Benelux Algorithm Programming Contest (BAPC) 2026

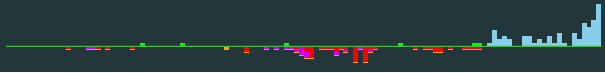
Solutions presentation

The BAPC 2026 Jury

November 2, 2026

A: Alternating Branch Cutting

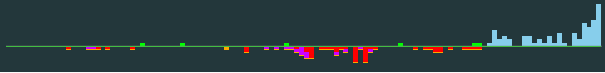
Problem author: Yanxu Chen



Problem: Given that each leaf of a ternary of height n is green with probability $0.5 + p$. After Alice and Emmy have pruned the tree, what is the probability that the final leaf is green?

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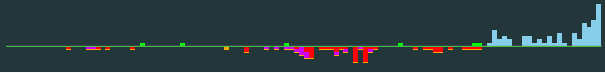
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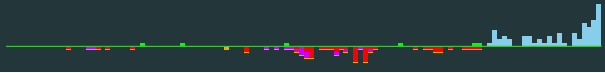
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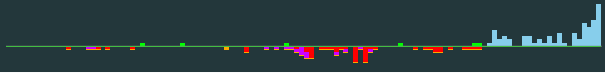
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General case: Define $p_0 = p$ and $p_{i+1} = p_i(1.5 - 2p_i^2)$. Then the answer is $0.5 + p_n$.

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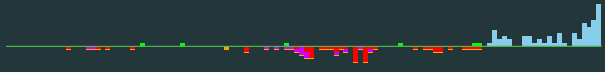
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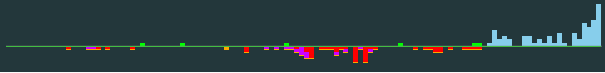


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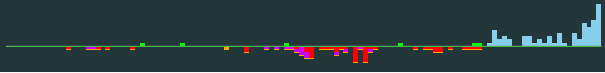
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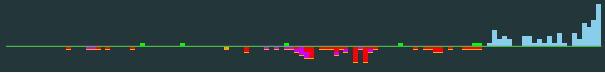
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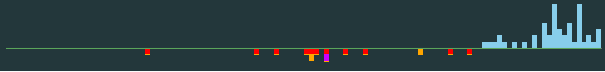
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Statistics: 139 submissions, 6 accepted, 72 unknown

B: Balloons and Dubloons

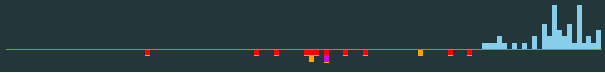
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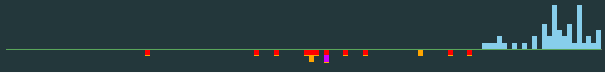


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Observation: The water does not matter, neither does the map. We can flatten the problem into $n + k$ land tiles in a row, with some marked.

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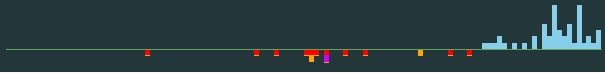
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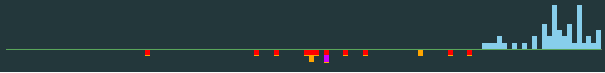
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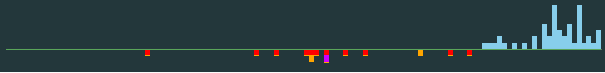
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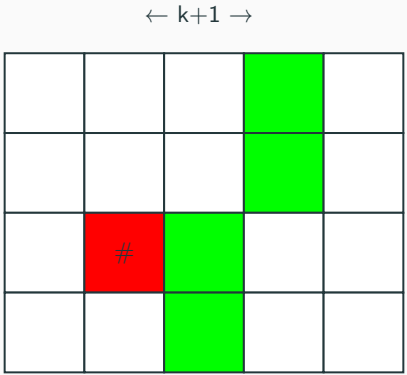
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Pitfall: Taking the marker index from left to right does not always work! A fix is to index from right to left instead.

