

Delft Algorithm Programming Contest 2026

Solutions presentation

The Benelux Algorithm Programming Contest (BAPC) 2026 Jury
September 26, 2026

B: Butter, Cheese, and Eggs

Problem author: Jeroen Op de Beek



Problem: Given numbers x and o , construct a valid, reachable game state in *Tic-tac-toe*, with x crosses and o circles.

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Condition 1: The board is 3×3 , so at most 9 moves can be played, so it must hold that $x + o \leq 9$.

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1 X	2 O	3 X
4 O	5 X	6 X
7 O	8 X	9 O

Construction for draw:

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Solution: Take the construction for a draw, alternate removing crosses and circles, until left with the correct total.

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Bonus: What if instead of a 3×3 board, the board was $n \times n$?

(See also: “Crosses and Circles” from GCPC 2026)

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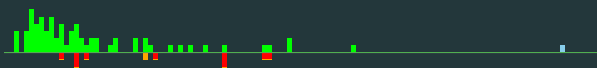
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Statistics: 99 submissions, 68 accepted

F: Football Forecast

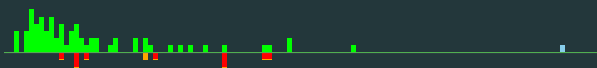
Problem author: Reinier Schmiermann



Problem: Forecast the winner of the World Cup, based on the quality score of each team.

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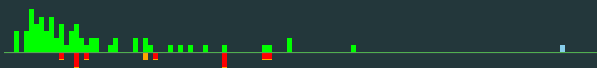


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Group phase: The top two teams in each group will continue to the elimination phase.

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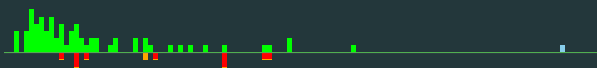
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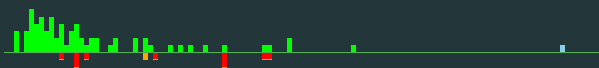
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Winner: It can be proven that the World Cup winner is the team with the highest quality score.

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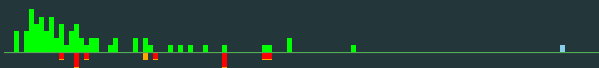
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Solution: Output the name of the team with the highest quality score.

(But the time limit is lenient enough to simulate the entire tournament.)

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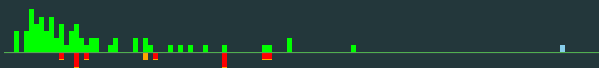
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Running time: $\mathcal{O}(n)$.

Statistics: 79 submissions, 68 accepted, 1 unknown

E: Exhausted Economist

Problem author: Mike de Vries



Problem: Given a list of prices that each person is willing to pay for your product, find your maximal revenue.

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Observation: You should always ask a price in the list.

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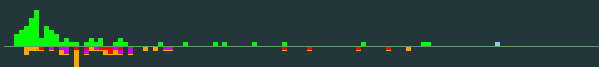
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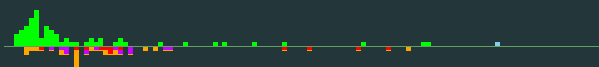
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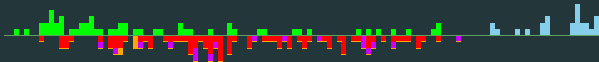
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Running time: $\mathcal{O}(n \log n)$.

Statistics: 106 submissions, 66 accepted, 1 unknown

M: Manic Ceramic

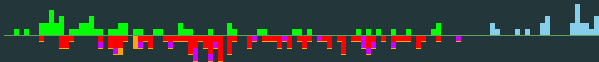
Problem author: Arnoud van der Leer, Maarten Sijm



Problem: Given two types of tiles with x and $\frac{1}{y}$ instances of a pattern, how many should you at least buy to get equally as many patterns as tiles?

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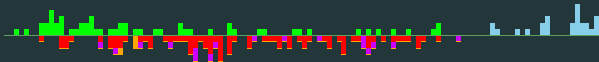


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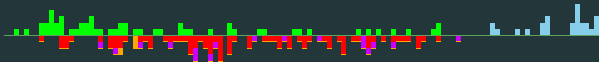
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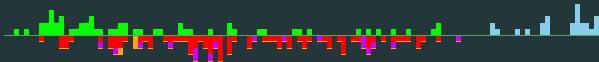
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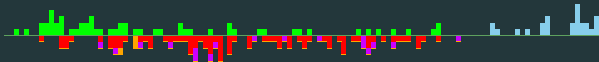
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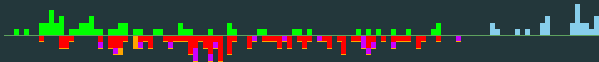
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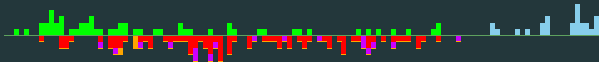
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Alternative: $N = \frac{xy-1}{\text{gcd}(x-1, y-1)}$.

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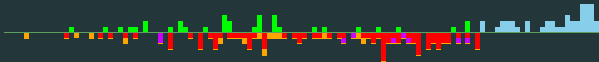
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Alternative: $N = \frac{xy-1}{\text{gcd}(x-1, y-1)}$.

