Delft Algorithm Programming Contest (DAPC) 2025

Solutions presentation

The BAPC 2025 Jury

October 4, 2025

K: Koehandel

Problem author: Mike de Vries

Problem: Your opponent bid c coins, and you have n coins. You get your opponent's cow when bidding more than c coins, and lose your cow when bidding less than c coins.
What should you bid to maximize the number of cows you end up with and secondarily your number of coins?

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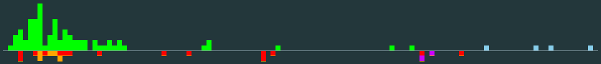
Complexity: $O(1)$.

Statistics: 83 submissions, 75 accepted

D: Dralinpome

Problem author: Mike de Vries



Problem: Determine whether a word is a *dralinpome*.

A word is a dralinpome if there exists a permutation of its letters that is a palindrome.

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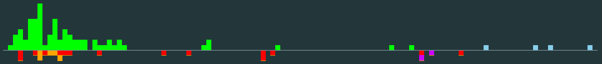

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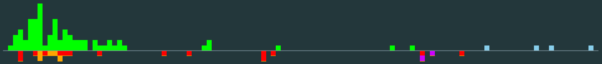

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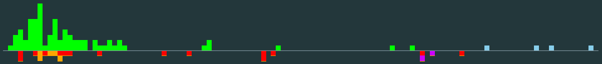

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Solution: Count the number of occurrences of each letter and check whether they are all even, with at most one odd one out.

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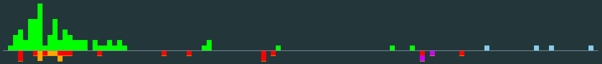

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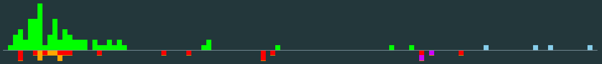

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Easter egg: Can you find all the dralinpomes in the problem statement?

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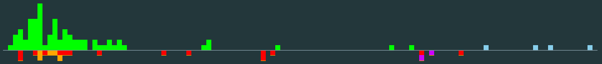

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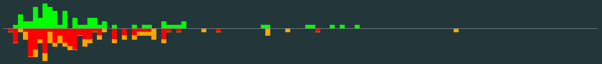
Running time: $\mathcal{O}(n)$.

Easter egg: Can you find all the dralinpomes in the problem statement?

Statistics: 98 submissions, 72 accepted, 4 unknown

B: Bottle of New Port

Problem author: Thore Husfeldt



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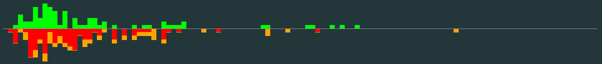

Problem: Compute the amount of alcohol left in a bottle after d days.

Solution:

- The amount of alcohol left is $x = \max(a - d \cdot \Delta_a, 0)$.

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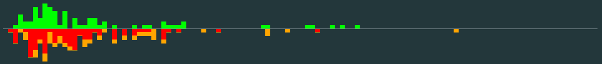

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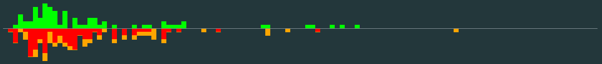

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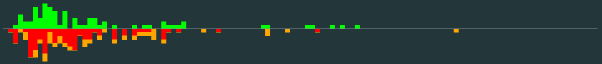

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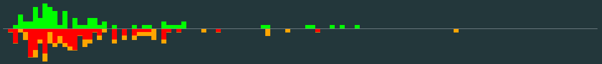

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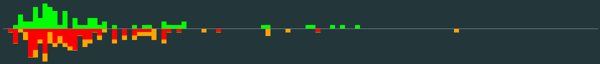

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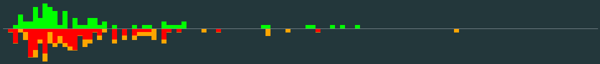

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Statistics: 191 submissions, 74 accepted

H: Hidden Sequence

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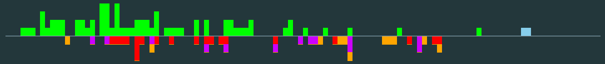

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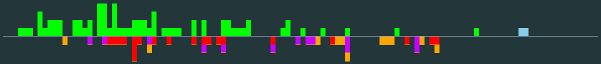

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Observation: For each game, even though the winner does not list their name, the other two players do append the winner to their sequence. The winner of the first/final game is always the first/final name in exactly two of the sequences. Remove that name from the two sequences, and iterate.