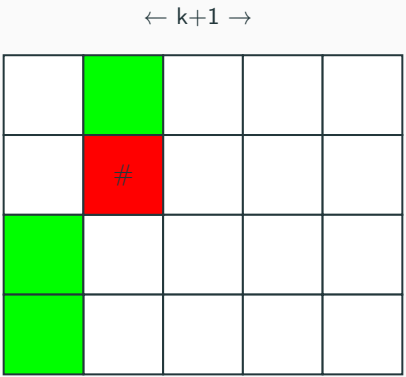
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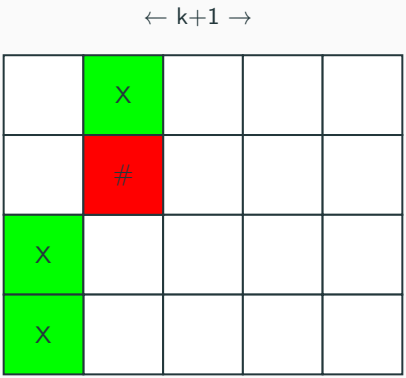
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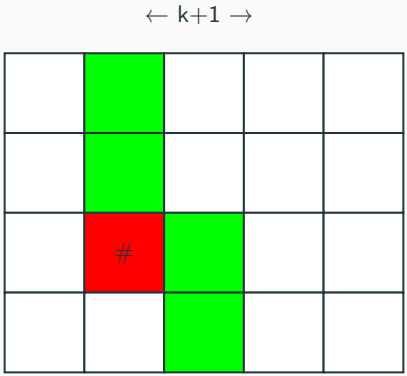
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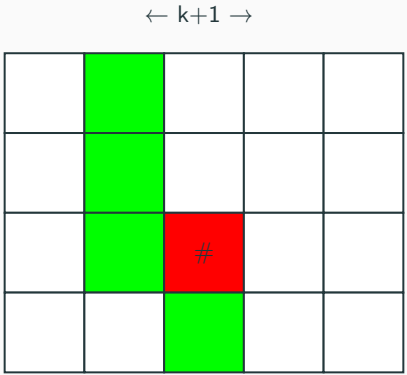
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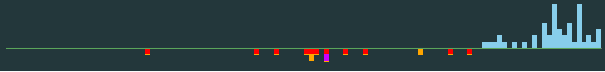
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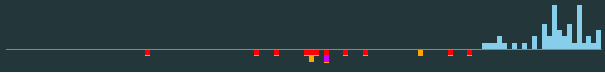
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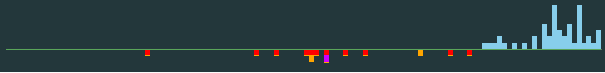


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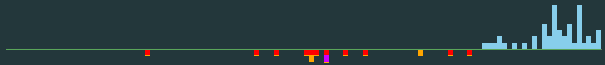
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Statistics: 61 submissions, 0 accepted, 47 unknown

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Problem: Solve two simultaneous preemptive scheduling problems, maximizing the overlapping running time.

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Observation: Start with the schedules obtained by Greedy 2, and consider fixing the schedules of each problem separately. This can be modeled as a bipartite maximum matching problem, subdividing the available time and the required time of each task into individual milliseconds!

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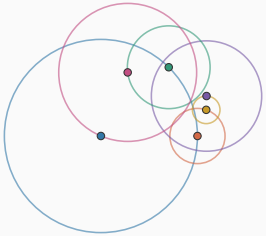
Statistics: 4 submissions, 0 accepted, 2 unknown

D: Discception

Problem author: Lammert Westerdijk



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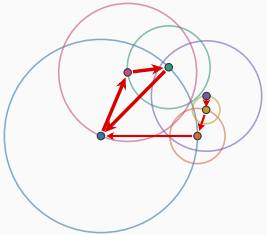
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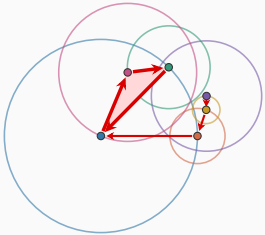
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Consequence: This directed cycle forms a polygon with edge lengths r_i.



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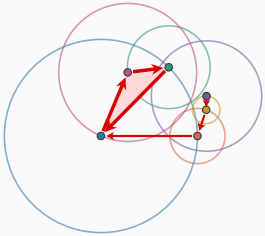


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Observation 1: Assume solution exists. For each circle, set $p_i = j$, if the centre of i lies on the circle j. The edges (i, p_i) form a functional graph. This graph has a directed cycle.

Consequence: This directed cycle forms a polygon with edge lengths r_i.

Solution: If you can make a polygon out of a subset of the r_i, put the circle centres of these circles on the corners of the polygon.



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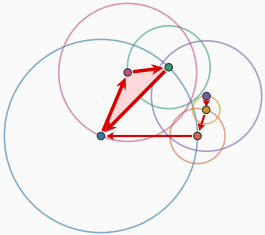
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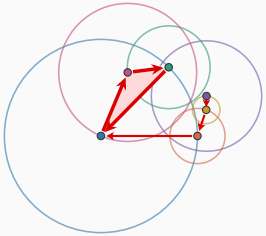
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Goal: Find a subset of r_i that can be the edges of a polygon, this is a necessary and sufficient condition.