Statistics: 180 submissions, 57 accepted, 25 unknown

A: Ambagaata

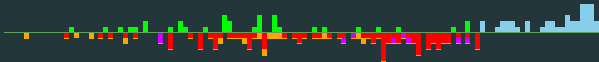
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- Problem:** Given: dictionary with n words, messages where all vowels except maybe y are replaced by a. At most 4 letters per word are a y. Determine for each message whether
- it corresponds to a unique message consisting of words from the dictionary, or
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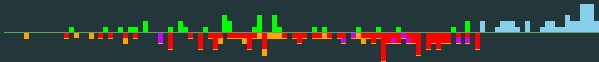
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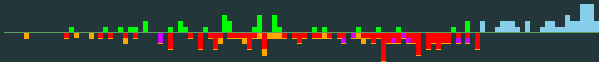
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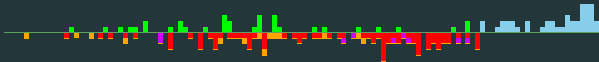
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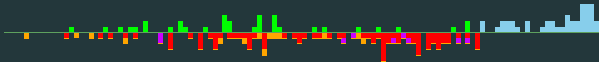
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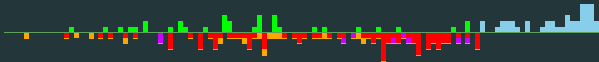
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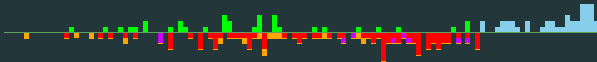
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Running time: $\mathcal{O}(2^Y D + M)$, where D is the total length of words in the dictionary, M is the total length of the messages, and Y is the maximum number of ys in a single word.

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Solution: Go over all messages and use the map to determine the translation, or that the message is impossible (if a string in the message is not in the map) or ambiguous.

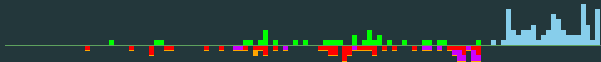
Pitfall: Messages with an ambiguous word can become impossible due to a later word.

Running time: $\mathcal{O}(2^Y D + M)$, where D is the total length of words in the dictionary, M is the total length of the messages, and Y is the maximum number of ys in a single word.

Statistics: 176 submissions, 33 accepted, 43 unknown

L: Lock In

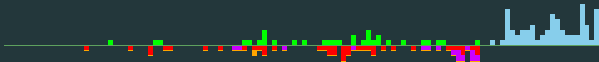
Problem author: Mike de Vries



Problem: Win the ranking game at least 1% of the time.

L: Lock In

Problem author: Mike de Vries

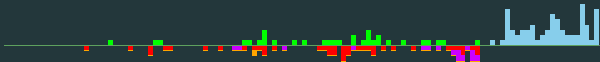


Problem: Win the ranking game at least 1% of the time.

Observation: For a game with n numbers to be placed, we may always assume that we must place n random numbers chosen from $1, \dots, m$.

L: Lock In

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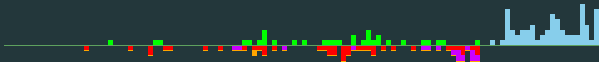
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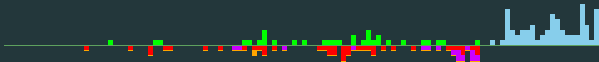
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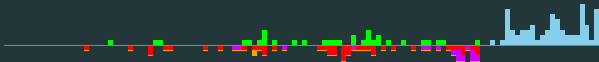
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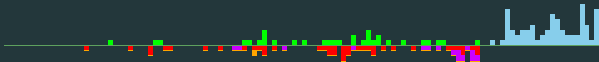
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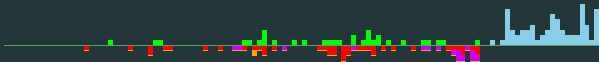
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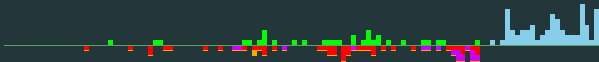
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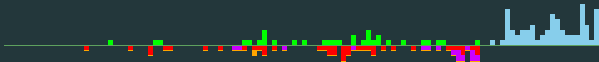
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J: Joyful Jogging

Problem author: Tobias Röhr



Problem: Find the minimum number of edges to cover all cycles in a connected undirected graph.



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Equivalent problem: Find the minimum number of edges to remove to break all cycles in a connected undirected graph.



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The edges we would remove are the edges that are not part of a fixed spanning tree.



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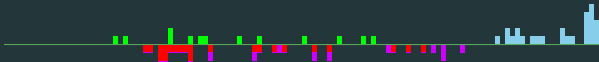
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Statistics: 43 submissions, 23 accepted, 11 unknown

K: Khoikhoi Dralinpome

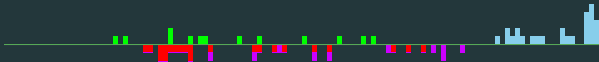
Problem author: Mike de Vries



Problem: Given a list of nouns, determine the largest dralinpome that can be made through concatenation of a subset.

K: Khoikhoi Dralinpome

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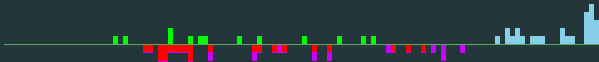


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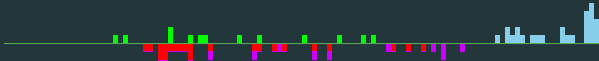
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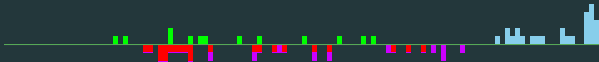
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Idea: Precompute a 26-bit letter-parity mask for each noun. We can efficiently determine whether a subset of words forms a dralinpome by XORing these masks.

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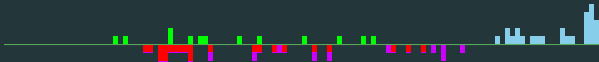
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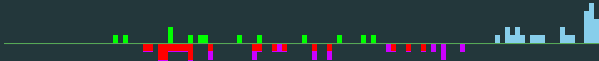
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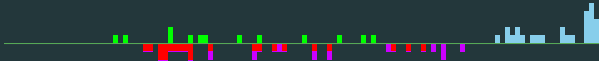
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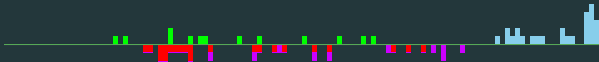
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Running time: $\mathcal{O}((n + 26)2^{n/2})$.

