Deep Blue Research Review

Deep Blue is a world-class chess machine which has been build based on the experience of previous machines like Deep Thought, Deep Thought 2, Deep Blue I. it gets benefited of a series of improvement on Deep Blue I. new design for chess chip (which enable it to have 8000 features calculated on the evaluation function), double the chess chips in the system, debugging and match preparation tools, and searching ability is some of the improvements.

A three layer parallel system support Deep Blue. Master processors search the top levels of the chess game tree and distributes the middle level to the workers. They carry out a few levels of additional search and distribute their leaf position into the last layer for more examination.

Deep Blue relies on many different ideas such as quiescence search, iterative deepening, transposition table and NegaScout. Large Searching Capacity (non-uniform and insurance search), hardware evaluation, hybrid search (software/hardware), and massively parallel search are some of important characteristic of Deep Blue.

Chess chip has been designed in such a way that provides move generation, evaluation function, search control, and extendability for Deep Blue. Generation of checking, check evasion moves, generation of certain kinds of attacking move, several search extensions are some of the benefits that provided by chess chip. In order to improve the performance, besides slow evaluation function, chess chip provides fast evaluation functionality to speeds up the process in the position which the approximation is good enough. It also gives the opportunities to use the external transposition table, complicated search control, and additional terms for evaluation function through FPGA (Field Programmable Gate Array).

Deep Blue empowered by software search which called “dual credit with delayed extensions”. Besides this software search, chess chip provides a fixed-depth null-window search as hardware search module. It also includes a various type of search extensions heuristics for full-width and quiescence search. Using 480 chess chips on Deep Blue, enable it to gain the benefit of parallel search as well.

Deep Blue Evaluation function is a sum of feature values. Chess chip recognizes roughly 8000 different “patterns” and assigns a value to each of them. Features range from very simple such as particular piece on a particular square to very complex includes extended example (Rooks on files) and automated evaluation function analysis.

In addition to the specifications discussed, Opening Book, Extended Book, and Endgame database has been created for Deep Blue. Opening book consisted of about 4000 positions. In addition, extended book is a summary information of 700,000 game database which influence and direct Deep Blue’s play even without opening book. Besides that, endgame database includes all chess position with five pieces or fewer. It

has been used off-line during the design of chess chip as well as on-line in software search module.

Also, two set of timer used as time control mechanism, normal and panic time target. First one is set to time remaining to the next time control divided by moves remaining. Deep Blue in some condition will go beyond this time but not exceed the second time target which called panic time target (roughly one third of remaining time).

In conclusion, large searching capability, non-uniform search, complex evaluation function, endgame database, extended book, and evaluation function tuning, together, are factors which played a significant role in the success of Deep Blue in 1997 match.