CS-370- H7066-Current/Emerging Trends in CS

Module 7: Project Two Design Defense

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This Treasure Hunt Game aims to train an intelligent agent to go through a particular path of the maze to find a treasure. A maze refers to a puzzle or a complex network of paths and passages with multiple routes, some of which may lead to a goal or an endpoint. Numerous approaches to solving a maze entail methodically examining every possible path until the goal is attained. The agents are trained through experiential learning. For instance, humans learn through a trial-and-error approach, “whereby a response is studied or learned and executed based on whether it is followed by reinforcement (Parot, 2001). This method involves trying different methods or approaches to solve a problem until the correct one is found. The agent can begin at the exit point, starting with one hand or both, always on a wall, left turn, or right turn.

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

The following are some approaches humans and intelligent agents would use to solve the maze. Human beings use their senses to perceive their environment, analyze the information, and understand the context to go through the path to get to where the treasure is hidden. Humans would rely on past experiences, which led to either failure or success, and knowledge gained to navigate and solve the maze problem. They can adapt their strategies based on unexpected situations or environmental changes. In contrast, machines like intelligent agents use algorithms and data to process information, lacking sensory perception like humans. The agents also follow predetermined logic and rules without adaptation unless explicitly programmed to do so (Praveen, 2018).

To solve the maze, human beings would visually inspect it, noting the pathways, dead-ends, and potential routes to the treasure. Upon observing the maze's general layout, humans will search for discernible patterns. Then, by breaking the task down into smaller pieces, they will attempt to make their way through the maze while keeping track of their accomplishments and making wise

choices. One would start from a point, note it, plan a path to go through based on their observations and make decisions based on intuition or prior knowledge. Humans can adapt their strategy, retrace steps, and try alternative routes if a pathway is blocked or unfavorable.

On the other hand, an intelligent agent would try to figure out the optimal course of action to take in order to navigate the maze by utilizing any number of random paths or solutions. An intelligent agent would approach a maze problem more systematically than a human, as both a human and an AI have a start and an endpoint. An intelligent agent like the Pirate in the treasure hunt game would solve the same maze by adhering to set-up rules and algorithms. The techniques may include applying deep Q-learning, in which the agent continuously acquires new skills and enhances decision-making ability (Hu, 2016). To solve a pathfinding puzzle, the Pirate agent would follow a set of steps, first gathering input data using the given algorithm and examining the start and target positions where the treasure is located. The Pirate would follow the calculated path to make decisions based on the algorithm's output and update its location in the maze accordingly.

One of the similarities between human and intelligent agents' approaches to solving this problem is that both of them have one major goal: to go through the right path and reach out to the treasure. There is no guarantee that they will automatically reach the treasure without encountering obstacles. The human and the agent may encounter obstacles or dead ends and must adapt their strategies accordingly. Also, I have discovered that humans and machines approach the maze problem by using the same problem-solving skills to navigate the path through the maze to solve the problem.

The difference between human beings and machine approaches is that the human approach involves perception, intuition, and adaptability based on experience. In contrast, the machine approach relies on algorithms and data processing. We can also discuss the techniques each applies

to solve a problem like the maze. Also, whereas machines rely on designed algorithms and learning techniques, humans rely on their creative and critical thinking capacity.

****Assess the purpose of the intelligent agent in pathfinding. ****

Exploitation involves utilizing experience, existing knowledge, or paths that have already been discovered to progress toward the goal efficiently. In the context of a maze, this could mean using known paths that have been explored and proven to lead closer to the goal. On the other hand, Exploration involves seeking new routes (paths) or unexplored areas within the maze. In a maze scenario, Exploration is when the pirate tries different new paths to find alternative routes whenever its selected path leads to a dead-end or is blocked. The goal of exploring is to find the right path that will make it achieve its goal efficiently with higher rewards (Wilkinson et al., 2021). According to an article I read from a website called javatpoint.com, "Exploitation is defined by a greedy strategy where agents make the optimal choice based on available information in an attempt to maximize rewards by using a projected value rather than actual value." Exploitation can also be referred to as using a resource to its fullest potential, with the key component being understanding how to maximize benefits.

The goal of pathfinding, especially in a maze, is for an intelligent agent to identify the best path by quickly investigating and analyzing the maze's structure to move from a starting point to a predetermined goal. The Ideal Proportion of Exploitation and Exploration is that as the agent gains more knowledge about the maze, it gradually shifts towards exploitation, which becomes more advantageous. Exploiting the known paths closer to the goal allows for a more directed approach to reaching the destination efficiently. Moreover, a greater focus on Exploration is beneficial in the early phases of maze exploration since it aids in choosing the optimal course of action.

Reinforcement learning can aid the agent in determining the path to the goal by using trial and error while navigating the maze. In reinforcement learning, state, action, and reward are the three basic concepts. Reinforcement learning uses four components the policy, reward, value function, and environmental model to help the agent figure out how to get to the objective (Hu, 2016). In reinforcement learning, "an agent is trained to make decisions based on feedback from its surrounding environment" (Pecioski, 2023). The agent, which is the pirate, takes actions by moving through the maze and receives feedback, which could be a reward or penalties based on these actions. Positive feedback could be given for moving closer to the goal, while negative feedback could be given for moving away from the goal or hitting dead ends.

The agent can update its strategies and preferences for selecting paths by learning from these rewards and penalties. Algorithms like Q-learning can iteratively update the value estimates associated with different actions in specific states, helping the agent make better decisions while exploring the maze. In solving the maze problem, the intelligent agent balances exploitation by using known paths and Exploration by finding new paths to navigate to the goal efficiently. Using reinforcement learning techniques helps the agent explore and exploit paths iteratively based on rewards and penalties, allowing it to learn from its experiences inside the maze and determine the best path toward the treasure, which is its ultimate goal.

**** Evaluate the use of algorithms to solve complex problems. ****

"Q-learning is an off-policy, model-free reinforcement learning technique that determines the optimal path of action based on the agent's present state" (Banoula, 2023). Implementing deep Q-learning using neural networks for a treasure hunt game or pathfinding game involves:

- Setting up the game environment.
- Designing a neural network architecture.

- Managing the learning process.
- Training the agent to navigate and find the treasure.

I ensured that I installed the latest version of Python, which is working properly. In the visual studio, I logged in and verified to ensure it already had the Jupyter Notebook set up, which would be used to test the agents. After that, an algorithm and a rewards and penalty system were developed to train the agent through reinforcement learning. In the game environment setup, we define the treasure hunt environment as a grid or maze-like structure where the pirate navigates to find the treasure while avoiding obstacles or traps to receive the highest reward.

To ensure that the trained agent followed the rules in search of the treasure, we evaluate the agent by letting it navigate the environment without updating the Q-network. We, therefore, assess its performance in navigating through the obstacles and finding the treasure. By implementing these steps, one can employ the deep Q-learning algorithm and integrate neural networks to effectively train an agent (the pirate) to locate the treasure in the treasure hunt game environment.

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