

2026 North America Qualifier Solutions

The Judges

October 3, 2026

Problem A: The n Days of Christmas

Problem

- On the n th day of Christmas, you receive $1 + \cdots + n$ gifts.
- Count the number of gifts you receive over the first n days of Christmas.

Problem A: The n Days of Christmas

Solution

- We can show by induction that the exact number is $\frac{n(n+1)(n+2)}{6}$.
- To compute this number modulo 998244353, we can either use a language with arbitrary precision integers like Java or Python, or remove a factor of 2 and 3, then reduce each of the three integers mod 998244353, then multiply and take a modulo twice.

Problem B: Airtime

Problem

- Given a list of altitudes a_i , one per second at times t_i , count all of the triples where the slope from (t_i, a_i) to (t_{i+1}, a_{i+1}) is strictly greater than the slope from (t_{i+1}, a_{i+1}) to (t_{i+2}, a_{i+2})

Problem B: Airtime

Solution

- Just do it.
- The only trick is to recognize that the difference between consecutive times is always 1, so it reduced to $a_{i+1} - a_i > a_{i+2} - a_{i+1}$
- Also, be sure to check all triples, not just every 3

Problem C: Babylon

Problem

- You are given n pairwise distinct rectangles. Count the number of distinct ways to stack them one on top of another such that the stack is n rectangles tall and no rectangles overhang the ones below them, allowing for any translations of blocks as long as the blocks are axis-aligned and spaced such that the vertices of each block are on lattice points.

Problem C: Babylon

Initial Observations

- Because rectangles cannot overhang each other, we can start by sorting them in decreasing order of area. If two rectangles of the same area but different dimensions exist, there are no ways.
- If there are k rectangles that are congruent (up to rotation), we can pretend that there is exactly one rectangle of that size and multiply the answer by $k!$.
- Squares cannot be rotated, rectangles can be rotated in one of two orientations. We only need to consider the relative orientation of a rectangle and the one below it.
- Take care that the answer needs to be multiplied by 2 if the biggest rectangle is not a square.

Problem C: Babylon

Solution

- Perform the above simplifications so we have unique rectangles by area.
- For each rectangle, compute the number of ways it can fit on the next-largest rectangle, rotating as necessary.

Problem D: Brownie Cutting

Problem

- Compute the minimum number of line segments that need to be drawn on a convex polygon such that no zero area regions are created and the length of the drawn line segments is at least $\frac{k}{2}$.

Problem D: Brownie Cutting

Initial Observations

- We can never do better than the diameter of the convex hull.
- If there are d diameters and the length of the diameter is l , then up to d the total length we can get is dl , above that the total length we can get is $cl - \epsilon$ where c is the number of cuts we perform and $c > d$.

Problem D: Brownie Cutting

Solution

- Use rotating calipers to compute both the diameter of the convex hull and the number of unique diameters. The number of unique diameters is $\mathcal{O}(n)$ because all diameters must pairwise intersect. Also note that a diameter which is a polygon side is invalid.
- Use integer arithmetic to carefully check the case where drawing diameters is sufficient - if it is not and the quotient of $\frac{k}{2}$ and l is an integer, you must increase it by one. Otherwise, output the ceiling of the quotient of $\frac{k}{2}$ and l .

Problem E: Espresso Macchiato

Problem

- Construct an $n \times n$ binary grid where every path that goes down and to the right from top-left corner to bottom-right corner goes through exactly one 1.

Problem E: Espresso Macchiato

Solution

- We can show that the set of valid grids is all grids where exactly one antidiagonal is all 1's and everywhere else the grid is 0's, and the antidiagonal has at least two elements on it.

Problem F: Fairytale

Problem

- Given a set of integers between 1 and 40, where integers 1 through 10 are in one bucket, integers 11 through 20 are in another bucket, integers 21 through 30 are in a third bucket, and integers 31 through 40 are in a fourth bucket, compute the number of buckets which have at least one integer.

Problem F: Fairytale

Solution

- There are many approaches. One of the simpler ways to implement involves reading in an integer x and inserting $\frac{x-1}{10}$, rounded down to the nearest integer, into a set and outputting the size of the set.

