Research Review of Deep Blue

Goal

Deep blue was designed to beat world-class chess player Garry Kasparov and win the final throne. It was a milestone showing computer's hardware and software ability on parallelism and search. The birth of deep blue was based on a series of its ancestors like deep thought I&II and deep blue I.

Algorithm

Compared to mini-max and mini-max with alpha beta search, deep blue II developed a special search algorithm called "The dual credit algorithm" built on top of negamax-alpha-beta search. Instead of having two mutually recursive function calls one for each player, it integrated two player states into one by the fact $\max(x, y) = -\min(-x, -y)$. However, the most primary difference which is also the most critically factor contributing to final victory should be dynamic recursion depth control, more specifically, the capability of depth extension. Regular mini-max and negamax with alpha beta will never consider adding search depth but only subtracting depth on a node until reaching base case. This new search algorithm is non-uniform, which means it may spend more efforts on the move of higher potential of wining. The capability of determining such better moves is attribute from an accumulated dual credit calculation. Every move has its own evaluation score but also an extra potential credit bonus. Therefore, the best move should be more accurately measured by a further calculation from a deeper re-search (up to 2 ply/level).

Another key factor contributing to the victory should be credited to the complex evaluation function. Unlike we only using one or two simple features within evaluation function in game Isolation, deep blue II incorporates 8000 different pattern reorganizations. Part of features are static and part of them are dynamic according to the phase of chess. Thus, deep II is able to better fit and describe the whole distribution of chess game states from a big picture.

Opening book and endgame database utilization also plays an important role. Such prior knowledge greatly helped to shrink search space.

Results

After increasing feature amount in evaluation function from 6400 deep blue I to 8000. Deep blue II finally beat Kasparov by a score of 3.5-2.5. It also won matches against Grandmasters Larry Christiansen and Michael Rohde. However, compared to the modern alphaGo and alphaZero AI agents which crashed human player, deep blue II was a true grandparent with many flaws. It required so many prior knowledge and evaluation functions hard coded. This is why approach of deep blue II is better called an algorithm rather than intelligence.