Deep Blue summary

Goal

Deep Blue is the culmination of a multi-year effort to build a world-class chess machine

Technique

The success of Deep Blue comes from many factors includes: Large search capacity, complex evaluation function, flexible and selective software search combine with fast fixed-depth hardware search and effective use of large grandmaster game database

Large search capacity

Deep Blue is a massively parallel system composed of 30 nodes/SP processors and 480 Deep Blue chess chips (16 chess chips per SP processor). The search capacity of Deep Blue for tactical positions would average about 100,000,000 positions. For quieter positions, the search speed can reach close to 200,000,000 positions per second on average.

Complex evaluation function

Deep Blue's evaluation function is essentially the summation of over 8000 feature values. The features are composed of "fast evaluation" and "slow evaluation" ones. This technique allows the system to skip computing an expensive full evaluation when an approximation is good enough. These features have programmable weights, allowing their relative importance can be easily adjusted. The weights are adjusted not only based on root conditions but also based on the situation onf board at the search positions by the combination of some distinct features forming a group.

Software search

The software search in Deep Blue is selective. This approach allows the system to search deeper on some important positions. The idea is based on a chess tactic called ***forced pairs of moves (ffp's)***. These moves show up in various context such as: keeps making threat with intention to outrun the delaying moves of opponent, or sacrifice a low value piece to capture a high value piece. It is clear that a strong human chess player can search very deep for some important positions.

Hardware search

The hardware search is carried out by chess chips at the last few levels of game tree and includes quiescence search. The move generator in the chess chips implicitly computes all the possible moves and selects one via an arbitration network. The Deep Blue chips has additional function to generate checking and check evasion moves and some certain kind of attack moves, which permits improved quiescence searching. A reasonable move ordering improves search efficiency when searching the game tree.

Use of game database

The opening book in Deep Blue was created by hand and consisted of about 4000 positions. When a position is absence in the opening book, the extended book is used. The extended book is based on 700,000 grandmaster games database. The specific mechanism was to assign bonuses (or penalties) to those moves in a given position that had been played in the games database.
The end game database in Deep Blue includes all chess positions with five or fewer pieces on the board, as well as some selected positions with six piece.

Result

Deep Blue beats the world chess champion Garry Kasparov in 1997 in a six games match