Summary of “Game Tree Searching by Min/Max Approximation.”

Goals

When using search to in games there are some well-known algorithms to search the tree, Min/Max with running is one of them. But even with Alpha Beta Pruning, an execution might have to visit all possible nodes to take a decision, the number of visited nodes is a function of the expansion order. Different strategies that try to optimize exploring order are known, but there are no optimality guarantees for big search spaces.

Other approaches use the concept of penalties to decide how to expand the nodes, a function calculates a penalty at each node, and the algorithm expands nodes with lower penalties first. Rivers proposes a family of functions that can be used in penalty based algorithms. The functions are a parametric family in which different values for the parameter varies the result, with zero and one producing the well known geometric and arithmetic mean and in the limit towards infinity and negative infinity approximate the Max and Min operators.

Results

The paper presents results of their approach against Alpha/Beta, as with many complex topics which one is better depends on your chosen metric. Alpha Beta win more games of connect four and seems to consume fewer resources, but their approach expanded fewer nodes than Alpha/Beta. This means for games in which the cost of expanding the game tree is more expensive the penalty based approach with their proposed function could outperform Alpha/Beta regarding games won.

The paper presents a limited analysis based only on the “Connect Four” game, and this, of course, leaves many questions open. For example, how does the approach behave under pathological games or circumstances, although Rivest stated that under a constant evaluation function his method would degenerate into Bread First Search.