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AIND Term 1
Isolation Project

Summary: Mastering the game of Go with deep neural networks and tree search

In this paper, a team from Google DeepMind present the techniques and algorithms that were used to build AlphaGo, an extremely dominant Go-playing AI agent that won 99.8% of all of it's matches against other AI programs, and even more significantly, was the first ever to defeat a human professional player in a full-sized game of Go, winning 5 games to 0.

Due to the number of legal moves and the length of the game of Go, the most successful attempts at building AI agents for Go had only led to amateur (1 dan to 9 dan) level performance. These prior attempts were based on of Monte Carlo tree search (MCTS), a technique that reduces the breadth of search by sampling action sequences using depth-limited search and then averaging over search branches to estimate position value. Additionally, they used policies that were trained to predict moves that a human Go expert would make.

AlphaGo built on this work by efficiently combining two deep neural networks with MCTS: a supervised learning network (the policy network), and a reinforcement learning policy network (the value network). The supervised learning network was trained on a dataset of human expert moves. Once the network was properly generalizing and predicting expert level moves, they used the reinforcement learning network to optimize the agent for winning games.

To evaluate the performance of AlphaGo, the researchers set up simulated competitions against other versions of AlphaGo as well as other Go programs that were either commercially available or open source. In the competitions, AlphaGo won 494 / 495 games (99.8%). When competitors were provided a 4-move handicap, AlphaGo still won the overwhelming majority of games.

In October 2015, AlphaGo was tested against the 2013-2015 European Go champion, Fan Hui in a 5 game formal competition. In the match, AlphaGo won 5 games to 0, marking the first time in world history that a computer program had beaten a human professional Go player in a full game, a feat that widely regarded as one of artificial intelligence's "grand challenges".