Artificial Intelligence

Logical Agent Project

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Introduction:

In this second project, my teammate Oumayma Elghamrasni and I, tried to write the code for a logical agent in Wumpus game using prolog. Due to time constraints, we couldn't code a logical agent that selects the best moves and avoid falling in a pit or being eaten by a Wumpus. The agent's goal is to kill the Wumpus. Also, it can move only to the rooms that are adjacent to the room it is located in. The agent is able to perceive stench, breeze, or glitter which will help it make assumption about the location of Wumpus, pits, or the gold.

I- Key predicates:

- r(X,Y): r represents a room in the environment. X and Y represent the coordinates of the room.
- breeze(r(X,Y)): Location r(X,Y) of the breeze
- wumpus(r(X,Y)): Location of the Wumpus.
- pit(r(X,Y)): Location of the pit.
- stench(r(X,Y)): Location of the stench.
- gold(r(X,Y)):Location of the gold.
- agentLocation(r(X,Y)): Agent location on the grid.
- glitter(r(X,Y)): Location of the glitter.
- adjacentTo (r (X, Y), r(T,U)) : r(X, Y) is adjacent to r(T,U).
- perceiveBreeze(true,r(X,Y)): The agent perceived breeze in r(X,Y).
- perceiveBreeze(false,r(X,Y)): The agent did not perceived breeze in r(X,Y).
- perceivestench(true,r(X,Y)): The agent perceived stench in r(X,Y).
- perceivestench(false,r(X,Y)): The agent did not perceived stench in r(X,Y).
- perceiveGlitter(true,r(X,Y)): The agent did perceived Glitter in r(X,Y).

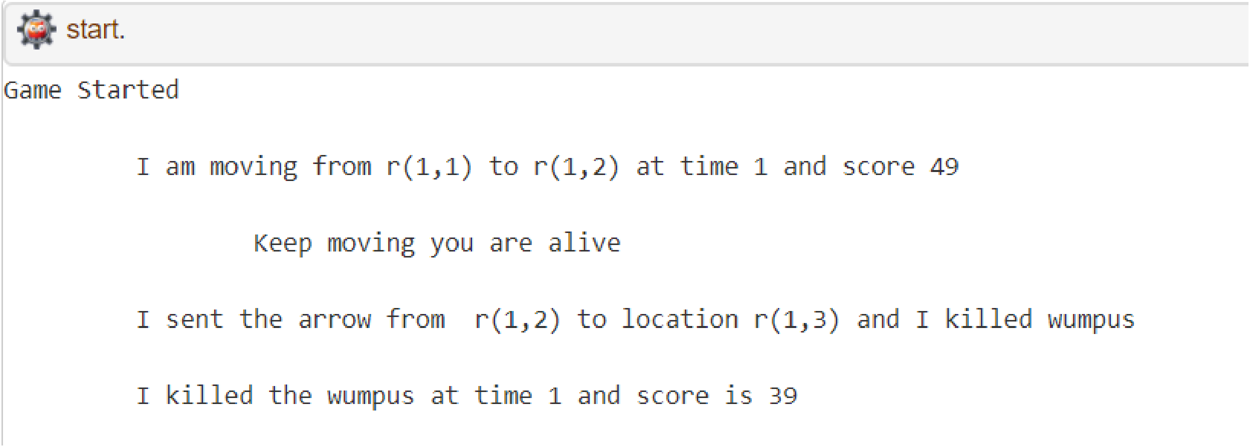
- perceiveGlitter(false, r(X,Y)): The agent did not perceived Glitter in r(X,Y).
- shootWumpus(r(X,Y)): Agent send the arrow from it current location to r(X,Y).
- preshootWumpus: Choose appropriate location to shoot the Wumpus.
- scream(true,r(X,Y)): There is scream coming from room r(X,Y).
- scream(false,r(X,Y)): There is no scream coming from room r(X,Y).
- permitted(true,r(X,Y)): r(X,Y) belongs to the grid.
- permitted(false,r(X,Y)): r(X,Y) does not belong to the grid.
- tell_KB(L): assert all the percepts of room L to the knowledge base and assumptions about adjacent rooms.
- updatebacktrack: updates the number of times agent backtracks.
- backtrack(AL,PL,B):B is the number of moves from position AL (agent location) to PL (previous location).
- move(H| Tail): move to element H, which is the head of the list, if it belong to the grid, it is safe, and not visited. Otherwise, it does a recursive call to the rest of the list which is called Tail.
- getAdjacentRooms(r(X,Y),List): List contains the adjacent rooms to r(X,Y).
- MoveFromTo(r(X,Y), r(Z,W), T) move from room r(X,Y) to room r(Z,W) at time T.
- GrabGold (r(X,Y)) grab the gold in room r(X,Y).

