Alpha GO: Convolutions to the rescue

The intractable game vs convolutional neural networks. DeepMind trained convolutional neural networks to improve the performance of boar valuation & move selection to beat the world's best.

Valuation Networks

The elephant in the room when it comes to Go is the search space. Searching through the entire tree is infeasible with B^d states (B≈250 and d≈150). A solution to capture the value of children states from a particular state S truncates the search space to produce super human performance. These "functions" are convolutional neural networks that replace the current standard of valuation networks that were limited to linear combinations of input features. These convolutional value networks have a much higher appetite for complexity thus vastly improving the value placed on a particular board state.

Policy Networks

The DeepMind team then set out to improve the move decision making process. They trained a network (SL) on 30M position to predict the moves of expert players. That was the first half of training. The second half utilized reinforcement learning. The RL network was equal to the SL in architecture and used the trained weights from the SL network, too. It then instituted self-play against previous version of the SL network for fine tuning. Over fitting was reduced by constructing a new dataset of uncorrelated positions from self-play. This data set was also 30M positions.

Results

The Results of incorporating convolutional neural networks into a Go agent proved to be outstanding. Even with the valuation networks and no look ahead search the DeepMind team was able to match the current state of the art performance. When their bespoke look ahead search algorithm is utilized, they achieved a win rate of 99.8% against other Go programs and beat the European champion 5 games to 0, beating the expected timeline for such a feat by a decade.

Win rates are a feat in and of themselves, especially against human experts in this game. Another *result*, albeit not explicitly mentioned in the paper, is successfully demonstrating the flexibility and adaptability of neural networks.