



USACO 2015 FEBRUARY CONTEST, GOLD PROBLEM 3. FENCING THE HERD

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English (en)

Farmer John needs your help deciding where to build a fence in the shape of a straight line to help restrict the movement of his cows. He has considered several possible fence locations and needs your help to determine which of these are usable, where a fence is considered usable if all of the cows are on the same side of the fence. A fence is not usable if there is a cow that lies directly on it. FJ will be asking you a number of queries regarding possible fence locations; a query should be answered "YES" if it corresponds to a usable fence location, "NO" otherwise.

Additionally, FJ may occasionally bring new cows into the herd. When a new cow joins the herd, all fence queries from that point onward will require her to be on the same side of a fence as the rest of the herd for the fence to be usable.

INPUT FORMAT: (file `fencing.in`)

The first line of input contains N ($1 \leq N \leq 100,000$) and Q ($1 \leq Q \leq 100,000$) separated by a space. These give the number of cows initially in the herd and the number of queries, respectively.

The following N lines describe the initial state of the herd. Each line will contain two space separated integers x and y giving the position of a cow.

The remaining Q lines contain queries either adding a new cow to the herd or testing a fence for usability. A line of the form " $1 x y$ " means that a new cow has been added to the herd at position (x, y) . A line of the form " $2 A B C$ " indicates that FJ would like to test a fence described by the line $Ax + By = C$.

All cow positions will be unique over the whole data set and will satisfy $(-10^9 \leq x, y \leq 10^9)$. Additionally the fence queries will satisfy $-10^9 \leq A, B \leq 10^9$ and $-10^{18} \leq C \leq 10^{18}$. No fence query will have $A = B = 0$.

OUTPUT FORMAT: (file `fencing.out`)

For each fence query, output "YES" if the fence is usable. Otherwise output "NO".

SAMPLE INPUT:

```
3 4
0 0
0 1
1 0
2 2 2 3
1 1 1
2 2 2 3
2 0 1 1
```

SAMPLE OUTPUT:

```
YES
NO
NO
```

The line $2x + 2y = 3$ leaves the initial 3 cows on the same side. However the cow $(1, 1)$ is on the other side of this fence making it no longer usable after she joins the herd. The line $Y = 1$ cannot be used because the cows $(0, 1)$ and $(1, 1)$ lie directly on it.

Warning: The I/O for this problem is fairly large. C++ users may consider using `scanf` or the line `"ios_base::sync_with_stdio(false)"` to read input faster. Java users should avoid using `java.util.Scanner`. Do not flush output (e.g. using `std::endl`) after each query.

[Problem credits: Richard Peng, 2015]

Contest has ended. No further submissions allowed.