II- Experiments with different starting configuration:

Example 1: Shooting Wumpus successfully

1,4 S	2,4	3,4 B	Pit 4,4
1,3 W	S 2,3 B GOLD Glitter	3,3 Pit	4,3 B
OK 1,2 S	2,2	3,2 B	4,2
1,1 OK A	2,1 OK B	3,1 Pit	4,1 B

Output:



start.

```
Game Started

         I am moving from r(1,1) to r(1,2) at time 1 and score 49

                 Keep moving you are alive

         I sent the arrow from  r(1,2) to location r(1,3) and I killed wumpus

         I killed the wumpus at time 1 and score is 39
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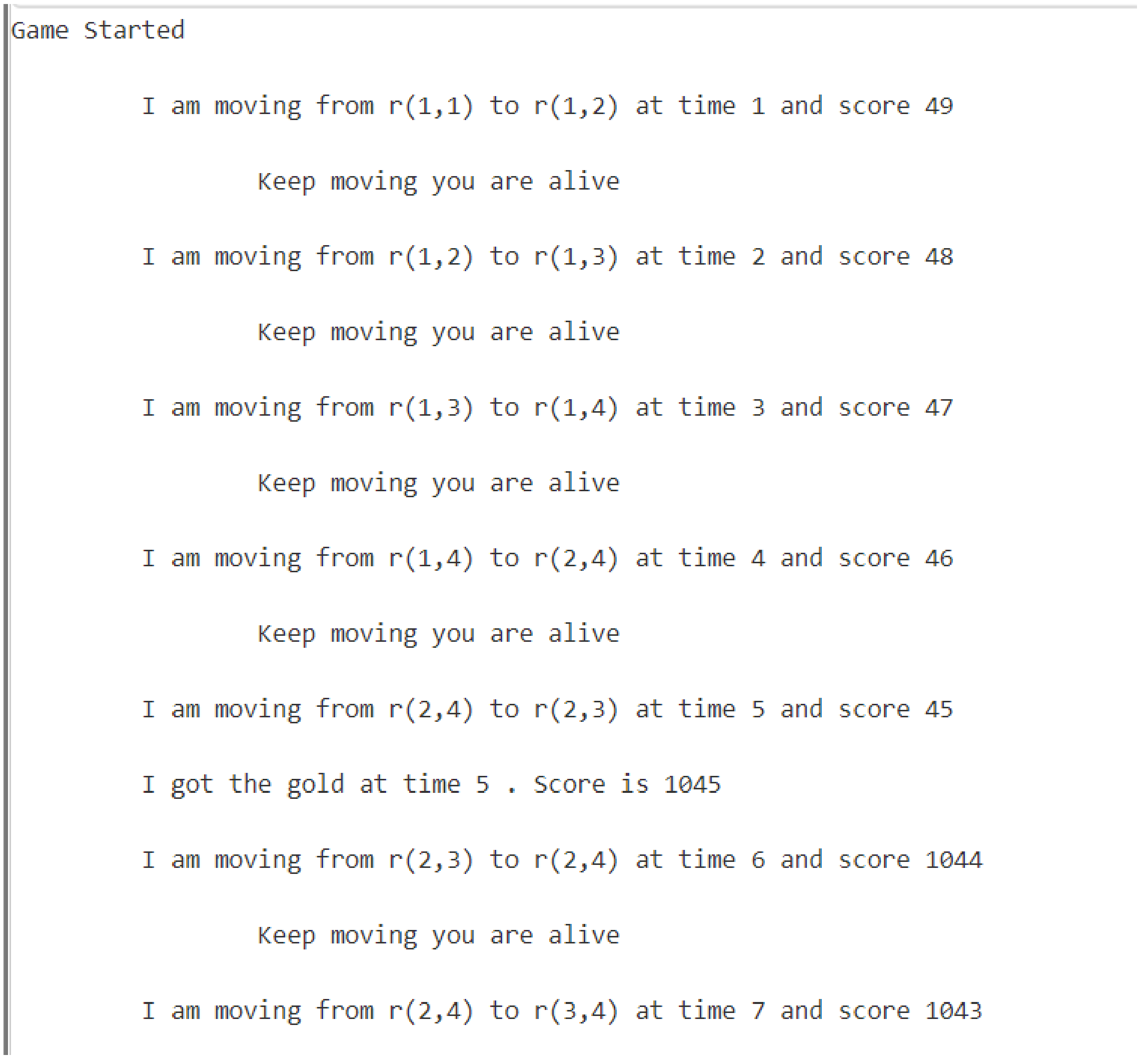
Explanation:

Our agent in this case moved to the room (1,2). It perceived stench and told the knowledge base that room(1,3) and room(2,2) are the possible locations for Wumpus. Thus, the agent had two choices which are backtracking to the room(1,1) or shooting to the room(1,3). In this case, the agent shot to the room(1,3) and it turns out to be the room that had the Wumpus.

Example 2: Agent get stuck and takes a random move

1,4	2,4	3,4 B	Pit 4,4
1,3	2,3 B GOLD Glitter	3,3 Pit	4,3 B S
OK 1,2	2,2	3,2 B S	4,2 W
1,1 OK A	2,1 OK B	3,1 Pit	4,1 B S

Output:



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Game Started

        I am moving from r(1,1) to r(1,2) at time 1 and score 49

