Deep Blue
Research Review

Deep Blue is a paper written by Murray Campbell, A. Joseph Hoane Jr., and Feng-hsiung Hsu describing the Deep Blue computer chess system developed by IBM. The paper describes the system architecture that resulted in a computer program that was able to defeat the World Chess Champion Gary Kasparov in a six game match in 1997. The authors start with a brief history of the predecessors to Deep Blue, including Deep Thought, Deep Thought 2, the move onto the Deep Blue system architecture. Deep Blue is a combination of hard ware as can be seen in the single chip chess search engine and the parallel processing, software functionality like the move evaluation functions, and a database of known moves.

Deep Blue's hardware was a major part of the system. IBM created dedicated processors called Chess Chips. The Chess Chips were specially designed to perform thinks like search and move generation faster than a generic processor running computer code. This increased the speed of the execution, although it was much harder to change once built. While a software solution can be reprogrammed, the hardware would need to be remade, or worked around with a software fix. "Deep Blue is composed of a 30-node RS/6000 SP computer and 480 chess chips, with 16 chips per node." Not only were the chips designed for special purposes,480 chess chips were used to give the system massive parallel processing power. This enabled each chip to perform it's own functionality like searching a tree or evaluating moves at the same time as other chips running their own processes. The hardware solutions gave Deep Blue a massive amount of computing power to evaluate millions of moves per second.

Deep Blue's evaluation function is responsible for ranking possible moves. Since Chess is such a complex game, the evaluation function is also very complex. The chess chip recognizes roughly 8000 patterns. Each patter in weighted based on a complex set of rules. For example a move that results in capturing a queen would be weighted much higher than a move that results in capturing a pawn. The evaluation's weightings are extremely important since there are so many patterns. If there was a mistake like for example the pawn capture was ranked higher than a queen capture, the match would have drastically different results. It is a very complex task which required a lot of human intervention to rank the 8000 patterns.

The database of knows moves is another important piece of the system. Deep Blue contained a database of 700,000 games. If a Grandmaster had used a move in the past it would be ranked higher. If a Grandmaster used a move much more than another move, the fist move would be ranked higher. The moves were also evaluated based on the strength of the player that made the move. A human score, given by a chess experts would also evaluate some moves which would be recorded in the database. The endgame, when there are five or fewer pieces on the board was also heavily influenced by the endgame database. Since there are much fewer options than with a full chess board, there are fewer combinations which makes a database of moves much more manageable.

Deep Blue was able to beat World Chess Champion Gary Kasparov in a six game match after a team of engineers spent years trying to solve a very specific problem.

They were able to accomplish the task using specially designed hardware, using massive parallel computing power, and a database of moves and situations built by humans. This paper shows how incredibly hard it is to create a system “smart enough” to beat a highly skilled human. It also shows how such a complex system isn’t really all that “intelligent”, it just searches a lot of options at an incredibly fast speed after being tweaked for years by a team of engineers. What impressed me the most is how hard it is for all of this massive parallel computing power to beat a human with only one brain.