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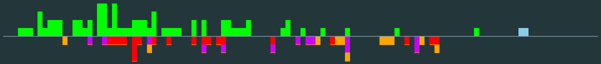

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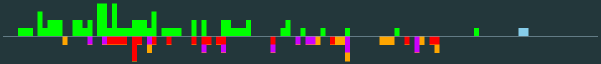

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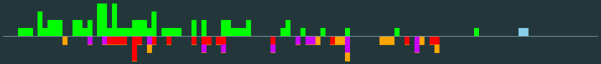

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Pitfall: Modifying the sequences themselves by removing characters from the strings can be unwantedly slow. Popping characters from the end is fine, but using `erase` is an $\mathcal{O}(n)$ operation $\implies \mathcal{O}(n^2)$ running time.

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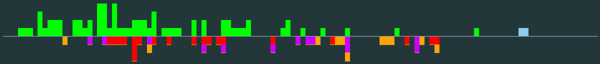

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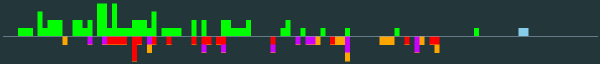

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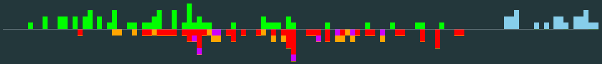
Statistics: 117 submissions, 71 accepted, 2 unknown

J: Journal Publication

Problem author: Ragnar Groot Koerkamp



Problem: Is it possible to pick a name part for each author such that the list is sorted?

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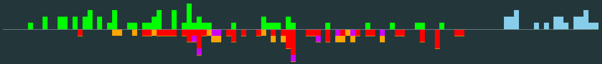

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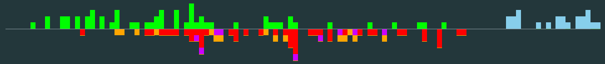

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Solution: For each author in order, determine the appropriate name part in linear time with a running minimum.

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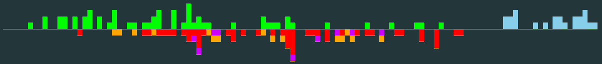

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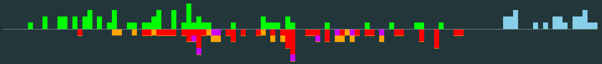

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Running time: Linear in the total size of the input.

Statistics: 152 submissions, 57 accepted, 23 unknown

E: Entropy Evasion

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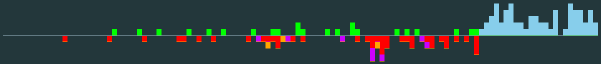

Problem: Repeatedly randomize a consecutive string of bits until at least 70% are 1.

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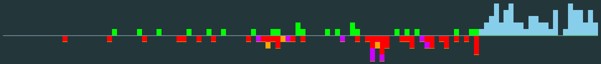

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Observation: The expected gain of a 0 is $\frac{1}{2}$ and that of a 1 is $-\frac{1}{2}$. So when we choose a string with a zeroes and b ones, the expected gain is $(a-b)/2$.

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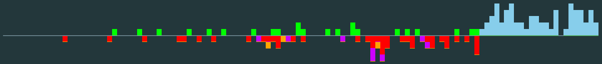

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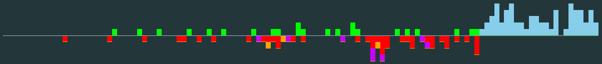

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Implementation: To find this, calculate all prefix sums of expected gains, and take the largest increase.

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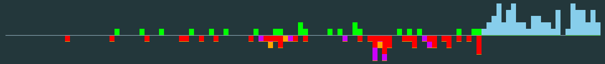

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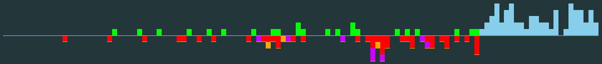
Pitfall: Off-by-one errors when finding the maximum subarray are hard to debug, and only fail on a few testcases.

E: Entropy Evasion

Problem author: Ragnar Groot Koerkamp



Problem: Repeatedly randomize a consecutive string of bits until at least 70% are 1.

Observation: The expected gain of a 0 is $\frac{1}{2}$ and that of a 1 is $-\frac{1}{2}$. So when we choose a string with a zeroes and b ones, the expected gain is $(a-b)/2$.

Solution: Repeatedly choose the string that maximizes expected gain.

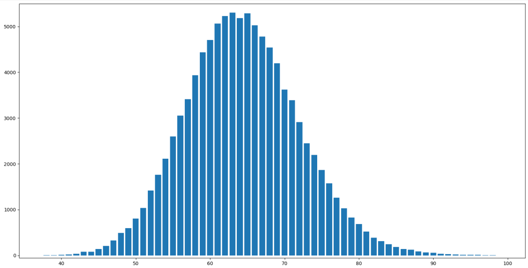
Implementation: To find this, calculate all prefix sums of expected gains, and take the largest increase.

