Deep Blue

Chess machine that defeated the reigning World Champion

In 1997 Deep Blue won in a six-game match against Garry Kasparov. It was a 30 processor IBM/RS6000 SP computer with 480 chess search engine chips. Each chess chip was capable of doing 2-2.5 million positions search per second, having as a result an average speed of 126 million position per second with a maximum measured of 300 million per second. The main factors that decided the victory are listed and summarised in the following points.

Chess Chip and Hardware Search

The chip divides into three parts:

Move generator:. It was able to chose a reasonable move listing them by "best-first", being first captures, then non-capture moves.

Evaluation function: It used a fast evaluation function called "piece placement" that was the sum of the basic piece values with their location. While the slow one scanned the chess board one column at a time, computing values for different chess concepts.

Search control: Implemented using null-window alpha-beta search with quiescence search. Since it was implemented in hardware it had some limitations like the lack of transposition table and also included a repetition detector. It was used to carry out only shallow searches.

Software Search

A "dual credit with delayed extensions" was implemented in the software search functionality using depth-limited alpha-beta with negamax formulation. To identify which nodes should receive credits it it had some mechanisms, being "a singular move", the better of all and therefore the one that receives more credits. Those positions near to the root received more credits than those far from it.

Massive Parallel Search

Deep Blue was a massive parallel system. Hardware searches explained before could be done in parallel in multiple Chess Chips at the same time.

Evaluation Function

The evaluation function was implemented on hardware, so difficult to update. It had about 8000 different patterns it could recognise, each one with an assigned value.

Opening and endgame databases

The opening book had about 4000 positions, and were chosen the ones that Deep Blue played well. Also a database of 700.000 game database was available and used to give the moves in a given position position bonuses or penalties. Finally, when there were 5 or fewer pieces the endgame database was used. Each entry was stored with a bit indicating lose or not-lose. This endgame database did not play a critical role.

- Campbell, Murray and Hoane, A Joseph and Hsu, Feng-hsiung. *Deep Blue.* Artificial Intelligence 134 (2002), pp 57–83.