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Statistics: 122 submissions, 36 accepted, 14 unknown

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Proof: Assume $s = t^k$, for $k > 1$ (otherwise answer is 1).

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Running time: $\mathcal{O}(nd(n))$. Results in $\approx 6 \cdot 10^7$ simple operations.

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Statistics: 92 submissions, 26 accepted, 14 unknown

F: Flippin' Cards

Problem author: Mike de Vries

Problem: You must orient n cards, each card is upside down with probability p independent of the other cards (p is drawn uniformly from $[0, 1]$). You go from card 1 to card n. If card i is right side up, then it takes time x. If card i is upside down, then either you flip card i in time y or you flip all cards $i, i + 1, \ldots, n$ in time z. Determine the expected time needed to orient all cards using an optimal strategy.

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Observation: Suppose you have seen c cards. The only thing that impacts the conditional probability on p (and thus your strategy) is the number of cards that are upside down u.

Solution: Denote with $f(c, u)$ the expected time to orient the remaining $n - c$ cards if you have seen c cards and u of them were upside down. If $q(c, u)$ denotes the probability that the next card is upside down, then you get:

$$f(c,u) = (1 - q(c,u)) \cdot (f(c+1,u) + x) + \\ q(c,u) \cdot \min(f(c+1,u+1) + y, f(c+1,c-u) + z)$$

The second alternative describes performing move 3: all remaining cards flip, which we mimic by saying that exactly the previous $c - u$ correct cards were "upside down".

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The second alternative describes performing move 3: all remaining cards flip, which we mimic by saying that exactly the previous $c - u$ correct cards were "upside down".

Algorithm: Calculate $f(c, u)$ using dynamic programming in $\mathcal{O}(n^2)$ and we are done.

Are we done? In this algorithm, we need to know $q(c, u)$ (= the probability that the next card is upside down if u cards out of the seen c cards are upside down). How to calculate it?

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Calculation: For fixed p, the probability of u cards out of c upside down is $\binom{c}{u} \cdot p^u \cdot (1-p)^{c-u}$. Hence for random p, the probability becomes: $\int_0^1 \binom{c}{u} \cdot x^u \cdot (1-x)^{c-u} dx$

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For fixed p, the probability that the next card is upside down is $\binom{c}{u} \cdot p^u \cdot (1-p)^{c-u} \cdot p$.

Hence, we find:

$$q(c,u) = \frac{\int_0^1 \binom{c}{u} \cdot x^{u+1} \cdot (1-x)^{c-u} dx}{\int_0^1 \binom{c}{u} \cdot x^u \cdot (1-x)^{c-u} dx} = \frac{\int_0^1 x^{u+1} \cdot (1-x)^{c-u} dx}{\int_0^1 x^u \cdot (1-x)^{c-u} dx}$$

How to evaluate this?

F: Flippin' Cards

Problem author: Mike de Vries

Are we done? In this algorithm, we need to know $q(c, u)$ (= the probability that the next card is upside down if u cards out of the seen c cards are upside down). How to calculate it?

Calculation: For fixed p, the probability of u cards out of c upside down is $\binom{c}{u} \cdot p^u \cdot (1-p)^{c-u}$.
Hence for random p, the probability becomes: $\int_0^1 \binom{c}{u} \cdot x^u \cdot (1-x)^{c-u} dx$
For fixed p, the probability that the next card is upside down is $\binom{c}{u} \cdot p^u \cdot (1-p)^{c-u} \cdot p$.
Hence, we find:

$$q(c,u) = \frac{\int_0^1 \binom{c}{u} \cdot x^{u+1} \cdot (1-x)^{c-u} dx}{\int_0^1 \binom{c}{u} \cdot x^u \cdot (1-x)^{c-u} dx} = \frac{\int_0^1 x^{u+1} \cdot (1-x)^{c-u} dx}{\int_0^1 x^u \cdot (1-x)^{c-u} dx}$$

How to evaluate this?

1. **Numeric:** We can apply numeric integration (for example, Simpson's Rule) to calculate this for all $q(c, u)$: doable, but can be tricky to get past time limit.

2. **Heavy Math:** Note that $\int_0^1 x^a(1-x)^b dx$ is the beta-function: it evaluates to

$$\int_0^1 x^a(1-x)^b dx = \frac{a! \cdot b!}{(a+b+1)!}$$

This formula can be found by trying some small a and b by hand (and can be proven by AC).
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Plug in and we get:

$$q(c,u) = \frac{\int_0^1 x^{u+1} \cdot (1-x)^{c-u} dx}{\int_0^1 x^u \cdot (1-x)^{c-u} dx} = \frac{(u+1)! \cdot (c-u)! \cdot (c+1)!}{u! \cdot (c-u)! \cdot (c+2)!} = \frac{u+1}{c+2}$$

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   Observation: We have $c + 1$ numbers $x_1, \ldots, x_c, p$ drawn uniformly from $[0, 1]$ and we are only interested in their order (or specifically, the location of p in their order): the order $x_1, \ldots, x_c, p$ is uniformly random over all permutations.

