**Project 2 – Design Defense**

**Human vs Machine Intelligence:**

Depending on how complicated the maze is humans and machines would solve it differently. For example, for the maze in this problem a human can easily see the correct path and immediately draw the solution. Humans will typically look ahead to determine the best path through the maze before going forward. For a larger maze humans may perform random movements if they are unsure of where to go and backtrack if necessary. According to John Wentworth (2018), “A human solving a maze usually tries to work their way closer to the end.” Humans will usually choose the path that looks like it is heading in the right direction.

On the other hand, the AI will make random movements in order to find the end of the maze. This AI works on a point system where it will lose points if it hits a wall and gain points when it reaches the goal. With enough iterations it will seek to maximize its point gain. At first it will make completely random movements to reach the end. As time goes on it will remember past trials and know that hitting walls is detrimental and will make better decisions. Both humans and AI will do seemingly random movements in the search for the end of the maze. Backtracking is necessary for both approaches depending on the difficulty of the maze. They are different in that humans will use context and visual cues to find the goal, while AI will use algorithms and past data (Bhopal, 2023). Humans and AI are different in that humans learn much quicker than AI, but the AI eventually will perform faster than a human. They ultimately will process and act on information a lot faster than a human will.

**Purpose of Intelligent Agent:**

An agent should use both exploration and exploitation in their pursuit of the end goal. Exploration is when the agent will perform a move in order to gain a better understanding of their environment. It could be a good or bad move, but its main goal is to gather information to improve their long-term score. Exploitation is when the agent makes a move that they know is good based on their current information (Yang, 2022).Since the main goal is for the agent to learn as quickly as possible it can be difficult to balance exploration with exploitation. For this particular problem I used an exploration factor of 0.1. This means that the agent will attempt a new path every once every ten attempts in order to gather information. This caused the agent to typically solve the maze with 100% efficiency in about 60-100 attempts. Other exploration factors caused the agent to take much longer to solve the maze with 100% efficiency, so I believe 0.1 is the ideal proportion.

Reinforcement learning can help the agent to determine the best path to the goal by letting the agent learn by trial and error. Typically at the end of each trial the agent will modify itself in some way in order to improve their next attempt. For instance, if in one trial the pirate hits a wall on the way to the treasure, it will know on the next instance that there is a wall there and will avoid it. With enough iterations the pirate will know enough about the environment where they can reach the treasure with little difficulty.

**Evaluating Algorithms:**

This project uses deep Q-learning instead of normal Q-learning. In normal Q-learning there is a chart of all possible actions with associated penalties and rewards. However, this is not very practical for large environments (GeeksforGeeks). After each trial the agent will update its model for the next iteration. For this project instead of mapping all possible actions and states, the agent seeks to minimize the route it takes to reach the end. By minimizing the route they earn a higher reward. It will try and approximate the Q-function based on past experience when reaching the goal. This type of learning works better for more complex and varied environments with more states than you could possibly map out.

**Citations:**

Wentworth, J. (2018, June 19). *Problem solving with mazes and crayon*. Medium. <https://medium.com/@johnwentworth/problem-solving-with-mazes-and-crayon-f262f957e3a0>

BGI Bhopal. (2023, August 1). *What is the difference between human intelligence and machine intelligence?* https://bgibhopal.com/blog/the-difference-between-human-intelligence-and-machine-intelligence/

Yang, A. (2022, July 25). *What is exploration vs. exploitation in reinforcement learning?*. Medium. https://angelina-yang.medium.com/what-is-exploration-vs-exploitation-in-reinforcement-learning-a3b96dcc9503

GeeksforGeeks. (2023, January 23). *Deep Q-learning*. GeeksforGeeks. https://www.geeksforgeeks.org/deep-q-learning/