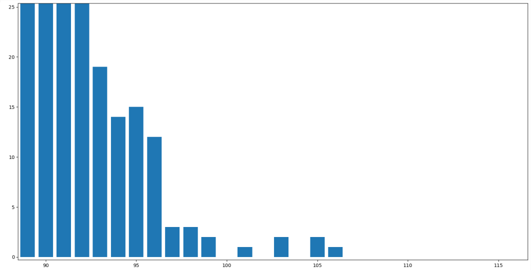
Pitfall: Off-by-one errors when finding the maximum subarray are hard to debug, and only fail on a few testcases.

Running time: $\mathcal{O}(nq)$ for q commands.

Problem author: Ragnar Groot Koerkamp

Statistical analysis: Out of 100 000 runs, the highest number of commands used is 106.
Lowest number of commands is 34.





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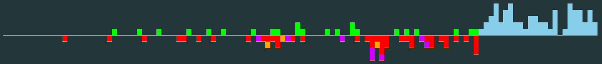

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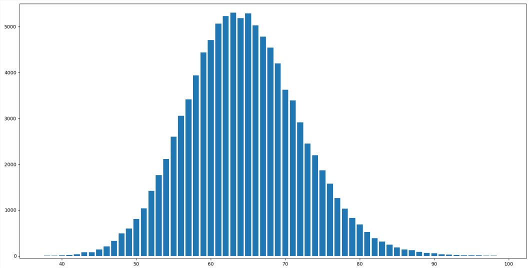
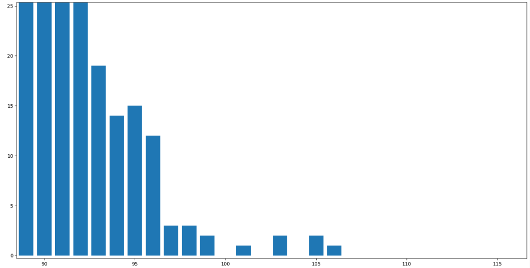
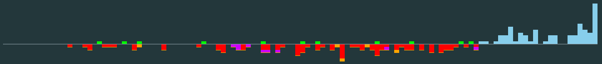




Statistics: 138 submissions, 23 accepted, 64 unknown

G: Genealogy Gumbo

Problem author: Lammert Westerdijk



Problem: Determine whether everyone can have the same ancestor.

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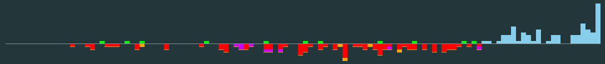

Problem: Determine whether everyone can have the same ancestor.

Initial idea: This is a graph problem.

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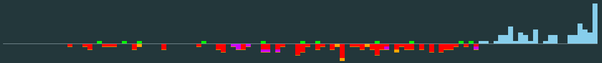

Problem: Determine whether everyone can have the same ancestor.

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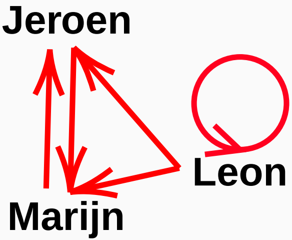
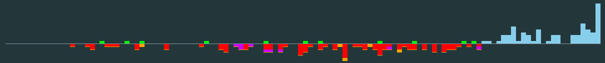
Naive solution: Make a directed graph. If A is a son of B, add a directed edge from B to A.





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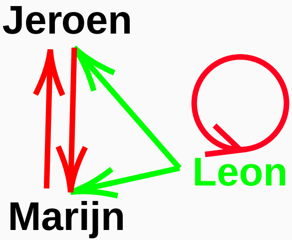
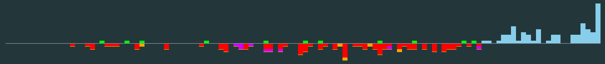


Naive solution: Output `possible` if some node reaches all other nodes, and `impossible` otherwise.



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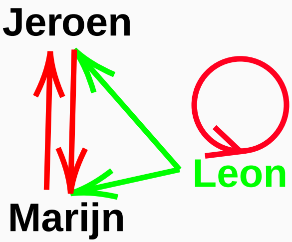

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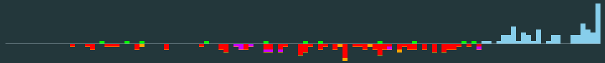

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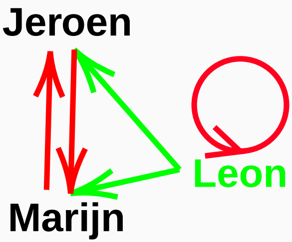

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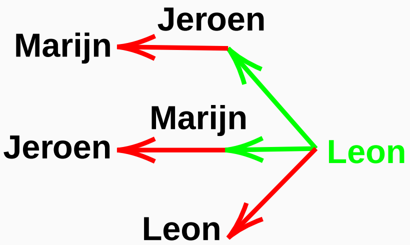

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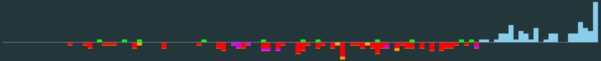

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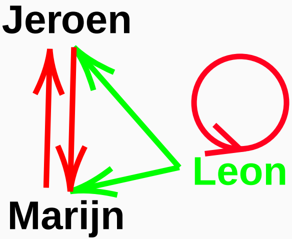

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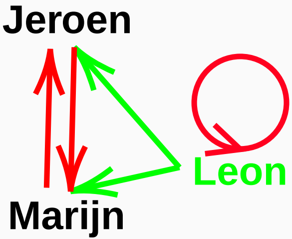

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Issue: Take some spanning tree. What about unused edges?

