CodeForces Problem

June 20, 2023

A. Sasha and Array Coloring

Constriants

Time Limit 1 seconds **Memory Limit** 256 MB

Problem Statement

Sasha found an array a consisting of n integers and asked you to paint elements.

You have to paint each element of the array. You can use as many colors as you want, but each element should be painted into exactly one color, and for each color, there should be at least one element of that color.

The cost of one color is the value of $\max(S) - \min(S)$, where S is the sequence of elements of that color. The cost of the whole coloring is the sum of costs over all colors.

For example, suppose you have an array $a = [1, 5, 6, 3, 4]$, and you painted its elements into two colors as follows: elements on positions 1, 2 and 5 have color 1; elements on positions 3 and 4 have color 2. Then: the cost of the color 1 is $\max([1, 5, 4]) - \min([1, 5, 4]) = 5 - 1 = 4$; the cost of the color 2 is $\max([6, 3]) - \min([6, 3]) = 6 - 3 = 3$; the total cost of the coloring is 7.

For the given array a, you have to calculate the maximum possible cost of the coloring.

Input Description

The first line contains one integer t ($1 \leq t \leq 1000$) — the number of test cases.

The first line of each test case contains a single integer n ($1 \leq n \leq 50$) — length of a.

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($1 \leq a_i \leq 50$) — array a.

Output Description :

For each test case output the maximum possible cost of the coloring.

Examples

```
Input
6
5
1 5 6 3 4
1
5
4
1 6 3 9
6
1 13 9 3 7 2
4
2 2 2 2
5
4 5 2 2 3
Output
7
0
11
23
0
5
```

Note

In the first example one of the optimal coloring is $[1, 5, 6, 3, 4]$. The answer is $(5 - 1) + (6 - 3) = 7$.
In the second example, the only possible coloring is $[5]$, for which the answer is $5 - 5 = 0$.
In the third example, the optimal coloring is $[1, 6, 3, 9]$, the answer is $(9 - 1) + (6 - 3) = 11$.

B. Long Long

Constriants

Time Limit 2 seconds **Memory Limit** 256 MB

Problem Statement

Today Alex was brought array $a_1, a_2, \ldots, a_n$ of length n. He can apply as many operations as he wants (including zero operations) to change the array elements.

In 1 operation Alex can choose any l and r such that $1 \le l \le r \le n$, and multiply all elements of the array from l to r inclusive by -1. In other words, Alex can replace the subarray $[a_l, a_{l+1}, \ldots, a_r]$ by $[-a_l, -a_{l+1}, \ldots, -a_r]$ in 1 operation.

For example, let $n = 5$, the array is $[1, -2, 0, 3, -1]$, $l = 2$ and $r = 4$, then after the operation the array will be $[1, 2, 0, -3, -1]$.

Alex is late for school, so you should help him find the maximum possible sum of numbers in the array, which can be obtained by making any number of operations, as well as the minimum number of operations that must be done for this.

Input Description

The first line contains a single integer t ($1 \le t \le 10^4$) — number of test cases. Then the descriptions of the test cases follow.

The first line of each test case contains one integer n ($1 \le n \le 2 \cdot 10^5$) — length of the array.

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($-10^9 \le a_i \le 10^9$) — elements of the array.

It is guaranteed that the sum of n for all test cases does not exceed $2 \cdot 10^5$.

Output Description :

For each test case output two space-separated numbers: the maximum possible sum of numbers in the array and the minimum number of operations to get this sum.

Pay attention that an answer may not fit in a standard integer type, so do not forget to use 64-bit integer type.

Examples

Input

```
5
6
-1 7 -4 -2 5 -8
8
-1 0 0 -2 1 0 -3 0
5
2 -1 0 -3 -7
5
0 -17 0 1 0
4
-1 0 -2 -1
```

Output

```
27 3
7 2
13 1
18 1
4 1
```

Note

Below, for each test case, only one of the possible shortest sequences of operations is provided among many. There are others that have the same length and lead to the maximum sum of elements.
In the first test case, Alex can make operations: $(1, 4)$, $(2, 2)$, $(6, 6)$.
In the second test case, to get the largest sum you need to make operations: $(1, 8)$, $(5, 6)$.
In the fourth test case, it is necessary to make only one operation: $(2, 3)$.

C. Sum in Binary Tree

Constriants

Time Limit 1 seconds **Memory Limit** 256 MB

Problem Statement

Vanya really likes math. One day when he was solving another math problem, he came up with an interesting tree. This tree is built as follows.

