

## Part 2: Research Review

### Mastering the game of Go with deep neural networks and tree search.

#### What are the paper's goals?

This paper presents how the Google DeepMind team have used a combination of deep neural networks and tree search that plays at the level of the best human players. The authors explain how they achieved one of artificial intelligence's grand challenges and enumerated the difference between their program and Deep Blue.

#### What are the paper's results?

Even if the game of Go was viewed as the most challenging of classic games for artificial intelligence due to its vast search space and the difficulty of evaluating board positions, it's still a game of perfect information and the Google DeepMind team have successfully build algorithms to approximate the optimal value function,  $v^*(s)$  which determines the outcome of the game, from every board position or state  $s$ , under perfect play by all players.

In doing so, the central problem they faced was due to the vast search space of the game of Go which makes the exhaustive search impossible. But, they successfully reduced it using depth search, and by sampling actions from a policy  $p(a | s)$  that is a probability distribution over possible moves for a given position.

Then, they select moves by using value networks and policy networks. The value networks evaluate positions while the policy network sample actions (by using Monte Carlo rollouts to estimate the value of each state in a search tree).

Indeed, the authors explain that one of their breakthrough is their search algorithm that successfully combines neural network evaluations with Monte Carlo rollouts. Monte Carlo search to maximum depth without branching at all! By sampling long sequences of actions for both players and by averaging they obtain an efficient position evaluation.

Of course, these algorithms aren't just to play games. Complex decision-making combined with intractable solutions and consequences challenge every intelligent being, and it's the goal of a broader AI.