Othello Artificial Intelligence with Machine Learning

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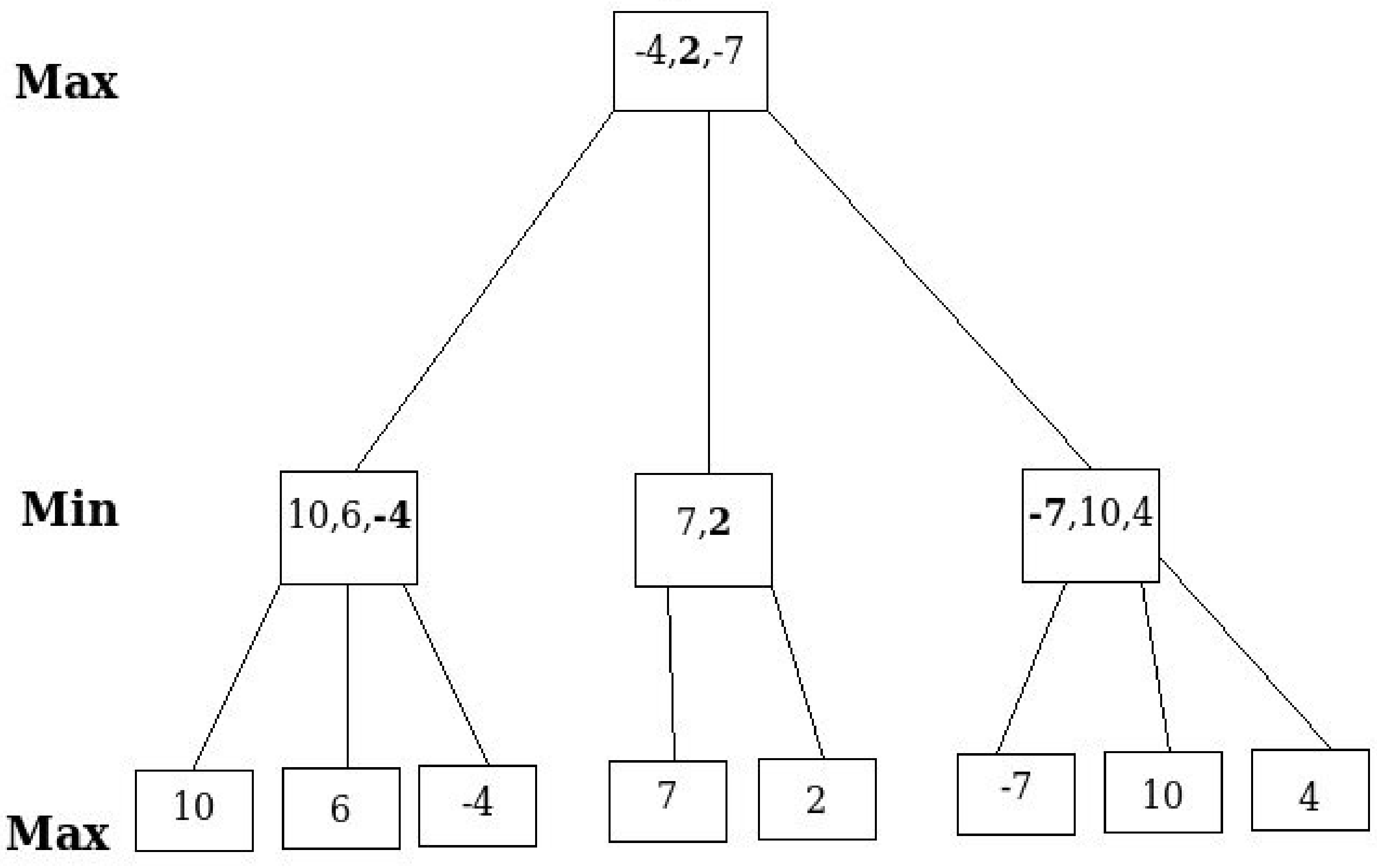
Introduction

Machine learning is an extensive field of study. Most of what is done with machine learning is tied to artificial intelligence which is why Othello seemed to be a good vessel for my research. It is simple enough game for me to work on, yet difficult enough to keep me working throughout the quarters.