                Keep moving you are alive

        I am moving from r(1,2) to r(1,3) at time 2 and score 48

                Keep moving you are alive

        I am moving from r(1,3) to r(1,4) at time 3 and score 47

                Keep moving you are alive

        I am moving from r(1,4) to r(2,4) at time 4 and score 46

                Keep moving you are alive

        I am moving from r(2,4) to r(2,3) at time 5 and score 45

        I got the gold at time 5 . Score is 1045

        I am moving from r(2,3) to r(2,4) at time 6 and score 1044

                Keep moving you are alive

        I am moving from r(2,4) to r(3,4) at time 7 and score 1043
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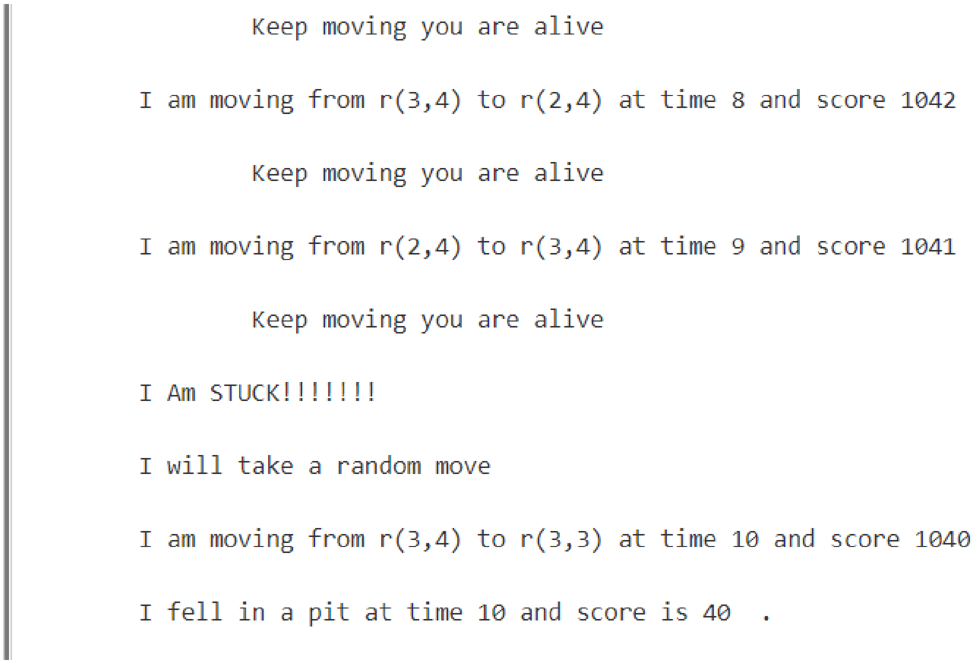

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        Keep moving you are alive

I am moving from r(3,4) to r(2,4) at time 8 and score 1042

        Keep moving you are alive

I am moving from r(2,4) to r(3,4) at time 9 and score 1041

        Keep moving you are alive

I Am STUCK!!!!!!!

I will take a random move

I am moving from r(3,4) to r(3,3) at time 10 and score 1040

I fell in a pit at time 10 and score is 40  .
```
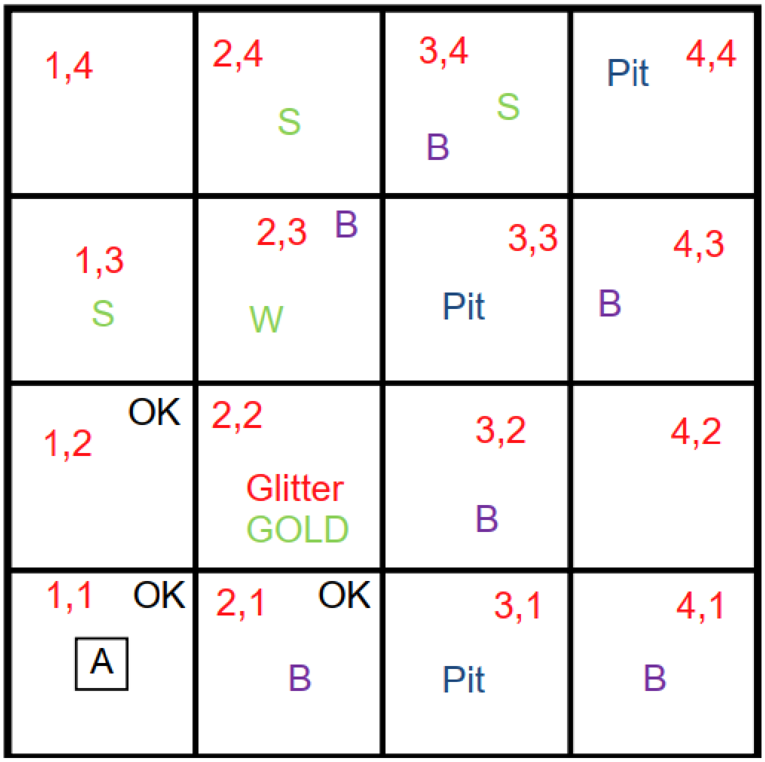

