Universidad Nacional Autónoma de México

Faculty of Engineering

Maze solver

S U B J E C T

Artificial Intelligence

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1. Objectives

The objective of this practice is to implement and compare two intelligent agent approaches for solving a matrix-represented maze: a simple reflective agent and a goal-based. The goal is to identify the advantages, limitations, and outcomes of each strategy, as well as to understand the importance of planning in artificial intelligence systems.

2. Introduction

In the field of Artificial Intelligence, agents are entities that perceive their environment and act upon it to achieve certain goals. There are different types of agents, but in this practice, we'll focus on the following two:

- **Simple reflective agents:** They make decisions based on reactive rules, responding only to the current situation without considering a long-term plan.
- **Goal-based agents:** They take into account the desired goal state and plan their actions accordingly, often using search and optimization techniques to find the best path to the goal.

The complete source code of the implementation is available in the repository of GitHub : `https://github.com/ksobrenat32/artificial-intelligence-2026-1/tree/main/01-maze`

3. Development

3.1. Problem Representation

The maze waz modeled as a matrix where:

- 1: represent a wall
- 0: represent a free space
- S: represent the start point
- M: represent the goal point

the agent's task is to move form S to M, following the maze's constraints.

3.2. Simple Reflective Agent

The reflective agent was designed to act based on simple rules: it attempts to move in the following order: right, down, left, up.

- It does not plan ahead.
- It does not remember previously explored routes.
- It only reacts to immediate environmental conditions.

3.2.1. Advantages

- Simplicity of implementation.
- Speed of execution when the path to the goal is direct.

3.2.2. Disadvantages

- It can get stuck in a loop or dead end.
- It does not guarantee finding the goal in complex mazes.

3.3. Goal-Based Agent

The goal-based agent for our implementation uses the Breadth-First Search (BFS) algorithm. This approach explores all possible paths in a breadth-first manner, ensuring that, if a solution exists, the shortest route to the goal is found.

- Uses a queue to store partial routes.
- Records visited positions to avoid repeating steps.
- Evaluates neighbors in four directions (right, down, left, up).

3.3.1. Advantages

- Always finds the goal if there is a path.
- Guarantees the shortest solution in terms of number of steps.
- Reflects a model closer to intelligent planning.

3.3.2. Disadvantages

- Can be memory-intensive due to storing all explored paths.
- May be slower in practice compared to simpler methods.

4. Results

During testing with different mazes, the following situations were observed:

- When the reflective agent performs well:
  - In mazes with a direct path from the start to the goal.
  - It arrives quickly because it doesn't need to evaluate alternatives.
- When the reflective agent fails:

    - In scenarios where the correct path involves backtracking or bypassing obstacles.
    - It can get stuck and never reach the goal.
- When the goal-based agent is superior:
    - In complex mazes with multiple branches.
    - It finds the goal whenever a path exists.
    - It identifies the shortest path, optimizing the number of steps.

5. Conclusion

The practical experience provided insight into the fundamental differences between a reactive agent and a planning agent. The simple reflective agent proved useful in simple environments, but insufficient for solving more complex problems. In contrast, the goal-based agent, although more computationally expensive, guarantees optimal results.

This contrast highlights the importance of choosing the type of agent based on the problem to be solved. In real-life applications, reflective agents are useful for quick and straightforward tasks (such as alarms or sensors), while goal-based agents are essential in navigation systems, robotics, or video games, where planning is necessary to achieve complex objectives.