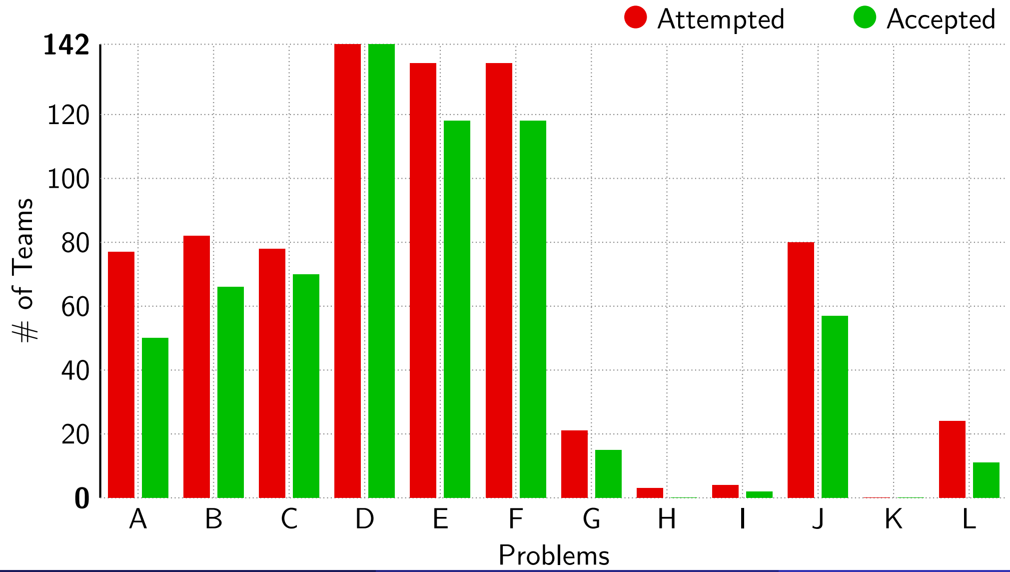
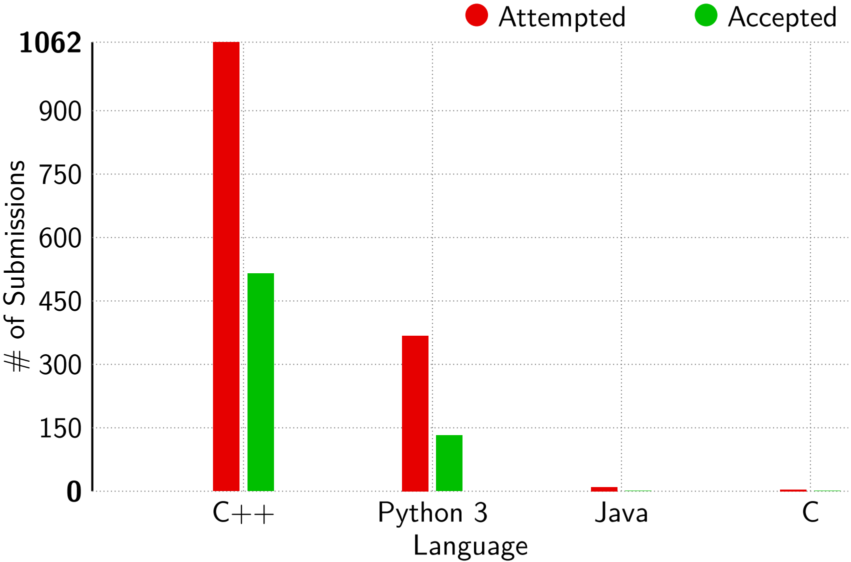
SWERC 2025

Problem Analysis

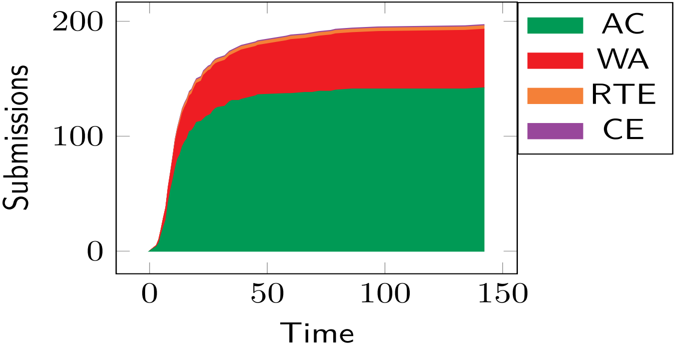
November 23, 2025


Attempted
Accepted
142
120
100
80
60
40
20
0
# of Teams
A
B
C
D
E
F
G
H
I
J
K
L
Problems


Attempted
Accepted
1062
900
750
600
450
300
150
0
# of Submissions
C++
Python 3
Java
C
Language

D: Dungeon Equilibrium

Solved by 142 teams before freeze.
First solved after 3 min by UXT.



