Problem 1: Bovine Ballet

In an attempt to challenge the stereotypical perception of cows as awkward creatures, Farmer John's prize cow Bessie has signed up for an introductory ballet class. Her final performance is next week, and FJ wants to help her by building a rectangular stage large enough so that she can perform her entire dance without falling off the edges.

Bessie's dance will take place on a rectangular stage consisting of a grid of 1 x 1 square cells. Bessie's four feet are described concisely as follows:

FR: Front right foot
FL: Front left foot
RR: Rear right foot
RL: Rear left foot

Her four feet start out in 4 adjacent cells forming a square as follows, with Bessie facing north.

```
FL FR
RL RR
```

Bessie's dance follows a series of N instructions (1 <= N <= 1000), where each instruction tells her to either move one foot by one cell or to pivot 90 degrees clockwise.

Instructions to move a foot consist of 3 characters, the first two identifying the foot to move, and the final character specifying the direction of movement (F = forward, B = back, R = right, L = left). For example, "FRF" means Bessie should move her front right foot forward one cell, and "RLR" means she should move her rear left foot right one cell. Of course, the direction of movement is relative to the direction Bessie is facing.

Instruction to pivot are also 3 characters, the first two specifying the single foot that Bessie keeps planted, around which she rotates 90 degrees clockwise. The last character is "P" (for pivot). For example, the instruction "FRP" means Bessie should pivot 90 degrees clockwise about her stationary front right foot. This means that if her feet are currently situated as follows (with Bessie facing north)

```
.. .. ..
.. .. FR
.. FL ..
.. RL RR
```

then the after the instruction "FRP" her feet will be located as follows, with Bessie now facing east:

```
RL FL ..
RR .. FR
.. .. ..
.. .. ..
```

Given the N instructions in Bessie's dance, please compute the minimum area of a rectangular stage necessary contain her feet during the entire dance.

If Bessie clumsily ever moves one foot onto the same cell as another foot, she will trip and fail to complete the dance; in this case, please output -1. Note that this is the only case where Bessie will trip; she has become quite flexible after all her practice, and can easily move her feet into rather strange configurations (for example, with her back feet farther forward than her front feet).

INPUT FORMAT:

* Line 1: The integer N.

* Lines 2..1+N: Each line contains one of the 3-character instructions
        in Bessie's dance.

SAMPLE INPUT:

```
3
FRF
FRP
RLB
```

INPUT DETAILS:

Bessie's dance consists of the instructions "front right foot forward",
"front right foot pivot", and "rear left foot back".

OUTPUT FORMAT:

* Line 1: The minimum area of a rectangular stage necessary to contain
        Bessie's feet during the entire dance, or -1 if Bessie trips.

SAMPLE OUTPUT:

```
16
```

OUTPUT DETAILS:

Bessie needs a 4 x 4 stage to complete her dance. Her feet move as follows:

```
.. .. .. ..
.. .. .. .. (facing north)
.. .. FL FR
.. .. RL RR
```

After FRF:

```
.. .. .. ..
.. .. .. FR (facing north)
.. .. FL ..
.. .. RL RR
```

After FRP:

```
.. RL FL ..
.. RR .. FR (facing east)
.. .. .. ..
.. .. .. ..
```

After RLB:

```
RL .. FL ..
.. RR .. FR (facing east)
.. .. .. ..
.. .. .. ..
```

Problem 2: Blink

Unhappy with the dim lighting in his barn, Farmer John has just installed a fancy new chandelier consisting of N (3 <= N <= 16) lights bulbs arranged in a circle.

The cows are fascinated by this new light fixture, and enjoy playing the following game: at time T, they toggle the state of each light bulb if its neighbor to the left was turned on at time T-1. They continue this game for B units of time (1 <= B <= 10^15). Note that B might be too large to fit into a standard 32-bit integer.

Given the initial states of the light bulbs, please determine their final states after B units of time have elapsed.

INPUT FORMAT:

* Line 1: Two space-separated integers, N and B.

* Lines 2..1+N: Line i+1 contains the initial state of bulb i, either 0 (off) or 1 (on).

SAMPLE INPUT:

```
5 6
1
0
0
0
0
```

INPUT DETAILS:

There are five light bulbs. The first is initially on, and the others are off.

OUTPUT FORMAT:

* Lines 1..N: Line i should contain the final state of bulb i, either 0 (off) or 1 (on).

SAMPLE OUTPUT:

```
1
1
1
0
1
```

OUTPUT DETAILS:

The light bulb states are as follows:
Time T=0: 1 0 0 0 0
Time T=1: 1 1 0 0 0
Time T=2: 1 0 1 0 0
Time T=3: 1 1 1 1 0
Time T=4: 1 0 0 0 1
Time T=5: 0 1 0 0 1
Time T=6: 1 1 1 0 1

Problem 3: What's Up With Gravity?

Captain Bovidian is on an adventure to rescue her crew member, Doctor Beefalo. Like all great adventures, this story plays out in a two dimensional N by M grid (1 <= N, M <= 500), representing a side view of the captain's world. Some grid cells are empty while others are blocked and cannot be traversed.

Unfortunately, Captain Bovidian cannot jump. She must obey the following rules of physics while traversing her world.

