**DESIGN DEFENSE DOCUMENT**

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

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

A human would solve this maze manually by following the path throughout several different routes- perhaps the user attempts to move one square to the right each time, or they try starting at the beginning and working their way to the end of the square. This would be repeated until the solution was found. Essentially, they would solve this problem with manual trial and error efforts.

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

The AI agent will attempt to solve the maze by starting with a random path, collecting data and learning from the data each time a new path is tried. This method is similar to the human manual method of trial and error except the Ai agent is able to approach the problem with a bit more of an advanced approach. The AI agent will be able to use the data it has collected to quickly optimize it's paths until the correct solution is found.  The agent will collect the input data, determine key points that allow it to optimize the path, and then output the solution.

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

The similarities are that both methods are essentially trial and error. The human method is obviously manual, the AI method is automated. Both the human and the AI agent have similar start points, end points, and goals. The AI agent will be able to use data collected from previous games to better guess what the end point will be based off of many things such as states and input data whereas each time a human plays it will most likely just be a 'new' game of trial and error. A human uses logic to determine the solution, the machine uses an algorithm. Both capable of obtaining the goal.

**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.**

Exploration, in terms of AI, relates to the agent analyzing data it has collected through 'experience' over time to teach itself and improve output accuracies. The agent essentially works to find patterns in the data, and then uses that information to produce better output. Exploration requires experimentation, which could be risky but is also necessary to improve. Exploitation, in terms of AI, relates to the agent evaluating resources to determine where the greatest reward will be - never taking into account other values. Exploitation would be considered lower risk since it only uses already known data and does not experiment to try to produce new or better results. It is only looking to gain as much reward as possible with the information it already has.  Exploration and exploitation work closely together to create a balanced and accurate algorithm. It's important to balance the two just right as too much exploration will cause the agent to take far too long to come up with a solution and too much exploitation could cause the agent to become stagnant with it's learning capabilities.

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

Reinforcement learning can help the agent to determine the path by increasing the reward when the shortest path is found. This way the algorithm will be consistently attempting to find the shortest, quickest path in order to gain the maximum reward. which is the goal of the game.

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

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

Q-learning is a value based approach where the expected reward is calculated for each state-action pair. The agent chooses an action based on the action that has the highest expected reward in the current state. To implement deep Q Learning I created a python notebook in JUPYTER and imported all appropriate libraries. I used that notebook to create the nerual network that the machine would use to learn or train. I consistently adjusted parameters within the algorithm until the agent had decent accuracy. All of that paired with the reward system implemented in the algorithm itself created an accurate agent that was able to obtain the goal. A reward system was implemented where the agent was rewarded when the correct path was found. The agent was trained with a reward system in place, thus implementing the deep Q learning methodologies.

SOURCES:

• Exploitation vs Exploration in Machine Learning: All You Need To Know. (2024, February 7). https://surveypoint.ai/blog/2024/02/07/exploitation-vs-exploration-in-machine-learning-all-you-need-to-know/

• Deep Q-Learning. (2019, June 13). GeeksforGeeks. https://www.geeksforgeeks.org/deep-q-learning/