Deep Blue by IBM Watson team

The goal of the Deep Blue paper is to provide the rationale about what design improvement decisions were implemented after the defeat of Deep Blue I in 1996 to Garry Kasparov that finally led to Deep Blue II's victory in 1997. The improvements were based on observations of the 1996 match as well as feedback from test games against Grandmaster Joel Benjamin.

The changes basically involved 1) an enhanced chess chip that improved search speed, 2) nearly doubling the number of chess chips in the system to support the higher processing needs, 3) better evaluation and visualization tools to help with debugging. The basis of Deep Blue is formed around quiescence search, iterative deepening, the use of transposition tables which are predominantly used to speed up the search of the game tree and is essentially a form of memorization and NegaScout, a directional search algorithm for computing the minimax value that can be faster than alpha-beta pruning.

However, the increased processing power of Deep Blue II required additional considerations such as 1) how to address the larger search capacity which was guided by two principles where the search should be non-uniform and the search should provide 'insurance' against simple errors, 2) hardware evaluation where additional features cannot be added once implemented and that there has to be balance between improved hardware and efficiency for example the improved evaluation chip functions that composed of a 'fast evaluation' when an approximation is ok and 'slow evaluation' when a deeper search is needed, 3) choosing the right strategy between hardware (fixed search) and software (flexible) search and 4) how to correctly utilize and use a massive parallel search and 5) other factors such as the use of endgame databases (although the paper states that this strategy may only have been used in 1 of the 1997 games) and the use of extended book which is the use of summary information of a 700,000 game database to nudge Deep Blue in the consensus direction of chess opening theory.

The results of the paper show that the improved modifications lead Deep Blue II to a 3.5-2.5 victory over Garry Kasparov, an improvement over Deep Blue I's 4-2 defeat in 1996.