Thesis: Dominion AI Using Monte Carlo Tree Search

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Summary

My thesis was building an artificial intelligence (AI) to play the deckbuilding card game of Dominion. I chose this project because I have a love of boardgames, but I had not had a chance to build one in the Guildhall curriculum. I chose Monte Carlo Tree Search because it is a general AI strategy that can be used on many types of games and can be combined with other AI strategies to improve them. The project took roughly 8 months to complete.

MCTS tries to intelligently build a tree of all possible moves that can be used to decide what move to make. It generalizes the building process for most kind of games by using an evaluation function that is playing a game of random moves. Whichever move looks the best to the evaluation function then is where MCTS will try to build next.

The first thing I learned was how to even use MCTS for a game like Dominion. Pure MCTS was made for games like chess where all information is known, but a card game has plenty of hidden information like what cards your opponent has or what card you will draw next in your deck. I learned quickly that pure MCTS was awful at playing Dominion, so my thesis became how to tweak MCTS, so it can play Dominion while also not being too heavy handed. I learned a lot about how MCTS thinks. For example, it does not look at a game as a game but as a black box with multiple levers. Any lever that is pulled will change the black box, but it does not know the result until the game is finished. I also learned how important making a good user interface is for a game like Dominion. Nobody knew how to use my artifact except for me until I redid it to be more visual and clickable with a mouse.

In the game industry MCTS is an awesome took that could be applied in a bunch of different areas. In turn-based games, you can use it as the opposing AI, but you could also use it to playtest your game that you are developing. For example, if you are making a card game and want to see how adding a card will change strategies, MCTS is a great way of quickly testing the effects of the new card. It could also be used to search over strategies of what an army should do in an RTS.