Initially, the tree has only one vertex with the number 1 — the root of the tree. Then, Vanya adds two children to it, assigning them consecutive numbers — 2 and 3, respectively. After that, he will add children to the vertices in increasing order of their numbers, starting from 2, assigning their children the minimum unused indices. As a result, Vanya will have an infinite tree with the root in the vertex 1, where each vertex will have exactly two children, and the vertex numbers will be arranged sequentially by layers. Part of Vanya's tree.

Vanya wondered what the sum of the vertex numbers on the path from the vertex with number 1 to the vertex with number n in such a tree is equal to. Since Vanya doesn't like counting, he asked you to help him find this sum.

Input Description

The first line contains a single integer t ($1 \leq t \leq 10^4$) — the number of test cases.

This is followed by t lines — the description of the test cases. Each line contains one integer n ($1 \leq n \leq 10^{16}$) — the number of vertex for which Vanya wants to count the sum of vertex numbers on the path from the root to that vertex.

Output Description :

For each test case, print one integer — the desired sum.

Examples

Input
```
6
3
10
37
1
10000000000000000
15
```
Output
```
4
18
71
1
19999999999999980
26
```

Note

In the first test case of example on the path from the root to the vertex 3 there are two vertices 1 and 3, their sum equals 4.

In the second test case of example on the path from the root to the vertex with number 10 there are vertices 1, 2, 5, 10, sum of their numbers equals $1 + 2 + 5 + 10 = 18$.

D. Apple Tree

Constriants

Time Limit 4 seconds **Memory Limit** 512 MB

Problem Statement

Timofey has an apple tree growing in his garden; it is a rooted tree of n vertices with the root in vertex 1 (the vertices are numbered from 1 to n). A tree is a connected graph without loops and multiple edges.

This tree is very unusual — it grows with its root upwards. However, it's quite normal for programmer's trees.

The apple tree is quite young, so only two apples will grow on it. Apples will grow in certain vertices (these vertices may be the same). After the apples grow, Timofey starts shaking the apple tree until the apples fall. Each time Timofey shakes the apple tree, the following happens to each of the apples:

Let the apple now be at vertex u. If a vertex u has a child, the apple moves to it (if there are several such vertices, the apple can move to any of them). Otherwise, the apple falls from the tree.

It can be shown that after a finite time, both apples will fall from the tree.

Timofey has q assumptions in which vertices apples can grow. He assumes that apples can grow in vertices x and y, and wants to know the number of pairs of vertices (a, b) from which apples can fall from the tree, where a — the vertex from which an apple from vertex x will fall, b — the vertex from which an apple from vertex y will fall. Help him do this.

Input Description

The first line contains integer t ($1 \leq t \leq 10^4$) — the number of test cases.

The first line of each test case contains integer n ($2 \leq n \leq 2 \cdot 10^5$) — the number of vertices in the tree.

Then there are $n - 1$ lines describing the tree. In line i there are two integers u_i and v_i ($1 \leq u_i, v_i \leq n$, $u_i \neq v_i$) — edge in tree.

The next line contains a single integer q ($1 \leq q \leq 2 \cdot 10^5$) — the number of Timofey's assumptions.

Each of the next q lines contains two integers x_i and y_i ($1 \leq x_i, y_i \leq n$) — the supposed vertices on which the apples will grow for the assumption i.

It is guaranteed that the sum of n does not exceed $2 \cdot 10^5$. Similarly, It is guaranteed that the sum of q does not exceed $2 \cdot 10^5$.

Output Description :

For each Timofey's assumption output the number of ordered pairs of vertices from which apples can fall from the tree if the assumption is true on a separate line.

Examples

```
Input
2
5
1 2
3 4
5 3
3 2
4
3 4
5 1
4 4
1 3
3
1 2
1 3
3
1 1
2 3
3 1
Output
2
2
1
4
4
1
2
```

```
Input
2
5
5 1
1 2
2 3
4 3
2
5 5
5 1
5
3 2
5 3
2 1
4 2
3
4 3
2 1
4 2
Output
1
2
1
4
2
```

Note

In the first example: For the first assumption, there are two possible pairs of vertices from which apples can fall from the tree: $(4,4),(5,4)$. For the second assumption there are also two pairs: $(5,4),(5,5)$. For the third assumption there is only one pair: $(4,4)$. For the fourth assumption,

there are 4 pairs: $(4,4),(4,5),(5,4),(5,5)$. Tree from the first example.
For the second example, there are 4 of possible pairs of vertices from which apples can fall: $(2,3),(2,2),(3,2),(3,3)$. For the second assumption, there is only one possible pair: $(2,3)$. For the third assumption, there are two pairs: $(3,2),(3,3)$.