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   Consequence: If we draw c cards and u are upside down, then this means that u cards x_i are put before p and $c - u$ cards are put after c. For the conditional probability $q(c, u)$ that card $c + 1$ is upside down, we must consider all ways to put card x_{c+1} in the order of $x_1, x_2, \ldots, x_c, p$ and all options are equally likely. There are $u + 1$ locations before p (in which card $c + 1$ is upside down) and $c - u + 1$ locations after p (in which card $c + 1$ is right side up), so $q(c, u) = \frac{u+1}{c+2}$.

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Fun fact: Note that this technique immediately proves the formula for the beta-function (for non-negative integers a, b).

Wrap up: We know that $q(c,u) = \frac{u+1}{c+2}$. This gives the dynamic program:

$$f(c,u) = \frac{c-u+1}{c+2} \cdot (f(c+1,u)+x) + \frac{u+1}{c+2} \cdot \min(f(c+1,u+1)+y, f(c+1,c-u)+z)$$

Calculate it from $c = n$ to $c = 0$ for all $0 \leq u \leq c$ with base case $f(n,u) = 0$ for all u. The answer is $f(0,0)$.

F: Flippin' Cards

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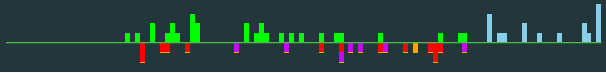
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Statistics: 0 submissions, 0 accepted

G: Graph Theft Auto

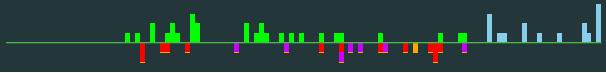
Problem author: Lammert Westerdijk



Problem: On an undirected unweighted graph, some gangsters walk from their hideout at unknown vertex to vertex 1 using the shortest path. You can place cameras at vertices that detect if the gangsters walk past this vertex and the number of edges they have traversed so far. Determine the minimum number of required cameras to spot the gangsters and be able to determine their hideout.

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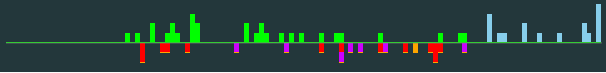


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Step 1: Determine the shortest paths. We can calculate the shortest path from any starting vertex to all other vertices in $\mathcal{O}(n+m)$ running time using BFS.
Run BFS for all starting vertices is too slow ($\mathcal{O}(n^2+mn)$).
We can run BFS from vertex 1: $\mathcal{O}(n+m)$ is fast enough.

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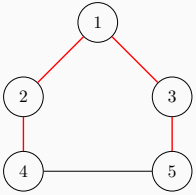
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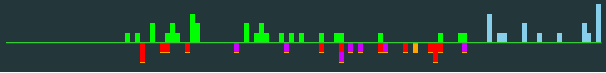
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The gangsters always walk upward to the root of the BFS tree (forget all other edges):



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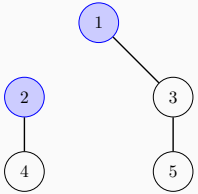
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Step 2: Place cameras optimally.

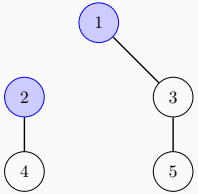
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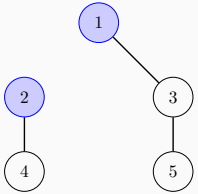
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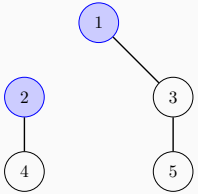


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Solution: All leaves need their own path. We can create these paths by cutting off as high as possible: the answer is the number of leaves in BFS-tree!

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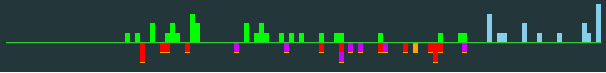
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Running time: $\mathcal{O}(n + m)$

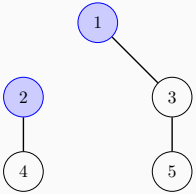
G: Graph Theft Auto

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

Statistics: 66 submissions, 29 accepted, 16 unknown

H: Historical Hierarchy

Problem author: Reinier Schmiermann



Problem: There is a hidden permutation $p_1, \ldots, p_n$. In one step, you are allowed to remove an element from position i, and insert it at position j instead. After each operation you get told the length of a Longest Increasing Subsequence (LIS). Sort the permutation in at most $4n^2$ operations.

