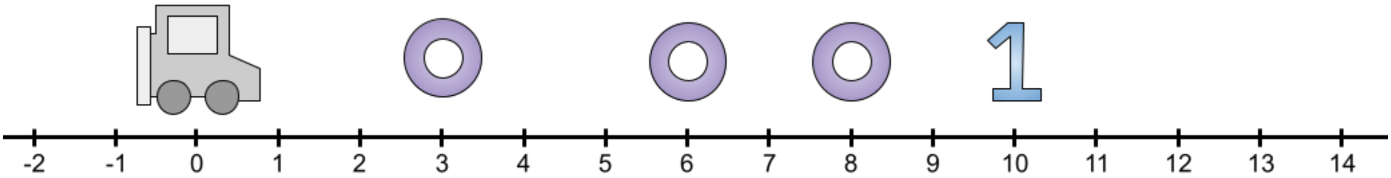
Code Jam 2022 - Round 2

I, O Bot

Problem

To welcome attendees to a developers' conference on Jupiter's moon of Io, the organizers inflated many giant beach balls. Each ball is in roughly the shape of either a 1 or a 0, since those look sort of like the letters I and O. The conference just ended, and so now the beach balls need to be cleaned up. Luckily, the beach ball cleanup robot, BALL-E, is on the job!

The conference was held on an infinite horizontal line, with station 0 in the middle, stations $1, 2, \ldots$ to the right, and stations $-1, -2, \ldots$ to the left. Station 0 contains the conference's only beach ball storage warehouse. Each other station contains at most one beach ball.



BALL-E has two storage compartments, each of which can hold a single beach ball. One compartment can only hold 1-shaped balls and the other can only hold 0-shaped balls. (The 1-shaped balls are more oblong than the 0-shaped balls, so neither shape of ball will fit in the other shape's compartment.)

BALL-E initially has both the 0 and 1 compartments empty, and it starts off at station 0. The robot can do the following things:

- Move left one station or right one station. This costs 1 unit of power.
- If there is a ball at the current station, and BALL-E is not already storing a ball of that shape, it can put the ball in the appropriate compartment. This takes 0 units of power.
- If there is a ball at the current station, BALL-E can compress it so that its shape becomes the other shape. That is, a 1-shaped ball becomes a 0-shaped ball, or vice versa. It takes $\mathbf{C}$ units of power to do this. Note that BALL-E may not change the shape of a ball that it has already put into one of its compartments.
- If BALL-E is at station 0 and is storing at least one ball, it can deposit all balls from its compartment(s) into the beach ball storage warehouse. This takes 0 units of power and leaves both compartments empty.

Notice that if BALL-E moves to a station and there is a ball there, BALL-E is not required to pick it up immediately, even if the robot has an open compartment for it. Also, if BALL-E moves to the station with the warehouse, it is not required to deposit any balls it has.

Find the minimum number of units of power needed for BALL-E to transfer all of the balls to the warehouse, using only the moves described above.

Input

The first line of the input gives the number of test cases, $\mathbf{T}$. $\mathbf{T}$ test cases follow.
The first line of each test case contains two integers, $\mathbf{N}$ and $\mathbf{C}$: the number of balls and the amount of power units needed to change the shape of a ball, respectively.
The next $\mathbf{N}$ lines describe the positions (i.e., station numbers) and the shapes of the balls. The i-th line contains two integers, $\mathbf{X_i}$ and $\mathbf{S_i}$: the position and the shape of the i-th ball, respectively.

Output

For each test case, output one line containing `Case #`x`: `y, where x is the test case number (starting from 1) and y is the *minimum* number of units of power needed to transfer all of the balls to the warehouse, as described above.

Limits

Time limit: 40 seconds.
Memory limit: 1 GB.
$1 \leq \mathbf{T} \leq 100$.
$0 \leq \mathbf{S_i} \leq 1$, for all i.
$-10^9 \leq \mathbf{X_i} \leq 10^9$, for all i.
$0 \leq \mathbf{C} \leq 10^9$.
$\mathbf{X_i} \neq 0$, for all i.
All $\mathbf{X_i}$ are distinct.

Test Set 1 (Visible Verdict)

For at most 15 cases:
$1 \leq \mathbf{N} \leq 5000$.
For the remaining cases:
$1 \leq \mathbf{N} \leq 100$.

Test Set 2 (Hidden Verdict)

For at most 15 cases:
$1 \leq \mathbf{N} \leq 10^5$.
For the remaining cases:
$1 \leq \mathbf{N} \leq 5000$.

Sample

Sample Input	Sample Output

Sample Input

```
4
5 0
3 0
6 0
8 0
10 1
15 1
5 10
3 0
6 0
8 0
10 1
15 1
5 1
3 0
6 0
8 0
10 1
15 1
2 0
1000000000 0
-1000000000 1
```

Sample Output

```
Case #1: 52
Case #2: 56
Case #3: 54
Case #4: 4000000000
```

In Sample Case #1 (illustrated in the statement), there are $\mathbf{N} = 5$ balls and $\mathbf{C} = 0$. One optimal strategy is to make three round trips from (and back to) the warehouse:

- First round trip: Move to station 3, pick up the 0 ball there and store it in the 0 compartment, move back to station 0, and deposit the ball in the warehouse. This takes 6 units of power.
- Second round trip: Move to station 8, pick up the 0 ball there, and store it in the 0 compartment. Move to station 6, change the 0 ball there into a 1 ball, and pick it up and store it in the 1 compartment. Move to station 0 and deposit both balls in the warehouse. This takes 16 units of power. (Recall that in this case, it takes 0 units of power to change a ball's shape.)
- Third round trip: Move to station 10. Change the 1 ball there into a 0 ball, and pick it up and store it in the 0 compartment. Move to station 15. Pick up the 1 ball there and store it in the 1 compartment. Move to station 0 and deposit both balls in the warehouse. This takes 30 units of power.

The total number of units of power needed to collect all the balls is 52.

Sample Case #2 is like Sample Case #1, but now with $\mathbf{C} = 10$. Now BALL-E has to use at least 56 units of power:

- First round trip: Get the ball from station 3. This takes 6 units of power.
- Second round trip: Get the differently-shaped balls from stations 6 and 10. (These are a 0 and a 1, respectively, so there is no need to change the shape of either of them.) This takes 20 units of power.
- Third round trip: Get the differently-shaped balls from stations 8 and 15. This takes 30 units of power.

Sample Case #3 is also like Sample Case #1, but now with $\mathbf{C} = 1$. Here, BALL-E needs at least 54 units of power:

- First round trip: Get the ball from station 3. This takes 6 units of power.
- Second round trip: Get the ball from station 8. When passing through station 6 on the way back, change the shape of the ball there and get it. This takes 17 units of power.
- Third round trip: Do the same with the balls at stations 15 and 10. This takes 31 units of power.

In Sample Case #4, one optimal strategy is for BALL-E to move to station -1000000000, get the 1 ball there, move to station 1000000000, get the 0 ball there, and then return to station 0 to deposit both of them.