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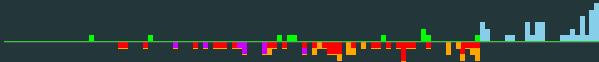
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Running time: $\mathcal{O}((n + 26)2^{n/2})$.

Statistics: 72 submissions, 13 accepted, 26 unknown

I: Irritating Interruption I

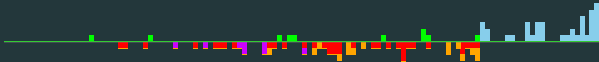
Problem author: Jonas van der Schaaf



Problem: Given a set of arrows on an $n \times m$ grid, calculate how many can be removed. An arrow can be removed when it points at nothing.

I: Irritating Interruption I

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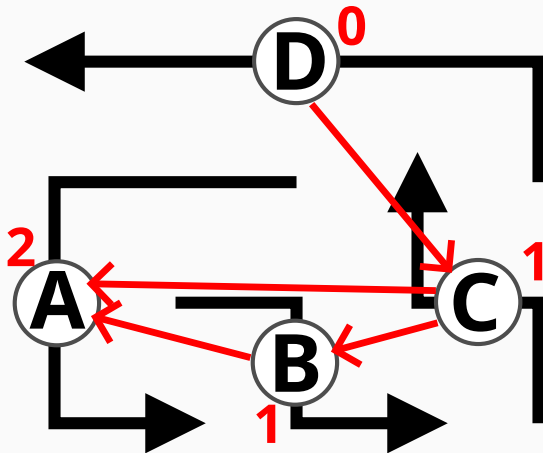
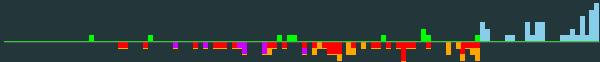


Problem: Given a set of arrows on an $n \times m$ grid, calculate how many can be removed. An arrow can be removed when it points at nothing.

Naive solution: Compute the dependency graph, then prune.

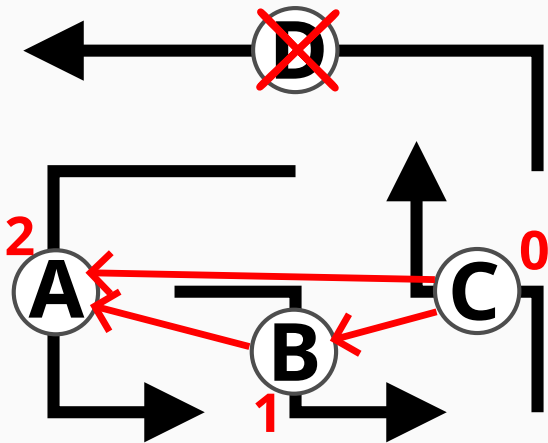
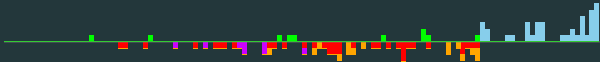
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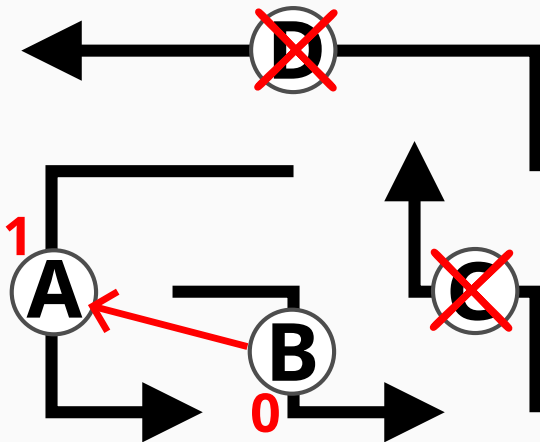
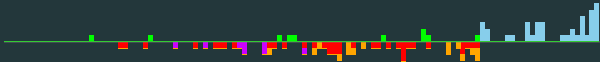
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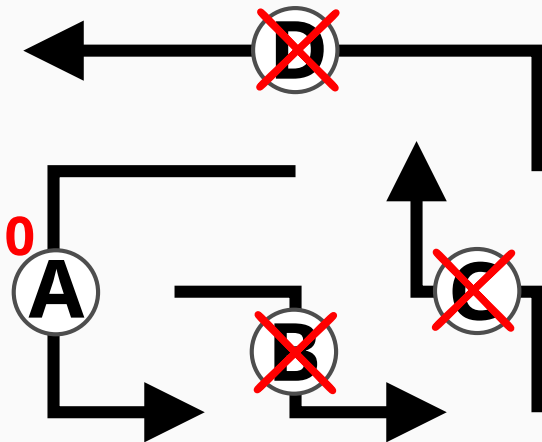
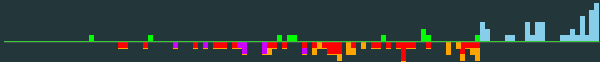
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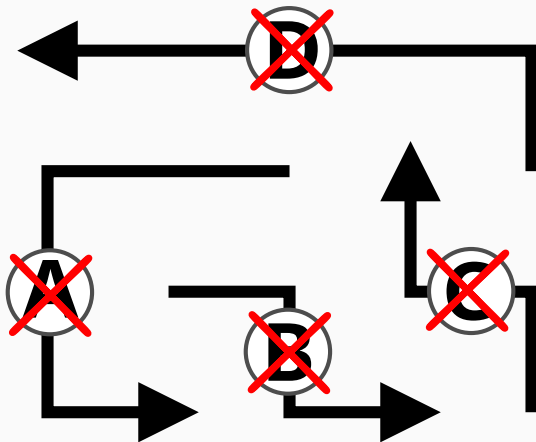
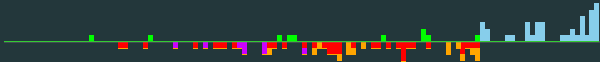
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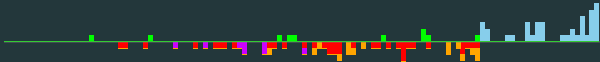
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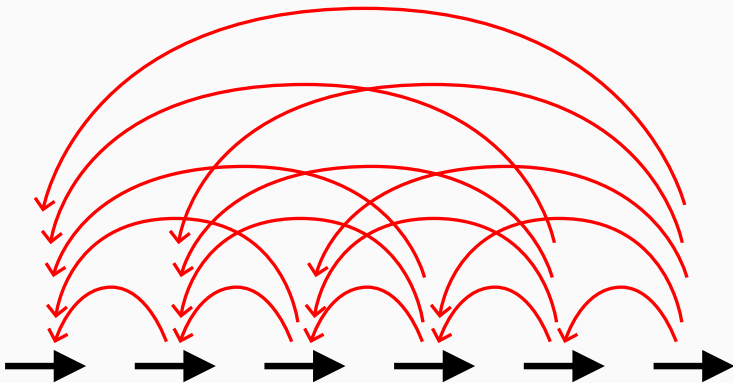


