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### Project 3 Report

For this project, we were tasked with creating an interactive, text-based game of 4-in-a-line, an enhanced version of the classic Tic-Tac-Toe game. To develop our AI, we used a technique called alpha-beta pruning which is an optimization method used in many games that utilize tree search algorithms. Alpha-beta pruning utilizes the “pruning” or elimination of branches of the search tree which are known to be worse than the current best move available for the player. This significantly increases the efficiency of the program, as it doesn’t spend precious time and computational power searching through a branch/subtree that will eventually yield suboptimal results.

When it came to the evaluation function, we realized that each position on the board has its own value determined by what is around it. Given one position on the board, we could scan in all 4 directions to see what positions were taken/open, and basically, what potential was there. For example, if there are 3 pieces in a row and placing a piece at the current position would win the game, the value of that state is extremely high.

Of note for our implementation of the program’s evaluation are a few oddities. For the computer's first move (whether or not the player had a move already), it will get to a depth of 4 before timing out (with the 5 second max time as instructed). However, after a few more moves are played, the algorithm reaches completion times and finds optimal paths well under the

allotted 5 seconds. The algorithm is especially adept in blocking your moves, so it makes sense that it runs significantly faster once there's more of your moves to react off of.

Looking back at the project, it was definitely a bit of a challenge translating the conceptual idea of the algorithm into code. There is a lot to keep track of with this approach, so it took a lot of step-by-step work to develop it fully. However, being able to work on it as a group of 2 made it a lot more manageable.