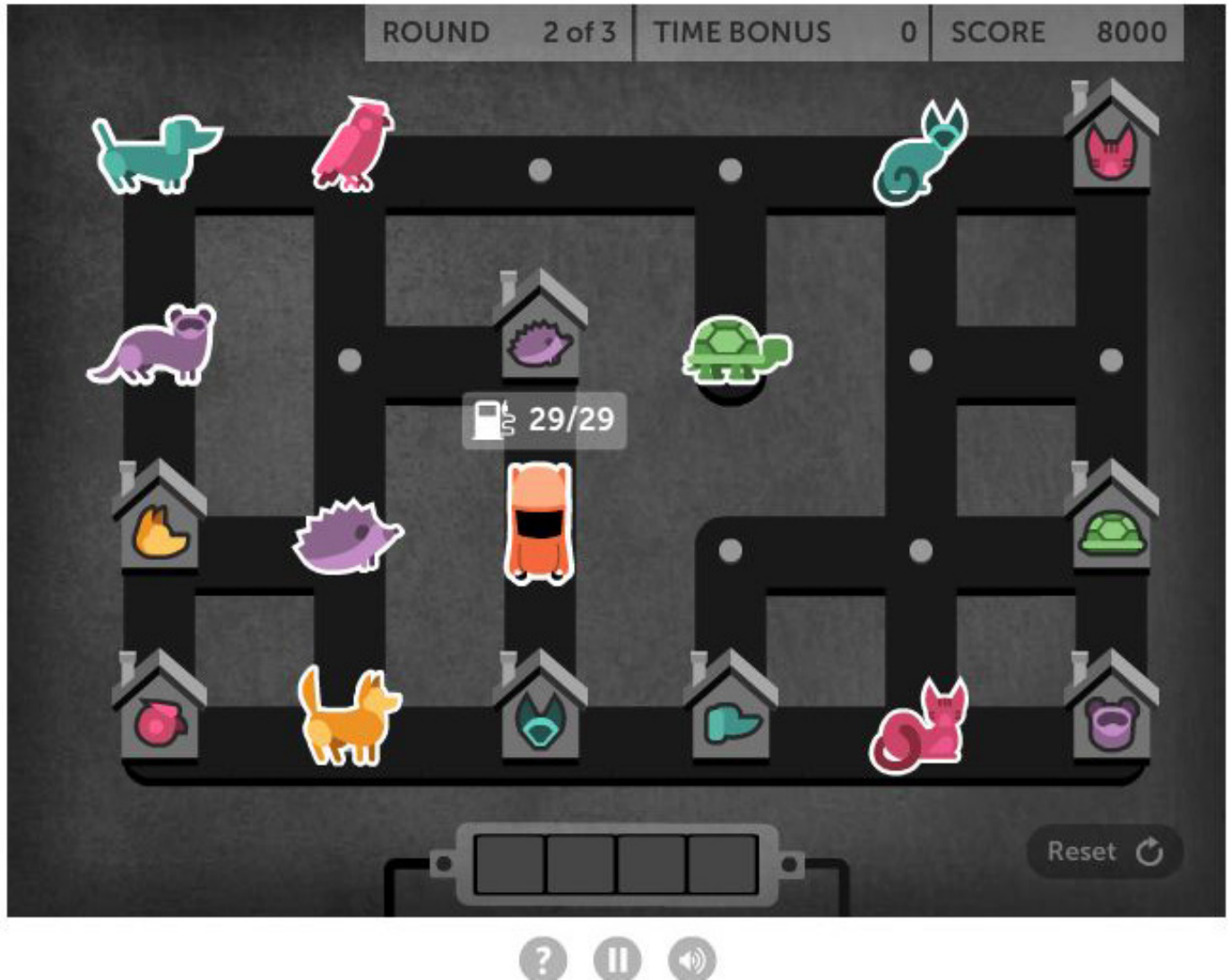


# Statement

In this problem, you need to find solution to a puzzle game named "Pet detective".



The game is played in a field with  $M$  rows and  $N$  columns. The rows are numbered with 1 to  $M$ , from the top to bottom, and the columns are numbered from 1 to  $N$  from left to right. The cell in  $i$ -th row and  $j$ -th column is denoted as cell  $(i, j)$ . For example, the pink bird in the above figure is in cell  $(1, 2)$ .

