CS – 370

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Project 2: Design Defense

Machine learning and artificial intelligence a relatively new emerging technology that can be applied across a wide range of sectors, such as self-driving cars, powerful search algorithms, gaming, language software, drug development, and smart home functionality. The basis of how a machine learns involves inputs that are run through neural networks and analyzing the outputs for accuracy. For this project, AI is used to create an intelligent agent as a non-playable character to act as an opponent against the user in a treasure hunt pathfinding game. Before the agent can be used in the game however, it needs to be trained to understand how the game is played and how to win so it is competitive against a human user playing opposed to it. Understanding the differences between how humans and machines approach solving problems is key in setting up the learning environment to create a successful intelligent agent for the game.

In context of the maze game, a human approach is going to be quite different than a machines approach when it comes to finding the end of the maze. A human would walk through the maze until they get to a dead end. Then, the human would backtrack to find another possible path to try. This process would be repeated until the end of the maze is found. For example, a human will be able to see the walls and paths much further ahead from their current position. This will help with navigating through the maze much quicker rather than testing each direction to find a clear route. Also, a human doesn’t require as much data to understand rules or spatial physics (such as trying to walk through a wall), or as better put, “Humans are great ‘one-shot learners’” (Fernandez, 2019). The longer the maze is however, the more reliant a human would have to rely on memory to make sure that previous dead-ended paths aren’t taken when trying to find the end of the maze. A machine would start off by picking a direction to navigate the maze in. Then, depending on the result (wall, previously visited path, new path), then machine would pick another choice and repeat. Then the machine would analyze the run based on reinforced learning and adjust its moves in the next round. A machine’s approach to this would be more based on trial and error initially until the basic spatial rules are understood by using reinforced learning to train the machine. For example, negatively reinforcing the machine by revisiting old paths and running into walls or out of bounds will help the machine understand the spatial rules of the game. The advantage that a machine will have over a human is in terms of backtracking through the maze because it doesn’t rely on losing track of its position in the maze that might occur with a human’s approach.

The purpose of using an intelligent agent in a pathfinding game is because for the game to be competitive, the agent needs to be able to understand how the game works as well as “think” or make decisions like a human user. The machine learns through reinforcement by being rewarded for various behaviors that will help it get to the treasure whilst following all the rules of the game. When a machine understands that certain orders of actions will get a higher reward, this is called exploitation. Exploitation essentially means that that if left to just the enforced learning, the machine will not risk exploring in the game because it wants to obtain the highest reward possible. Exploration, on the other hand, is making random moves outside of the typical actions that might lead to other possible winning runs. In the pathfinder example, the ratio of exploitation versus exploration should be a closer to the exploitation side because the goal is still to get to the treasure in the least amount of moves possible, but exploration can lead a better path to the treasure.

Neural networks and deep Q-learning were used to train the intelligent agent for this pathfinding game. The environment was initially set up with a visual representation of the maze and the directional as well as exploitation ratio of the intelligent agent. A neural network of three neural layers, two PReLU activation layers, and an ADAM optimizer is used as the model for the training. Then the agent is trained using this model by starting the run and taking each action from the previous reward. After the training of the epoch has concluded and a win or loss is determined for the agent, the data is fed back into the model to refine and tune the decision-making process of the agent for the next run. Once the agent has met the win rate percentage requirements, it passes the training.

In conclusion, machine learning is different than human learning when it comes to approaches to solving problems. One is a refinement of algorithms based off a lot of data and a reinforced learning process, while the other is more intuitive to understanding how rules work without much information needed. The purpose of an intelligent agent in pathfinding is its ability to learn from a balance of exploitation and exploration to refine the algorithms used to solve the problem and find the end of the maze. This model of learning is built using neural networks and Q-learning to train the agent until it meets its completion requirements.

References:

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