PART-2

ROADMAP TO LEARN DATA STRUCTURES & ALGORITHMS STEP-BY-STEP

Curated By-

HIMANSHU KUMAR(LINKEDIN) http://www.linkedin.com/in/himanshukumarmahuri

Telegram channel- https://t.me/the_rising_engineers

TOPICS COVERED -

- Basic Data Structures: Arrays, Strings, Stacks, Queues
- Asymptotic analysis (Big-O notation)
- Basic math operations (addition, subtraction, multiplication, division, exponentiation)
- Sqrt(n) primality testing
- Euclid's GCD Algorithm
- Basic Recursion
- Greedy Algorithms
- Basic Dynamic Programming
- Naive string searching
- O(n logn) Sorting
- Binary Searching

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Basic Data Structures:

Arrays, Strings, Stacks, Queues

Arrays

Resources:-

I. codechef.com - Data Structure Tutorial: Array
II. cs.cmu.edu - Arrays
III. geeksforgeeks.org - Arrays Data Structure

Practice Problems:-

I. codechef.com - LECANDY, editorial
II. codechef.com - CNOTE, editorial ;
III. codechef.com - SALARY, editorial
IV. codechef.com - CHN15A, editorial
V. codechef.com - RAINBOWA, editorial
VI. codechef.com - FRGTNLNG, editorial
VII. codechef.com - COPS, editorial

Strings

Resources

I. tutorialspoint.com - C++ strings
II. guru99.com - Java strings
III. docs.python.org - Python strings
IV. tutorialspoint.com - Python strings
V. geeksforgeeks.org - Many string questions

Practice Problems

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I. codechef.com - CSUB, editorial
II. codechef.com - LAPIN, editorial

Stack and Queue

Resources

I. geeksforgeeks.org – Stack Data Structure
II. geeksforgeeks.org – Introduction and Array Implementation
III. tutorialspoint.com – Data Structures Algorithms
IV. cs.cmu.edu – Stacks
V. iterbi-web.usc.edu – Stacks and Queues
VI. cs.cmu.edu – Stacks and Queues

Practice Problems

I. spoj.com – JNEXT
II. spoj.com – STPAR
III. spoj.com – ONP
IV. codechef.com – COMPILER
V. spoj.com – MMASS
VI. spoj.com – HISTOGRA
VII. codeforces.com – D. Maximum Xor Secondary
VIII. spoj.com – ANARC09A
IX. codeforces.com – C. Minimal string
X. codeforces.com – B. Alternating Current
XI. codeforces.com – C. Longest Regular Bracket Sequence

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Asymptotic analysis (Big-O notation)

Basic

1. youtube.com - Time complexity of a computer program
2. youtube.com - Big-O notation in 5 minutes - The basics
3. youtube.com - Definition Of Big O Notation - Intro to Theoretical Computer Science
4. youtube.com - Algorithms Lecture 1 -- Introduction to asymptotic notations
5. iarcs.org.in - Measuring the efficiency of algorithms
6. runestone.academy - Particularly for Big-O notation

Advanced

1. rob-bell.net - A beginner's guide to Big O notation
2. youtube.com - Big O Notation, Gayle Laakman McDowell
3. web.mit.edu - Big O notation
4. youtube.com - Time and space complexity analysis of recursive programs - using factorial
5. A very nice tutorial with examples

Practice Problems

1. Check some MCQs on space and time complexity here.
2. You can see some problems with solutions here: Time complexity of an algorithm

Basic math operations (addition, subtraction, multiplication, division, exponentiation)

- codechef.com - A tutorial on Fast Modulo Multiplication

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Euclid's GCD Algorithm

Resources

1. youtube.com - Mycodeschool video
2. khanacademy.org - The Euclidean Algorithm
3. geeksforgeeks.org - Example program to find gcd in c++:

Prime Numbers, divisibility of numbers

Resources:

1. Only O(sqrt(n)) algorithm for finding whether a number is a prime, factorization of a number.
2. Finding prime factors by taking the square root

Practice Problems:

1. community.topcoder.com - DivisorInc
2. community.topcoder.com - Prime Polynom
3. community.topcoder.com - Prime Anagrams
4. community.topcoder.com - Refactoring

Basic Recursion

Resources:

1. topcoder.com - An Introduction to Recursion, Part 1
2. topcoder.com - An Introduction to Recursion: Part 2
3. geeksforgeeks.org - Recursion ;(along with questions)
4. web.mit.edu - Recursion
5. csee.umbc.edu - Recursion ;(Examples with exercises)
6. loveforprogramming.quora.com - Backtracking, Memoization & Dynamic Programming
7. byte-by-byte - Recursion for Coding Interviews

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Practice Problems:

1. codechef.com - NOKIA, editorial
2. codechef.com - TRISQ, editorial
3. codechef.com - LFSTACK, editorial
4. codechef.com - FICE, editorial

Greedy Algorithms

Resources

1. iarcs.org.in - Greedy Algorithms
2. iarcs.org.in - Greedy Algorithms
3. topcoder.com - Greedy Algorithms
4. Greedy Algorithms