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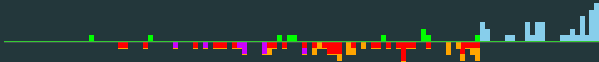


Problem: For a arrows, there may be $\mathcal{O}(a^2)$ dependencies. This leads to a running time of $\mathcal{O}(wh(w + h))$, which is too slow.



I: Irritating Interruption I

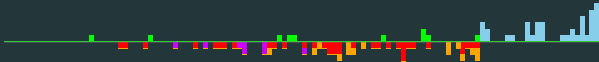
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Observation: If A points at B and C , and B points at C , then the fact that A points at C is redundant.

I: Irritating Interruption I

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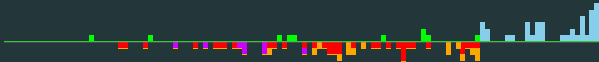


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I: Irritating Interruption I

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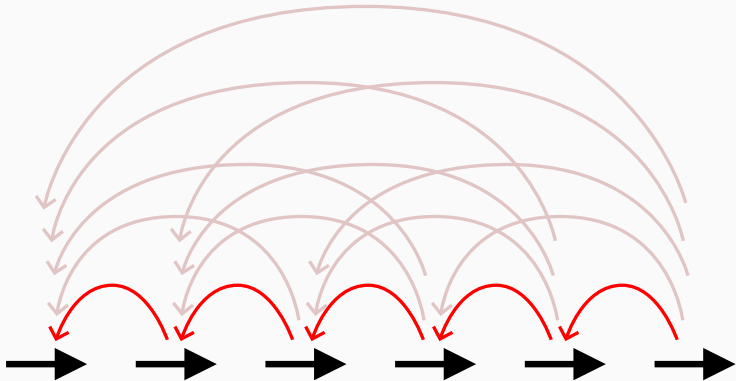
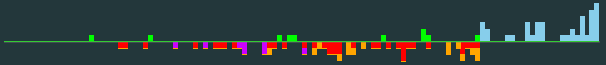
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Fast solution: Stop looking when you encounter an arrowhead in the same direction, since all further dependencies you might find would be redundant.

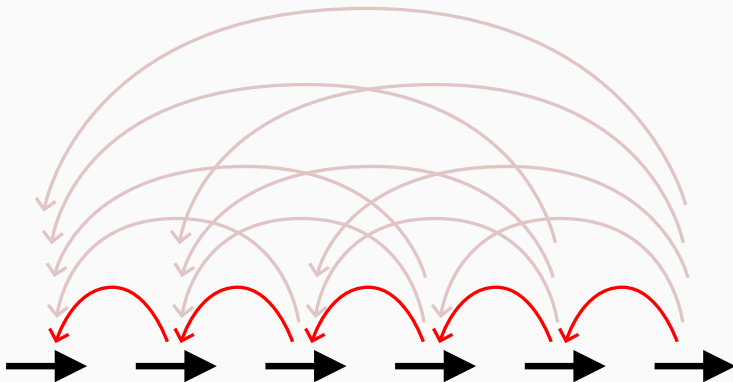
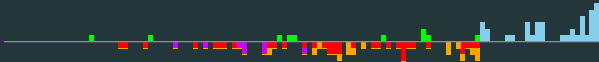
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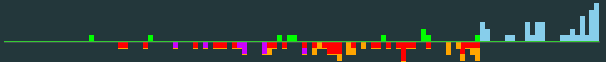
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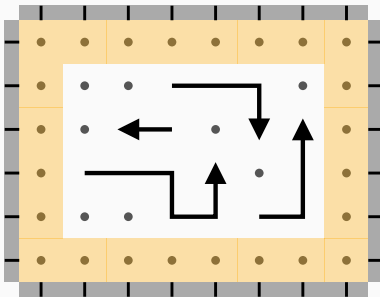
Running time: $\mathcal{O}(wh)$.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf



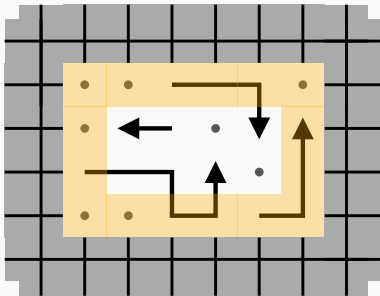
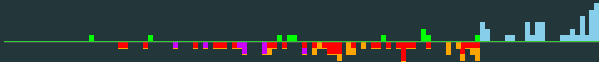
Alternative solution: Move edge bounds and remove arrows pointing outwards.



All borders start at the edges, and cells next to the edges are marked to be updated.

