CCC '18 S3 - RoboThieves

Canadian Computing Competition: 2018 Stage 1, Senior #3

A robot has stolen treasure from a factory and needs to escape without getting caught. The factory can be modelled by an N by M grid, where the robot can move up, down, left, or right.

Each cell of the grid is either empty, a wall, a camera, a conveyor, or the robot's initial position. The robot can only walk on empty cells (denoted by `.`) or conveyors. The first row, last row, first column and last column of the grid consists of walls (denoted by `W`), and there may be walls in other cells.

Conveyors cause the robot to move in a specific direction, denoted by `L`, `R`, `U`, `D` for left, right, up, down respectively. The robot is unable to move on its own while on a conveyor. It is possible that the robot can become stuck forever on conveyors. Cameras (denoted by `C`) can see in all four directions up, down, left, and right, but cannot see through walls. The robot will be caught if it is in the same cell as a camera or is seen by a camera while not on a conveyor. Conveyors are slightly elevated, so the robot cannot be caught while on a conveyor, but cameras can see empty cells on the other side of conveyors. The robot is initially at the cell denoted by `S`. The exit could be at any of the empty cells. For each empty cell, determine the minimum number of steps needed for the robot to move there without being caught, or determine that it is impossible to move there. A step consists of moving once up, down, left or right. Being moved by a conveyor does not count as a step.

Input Specification

The first line of input contains two integers N and M $(4 \leq N, M \leq 100)$. The next N lines of input will each contain M characters, each of which is one of the eight characters `W`, `.`, `C`, `S`, `L`, `R`, `U`, or `D`.

There will be exactly one `S` character and at least one `.` character. The first and last character of every row and column will be `W`.

For 5 of the 15 marks available, there are no cameras or conveyors.

For an additional 5 of the 15 marks available, there are no conveyors.

Output Specification

For each empty cell, print one line with one integer, the minimum number of steps for the robot to move to this empty cell without being caught or `-1` if it is impossible to move to this empty cell.

The output should be in row major order; the order of empty cells seen if the input is scanned line by line top-to-bottom and then left-to-right on each line. See the sample outputs for examples of row major order output.

Sample Input 1

```
4 5
WWWWW
W.W.W
WWS.W
WWWWW
```

Sample Output 1

```
-1
2
1
```

Explanation for Sample Output 1

The robot cannot move to the top left empty cell because it is blocked by walls. The top right empty cell can be reached in 2 steps and the bottom right empty cell can be reached in 1 step.

Sample Input 2

```
5 7
WWWWWWW
WD.L.RW
W.WCU.W
WWW.S.W
WWWWWWW
```

Sample Output 2

```
2
1
3
-1
-1
1
```

Explanation for Sample Output 2

The empty cell to immediate left of the robot is seen by the camera so the robot cannot move there.

The empty cell right below the `R` conveyor is also seen by the camera as conveyors do not block the the sight of cameras.

Note that the robot can use the `U` and `L` conveyors to avoid the getting caught by the camera.

If the robot moves to the `R` conveyor, it will become stuck forever there.