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Design Defense

CS-370 7-3 Project Two

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Analyze the differences between human and machine approaches to solving problems.

Describe the steps a human being would take to solve this maze.

I am not sure where this was learned from, but my approach to solving a maze has always been to put my hand on the wall and start walking, never taking my hand from the wall. Of course, this isn't the most efficient or quickest way of completing a maze, but it has always proven to be a reliable way of getting through it. There are other ways, like mapping it out and marking what paths lead to dead-ends, which avoids walking through the same areas more than once, but this requires planning. To solve this maze, I would start with my right hand on the wall and begin walking through it, eventually leading to the exit.

Describe the steps your intelligent agent is taking to solve this pathfinding problem.

At the start of learning, the agent randomly explores the environment to get a better idea of its surroundings. However, this leads to some bad moves (like running into walls or going outside the maze), which leads to negative rewards. Instead of always exploring, it does a little of both exploring and using some of its knowledge of the map. The epsilon value keeps it from always making random choices and is gradually decreased so the agent can focus more on its experience instead of pure chance.

What are the similarities and differences between these two approaches?

Honestly, the approach I mentioned is more of a brute force and trial-and-error method than any type of systematic or problem-solving method. It doesn't lead to a quick solution but will eventually get it. A similarity between the two methods might be that they both explore new areas of the maze,

the difference is that the agent eventually learns what paths are bad and will choose not to take them based on Q-values. A difference between me following a wall and the agent is that it will make decisions using its deep learning model, meaning that where I would follow the wall no matter what, the agent will predict future actions based on its current state.

Assess the purpose of the intelligent agent in pathfinding.

What is the difference between exploitation and exploration? What is the ideal proportion of exploitation and exploration for this pathfinding problem? Explain your reasoning.

In reinforcement learning, exploration refers to taking risks by trying new paths in the hope of finding a higher reward (GeeksforGeeks, 2024). Exploration involves making decisions in unknown areas by taking more random approaches to solving the maze (GeeksforGeeks, 2024). This process lets the agent find unknown possibilities that it can learn from (Survey Point Team, 2024; GeeksforGeeks, 2024).

Exploitation is when the agent makes decisions that will lead to the largest reward while hopefully getting the highest cumulative reward(Survey Point Team, 2024; GeeksforGeeks, 2024). It makes decisions in known areas, based on previous experience. Exploitation is about moving toward the best-known path and getting as close as possible to the goal (Survey Point Team, 2024; GeeksforGeeks, 2024).

How can reinforcement learning help to determine the path to the goal (the treasure) by the agent (the pirate)?

Reinforcement Learning (RL) is what we used for this project (Treasure Hunt Game). As seen in the results from the project and considering it knew nothing about mazes before it began, it was an effective way to solve the problem.

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Reinforcement learning can help to determine the path to the goal by using a set of different elements. A policy determines the agent's behavior. There is a map of different states of the environment that instructs the agent what to do while in that state (or spot). A reward function defines the goal through a score for each state. This encourages the agent to make decisions that will increase the reward. A value function helps the agent figure out the long-term benefits of the different states. This guides it toward actions that get the maximum reward in the end. Lastly, a Model of the Environment allows the agent to predict the outcomes of its actions which aids in planning the best path to the goal. (GeeksforGeeks, 2023)

Evaluate the use of algorithms to solve complex problems.

How did you implement deep Q-learning using neural networks for this game?

I believe we use a simple version of deep Q-learning in this game. It doesn't use any deep learning models, like Convolutional Neural Networks, that might typically used in deep q-learning. However, the `build_model` function creates a neural network and the game utilizes Q-learning in the `qtrain` function. Deep Q-learning, otherwise known as a DQN (Deep Q-Network), is essentially just a neural network plus Q-learning, replacing the Q-table with a neural network (Luu, 2024).

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