I: Irritating Interruption I

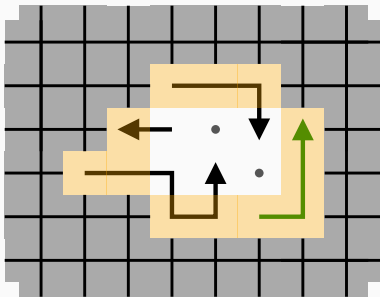
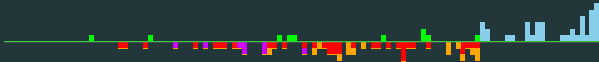
Problem author: Jonas van der Schaaf



Boundaries from all sides are moved inwards as empty cells next to the boundaries are updated.

I: Irritating Interruption I

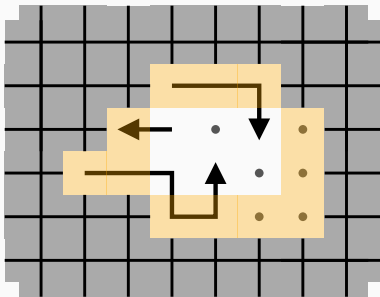
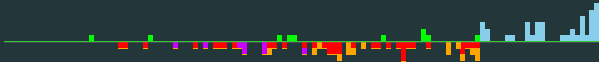
Problem author: Jonas van der Schaaf



An outwards facing arrow is found.

I: Irritating Interruption I

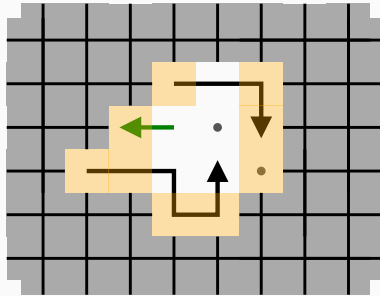
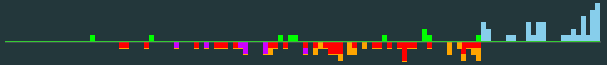
Problem author: Jonas van der Schaaf



The arrow is removed, and the empty spaces are marked for updating.

I: Irritating Interruption I

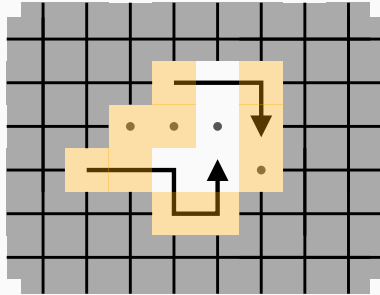
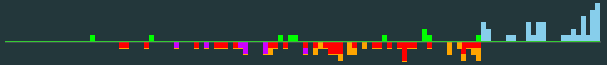
Problem author: Jonas van der Schaaf



Another free arrow is found.

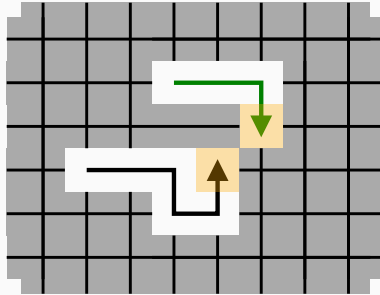
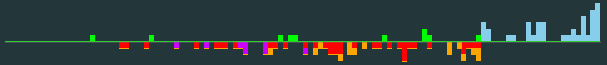
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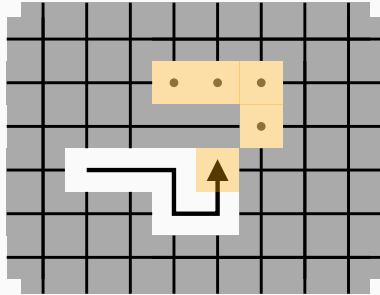
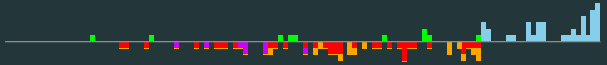
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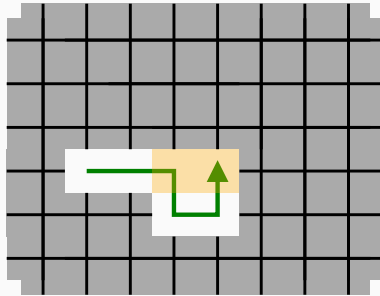
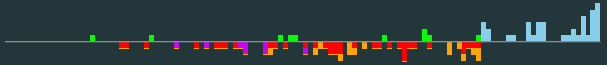
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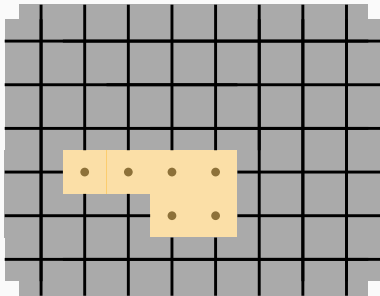
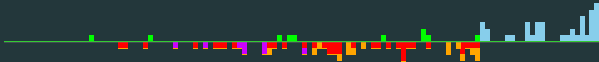
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Problem author: Jonas van der Schaaf



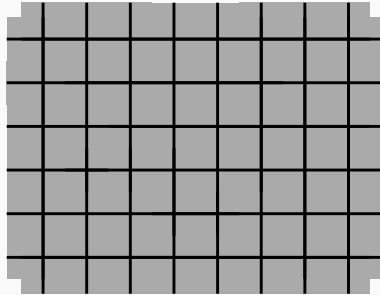
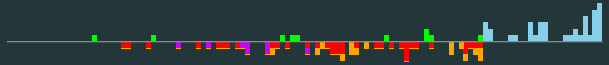
I: Irritating Interruption I

Problem author: Jonas van der Schaaf



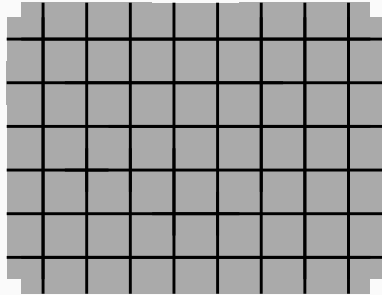
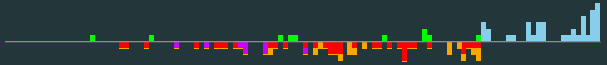
I: Irritating Interruption I

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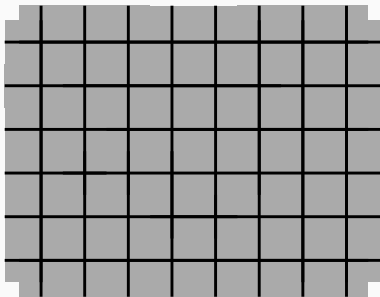
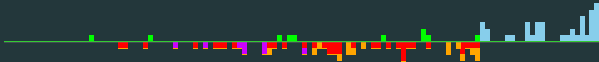
Problem author: Jonas van der Schaaf



Running time: Still $\mathcal{O}(wh)$.