Explanation:

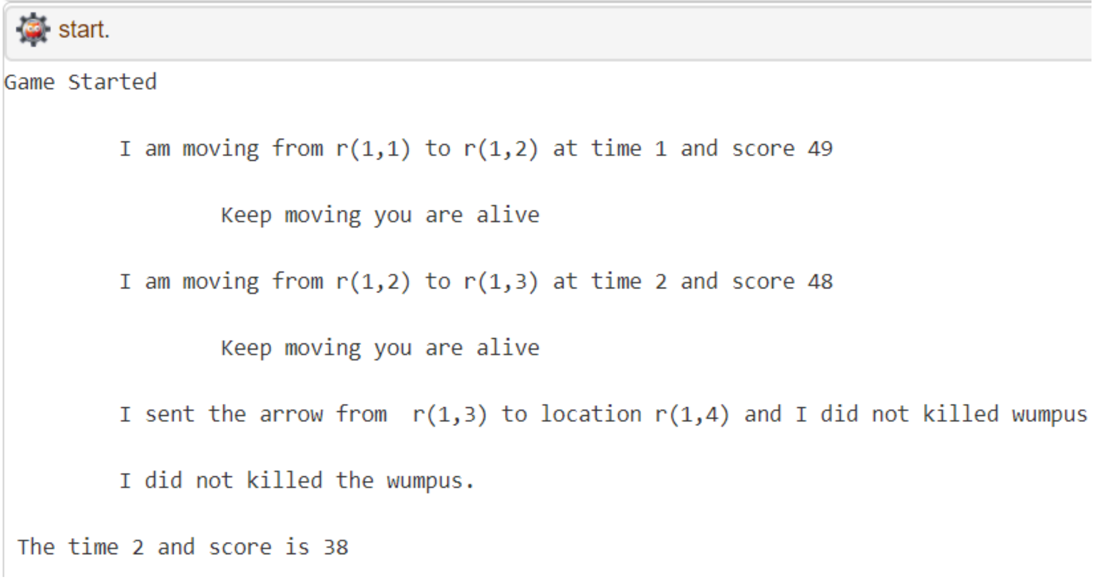
Our agent takes percepts from the room it stands in and chooses to move to a safe room. In room (2,3), the agent perceived glitter and grabbed the gold. Also, agent had to backtrack since it perceived breeze in room (2,3) and moved to room(3,4). Now, the agent got stuck because it can't move forward and find a safe room. Thus, it took a random move and will therefore fall in a pit. In addition to that, when the agent goes back and forth between room(3,4) and room(2,4) it just means that it couldn't find a safe room.

Example 3: Agent shoot in the wrong direction.



