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 Digit
- ❏ 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