Obviously machine learning is not limited to board games. For example, recently at MIT, students created a small robot child with an artificial intelligence. The goal of the project was to implement machine learning so the robot would be able to teach itself to walk using trial and error; it ended up working very well.

Although this seems as if it is miles away from an Othello artificial intelligence, it is closer than one might think.

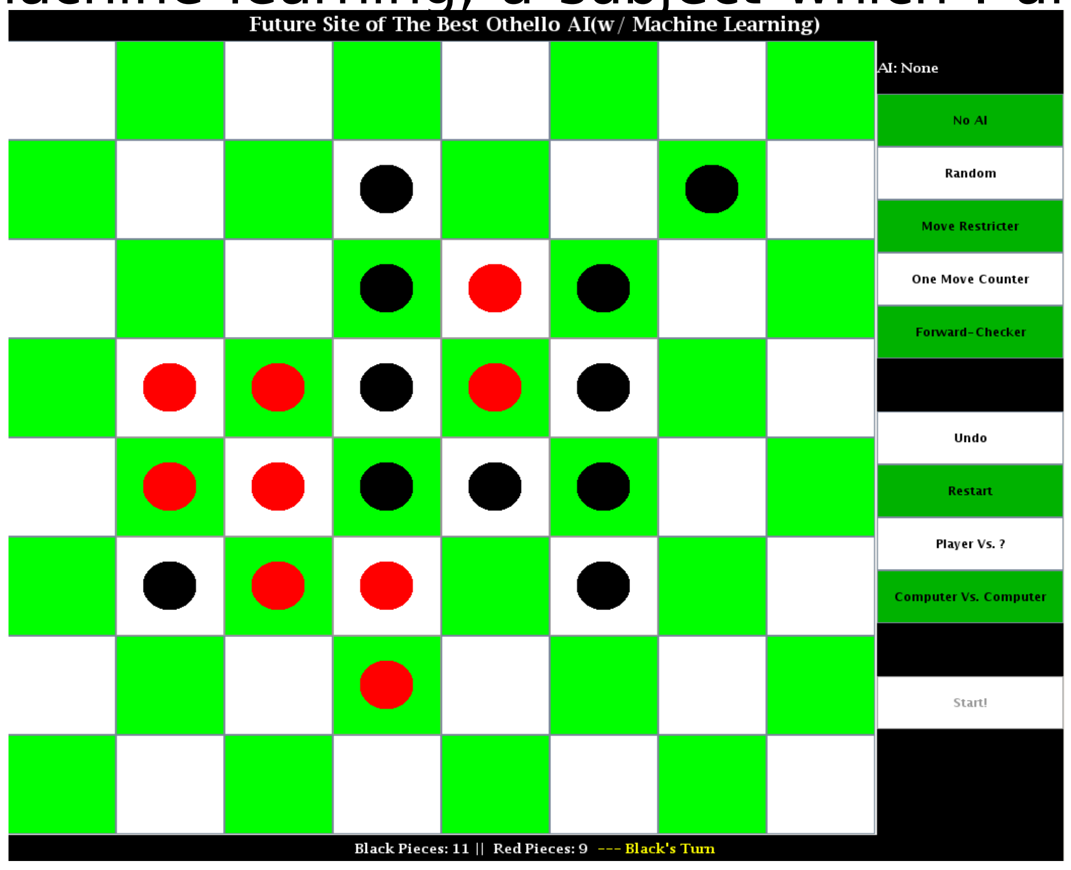
Diagram A



This is an example of a three ply Minimax tree. As you can see it traverses three levels and then begins to return evaluation ratings. At the second level it looks at all the evaluation ratings returned from the third level and returns the minimum (shown in bold). At the first level it looks at these selected values and returns the maximum (shown in bold).

Abstract

The purpose of this research project is to implement machine learning with artificial intelligence. The reason why I chose this project is two-fold. First, to create a very effective Othello AI for anyone's enjoyment. Second, and more academically oriented, is to gain a deeper understanding of machine learning, a subject which I am very interested in.



