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AIND Project 3: Research Review

A Summary of Deep Blue

Deep Blue was an Artificially Intelligent chess-playing computer manufactured by IBM. The agent became the first computer to defeat a world champion, after winning 4 out of 6 games in a 1997 rematch against world champion, grandmaster Gary Kasparov. This is a review of a paper written about the system published by *Campbell, Murray, A. Joseph Hoane and Feng-hsiung Hsu* in 2002[1]. The paper in question outlines Deep Blue's hardware design, its evaluation functions, and its evolution from predeceasing chess-playing agents.

The paper first traces the history of Deep Blue. The deep blue agent discussed in the paper is the 1997 version of the computer. Which was an update on a 1996 version, which the paper calls Deep Blue I. Deep Blue I had also pitted against Gary Kasparov in a losing effort in 1996. The efforts to build a chess-playing agent however went further back. Deep Blue itself evolved from earlier IBM chess agents called Deep Thought II and Deep Thought I.

Deep Blue introduced a number of hardware enhancements to its predecessors. It was a massively parallel system that could carry out deep game tree searches. The system had 30 nodes and 480 single chip chess search engines. Each node had 1 GB of RAM and 4 GB of Hard disk. This massive amount of dedicated hardware power meant that the engine could search between 2 and 2.5 million chess positions per second. This gave Deep Blue the advantage of having a large searching capacity, which was orders of magnitudes higher than that of its predecessors. Deep blue also made use of hardware evaluation by implementing its evaluation function in the hardware. This allowed the evaluation to happen a lot quicker than a software evaluation would have allowed. Furthermore, Deep Blue combined hardware and software search in a massively parallel system to give it unprecedented searching speed and capacity while evaluating game trees.

Similarly, Deep Blue made use of some clever software enhancements to the algorithms of its predecessors. Deep Blue like its predecessors used Alpha Beta search trees to generate moves. However, Deep Blue made a number of enhancements to its evaluation function. A new selective search algorithm was built for deep blue. The algorithm was able evaluate forced pair of moves. Which was a look into evaluating moves that a player forces onto their opponent. Deep Blue was able to assign a credit score by tracking chains of forced pair moves and decide when a move would be best made. Deep Blue also had an opening book which kept track of 4000 positions from various grandmasters. Deep Blue studied a number of Gary Kasporv specific moves but none of these situations arose in the 1197 match. Furthermore Deep Blue had access to a larger Grandmaster Database with 70000 positions with the help of a mechanism called extended book. Deep Blue's evaluation function would favor a move if it had been played frequently by Grand Masters and would even favor moves that were played by better players.

In conclusion Deep Blue made use of a large search capacity, parallel searching, complex evaluation functions, and a database of moves made by great chess players. This allowed it to achieve one of the most significant landmarks in Artificial Intelligence history

[1] Campbell, Murray, A. Joseph Hoane and Feng-hsiung Hsu. "Deep Blue." *Artif. Intell.* 134 (2002): 57-83.