1,4	2,4 S	3,4 S B	Pit 4,4
1,3 S	2,3 B W	3,3 Pit	4,3 B
OK 1,2	2,2 Glitter GOLD	3,2 B	4,2
1,1 OK A	2,1 OK B	3,1 Pit	4,1 B

Output:



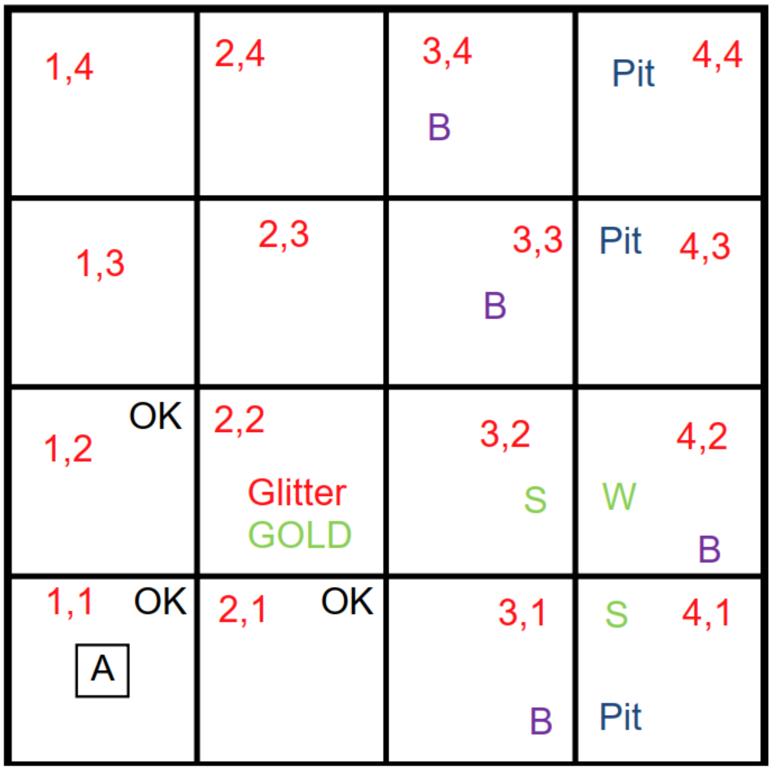
```
Game Started

        I am moving from r(1,1) to r(1,2) at time 1 and score 49

               Keep moving you are alive

        I am moving from r(1,2) to r(1,3) at time 2 and score 48

               Keep moving you are alive

        I sent the arrow from  r(1,3) to location r(1,4) and I did not killed wumpus

        I did not killed the wumpus.

 The time 2 and score is 38
```

Explanation:

In this case, when the agent perceived the stench in the room(1,3) it means that Wumpus is close to the agent's location. Our agent is programmed to send the arrow to an adjacent and unvisited room, and since the agent doesn't know where the Wumpus is located precisely, it may or may not kill the Wumpus. The predicate scream indicates whether the agent killed Wumpus or not.