D: Dungeon Equilibrium

Statement (summary).

We are given an array $a_1, \ldots, a_n$ $(0 \le a_i \le n)$. A level is *balanced* if, for every monster type x that appears, the total number of occurrences of x in the array is exactly x. We may delete elements. Compute the minimum number of deletions needed to make the level balanced.

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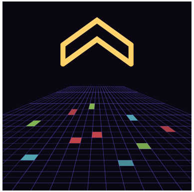
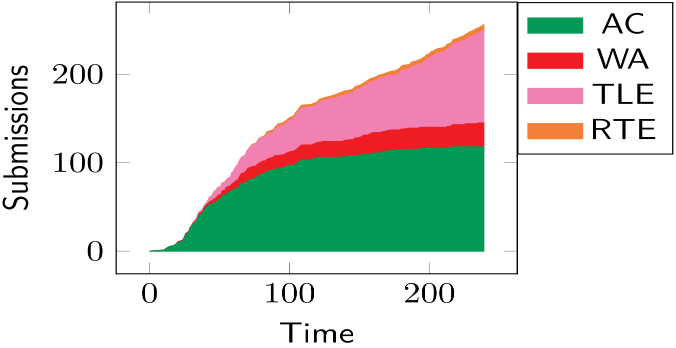
Complexity. $O(n)$ time (frequency array of size $n+1$). Slower solutions (e.g., $O(n^2)$) are allowed.

Solved by 118 teams before freeze.
First solved after 10 min by TempName.





Statement (summary).

Initially, only cell $(0, 0)$ is black. With a character 4, the 4 cells touching a black cell orthogonally become black. With a character 8, the 8 cells touching a black cell orthogonally or diagonally become black. Given a string s, answer queries (l, r, x, y): is cell (x, y) black after the commands in substring $[l, r]$?

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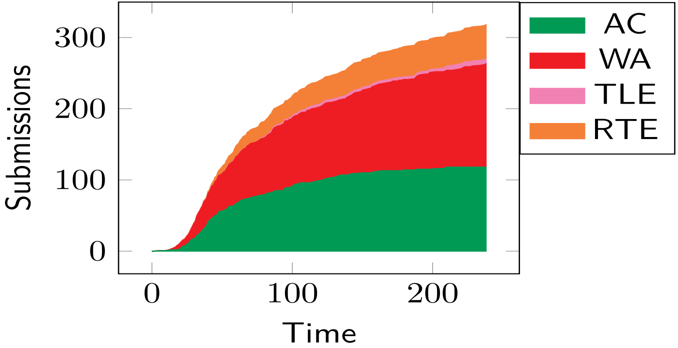
   - $a + 2b \geq x + y$ (number of orthogonal steps);
   - $a + b \geq \max(x, y)$ (number of orthogonal steps in the same direction).

Complexity. $O(n + q)$ time.

F: Factory Table

Solved by 118 teams before freeze.
First solved after 11 min by Segfault go BRRRR.

×	**1**	**2**	**3**	**4**
1	1	2	3	4
2	2	4	6	8
3	3	6	9	12
4	4	8	12	16



Statement (summary).

The k-th unrolled table is $[1 \cdot 1, 1 \cdot 2, \ldots, 1 \cdot k, 2 \cdot 1, 2 \cdot 2, \ldots, 2 \cdot k, \ldots, k \cdot 1, k \cdot 2, \ldots, k \cdot k]$. We are given a subarray of an unrolled table, with length ≥ 2. Find the minimum possible k.

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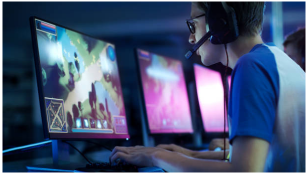
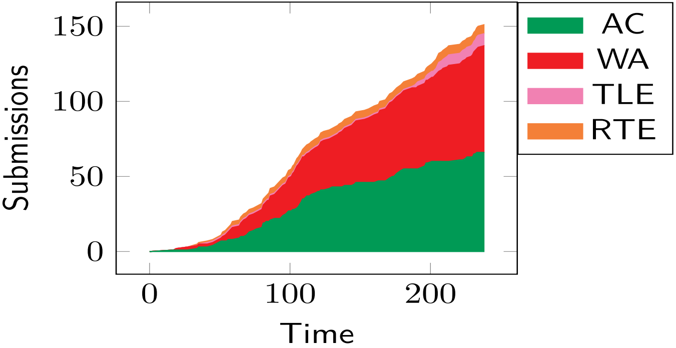
Complexity. $O(n)$ time per test case.

