Deep Blue: Summary

This paper describes about the compute chess system "Deep Blue" developed by IBM that defeated the World Chess Champion Garry Kasparov in 1997. There were number of elements that contributed to the success of the Deep Blue System and this paper talks about some of the key logical design decisions behind this system.

Looking back the history of this system, the initial version of this system called "Deep Thought" went through multiple enhancements such as medium scale multiprocessing, enhanced evaluation hardware, improved search software and Extended book. With all the hardware and software improvements, finally the Deep Blue 2 system defeated Gary Kasparov in the 1997 match with 3.5-2.5.

Deep Blue is greatly parallel system designed for functioning the chess game tree searches. This system is composed of a 30-node (30 processor) IBM RS/6000 SP computer and 480 search-chip chess search engine. Deep Blue is structured into three layers – one of the SP processors is designated as master and rest of them as workers. Deep Blue relies on the some of the basic and sound techniques developed in early chess programs which are quiescence search, iterative deepening, transportation tables.

Here are some of the characteristics of the Deep Blue system:

- Large Searching Capacity: There were a couple of principles that lead to develop additional search power such that search should be highly non-uniform and search should provide insurance against simple errors.
- Hardware evaluation: The Deep Blue evaluation function is implemented in hardware because the evaluation function complexity becomes possible in hardware.
- Hybrid software and hardware search: The Deep Blue search combines a software search implemented in compiled in C code on a general purpose CPU with the hardware search encoded in chess chip.
- Massive parallel Search: Deep Blue is a massively parallel system with over 500 processors available to participate in the game tree search.

A new selective search built for Deep Thought 2 was called dual credit with delayed extension that was based on number of ideas as below,

- Extend forcing/forced pairs of moves
- Forced moves are expectation dependent
- Fractional extensions
- Delayed extensions
- Dual credit
- Preserve the search envelope

Another aspect for Deep Blue systems success is parallel search algorithm. Here are the major issues with parallel search that needed to be addressed,

- Load balancing
- Master overload:

· Sharing between the nodes:

There were some techniques used for the success of the game,
· Opening book:
· Extended book
· Endgame database
· Time control

Results:

Deep Blue defeated Garry Kasparov in the 1997 match by a score of 3.5–2.5. The success of Deep Blue in the 1997 match was with many crucial factors such as large searching capability, non-uniform search, and complex evaluation function, endgame databases, the extended book, and evaluation function tuning.