I: Irritating Interruption I

Problem author: Jonas van der Schaaf



Running time: Still $\mathcal{O}(wh)$.

Statistics: 107 submissions, 10 accepted, 38 unknown

D: Dickey Decision

Problem author: Freek Henstra



Problem: Given a *Snakes and Ladders*-type board with n spaces, m shortcuts, turn limit t , and four six-sided dice to choose from. If you can pick your die first and you start playing last, what is your maximum possible probability of winning?

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Problem author: Freek Henstra



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Naive solution: Dynamic programming on the state space. There are $\mathcal{O}(tn^4)$ possible states, which is too many. (State is number of turns to go and each player's position.)

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Observation: The players don't interact with one another, so we can consider each player separately.

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Observation: The players don't interact with one another, so we can consider each player separately.

Solution part 1: Dynamic programming for each die separately. For each die, calculate each value of $P(i, j)$: The probability of landing on space i after j turns.

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Problem author: Freek Henstra



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Recursion: For each i, j with j from small to large, starting on space i , determine for each possible die roll the landing space k , and add $\frac{1}{6}P(k, j + 1)$ to $P(i, j)$.

D: Dickey Decision

Problem author: Freek Henstra



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Solution part 2: For each die independently, calculate the probability of winning (with tie-break rules). For each die, determine after each turn the probability of finishing on that turn with no other player having finished yet, and after t turns, determine for each space the probability of landing there ahead of all other players.

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Running time: $\mathcal{O}(tn)$ (times #players and #sides-per-die, which are constant).

D: Dickey Decision

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Running time: $\mathcal{O}(tn)$ (times #players and #sides-per-die, which are constant).

Statistics: 49 submissions, 3 accepted, 38 unknown

C: Chaotic Crossing

Problem author: Reinier Schmiermann



Problem: Given an undirected graph. Each edge ij has a probability p_{ij} that it can be used during each second, and crossing an edge takes exactly one second. What is the minimum expected time to go from s to t ?

C: Chaotic Crossing

Problem author: Reinier Schmiermann



Problem: Given an undirected graph. Each edge ij has a probability p_{ij} that it can be used during each second, and crossing an edge takes exactly one second. What is the minimum expected time to go from s to t ?

Strategy: Each vertex i has some minimum expected time E_i to go from i to B . For t , we have $E_t = 0$. For any other vertex i , each second, we only cross an edge if we can move to a vertex j with $E_j < E_i$, and if we can, then we pick the smallest E_j .

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Algebra: For example, if vertex 4 neighbors vertices 1, 2, 3 with $E_1 < E_2 < E_3 < E_4$, we get

$$E_4 = 1 + p_{41}E_1 + (1 - p_{41})p_{42}E_2 + (1 - p_{41})(1 - p_{42})p_{43}E_3 + (1 - p_{41})(1 - p_{42})(1 - p_{43})E_4.$$

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If we write this as $E_4 = A_4 + B_4E_4$, then this solves to $E_4 = \frac{A_4}{1 - B_4}$.

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Issue: The values of E_i depend on each other, so where do we start?

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Repeatedly take the lowest possible valuation $E_i = x$ from the heap and assign the value if E_i wasn't already assigned. Update all neighbors j , increasing A_j by $B_j p_{ij} E_i$ and multiplying B_j by $1 - p_{ij}$, and adding the possible valuation $E_j = \frac{A_j}{1 - B_j}$.

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Running time: $\mathcal{O}((n + m) \log(n + m))$ with a binary heap.

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Running time: $\mathcal{O}((n + m) \log(n + m))$ with a binary heap.

Statistics: 7 submissions, 1 accepted, 5 unknown

H: Handing Over

Problem author: Mike de Vries



Problem: n people with wingspans $w_1, \dots, w_n$ are seated around a table. People i and j can hand each other condiments if $w_i + w_j \geq \min(|i - j|, n - |i - j|)$. Answer q queries of the form: how many handovers are needed to pass from i to j ?

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Strategy: Pick one of the two possible directions to handover. Then repeatedly handover to the person within reach that can reach the farthest in the desired direction, until the destination can be reached.

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Edge case: For the first handover, it can be optimal to handover in the opposite direction if there is a person with a very large wingspan. The final handover can also be in the opposite direction.

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Problem: n people with wingspans $w_1, \dots, w_n$ are seated around a table. People i and j can hand each other condiments if $w_i + w_j \geq \min(|i - j|, n - |i - j|)$. Answer q queries of the form: how many handovers are needed to pass from i to j ?

Strategy: Pick one of the two possible directions to handover. Then repeatedly handover to the person within reach that can reach the farthest in the desired direction, until the destination can be reached.

Edge case: For the first handover, it can be optimal to handover in the opposite direction if there is a person with a very large wingspan. The final handover can also be in the opposite direction.

Solution: First determine for each person and each of the two directions the optimal first handover, and then apply binary lifting on this.

H: Handing Over

Problem author: Mike de Vries



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Todo: How do we determine the optimal first handovers? And how do we apply (and what even is) binary lifting?

H: Handing Over

Problem author: Mike de Vries



Step 1: We must determine for each person and each of the two directions the optimal first handover.

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Step 1: We must determine for each person and each of the two directions the optimal first handover.