B: Billion Players Game

Solved by 66 teams before freeze.
First solved after 17 min by UniBois.





B: Billion Players Game

Statement (summary).

There is a hidden integer x in the interval $[l, r]$. We are given some offers $a_1, a_2, \ldots, a_n$. For each of them, we can choose to either get $x - a_i$ coins, $a_i - x$ coins, or nothing. Maximize the number of coins in the worst case.

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Optimal strategy. Let's color a_i red if we get $x - a_i$ coins.

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Sketch of proof. Use exchange argument. For example, if $y \leq z$, y is white and z is red, then we get $x - z$ coins. If we make y red and z white, we make $x - y$ coins instead.

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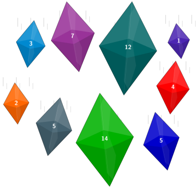
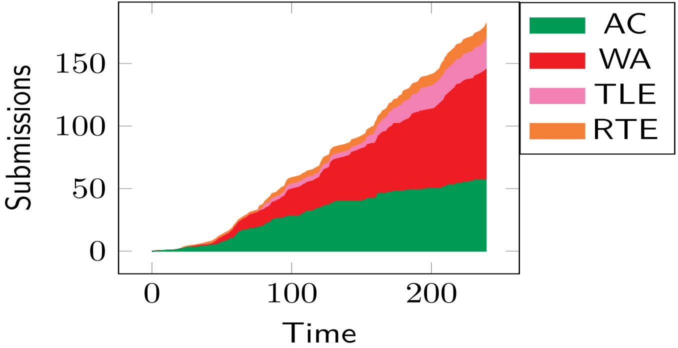
Complexity. $O(n)$ time per test case ($O(n \log n)$ is also possible, for example using ternary search).

J: Jewels Building



Solved by 57 teams before freeze.
First solved after 17 min by TempName.



J: Jewels Building

Statement (summary).

We are given two arrays $a_1, a_2, \ldots, a_n$ and $b_1, b_2, \ldots, b_m$. Determine whether it is possible to turn a into b in a finite number of operations.
Operation: pick a subarray of length $x \geq 1$ containing equal elements, and replace it with x.

J: Jewels Building

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Operation 3

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Can be done using operation 2: $[a_l, a_{l+1}, \ldots, a_r] \to [a_l, a_{l+1}, \ldots, a_{l+y-2}, x - y + 1] \to [y]$.

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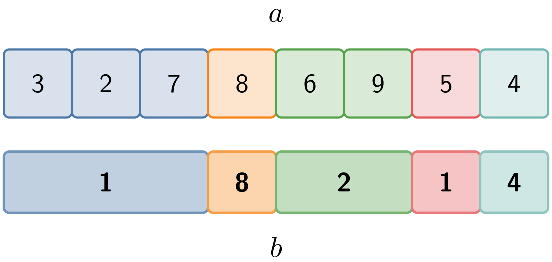

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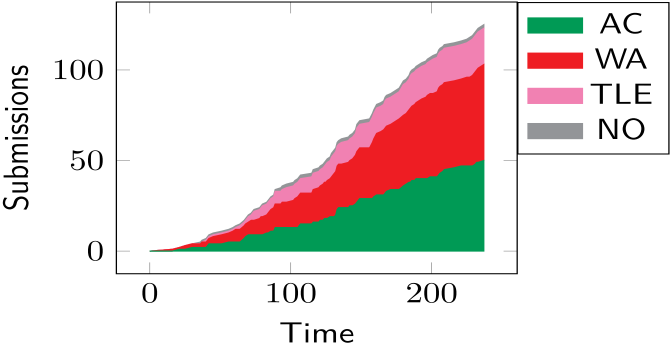
Complexity. $O(nm)$ time per test case.

A: Adjusting Drones

Solved by 50 teams before freeze.
First solved after 21 min by ENS de Lyon 3.



A: Adjusting Drones

Statement (summary).

Given an array, on each operation we increase simultaneously by 1 all the elements which are equal to some previous element. After how many operations every element appears at most k times?

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The order of the elements does not matter. So let's sort the elements in increasing order. Also, we have the freedom to choose the tiebreaker rule (i.e., which elements are increased by 1).

