Problem Solving Workshop #30 Tech Interviews and Competitive Programming Meetup

October 22, 2017 https://www.meetup.com/tech-interviews-and-competitive-programming/

Instructor: Eugene Yarovoi (can be contacted through the group Meetup page above under Organizers)

More practice questions: leetcode.com, glassdoor.com, geeksforgeeks.org
Books: Elements of Programming Interviews, Cracking the Coding Interview
Have questions you want answered? Contact the instructor, or ask on Quora. You can post questions and follow the instructor and other people who write about algorithms.

Try to find optimized solutions, and provide a time and space complexity analysis with every solution.

Special Dynamic Programming Edition

Problem #1, "Alphabet Encodings" (Easy)

Consider taking a string S containing characters a-z, and converting it into a string D containing digits 0-9 by the following procedure: convert each letter of S to a number from 1-26 (a = 1, b= 2, ..., z = 26) and then concatenate all the numbers together. For example, the string "abu" becomes "1221" (a = 1, b=2, u=21). As you might notice, if you want to decode the numeric string back to an a-z string, the encoding can be ambiguous in the sense that "1221" could have been generated from "abu", but also from the strings "lu" (l = 12, u=21), "ava" (a = 1, v = 22, a = 1), "abba" (a =1, b = 2, b = 2, a = 1), or "lba" (l = 12, b = 2, a = 1).

When letters are converted to numbers, there are never any leading zeroes. For example, h -> "8", never h -> "08".

Given a numeric string encoded in this way, how many possible a-z strings does it decode to?

Example Input: "1221"
Output: 5
Explanation: 5 different strings are possible, as described above.

Online judge: http://www.spoj.com/problems/ACODE/

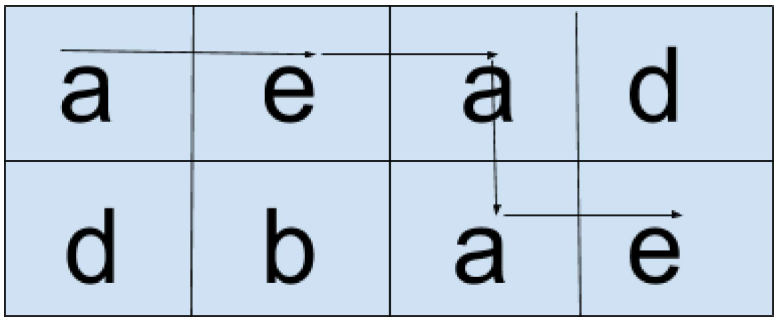
Problem #2, "Strings on a Grid" (Medium)

You're given an M x N grid, where each cell contains a letter a-z. You start at the upper left corner, and have to reach the lower right corner, moving only down or right by one cell in each move. When you move to a cell (you are considered to have "moved" to the starting cell as well), you pick up that letter. When you are finished your traversal, you sort all the letters (standard character order) and get a string. Find the path that will result in the lexicographically smallest (first by dictionary order) string in the end.

Example Input:

a	e	a	d
d	b	a	e

Output: Some representation of this path:



Explanation: the letters picked up through this path are a, e a, a, e, which after sorting is “aaaee”. This is the lexicographically smallest possible string that can be obtained by going from the upper left corner to the lower right corner.

(No online judge.)

Problem #3, “Class Schedules” (Medium)

A university student wants to know in how many ways they can pick their class schedule. They have a list of classes where each class has an associated start and end time (for simplicity, assume each class meets every day). Some of these class times may conflict, and a student can’t register for two classes whose class times overlap. How many different subsets of the courses on offer can the student choose such that no courses conflict in the chosen subset?

Example Input:
Latin: 8:30 - 10
French: 11-12
Calculus: 11:30 - 13
Output: 6

Explanation: French and Calculus conflict and can't both be taken. The student may take Calculus, French, or neither (3 choices). For each of those 3 choices, Latin can be taken or not taken, so there are 6 possible combinations in total.

Online judge: http://www.spoj.com/problems/ACTIV/

Follow-up: what if the student should choose a minimum of K courses and a maximum of M courses (given K and M with each input)?

Problem #4, "Airline Seats" (Medium-Hard)

Jumbo airlines has a new offering where they promise people will have "no annoying neighbors".

There are M seats in each row, and there are N rows of seats in the airplane. Hence the seats form an M * N grid. The airline sells exactly K tickets for each flight, which is smaller than M * N.

To make sure that the "no annoying neighbors" part of the motto is satisfied, the seating must obey the following rule: Whenever a seat is occupied, the seats one seat away from it, in each of the 4 directions, must remain free. Given M, N, and K, how many distinct seating arrangements are possible that satisfy this rule? A seating arrangement is a specification of which seats will be occupied and which will be empty; two seating arrangements are considered distinct if the set of occuipied seats is different.

Assume M is small (e.g. < 10) but N could be larger (e.g. < 1000). K can be any value between 0 and M*N.

Example Input: M =2, N = 4, K = 4
Output: 2
Explanation: Once you decide whether to put a person in the left lower corner, the rest of the arrangment is forced. There is one choice where the lower left corner is filled, and another where it is empty.

Online judge: http://www.spoj.com/problems/AIRLINES/

Problem #5, "Number Game" (Medium-Hard)

Two players play a game as follows: at first, there is a four-digit number N and a number of moves M. The players allternate turns. Each player must, on their turn, increase any digit of the number, but if the digit was 9 it will become 0. For example, the number 3590 can be converted to 4590, 3690, 3500, or 3591.

The game is over after M moves have been made (a move is one player making a move, not both). If, when the game is over, the final number is greater than the original number, the first player wins. Given the initial number N and the number of moves S, decide whether under optimal play, the first or second player to move wins. Suppose the number of moves is < 1000.

Example Input: N = 5566, M = 3

Output: First player
Explanation: Once the first player plays a move incrementing the first digit, the second player doesn't have enough moves left to stop the final number from being greater than the starting number.

Online judge: http://www.spoj.com/problems/ADAGAME/