Research Review for Game-Playing Agent

Selected Paper: AlphaGo by DeepMind Team

Technique Introduced

The paper discusses how AlphaGo used deep neural networks and a custom search algorithm to develop a Go playing agent that is better than any AI agent created before to play the game of Go. The paper starts with introducing a value function $v^*(s)$, which determines outcome of game from any position or state s. The game can be solved by recursively searching the game tree for optimal $v^*(s)$ value. For a game with breadth b and depth d, there can be b^d moves at any position, which makes an exhaustive search impractical. The depth of search space can be reduced by searching only up to state s and reducing the search space below s by an approximate value function v(s) that predicts outcome of search below state s. The breadth of search space can be reduced by sampling actions from a policy p(a|s), that is probability distribution of a possible action a from state s. Deep convolution neural networks can be used to represent 19x19 board image and its size can be reduced by dimensionality reduction techniques. Then the deep convolution network can be trained using supervised learning technique using data from expert moves to output best moves in different positions. This output from the convolution neural network is used as the policy network p(a|s). The approximate value function v(s) can be the value function for with the probability of policy network p(a|s) is highest.

Result

To evaluate performance of AlphaGo a tournament was setup to play AlphaGo against other Go programs and human players. AlphaGo won 494 out of 495 times against other Go programs, making its winning rate 99.8%. To provide greater challenge to AlphaGo it was played with 4 handicap stones (free moves for opponent). AlphaGo won 77%, 86% and 99% of handicap games against other go programs such as Crazy Stone, Zen and Pachi respectively. During the match against Fan Hui, AlphaGo evaluated thousands of times fewer positions than Deep Blue did in its chess match against Kasprov.