Paper Review

"Mastering the game of Go with deep neural networks and tree search" by the DeepMind team.

AlphaGo utilizes Monte Carlo Tree Search (MCTS) using a policy to give values to different board configurations. It also employs a pipeline of three Machine Learning stages. First, it was trained with Supervised Learning using data from human games, called a policy network. This provides a fast learning rate and fast feedback. The team utilized two versions: a fast one with low accuracy and a slow one with high accuracy. Data was provided by the KGS Go server, consisting of around 30 million positions. The fast network achieved an accuracy of 24.2% when predicting expert moves, while the slower one achieved an accuracy of 57.0%

The team then improved AlphaGo using the Reinforcement Learning approach, letting AlphaGo play Go games against itself. At the end of this process, the Reinforcement Learning policy network won around 80% of the games against the earlier version, the Supervised Learning policy network. Finally, a value network was trained that predicts the winner of games played by the RL policy network against itself. AlphaGo then efficiently combines the policy and value network with MCTS.

Most notable results include:
- AlphaGo won 99.8% (494 out of 495 games) against other Go-playing programs.
- AlphaGo won 77%, 86%, and 99% against the other Go programs (Crazy Stone, Zen, and Pachi, respectively) in handicapped games.
- AlphaGo was more efficient than Deep Blue. In particular, during the match against Fan Hui, it searched some 1000x fewer positions than Deep Blue vs. Kasparov.
- AlphaGo evaluation functions were trained through SL and RL rather than being handcrafted as in the case for Deep Blue.
- During the final evaluation, AlphaGo played against Fan Hui, who was a professional 2 dan player, winner of the 2013, 2014, and 2015 European Go Championships. It won all 5 games, marking the first time a computer Go program defeating a human professional player.
- Perhaps AlphaGo's best achievement (and most certainly high-profile in pop culture) was winning 4 out of 5 games against Lee Sedol, who is among the best Go players in the world, a professional 9 dan player.