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Solution? Based on the Naive Solution, try to gradually improve the LIS to n, but use fewer queries than random operations.

Number the elements from 1 to n from left to right (although this numbering may differ from the hidden permutation $p_1, \ldots, p_n$). Then store the array a_i which is the current permutation in your own numbering system.

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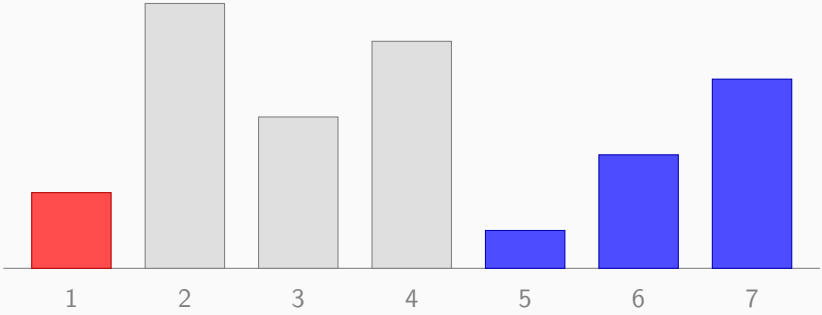
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But why does this algorithm sort the permutation in the end?

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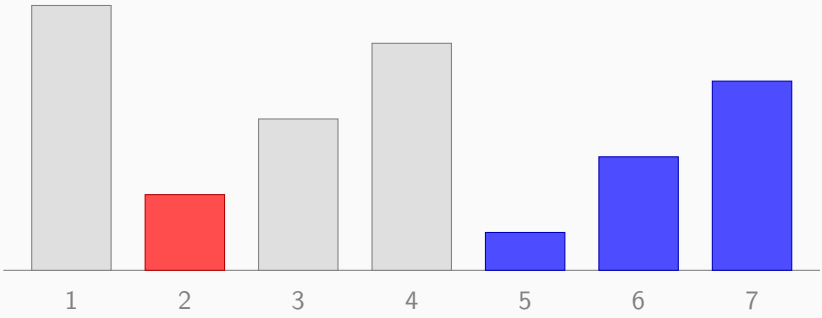


LIS: 3

1 1

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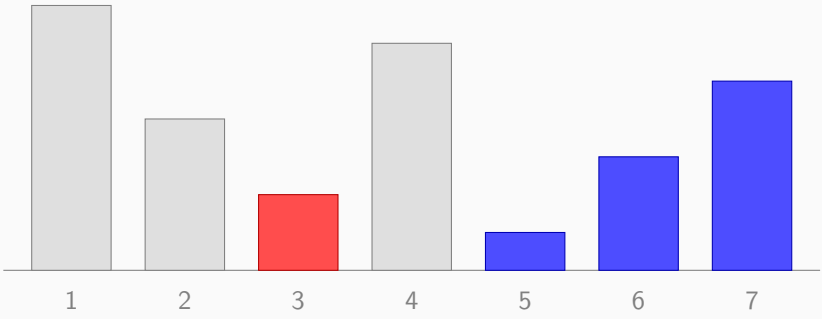


LIS: 3 3

1 2

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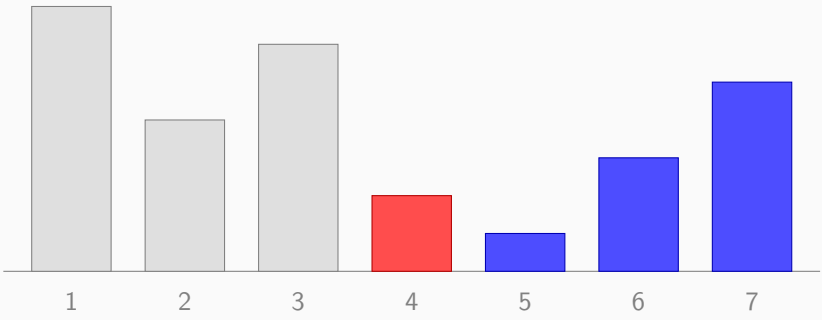


LIS: 3 3 3

2 3

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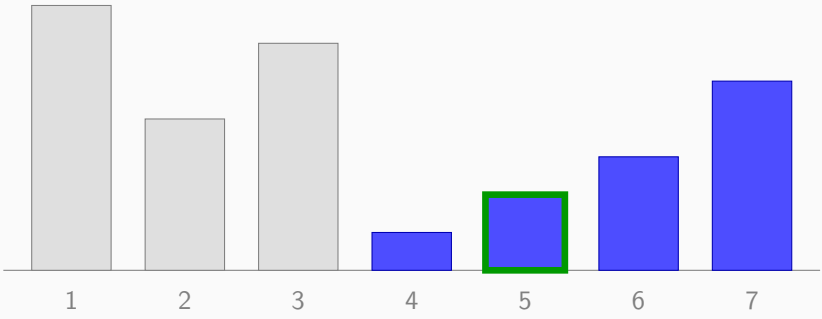


