# Research Review of "Mastering the game of Go with deep neural networks and tree search"

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## Introduction & Goals

The game of Go is a two-player turn-based strategy board game with the objective of surrounding a larger area on the game board than the opponent. While the rules are relatively simple, Go is very abstract and has many different possible outcomes. Prior to the development of AlphaGo, the artificial intelligent agent developed by the DeepMind Team, it was thought that an AI agent that would be able to defeat a human professional player in Go would not be conceived at least a decade from when AlphaGo was created. This research paper seeks to demonstrate the techniques utilized in creating the logic based in AlphaGo.

## Techniques Used

AlphaGo takes advantage of deep neural networks to reduce the search tree and help find the best moves to take during gameplay. 'Value networks' were used to evaluate board positions and 'policy networks' to select moves. These neural networks are policy networks that are trained using two machine learning techniques called supervised and reinforced learning. Supervised learning uses data to classify the neural network properties from a collection of expert human games and reinforced learning uses data from games played between the AI agent and itself to progressively get better. These two policy networks are then efficiently combined using a Monte Carlo tree search (MCTS) algorithm. The MCTS is used to estimate the value of each state in a search tree.

## Key Results

The strength of AlphaGo was evaluated by comparing variants of AlphaGo and several other Go programs, all of which are based on high-performance MCTS algorithms except for GnuGo, an open source Go program that uses search methods that preceded MCTS. All these programs were compared by conducting a tournament. A single machine AlphaGo won 99.8% of all matches without a handicap against all other Go programs. A distributed version of AlphaGo proved to be significantly better, winning 77% of games against the single-machine AlphaGo and all of the games against the other programs. The distributed version of AlphaGo was the program that defeated Fan Hui, the world's best human Go player, in October 2015.