Future Site of The Best Othello AI(w/ Machine Learning)

AI: None

Black Pieces: 11 || Red Pieces: 9 --- Black's Turn

Procedure

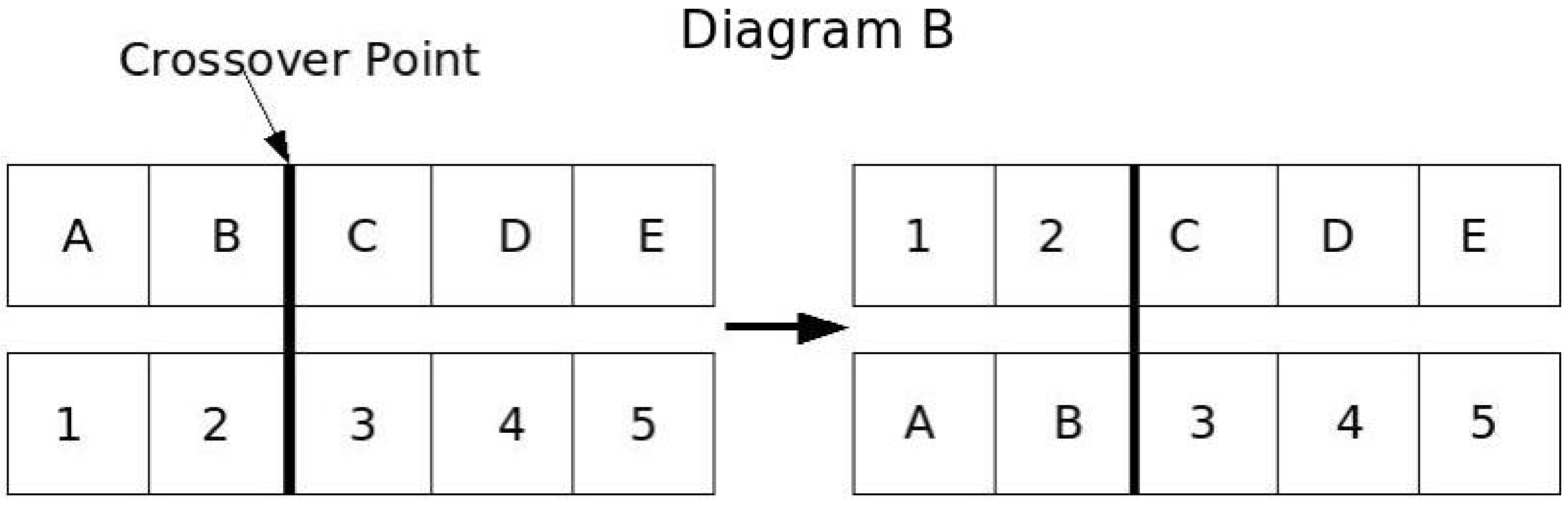
The two main algorithms that I will work on during this quarter are the forward-checking and evaluation methods. The way the forward-checker works is by looking through each possible move that the computer has, making one of the moves, looks at the moves the opponent is presented with, and repeats. In other words, the goal is to traverse a tree of possible moves and picking the move that will lead to the best scenario down the line. The ply determines how many levels of the tree it goes through. The trick about this algorithm is that at each level of the tree it picks the move that is best for which player it is simulating for. Therefore, the computer assumes that its opponent will play perfectly. This is why it has been labeled the Minimax algorithm. First it looks for the move that is best for it, then at the opponent's move that will be worst for it. (See Diagram A)

In order to increase the efficiency of this algorithm and effectiveness of the AI, the AI will learn from each of it takes in a game. Every move will be recorded, along with the board and its evaluation, into a HashMap. Therefore, the next time a similar board situation comes up, all the AI will need to do is look into the HashMap for the move and this will save the time and trouble of traversing through the entire tree of possible moves.

The other algorithm that will be worked on is the evaluation function. This function returns a number rating how good a specific scenario is for a player. It does this based on the positions of the pieces and amount of available moves for each player. For example, pieces in the corners are very valuable so they will add many more points to the rating then a piece near the center.

To find the best evaluation function I will use the Genetic Algorithm(GA). The GA is a sort of Darwinian evolution cycle that tests the quality of different evaluation functions and then splices the strongest ones together (as shown in Diagram B) in order to produce the next generation (a new, presumably stronger, set of functions). The next generation will go through the same process and eventually an optimal evaluation function will be reached.

Diagram B



Conclusion

When my project is complete I plan on having a very skilled Othello AI that uses machine learning extensively and will be challenging to the best of players.