

A review on IBM Deep Blue

Deep Blue computer chess system is developed at IBM Research during the mid-1990s. Deep Blue is the culmination of a multi-year effort to build a world-class chess machine. There was a series of machines and methods that led up to Deep Blue. In fact, there are two distinct versions of Deep Blue, one which lost to Garry Kasparov in 1996 and the one which defeated him in 1997.

System Overview:

Deep Blue is a massively parallel system designed for carrying out chess game tree searches. The system is composed of a 30-node IBM RS/6000 SP computer and 480 single-chip chess search engines, with 16 chess chips per SP processor.

Deep Blue is organized in three layers. The processor are the master and remaining things are workers. The master searches the top levels of the chess game tree, and then distributes "leaf" positions to the workers for further examination.

The Chess Chip:

It is divided into three parts

1. Move generation
2. Evaluation function
3. Search control

Software Search:

A new selective search was built for Deep Thought 2. This search is call the "dual credit with delayed extensions" was designed based on many principles. They are:

1. Extend forcing/forced pairs of moves
2. Forced moves are expectation dependent
3. Fractional extensions
4. Delayed extensions
5. Dual credit

Credit Generation Mechanisms:

The credit generation mechanism played an important role in beating the grandmaster. Many of these methods require auxiliary computation to gather the information necessary to make extension decisions. This was in line with our philosophy of using the tremendous

raw searching power of Deep Blue to enable a more selective search. The credit assigned for various conditions is depth dependent, with positions near the root of the tree generally receiving more credit than positions far from the root.

Hardware Search:

The hardware search is that part of the Deep Blue search that takes place on the chess chip. A chess chip carries out a fixed-depth null-window search, which includes a quiescence search. There are also various types of search extension heuristics, both for the full-width and the quiescence portions of the search.

This search is fast and simple. Once a hardware search is initiated, the host processor controlling that chip is free to do other work, including performing the software search and initiating hardware searches on other chips. The host polls the chips to determine when a hardware search has completed.

Parallel Search:

The parallel search played the major role in minimizing the time taken to decide for a move for Deep Blue. The chess chips process and communicate with the host node via Microbus channel. The parallel search algorithms used in Deep Blue are:

1. Processor Hierarchy
2. Control distribution
3. Parallelism possible
4. Synchronization

Evaluation Function:

The Deep blue evaluation function is summation of all features. The chess chip has identified almost 8000 different patterns and each is assigned a value to it.

The Deep Blue evaluation function generator is run only at the root of the search tree. The evaluation function generator has a second role beyond simply adjusting feature values based on the context of the root position. The large number of distinct feature values dictate that some sort of abstraction be imposed on the values to keep the task manageable.

Opening Book & Extended book:

The book consisted of about 4000 positions and every position had been checked by Deep Blue in overnight runs. The openings were chosen to emphasize positions that Deep Blue played well. The book contains all the best opening moves that can be considered for playing the game. But this has not been in much use during the match with Kasparov

The extended book in Deep Blue is a mechanism that allows a large Grandmaster game database to influence and direct Deep Blue's play in the absence of opening book information. The basic idea is to summarize the information available at each position of a 700,000-game database and use the summary information to nudge Deep Blue in the consensus direction of chess opening theory.

This became handy to the Deep blue during the 1997 match and had been used successfully by the Deep blue to win the game.

Summary:

Deep Blue has proved that the machines too can search up 10 to 15 ply deeper like human and can win. Deep blue win is not because of one algorithm or one logic but a cumulation of many factors. It has been clear that, there are still some loop holes which have been ignored. During the development of Deep Blue, there were many design decisions that had to be made. The makers of Deep blue have ignored alternative site unexplored. But the result is what that matters, Deep Blue had won the chess game against the human grand master Kasparov in 1997 which is extraordinary and brilliant.