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Assume the process stops when all the elements are distinct. Let's find the configuration $b_1, b_2, \ldots, b_n$ at that point. If some elements are equal, the **rightmost** does not increase.

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A: Adjusting Drones

t	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	3	3	3	4	5	5	6	6	6	6	6	7	7	7	13	13
1	4	4	3	4	6	5	7	7	7	7	6	8	8	7	14	13
2	5	5	3	4	7	5	8	8	8	8	6	9	8	7	14	13
3	6	6	3	4	8	5	9	9	9	9	6	9	8	7	14	13
4	7	7	3	4	9	5	10	10	10	10	6	9	8	7	14	13
5	8	8	3	4	10	5	11	11	11	10	6	9	8	7	14	13
6	9	9	3	4	11	5	12	12	11	10	6	9	8	7	14	13
7	10	10	3	4	12	5	13	12	11	10	6	9	8	7	14	13
8	11	11	3	4	13	5	14	12	11	10	6	9	8	7	14	13
9	12	12	3	4	14	5	15	12	11	10	6	9	8	7	14	13
10	13	13	3	4	15	5	15	12	11	10	6	9	8	7	14	13
11	14	14	3	4	16	5	15	12	11	10	6	9	8	7	14	13
12	15	15	3	4	16	5	15	12	11	10	6	9	8	7	14	13
13	16	16	3	4	16	5	15	12	11	10	6	9	8	7	14	13
14	17	17	3	4	16	5	15	12	11	10	6	9	8	7	14	13
15	18	17	3	4	16	5	15	12	11	10	6	9	8	7	14	13

Binary search.

- The maximum number of occurences of one element does not increase after one operation (if value x appeared $\leq k$ times, it produces $\leq k-1$ copies of $x+1$, and at most one other copy of $x+1$ survives).

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- So we can binary search the answer. Using the process described earlier, we can retrieve the configuration after m moves in $O(n)$.

A: Adjusting Drones

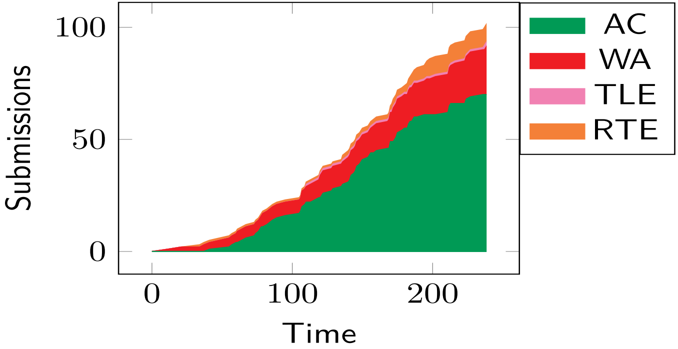
Binary search.

- The maximum number of occurences of one element does not increase after one operation (if value x appeared $\leq k$ times, it produces $\leq k-1$ copies of $x+1$, and at most one other copy of $x+1$ survives).
- So we can binary search the answer. Using the process described earlier, we can retrieve the configuration after m moves in $O(n)$.

Complexity. $O(n \log n)$ time (there also exist “magical” $O(n)$ solutions!)

C: Chamber of Secrets 2

Solved by 70 teams before freeze.
First solved after 41 min by Ctrl+Alt+DelETHe.



Statement (summary).

We have n arrays of length m built as follows:

1. start from a secret key $[p_1, p_2, \ldots, p_{nm/2}]$ (a permutation);
2. concatenate p with itself;
3. split the resulting array into n consecutive blocks, i.e., disjoint subarrays of length m;
4. shuffle these arrays.

Find a possible secret key $[p_1, p_2, \ldots, p_{nm/2}]$.

Case 1: n is even.

- The subarrays in the first half correspond exactly to the subarrays in the second half.

C: Chamber of Secrets 2

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5	6	3	4	1	2	5	6	3	4	1	2

Case 2: n is odd.