LIS: 3 3 3 3

3 4

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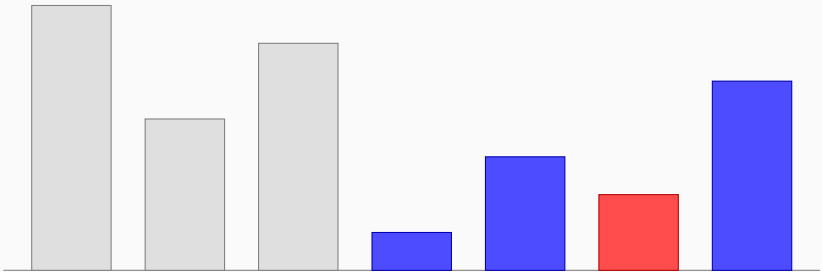


LIS: 3 3 3 3 **4**

4 5

H: Historical Hierarchy

Problem author: Reinier Schmiermann

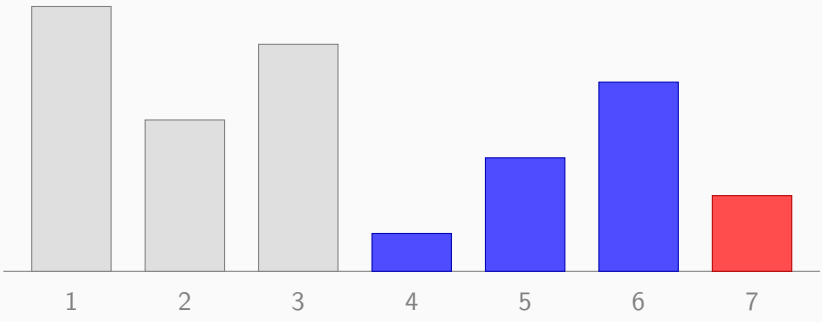


LIS: 3 3 3 3 4 3

5 6

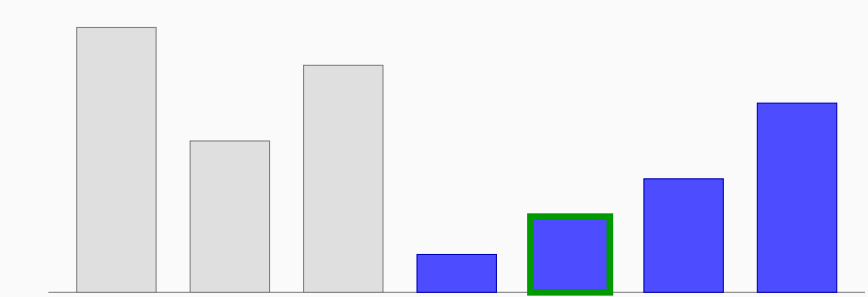
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Algorithm: For all x from 1 to n, find the element with $a_i = x$, and try deleting it and placing it everywhere. Choose to place $a_i = x$ at position of max LIS.

But why does this algorithm sort the permutation in the end?

Issue: Multiple increasing subsequences that are tied for longest make things confusing.

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Proof: Prove that after maximizing the LIS for the element $x = a_i$ the elements that we labeled $1, 2, \ldots, x$ are all part of all LISes $(*)$.

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Option 1: x is already part of all LISes, then wherever it moves, the LIS can only stay equal or go down. In this case we should keep x on its original position, before the operations. Then $(*)$ holds for this x as well.

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Option 2: x is not part of some LIS. Then in some operation it gets inserted at the right spot inside the gaps of this LIS, So there is a position which makes the length of LIS increment. There could be multiple previous LIS which now increased in length by 1. But by assumption, elements 1 to $x - 1$ are in all LISes, so also the ones that grew to length+1, so $(*)$ still holds after this step.

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Statistics: 48 submissions, 9 accepted, 28 unknown

I: Irritating Interruption II

Problem author: Tobias Röhr



Problem: Repeatedly assign mathematical operations ($+, \times$) to armies to maximize their combined strength.

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Statistics: 85 submissions, 48 accepted, 2 unknown

J: Juxtaposort

Problem author: Lammert Westerdijk



Problem: Sort a list of values, if unambiguously possible, using the results of all $a_i - 1 < a_j$ comparisons.