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Solution: Therefore, we need to find a node that can reach all other nodes.

Issue: $n = 10^5$, so we need an $\mathcal{O}(n)$-time solution.

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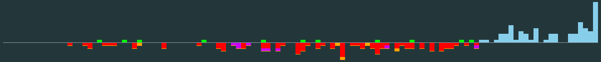

Solution:

- Loop through all nodes, and run a DFS if not yet visited.

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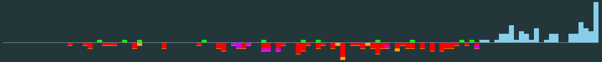

Solution:

- Loop through all nodes, and run a DFS if not yet visited.
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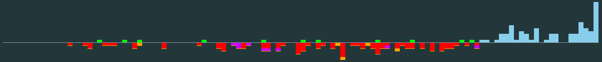

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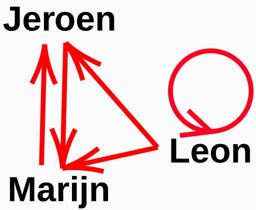

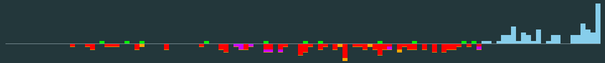

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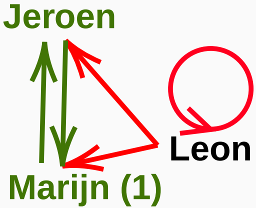

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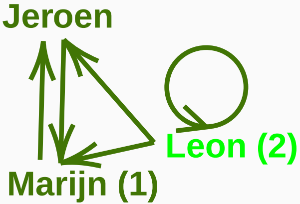

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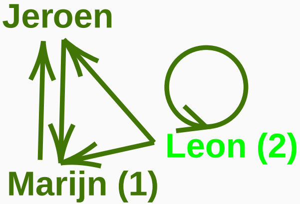

- Check whether this is true using a DFS, starting from this last node.

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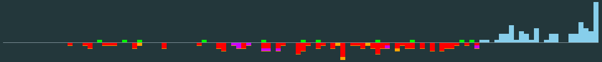

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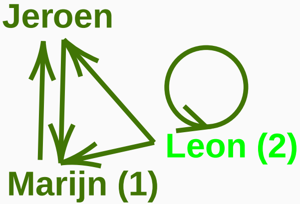

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Running time: $\mathcal{O}(n)$.

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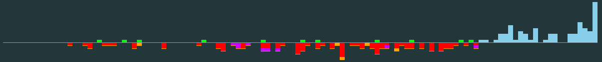

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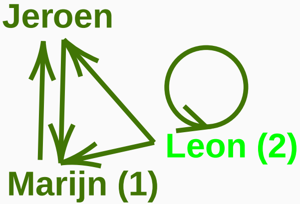

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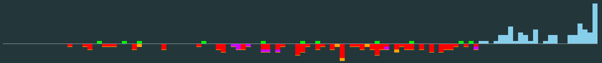
Running time: $\mathcal{O}(n)$.

Alternative solution: Using strongly connected components.



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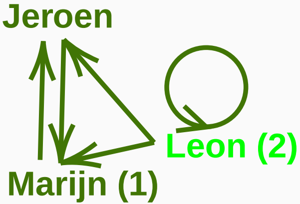


- Check whether this is true using a DFS, starting from this last node.

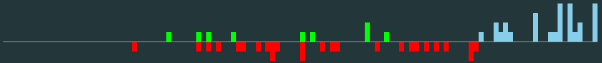
Running time: $\mathcal{O}(n)$.

Alternative solution: Using strongly connected components.

