Competitive Programming 3 Textbook

Notes / Attempted Questions

# 1.3 Easy Problems

Super Easy

* **UVa 11172 - Relational Operators \*** (ad hoc, very easy, one liner)
  + Accepted
* **UVa 11498 - Division of Nlogonia \*** (just use if-else statements)
  + Accepted
* **UVa 11727 - Cost Cutting \*** (sort the 3 numbers and get the median)
  + Accepted

Easy

* **UVa 10114 – Loansome Car Buyer \*** (just simulate the process)
  + Accepted
* **UVa 11559 – Event Planning \*** (one linear pass)
  + Accepted
* **UVa 11799 – Horror Dash \*** (one linear scan to find the max value)
  + Accepted

Medium

* **UVa 00573 – The Snail \*** (simulation, beware of boundary cases)
  + Accepted
* **UVa 10141 – Request for Proposal \*** (solvable with one linear scan)
  + Accepted
* **UVa 11507 – Bender B. Rodriguez \*** (simulation, if-else)
  + Accepted

# 1.4 Ad Hoc

Game (Card)

* **UVa 00462 - Bridge Hand Evaluator \*** (simulation; card)
  + Accepted
* **UVa 10646 - What is the Card? \*** (shuffle cards with some rule and  then get certain card)
  + Accepted
* **UVa 12247 - Jollo \*** (interesting card game; simple, but requires good logic to get all test cases correct)
  + Accepted
  + Current solution is a bit of a cop out, uses checking for win rather than explicit if statements with full understanding of cases

Game (Chess)

* **UVa 00278 - Chess \*** (ad hoc, chess, closed form formula exists)
  + Accepted
* **UVa 00696 - How Many Knights \*** (ad hoc, chess)
  + Accepted
* **UVa 10284 - Chessboard in FEN \*** (FEN = Forsyth-Edwards Notation is a standard notation for describing board positions in a chess game)
  + Passes all uDebug cases but gets Wrong Answer

Game (Others)

* **UVa 00489 - Hangman Judge \*** (just do as asked)
  + Accepted
* **UVa 10189 - Minesweeper \*** (simulate Minesweeper, similar to UVa 10279)
  + Accepted

Palindrome

* **UVa 00401 - Palindromes \*** (simple palindrome check)
  + Accepted
* **UVa 11221 - Magic Square Palindrome \*** (we deal with a matrix)
  + Accepted

# 2.2 Linear DS

1D Array Manipulation

* **UVa 10038 - Jolly Jumpers \*** (use 1D boolean flags to check [1..n − 1])
  + Accepted
* **UVa 11340 - Newspaper \*** (DAT; see Hashing in Section 2.3)
  + TLE (Python)
  + Accepted (C++)
* **UVa 12356 - Army Buddies \*** (similar to deletion in doubly linked lists, but we can still use a 1D array for the underlying data structure)
  + TLE (Python)
  + Accepted (C++)

2D Array

* **UVa 10855 - Rotated squares \*** (string array, 90o clockwise rotation)
  + Accepted (C++)
  + TLE (Python)
* **UVa 10920 - Spiral Tap \*** (simulate the process)
  + Accepted (C++)
* **UVa 11581 - Grid Successors \*** (simulate the process)
  + Come back to this later – solution probably involves finding the first duplicate grid as the start of an infinite cycle

C++ STL algorithm

* **UVa 00146 - ID Codes \*** (use next permutation)
  + Accepted
* **UVa 10107 - What is the Median? \*** (find median of a growing/dynamic  list of integers; still solvable with multiple calls of nth element in algorithm)
  + Accepted
* **UVa 10258 - Contest Scoreboard \*** (multi-fields sorting, use sort)
  + Accepted

Bit Manipulation

* **UVa 10264 - The Most Potent Corner \*** (heavy bitmask manipulation)
  + Accepted (Python) – could be made more efficient, almost too slow
* **UVa 11926 - Multitasking \*** (use 1M bitset to check if a slot is free)
  + Accepted (C++)
  + TLE (Python)
* UVa 11933 - Splitting Numbers \* (an exercise for bit manipulation)
  + Accepted

Linked List

* **UVa 11988 - Broken Keyboard ... \*** (rare linked list problem)
  + Accepted (C++)