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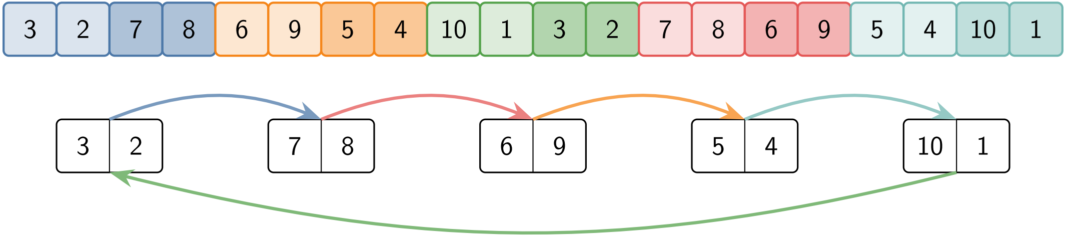

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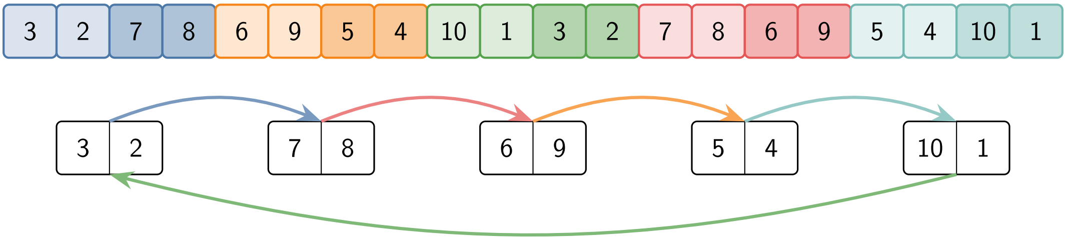
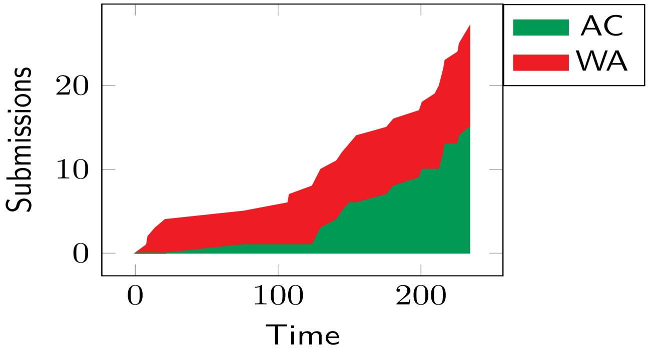


Complexity. $O(nm)$ time per test case.

Solved by 15 teams before freeze.
First solved after 76 min by Team 2.



G: Git Gud

Statement (summary).

We want to make our skill $\geq n$ using a limited amount of robocoins. We can perform operations (y, l) with cost l and additional cost 1000 if y is larger than the previous one. The operation makes our skill $y + l$ if it was exactly y.

G: Git Gud

Checker. As a warm-up, think about how we would write the checker for this problem.

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Use operations $1, 2, \ldots, n - 1$. Unfortunately, they are too "increasing".

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Naive strategy 1.

Use operations $1, 2, \ldots, n - 1$. Unfortunately, they are too "increasing".

Naive strategy 2.

Use operations $n - 1, n - 2, \ldots, 1$. Unfortunately, they are too long.

G: Git Gud

Better strategy.

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The cost is $O(n \log n)$ ($\approx \log_2 n$ layers, $O(n)$ per layer). We use very few “increasing” operations (1 per layer): we can try to use more (and maybe use less layers).

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Generalization.

- Fix our skill modulo 3 using operations $n-2, n-5, n-8, \dots, n-1, n-4, n-7, \dots$

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- Fix our skill modulo 3 using operations $n-2, n-5, n-8, \dots, n-1, n-4, n-7, \dots$
- Fix our skill modulo 9 using operations $n-6, n-18, n-30, \dots, n-3, n-12, n-21, \dots$

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Now we have $\approx \log_3 n$ layers and 2 "increasing" operations per layer.

G: Git Gud

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		26	27
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21		23	24		26	27
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		20	21		23	24		26	27
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		17	18		20	21		23	24		26	27
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1	2	3	4	5	6		8	9		11	12		14	15		17	18		20	21		23	24		26	27
1	2	3		5	6		8	9		11	12		14	15		17	18		20	21		23	24		26	27
	2	3		5	6		8	9		11	12		14	15		17	18		20	21		23	24		26	27
	2	3		5	6		8	9		11	12		14	15		17	18		20	21		23	24			27
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		3			6			9			12			15			18			21			24			27
		3			6			9			12			15			18						24			27
		3			6			9						15			18						24			27
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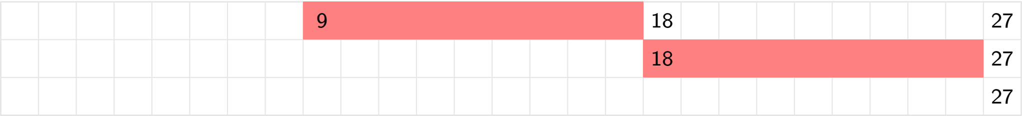
G: Git Gud



G: Git Gud

Generalization.