E. Tracking Segments

Constriants

Time Limit 2 seconds **Memory Limit** 256 MB

Problem Statement

You are given an array a consisting of n zeros. You are also given a set of m not necessarily different segments. Each segment is defined by two numbers l_i and r_i ($1 \le l_i \le r_i \le n$) and represents a subarray $a_{l_i}, a_{l_i+1}, \ldots, a_{r_i}$ of the array a.

Let's call the segment l_i, r_i beautiful if the number of ones on this segment is strictly greater than the number of zeros. For example, if $a = [1, 0, 1, 0, 1]$, then the segment $[1, 5]$ is beautiful (the number of ones is 3, the number of zeros is 2), but the segment $[3, 4]$ is not is beautiful (the number of ones is 1, the number of zeros is 1).

You also have q changes. For each change you are given the number $1 \le x \le n$, which means that you must assign an element a_x the value 1.

You have to find the first change after which at least one of m given segments becomes beautiful, or report that none of them is beautiful after processing all q changes.

Input Description

The first line contains a single integer t ($1 \le t \le 10^4$) — the number of test cases.

The first line of each test case contains two integers n and m ($1 \le m \le n \le 10^5$) — the size of the array a and the number of segments, respectively.

Then there are m lines consisting of two numbers l_i and r_i ($1 \le l_i \le r_i \le n$) —the boundaries of the segments.

The next line contains an integer q ($1 \le q \le n$) — the number of changes.

The following q lines each contain a single integer x ($1 \le x \le n$) — the index of the array element that needs to be set to 1. It is guaranteed that indexes in queries are distinct.

It is guaranteed that the sum of n for all test cases does not exceed 10^5.

Output Description :

For each test case, output one integer — the minimum change number after which at least one of the segments will be beautiful, or -1 if none of the segments will be beautiful.

Examples

Input

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

Output

```
3
-1
3
3
3
1
```

Note

In the first case, after first 2 changes we won't have any beautiful segments, but after the third one on a segment $[1; 5]$ there will be 3 ones and only 2 zeros, so the answer is 3.
In the second case, there won't be any beautiful segments.

F1. Omsk Metro (simple version)

Constriants

Time Limit 2 seconds **Memory Limit** 512 MB

Problem Statement

This is the simple version of the problem. The only difference between the simple and hard versions is that in this version $u = 1$.

As is known, Omsk is the capital of Berland. Like any capital, Omsk has a well-developed metro system. The Omsk metro consists of a certain number of stations connected by tunnels, and between any two stations there is exactly one path that passes through each of the tunnels no more than once. In other words, the metro is a tree.

To develop the metro and attract residents, the following system is used in Omsk. Each station has its own weight $x \in \{-1, 1\}$. If the station has a weight of -1, then when the station is visited by an Omsk resident, a fee of 1 burle is charged. If the weight of the station is 1, then the Omsk resident is rewarded with 1 burle.

Omsk Metro currently has only one station with number 1 and weight $x = 1$. Every day, one of the following events occurs: A new station with weight x is added to the station with number v_i, and it is assigned a number that is one greater than the number of existing stations. Alex, who lives in Omsk, wonders: is there a subsegment (possibly empty) of the path between vertices u and v such that, by traveling along it, exactly k burles can be earned (if $k <; 0$, this means that k burles will have to be spent on travel). In other words, Alex is interested in whether there is such a subsegment of the path that the sum of the weights of the vertices in it is equal to k. Note that the subsegment can be empty, and then the sum is equal to 0.

You are a friend of Alex, so your task is to answer Alex's questions.

Input Description

The first line contains a single number t ($1 \leq t \leq 10^4$) — the number of test cases.

The first line of each test case contains the number n ($1 \leq n \leq 2 \cdot 10^5$) — the number of events.