Approach: Duplicate the array of wingspans and go right to left. Keep a stack (variable sized array) with each person whose reach is not a subset of another person's reach, sorted by index.

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Approach: Duplicate the array of wingspans and go right to left. Keep a stack (variable sized array) with each person whose reach is not a subset of another person's reach, sorted by index.

For the people in the original half of the array, the top of the stack gives the optimal first handover for the case that we want to move left, but the first handover is to the right. Then with binary search, you can find the optimal first handover for the case that we want to move right, and the first handover is to the right.

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Then remove all people from the top of the stack that are obsoleted by the new person, and add the new person to the top if they are not obsolete themselves.

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Finally, reverse the array and repeat the process to get the optimal first handovers in the opposite directions.

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Performance: This step takes $\mathcal{O}(n \log n)$ time.

H: Handing Over

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Step 2: Binary lifting.



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Setup: We know for each person the optimal first move in each direction. If we know for each person the optimal first 2^k moves in each direction, we can combine two such sequences to form the optimal first 2^{k+1} moves in each direction.

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Statistics: 24 submissions, 0 accepted, 17 unknown

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Problem: Given a rooted forest, two players alternate grabbing the good at one of the roots, causing the rest of its tree to split into multiple new rooted trees. Going first, and with both players playing optimally to maximize the sum of values of their grabbed goods, how much total value will you accumulate?

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Observation 1: Maximizing our own total is equivalent to maximizing the signed difference between our own total and the opponent's total, because the combined total is fixed. We may thus assume that we lose value whenever the opponent grabs a good.

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Simpler case: Consider if each rooted tree is a path.

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Observation 2: Consider a path of two vertices with the second value larger than the first. Then it is never advantageous to grab the first good.

Proof: The opponent can reply by grabbing the second good. As a result, it is again your turn, and besides the net loss you just made, the only change to the game is that this path is removed, so nothing is gained.

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Strategy: It follows that such paths only come into play once there are no other options remaining. We can thus use the parity of the total number of goods to determine which player has to tank the net loss of each such path, and we can then remove all such paths from the game.

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Strategy: It follows that such paths only come into play once there are no other options remaining. We can thus use the parity of the total number of goods to determine which player has to tank the net loss of each such path, and we can then remove all such paths from the game.

Furthermore, we can do the same whenever the last value of a path is larger than the previous, since those two goods will eventually reduce to a path of length two.

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Simpler case: Consider if each rooted tree is a path.

Observation 2: We may assume that the last value of a path is never larger than the previous.

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Observation 3: Consider a path with first three values a, b, c with $b > a$. Then it can only be advantageous to grab the first good if the intention is for the opponent to grab the second good so that you can grab the third good afterwards.

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Proof: Again, the opponent can reply by grabbing the second good. As a result, it is again your turn, and besides the net loss you just made, the only change to the game is that you can now grab the third good, so that is the only possible advantage.

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Proof: Again, the opponent can reply by grabbing the second good. As a result, it is again your turn, and besides the net loss you just made, the only change to the game is that you can now grab the third good, so that is the only possible advantage.

Strategy: We may thus combine the first three goods into one good with value $a - b + c$.

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Strategy: We may thus combine the first three goods into one good with value $a - b + c$.

We can furthermore do the same whenever any value besides the last value of a path is larger than the previous, since the path will eventually reduce for that value to become the second value of the path.

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Strategy: We may thus combine the first three goods into one good with value $a - b + c$.

We can furthermore do the same whenever any value besides the last value of a path is larger than the previous, since the path will eventually reduce for that value to become the second value of the path.

Combined with Observation 2, we may thus assume that no value in any path is larger than the previous!

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Simpler case: Consider if each rooted tree is a path.

Observations 2 & 3: We may assume that no value in any path is larger than the previous.

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Observation 4: Since there is never a reason to grab anything other than the good with the highest value, we can combine all the paths into a single path by sorting all the values from largest to smallest!

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Observation 4: Any collection of paths reduces to a single path with its values sorted from largest to smallest.

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Next case: Consider a rooted tree for which the root is the only vertex with multiple children.

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Observation 4: Any collection of paths reduces to a single path with its values sorted from largest to smallest.

Next case: Consider a rooted tree for which the root is the only vertex with multiple children.

Strategy: Grabbing the good at the root reduces the tree to a collection of paths.

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Strategy: Grabbing the good at the root reduces the tree to a collection of paths.

This collection of paths can be reduced to a single path with its values sorted from largest to smallest.

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Strategy: Grabbing the good at the root reduces the tree to a collection of paths.

This collection of paths can be reduced to a single path with its values sorted from largest to smallest.

The entire tree thus reduces to the same path, but with the root added to the front.

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This collection of paths can be reduced to a single path with its values sorted from largest to smallest.

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Even if this path is no longer sorted from largest to smallest, it can again be reduced until it is.

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Even if this path is no longer sorted from largest to smallest, it can again be reduced until it is.

Observation 5: Any rooted tree can recursively be reduced to a single path with its values sorted from largest to smallest!

G: Grabbing Goods

Problem author: Jippe Hooegeveen, Mike de Vries

Observation 5: Any rooted tree can recursively be reduced to a single path with its values sorted from largest to smallest.

Algorithm: Recursively calculate for each subtree how it reduces to a single path with its values sorted from largest to smallest.

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Observation 5: Any rooted tree can recursively be reduced to a single path with its values sorted from largest to smallest.

Algorithm: Recursively calculate for each subtree how it reduces to a single path with its values sorted from largest to smallest.

Base case: A leaf with value a reduces to a path with a singular value a .

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Base case: A leaf with value a reduces to a path with a singular value a .

Recursion: For a non-leaf vertex with value a , first calculate for each child how its subtree reduces to a single path with its values sorted from largest to smallest.

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Recursion: For a non-leaf vertex with value a , first calculate for each child how its subtree reduces to a single path with its values sorted from largest to smallest.

Then merge these paths into one by sorting all combined values from largest to smallest, and add the value a to the front of the path.

