2025 Pacific Northwest Division 2 Solutions

The Judges

November 15, 2025

An Elephant Problem

Problem

- Given that a single peanut weighs m milligrams, how many peanuts does it take to have at least d milligrams worth of peanuts?

Solution

- We want to compute the smallest integer p such that $m \times p \geq d$.
- Because m and d are small, we can just increment p starting from 1 and stop once we find a valid value of p.
- The closed form for the answer is $\lceil \frac{d}{m} \rceil$.

Call For Problems, Round 3

Problem

- Given n integers, compute the maximum number of integers you can select such that no two selected integers have difference strictly less than t.

Observation

- There always exists an optimal selection that contains the smallest integer. Consider an optimal selection that does not, we can always unselect the smallest integer in that collection and replace it with the globally smallest integer.

Solution

- Consider the values in increasing order. If a value is valid to take considering past selections, take it.

GPA Computation

Problem

- Compute the weighted GPA given the grades and tiers for a high school transcript.

Solution

- This can be implemented by following the rules directly. Compute the unweighted GPA with floating point division and then add in all the bonuses.

Honkai Stress Relief

Problem

- Given an interval (a, b) and n intervals (s_i, e_i), compute the probability that if we sample a value independently and uniformly at random from (a, b) for each of the given n intervals, at least one of the sampled values will be outside its corresponding intervals.

Honkai Stress Relief

Solution

- We compute the complementary probability - the probability that none of the sampled values are outside the corresponding intervals, or that all sampled values are inside their corresponding intervals.
- We therefore only need to solve whether a sampled value in (a, b) is in (s_i, e_i).
- Compute the intersection of the two intervals, the length of the intersection divided by $b - a$ is the probability of the sampled value being in the interval.
- The final answer is therefore 1 minus the product of all the above probabilities.

Missed Alarm

Problem

- You are given two times in `HH:MM` format. Determine whether one is earlier than the other.

Solution 1

- Manually parse out the hour and minute for both and compare with some casework.

Solution 2

- Compare the strings lexicographically directly. This works because the format of the timestamps means that lexicographic comparison ends up being equivalent to comparing the hours first, then comparing the minutes if needed.

Strawberry

Problem

- Given a string s, define $f^p(s)$ to be the string Caesar shifted backwards p times. Compute the number of times the letter `r` appears in $f^0(s)$ through $f^{N-1}(s)$.

Observation

- $f^{26}(s) = f^0(s)$.

Solution

- We can compute the number of times $f^0(s)$ through $f^{25}(s)$ appear with some modular arithmetic. We can then count exactly how many times `r` appears in each of these 26 strings.

Bouquet of Balloons

Problem

- You're competing in a contest where problem i takes s_i minutes to solve. You get a balloon with one liter of helium that deflates at the rate $\frac{1}{d}$ liters per minute. If your goal is to have balloons that aggregate to at least m liters of helium, compute the minimum number of problems to solve to attain this, or report it is impossible.

Bouquet of Balloons

Observations

- If it is possible to do it by solving k problems, you can do it by solving the problems with the k smallest solve times.
- You should solve problems in decreasing time order.

Solution

- Sort the problems in increasing order of solve time. The amount of deflated air obtained by solving k problems can be done by computing the sum of the first k prefix sums of solve times. We can use this to determine whether the goal is attainable by solving k problems.

Fractal Painting

Problem

- An infinite fractal is set up where a segment has two outgoing segments drawn out of it, and each of the outgoing segments recursively has similar outgoing segments going out of it. Determine if the infinite fractal fits in a finite size rectangle.

Solution

- The infinite fractal extends infinitely in the following cases:
  - Either of the two recursive segments is longer than the original.
  - One of the recursive segments points in the same direction as the original segment and the same length.
  - Both segments are the same length as the original segment.
- We can show that, in all other cases, the fractal is bounded.

Server Corridor

Problem

- Given a ternary string, compute the maximum number of 1's that can be flipped to 2's where no 2's are adjacent.

Solution

- Sweep the string from left to right. If a 1 is not adjacent to a 2, change it to a 2 immediately. Count the number of changes that were made.

Shh

Problem

- Given a string, compute the minimum number of characters to change such that it has exactly k instances of the substring `shh`. Furthermore, compute the number of distinct strings with exactly k instances of `shh` that can be obtained by changing exactly that many characters.

Solution

- We solve this with dynamic programming. The state to maintain is the length of the prefix, the number of full occurrences of `shh`, and the length of the longest suffix that is a strict prefix of `shh`, and we maintain both the minimum number of characters needed to change to get to this state along with the number of ways to get to this state.

Solidarity of the Happy Cats

Problem

- Given some wires that must be in a fixed relative order and distance constraints between pairs of wires, determine the minimum distance that the leftmost and rightmost wire can be from each other.

Solution

- We solve this with dynamic programming. Assume the leftmost wire is at location 0, we compute a leftmost location for each wire. We can then sweep the wires from left to right, updating the leftmost location for subsequent wires based on its distance constraints. The answer is therefore the location of the rightmost wire, plus one.

Training, Round 4

Problem

- You are given n lattice points (x_i, y_i). You can start at any point (X, Y). On turn i, both $X \geq x_i$ and $Y \geq y_i$ must be true. Then, you must increment exactly one of X and Y. Determine the minimum possible value of $X + Y$ such that this condition is true over all n turns.

Solution

- We maintain a lower bound of X and Y over all turns, along with a count of increments we have not used yet.
- When we see a new point, we consume as many increments as possible, and then update X and Y if needed.
- The final answer is therefore the current sum of X, Y, and any unused increments, minus n.

Triangle of Triangles

Problem

- Given a triangle T and two triangles T_1 and T_2, is it possible to draw a line segment on T that splits the triangle into two subtriangles, both of which are similar to either T_1 or T_2?

Solution

- We solve the reverse problem - is it possible to combine two triangles to form T? We can then use this primitive to the three distinct combinations.
- To combine two triangles, one angle from each must sum to 180 degrees.
- We brute force over all such combinations of angles.