Artificial Intelligence Nanodegree

Summary: Game Tree Searching by Min/Max Approximation

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November 25th, 2017

The aim of this paper is to present an iterative method for searching min/max game trees, based on the idea of approximating the min and max operators with a generalized mean-value operator. The result of this is a good approximation technique with respect to all arguments, to determine a path to next best move.

The aforementioned generalized mean-value operator simply consists of the mean values of the possible moves. These help determine which leaf nodes in a game tree will affect the most the game's root node by identifying those moves with maximum effect and those with minimum effect.

Depending on the size of the game, the underlying tree might be completely explored. In the case of larger trees, classical algorithms such as minimax with alpha-beta pruning can yield better results without exploring large portions of the tree.

The author used pruning in combination with several depth search techniques under time constraints. When the time is up, the last search result was returned. Also search based on penalties were used, where every edge in the game had a weight, resulting in bad moves being penalized more heavily than good moves. In order to identify the weight, an implementation of "reverse approximation" was used.

To test the method described in the last paragraphs, the author chose the Connect-Four game. The penalty-base heuristic constant was set to 0.05. Here are the results:

- An increase in the resource time per turn derived in a higher win ratio for alpha-beta pruning.
- An increase in the total moves per turn also increased total wins by minimax approximation.

Finally, the author highlights that penalty-based algorithms are memory bound. Hence, they might need larger amounts of available memory to work with in order to perform well.