If we use modulo m, we have $\approx \log_m n$ layers, each with cost $\approx n$, and $m-1$ "increasing" operations per layer, each with cost 1000.

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$$(\log_m n)(n + 1000m) = 3(n + 1000\sqrt[3]{n}) < 4n$$

if $n = 250\,000$.

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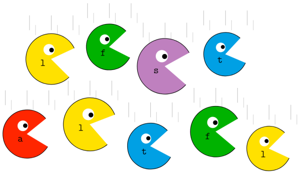
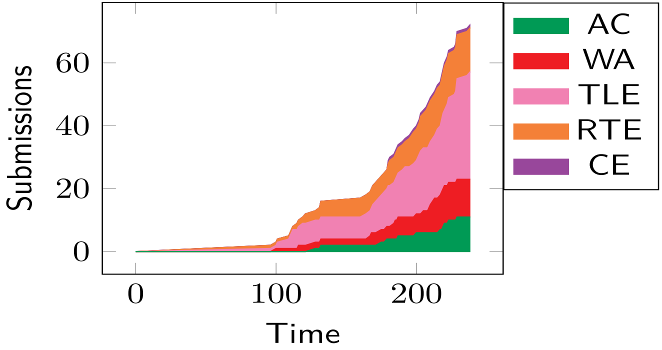
if $n = 250\,000$.
If n is smaller, we can pretend it is $250\,000$.

L: LFS



Solved by 11 teams before freeze.
First solved after 128 min by Northern Spy.



L: LFS

Statement (summary).

Given a string s, answer q queries: what is the maximum length of a substring appearing with maximum frequency in the substring $[l, r]$?

L: LFS

Key observations. Let $\alpha = 26$ (size of the alphabet).

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- A substring which ends with a character c can be extended to the right if and only if $s[r] \neq c$, and every occurrence of c in $[l, r]$ is followed by the same character d.
- Make an edge for every such pair (c, d) of characters. There are $O(\alpha)$ such pairs (for each c, there exists at most one valid d).

Algorithm.

- Switch point from some position i: next position j such that the following character is different (i.e., $s[i] = s[j]$ but $s[i+1] \neq s[j+1]$).

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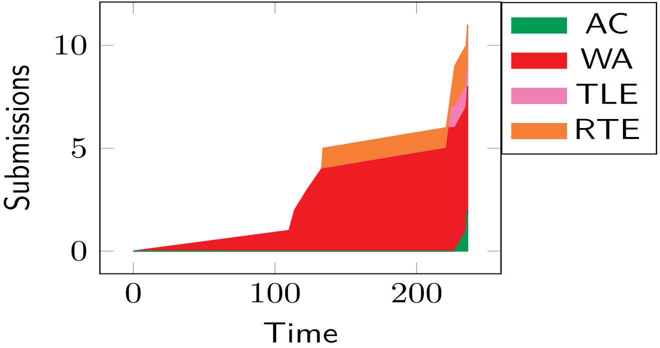
Complexity. $O((n+q)\alpha)$ time (additional $O(\log n)$ factors with low constant are allowed).

I: Isaac's Queries

Solved by 2 teams before freeze.
First solved after 235 min by Segfault go BRRRR.



Statement (summary).

There is a hidden array, generated randomly. For each subarray $[l, r]$, we want to find the most significant bit of $a_l \oplus a_{l+1} \oplus \ldots \oplus a_r$. We can ask the answer for some $[l, r]$, with cost $\frac{1}{r-l+1}$. Find all the answers with limited total cost.

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Let $g(l, r)$ be the answer for the subarray $[l, r]$.

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Saving queries (I).

If $g(l, m) \neq g(m+1, r)$, then $g(l, r) = \max(g(l, m), g(m+1, r))$. Otherwise, we know that $g(l, r) < g(l, m)$.

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We can generalize for m outside $[l, r]$.

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If $x < l$ and $g(x, l-1) \neq g(x, r)$, then $g(l, r) = \max(g(x, l-1), g(x, r))$.

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If $x < l$ and $g(x,l-1) \neq g(x,r)$, then $g(l,r) = \max(g(x,l-1), g(x,r))$.
If $y > l$ and $g(l,y) \neq g(r+1,y)$, then $g(l,r) = \max(g(l,y), g(r+1,y))$.

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Cost of Solution 1.

