ Lists
  - ❏ Design Linked List
  - ❏ Design Skiplist
- ❏ Stacks
  - ❏ Implement Stack using Queues
  - ❏ Design a Stack With Increment Operation
  - ❏ LRU Cache
  - ❏ Min Stack
  - ❏ Max Stack
  - ❏ Dinner Plate Stacks
  - ❏ Implement Queue using Stacks
- ❏ Queue
  - ❏ Design Circular Queue
- ❏ Hashtable
  - ❏ Design HashMap
  - ❏ Design HashSet
- ❏ BST
  - ❏ Binary Search Tree Iterator
  - ❏ Serialize and Deserialize BST
- ❏ Red Black Tree
  - ❏ Find Median from Data Stream
  - ❏ Count of Range Sum
- ❏ Heaps
  - ❏ Design Twitter
  - ❏ Kth Largest Element in a Stream
- ❏ Fibonacci Heaps
  - ❏ Fibonacci Heaps
- ❏ Disjoint Sets
  - ❏ Review of two popular approaches, Disjoint Sets and DFS
- ❏ Tries (PrefixTree, suffixTree)
  - ❏ Implement Trie (Prefix Tree)
  - ❏ Add and Search Word - Data structure design
- ❏ Interval Trees/Segment Tree
  - ❏ Lazy Dynamic Segment Tree - A general template
  - ❏ A Recursive approach to Segment Trees, Range Sum Queries & Lazy Propagation
- ❏ Other Tree Data Structures(Graphs)
  - ❏ Serialize and Deserialize N-ary Tree
  - ❏ Encode N-ary Tree to Binary Tree

Algorithms - Analysis Time and Space - (3 Weeks)

- ❏ Sorting **- 2 Days**
  - ❏ Selection Sort - Merge Sorted Array
  - ❏ Bubble Sort - Sort Colors
  - ❏ Insertion Sort - Insertion Sort List
  - ❏ Merge Sort - Sort an Array

- ❏ Quick Sort
  - ❏ Kth Largest Element in an Array
  - ❏ K Closest Points to Origin
- ❏ Counting Sort - Relative Sort Array
- ❏ Tree sort - Convert Sorted List to Binary Search Tree
- ❏ Bucket Sort - Top K Frequent Elements
- ❏ Radix Sort - Maximum Gap
- ❏ Topological sort - Covered in Graphs

❏ Divide-and-Conquer **- 2 Days**

- ❏ The maximum-subarray problem - Maximum Subarray
- ❏ Strassen's algorithm for matrix multiplication - Divide and Conquer | Set 5 (Strassen's Matrix Multiplication)
- ❏ The substitution method for solving recurrences
- ❏ The recursion-tree method for solving recurrences
- ❏ The master method for solving recurrences

❏ Dynamic Programming **- 2 Days**

- ❏ Rod cutting - Integer Break
- ❏ Dynamic Programming for the confused : Rod cutting problem
- ❏ Matrix-chain multiplication - Burst Balloons
- ❏ Elements of dynamic programming
- ❏ Longest common subsequence - Longest Common Subsequence
- ❏ Optimal binary search trees
  - ❏ Unique Binary Search Trees
  - ❏ Unique Binary Search Trees II

❏ Greedy Algorithms **- 2 Days**

- ❏ An activity-selection problem - Minimum Number of Arrows to Burst Balloons
- ❏ Elements of the greedy strategy
- ❏ Huffman codes - Construct Huffman Tree, Google | Onsite | Software Engineer | Huffman Coding Algorithm, Minimum Cost Tree From Leaf Values
- ❏ Matroids and greedy methods - Matroid intersection in simple words
- ❏ A task-scheduling problem as a matroid - Task Scheduler

