

## Challenge I

### Objective

In this challenge, the participant must get the particle from the start point to the end point in the fewest number of moves without ever passing a live cell = green. With each move the board changes, the participant must calculate the next state of the board and avoid all living cells.

### Board

The board for this challenge is a rectangle formed by  $R * C$  cells. The cells are arranged in a grid of  $R$  rows (horizontal) and  $C$  columns (vertical). The rows are numbered 0 to  $(R - 1)$  from top to bottom and the columns 0 to  $(C - 1)$  from left to right. Each cell is given an ID based on its row and its column  $a_{i,j}$ . The first cell is identified by  $a_{0,0}$  and is located in the upper left corner of the board. The first index corresponds to the rows and the second to the columns.

In this board each cell has a state = color, defined based on its value:

1 = alive (green)

0 = dead (white)

However, the initial (starting point) and final (target point) cells are exceptions to this rule. They never assume a value of 0 or 1, can be represented by the color yellow, and are immutable. As long as the particle is in a cell orthogonally adjacent to one of these points it can always access it.

### Motion of the particle

The particle begins its trajectory on the initial cell, makes only one move per turn, always orthogonal (Right, Left, Down, Up). It cannot leave the board's limits and cannot finish its movement on a live cell. It also cannot remain stationary for one turn.

The particle starts moving in the current state of the board, and ends its movement in the next state. The particle can start movement toward a live cell, but cannot end its movement on a live cell.

Right - an increment in  $j$  in the particle's position. If the particle is in cell  $a_{3,4}$  and makes a rightward move it ends its move in cell  $a_{3,5}$

Left - an increment by  $j$  in the particle's position. If the particle is in cell  $a_{3,4}$  and moves left it finishes its move in cell  $a_{3,3}$

Down - an increment by  $i$  in the particle's position. If the particle is in cell  $a_{3,4}$  and moves right it finishes its move in cell  $a_{4,4}$

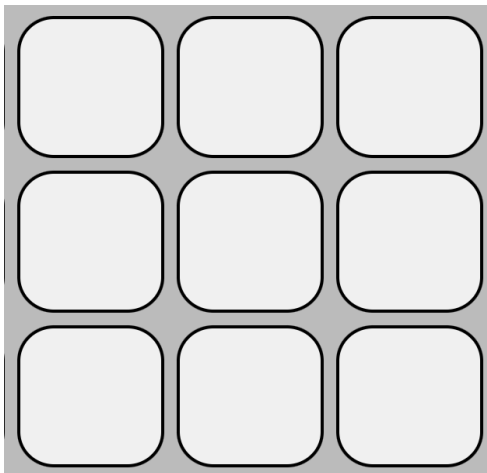
Up - an i-decrement in the particle's position. If the particle is in cell a3,4 and makes a move up it finishes its move in cell a2,4

### Propagation rule

White cells turn green if they have a number of green adjacent cells greater than 1 and less than 5. Otherwise, they remain white.

Green cells remain green if they have a number of green adjacent cells greater than 3 and less than 6. Otherwise, they become white.

Two cells are considered adjacent if they have a border, either on the side, above, below or diagonally. In the example below, the white cell in the center therefore has 8 adjacent white cells.



### Input

For this challenge the participant will receive the initial layout of the board in a text file. 3 represents the starting point and 4 represents the destination point. Immutable cells that never take on the value of 0 or 1.

0 represents dead cells = white and 1 represents live cells = green. Each line in the file represents a row of the board and the values in that row represent the cells. The values are separated by a space and an '\n' character represents the end of the line.

### Output

The participant must formulate a text file in UTF-8 format with their answer to the challenge. The file should be named as output1.txt and should contain only one line with all the movements of the particle separated by a space.

R - to the right

L - to the left  
U - up  
D - down

response example

R R R D D D D R D U D R R

Output limitation. 50,000 moves

Score

The maximum score for this challenge is 1000 points. The maximum score will be awarded to whoever finds the shortest path to the destination, the path with the fewest moves. The score of the other participants will be in reference to the score of the shortest path following the rule

a - shortest path found  
b - path found by the participant  
n - score

$$n = 1000 * a / b$$

In case a participant doesn't reach the final point, he can still have a score, as long as he hasn't broken the rule of passing by a live cell. In the case of failing to reach the destination the participant's grade will be in reference to the grade of the candidate who reached the destination with the greatest number of steps:

d1 - vertical + horizontal distance between the destination point and the final position of the particle following the path provided by the participant

d2 - vertical + horizontal distance from the starting point to the destination point

nr - reference score of the candidate who reached the destination with the worst performance

n - score

$$n = nr * (1 - d1 / d2)$$

If no participant reaches the destination, the candidate who gets closest to the destination will receive 1,000 points. In this case, the number of moves will be indifferent and the scores of the others will follow the second informed pattern.

Cases in which the score will be 0:

- File with incorrect name or incorrect formatting
- Not respecting the board limits
- Passing through a live cell