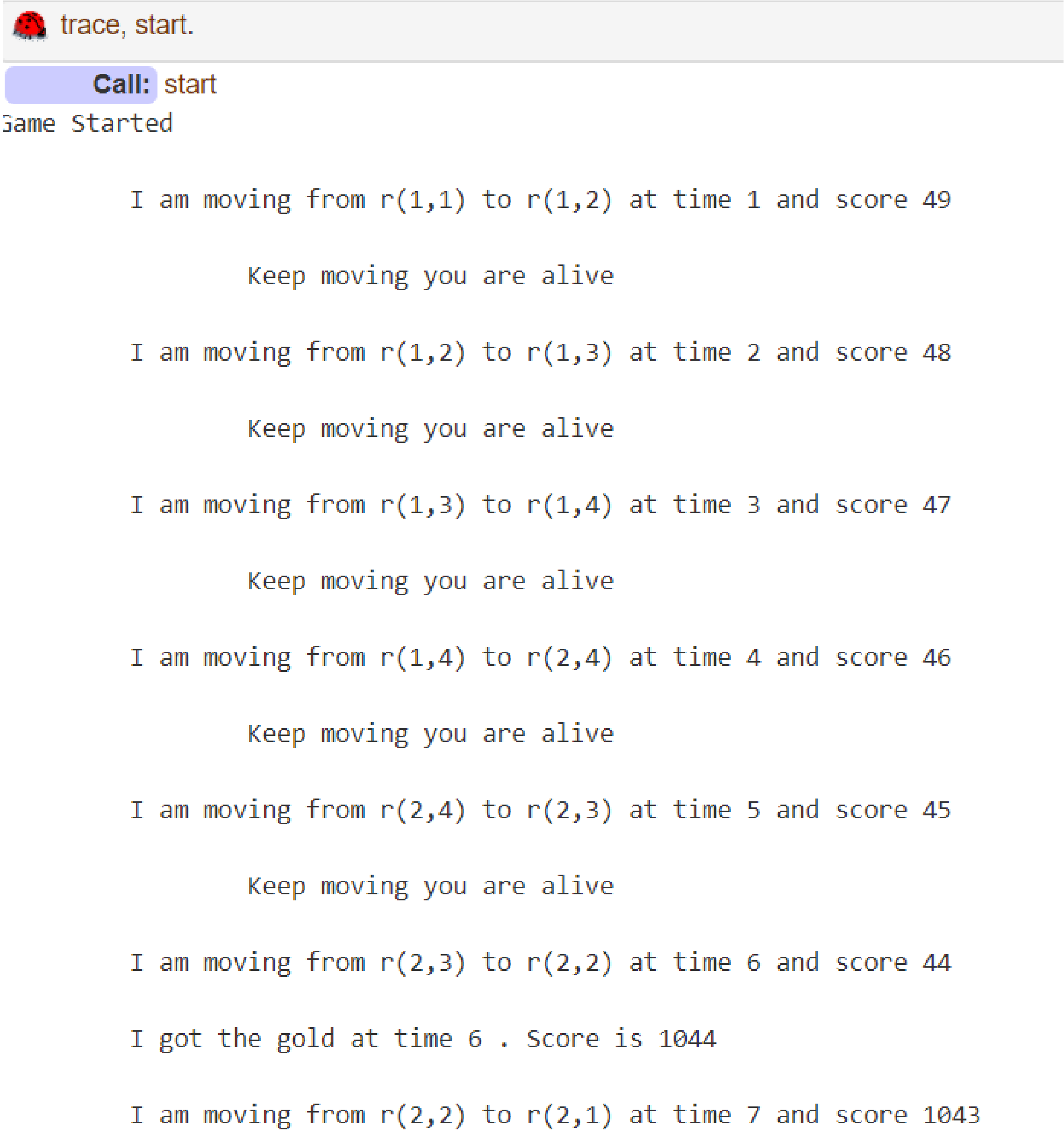
In this case, the agent couldn't shoot the Wumpus because it didn't have enough information about its location so when it perceive stench in room(1,3) it assumed that Wumpus may be located in room(1,4). Eventually, the agent sent the arrow to room(1,4) and did not kill the wumpus.

Example 4: Backtracking and choosing a random move



1,4	2,4	3,4 B	Pit 4,4
1,3	2,3	3,3 B	Pit 4,3
OK 1,2	2,2 Glitter GOLD	3,2 S	4,2 W B
1,1 OK A	2,1 OK	3,1 B	S 4,1 Pit

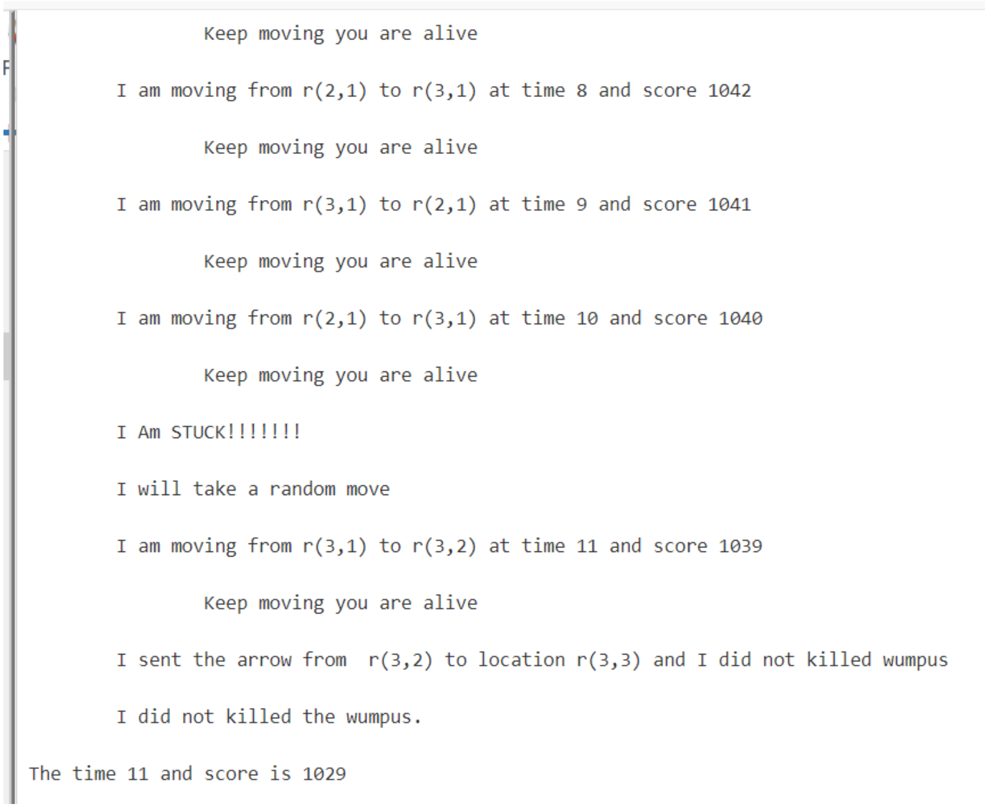
Output:



🐞 trace, start.