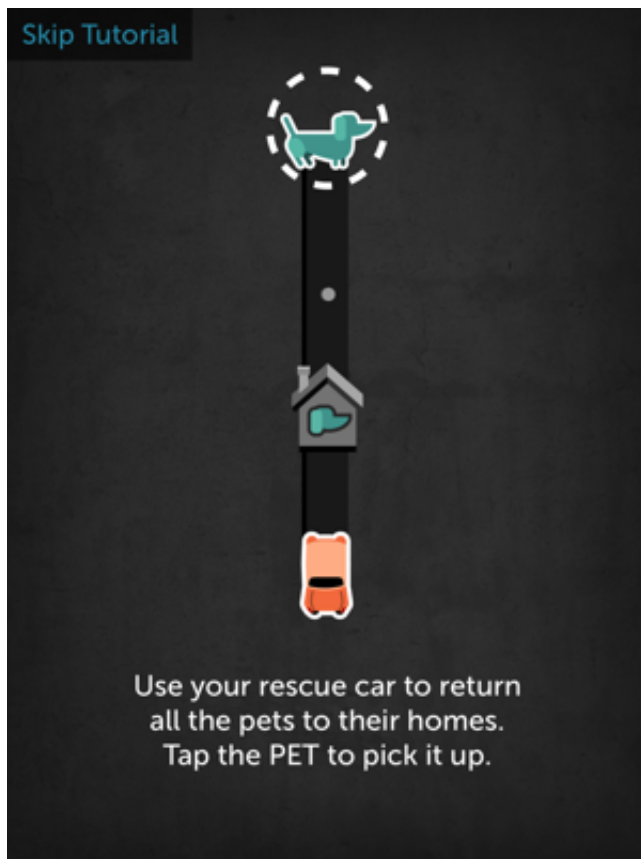
Your mission is to drive the car (located in cell  $(3, 3)$  in the above figure) around the field, pick up the animals and return them to their home. You have the following restrictions:

- You must use the shortest route.
- You can only move in 4 directions (up, down, left, right), and you can only moves between cells having road between them (in above figure, the roads are highlighted in black)
- At each moment, your car can only have at most 4 animals.

- You must return each animal to their correct home. For example, the pink bird in cell (1, 2) must be returned to cell (4, 1).

## Example 1:

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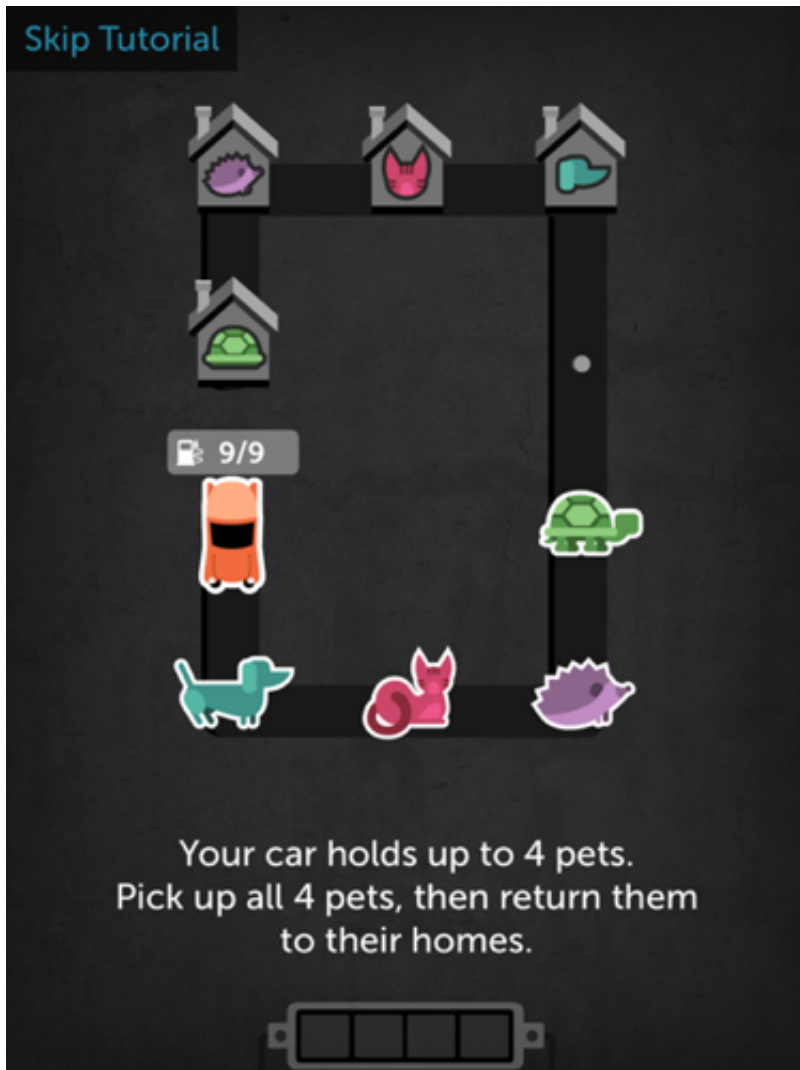


