Goal of paper:

The paper describes the Deep blue computer chess system, developed at IBM research during the mid-1990s. Deep blue being the result of a decade long effort in building a world-class chess machine, involved the development of a series of machines. Two distinct versions of deep blue exist, one which lost to Garry Kasparov in 1996 and the one which defeated him in 1997.

It starts by enlisting brief specifications of distinct machines like ChipTest, Deep Thought and Deep Blue and then comparing these machines based on features like processing power, evaluation hardware and search software. Under the hood, Deep blue runs on a massively parallelized architecture which supports large searching capacity and hardware implementation of the evaluation and searching capabilities.

Results of paper:

The search strategies adopted by Deep Blue combines a software search, implemented in compiled C code on a general purpose CPU, with a hardware search, encoded in silicon on the chess chip. The software implementation surpasses its counterpart in terms of extensibility with the execution time taking a hit due to the emphasis placed on a "better" evaluation function. The hardware implementation doesn't face these issues as the time to execute is a fixed constant, whereas it is not possible to add new features which affects the extensibility. An amalgamation of the two approaches is used to complement functionalities which wouldn't have been provided by otherwise isolated units.

A brief overview of the chip used in Deep Blue is presented which further builds on the implementation details of the hardware search and evaluation function. The chess chip divides into three parts: the move generator, the evaluation function and the search control.

The software search is formulated based on the experiences with Deep Thought 2. The pseudocode for this search called "dual credit with delayed extensions" is based on a depth-limited version of alpha-beta using the negamax formulation. The hardware search takes place on the chess chip which is fast, but is relatively simple in the configuration. To strike a balance between the speed of the hardware search and the efficiency and complexity of the software search, we limit the chess chips to carry out only shallow searches.

The system configuration for the Parallel search is composed of a 30-node RS/6000 SP computer and 480 chess chips, with 16 chips per node. The heterogeneous architecture has a strong influence on the parallel search algorithm used in Deep Blue. Most accurate numbers were derived on a single-node version with 24 chess chips. The results varied widely depending on the tactical complexity of the position searched. For positions with many deep forcing sequences speedups averaged about 7, for an observed efficiency of about 30%. For relatively quieter positions, speedups averaged 18, for an observed efficiency of 75%.

Indirect evidence for a full 30-node system suggests an overall observed efficiency of about 8% in tactical positions and about 12% in quiet positions. However the Deep Blue team consciously focused on improving the evaluation function following the 1996 Kasparov match, and the parallel search code was untouched between the 1996 and 1997 matches.