

Since the 20<sup>th</sup> century artificial intelligence (AI) has been delighting the minds of many sci-fi dreamers. Particularly game playing AI's have sparked a futuristic idea. In their article, "Mastering the Game of Go with Deep Neural Networks and Tree Search", the DeepMind Team covers their novel approach to the now infamous AlphaGo AI. Although the paper does not clearly state their original goals, it reads as if they were trying to improve upon the work of several competing AIs who had reached an amateur level of Go.

The DeepMind Team introduced a novel approach that combined known methodologies in Go game playing agent and neural network strategies with new formulas in a completely new manner. They began by creating a 19x19 image of the board that they fed into deep convolutional neural networks to reduce the depth and breadth of the game's search tree.

The first network is a supervised learning policy network that trains the AI based off expert human moves. The next is a reinforcement learning policy network that improves the first network by adjusting the policy based on whether it network won or lost in self play. This helps the networks look at the long-game goal of winning, instead of simply picking the best move for the short term. Finally, they trained a value network which estimates a value function that predicts the winning player based on the reinforcement policy network. Lastly, they bring all of this together in the Monte Carlo tree search. This approach had seen some success in Go game playing agents in previous works, but they had suboptimal policy networks and value functions. AlphaGo was able to leverage its deep value networks with this search and create an incredibly successful AI.

The DeepMind team had created a master that performed several *dan* (Go rankings) higher than the other most impressive Go programs. In fact, it won 99.8% of them, and between 77-99% (depending on the opponent program respectively) while handicapped while still not using their more powerful distributed version.

Their successes lead them to test their game playing agent against European Go champion, Fan Hui. Fan Hui is a professional 2 dan player. In October 2015, the DeepMind team achieved one of the "grand challenges" in AI by beating Fan Hui 5-0. AlphaGo's shocking win was decades ahead of the closest estimation. By combining convolutional policy and value networks with an efficient tree search approach, they were able to improve upon the previous breakthrough of the Monte Carlo search tree and opened the door for more solutions to previously intractable domains.