Ten Years of Programming MCTS in a Number of Different Games

Extended Abstract

Richard J. Lorentz

There was a revolution in Computer Go Programming in 2006. Up until then the best go playing computer programs performed at a level no better than a beginner – maybe somebody who had been playing for about 6 months. With the introduction of Monte Carlo Tree Search (MCTS) suddenly go programs were playing at levels never seen before and not expected for at least another 10 years.

Intrigued by the success of MCTS we decided to enter the fray and learn how this new algorithm could be applied to other games and see how fruitful it could be in other settings.

Our first effort was in the game of Amazons. Like Go, it is a game with a very large branching factor. Unlike go, there were already a number of programs that played a very strong game of Amazons and all of these programs incorporated sophisticated evaluation functions. The results of this research were published in 2008 and the resulting program significantly outperformed our existing mini-max based program. In fact, this MCTS based program won every Computer Olympiad it entered, has never lost a game on Little Golem, and in fact has only lost 3 or 4 tournament games in total. Part of the reason for its success was our introduction of early playout termination (EPT), an idea independently discovered by many researchers at this time.

We also began studying MCTS with the game of Havannah, partially motivated by the Havannah Challenge. The challenge, offered by the game's inventor, Christian Freeling, was to create a program that could beat Mr. Freeling in at least one game of a 10 game match. While the best mini-max programs performed at extremely weak levels, especially on large board sizes, by using MCTS programs were produced that were quite strong – strong enough to beat Mr. Freeling in a couple of games during a match in October, 2012.

EWN, a game that incorporates an element of chance because the rules require the use of a die, seemed like a good candidate for MCTS study. Indeed one of the first very successful Monte Carlo based programs (it did not use MCTS) was written for Backgammon, another game that uses dice. Our results were less satisfying for this game though interestingly, results were best for a variation of the game that increased the branching factor a little and seems to have a more tactical flavor. These results were published in 2011.

Our fourth and final foray in MCTS programming was with the game of Breakthrough. At this point the power of MCTS was well known and well understood so in addition to continuing our studies of MCTS our interest was also focused on EPT. In this case it was interesting to see that the program performed at about the same level as the strongest mini-max based programs. Considering how different the two algorithms are this is perhaps an interesting result in its own right.

The goal of my presentation is to provide a historical look at MCTS in a slightly different context from the usual go related discussions along with personal observations gleaned from my experiences.