Mastering Algorithms Resources

1. Basic C++ STL and time complexity

- Resources
  - cppreference.com
  - STL Containers - C++ Reference
  - HackerEarth
  - STL for CP 🎥
  - Standard Template Library
  - Power up C++ with the Standard Template Library: Part 1
  - Power up C++ with the Standard Template Library: Part 2
  - C++ intro 🎥
  - Intro to codeforces
  - STL 🎥
  - Time complexity 🎥
  - Time complexity guide for contests
  - Intro to CP 🎥
- Problems
  - https://codeforces.com/problemset/problem/855/B
  - https://codeforces.com/contest/1140/problem/C
  - https://codeforces.com/problemset/problem/740/B
  - https://leetcode.com/problems/maximal-rectangle/description/

Stacks

  - https://www.geeksforgeeks.org/problems/implement-two-stacks-in-an-array/1 -> two stacks implementation
  - https://leetcode.com/problems/valid-parentheses/description/
  - https://leetcode.com/problems/largest-rectangle-in-histogram/description/
  - https://codeforces.com/contest/548/problem/D
  - https://leetcode.com/problems/sum-of-subarray-minimums/description/
  - https://codeforces.com/contest/797/problem/C

QUEUES

  - https://leetcode.com/problems/implement-queue-using-stacks/description/
  - https://www.geeksforgeeks.org/problems/queue-reversal/1
  - https://leetcode.com/problems/sliding-window-maximum/description/
  - https://leetcode.com/problems/shortest-subarray-with-sum-at-least-k/description/
  - https://leetcode.com/problems/longest-continuous-subarray-with-absolute-diff-less-than-or-equal-to-limit/description/

2. Mathematics for CP

Lecture link - https://colab.research.google.com/drive/13dRKA2SYS89yRAQFMtzKICXvkYXgDANs?usp=sharing

Number Theory

a. Modulus arithmetic - basic postulates
   - Suggested reading
     1. Chapter 1 from Number Theory for Computing by SY Yan [Recommended]
     2. 31.1, 31.3, and 31.4 from CLRS [optional]
     3. www.topcoder.com/tc?module=Static&d1=tutorials&d2=primeNumbers
   - Problems
     1. http://projecteuler.net/index.php?section=problems&id=64
     2. http://projecteuler.net/index.php?section=problems&id=65

b. Fermat's theorem, Euler's Totient theorem (totient function, order, primitive roots)
   - Suggested Reading
     1. 1.6, 2.2 from Number Theory by SY Yan
     2. 31.6 , 31.7 from Cormen
   - Problems
     1. http://projecteuler.net/index.php?section=problems&id=70

2. http://www.spoj.pl/problems/NDIVPHI/

c. Chinese remainder theorem
   - Suggested Reading
     1. 1.6 from Number Theory by SY Yan
   - Problems
     1. Project Euler 271
     2. http://www.topcoder.com/stat?c=problem_statement&pm=10551&rd=13903

d. Primality tests -
   - Deterministic O(sqrt(n)) approach

e. Prime generation techniques - Sieve of Eratosthenes
   - Suggested Problems - PRIME1 on SPOJ

f. Integer Factorization
   - Naive O(sqrt(n)) method
   - Pollard Rho factorization
   - Problems -
     1. http://www.topcoder.com/stat?c=problem_statement&pm=2986&rd=5862
     2. http://www.spoj.pl/problems/DIVSUM2/
     3. http://www.topcoder.com/stat?c=problem_statement&pm=4481&rd=6538

g. Stirling numbers

h. Wilson theorem
   - nCr % p in O(p) preprocess and O(log n) query

i. Lucas Theorem

j. Suggested Reading for Number Theory -
   - Number Theory for Computing by Song Y Yan
   - Concepts are also superficially covered in Chapter 31 of Introduction to Algorithms by Cormen
   - http://www.codechef.com/wiki/tutorial-number-theory
   - http://www.algorithmist.com/index.php/Category:Number_Theory

k. Problems on Number Theory -
   - http://www.algorithmist.com/index.php/Category:Number_Theory

Bit manipulation, Combinatorics, and Game theory [optional]

- Resources
  - Bit manipulation 🎥
  - Bitwise fiddling hacks
  - complete playlist for bit manipulation 🎥
  - Combinatorics
  - Problems discussion 🎥
  - Intro to Game Theory 🎥
- Problems

Bit manipulation

- https://codeforces.com/problemset/problem/1567/B
- https://codeforces.com/problemset/problem/1514/B
- https://codeforces.com/contest/1879/problem/D

