CSC14003 – Artificial Intelligence

PROJECT 02: LOGICAL AGENT

1. Wumpus World

The purpose of this project is to design and implement a ***logical agent*** that navigates through the Wumpus World, a ***partially-observable*** environment.

The Wumpus World presents the following key features:

- The environment is an underground cave with a network of interconnected two-dimensional rooms.
- A room may contain a *deadly* ***pit***, signaled by a perceivable ***breeze***, or a *fatal* ***Wumpus*** *monster*, detectable via a discernible ***stench***.
    - The agent will die immediately when entering a room containing one of those harmful factors. No withdrawal is possible.
    - The percepts are available in the *four-neighborhood of the room* containing one of those harmful factors.
- The agent has ***arrows*** to shoot in the direction he is facing.
- There is one ***chest of gold***, located somewhere in the cave.
- Movement options: *forward, turn left, or right by 90 degrees*.

The primary objective encompasses locating the gold. During the journal, the agent may need to kill Wumpus to pursuit success in this environment.

Figure 1 demonstrates an example of the Wumpus world with key entities.

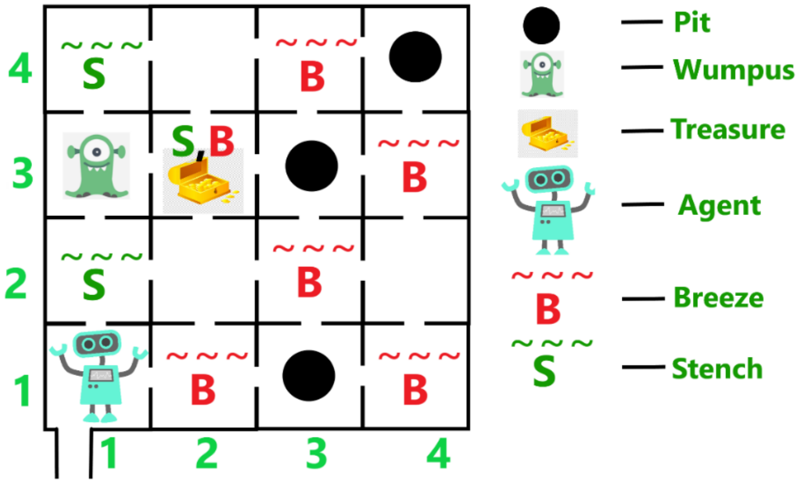

Figure 1. An example of the Wumpus world with key entities.

2. Project Description

Our Wumpus World for actual implementation slightly differs from the original problem description. The environment's specification is as follows.

1. **Grid Layout**:
    - The grid size has increased from 4x4 to **10x10**.
2. **Elements**:
    - **Agent**: The agent moves around the grid trying to achieve its goals.
    - **Wumpus**: A monster that kills the agent if they end up in the same cell.
    - **Gold**: The agent's goal is to find and retrieve the gold.
    - **Pits**: Dangerous cells that the agent falls into and dies.
    - **Poisonous Gas**: Reduces the agent's health by 25% if entered.
    - **Healing Potions**: Restores the agent's health by 25% when using.
3. **Percepts**:
    - **Breeze**: Indicates an adjacent cell contains a pit.
    - **Stench**: Indicates an adjacent cell contains the Wumpus.
    - **Scream**: Heard if the Wumpus is killed.
    - **Whiff**: Indicates an adjacent cell contains poisonous gas.
    - **Glow**: Indicates an adjacent cell contains a healing potion.
4. **Agent's Actions.**
    - **Move Forward**: Moves to the next cell in the direction the agent is facing.
    - **Turn Left/Right**: Changes the agent's direction.
    - **Grab**: Picks up gold or healing potions if present in the cell.
    - **Shoot**: Fires an arrow in the direction the agent is facing to kill the Wumpus. Arrows can only hit targets in adjacent cells.
    - **Climb**: Exits the cave (used when the agent is in the starting position).
    - **Heal**: Uses a healing potion to restore health.
5. **Goals**
    - The primary goal remains to find the gold and return to the starting position without dying with the highest score the agent can achieve.
6. **Other requirements**
    - Recommended libraries for solving logic problems on Python: PySAT, SciPy.

