UDACITY – Artificial Intelligence Nanodegree
Project 2 – Research Review

Paper: Deep Blue, by the IBM Watson Team

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Deep Blue, also referred as Deep Blue II, was a computer chess system developed by IBM Research at mid-1990s. It was the last iteration of a series of chess machines developed with the goal of defeat chess Grandmasters. It was preceded by ChipTest, Deep Thought, Deep Thought 2 and Deep Blue I. Following is a brief summary of each system:

ChipTest and Deep Thought

They were developed in 1980s in the Carnegie Mellow University. ChipTest was capable to perform searches in a speed of 500,000 positions per second and Deep Thought 700,000 positions per second. Deep Thought was the first machine to beat a Grandmaster in a tournament play.

Deep Thought 2

Deep Thought 2 was an intermediate step to Deep Blue. It had the same move generator of Deep Thought but with four improvements: Medium-scale multiprocessing, enhanced evaluation hardware, improved search software and extended book. It played in some public events from 1991 to 1995.

Deep Blue I

It was based in a single-chip search engine, running on a 36-node computer, using 216 chess chips. Each chip was capable to search 1.6 to 2 million chess positions per second, with overall search speed of 50 to 100 million positions per second. A single-node/24 chess chips version has beat two Grandmasters and has lost to another one. The full version was defeated by the best Grandmaster Garry Kasparov in February of 1996.

Deep Blue II

Several improvements were made in Deep Blue II: a new and enhanced chess chip, added hardware repetition detection, more specialized move generation mode and efficiency improvements. Also, the number of chess chips were more than doubled and a set of software tools were created. The system was a 30-node computer, with 480 single chess chips, each one capable of perform searches of 2 to 2.5 million positions per second. It was organized in three layers, with one of the nodes as master, responsible to search the top levels of the game trees, and all the others as workers, which perform additional search on few more levels from the "leaf" positions received from the master and distributing their "leaves" to the chess chips, which searches the remaining levels of the tree. The entire system can search at speeds of 100 to 330 million positions per second, depending on the characteristics of the positions been analyzed. Deep Blue implemented many of the ideas developed on early system, such as quiescence search, iterative deepening and transposition tables. New characteristics were also added, such as large searching capacity, hardware evaluation, hybrid software/hardware search and massively parallel searching. The chess chips were divided into three parts: move generator, evaluation function and search control. The evaluation function was a sum of feature values, recognizing and assigning values to 8000 different patterns. Values can be static or dynamic, the former being set once at the beginning of the search and the latter set at the beginning and adjusted during the search. The Deep Blue also had a database of known best moves created by chess Grandmasters. After all these improvements, in May of 1997, Deep Blue defeated Gary Kasparov in a six games match by the score of 3.5-2.5, awarding the Deep Blue team with the Fredkin prize for defeating the world champion.