Then there are n lines describing the events. In the i-th line, one of the following options is possible: First comes the symbol "+" (without quotes), then two numbers v_i and x_i ($x_i \in \{-1, 1\}$, it is also guaranteed that the vertex with number v_i exists). In this case, a new station with weight x_i is added to the station with number v_i. First comes the symbol "?" (without quotes), and then three numbers u_i, v_i, and k_i ($-n \leq k_i \leq n$). It is guaranteed that the vertices with numbers u_i and v_i exist. In this case, it is necessary to determine whether there is a subsegment (possibly empty) of the path between stations u_i and v_i with a sum of weights exactly equal to k_i. In this version of the task, it is guaranteed that $u_i = 1$.

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^5$.

Output Description :

For each of Alex's questions, output "Yes" (without quotes) if the subsegment described in the condition exists, otherwise output "No" (without quotes).

You can output the answer in any case (for example, the strings "yEs", "yes", "Yes" and "YES" will be recognized as a positive answer).

Examples

Input 1 8 + 1 -1 ? 1 1 2 ? 1 2 1 + 1 1 ? 1 3 -1 ? 1 1 1 ? 1 3 2 ? 1 1 0 **Output** NO YES NO YES YES YES
Input 1 10 + 1 -1 + 1 -1 + 3 1 + 3 -1 + 3 1 ? 1 6 -1 ? 1 6 2 ? 1 2 0 ? 1 5 -2 ? 1 4 3 **Output** YES NO YES YES NO

F2. Omsk Metro (hard version)

Constriants

Time Limit 2 seconds **Memory Limit** 512 MB

Problem Statement

This is the hard version of the problem. The only difference between the simple and hard versions is that in this version u can take any possible value.

As is known, Omsk is the capital of Berland. Like any capital, Omsk has a well-developed metro system. The Omsk metro consists of a certain number of stations connected by tunnels, and between any two stations there is exactly one path that passes through each of the tunnels no more than once. In other words, the metro is a tree.

To develop the metro and attract residents, the following system is used in Omsk. Each station has its own weight $x \in \{-1, 1\}$. If the station has a weight of -1, then when the station is visited by an Omsk resident, a fee of 1 burle is charged. If the weight of the station is 1, then the Omsk resident is rewarded with 1 burle.

Omsk Metro currently has only one station with number 1 and weight $x = 1$. Every day, one of the following events occurs: A new station with weight x is added to the station with number v_i, and it is assigned a number that is one greater than the number of existing stations. Alex, who lives in Omsk, wonders: is there a subsegment (possibly empty) of the path between vertices u and v such that, by traveling along it, exactly k burles can be earned (if $k <; 0$, this means that k burles will have to be spent on travel). In other words, Alex is interested in whether there is such a subsegment of the path that the sum of the weights of the vertices in it is equal to k. Note that the subsegment can be empty, and then the sum is equal to 0.

You are a friend of Alex, so your task is to answer Alex's questions.

Input Description

The first line contains a single number t ($1 \leq t \leq 10^4$) — the number of test cases.

The first line of each test case contains the number n ($1 \leq n \leq 2 \cdot 10^5$) — the number of events.

Then there are n lines describing the events. In the i-th line, one of the following options is possible: First comes the symbol "+" (without quotes), then two numbers v_i and x_i ($x_i \in \{-1, 1\}$, it is also guaranteed that the vertex with number v_i exists). In this case, a new station with weight x_i is added to the station with number v_i. First comes the symbol "?" (without quotes), and then three numbers u_i, v_i, and k_i ($-n \leq k_i \leq n$). It is guaranteed that the vertices with numbers u_i and v_i exist. In this case, it is necessary to determine whether there is a subsegment (possibly empty) of the path between stations u_i and v_i with a sum of weights exactly equal to k_i.

It is guaranteed that the sum of n over all test cases does not exceed $2 \cdot 10^5$.

Output Description :

For each of Alex's questions, output "Yes" (without quotes) if the subsegment described in the condition exists, otherwise output "No" (without quotes).

You can output the answer in any case (for example, the strings "yEs", "yes", "Yes" and "YES" will be recognized as a positive answer).

Examples

Input
```
1
8
+ 1 -1
? 1 1 2
? 1 2 1
+ 1 1
? 1 3 -1
? 1 1 1
? 1 3 2
? 1 1 0
```
Output
```
NO
YES
NO
YES
YES
YES
```

Input
```
1
7
+ 1 -1
+ 2 -1
+ 2 1
+ 3 -1
? 5 2 2
? 3 1 -1
? 5 4 -3
```
Output
```
NO
YES
YES
```