- There may be any number of pits and chests of gold in the world.
- There is **at least** one Wumpus.
- The agent carries an **infinite** number of arrows.
- When the agent **grabs** the **healing potion**, the **glow of that healing potion** will **disappear**.
- The **poison gas** will **last forever**. The agent can be poisoned **multiple times** in the same cell.
- When the **Wumpus dies**. It will **scream** and you will know this information.
- After Wumpus dies, the **stench of that Wumpus** will **disappear** (you should update the state of map after Wumpus dies)
    - The game will end when one of the following **two** conditions occurs:
    - The agent dies (by wumpus, pit or 0% of health).
    - The agent climbs out of the cave **(exit the cave).**

The following activities can give the agent certain amounts of points.

Activity	**Points**
Pick up each chest of gold	+5000
Shoot an arrow	– 100
Killed by the Wumpus or Fall into a pit	– 10,000
Climb of the cave	+ 10
All Agent's Action	– 10

3. Tasks

Your group must play two roles:

- **Program**: set up a program to build the map
- **Agent**: explore the Wumpus world and get the highest score possible for that world, using either Propositional Logic or First-Order Logic (or both).

Your implementation should *output information about the search*, including the *percepts at every room the agent enters*, the *updates in the knowledge base after each new percept*, and the *action decided upon by the agent*. The program should also *output the score of the agent*.

Having your implementation generate worlds randomly can help you test your agent.

4. Specifications

You need to create 2 classes Program and Agent in separate files.

For class Program: This class is responsible for building the map, and reporting information about the elements in the cell.

Input: the given map is represented by matrix, which is stored in the input file, for example, map1.txt. The input file format is described as follows:

- The first line contains an integer N, which is the size of map.
- N next lines with each line represents a string. If room empty, it is marked by hyphen character (-). If room has some things or signal such as Wumpus(W), Pit(P), Breeze(B), Stench(S), Agent(A) or Gold(G). Between two adjacent rooms is separated by a dot (.)
- **Input only includes Wumpus(W), Pit(P), Agent(A) and Gold(G), Poisonous Gas(P_G), Healing Potions(H_P). You need to update information about Stench(S), Breeze(B), Whiff(W) and Glow(G_L) on the map based on input data.**
- For example:

  -.-.W.-.P.-.-.P_G.-.-

  -.-.-.-.-.-.-.-.-.-

	S	W	BS	P	B	W	P_G	W	
		S		B			W		

Output: The map with all infomation

Class Agent

The agent can only know the components of the cell where it is standing. The agent must go step by step and call the program to get information about the cell it is standing on from class program. From there, it makes percepts to find the direction of movement and infer objects based on the available information.

NOTE: The agent does not know the information on the whole map.

Result: a result with path for agent, game point will be displayed on screen and written in output text file such as result1.txt.

You can write output in the following format:

```
(1,1): move forward
(1,2): turn right
(1.2): shoot
…..
```

5. Requirements

No.	Specifications	Scores
1	Finish problem successfully.	50%
2	Graphical demonstration of each step of the running process. You can demo in console screen or use any other graphical library.	10%
3	Generate at least 5 maps with difference structures such as position and number of Pit, Gold and Wumpus.	20%
4	Report your algorithm, experiment with some reflection or comments.	20%
Total		100%

6. Notice

This assignment will be completed in **groups**, as registered at the beginning of the course. To prepare, you will need to create a folder that contains various subfolders, including source, input, output, and document. The report must give the following information:

- Your detailed information (Student Id, Full Name)
- Assignment Plan
- Environment to compile and run your program.
- Estimating the degree of completion level for each requirement.
- References (if any)

Any plagiarism, tricks, or any lie will have 0 points for the course grade.