UNSW ICPC Workshop T3W2
Hard Problem Set
Source: South Pacific Divisionals and ANZAC rounds (various years)

Discuss the problems in this document and try to solve them with your group. Make sure everyone is comfortable with the solution before moving on.
Ask us if you need help, or want to check your solution.

We recommend doing the problems in the given order (roughly difficulty order), but if you don’t like a problem feel free to skip it.

The first and third problems have links if you wish to code and submit them later icpc.foundation

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Problem D
Dank Invader
Time limit: 20 seconds

D-Unit the Dank Invader has landed on a peculiar planet. This planet has a series of platforms going from left to right of varying heights. D-Unit must visit a sequence of platforms from left to right, with strictly increasing height.

After D-Unit has finished, they look at the set of platforms they visited. If there are no platforms that D-Unit could have added to the visited platforms that would have maintained the strictly increasing requirement, then D-Unit successfully completed a *dank walk*.

For example, if the platforms are of height $[11, 12, 13, 15, 14]$, and D-Unit visited $12, 13, 14$, then this is not a dank walk since they could have also visited the platform of height 11. Similarly, $11, 13, 14$ is not a dank walk because they could have visited the platform of height 12. Visiting $11, 12, 13, 14$ is a dank walk (even though the platform of height 15 is higher than 14, D-Unit's path would not be left to right).

What is the minimum number of platforms that D-Unit can visit among all dank walks?

Input

The first line of input contains a single integer N $(1 \le N \le 10\,000)$, which is the number of platforms.

The second line contains N integers, H_i $(1 \le H_i \le 10^9)$, each denoting the height of the i-th platform.

Output

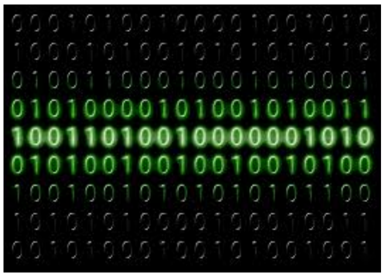
Display the minimum number of platforms that D-Unit can visit among all dank walks.

Sample Input 1	Sample Output 1
3 1 3 2	2

Sample Input 2	Sample Output 2
5 2 5 1 2 3	2

Sample Input 3	Sample Output 3
6 1 2 3 4 2 5	3

Problem D
Bit Counting
Time limit: 2 seconds



Start with an integer, N_0, which is greater than 0. Let N_1 be the number of ones in the binary representation of N_0. So, if $N_0 = 27$ (which is 11011 in binary), then $N_1 = 4$. Similarly, if $N_0 = 5$ (which is 101 in binary), then $N_1 = 2$.

For all $i > 0$, let N_i be the number of ones in the binary representation of N_{i-1}. This sequence will always converge to one. For any starting number, N_0, let K be the minimum value of $i \geq 0$ for which $N_i = 1$. For example, if $N_0 = 31$, then $N_1 = 5$, $N_2 = 2$, $N_3 = 1$, so $K = 3$. Given a range of consecutive numbers, and a value X, how many numbers in the range have a K value equal to X?

Input

This problem contains multiple test cases.

The first line of input starts with an integer T ($1 \leq T \leq 100$), which is the number of test cases to process.

The next T lines describe the test cases. Each test case consists of a single line containing three integers L ($1 \leq L \leq 10^{18}$), H ($L \leq H \leq 10^{18}$) and X ($1 \leq X \leq 10$). L and H are the lower and upper limits of the range of integers in question and X is the target value.

Output

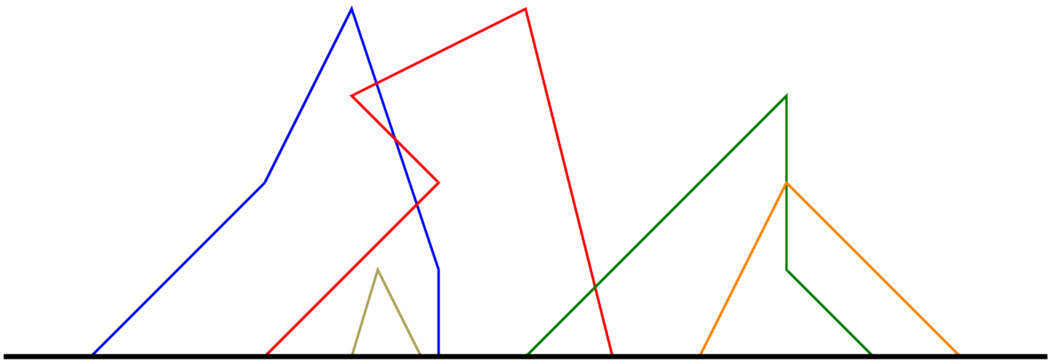
For each test case, display the number of integers in the range from L to H (inclusive) which have a K value equal to X.

Sample Input 1	Sample Output 1
7 31 31 3 31 31 1 27 31 1 27 31 2 1023 1025 0 1023 1025 1 1023 1025 2	1 0 0 3 0 1 1

Problem E
Explosive Wiring
Time limit: 5 seconds

You are trying to design the wiring for a new kind of computer chip. Unfortunately, the wires are made of a strange material that will explode under the wrong conditions. You have a set of wires that you can install on the chip. Each wire has an associated usefulness value.

To simplify things, you may assume that the chip is on the x-axis. Each wire connects two different points on the x-axis and is described by a 2D polyline connecting those two points. A polyline is a sequence of points connected by straight line segments. All wires are above the x-axis except where they touch the chip at their first and last points. In addition, all the x-coordinates of each wire polyline stay within the interval on the x-axis formed by that polyline's first and last points.



Two wires *interfere* if their polylines touch or intersect at one or more points (a wire does not interfere with itself). A set of the wires is *safe* if each wire in the set interferes with exactly one other wire in the set. A set's *utility* is the sum of the wires' usefulness values. Given a set of wires from which to choose, what is the largest utility over all safe subsets of those wires?

Input

The first line of input contains a single integer N ($1 \leq N \leq 150$), which is the number of wires.

The next N lines describe the wires. Each of these lines starts with two integers k ($0 \leq k \leq 100\,000$), which is the usefulness of the wire, and p ($3 \leq p \leq 10$), which is the number of points in the polyline. Following this are p pairs of integers $x_1, y_1, x_2, y_2, \ldots, x_p, y_p$ ($0 \leq x_i, y_i \leq 100\,000$), which denote that this wire's polyline is defined by $(x_1, y_1) - (x_2, y_2) - \cdots - (x_p, y_p)$. It is guaranteed that $x_1 < x_p$ and $x_1 \leq x_i \leq x_p$ for $2 \leq i < p$. Furthermore, $y_1 = y_p = 0$ and $y_i > 0$ for $2 \leq i < p$.

All points in the input are distinct.

Output

Display the largest utility over all safe subsets of the given wires.

Sample Input 1	Sample Output 1
1 1 3 0 0 1 1 2 0	0

Sample Input 2

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5
1 3 0 0 50 50 100 0
1 3 45 0 50 40 110 0
1 3 10 0 20 10 30 0
1 3 20 0 30 10 40 0
1 3 35 0 45 10 50 0
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Sample Output 2

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4
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Sample Input 3

```
5
1 3 0 0 50 50 100 0
1 3 45 0 50 40 110 0
1 3 10 0 20 10 30 0
1 3 20 0 30 10 40 0
10 3 35 0 45 10 50 0
```

Sample Output 3

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11
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