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Then merge these paths into one by sorting all combined values from largest to smallest, and add the value a to the front of the path.

Finally, while the first value of the path is smaller than the second, apply Observations 2 and 3 to reduce the path.

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Finally, while the first value of the path is smaller than the second, apply Observations 2 and 3 to reduce the path.

Running time: Since every value may need to get sorted n times, the total running time is $\Omega(n^2 \log n)$, which is too slow!

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Algorithm: Recursively calculate for each subtree how it reduces to a single path with its values sorted from largest to smallest.

Speed-up: Store each sorted path in a binary heap data structure, and apply small-to-large merging to the heaps.

G: Grabbing Goods

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Algorithm: Recursively calculate for each subtree how it reduces to a single path with its values sorted from largest to smallest.

Speed-up: Store each sorted path in a binary heap data structure, and apply small-to-large merging to the heaps.

Running time: Ignoring the fact that the heaps get smaller due to the reduction step, values can only move into a larger heap at most $\log_2 n$ times.

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The fact that the heaps get smaller due to the reduction step only reduces the number of times a value moves into a larger heap.

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Amortized, we thus have to move a value to a larger heap at most $n \log_2 n$ times.

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The fact that the heaps get smaller due to the reduction step only reduces the number of times a value moves into a larger heap.

Amortized, we thus have to move a value to a larger heap at most $n \log_2 n$ times.

Since heap operations cost $\mathcal{O}(\log n)$ time, the total running time is $\mathcal{O}(n(\log n)^2)$, which is fast enough!

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Running time: $\mathcal{O}(n(\log n)^2)$.

Even faster: With a custom heap implementation, you can insert all k elements of a heap of size k into a larger heap of size n in $\mathcal{O}(n \log(n/k))$ time.

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Combined with small-to-large merging, this results in a total running time of $\mathcal{O}(n \log n)$!

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Even faster: With a custom heap implementation, you can insert all k elements of a heap of size k into a larger heap of size n in $\mathcal{O}(n \log(n/k))$ time.

Combined with small-to-large merging, this results in a total running time of $\mathcal{O}(n \log n)$!

However, in practice, the difference turns out to be immeasurable. In fact, only reading the input already takes up half the time of the $\mathcal{O}(n(\log n)^2)$ solution!

G: Grabbing Goods

Problem author: Jippe Hoogeveen, Mike de Vries

Short version

Problem: Given a rooted forest, two players alternate grabbing the good at one of the roots, causing the rest of its tree to split into multiple new rooted trees. Going first, and with both players playing optimally to maximize the sum of values of their grabbed goods, how much total value will you accumulate?

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Main idea: It can be shown that any rooted tree can be reduced to a single path with its values sorted from largest to smallest.

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Running time: Must use heaps and small-to-large merging to obtain $\mathcal{O}(n \log^2 n)$.

G: Grabbing Goods

Problem author: Jippe Hoozeveen, Mike de Vries

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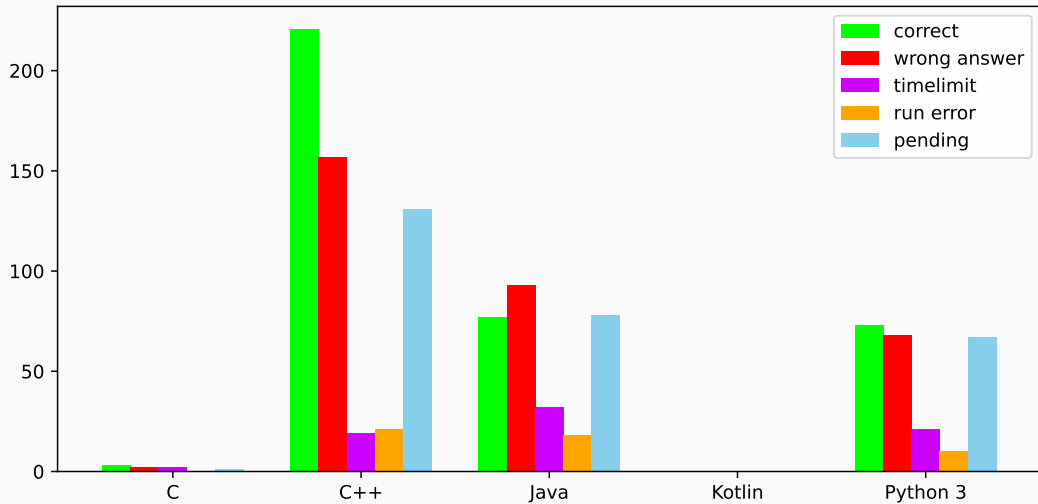
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Statistics: 4 submissions, 0 accepted, 2 unknown

ETV also did their best!



Language stats



Random facts

Jury work

- 382 commits (last year: 440)

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- 237 jury + proofreader solutions (last year: 221)
- The minimum¹ number of lines the jury needed to solve all problems is

$$8 + 2 + 15 + 14 + 1 + 1 + 20 + 12 + 18 + 1 + 11 + 9 + 1 = 113$$

On average 8.7 lines per problem, up from 4 in last year's preliminaries

¹With mostly™ PEP 8-compliant code golfing

Thanks to:

The proofreaders

Arnoud van der Leer

Bartjan Henkemans

Davina van Meer

Jaap Eldering

Kevin Verbeek

Pavel Kunyavskiy  Kotlin Hero 

Ragnar Groot Koerkamp

Thore Husfeldt

Thomas Verwoerd  Kotlin Hero 

The jury

Jeroen Op de Beek

Jippe Hoogeveen

Jonas van der Schaaf

Lammert Westerdijk

Leon van der Waal

Maarten Sijm

Marijn Adriaanse

Mike de Vries

Reinier Schmiermann

Tobias Röhr

Wietze Koops

Yanxu Chen

Want to join the jury? Submit to the Call for Problems of BAPC 2027 at:

<https://jury.bapc.eu/>