Combinatorics and Game Theory

- Basic principles - Pigeon hole principle, addition, multiplication rules
  1. Suggested problems
     a. http://acm.timus.ru/problem.aspx?space=1&num=1690
     b. http://www.topcoder.com/stat?c=problem_statement&pm=10805
  3. Suggested readings
     a. http://en.wikipedia.org/wiki/Combinatorial_principles
     b. http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=combinatorics
     c. http://www.maa.org/editorial/knot/pigeonhole.html
- Inclusion-exclusion
  1. Suggested readings
     a. http://en.wikipedia.org/wiki/Inclusion–exclusion_principle
  2. Suggested problems
     a. http://www.topcoder.com/stat?c=problem_statement&pm=4463&rd=6536
     b. http://www.topcoder.com/stat?c=problem_statement&pm=10238
- Basic Principles and Nim game[optional]
  1. Sprague grundy theorem, grundy numbers

2. Suggested readings
    a. http://en.wikipedia.org/wiki/Sprague%E2%80%93Grundy_theorem
    b. http://www.topcoder.com/tc?module=Static&d1=tutorials&d2=algorithmGames
    c. http://www.ams.org/samplings/feature-column/fcarc-games1
    d. http://www.codechef.com/wiki/tutorial-game-theory
3. Suggested problems
    a. https://codeforces.com/contest/1965/problem/A
    b. https://cses.fi/problemset/task/2207

3. Searching, Sorting, Divide and Conquer

- Problems
    - https://codeforces.com/contest/456/problem/A
    - https://codeforces.com/contest/492/problem/B
    - https://codeforces.com/contest/755/problem/B
    - https://codeforces.com/contest/1260/problem/B

Rotated Array | Interviewbit

Search for a Range | Interviewbit

Allocate Books | Interviewbit

The median of two Sorted Arrays of Different Sizes - GeeksforGeeks

Inversion count in an Array

Binary Search Blog

4. Binary Heaps

- References
    - https://www.geeksforgeeks.org/priority-queue-in-cpp-stl/
    - https://www.geeksforgeeks.org/building-heap-from-array/
    - https://leetcode.com/discuss/general-discussion/1127238/master-heap-by-solving-23-questions-in-4-patterns-category (optional)
- Problems
    - https://leetcode.com/problems/kth-largest-element-in-an-array/description/
    - https://leetcode.com/problems/ugly-number-ii/description/ (can also be solved using dynamic programming once taught)
    - https://leetcode.com/problems/design-twitter/description/
    - https://codeforces.com/contest/681/problem/C (Hard to do without knowing the greedy approach which will be taught later)

Mid-term evaluation -- Assignment 1

5. Recursion, Backtracking, Greedy Algorithms

Lecture link - https://colab.research.google.com/drive/1kYtT7Ntej81KfGIx-P78ZxkJCQzG73zd?usp=sharing

- Resources
    - USACO Greedy
    - Top coder Greedy
    - Recursion GFG
    - Backtracking
    - Greedy 🎥
- Problems
    - https://codeforces.com/problemset/problem/1896/C
    - https://cses.fi/problemset/task/1073
    - https://cses.fi/problemset/task/1643
    - https://www.geeksforgeeks.org/activity-selection-problem-greedy-algo-1/
    - https://codeforces.com/group/MWSDmqGsZm/contest/223339/problem/Y

6. Dynamic programming

problems related to class today

Nth staircase problem

Tiling problem

Flowers (difficult problem)

Max Non-Adjacent sum

difficult problem -> https://codeforces.com/contest/456/problem/C

difficult problem -> https://codeforces.com/problemset/problem/698/A

Rod cutting problem

Decode ways

https://leetcode.com/problems/coin-change/description/

try to write both top bottom and bottom up code for all the questions

https://www.geeksforgeeks.org/problems/coin-change2448/1

https://www.geeksforgeeks.org/problems/subset-sum-problem-1611555638/1

https://www.geeksforgeeks.org/problems/minimum-sum-partition3317/1

https://www.geeksforgeeks.org/problems/0-1-knapsack-problem0945/1

https://www.geeksforgeeks.org/problems/knapsack-with-duplicate-items4201/1

https://leetcode.com/problems/longest-increasing-subsequence/description/

https://leetcode.com/problems/longest-common-subsequence/

https://leetcode.com/problems/edit-distance/description/

https://leetcode.com/problems/wildcard-matching/

7. Graphs

- Resources
    - Graph traversal - BFS DFS
    - Cycle Detection
    - Djikstras Algo 🎥
    - Minimum Spanning trees
    - Graphs complete playlist 🎥
- Problems
    - DFS
    - BFS
    - Cycles+connected components
    - Djikstra
    - https://codeforces.com/problemset/problem/1000/E
    - https://cses.fi/problemset/task/1675

End-term evaluation -- Final Assignment