7-3 Project Two Submission

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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.**

Multiple steps can be taken to solve a Treasure Hunt Game for a human being. Human beings would typically carefully go through the instructions provided for the Treasure Hunt Game. Understand the objective, rules, and any specific guidelines or clues provided. Collect any materials or tools that might be required for the game, such as a map, a compass, a pen or pencil, a notebook, or other specified items. Examine the given clues closely. Read them multiple times to understand their context, language, and possible hidden meanings. Look for keywords, numbers, symbols, or patterns relevant to solving the puzzle. To decipher the clues, utilize general knowledge, research skills, and logical thinking. Use search engines, reference books, or consult with others (if necessary) to gather information or insights that may help solve the puzzle. Focus on solving one clue at a time rather than solving the entire puzzle simultaneously. Break each clue into its components, identify the key elements, and brainstorm possible interpretations or solutions. Maintain a record of solved clues, notes, and observations. Doing this will make it easier to keep track of progress, eliminate redundant efforts, and spot connections between clues. If the Treasure Hunt Game allows collaboration, discuss the clues and potential solutions with others participating. Different perspectives and ideas can enhance problem-solving and lead to breakthroughs.

Once a potential solution is derived for a clue, test it to see if it leads to the desired outcome. If the solution is incorrect, reassess and try alternative approaches. Continue solving each clue progressively, using the previously solved and acquired knowledge as steppingstones. Each solved clue should provide a hint or lead to the next step in the game. Eventually, the treasure's location or final solution will be revealed by following the clues and successfully deciphering them. Celebrate the accomplishment and enjoy the reward! However, there may be variations in the specific steps and strategies based on the complexity and nature of the Treasure Hunt Game.

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

The intelligent agent follows a systematic approach to solve the pathfinding problem in the treasure hunt game.It establishes a suitable representation of the game’s state, including the player's position, treasure locations, walls, and other relevant information. The agent initializes the game by setting the initial state, such as the player's starting position and the positions of treasures. It then evaluates the possible actions available based on the current state. The process involves generating a list of potential moves, such as moving in different directions or performing game-specific actions. Next, the agent employs a decision-making strategy to select the best action. Factors like proximity to treasures, obstacles, and remaining moves are considered to make an informed decision.

Once the action is selected, the agent performs the action within the game environment. The process involves updating the game’s state, such as moving the player to a new position or collecting a treasure. The agent then checks for termination conditions to determine if the game has ended. If not, it repeats the process by evaluating possible actions based on the updated state. After the game concludes, the agent evaluates the outcome, considering factors such as the number of treasures found, or the final score achieved. This assessment provides feedback on the agent's performance and helps guide further improvements. Its knowledge or policy is updated based on the game's outcome, enhancing its decision-making abilities. The agent continues to iterate by evaluating actions, selecting the best move, and updating its knowledge until it achieves satisfactory performance or completes a predefined number of episodes.By following this systematic approach, our intelligent agent efficiently solves the pathfinding problem in the treasure hunt game.

**What are the similarities and differences between these two approaches?**

When solving the Treasure Hunt Game, intelligent agents and humans share some similarities in their approaches, yet they also exhibit significant differences. Both agents and humans are driven by the common objective of finding treasures and maximizing rewards or scores. They process information, analyze the game’s state, and consider factors like treasure positions and player location to make informed decisions about their actions. However, the differences between intelligent agents and humans become apparent when considering their respective capabilities.

Intelligent agents possess the advantage of learning and adaptation through algorithms like reinforcement learning. They can continuously improve their performance by updating their policies based on feedback and experience, allowing them to refine their strategies over time. In contrast, humans may rely on prior knowledge, reasoning, and intuition to solve the game, utilizing their cognitive abilities to make decisions without explicit learning mechanisms. Another notable distinction lies in computational power and memory. Intelligent agents can perform computations at high speeds and have access to vast memory resources, enabling them to process and analyze information rapidly. While capable of complex reasoning, humans may face computational speed and memory capacity limitations, which can impact their decision-making process and overall efficiency.

Creativity is another aspect where humans differ from intelligent agents. Humans can think creatively and employ diverse strategies to solve the game. They can devise innovative approaches, think outside the box, and leverage their cognitive abilities, intuition, and insights to navigate the game environment. Intelligent agents, on the other hand, typically adhere to predefined algorithms or strategies unless explicitly programmed to explore alternative approaches. Sensory perception is yet another distinguishing factor. Humans rely on sensory experiences, such as visual and auditory cues, to comprehend the game environment and make decisions. Intelligent agents may possess similar or different sensors or directly process game state information as input without relying on sensory perception, depending on their design and implementation.

Lastly, humans bring emotions, subjective experiences, and personal preferences into their decision-making process. They may prioritize sure treasures based on unique value or derive enjoyment from the game's entertainment value. In contrast, intelligent agents lack emotions and subjective experiences, and their decision-making is solely based on optimizing predefined objectives without being influenced by personal preferences.