Practice Problems

- codechef.com - TACHSTCK, editorial
- codechef.com - CIELRCPT, editorial
- codechef.com - MAXDIFF, editorial
- codechef.com - CHEFST, editorial
- codechef.com - CAKEDOOM, editorial
- codechef.com - CLETAB, editorial
- codechef.com - TADELIVE, editorial
- codechef.com - MANYCHEF, editorial
- codechef.com - MMPROD, editorial
- codechef.com - CHEFTMA, editorial
- codechef.com - STICKS, editorial
- spoj.com - BAISED
- spoj.com - BALIFE
- spoj.com - GCJ101BB

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- codechef.com - FGFS
- codechef.com - KNPSK
- codechef.com - LEMUSIC
- spoj.com - ARRANGE
- spoj.com - FASHION

Dynamic programming (Basic DP)

Resources

- medium.freecodecamp.org - Demystifying Dynamic Programming
- iarcs.org.in - Dynamic Programming - Tiling
- topcoder.com - Dynamic Programming – From Novice to Advanced
- illinois.edu - Dynamic Programming ;(Exercises are recommended)
- codechef.com - Dynamic Programming
- geeksforgeeks.org - Dynamic Programming ;(Contains a lot of practice sessions)
- MIT OCW (Contains some Advanced topics as well)
    - Dynamic Programming I
    - Dynamic Programming II
    - Dynamic Programming III
    - Dynamic Programming IV

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Practice Problems

- codechef.com - ALTARAY, editorial
- codechef.com - DELISH, editorial
- codechef.com - DBOY, editorial
- codechef.com - XORSUB, editorial
- codechef.com - GRID, editorial
- codechef.com - TADELIVE, editorial
- codechef.com - FROGV, editorial
- codechef.com - MATRIX2, editorial
- codechef.com - AMSGAME2, editorial
- spoj.com - MDOLLS
- spoj.com - MSTICK
- spoj.com - MCARDS
- spoj.com - MIXTURES
- spoj.com - SAMER08D
- spoj.com - AIBOHP

Naive string searching

Resources

i. geeksforgeeks.org - Naive Pattern Searching

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Sorting

A. khanacademy.org
B. visualgo.net
C. iarcs.org.in
D. Merge Sort
   - youtube.com - Merge sort algorithm
   - Practice Problems

     codechef.com -MRGSRT
E. Quick Sort
   - youtube.com - Quicksort algorithm
   - Practice Problems

     codechef.com -TSORT

F. Counting Sort
   - geeksforgeeks.org - Counting Sort
   - Practice Problems
     - codechef.com - TACHSTCK, editorial
     - codechef.com - STICKS, editorial

Binary Search

Resources

1. topcoder.com (Try solving problems of Simple and Moderate level as mentioned in the end of the link)
2. codechef.com
3. usfca.edu
4. khanacademy.org

Detailed Theoretical analysis

- cmu.edu (A theoretical analysis)

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Problems

- geeksforgeeks.org - Binary Search (Contains some solved problems)
- codechef.com - STRSUB, editorial
- codechef.com - ASHIGIFT, editorial
- codechef.com - STACKS, editorial
- codechef.com - DIVSET, editorial
- codechef.com - LOWSUM, editorial
- codechef.com - SNTEMPLE, editorial
- codechef.com - SNAKEEAT, editorial
- codechef.com - SCHEDULE, editorial
- codechef.com - RIGHTTRI, editorial
- codechef.com - FORESTGA, editorial
- codechef.com - CHEFHCK2,editorial
- spoj.com - ABCDEF
- spoj.com - NOTATRI
- spoj.com - SCALE
- spoj.com - SUMFOUR
- spoj.com - SUBSUMS
- spoj.com - ANARC05B
- spoj.com - RENT
- spoj.com - PIE
- spoj.com - MKUHAR
- spoj.com - SVADA
- spoj.com - SUBS

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ADVANCED DSA TOPICS FOR PART-2

TOPICS-

- Heaps (priority queue)
- Disjoint Set Union
- Segment Trees
- Binary Index Tree (Fenwick tree)
- Trees (traversals, tree dynamic programming)
- Finding Lowest Common Ancestors (O(log N) solution where N is number of nodes).
- Graph Algorithms:
    - Finding connected components and transitive closures.
    - Shortest-path algorithms (Dijkstra, Bellman-Ford, Floyd-Warshall)
    - Minimum spanning tree (Prim and Kruskal algorithms)
    - Biconnectivity in undirected graphs (bridges, articulation points)
    - Strongly connected components in directed graphs

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- Topological Sorting
- Euler path, tour/cycle.

- Modular arithmetic including division, inverse
- Amortized Analysis
- Divide and Conquer
- Advanced Dynamic Programming problems (excluding the dp optimizations which are added in expert level)
- Sieve of Eratosthenes

MUST JOIN THE TELEGRAM CHANNEL FOR NOT MISSING ANY FUTURES UPDATES.

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