

## **Summary of „Mastering the game of GO with deep neural networks and tree search“ By the Alpha Go Team**

Source: <https://storage.googleapis.com/deepmind-media/alphago/AlphaGoNaturePaper.pdf>  
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### **Goal**

Since „Go“ is regarded as one of the most difficult classic board games, it was the teams objective to solve it by utilizing artificial intelligence. Difficulty in this case is defined in the games dimensionality in terms of depth and breath of the search tree.

Since GO is a deterministic game, it is theoretically possible to build a brute-force search tree. However, due to dimensionality involved, it is practically impossible to search such a tree in full depth.

Therefore search optimization techniques were deployed and improved over traditional methods that may have involved monte carlo methods.

### **Techniques**

The team uses „value networks“ to evaluate board positions and „policy networks“ to select moves. Both are essentially deep neural networks with as much as 13 layers.

Various scenarios are tested such as utilizing only policy networks or combining them with value networks.

Whats unique about the teams approachs is that the networks are trained through reinforcement learning as well as human input through supervised learning techniques where ground truths were indicated.

Also, no lookahead search was performed and the neural networks can compete easily with traditional modern monte carlo tree searches.

Furthermore a new search method that combines novel approaches and traditional monte carlo methods is introduced

### **Results**

The newly established search algorithms achieve a 99.8% winning rate over traditional GO programs which would have utilized Monte Carlo tree search. Also human players were defeated in 100% of cases while the sample rate was only 5.

If only policy networks were utilized, a 80% win rate would have been achieved.

This is mostly due to combination of policy and value networks causing highly efficient search tree heuristics essentially pruning a majority of cases.

Since it was the first time that a world Go champion was defeated by AI, the paper marked a new era for AI.