1) If there is no cell directly underneath Captain Bovidian (that is, if she is at the edge of the grid), then she flies out into space and fails her mission.
2) If the cell directly underneath Captain Bovidian is empty, then she falls into that cell.
3) Otherwise:
  a) Captain Bovidian may move left or right if the corresponding cell exists and is empty.
  b) Or, Captain Bovidian may flip the direction of gravity.

When Captain Bovidian changes the direction of gravity, the cell that's 'underneath' her (as mentioned in rules 1 and 2) toggles between the cell with one higher row index and the cell with one lower row index (the first row in the input has index 1, and the last row has index N). Initially, the cells with one higher row index are underneath Captain Bovidian.

Doctor Beefalo is lost somewhere in this world. Help Captain Bovidian arrive at her cell using the least number of gravity flips as possible. If it is impossible to reach Doctor Beefalo, please output -1.

INPUT FORMAT:
* Line 1: Two space-separated integers N and M.

* Lines 2..1+N: Line i+1 describes the ith row of Captain Bovidian's world: '.' indicates an empty cell, '#' indicates a blocked cell, 'C' indicates Captain Bovidian's starting position, and 'D' indicates Doctor Beefalo's starting position.

SAMPLE INPUT:
5 5
#####
#...#
#...D
#C...
##.##

OUTPUT FORMAT:
* Line 1: A single integer indicating the minimum number of times Captain Bovidian must flip gravity to reach Doctor Beefalo, or -1 if it is impossible to reach Doctor Beefalo.

SAMPLE OUTPUT:
3

OUTPUT DETAILS:
The captain starts at position (4, 2). She flips gravity and falls to position (2, 2) and then moves right twice to arrive at (2, 4). She flips gravity again and falls to position (4, 4) and then moves right once to position (4, 5). Finally she flips gravity again to fall to Doctor Beefalo's position at (3, 5).

Problem 4: Photo

Farmer John has decided to assemble a panoramic photo of a lineup of his N cows (1 <= N <= 200,000), which, as always, are conveniently numbered from 1..N. Accordingly, he snapped M (1 <= M <= 100,000) photos, each covering a contiguous range of cows: photo i contains cows a_i through b_i inclusive. The photos collectively may not necessarily cover every single cow.

After taking his photos, FJ notices a very interesting phenomenon: each photo he took contains exactly one cow with spots! FJ was aware that he had some number of spotted cows in his herd, but he had never actually counted them. Based on his photos, please determine the maximum possible number of spotted cows that could exist in his herd. Output -1 if there is no possible assignment of spots to cows consistent with FJ's photographic results.

INPUT FORMAT:

* Line 1: Two integers N and M.

* Lines 2..M+1: Line i+1 contains a_i and b_i.

SAMPLE INPUT:

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

INPUT DETAILS:

There are 5 cows and 3 photos. The first photo contains cows 1 through 4, etc.

OUTPUT FORMAT:

* Line 1: The maximum possible number of spotted cows on FJ's farm, or -1 if there is no possible solution.

SAMPLE OUTPUT:

```
1
```

OUTPUT DETAILS:

From the last photo, we know that either cow 3 or cow 4 must be spotted. By choosing either of these, we satisfy the first two photos as well.

Problem 5: Yin and Yang

Farmer John is planning his morning walk on the farm. The farm is structured like a tree: it has N barns (1 <= N <= 100,000) which are connected by N-1 edges such that he can reach any barn from any other. Farmer John wants to choose a path which starts and ends at two different barns, such that he does not traverse any edge twice. He worries that his path might be a little long, so he also wants to choose another "rest stop" barn located on this path (which is distinct from the start or the end).

Along each edge is a herd of cows, either of the Charcolais (white hair) or the Angus (black hair) variety. Being the wise man that he is, Farmer John wants to balance the forces of yin and yang that weigh upon his walk. To do so, he wishes to choose a path such that he will pass by an equal number of Charcolais herds and Angus herds-- both on the way from the start to his rest stop, and on the way from the rest stop to the end.

Farmer John is curious how many different paths he can choose that are "balanced" as described above. Two paths are different only if they consist of different sets of edges; a path should be counted only once even if there are multiple valid "rest stop" locations along the path that make it balanced.

Please help determine the number of paths Farmer John can choose!

INPUT FORMAT:

* Line 1: The integer N.

* Lines 2..N: Three integers a_i, b_i and t_i, representing the two barns that edge i connects. t_i is 0 if the herd along that edge is Charcolais, and 1 if the herd is Angus.

SAMPLE INPUT:

```
7
1 2 0
3 1 1
2 4 0
5 2 0
6 3 1
5 7 1
```

INPUT DETAILS:

There are 7 barns and 6 edges. The edges from 1 to 2, 2 to 4 and 2 to 5 have Charcolais herds along them.

OUTPUT FORMAT:

* Line 1: One integer, representing the number of possible paths Farmer John can choose from.

SAMPLE OUTPUT:

```
1
```

OUTPUT DETAILS:

No path of length 2 can have a suitable rest stop on it, so we can only consider paths of length 4. The only path that has a suitable rest stop is 3-1-2-5-7, with a rest stop at 2.