Game-playing paper review

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In 2016 Googleś AlphaGo has beaten Fan Hui, the European Go champion 5:0. It uses a modified approach to searching the game state space that allows it to take more intelligent decisions as well as reduce the computational cost involved.

So far the best computer players in Go were based on the Monte Carlo tree search algorithm and employed a fair number of carefully selected strategies, defined and implemented by domain masters.

In general games like Go or chess can be completely described by constructin a tree of possible move sequences. Such a tree would have size of b^d, in chess $b = 35$, $d = 80$, in Go $b = 250$, $d = 150$. Such vast state space cannot be navigated using modern computers, especially in time-bound tasks, like gameplay, and so it has to be greatly reduced in order to compete in games like Go.

Two general principles can be followed in order to reduce the search space to a sensible size:

- reduce depth by position evaluation - truncate the search tree at state s and replace the subtree with an estimate that predicts the outcome of the game from state s - similarly to the heuristic used in minimax with alpha-beta pruning and iterative deepening

- reduce breadth of the search by sampling actions from ap olicy p(a—s) (probability distribution over possible moves a in position s)

Pre alpha-go state-of-the art players used MCTS (Monte Carlo tree search) enhanced with policies, that help narrow down the search space of high-probability actions,

Alpha-go uses separate, individually trained, deep neural nets to serve as value estimation and policy. The training pipeline consists of several steps of supervised and reinforcement learning of each of the networks. Finally the networks are combined in and Monte Carlo Tree Search algorithm using lookahead search.

Previous breakthrough in Go play led to advances in many fields - planning, scheduling, constraint satisfaction. It is expected that likewise - the use of deep neural nets will bring significant improvements in these fields.