Documentation: Wumpus World Implementation

1. Introduction

The Wumpus world is a 16-room (4x4) cave. There are pathways connecting each room to the others; no rooms are connected diagonally. Room is where the knowledge-based agent begins [1, 1]. The cave has a beast called Wumpus, a treasure, and a few pitfalls. The Wumpus, unable to move, consumes everybody who enters its chamber. The agent becomes stuck in the pit if it goes inside. The agent's objective is to retrieve the treasure and exit the cave. When the objective requirements are fulfilled, the agent receives a reward. When the agent is devoured by a wumpus or falls into a pit, it is punished.
The stink of the wumpus's surrounding quarters is one of the elements that aids the agent in exploring the cave.
When encountering the wumpus, the agent is equipped with a single arrow that it can use to kill it; the wumpus will scream when it is slain. – There is a lot of airflow in the rooms next to the pits.It's always glittering in the treasure room.

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2. Environment Description

Grid Structure

- The Wumpus World consists of a **4x4 grid**.
- Each cell in the grid can contain one or more of the following:
    - **Wumpus (W):** A dangerous monster.
    - **Pit (P):** A hazard where the agent falls to its death, it is bottomless hole.
    - **Gold (G):** The goal item for the agent.
    - **Agent (A):** Knowledge based Agent.
    - **Empty Space:** A safe cell without any hazards.

Example Grid Layout

Here is an example of a possible 4x4 grid:

```
    0    1    2    3
3 [' ', 'P', ' ', ' ']
2 [' ', ' ', 'W', ' ']
1 [' ', 'P', ' ', 'G']
0 ['A', ' ', ' ', ' ']
```

Agent

- The agent starts in the bottom-left corner of the grid (0,0).
- It must find and grab the gold, avoid hazards, and exit the grid safely.

Percepts

The agent receives sensory information about the environment:

PEAS Description for the Wumpus World problem:

Performance measures:

If agent gets the gold and return back safe it gets reward.

If agent dies it loses the point (reward).

Environment:

A cave with *16(4×4)* rooms

Actuators:

- Move forward
- Turn right
- Turn left
- Shoot
- Grab
- Release

Sensors:

- **Stench:** Detected in cells adjacent to the Wumpus.
- **Breeze:** Detected in cells adjacent to a pit.
- **Glitter:** Detected in the same cell as the gold.

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3. Implementation Steps

Step 1: Grid Initialization

- The grid is represented as a 4x4 matrix.
- Objects (Wumpus, pits, and gold) are placed randomly, ensuring no overlap with the agent's starting position.

Step 2: Percept Mechanism

- Percepts are generated based on the contents of adjacent cells:
    - **Stench:** If a Wumpus is in a neighboring cell.

    - **Breeze:** If a pit is in a neighboring cell.
    - **Glitter:** If the gold is in the current cell.

Step 3: Agent Design

The agent uses logical reasoning to decide its actions:

- **Grab:** Collect the gold if it is in the same cell.
- **Move:** Navigate to adjacent cells based on percepts.
- **Avoid:** Stay away from cells perceived to be dangerous.
- **Exit:** Leave the grid safely once the gold is collected.

Step 4: Simulation

- Multiple scenarios are tested by generating random grids.
- The agent is run in these environments to validate its performance.

4. Code Structure

Grid Representation

- **4x4 matrix:** Each cell can contain 'W', 'P', 'G', or ' '.

Percept Calculation

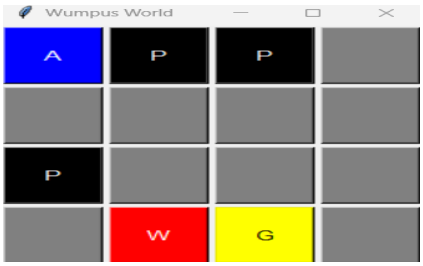
- Adjacent cells are checked for Wumpus, pits, and gold.

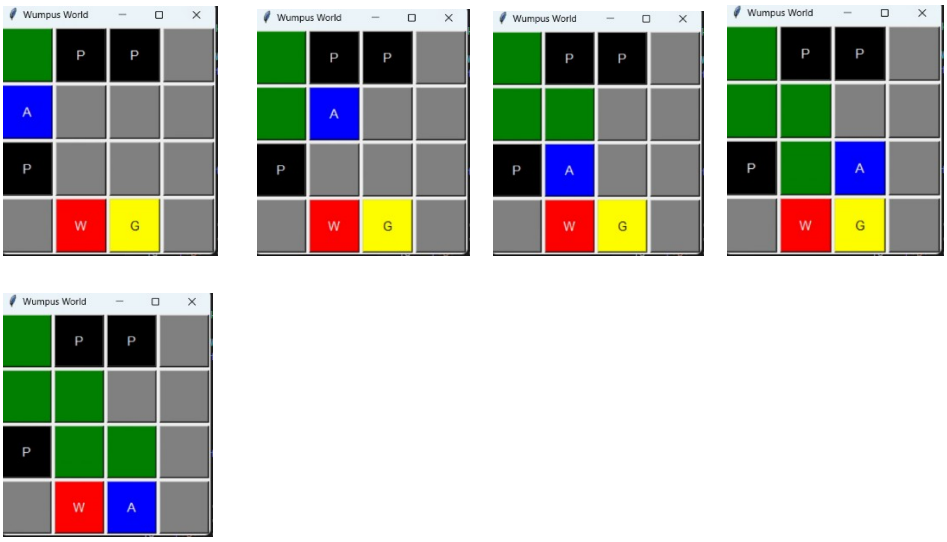
Agent Logic

- Actions are determined based on percepts.
- Decision-making uses simple logical rules.

5. Testing Scenarios

Example 1: Safe Path

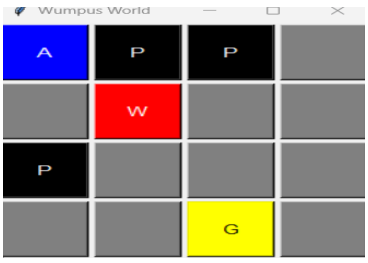




- **Agent Actions:**
    1. Move to (0,0): Perceives Breeze, avoids pits.
    2. Move to (1,0): Perceives Breeze, avoids pits.
    3. Move to (1,1): Perceives Breeze, avoids pits.
    4. Move to (2,1): Perceives Breeze, avoids pits and perceives Stench avoid Wumpus.
    5. Move to (2,2): Safe continue Explore.
    6. Move to (3,2): Perceives Glitter grab the gold and climb.
    7. Exit safely.

Example 2: Hazard Encounter

- **Grid:**



- **Agent Actions:**
    1. Move to (1,0): Perceives Breeze and Perceives Stench avoids further exploration in this direction.
    2. No way to Explore.

6. Results

- The agent successfully avoids hazards and collects gold in most scenarios.

- Performance depends on the logical rules implemented and the randomness of the grid configuration.