Escape Plan

Time Limit : 1 Second
Memory Limit : 512 Mb

Kurt Wagner managed to rescue a mutant boy confined in a dungeon by an evil mastermind. Now it's time to escape from the dungeon. However, the dungeon layout has changed the moment he saved the boy. Presumably, this is a trap laid by the evil mastermind so that no one can escape from it. The dungeon in which Wagner and the boy are in can be represented by a grid of N rows and M columns. Each cell is either '`#`' (denoting a concrete/wall) or '`.`' (denoting an empty space). Wagner's position is denoted by '`S`' while the exit is denoted by '`E`'.

Wagner has the ability to teleport (along with whomever he touches), but he needs to see (or at least, know) the target, otherwise, he will risk teleporting into concrete (and die!). Fortunately, the mutant boy he just saved has a unique ability. He can see through concretes! Moreover, he can project what he saw into other's mind directly. His only limitation is he can only see straight in north/south/east/west direction.

For example, let the dungeon contains 3 rows and 6 columns, and the layout be:

```
S#####
.##.#.
######
##E#..
```

Then, Wagner and the boy can escape the dungeon by:

- Run from (1,1) to (2,1).
- Teleport from (2,1) to (2,6).
- Teleport from (2,6) to (4,6).
- Teleport from (4,6) to (4,3) – the exit.

Wagner can teleport as far as he wants given that he has enough energy to do so. The farther he teleports, the more energy he requires. Specifically, to teleport from (r_1, c_1) to (r_2, c_2), he needs w^2 energy where w is the number of concretes between (r_1, c_1) and (r_2, c_2). Note that running cost no energy.

In the example above, teleporting from (2,1) to (2,6) requires 3^2 (there are 3 concretes in between) = 9 energy. Teleporting from (2,6) to (4,6) requires 1^2 = 1 energy. Finally, teleporting from (4,6) to (4,3) requires 1^2 = 1 energy. However, if instead of teleporting from (2,1) to (2,6) directly, Wagner teleports to (2,4) then to (2,6), then he'll only need 2^2 + 1^2 = 4 + 1 energy. Thus, the overall escape plan requires 4 + 1 + 1 + 1 = 7 energy.

Given the dungeon layout in which Wagner and the boy are trapped, compute the minimum energy Wagner will need to escape from there. If there's no way for Wagner and the boy to escape, then output -1.

Input

Input begins with an integer: T (1 ≤ T ≤ 100) denoting the number of cases.

Each case contains the following input block: Each case begins with two integers: N M (1 ≤ N, M ≤ 25; N * M ≥ 2) in a line denoting the number of rows and columns of the dungeon, respectively. Each of the next N lines contains M characters denoting the dungeon layout. Each cell will be either:

- '`S`' (without quotes) denoting the location of Wagner and the boy.
- '`E`' (without quotes) denoting the exit.
- '`.`' (without quotes) denoting an empty space.
- '`#`' (without quotes) denoting a concrete.

There will be exactly one '`S`' and one '`E`' on any given dungeon layout.

Output

For each case, output in a line "`Case #X: Y`" where `X` is the case number (starts from 1) and `Y` is the output for the respective case.

Examples

input **Example #1**

```
4
4 6
S#####
.##.#.
######
##E#..
2 11
E#.#.#.#..S
.######....
2 2
#S
E#
3 3
...
S#E
...
```

output

```
Case #1: 7
Case #2: 4
Case #3: -1
Case #4: 0
```

explanation

Case 1: This is the example from the problem statement.

Case 2: Start at (1,11) → run to (1,9) → teleport to (1,7) → teleport to (1,5) → teleport to (1,3) → teleport to (1,1). Wagner teleports 4 times each with an energy of 1.

Case 3: It's doom for Wagner and the boy.

Case 4: No need to teleport. Just go around the wall and you'll find the exit.

End of Problem