Problem G
X Aura

Mount ICPC can be represented as a grid of R rows (numbered from 1 to R) and C columns (numbered from 1 to C). The cell located at row r and column c is denoted as (r, c) and has a height of $H_{r,c}$. Two cells are adjacent to each other if they share a side. Formally, (r, c) is adjacent to $(r-1, c)$, $(r+1, c)$, $(r, c-1)$, and $(r, c+1)$, if any exists.

You can move only between adjacent cells, and each move comes with a penalty. With an aura of an **odd positive integer** X, moving from a cell with height h_1 to a cell with height h_2 gives you a penalty of $(h_1 - h_2)^X$. Note that the penalty can be negative.

You want to answer Q independent scenarios. In each scenario, you start at the starting cell (R_s, C_s) and you want to go to the destination cell (R_f, C_f) with minimum total penalty. In some scenarios, the total penalty might become arbitrarily small; such a scenario is called *invalid*. Find the minimum total penalty to move from the starting cell to the destination cell, or determine if the scenario is invalid.

Input

The first line consists of three integers R C X ($1 \leq R, C \leq 1000; 1 \leq X \leq 9; X$ is an odd integer).

Each of the next R lines consists of a string H_r of length C. Each character in H_r is a number from 0 to 9. The c^{th} character of H_r represents the height of cell (r, c), or $H_{r,c}$.

The next line consists of an integer Q ($1 \leq Q \leq 100\,000$).

Each of the next Q lines consists of four integers R_s C_s R_f C_f ($1 \leq R_s, R_f \leq R; 1 \leq C_s, C_f \leq C$).

Output

For each scenario, output the following in a single line. If the scenario is invalid, output `INVALID`. Otherwise, output a single integer representing the minimum total penalty to move from the starting cell to the destination cell.

Sample Input #1

```
3 4 1
3359
4294
3681
5
1 1 3 4
3 3 2 1
2 2 1 4
1 3 3 2
1 1 1 1
```

Sample Output #1

```
2
4
-7
-1
0
```

Explanation for the sample input/output #1

For the first scenario, one of the solutions is to move as follows: $(1,1) \to (2,1) \to (3,1) \to (3,2) \to (3,3) \to (3,4)$. The total penalty of this solution is $(3-4)^1 + (4-3)^1 + (3-6)^1 + (6-8)^1 + (8-1)^1 = 2$.

Sample Input #2

```
2 4 5
1908
2023
2
1 1 2 4
1 1 1 1
```

Sample Output #2

```
INVALID
INVALID
```

Explanation for the sample input/output #2

For the first scenario, the cycle $(1,1) \to (2,1) \to (2,2) \to (1,2) \to (1,1)$ has a penalty of $(1-2)^5 + (2-0)^5 + (0-9)^5 + (9-1)^5 = -26250$. You can keep repeating this cycle to make your total penalty arbitrarily small. Similarly, for the second scenario, you can move to $(1,1)$ first, then repeat the same cycle.

Sample Input #3

```
3 3 9
135
357
579
2
3 3 1 1
2 2 2 2
```

Sample Output #3

```
2048
0
```