Summary on Game Tress Searching by Min/Max Approximation by Ron Rivest , MIT.

Papers's goal : The paper attemts to formulate a method to approximate the min and max values at each node . The main focus of the paper is to choose "expandable tip upon whose value the backed up value at the root most heavily depends on". In other words it means, to choose a node that dramatically affects the board state given multiple choices from a given position .

Techiniques introduced:

1. Generalized Mean Values - The techinique proposes to give an estimate of the minimum and maximum values at the node , it does so with the definition given in equation 1 in the paper . It further shows that choosing a higher value of p in the equation would give a better approzimation to maximium or minimum value on the node . However , it is computationally taxing to calcuate the the squares and roots of the number at each node , it also poposes since the generalized mean values are intended to approximate the min and max functions , this may not introduce much error if a static evaluator was used instead of the mean approach .

2 Penalty – based iterative search method : The method proposes to assign weight associated with each branch from the parent to the child and choosing the child with the least penalty . The penalty is defined as the cost incurred to reach the node from the its father . Where a constant penalty is added by increase in depth of the tree . It also states that this static factor in the penalty equation has some drastic changes in the results obtained . After associating a penalty to travel to any of the children the child with the lowest penalty is explored further .

3. Searching by min/max approximation – At the heart of the paper is this technique which employs the above two technique and an equation D(s,x) which provides a better approximation of the dependence of the tree node on the corrosponding child node . D(s,x) helps to choose which child node is to be explored further , it gives an estimation to which move 'a' in a set of offical moves in state 's' could drastically have an effect on the game in favour or against the player depending on the min or max node and lets us explore the game tree in that direction .

Results :

Games were played between alpha beta and min / max approximation . Considering time as a limiting factor solely , alpha beta seems to be superior than the min / max approximation . While , considering move- based resource limits min / max approximation outperforms alpha beta . It was also noted that the number of distinct positions considered by alpha-beta was approximately three times larger than the number of distinct positions considered by min / max when a time bound was in effect . While , in a move bound approach the number of distinct positions considered were approximately equal. The mini max search with alpha beta prunning called the move operator 3500 times while the min/max approximation called approximately 800 times.

It was observed a lot of time was spends traversing back and forth between the root and leaves to expolre paths with the least penalty compared to the depth first approach which spends most time near the lives .

It was also observed that penalty based schemes spent some time evaluating non-optimal lines of play , while the time spent examining such lines of play decreases as the number of non-optimal moves in the line increases.