STL Stack

* **UVa 00514 - Rails \*** (use stack to simulate the process)
  + Accepted
* **UVa 00732 - Anagram by Stack \*** (use stack to simulate the process)
  + TLE (Python)
* **UVa 01062 - Containers \*** (LA 3752, WorldFinals Tokyo07, simulation with stack; maximum answer is 26 stacks; O(n) solution exists)
  + Accepted – solution not very efficient though, could be improved maybe using linked list

STL Queue and Deque

* **UVa 10172 - The Lonesome Cargo ... \*** (use both queue and stack)
  + Accepted – could be written more efficiently though, should redo in C++
* **UVa 10901 - Ferry Loading III \*** (simulation with queue)
  + Accepted – solution very messy & not using proper queue data structure
* **UVa 11034 - Ferry Loading IV \*** (simulation with queue)
  + Accepted – easier than Ferry Loading III

# 2.3 Non-Linear DS

C++ STL map

* **UVa 10226 - Hardwood Species \*** (use hashing for a better performance)
  + Accepted (C++)
  + TLE (Python)
* **UVa 11286 - Conformity \*** (use map to keep track of the frequencies)
  + Accepted
* **UVa 11572 - Unique Snowflakes \*** (use map to record the occurrence index of a certain snowflake size; use this to determine the answer in O(n log n))
  + Accepted

C++ STL set

* **UVa 00978 - Lemmings Battle \*** (simulation, use multiset)
  + Accepted (C++)
  + TLE (Python)
* **UVa 11136 - Hoax or what \*** (use multiset)
  + Accepted (C++)
* **UVa 11849 - CD \*** (use set to pass the time limit, better: use hashing!)
  + Accepted (C++)

C++ STL priority\_queue

# 3.2 Complete Search

Iterative 1 (Linear Scan)

* **UVa 00927 - Integer Sequence from ... \*** (use sum of arithmetic series)
  + Accepted
* **UVa 01237 - Expert Enough \*** (LA 4142, Jakarta08, input is small)
  + Accepted
* **UVa 10976 - Fractions Again ? \*** (total solutions is asked upfront; there- fore do brute force twice)
  + Accepted (C++)
  + TLE (Python)

Iterative 2 (Two Nested Loops)

* **UVa 01260 - Sales \*** (LA 4843, Daejeon10, check all)
  + Accepted (C++)
  + TLE (Python)
* **UVa 10487 - Closest Sums \*** (sort and then do O(n2) pairings)
  + Accepted (Python) using nlogn method
* **UVa 11242 - Tour de France \*** (plus sorting)
  + Accepted

Iterative 3 (Easier)

* **UVa 00441 - Lotto \*** (6 nested loops)
  + Accepted (Python) – used itertools.combinations() instead of loops
* **UVa 00735 - Dart-a-Mania \*** (3 nested loops, then count)
  + TLE (Python)
  + Accepted (C++)
* **UVa 10102 - The Path in the Colored Field \*** (4 nested loops will do, we do not need BFS; get max of minimum Manhattan distance from a ‘1’ to a ‘3’.)
  + Accepted (C++)

Iterative 3 (Harder)

* **UVa 11236 - Grocery Store \*** (3 nested loops for a, b, c; derive d from a, b, c; check if you have 949 lines of output)
  + Accepted (C++)
  + Python too slow

# 3.4 Greedy Algorithms

Classical

* **UVa 11264 - Coin Collector \*** (coin change variant)
  + Accepted
* **UVa 11389 - The Bus Driver Problem \*** (load balancing)
  + Accepted
* **UVa 12405 - Scarecrow \*** (simpler interval covering problem)
  + Accepted
* UVa 12321 - Gas Station (interval covering)
  + Accepted

Involving Sorting

* **UVa 11100 - The Trip, 2007 \*** 
  + Runtime Error despite passing uDebug, might be broken for Python
* **UVa 11292 - Dragon of Loowater \*** 
  + Accepted
* **UVa 12210 - A Match Making Problem \*** 
  + Accepted
* UVa 10763 - Foreign Exchange
  + Accepted
* UVa 10026 – Shoemaker’s problem
  + Wrong answer, probably due to float comparisons
* UVa 10785 - The Mad Numerologist
  + Accepted

Non-Classical

* **UVa 10656 - Maximum Sum (II) \*** 
  + Accepted
* **UVa 10718 - Bit Mask \***
  + Wrong Answer
* **UVa 11157 - Dynamic Frog \***
  + Accepted
  + Solved by alternating usage of the small rocks
* UVa 11240 - Antimonotonicity
  + Accepted
* UVa 11900 – Boiled eggs
  + Accepted
* UVa 10340 – All in All
  + Accepted