In order to ask $g(l, r)$, it must be less than $g(1, r), g(2, r), \ldots, g(l-1, r)$. So the probability of asking it is $O(1/l)$. So the average cost is

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In practice, the average cost is ≈ 20.

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Solution 2.

Let's build a trie containing the a_i. Specifically, each node corresponds to a prefix of the binary representation, and contains positions i such that a_i has that prefix. It is not possible to recover the a_i uniquely, but we can set bits to 0 without loss of generality if they do not impact any queries.

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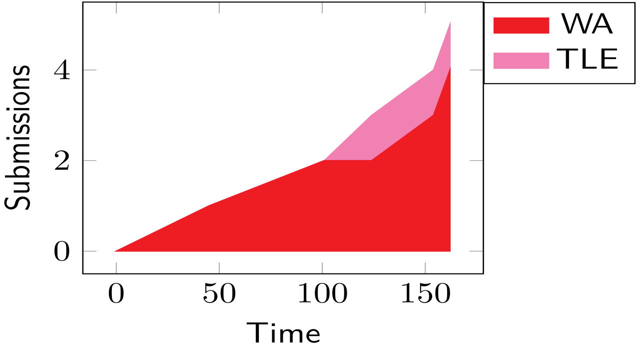
Specifically, suppose that a node contains positions $p_1, p_2, \ldots, p_k$. In order to recurse, we need to ask queries between some pairs. We choose this pairs greedily, by calculating a minimum spanning tree (the edges have cost $\frac{1}{p_j - p_i + 1}$).

Cost of Solution 2.

The same analysis of Solution 1 gives an upper bound. However, this solution is much more efficient (average cost ≈ 9).

H: Hyper Smawk Bros

Not solved before freeze.



Statement (summary).

You and Bob want to make an integer $n \leq 0$. You alternately subtract an integer in $[1, m]$ from n, but it must be different from the one just chosen by the opponent. Given n, m, determine whether you can force a win. Answer multiple test cases.

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Bound on the evil n (I).

Claim: there are $O(N/m)$ evil n. Specifically, let $v_1, v_2, \ldots, v_k$ be the evil $n \le N$. Then, $v_i - v_{i-1} \ge m + 1$ (otherwise you would be able to move from an evil n to another, contradiction).

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Structure of losing positions and solution in $O(t(N+m))$.

If (n, l) is losing, then $(n+l, l')$ with $l' \neq l$ is winning. This means that the number of losing l for a fixed n is either 0, 1, or $m+1$. Let's call n "good", "neutral", and "evil", respectively.

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Even m.

For even m, only the multiples of $m + 1$ are evil. In order to win, you can ensure that the last two moves have sum $m + 1$. Since $m + 1$ is odd, the last move will never be the same as the second last.

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From now, let's only consider odd m.

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Bound on the evil n (II).

Let $v_1, v_2, \ldots, v_k$ be the evil $n \leq N$. Then, $m + 1 \leq v_i - v_{i-1} \leq m + 2$.

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n	losing last moves l (if $m = 9$)
21	[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
22	[1]
23	[]
24	[]
25	[]
26	[5]
27	[6]
28	[]
29	[8]
30	[9]
31	[5]
32	[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
33	[]
34	[2]
35	[3]

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Our goal.

Let $v_1, v_2, \ldots, v_k$ be the evil $n \leq N$. We want to find them in $O(k) = O(N/m)$. In this way, we can solve the problem for all m in $O(\sum_{1 \leq m \leq M} N/m) = O(N \log M)$.

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Finding v_{i+1}.

We have $v_1, v_2, \ldots, v_i$, and we want to find v_{i+1} in $O(1)$. It is enough to check whether $v_i + m + 1$ is evil. It's easier to check whether it is **not** evil, i.e., whether there exists a winning move.

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So the function calls itself $\lesssim 7/8$ times on average. This is fast enough for all m (it can be tested locally).

K: Keygen 3

Not solved before freeze.

K: Keygen 3

Statement (summary).

Print all the bitonic permutations of length n with m cycles. If there are more than 2000 of them, print 2000 of them.

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Minor modification.

For convenience, let's find "anti-bitonic" permutations instead (decreasing, then increasing).

