CCC 2013 Stage 2
Day 2, Problem 1: A Romantic Movie Outing

Problem Description

Brian the Computer Science Nerd is going on a date with his girlfriend, Anatevka! His romantic location of choice is a movie theatre - but not an IMAX theatre, of course, as that would be far too expensive.

This theatre has 10^9 rows of 1000 seats each, which are initially empty. The rows are numbered $1..10^9$ starting from the one closest to the screen, and the seats in each row are numbered $1..1000$ from left to right. Seat c in row r is denoted as seat (r,c). Seats in rows $1..L$ ($1 \leq L \leq 1000$) are considered to be "close" to the screen, while seats in further rows are considered to be "far".

Over the course of T ($1 \leq T \leq 500\ 000$) minutes before the movie starts, a number of events occur. During the ith minute, either a person enters and sits in the empty seat (R_i,C_i), the person sitting in the occupied seat (R_i,C_i) leaves, or Anatevka suggests that she and Brian take seats (R_i,C_i) and (R_i,$C_i + 1$). The type of the ith event is represented by the character E_i, with $E_i =$ "E" indicating a person entering, $E_i =$ "L" indicating a person leaving, and $E_i =$ "S" indicating a seating suggestion. All seats involved in the events are valid seats inside the theatre, and every seat that Anatevka suggests will be "close", as she believes that they're the best.

Every time Anatevka makes a suggestion, Brian must, of course, analyze its quality. If either of the two seats she suggests is already occupied, he should explain that her recommendation is invalid with a simple "No". Otherwise, he'd like to calculate the total inconvenience of both seats in such an arrangement. The inconvenience of sitting in seat (r,c) is the number of occupied seats in its field of vision (excluding itself). The field of vision of seat (r,c) includes all seats which are no further than it from seat (1,c) by Manhattan distance (i.e., Manhattan distance between (x_1, y_1) and (x_2, y_2) is $|x_1 - x_2| + |y_1 - y_2|$), as shown below (with the "S" representing a suggested seat, and an "F" representing a seat within its field of vision):

			S			
		F	F	F		
	F	F	F	F	F	
F	F	F	F	F	F	F

After all of the events have taken place, the movie is about to start, and a final decision must be made on where to sit - and Brian will handle that. He concludes that seats that are "far" are clearly superior (as they offer a broader view of the screen), and he knows that the point of going to the movies is to have an optimal viewing experience, so selecting two adjacent seats is certainly not

mandatory. As such, he'd like to determine the minimum total inconvenience for any two "far", unoccupied seats in the theatre. Note that, if one of the chosen seats is in the other's field of vision, this does not count towards its inconvenience - it's only determined by other people sitting in the theatre.

Input Specification
The first line of input contains two integers, L ($1 \leq L \leq 1000$) and T ($1 \leq T \leq 500000$).

The next T lines each contain one character, E_i ($E_i \in \{\mathrm{E}, \mathrm{L}, \mathrm{S}\}$), and two integers, R_i and C_i, for $i = 1..T$ ($1 \leq R_i \leq 1\ 000\ 000\ 000$; $1 \leq C_i \leq 1000$).

For test cases worth 20% of the points, you may assume $L \leq 100$ and $T \leq 400$.

For test cases worth 60% of the points, you may assume $L \leq 500$ and $T \leq 50000$.

Output Specification
For each of Anatevka's suggestions (i.e., when $E_i = \mathrm{S}$ in the input), output the string `No` if the suggestion is invalid; otherwise, output the total inconvenience of the two suggested seats.

The last line of output should contain the minimum total inconvenience of any pair of "far", unoccupied seats.

Sample Input
```
3 7
E 1 2
E 2 5
S 3 4
E 2 3
L 2 5
S 1 3
S 2 2
```

Output for Sample Input
```
3
0
No
0
```

Explanation of Output for Sample Input
When Anatevka makes her first suggestion, the front 3 rows and leftmost 5 columns of the theatre look as follows (where a "P" represents a person, and an "S" represents one of the suggested seats):

			S	S
				P
	P			

The person sitting in seat (1,2) is in the field of vision of both suggested seats, while the person sitting in seat (2,5) is only in the way of the right one. As such, the total inconvenience of the two seats is $1 + 2 = 3$.

The second suggestion is shown below:

		P		
	P	S	S	

These two seats aren't obstructed by any people, so their total inconvenience is 0. The final suggestion is invalid, as one of its two seats (seat (2,3)) is already occupied.

Finally, Brian can easily select two "far" which each have inconvenience 0, as the theatre has $10^9 - 3$ "far" rows with 1000 seats each, and most are far from the two people setting in the theatre after the last event. For example, he might choose to take seat (4,6), while recommending that Anatevka enjoy the view from seat (100,1000).

QOJ adaptation notes

Official-answer correction

The archived answer for movie.12-2.in gives 96660 on its final line. This QOJ edition corrects that line to 96659; all earlier answers in the file are unchanged.

At the end of the test, seats (1003, 1000) and (1003, 999) are both empty and are far seats (L = 1000). Their inconveniences are 48285 and 48374, respectively, giving a total of 96659. An independent direct enumeration of the candidate seats and all final occupied seats confirms this minimum.

For each column, only the first two empty far seats need to be considered: inconvenience cannot decrease as the row number increases, because its field of vision only grows. This gives 2000 candidate seats. The two smallest inconvenience values give the optimal pair; the statement explicitly excludes the two chosen people from each other's inconvenience.

Scoring and limits

The 25-point scale and missing batch weights are reconstructed for QOJ. Original numbered batches and the stated 20% and 60% restriction guarantees are preserved. Full details are in the downloadable QOJ-notes.md file. Judging limits are 5 seconds and 512 MiB.

The preceding three pages are the unmodified original statement. The original-only PDF is also provided as a download.