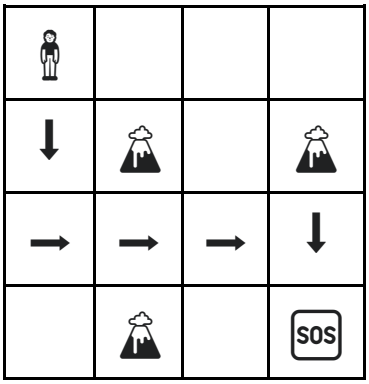
Problem D: Island of Valću

Filename: *valcu*
Time limit: *3 seconds*

Embark on a thrilling adventure to the mystical island of Valću, home to ancient volcanoes that have slumbered for a billion years. The island is a treasure trove of unique Valćun culture, and you've eagerly awaited the chance to experience it firsthand. Finally, the day arrives when you secure tickets to this hotspot of excitement.

As you immerse yourself in the vibrant Valćun traditions, an unexpected twist unfolds – the long-dormant volcanoes have suddenly come to life! The island is in the grip of an eruption, and the lava is spreading rapidly, putting everyone at risk.



In the midst of chaos, a rescue mission is underway and you need to reach them as quickly as possible. Your mission is clear: navigate the terrain of Valću, strategically choosing a route to the rescue zone while maximizing the distance from the erupting volcanoes in your path. For the purposes of this question, we define distance between two grid squares to be Manhattan Distance. The Manhattan Distance between row a, column b and row c column d is |a - c| + |b - d|.

The Problem

Given a $n \times m$ grid representing Valću with information about the locations of volcanoes, you must reach the rescue zone. The best route is any route that maximizes the minimum distance between you and all volcanoes at any given moment to escape safely. It is guaranteed that a viable path exists without intersecting any volcanoes. The distance between two cells is the Manhattan Distance between those cells as previously described.

The Input

The input consists of multiple cases. The first line contains a positive integer, $\boldsymbol{c}$ ($1 \leq \boldsymbol{c} \leq 15$), representing the number of cases to be processed. Each case is defined by the following lines.
For each case:

- The first line contains two positive integers **n** and **m** ($2 \leq \boldsymbol{n}, \boldsymbol{m} \leq 500$), representing the island's size in rows and columns, respectively.
- The next $\boldsymbol{n}$ lines contain strings of length $\boldsymbol{m}$, representing the island's layout. All characters from all of these strings will be one of the following characters:

`'S'`: Start, `'E'`: SOS Zone, `'.'`: Empty, `'*'`: Volcano

Both 'S' and 'E' will appear exactly once in the grid.
'*' will appear at least once in the grid.
There will exist a path from 'S' to 'E' in the grid that doesn't use a grid square containing '*'.

The Output

For each test case, provide the minimal Manhattan Distance from a volcano in the optimal route to safety.

Sample Input

```
3
4 4
S...
.*.*
....
.*.E
3 3
SE.
...
*..
3 4
S..E
.*..
..*.
```

Sample Output

```
1
2
1
```