Statistics: 176 submissions, 11 accepted, 72 unknown

I: Ingredient Intervals

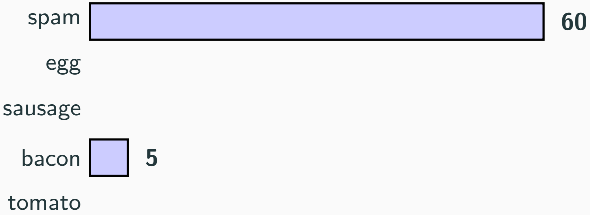
Problem author: Mike de Vries



Problem: There is a sequence of real numbers $a = (a_1, \ldots, a_n)$ with $a_1 + \cdots + a_n = 100$ and $a_1 \geq \cdots \geq a_n \geq 0$. Given a subset $\{a_i\}_{i \in S}$ of these numbers, determine maximal lower bounds $l_1, \ldots, l_n$ and minimal upper bounds $r_1, \ldots, r_n$ such that

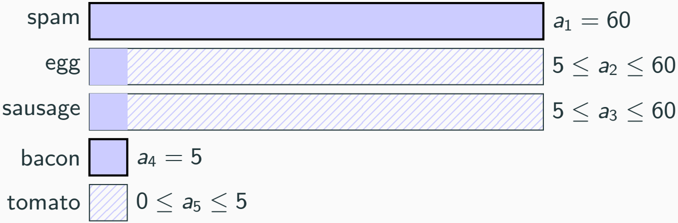
$$l_i \leq a_i \leq r_i \quad \text{for } 1 \leq i \leq n\,.$$

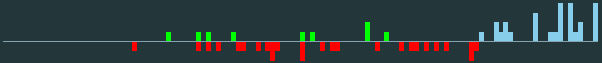
E.g., with $a = (60, ?, ?, 5, ?)$:



First observation: Since a is nonincreasing, it is immediate that a_i satisfies $l'_i \le a \le r'_i$ with

$$l'_i = \max\{\, a_j : j \ge i, j \in S \,\} \qquad r'_i = \min\{\, a_j : j \le i, j \in S \,\}\,.$$





First observation: Since a is nonincreasing, it is immediate that a_i satisfies $l_i' \le a \le r_i'$ with

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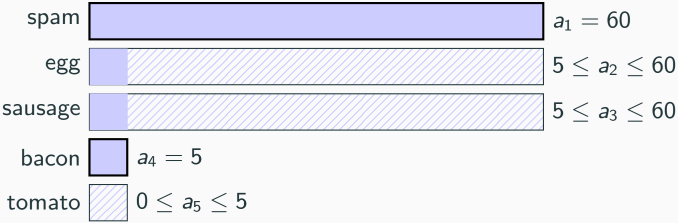


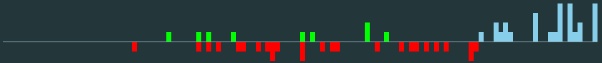
Implementation: These values can be computed in linear time by first computing

$$\mathrm{prev}(i) = \max\{\, j \in S : j < i \,\}, \qquad \mathrm{next}(i) = \max\{\, j \in S : j > i \,\}\,,$$

preferably with useful boundary values, for instance by introducing $a_0 = 100$ and $a_{n+1} = 0$. Then, for $i \notin S$ we have $l_i' = a_j$ with $j = \mathrm{next}(i)$ because a is decreasing.

I: Ingredient Intervals

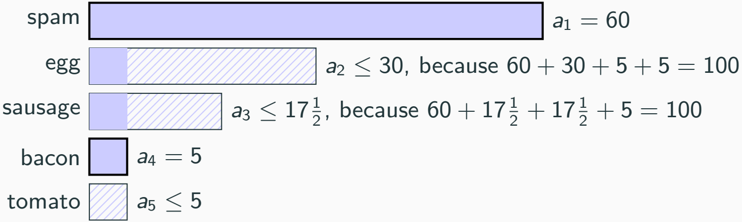
Problem author: Mike de Vries



Fix upper bounds: For $i \notin S$, the (unknown) amount a_i satisfies $l_i' \leq a_i \leq r_i'$, but we know more: Assuming all other amounts attain their *lower* bound, then their sum cannot exceed 100, so we have the constraint

$$\left(\sum_{j<i} \max(a_i, l_j')\right) + a_i + \sum_{j>i} l_j' \leq 100\,,$$

Can solve for the largest a_i.



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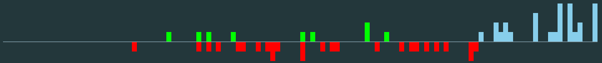

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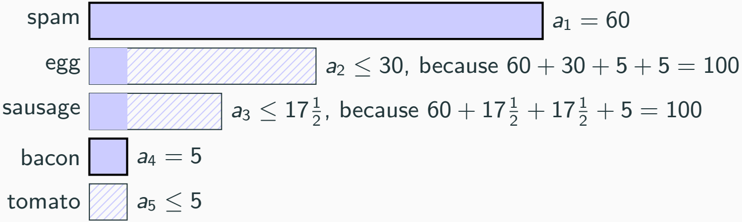


Implementation: To determine $\max a_i$, use binary search in the interval $[l'_i, r'_i]$ or rewrite the constraint for closed formula.