In summary, while intelligent agents and humans share common objectives and engage in information processing and decision-making to solve the treasure hunt game, their learning capabilities, computational power, creativity, sensory perception, and subjective experiences differ. These differences highlight the distinct approaches taken by each entity, with intelligent agents leveraging learning algorithms and computational advantages and humans relying on their cognitive abilities, creativity, emotions, and sensory perception.

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

**What is the difference between exploitation and exploration?**

Exploitation and exploration are two fundamental concepts in reinforcement learning and decision-making processes. They represent different approaches to selecting actions in a given environment. Exploitation (also called the greedy approach) refers to selecting actions that are known to yield the highest expected rewards based on the agent's current knowledge or policy(*Exploitation and Exploration in Machine Learning*, 2022). It involves exploiting the information the agent already possesses to make the most favorable decisions. Exploitation focuses on maximizing immediate rewards and making choices based on the agent's current understanding of the environment.

On the other hand, exploration involves taking actions that may not have been tried or have uncertain outcomes. It aims to gather environmental information and learn better policies (*Exploitation and Exploration in Machine Learning*, 2022). Exploration is essential for discovering new, potentially more rewarding actions and improving the agent's understanding of the environment. It trades off immediate rewards for the potential of gaining more knowledge and refining the decision-making process in the long run.

**What is the ideal proportion of exploitation and exploration for this pathfinding problem?**

The ideal proportion of exploitation and exploration for a pathfinding problem like the Treasure Hunt game depends on various factors, including the level of uncertainty in the environment, the complexity of the game, and the agent's prior knowledge. In the initial stages, when the agent has limited information about the environment, a higher proportion of exploration is typically favored to discover optimal paths and gain knowledge about the game state. It enables the agent to explore different routes and learn from the outcomes. As the agent's knowledge and understanding of the environment improve, it can gradually shift towards more exploitation. Once the agent has learned effective strategies and identified optimal paths, exploitation becomes more valuable as it focuses on exploiting the known favorable actions to maximize rewards and achieve the game's objective efficiently.

However, it is important to maintain a balance between exploitation and exploration throughout the learning process. If the agent focuses solely on exploitation, it may get stuck in suboptimal solutions or fail to adapt to environmental changes **(***Exploitation and Exploration in Machine Learning*, 2022). Conversely, excessive exploration can lead to inefficient decision-making and prolonged learning times. The exact proportion of exploitation and exploration can vary based on the specific requirements of the pathfinding problem and can be adjusted through experimentation and tuning to achieve optimal performance.

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

Reinforcement learning is a powerful approach to determining the path to the goal (the treasure) by the agent (the pirate) in the treasure hunt game. The first step is to define the problem as a Markov Decision Process (MDP) by specifying the states, actions, rewards, and transition probabilities. Then, the Q-learning algorithm, a model-free reinforcement learning technique, is employed. The agent initializes the Q-values for each state-action pair and balances exploration and exploitation using an exploration-exploitation strategy. The Q-values are updated iteratively based on the agent's experiences, incorporating immediate rewards, and expected future rewards (Nicholson, 2023). The agent learns an optimal policy through repeated episodes of selecting actions, performing them, and updating Q-values. To find the path to the treasure, the agent selects actions with the highest Q-values from the initial state until it reaches the goal. The learned policy can be further fine-tuned if desired. Overall, reinforcement learning empowers the agent to navigate the game environment, estimate action values, and determine the optimal path to the treasure based on the learned Q-values.

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

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

I was able to provide valuable assistance to the agent during the Treasure Hunt game. By implementing the deep Q-Learning algorithm, I could guide the agent through the challenging maze and effectively collect the highest rewards possible. For the process to be completed, strategic planning and decision-making were crucial. The process involved identifying the most efficient sequence of actions and determining the optimal number of times to train the neural network. During the process, I was constantly attentive. I closely watched the training losses to guarantee that the model met the completion check and achieved a win rate that exceeded the necessary threshold*.*After carefully selecting a cell for the agent, I trained the network and closely analyzed the results. My diligent efforts determined that only two epochs were needed to achieve a 100%-win rate, which occurred at Epoch 91.

**References**

*Exploitation and Exploration in Machine Learning*. Java T Point. (2022). [https://www.javatpoint.com/exploitation-and-exploration-in-machine-learning](https://www.javatpoint.com/exploitation-and-exploration-in-machine-learning%20)

Nicholson, C. (2023). *A Beginner’s Guide to Deep Reinforcement Learning*. Pathmind. [https://wiki.pathmind.com/deep-reinforcement-learning#:~:text=Deep%20reinforcement%20learning%20combines%20artificial%20neural%20networks%20with,and%20actions%20to%20the%20rewards%20they%20lead%20to.](https://wiki.pathmind.com/deep-reinforcement-learning%23:~:text=Deep%20reinforcement%20learning%20combines%20artificial%20neural%20networks%20with,and%20actions%20to%20the%20rewards%20they%20lead%20to.%20)