Problem G: Last Dance

Problem

- You are maintaining a map from integers to integers. Support two operations - setting multiple keys to a single value, and outputting the number of keys that have a given value.

Problem G: Last Dance

Solution

- On top of maintaining this map, maintain a second map from values to the number of integers in the original map that have this value.
- When setting multiple keys, for each such key, decrement the frequency for its original value and increment its frequency for the new value.
- When outputting the number of keys that have a given value, inspect the second map directly.

Problem H: My System

Problem

- There is a hidden binary string of length 200, which can be broken up into 100 substrings of length 2 where each substring is either 01 or 10. You can guess characters one at a time, and you will be told what the correct character was. Guess at least 60% of the characters correctly.

Problem H: My System

Solution

- For each pair, guess the first character randomly. You can always guess the second character correctly with 100% probability, so in expectation you will guess 75% of the characters correctly.
- The probability of this algorithm failing is small enough (less than 10^{-9} per test case) that it can be ignored as a possibility.
- A deterministic strategy can be forced to fail. For example, if a solution tries to guess the same random binary string for each test case, on the second test case the interactor can guess

Problem I: Only One Order

Problem

- You are given a directed graph. Compute the minimum number of edges to add such that the only topological ordering of the graph is $1, \dots, n$, or report that it is impossible.

Problem I: Only One Order

Solution

- If there is any edge from j to i where $i < j$, then it is impossible.
- Otherwise, the answer is the number of edges $(i, i + 1)$ that do not exist.
- The reason for the above is that without such an edge, even if you include all other edges $a < b$, the relative order of i and $i + 1$ is not constrained. Therefore, the inclusion of the edge is a necessary and sufficient condition.

Problem J: Regarde!

Problem

- Given an integer n , output s followed by $n + 1$ h's.

Problem J: Regarde!

Solution

- This can be done directly by using a for loop to print the correct number of h's.
- or, in Python:

```
n = int(input().strip())+1  
print( 's' + 'h'*n )
```

Problem K: Six Seven

Problem

- Audrey likes exactly the numbers where each digit is exactly one larger than the digit to its left. Given $t \leq 10^5$ integers in $[1, 10^8]$, for each integer n , output the smallest number that is at least n that Audrey likes, or output -1 if there is none.

Problem K: Six Seven

Observation 1

- Since the smallest digit is 1 (we don't count 0 since we cannot have a leading zero) and the biggest digit is 9, the biggest number that Audrey likes is 123 456 789 which is greater than 10^8 . Therefore, we will never output -1 .

Problem K: Six Seven

Observation I

- Since the smallest digit is 1 (we don't count 0 since we cannot have a leading zero) and the biggest digit is 9, the biggest number that Audrey likes is 123 456 789 which is greater than 10^8 . Therefore, we will never output -1 .

Observation II

- Every number that Audrey likes is a non-empty substring of 123456789.

Problem K: Six Seven

Solution

- Since there are only 45 integers that Audrey likes, one can iterate through this list or use binary search to find the desired number.

Problem L: Stardust Curry

Problem

- Given n integers t_i , find n real numbers p_i such that $\sum p_i = p$ and $\sum \frac{p_i^2}{t_i}$ is minimized.

Problem L: Stardust Curry

Solution

- We can show that the optimal allocation of p_i scales linearly with t_i . We can prove this formally with multivariable calculus, but we can intuitively see this by playing with the case $n = 2$ by hand.
- If we do this, we can show that the answer is $\frac{p^2}{\sum t_i}$.

Problem M: Tourism Balance

Problem

- Given a connected graph of n vertices and n edges where each vertex is annotated with a value v_i , compute the number of simple paths where the ending and starting vertices differ in value by k .

Problem M: Tourism Balance

Solution

- Consider the cycle on the graph, note that there are subtrees hanging off of each vertex. Consider each vertex on the cycle to be the root of its subtree.
- If two vertices are in the same subtree, there is exactly one simple path.
- Otherwise, there are two simple paths, because there are two ways around the cycle.
- We can therefore count the number of total pairs of vertices that could work, double it, and subtract the number of pairs of vertices in the same subtree that meet the constraint.