Call: start

```
Game Started

        I am moving from r(1,1) to r(1,2) at time 1 and score 49

                Keep moving you are alive

        I am moving from r(1,2) to r(1,3) at time 2 and score 48

                Keep moving you are alive

        I am moving from r(1,3) to r(1,4) at time 3 and score 47

                Keep moving you are alive

        I am moving from r(1,4) to r(2,4) at time 4 and score 46

                Keep moving you are alive

        I am moving from r(2,4) to r(2,3) at time 5 and score 45

                Keep moving you are alive

        I am moving from r(2,3) to r(2,2) at time 6 and score 44

        I got the gold at time 6 . Score is 1044

        I am moving from r(2,2) to r(2,1) at time 7 and score 1043
```

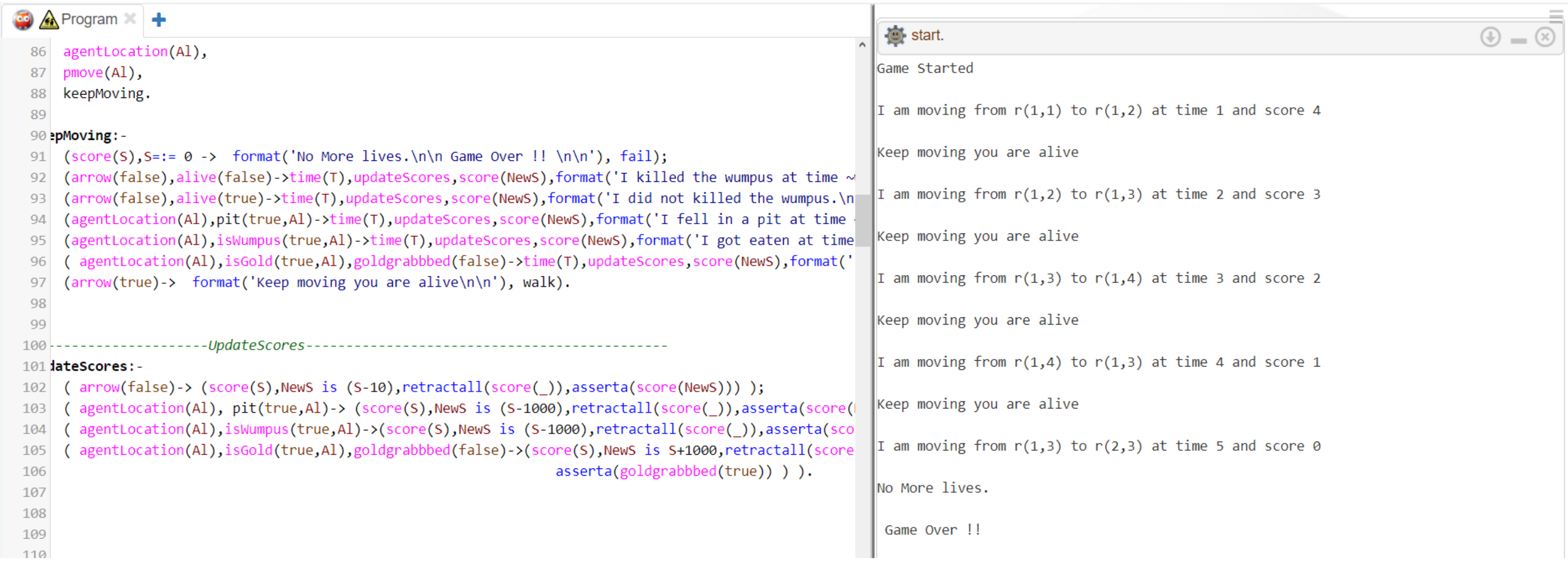


```
                Keep moving you are alive

        I am moving from r(2,1) to r(3,1) at time 8 and score 1042

                Keep moving you are alive

        I am moving from r(3,1) to r(2,1) at time 9 and score 1041

                Keep moving you are alive

        I am moving from r(2,1) to r(3,1) at time 10 and score 1040

                Keep moving you are alive

        I Am STUCK!!!!!!!

        I will take a random move

        I am moving from r(3,1) to r(3,2) at time 11 and score 1039

                Keep moving you are alive

        I sent the arrow from  r(3,2) to location r(3,3) and I did not killed wumpus

        I did not killed the wumpus.

The time 11 and score is 1029
```