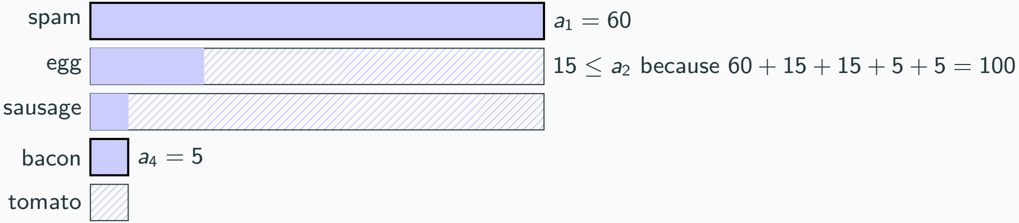
I: Ingredient Intervals

Problem author: Mike de Vries

Fix lower bounds: Symmetrically, assuming all other amounts attain their *maximum* bound, then their sum must be at least 100, so we have the constraint

$$\left(\sum_{j<i} r'_j\right) + a_i + \sum_{j>i} \min(a_i, r'_j) \geq 100\,,$$

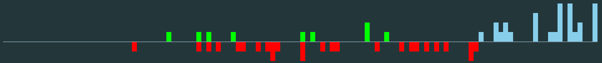
Can solve for the smallest a_i.



Tightness: Observe that the improved bounds are tight because the constraints describe valid values for a.

I: Ingredient Intervals

Problem author: Mike de Vries



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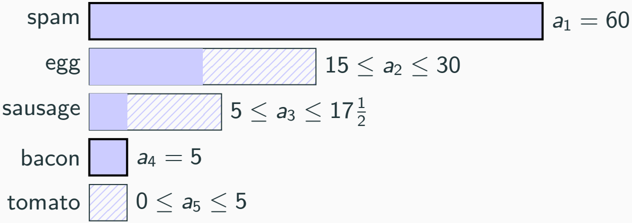
Combine bounds:



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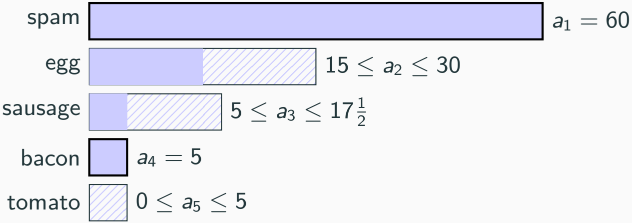
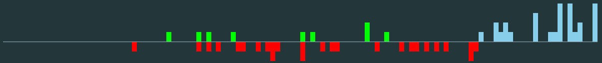


Running time: $\mathcal{O}\left(n^2 \log(100/\varepsilon)\right)$ using binary search.
With precomputing next and prev and solving the constraints: $\mathcal{O}(n)$.



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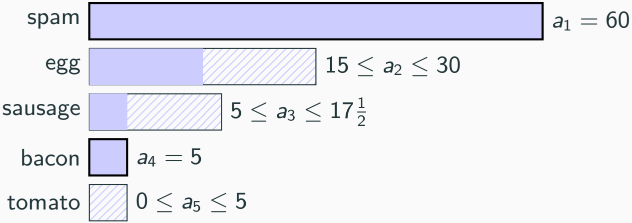
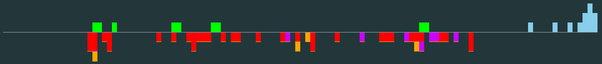


Running time: $\mathcal{O}\left(n^2 \log(100/\varepsilon)\right)$ using binary search.
With precomputing next and prev and solving the constraints: $\mathcal{O}(n)$.

Statistics: 62 submissions, 9 accepted, 27 unknown

A: Alto Adaptation

Problem author: Arnoud van der Leer, Maarten Sijm



Problem: By transposing notes to fit your vocal range, maximize the shortest interval of equally transposed notes.

A: Alto Adaptation

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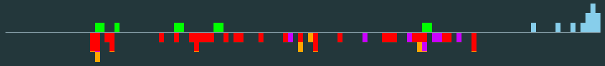

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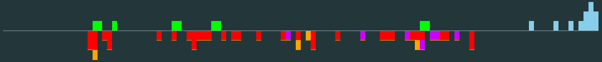

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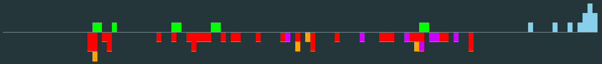

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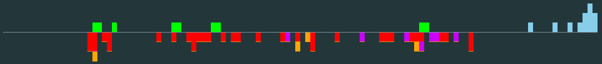

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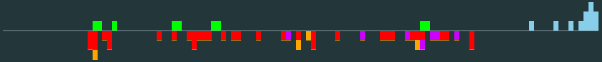

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Fun fact: $\mathcal{O}(n \log n)$ is possible with segment trees, or with binary search on the answer.

