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CS-370: Project Two - Design Defense

SNHU

The topics covered within this course are the current and emerging trends in computer science, more specifically, artificial intelligence and machine learning. In project two of this course, I was provided with the starter code for a treasure hunt game and was tasked with developing my own pirate intelligent agent. The goal of the pirate is to win the treasure hunt and find the treasure however, in order to do so, it must learn how to solve the pathfinding problem within of the game. To help the pirate achieve this goal, I applied a deep Q-learning algorithm so that it could continuously train against the game, learn from the mistakes taken in previous attempts, and improve upon the pathfinding strategy applied. Eventually, the pirate was able to find the treasure and win the game as efficiently and as in as little moves as possible.

Contrary to my pirate intelligent agent, a human being would most likely attempt to solve this maze through trial and error, essentially reaching as far as they can within a single attempt, before eventually losing and having to start over. Since humans are prone to guesswork, it’s likely that there would be a series of random attempts to solve the game’s pathfinding problem until an effective strategy is uncovered, applied, and improved upon. The pirate intelligent agent, however, analyzes the pathfinding problem the game presents entirely, then uses an algorithm to apply a solution the problem. Once the pirate is able to solve the pathfinding problem, it will be able to navigate through the maze and in just a single attempt. The similarities between the two approaches is that there is some guesswork and randomness to be used of the respective strategies to solve the problem and move through the maze successfully. The key difference in the approach that an artificially intelligent agent and a human being would take is the effectiveness of each strategy, how the respective strategy is improved upon over time, and the ability to repeatedly apply that winning strategy with machine-like consistency. Although artificially intelligent agents are modeled after the human brain to solve complex problems, A.I. requires thousands of examples of consistent data to identify a problem before solving it, while humans require far less. The key distinction is the effectiveness and accuracy an artificially intelligent agent and a human being can execute a solution once a problem has been identified. The human brain uses previous experiences relative to the individual and relies heavily on memory, which is subject to inaccuracies, whereas A.I. can store and recall large amounts of data from memory significantly faster to complete repeated tasks successfully beyond human ability.

The purpose of the pirate intelligent agent in this project is to solve the pathfinding problem of the treasure hunt game to achieve its goal of reaching the treasure and winning the game. Pathfinding, when it comes to computer algorithms, refers to the systems’ ability to determine the shortest path between two or more points (Manifold, 2022). In this particular scenario, the pirate finds the shortest path from the game’s starting point to the treasure at the game’s ending point by using executing two separate actions, exploration, and exploitation. Exploration is the process of discovery, research, and experimentation, whereas exploitation is the process of refinement and optimization. The dilemma that I faced in this project was determining the appropriate proportion of exploration and exploitation that was ideal for my pirate intelligent agent achieve its’ goal. The pirate could explore for a very long time, cast a wide net, and fully understand the complexity of the game’s environment entirely, determining every possible path that could be taken to reach the treasure at the end. Following this odyssey of an exploration, the pirate could then use the information gathered to exploit the game and find the most optimal path, thus beating the game and finding the treasure every time quickly and with ease. The inverse of this proportion would be to lessen the vastness of the exploration and save that time to exploit possible solutions to reach the end faster, but with less accuracy. The battle of the pirate’s problem-solving speed vs its’ effectiveness can be eased with reinforcement learning. Since reinforcement learning rewards the agent (pirate) for making decisions that bring it closer to achieving the goal, and punishes the decisions that do the opposite, reinforcement learning can improve the agent’s (pirate) exploitation of the environment and problem by eliminating the decisions that don’t reach the goal (treasure) and homing in on the one’s that draw closer.

In this project, I implemented deep Q-learning using neural networks for the treasure hunt game by creating an algorithm for my pirate that leveraged reinforcement learning. The reinforcement learning algorithm that I implemented in my code allows my pirate to use less exploration time, without the sacrificing the accuracy of the exploitation time. Although the pirate might not find the treasure perfectly every time on the first time, it’s able to find the treasure typically in about a half of a second in most runs.

References:

Journals &amp; Books Online: Cambridge University Press. Cambridge Core. (n.d.). Retrieved April 17, 2022, from https://www.cambridge.org/core  
  
Manifold. (n.d.). Exploration vs. exploitation in reinforcement learning. Exploration vs. Exploitation in Reinforcement Learning. Retrieved April 17, 2022, from https://www.manifold.ai/exploration-vs-exploitation-in-reinforcement-learning

WWW-sciencedirect-com.ezproxy.snhu.edu. (n.d.). Retrieved April 17, 2022, from https://www-sciencedirect-com.ezproxy.snhu.edu/science/article/pii/S0029655414000578?via%3Dihub

Fernandez, E. (2019, November 28). Ai is not similar to human intelligence. thinking so could be dangerous. Forbes. Retrieved March 9, 2022, from https://www.forbes.com/sites/fernandezelizabeth/2019/11/30/ai-is-not-similar-to-human-intelligence-thinking-so-could-be-dangerous/?sh=37f7b46d6c22

Gulli, A., & Pal, S. (2017). Deep learning with keras: Implement neural networks with Keras on Theano and tensorflow. Packt Publishing.

Reed, N. (2019, October 24). ELI5: what is an artificial neural network? ThinkAutomation. Retrieved March 3, 2022, from https://www.thinkautomation.com/eli5/eli5-what-is-an-artificial-neural-network/