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CZ3005 Artificial Intelligence – Lab Assignment 2

Wumpus World II

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# Background

The objective was to use Prolog to implement an agent to explore a Wumpus World game space intelligently, using first-order logic to reason about its moves and avoid death. The space would be created by a Python driver, which would supply percepts to the agent.

This assignment is specified to be a relaxed version of the classic Wumpus World problem whereby there is no requirement to kill the Wumpus and collect all the coins.

# Verification

We verify our results by matching the relative map generated by the Agent to the absolute map stored by the Driver. We assess the results based on the following criteria, and detail how we verify correctness in each scenario.

1. Correctness of Agent’s localization and mapping abilities
2. Correctness of Agent’s sensory inference
3. Correctness of Agent’s memory management in response to stepping though a Confundus Portal
4. Correctness of Agent’s exploration capabilities

# Approach

We implemented the Prolog Agent in SWI-Prolog. Because the Agent must perform an action to receive new information from the world, the logical architecture of the program is segmented between the Python Driver and the Prolog Agent.

The Python Driver contains the true state of the world, including absolute coordinate values for the Wumpus and other items in the game space. Meanwhile, the Agent moves in the world, determining the best possible move it can make given the current explored state of the space and executing it to learn more about the world. The Driver controls the event flow, prompting the Agent for its next move or allowing it to execute the moves it has generated. The Driver will also supply percepts for any given move the Agent makes. Generally, the Driver maintains active control flow over the program.

We match the specifications provided for both Driver and Agent, allowing both components to interface with others if they follow the specification as well. Beside the standard functions/terms (i.e.. move/2, explore/1, reposition/1, etc.), private functions are used to implement functionality. Usage of these internal functions should be avoided by other teams/evaluators.

Prolog Agent

Diagram

Description automatically generatedThe Agent evaluates its moves in several steps. Firstly, it uses the knowledge it has about the world to determine which room it should explore next.

Rooms may be unvisitable if there is a Stench/Tingle in neighboring rooms until the Agent can confirm that the room is safe. Therefore, the Agent’s knowledge limits the search space for pathfinding.

Secondly, the Agent tries to pathfind to the best available room, defined as the room with the lowest number of moves required, that is both non-dangerous and unvisited. It can also reason that given the size of the game space, it cannot move more than M or N distance in a single direction. Lastly, walls discovered will also inhibit the Agent’s movement.

Lastly, after the Agent has declared the moves it will make, the Driver determines the percepts the Agent experiences. It uses the percepts in two ways: reasoning about the world based on the information given, and the information that is absent. Reasoning based on present information is simple – if there is a stench/tingle, then the surrounding cells may be dangerous. Glitter indicates a coin to be picked up in the next turn, and Bumps indicate a wall directly in front.

Reasoning based on missing information is just as simple, but important. Because Stenches/Tingles limit the search space drastically in the small game space, it is important to update the knowledge base once it can be confirmed that there is no danger.

Given that there is no scenario in which the Agent will die immediately without a percept indicating danger, given properly implemented heuristics, the Agent will always complete the game. The Agent may not be able to collect all the coins or kill the Wumpus as there may be sequences where the Wumpus and Confundus Portal locations prevent movement to important cells, but the Agent is guaranteed to survive the game.

Python Driver