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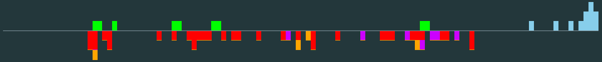

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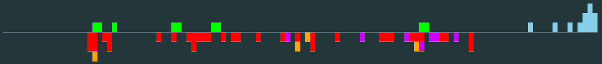

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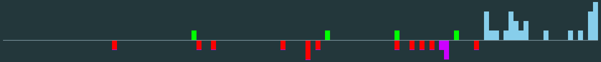
Statistics: 65 submissions, 9 accepted, 11 unknown

F: Friendly Formation

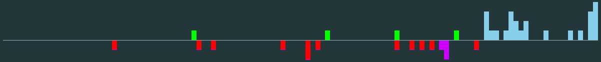
Problem author: Tobias Roehr



Problem: Partition a graph into two equally sized cliques.

F: Friendly Formation

Problem author: Tobias Roehr



Problem: Partition a graph into two equally sized cliques.

Condition: Need $n = 2k$ and need $m \geq k(k-1)$, which gives $n \leq 2(\sqrt{m} + 1) \leq 2002$.

F: Friendly Formation

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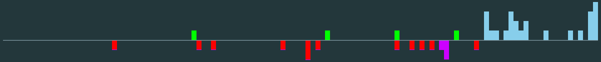

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Reduction: Take the edge complement, we need to partition the graph into two independent sets of size k.

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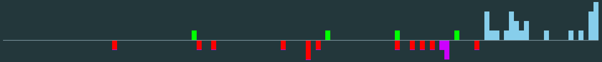

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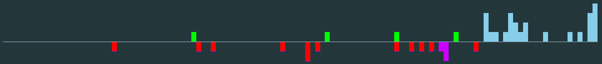

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Reduction: Let component i have parts of size a_i and b_i. We need to pick one of each tuple and end up with a total of exactly k.

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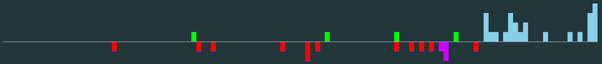

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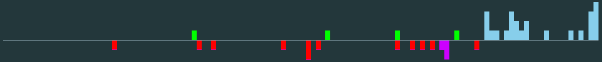

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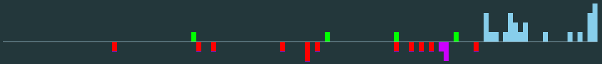

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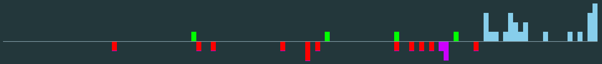

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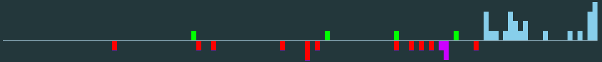

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Statistics: 43 submissions, 4 accepted, 24 unknown

Problem: Connect some of the given points in a cycle to create a polygon with all interior angles at least 90 degrees.

L: Landgrave

Problem author: Lammert Westerdijk

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Idea: Start with the convex hull, and simply verify whether this is a solution.

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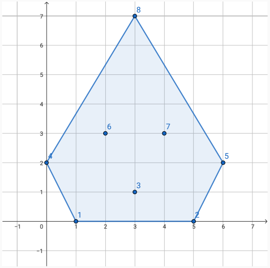

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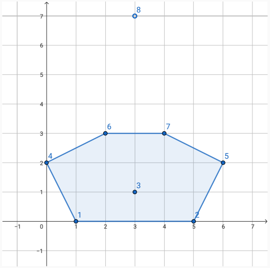

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Bonus: With monotone chain convex hull algorithm, after $\mathcal{O}(n \log n)$ precomputation sorting the points, we can recalculate the hull in linear time, leading to $\mathcal{O}(n^2)$ total time.

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Statistics: 13 submissions, 0 accepted, 11 unknown

C: Calculation Obfuscation

Problem author: Marijn Adriaanse

Problem: Reorder a string to form a syntactically valid expression without redundant parentheses.

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Possible solution: Create k numbers/variables using single characters, starting with zeros. Put the remaining characters in the last token, making sure to start with letters, then non-zero digits. Sorting makes it easier, but is not strictly necessary.