❏ Graph Algorithms **- 6 Days**

Leetcode Pattern 1 | DFS + BFS == 25% of the problems

- ❏ N-ary Tree Preorder Traversal
- ❏ N-ary Tree Postorder Traversal
- ❏ N-ary Tree Level Order Traversal
- ❏ BFS
  - ❏ Binary Tree Level Order Traversal
  - ❏ Binary Tree Level Order Traversal II
  - ❏ Web Crawler Multithreaded
  - ❏ Web Crawler
  - ❏ Cut Off Trees for Golf Event
  - ❏ Course Schedule
- ❏ DFS

        - ❏ Binary Tree Postorder Traversal
        - ❏ Binary Tree Preorder Traversal
        - ❏ Binary Tree Inorder Traversal
        - ❏ Is Graph Bipartite?
        - ❏ Remove Invalid Parentheses
        - ❏ Construct Binary Tree from Preorder and Inorder Traversal
    - ❏ Topological Sort - Topological Sort
    - ❏ Strongly Connected Components - SCC - Course Schedule, Facebook | Minimum number of people to spread a message, Airbnb | Cover all vertices with the least number of vertices, Critical Connections in a Network
    - ❏ Minimum spanning Tree - Prim's Algorithm
        - ❏ Cheapest Flights Within K Stops
        - ❏ Minimum Height Trees
        - ❏ Number of Operations to Make Network Connected
        - ❏ Connecting Cities With Minimum Cost
    - ❏ Shortest Path Algos -
        - ❏ Bellman-Ford - Network Delay Time, https://leetcode.com/problems/get-watched-videos-by-your-friends/
        - ❏ Dijkstra's algorithm
            - ❏ Reachable Nodes In Subdivided Graph
            - ❏ Shortest Path Visiting All Nodes
        - ❏ Floyd-Warshall
            - ❏ Find the City With the Smallest Number of Neighbors at a Threshold Distance
            - ❏ Evaluate Division
        - ❏ Johnson's algorithm
            - ❏ All-pairs shortest paths - Johnson's algorithm for sparse graphs - GeeksforGeeks
            - ❏ Johnson's algorithm
        - ❏ The Ford-Fulkerson method
            - ❏ Google | Onsite | Network flow for the matrix with given row and column sums
            - ❏ Ford-Fulkerson Algorithm for Maximum Flow Problem

- ❏ Number-Theoretic Algorithms **- 2 Days**
    - ❏ The Chinese remainder theorem - Check If It Is a Good Array
    - ❏ Greatest common divisor
        - ❏ Greatest Common Divisor of Strings
        - ❏ X of a Kind in a Deck of Cards
        - ❏ Google | OA Summer Intern 2020 | Greatest Common Divisor
    - ❏ Powers of an element
        - ❏ Pow(x, n)
        - ❏ Sort Integers by The Power Value
    - ❏ The RSA public-key cryptosystem
        - ❏ Keys and Rooms
        - ❏ Shortest Path to Get All Keys
    - ❏ Integer factorization
        - ❏ Largest Component Size by Common Factor
        - ❏ Minimum Factorization

- 2 Keys Keyboard
- Bulb Switcher

- String Matching **- 2 Day**
  - The Rabin-Karp algorithm
    - Implement strStr()
    - Binary String With Substrings Representing 1 To N
    - Shortest Palindrome
    - Find All Anagrams in a String
  - String matching with finite automata
  - The Knuth-Morris-Pratt algorithm
    - Shortest Palindrome
    - Rotate String
    - KMP Algorithm for Pattern Searching

- Approximation Algorithms **- 3 Days**
  - The vertex-cover problem
    - Binary Tree Cameras
    - Vertex Cover Problem-2
    - Vertex Cover Problem
  - The traveling-salesman problem Find the Shortest Superstring
  - The set-covering problem
    - Video Stitching
    - Set Intersection Size At Least Two
    - Non-overlapping Intervals
  - Randomization and linear programming
  - The subset-sum problem
    - Partition Equal Subset Sum
    - Partition to K Equal Sum Subsets