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For convenience, let's find "anti-bitonic" permutations instead (decreasing, then increasing). There is a bijection between bitonic and anti-bitonic permutations.

```
vector<int> f(vector<int> p) {
    int n = p.size();
    reverse(p.begin(), p.end());
    for (auto &u : p) u = n - u + 1;
    return p;
}
```

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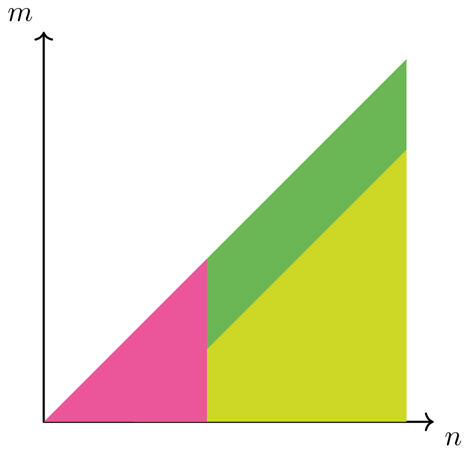

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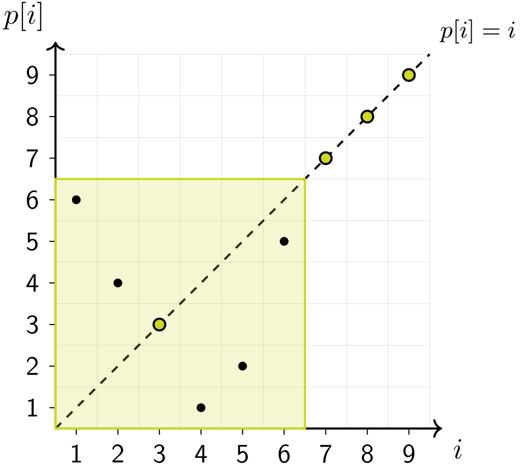
$n \geq 19, n - m \geq 10$.

First, solve $(18, i)$ for $1 \leq i \leq 8$ (for each i, we have ≥ 2000 solutions). Transform these solutions into solutions to (n, m).

K: Keygen 3



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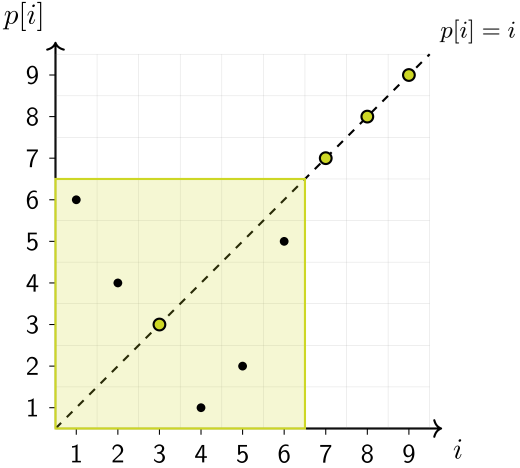

$n \geq 19, n - m \leq 9$.

$p_1, p_2, \ldots, p_n$ must have at least $n - 9$ cycles, so it must have at least $n - 18$ fixed points (i.e., $p_i = i$).

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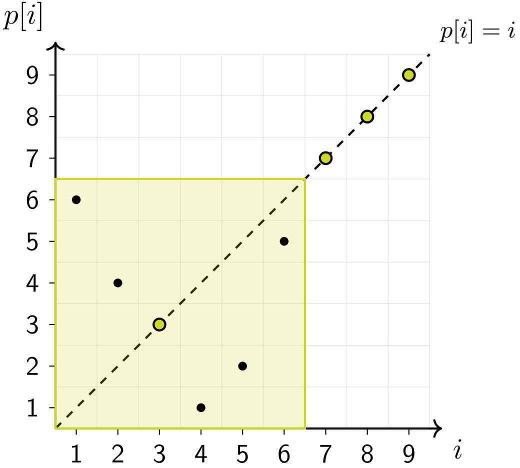

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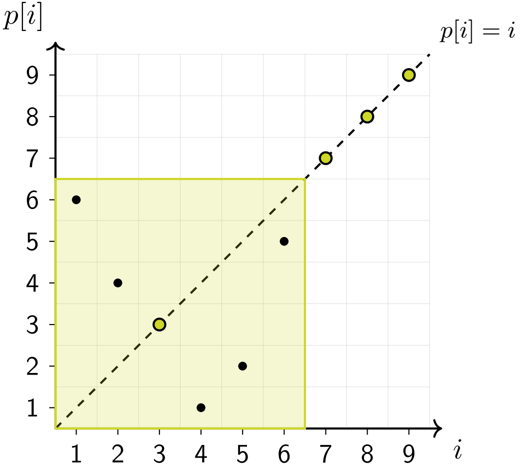

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Therefore, $p_1 \leq 19$, and we can iterate over all such permutations.