`00123abcd` $\rightarrow$ `0, 0, 1, 2, dcba3`

`000000001` $\rightarrow$ `0, 0, 0, 0, 10000`

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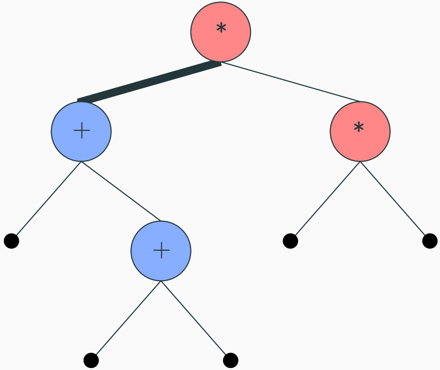

$(\; \ldots \; + \; \ldots \; + \; \ldots \;) \; * \; \ldots \; * \; \ldots$

Observation: Since each operator can have at most one parent, and has two children, if there are M multiplication operators and P plus operators, we can place no more than $2M$ or A pairs of non-redundant parentheses.

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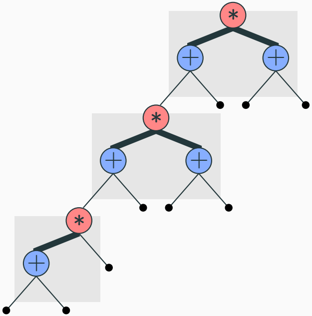
Observation: Since each operator can have at most one parent, and has two children, if there are M multiplication operators and P plus operators, we can place no more than $2M$ or A pairs of non-redundant parentheses.

Solution: Greedily construct as many (_+_)*(_+_) patterns as possible, use (_+_)*_ to get rid of a single pair of parentheses, and put all remaining operators at the end.



(((_+_)*_)*(_+_))*(_+_) +_+_+_*_*_

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Complete solution: Count the parentheses, operators, zeros, and other digits/letters, and check all edge conditions. Construct tokens. Then greedily construct the expression's structure, and fill in the tokens.

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Running time: $\mathcal{O}(n)$, or $\mathcal{O}(n \log n)$ when sorting the characters.

C: Calculation Obfuscation

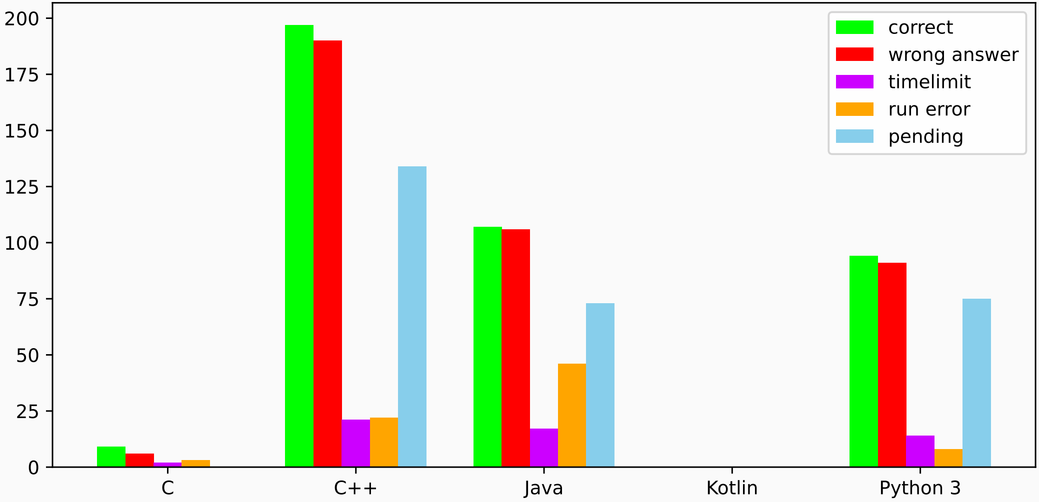
Problem author: Marijn Adriaanse

Complete solution: Count the parentheses, operators, zeros, and other digits/letters, and check all edge conditions. Construct tokens. Then greedily construct the expression's structure, and fill in the tokens.

Running time: $\mathcal{O}(n)$, or $\mathcal{O}(n \log n)$ when sorting the characters.

Statistics: 83 submissions, 2 accepted, 44 unknown

Language stats



Random facts

Jury work

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- 221 jury + proofreader solutions (last year: 236)
- The minimum[1] number of lines the jury needed to solve all problems is

$$4 + 2 + 6 + 1 + 4 + 11 + 3 + 2 + 5 + 2 + 1 + 7 = 48$$

On average 4 lines per problem, down from $16\frac{1}{4}$ in last year's preliminaries[2]

[1] With mostly™ PEP 8-compliant code golfing
[2] But we did way less golfing last year

Thanks to:

The proofreaders

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Michael Zündorf
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Tobias Roehr
Thomas Verwoerd
Wendy Yi

The jury

Ivan Fefer
Jeroen Op de Beek
Jonas van der Schaaf
Lammert Westerdijk
Leon van der Waal
Maarten Sijm
Marijn Adriaanse
Mike de Vries
Ragnar Groot Koerkamp
Reinier Schmiermann
Thore Husfeldt
Wietze Koops

Want to join the jury? Submit to the Call for Problems of BAPC 2026 at:

`https://jury.bapc.eu/`