PROBLEM 6

Yet Another Lights Problem

Input file: `yalpin.txt`
Output file: `yalpout.txt`

Time and memory limits: 2 seconds, 1 GB

Your friend has a grid of lights with R rows (numbered from 0 to $R-1$ top to bottom) and C columns (numbered from 0 to $C-1$ left to right). We say that the light in the rth row and cth column has *position* (r, c). Each light starts either *on* or *off*. Your goal is to turn all the lights on.

The only thing your friend will allow you to do is to make *cross-flips*. A cross-flip is made by choosing a position (a, b) in the grid and then toggling the light there (turning it off if it is currently on, or on if it is currently off). Because of the way the lights are wired, this will also toggle all the other lights in row a and all the other lights in column b.

For example, in a grid with $R = 4$ rows and $C = 5$ columns where all the lights are off, a cross-flip at position $(2, 3)$ toggles the following lights:

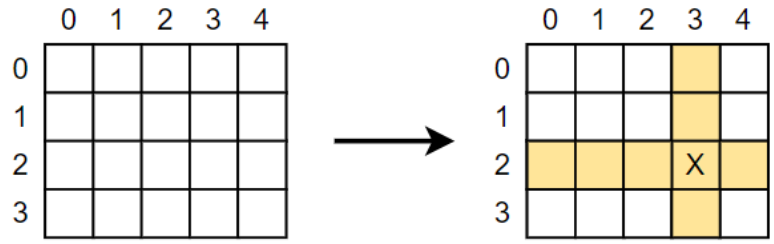

Figure 1: The described scenario. White squares represent lights that are off, and yellow squares represent lights that are on. The cross-flipped square is denoted by an `X`.

Find a sequence of at most $40\,000$ cross-flips that turns all the lights on. Or is that impossible?

Input

- The first line of input contains the integers R and C.
- R lines of input follow, each containing a string of C characters. On the rth line, the cth character describes the initial state of the light at position (r, c):
  - It is a `*` if the light at position (r, c) is on.
  - It is a `.` if the light at position (r, c) is off.

Output

If it is not possible to turn all the lights on, your program must output `-1`.

Otherwise, your program must output a sequence of up to $40\,000$ cross-flips that turns all the lights on.

- On the first line, output the number of cross-flips in your sequence, M.
- On the next M lines, output your sequence of cross-flips. The ith line should contain two integers a_i and b_i, indicating that for the ith cross-flip, you chose position (a_i, b_i).

You are guaranteed that whenever it is possible to turn all the lights on, there is a sequence of at most $40\,000$ cross-flips that will turn all the lights on.

Sample input 1

```
4 5
****.
**.**
..*.*
****.
```

Sample input 2

```
4 2
.*
*.
.*
*.
```

Sample input 3

```
3 3
*..
.*.
...
```

Sample output 1

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

Sample output 2

```
4
3 0
1 0
0 1
2 1
```

Sample output 3

```
-1
```

Explanation

In the first sample case, the cross-flips in the sample output are illustrated below:

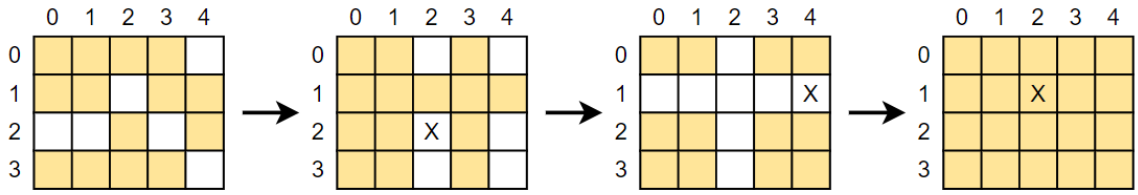

Figure 2: Sample case 1

There are other possible sequences.

In the second sample case, the cross-flips in the sample output are illustrated below:

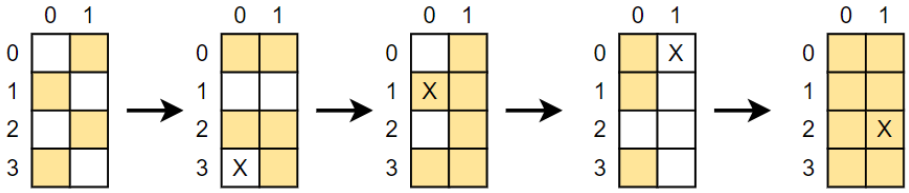

Figure 3: Sample case 2

There are other possible sequences.

In the third sample case, there is no sequence of cross-flips that will turn all the lights on.

Subtasks and constraints

For all subtasks:

- $2 \leq R \leq 200$.
- $2 \leq C \leq 200$.

Additionally:

- For Subtask 1 (25 marks), R and C are even, $R \leq 20$, and $C \leq 20$.
- For Subtask 2 (18 marks), R and C are even.
- For Subtask 3 (25 marks), R is odd, C is even, $R < 20$, and $C \leq 20$.
- For Subtask 4 (25 marks), R and C are odd, $R < 20$, and $C < 20$.
- For Subtask 5 (7 marks), no special constraints apply.