# Game Tree Search by Min/Max Approximation

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I chose the Game Tree Search by Min/Max Approximation article. As unsexy as this may sound, when compared to a computer winning chess games against Kasparov, or wining Alpha Go, this article seemed more relevant and directly applicable to the topic at hand. In particular, as it expands on the very topics raised in class.

## Goals and Techniques Introduced

The goal of the paper was to identify a method that would be more efficient than min-max with alpha-beta pruning. With this method, game agents are more efficient and capable of running in smaller and simpler CPUs, with better results than otherwise. The method introduced by the paper is called: *Min/Max approximation*

*Min/Max approximation,* in a nutshell, consists of using an approximated function to calculate average score at a point. That approximated function lends itself to continuous derivation (which is the very method in mathematics to find the maximum or minimum point of a function for a given point). That function is used to calculate the min and max for each level. By doing so, the search method identifies the best leafs of each subtree to explore. This would reduce significantly the number of leaves to be searched, making it significantly more efficient for a game agent to search large trees and return the best moves - even better than min/max with alpha-beta pruning.

In describing the method, the paper describes search methods:

- Iterative Search

Iterative search is the approach we have been using in our game agent in class - and the one used in the project I submitted. It consists in searching the tree up to an arbitrary non-terminal level, estimating the utility of the game via a heuristic function.

- Penalty-based Search

This search assigns a non-negative penalty to each edge of the game - higher for losing edges and lower for winning edges. The best moves are those with the lowest sum of weights.

- Min/Max Approximation - the method proposed by the paper

This is a special case of Penalty-based Search - where minimum and maximum penalties are calculated by the derivative of the approximated function.

## Paper's Results

The research team found that the proposed method outplays min-max with alpha-beta running and iterative deepening, for the same number of moves. So, the method is viable, and should be further explored in other circumstances.