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Observation: Comparing numbers a and b both ways results in the cases $a \leq b - 1$ ($a \ll b$), $b - 1 < a < b + 1$ ($a \approx b$), $b + 1 \leq a_i$ ($a \gg b$)

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Result: $\mathcal{O}(n^3)$ is probably too slow (note: $\mathcal{O}(n^3/\mathrm{bitset})$ is doable).

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Observation: Comparing with one number divides the other numbers into 3 sets.

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Solution: Keep a sorted list of sets of unsorted values, and compare with each number to partition these sets.

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...but it is needlessly complicated!

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Simple solution: Give each value a_i a score s_i, then sort and check for ambiguity.

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Implementation: For each $a_i - 1 < a_j$, do `s[i]--` and `s[j]++`.

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Statistics: 31 submissions, 5 accepted, 18 unknown

K: Kaktus Kourse

Problem author: Leon van der Waal



Problem: Find the length of the k-th longest simple path in a kaktus graph.

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Observation: Fix the first and last node of a simple path. There are 2^c possible simple paths between these nodes, where c is the number of cycles inbetween these nodes.

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Running time: Finding all possible simple paths is too slow, we need to do something more efficient.



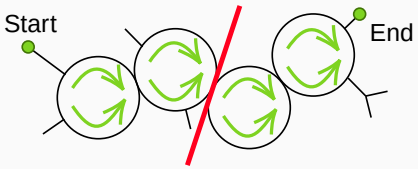
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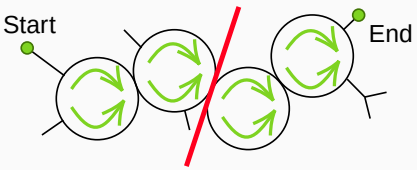
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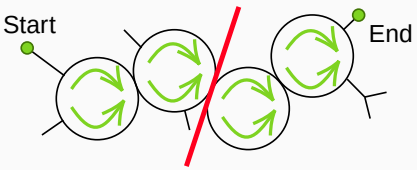
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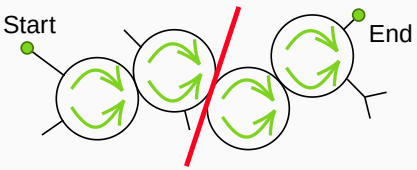
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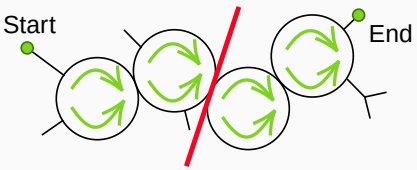
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Running time: By geometric sums, the overall complexity is hence $\mathcal{O}\left(2^{\frac{m}{6}} \log(nA)\right)$, with $A = 10^9$.

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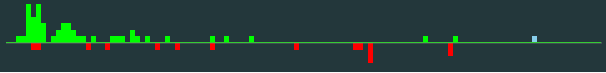
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Statistics: 4 submissions, 0 accepted

L: Letter Lottery

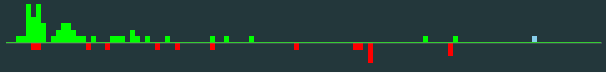
Problem author: Maarten Sijm



Problem: In a raffle, there are n codes, one is uniformly selected at random. A code consists of lowercase letters, and once the code is selected, a random letter is taken from this code. What is the lowercase letter with the highest probability? For that letter, output the probability.

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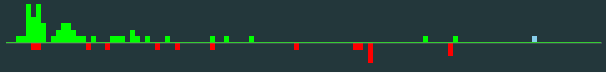
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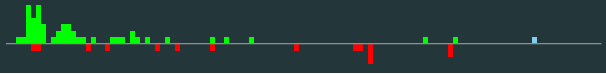
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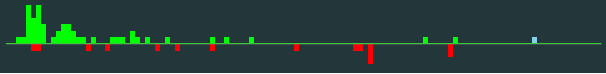
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Pitfall: Be sure to use 64-bit floating point numbers. 32-bit floating point numbers are not precise enough.

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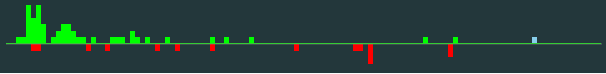
Solution: Add up the probabilities for each lowercase letter, and output the maximum probability out of the letters.

Pitfall: Be sure to use 64-bit floating point numbers. 32-bit floating point numbers are not precise enough.

Fun fact: Originally, jury wanted the output to be the letter with max probability. There can be very near ties, so this version needs big integer fractions.

L: Letter Lottery

Problem author: Maarten Sijm



Problem: In a raffle, there are n codes, one is uniformly selected at random. A code consists of lowercase letters, and once the code is selected, a random letter is taken from this code. What is the lowercase letter with the highest probability? For that letter, output the probability.

