Summary of article: Deep Blue by the IBM Watson Team

A watershed in the history of Artificial intelligence was reached twenty years ago when a computer program - Deep Blue computer chess system - beat the reigning chess world champion Gary Kasparov. This astonishing feat of technology has demonstrated that the very best can be beaten by machines in an area where we have prided ourselves on a very high degree of human intelligence. The techniques and processes used to develop the computerised chess system are what is discussed in this paper authored by various collaborators from IBM, Sandridge Tech and Compaq computers.

1. Objectives/goals

The project was established at IBM research in the 90s. The objective was to create a world class chess machine, bringing to bear all the relevant computing and AI techniques available at the time.

Some of the issues they faced included dealing with large and complex search tree and orchestrating parallel processes in both the firmware and software routines.

2. Techniques introduced.

The system consisted of a combination of cutting edge hardware and state-of-the-art software solutions.

2.1 Hardware

The hardware comprised multiple 120 MHz processors with 30 nodes within an IBM RS/6000 SP computer with 480 chess chips each capable of carrying out over 2.5 million searches per second. The chips had various assembly-level routines programmed into the firmware as part of the solution.

2.2. Software

The Software component was written mainly in c and it was run on a AIX® 4.2 operating system.

2.3. Routines and procedures

Sophisticated routines based on complex algorithms for nondeterministic parallel searches were implemented in the hardware chips as well as in the software program. They included evaluation functions covering over 8000 features, pruning procedures (e.g. “no progress”, null and alpha-beta to drastically eliminate redundant searches) repetition detection and some known optimal chess moves/positions implemented with the assistance of chess grandmasters such as Joel Benjamin, Nick De Firmian, John Fedorowicz and Miguel Illescas. The search routines included and involved quiescence search, iterative deepening, transposition tables, NegaScout (AKA Principal variation search), move ordering and move generation.

In the hardware, they implemented search procedures with master overload, load balancing and Sharing between nodes.

Additional specialised routines were implemented inside the software. These included Non-uniform searches and a selective search procedure called “Dual credit with delayed extensions”. Other finer procedures such as “forced moves” detection and prevention of “search explosions” were also included.

Several known chess repertoires were also incorporated into the software and chip-ware. Examples of these are “Rooks on files”, “Pinned pieces”, “simple hung” etc).

In addition, there were several different conceptual strategies such as Singular, binary, trinary and Absolute singular moves, Threat analysis (e.g. mate threat, attack on high value pieces etc), Influence mechanism (i.e. acknowledging the effect of prior moves), domain dependency and quiescence (i.e. “lull, less computationally demanding, periods) searches.

3. Results/outcomes

The result of the project was a remarkable success that earned the Deep Blue team the Fredkin prize for creating the first computer program to defeat the human world champion in a regulation match.

4. Conclusion

The computational tools that were available 20 years ago were used through the creation of the deep blue to successfully demonstrate the potentials of artificial intelligence. Much improvements have accrued over the years and more technological feats are being accomplished at less cost and with higher efficiencies.