

Game Tree Searching by Min/Max Approximation

This paper outlines how min/max approximation is superior to minimax search with alpha beta pruning and iterative deepening for searching in game trees. However, there is a constraint that both the schemes need to be restricted to the same number of calls to the move operator for min/max approximation to outperform minimax search.

Min/Max approximation attempts to focus on important lines of play by approximating the min and max operators with generalized mean-values. However, these are good approximations but have continuous derivatives with respect to all arguments and in turn have high computational cost. The tip to expand next after making these approximations is performed using a heuristic named penalty-based iterative search method. This method works in such a way that a penalty is assigned in terms of derivatives of the approximating functions to every edge in the game tree based on the move, bad moves are penalized more than good moves. Based on this information, the tip with the least penalty is expanded next and once the computation is done the appropriate values are backed up to the root.

An experiment was conducted to assess the impact of both the schemes when played against each other at a game called Connect-Four. For each experiment, 49 different starting positions were considered and each starting position is played twice with alternative schemes making the opening move, which translates to a total of 98 games for each experiment. For each experiment, total number of wins and ties are calculated.

Each experiment was run for five possible time bounds and move bounds with one second increments and move bounds with 1000 move increments respectively. Thus a total of 980 games are played altogether and the recorded data suggests that minimax with alpha-beta pruning performs better when based on time usage alone and when move-based resource limits are considered min/max approximation strategy performs better over minimax with alpha-beta pruning.