In this example,  $M = 4$ ,  $N = 1$ . You start at cell (4, 1) and need to return the dog at cell (1, 1) to his home at (3, 1). The shortest route is:

- Go from (4, 1) to (1, 1) and pick up the dog. Length = 3.
- Go from (1, 1) to (3, 1), return the dog to his home. Length = 2. So the shortest route has length = 5.

## Example 2:

---



$M = 4$ ,  $N = 3$ .

- You start at cell (3, 1), and need to:
  - Get dog at (4, 1) to (1, 3)
  - Get cat at (4, 2) to (1, 2)
  - Get hedgehog at (4, 3) to (1, 1)
  - Get turtle at (3, 3) to (2, 1).

The shortest route is:

- Go from (3, 1) to (4, 1), pick up dog --> length = 1
- Go from (4, 1) to (4, 2), pick up cat --> length = 1
- Go from (4, 2) to (4, 3), pick up hedgehog --> length = 1
- Go from (4, 3) to (3, 3), pick up turtle --> length = 1
- Go from (3, 3) to (1, 3), return dog --> length = 2
- Go from (1, 3) to (1, 2), return cat --> length = 1
- Go from (1, 2) to (1, 1), return hedgehog --> length = 1
- Go from (1, 1) to (2, 1), return turtle --> length = 1 Total length of route is 9.

Note that after picking up turtle, the car is carrying 4 animals, which is the maximum capacity of the car. At this point, the car cannot pickup any animal. But after returning dog to his home, the car has 3 animals, and can pick up another animal if needed.

## Constraints:

- $1 \leq M, N \leq 6$ .
- Let  $K$  be the number of animals.  $K$  is at most 11.
- There is at most 1 animal of each type (there is at most 1 dog, at most 1 cat, at most 1 turtle...)

## Input:

- 1st line:  $M, N$
- In the next  $M$  lines, each line contains  $N$  integers describing the field. Each integer can be one of the following:
  - 99: if the corresponding cell is the car. There is only one cell with value equal to 99.
  - 0: if the corresponding cell is empty
  - $1..K$ : if the corresponding cell has an animal. The animals are numbered from 1 to  $K$ . Each of these numbers occur at most once.
  - $-1 .. -K$ : if the corresponding cell is an animal's home. Each of these numbers occur at most once.
- In the next  $M$  lines, each line containing  $N-1$  integers, representing the horizontal roads of the field.
  - The number at  $(i, j)$  is equal to 1 if there is road between  $(i, j)$  and  $(i, j+1)$ .
  - Otherwise, it is 0.
- In the next  $M-1$  lines, each line containing  $N$  integers, representing the vertical roads of the field.
  - The number at  $(i, j)$  is equal to 1 if there is road between  $(i, j)$  and  $(i+1, j)$ .
  - Otherwise, it is 0.

Note: there can be extra spaces and/or empty lines anywhere in the input file.

## Output:

Print a single integer, which is the shortest length of your route. It is guaranteed that a solution exist.

## Example:

### Input 1

---

```
4 1
1
0
-1
99
```

```
1
1
1
```

## Output 1

---

```
5
```

## Input 2

---

```
4 3
-1 -2 -3
-4 0 0
99 0 4
3 2 1
```

```
1 1
0 0
0 0
1 1
```

```
1 0 1
0 0 1
1 0 1
```

## Output 2

---

```
9
```