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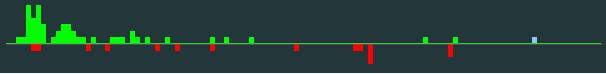
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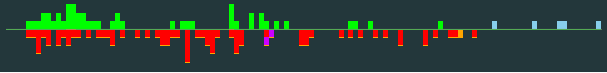
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Statistics: 66 submissions, 48 accepted, 1 unknown

M: Memory Management

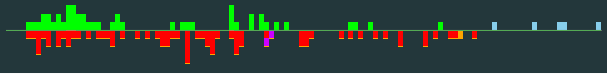
Problem author: Jeroen Op de Beek, Wietze Koops



Problem: For a generalized FizzBuzz sequence, with Fizz at multiples of a and Buzz at multiples of b, what is the largest k for which the answer string still fits in a memory of n bytes.

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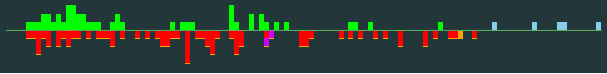


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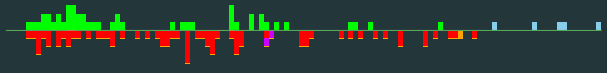
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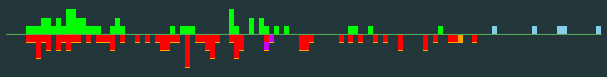
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Pitfall: When constructing the string, make sure to not run into a runtime of $O(n^2)$, due to slow concatenations.

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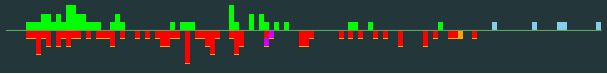
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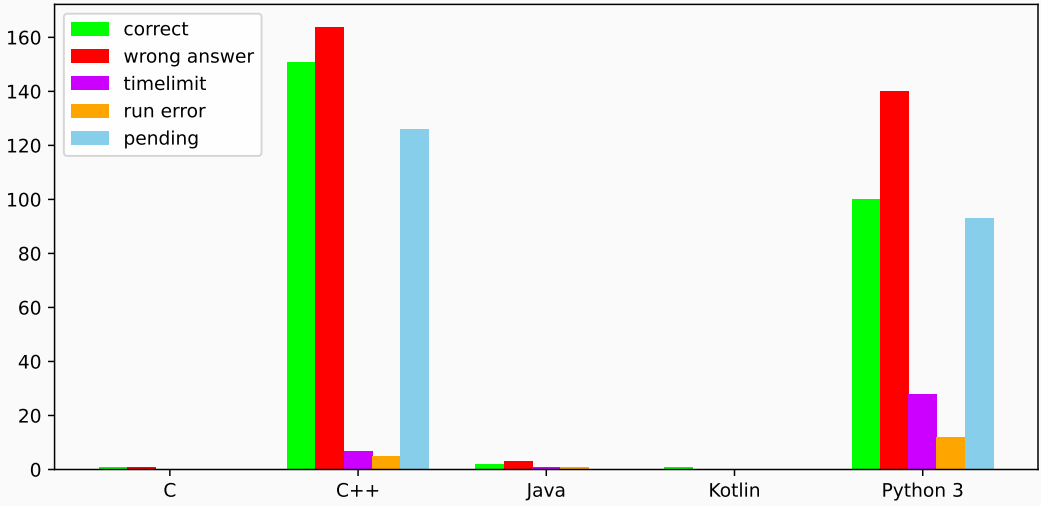
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Bonus: The problem can be solved in $O(\log n)$ with binary search, but this was not needed.

Statistics: 124 submissions, 47 accepted, 5 unknown

Language stats



Random facts

Jury work

- 825 commits, of which 449 for the main contest (last year: 945/525)

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- The minimum[1] number of lines the jury needed to solve all problems is

$$4 + 20 + 41 + 2 + 14 + 3 + 19 + 8 + 2 + 3 + 48 + 2 + 4 = 170$$

  On average, 13.1 lines per problem ($4\frac{1}{3}$ in BAPC 2025, 8.7 in preliminaries 2026)

[1] With limited code golfing

Thanks to:

The proofreaders

Arnoud van der Leer
Bartjan Henkemans
Hasso Plattner Institute team "Linked Liszt" 🎈
(Jakob Fanselow, Julian Windheuser, Konstantin Groth)
Hasso Plattner Institute team "Vikunjaaa" 🎈
(Helena Ullrich, Peter Zackrisson, Simon Bachran)
Jaap Eldering
Nicky Gerritsen 💥
Pavel Kunyavskiy Kotlin Hero 🎈
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
Ragnar Groot Koerkamp
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/`