- Randomized Algorithms **- 1 Day**
  - Quick Sort
  - Min Cut Palindrome Partitioning II

Concepts Problems and Maths - (1 Week)

- Matrix Operations
- Linear Programming
- Polynomials - DFT, FFT
- Computational Geometry
  - Line-segment properties
  - Determining whether any pair of segments intersects
  - Finding the convex hull - Erect the Fence, The Skyline Problem
  - Finding the closest pair of points - K Closest Points to Origin
- GCD and LCM
  - X of a Kind in a Deck of Cards
  - Greatest Common Divisor of Strings
  - Nth Magical Number
  - Ugly Number III

- ❏ Prime Factorization and Divisors
    - ❏ Largest Component Size by Common Factor
    - ❏ 2 Keys Keyboard
- ❏ Fibonacci Numbers
    - ❏ Length of Longest Fibonacci Subsequence
    - ❏ Split Array into Fibonacci Sequence
    - ❏ Find the Minimum Number of Fibonacci Numbers Whose Sum Is K
- ❏ Catalan Numbers - Unique Binary Search Trees
- ❏ Modular Arithmetic
- ❏ Euler Totient Function
- ❏ nCr Computations
- ❏ Set Theory
- ❏ Factorial
    - ❏ Last Substring in Lexicographical Order
    - ❏ Snakes and Ladders
    - ❏ Factor Combinations
    - ❏ Path With Maximum Minimum Value
    - ❏ Number of Closed Islands
- ❏ Prime numbers and Primality Tests
    - ❏ Prime Arrangements
    - ❏ K-th Smallest Prime Fraction
- ❏ Sieve Algorithms
    - ❏ Count Primes
- ❏ Divisibility and Large Numbers
- ❏ Series
- ❏ Number Digits
- ❏ Triangles
    - ❏ Triangle
    - ❏ Valid Triangle Number

Networks - (1 Week)

Leetcode

- ❏ Network Topology, OSI Architecture
- ❏ TCP/IP models
- ❏ TCP and UDP
- ❏ Firewall, DNS, Domains, workgroups
- ❏ Protocols i.e ICMP

OS - (1 week)

Operating System Tutorial

Shared Memory Systems

- ❏ Cache
- ❏ Multithreading
    - ❏ Producers-consumers problem
    - ❏ Dining philosophers problem
    - ❏ Cigarette smokers problem
    - ❏ Readers–writers problem
    - ❏ Web Crawler Multithreaded

- ❏ Scheduling algorithms
- ❏ Deadlock
- ❏ Virtual Memory
- ❏ Mutex and semaphore
- ❏ Kernels
- ❏ Paging

Software Design Principles - (2 weeks)

System Design Primer

Start learning about Theory of Distributed Systems?
Challenges with distributed systems
Microservices Design Guide 👨🏫 - Platform Engineer

Cloud design patterns - Azure Architecture Center
Design patterns for microservices | Azure Blog and Updates

TO READ:
Domain Driven Design (DDD) | Bounded Context (BC) | Polyglot Persistence (PP)| Command and Query Responsibility Segregation (CQRS) | Command Query Separation (CQS) | Event-Sourcing (ES) | CAP Theorem | Eventual Consistency | Twelve-Factor App | SOLID Principles |

Just some things to focus on.

- ❏ Load balancer
- ❏ API gateway
- ❏ Microservices - Scale Cube Concept, MVC - READ
- ❏ Database Sharding
- ❏ SQL vs NoSQL - Cassandra, Postgres, Hadoop, Data lake, other algorithms related to data lake, CAP Theorem

Leadership Principles - LPs - (1 Week)

TO BE UPDATED

Resume and Miscellaneous

#ADD WHATEVER YOU HAVE PUT IN RESUME

- ❏ Algos you have mentioned
- ❏ Project work and related references to read
- ❏ Achievements and information about it

REFERENCES
Introduction to Algorithms - Cormen
Leetcode