Report

The solution strategy is based on doing a BFS (Breadth Fist Search) with clockwise 4-connectivity (north, east, south, west) to explore the maze and mark the information found along the traversal over a status matrix, using the states described in the problem description (empty, wall, pit, Wumpus, …).

Initially we have a status matrix that looks like this:

|  |  |  |
| --- | --- | --- |
| u | u | u |
| u | u | u |
| u | u | u |
| u | u | u |

For example, a map with only empty spaces and placing a robot on position (1,1) or top left corner, would yield the following traversal order for that robot:

|  |  |  |
| --- | --- | --- |
| x | 1 | 3 |
| 2 | 4 | 6 |
| 5 | 7 | 9 |
| 8 | 10 | 11 |

And the following resulting status map:

|  |  |  |
| --- | --- | --- |
| . | . | . |
| . | . | . |
| . | . | . |
| . | . | . |

Every time there’s a change of direction along a path a shot is made. For example, in the previous map, the paths are:

1: east

2: south

3: east, east

4: east, south

5: south, south

…

11: east, east, south, south, south

And there will be a shot on 4 because there’s a change of direction rom east to south (shoot to south) but there will be no shot on 5 because there was no change in direction from east to east

Exploring all the reachable areas of a map means that neither the Wumpus nor the robot was killed during the movements and then the final matrix can be used to further guess where the Wumpus is.

As long as the status of a shot is ‘miss’, we keep exploring the maze until there are no cells left to visit or the Wumpus is killed or the robot is killed. For example, on the following map with the robot starting on position (1,5) or bottom left corner:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| . | . | . | . | . |
| . | **.** | **P** | **P** | **P** |
| . | **.** | **P** | **W** | **P** |
| . | **.** | **P** | **P** | **P** |
| . | . | . | . | . |

The traversal flow would be:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| u | u | u | u | u |
| 6 | u | **u** | **u** | **u** |
| 3 | 7> | **u** | **u** | **u** |
| 1^ | 4> | **u** | **u** | **u** |
| x | 2> | 5 | u | u |

And on the 7th try the Wumpus will be killed since it is on the direction of the shot (>) and there was no need to continue exploring.

As previously mentioned, in cases where neither the robot nor the Wumpus gets killed, the whole map is explored and the final status matrix is used to guess where the Wumpus is. For example, consider the following resulting status map:

|  |  |  |  |
| --- | --- | --- | --- |
| . | . | . | . |
| . | . | . | . |
| . | **P** | **#** | **#** |
| . | **P** | u | u |
| . | **P** | **#** | **#** |
| . | . | . | . |

Remember from the initial status matrix that the ‘u’ represents the cells or areas that couldn’t be explored or reached by the BFS because it was surrounded by walls/pits. However from this status map, it is still possible to try shots from the cells near to the pits in order to kill the Wumpus.

To summarize the implementation:

1. We explore the whole map, until no more unknown positions are reachable.
2. During this initial exploration, every time we change direction we shoot. This might give us an early Wumpus kill. Keeping track of all positions where we have shot from, so we do not repeat unnecessary shoots.
3. Once the whole map has been explored, we check if we found possible places where the Wumpus is. Then we try to shoot at those positions from different directions.
4. If we cannot kill the Wumpus from any of those positions (maybe the positions are inaccessible), or if we did not find any possible positions for the Wumpus, we proceed to shoot from the border of every pit we found (the Wumpus must be hiding behind a pit, so we should be able to kill him from one of those positions)

We believe this strategy is enough for killing the Wumpus, provided the initial position for the robots is not right next to the Wumpus, because we could be killed with our first step.