Summary of Game Tree Searching by Min/Max Approximation

The paper by Ronald L. Rivest introduces a penalty based iterative search method, which uses the generalized mean value operators to compute the penalties.

The generalized means provide a means to do a sensitivity analysis since the generalized mean function has continuous derivatives with respect to each of the values of the nodes in a tree at a certain depth. By way of the chain rule this technique allows one to compute the effect on the root node sue to branching on a particular node at a given depth in the tree.

This technique is implemented as a special case of the penalty based tree search methods to decide on to which node to expand next. The approximations to the backed up estimates for each node is computed using the generalized mean value operator with a large vale of 'p' (p=10) for both the maximizer and the minimizer nodes. The node that has the most effect on the root is next used for branching. This technique in its implementation is referred to as the '*reverse approximation*' idea by the author.

In the paper the author uses the Connect-Four game to compare the performance of the reverse approximation technique (MM) with the minimax search with alpha beta pruning method (AB). For each time limit specification there were 98 games played in total in which 49 games were opened by the MM method and the other 49 games were opened by the AB method. This experiment of 98 games was run for each of five possible time bounds of 1 sec to 5 seconds. In the second experiment the 98 games were run for each of five possible move bounds ranging from 1000 moves to 5000 moves. Thus in total 980 games were played.

For the results based on the time bounds the alpha beta pruning method performs better than the generalized mean value approximation of the min/max method. For the results based on the moves bound the MM method performs better than the alpha beta pruning method.