Explanation:

In this case when the agent arrived at room(3,1) and perceived breeze it couldn’t move anywhere for this reason it backtracked to room(2,1). Since all the rooms adjacent to room(2,1) are visited already, the agent went back to room(3,1) and made a random move to room(3,2) which turns out to be safe. Since there is stench in room(3,2), the agent sends the arrow in a random direction which is room(3,3) and did not kill the Wumpus.

Examples 5: Reduce lives from 50 to 5



```
agentLocation(Al),
pmove(Al),
keepMoving.

epMoving:-
(score(S),S=:= 0 ->  format('No More lives.\n\n Game Over !! \n\n'), fail);
(arrow(false),alive(false)->time(T),updateScores,score(NewS),format('I killed the wumpus at time ~
(arrow(false),alive(true)->time(T),updateScores,score(NewS),format('I did not killed the wumpus.\n
(agentLocation(Al),pit(true,Al)->time(T),updateScores,score(NewS),format('I fell in a pit at time
(agentLocation(Al),isWumpus(true,Al)->time(T),updateScores,score(NewS),format('I got eaten at time
( agentLocation(Al),isGold(true,Al),goldgrabbbed(false)->time(T),updateScores,score(NewS),format('
(arrow(true)->  format('Keep moving you are alive\n\n'), walk).


-------------------UpdateScores-------------------------------------------
dateScores:-
( arrow(false)-> (score(S),NewS is (S-10),retractall(score(_)),asserta(score(NewS))) );
( agentLocation(Al), pit(true,Al)-> (score(S),NewS is (S-1000),retractall(score(_)),asserta(score(
( agentLocation(Al),isWumpus(true,Al)->(score(S),NewS is (S-1000),retractall(score(_)),asserta(sco
( agentLocation(Al),isGold(true,Al),goldgrabbbed(false)->(score(S),NewS is S+1000,retractall(score
                                                            asserta(goldgrabbbed(true)) ) ).
```

```
Game Started

I am moving from r(1,1) to r(1,2) at time 1 and score 4

Keep moving you are alive

I am moving from r(1,2) to r(1,3) at time 2 and score 3

Keep moving you are alive

I am moving from r(1,3) to r(1,4) at time 3 and score 2

Keep moving you are alive

I am moving from r(1,4) to r(1,3) at time 4 and score 1

Keep moving you are alive

I am moving from r(1,3) to r(2,3) at time 5 and score 0

No More lives.

 Game Over !!
```

Explanation:

In this case, when we reduce the number of lives to 5 lives, we can see that the agent dies, and the game terminates when the agent moves five times.

“KeepMoving” aim at checking the current standing of the agent in the game. When it falls in a pit it calls updateScores, prints the score and derminates the game. Also, it checks the existence of the arrow, if the agent sent the arrow, it terminates the game. On the other hand, if the agent still has the arrow, it calls walk to allow the agent to move. In addition, to that it checks whether the agent still have more lives, if not it terminates the game.

III- Limitation of the solution presented:

We can conclude from the experiments that our agent can get stuck and randomly choose to move to an unsafe room that can contain a pit. Also, our agent shoots randomly since it couldn't find the location of the Wumpus. Even though our agent gathers perceptions from the room it visits and tries to infer the possible location for the Wumpus or the pit around it, the information in the agent's knowledge base is not enough to indicate which room is more dangerous than the other. Therefore, our agent still can't choose the best moves among the possible moves. Due to time constrain, we couldn't develop a solution for this problem. Eventually, we cannot affirm that our agent is an intelligent logical agent that can minimize the chances of falling in a pit or being eaten by the Wumpus and maximize the chances of directly shooting the Wumpus.

The solution for this problem is the following: we can create a heuristic that indicates the danger level of each room. This heuristic along with the percepts will help the agent make the best move and find the best direction to shoot the Wumpus and win the game.

In addition to that, the agent we implemented does uninformed search. In order to improve its efficiency in killing the Wumpus we have to use a heuristic that informs the agent about how far it is from the Wumpus location. Also, our agent gets stuck when it perceives breeze, and it finds itself stuck and surrounded by possible location of pit. In order to improve the agent efficiency in avoiding pits and finding the best move among the allowed moves we can implement a heuristic that assign degree of danger to each room to allow the agent to make a reasonable decision about its next move.