# 3.5 Dynamic Programming

Max 1D Range Sum

* UVa 00507 - Jill Rides Again (standard problem)
  + WA (Python and C++)
* **UVa 00787 - Maximum Sub ... \*** (max 1D range product, be careful with 0, use Java BigInteger, see Section 5.3)
  + Accepted
* **UVa 10684 - The Jackpot \*** (standard problem; easily solvable with the given sample source code)
  + Accepted (C++)
  + Runtime error (Python)
* **UVa 10755 - Garbage Heap \*** (combination of max 2D range sum in two of the three dimensions—see below—and max 1D range sum using Kadane’s algorithm on the third dimension)

Max 2D Range Sum

* **UVa 00108 - Maximum Sum \*** (discussed in this section with sample  source code)
  + TLE (Python)

Longest Increasing Subsequence

* **UVa 00481 - What Goes Up? \*** (use O(n log k) LIS; print solution; see our sample source code)
  + Accepted – possibly dodgy though, fails two uDebug cases and may not have implemented correct selection from multiple answers
* **UVa 11456 - Trainsorting \*** (max(LIS(i) + LDS(i) - 1), ∀i ∈ [0 . . . n-1])
  + Accepted
* **UVa 11790 - Murcia’s Skyline \*** (combination of LIS+LDS, weighted)
  + Accepted (C++)
  + TLE (Python)

# Knapsack

* UVa 00562 - Dividing Coins (use a one dimensional table)
  + Hint about using a 1D table seems bad – 2D table required?
  + Accepted (C++)
  + TLE (Python)
* **UVa 10616 - Divisible Group Sum \*** (input can be -ve, use long long)
  + Decently difficult knapsack-style problem using a 3D table
  + Accepted (Python)
* **UVa 10819 - Trouble of 13-Dots \*** (0-1 knapsack with ‘credit card’ twist!)
  + Difficult problem

# Coin Change

* **UVa 00357 - Let Me Count The Ways \*** (similar to UVa 147/674)
  + Accepted (C++)
  + TLE (Python)
* **UVa 10306 - e-Coins \*** (variant: each coin has two components)
  + Accepted
* **UVa 11517 - Exact Change \*** (a variation to the coin change problem)
  + Accepted (C++)
  + TLE (Python)

# Travelling Salesman Problem (TSP)

* **UVa 00216 - Getting in Line \*** (TSP, still solvable with backtracking)
  + Accepted
  + Solved using exhaustive search
* **UVa 10496 - Collecting Beepers \*** (discussed in this section with sam- ple source code; actually, since n ≤ 11, this problem is still solvable with recursive backtracking and sufficient pruning)
  + Accepted
* **UVa 11284 - Shopping Trip \*** (requires shortest paths pre-processing; TSP variant where we can go home early; we just need to tweak the DP TSP re- currence a bit: at each state, we have one more option: go home early) See more examples in Section 8.4.3 and Section 9.2.

# 5.2 Ad Hoc Mathematics

Simpler

* **UVa 10773 - Back to Intermediate ... \*** (several tricky cases)
  + Accepted
* **UVa 11723 - Numbering Road \*** (simple math)
  + Accepted
* **UVa 11875 - Brick Game \*** (get median of a sorted input)
  + Accepted

Mathematical Simulation (Brute Force), Easier

* **UVa 00382 - Perfection \*** (do trial division)
  + Accepted – solution must deal with arbitrary line breaks
* **UVa 01225 - Digit Counting \*** (LA 3996, Danang07, N is small)
  + Accepted
* **UVa 10346 - Peter’s Smoke \*** (interesting simulation problem)
  + Accepted

Mathematical Simulation (Brute Force), Harder

* **UVa 00616 - Coconuts, Revisited \*** (brute force up to n, get pattern)
  + TLE (Python)
  + Accepted (C++)
* **UVa 11130 - Billiard bounces \*** (use billiard table reflection technique:  mirror the billiard table to the right (and/or top) so that we will only deal  with one straight line instead of bouncing lines)
  + Accepted – using the hint makes this into a super neat O(1) problem
* **UVa 11254 - Consecutive Integers \*** (use sum of arithmetic progres-  sion: n = r × (2 × a + r − 1) or a = (2 × n + r − r2)/(2 × r); as n is given,  2  brute force all values of r from 2n down to 1, stop at the first valid a)
  + Accepted (C++)
  + TLE (Python)