Problem 159: Labyrinth

Difficulty: Hard

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Originally Published: Code Quest 2021

Problem Background

The term "labyrinth" has come to mean any large, difficult-to-navigate maze, but the word originates from Greek mythology. According to legend, the Greek Labyrinth was a massive, complex maze on the island of Crete, which held the fearsome half-human, half-bull Minotaur at bay. Anyone who entered the Labyrinth would become hopelessly lost and would eventually be devoured by its resident monster. According to that same legend, the hero Theseus entered the Labyrinth to slay the Minotaur and took a ball of thread with him to mark the path he followed so that he could eventually escape.

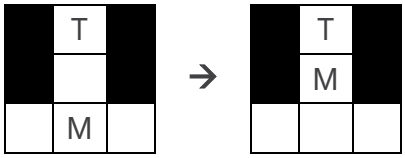
For this problem, we're going to change the legend somewhat. First, Theseus is entering the Labyrinth not to slay the Minotaur, but to steal a priceless treasure hidden inside. Secondly, Theseus is rather forgetful and has forgotten both his sword and his ball of thread; as a result, he can't defend himself against the Minotaur, and can't find his way back out once he gets the treasure. He'll need our help.

Problem Description

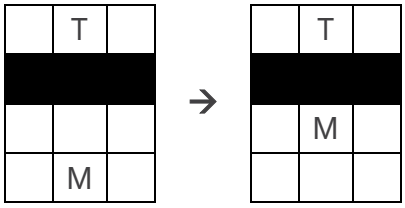
You will be provided with a map of the Labyrinth as viewed from above. On this map, you will be given the locations of both Theseus and the Minotaur. Theseus managed to find the treasure on his own without incident, but now he needs to escape as quickly as possible. You must find the shortest path Theseus can take to the exit that allows him to avoid the approaching Minotaur. If Theseus and the Minotaur ever run into each other (occupy the same position on the map), the Minotaur will eat Theseus.

Each cell within the map represents one step. Both Theseus and the Minotaur move at the same pace - one step at a time - but will take turns doing so. Theseus will move first, then the Minotaur, then Theseus again, and so on. Neither Theseus nor the Minotaur may move through walls or diagonally. The Minotaur may move through the exit as though it is an open space.

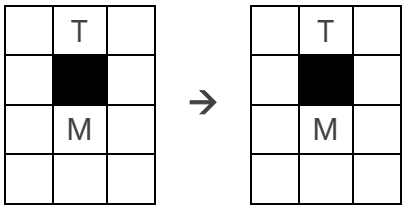
Fortunately for Theseus, the Minotaur isn't very smart, and will always move according to the following rules. In the diagrams below, "M" represents the Minotaur, "T" represents Theseus, and black cells are impassible walls.



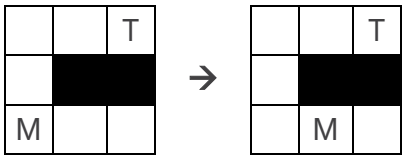
The Minotaur will always seek to reduce the straight-line distance between him and Theseus.



The Minotaur cannot move through walls, but will ignore walls when determining the distance between himself and Theseus.



If the only moves available to the Minotaur would increase the distance between himself and Theseus, the Minotaur will not move.



Given two choices that would result in an equal distance, the Minotaur will prefer to move left or right rather than up or down.

You program must calculate the fewest number of steps required to get Theseus safely to the exit. At each step, Theseus may move up, down, left or right. The Minotaur will then move in response to Theseus's new location. Theseus may also choose to remain still for one step; in this case, the Minotaur will still move on his turn, according to the rules above.

While the goal is to get Theseus to the exit as quickly as possible, be careful. If the Minotaur would ever move into the space occupied by Theseus, Theseus will be eaten and the path is invalid. Theseus may need to take a less direct route or lure the Minotaur into a dead end in order to safely reach the exit.

Sample Input

The first line of your program's input, received from the standard input channel, will contain a positive integer representing the number of test cases. Each test case will include:

- A line containing two positive integers separated by spaces, X and Y, representing the width and height of the map, respectively.
- Y lines, each containing X characters, representing the map of the labyrinth as follows:
    - An uppercase letter X represents an impassible wall.
    - An uppercase letter E represents the exit from the labyrinth. There is only one exit in each map, and it may occur anywhere within the map.

- An uppercase letter T represents Theseus's starting position. This will occur only once in each map.
- An uppercase letter M represents the Minotaur's starting position. This will occur only once in each map.
- Spaces represent navigable hallways. The exit and both starting positions should also be considered navigable spaces.

```
1
8 7
XXXXXXEX
X      X
X XXXX X
X X M  X
X XXXX X
X     TX
XXXXXXXX
```

Sample Output

For each test case, your program must print a single line containing an integer representing the fewest number of steps required to allow Theseus to escape the maze unharmed.

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15
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