Solution Slides FSR Coding Cup 2023

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IntuitiveCitations

Problem

- Given a list of names. Print the lexicographically smallest surname and add " et al.".

Solution

- Remove part before space (prename).
- Find the lexicographically smallest string by sorting and taking the first element.
- print string + " et al.".

FascinatingBooks

Problem

- Check if given list of strings contains every letter of the alphabet.

Solution

- Can concatenate strings and solve for a single string.
- For each char:
- If char is letter: Add lowercase version to set.
- Check if length of set is 26.

Gotchas

- Capitalization does not matter.
- Strings do not only contain letters

LeaderboardPrediction

Problem

- Given the times you need to solve each of the n problems.
- Determine the minimal penalty you can get on the contest.

Solution

- The time you needed for the first problem will be added to the penalty of all problems you solve.
- It is always best to solve shortest problems first.
- Greedy solution: Sort problems by length, then simulate.

CompilersBrackets

Problem

- Check if given bracket pattern makes sense.
- $\{\{\}\{$ Does not make sense.
- $\{\{\}\{\{\}\}\}$ Does make sense.

Solution

- Count number of currently open brackets.
- begin with open $= 0$
- "$\{$" $\rightarrow$ open$++$
- "$\}$" $\rightarrow$ open$--$
- pattern invalid if open < 0 at any time.
- pattern invalid if open $! = 0$ in the end.

DamConstruction

Problem

- Given (n_1, n_2, n_4) lego bricks of size 1, 2 and 4.
- Build the highest wall of width w.

Solution

- Should always use bricks of higher size first to maintain flexibility.
- Greedy solution by using n_4 bricks, then filling up with n_2, then with n_1.

BicycleLock

Problem

- Input: Initial lock position I and final lock position F of length n.
- Move to final position by always turning two consecutive dials at once.

Solution

- Dial 1 can only be turned by turning dials 1 and 2.
- It needs to be turned from I_1 to I_2.
- After turning that, we have a new subproblem of length $n-1$
- We can solve this recursively

Gotchas

- Always two ways to turn dials: Clockwise or Anti-clockwise.
- Need to check if dial n is at the right posititon in the end.

Aquarium Maze

Problem

- Input: grid of "." and "#" squares.
- Grid is filled with water from the top.
- Water can move down, left and right.

Solution

- Can simulate water by starting at a top square and then traversing the graph e.g. using BFS or DFS
  1. if square == "." and not yet visited
  2. visit all neighbours recursively
  3. add 1 to awnser

Gotchas

- Need to start once at every point on the top.
- Otherwise we might miss some air bubbles.

ExtravagantVoyage

Problem

- Given n items with happiness H and volume V
- Choose items with cumulative weight w
- Also called 0-1-Knapsack

Solution

- Recursive DP solution:
- Go through n items and start with remaining weight $r = w$.
- Recursively solve:
  - taking item: r -= W_i; h += H_i.
  - leaving item: r, h unchanged.
- Save states in dp-table.

Gotchas

- Not using a dp-table results in time limit exceeded.

HiddenWords

Problem

- Given n strings, find a string that contains all n strings in consecutive order and where no character is part of 3 strings.

Solution

- Start with two first strings X and Y.
- If Y starts with X:
- Add X to solutionword, continue with rest of Y and next string.
- Else: Remove first letter of X and repeat process.

JollyFishing

Problem

- Choose if fishers are allowed to fish on each day of the year.
- Fishes will reproduce when not being fished.
- After the year, there need to be at least as many fishes as in the beginning.

Solution

- It is always better to not allow fishing for the first part of the year and then allow fishing for the rest of the year
- (If we did not allow fishing after a day where we did, we would get a higher score by swapping the two days)
- Thus we only need to determine the day we start allowing fishing.
- Can simulate every 365 possible days (or use Ternary Search).

GoingHome

Problem

- Given different train connections, find the shortest time to get from Rostock to the given city.

Solution

- Can be solved using any shortest path algorithms that allows for edge weights e.g. Dijkstra.

Gotchas

- The input is rather complicated and has to be parsed into a graph structure first.
- Need to find the right time to take a connection which is driven multiple times.

KeyboardRobot

Problem

- Given a 6x6 keyboard layout of letters and some text.
- Find a way to move 2 fingers simultaneously such that the time is minimal to type the given text.

Insights

- Insight #1: the text is short, only 200 letters, so the maximum time is $(5 + 5) \cdot 200 = 2000$
- Insight #2: we can simulate it, but need fast way of prioritising interesting states

Solution

- Use a priority queue to track every "reasonable" reachable state
- A state is: (time, index in text, finger 1&2 target position and remaining movement)