Research Paper: Deep Blue, Murray Campbell, A. Joseph Hoane Jr., Feng-Hsiung Hsu (2002)

The research paper "Deep Blue" by Murray Campbell, A. Joseph Hoane Jr. and Feng-Hsiung Hsu describes the artificial intelligence behind the IBM Deep Blue ® computer chess system, defeating the then-reigning World Chess Champion Garry Kasparov in a six-game chess match in 1997. Although there are two distinct versions of *Deep Blue*, a Garry Kasparov defeating and non-defeating version, the paper primarily contributes to the success of the winning version, *Deep Blue II*.

First computer chess systems were introduced at Carnegie Mellon University in the 1980s. They used single-chip move generators which achieved search speeds at 500,000 to 700,000 positions per second. A move generator based on the generator chip helps to compute all possible moves of a game in an optimized order with the objective to minimize latency. Still using single-chip move-generators in the beginning 1990s, Deep Thought 2 built the foundation of Deep Blue by introducing multiprocessing, better evaluation functions and improved search software.

Using 216 chips to searching 50-100 million chess positions per second, *Deep Blue I* played a first match losing against Kasparov in 1996. To play a rematch in May of 1997, *Deep Blue I* was reengineered as *Deep Blue II;* a parallel system with 480 chips and a redesigned evaluation function to incorporate search control and new selective search methods (e.g. a dual credit with delayed extensions algorithm). By successfully integrating parallel search with selective search, *Deep Blue II* defeated Garry Kasparov in the 1997 match with an overall search speed of 126 - 330 million chess positions per second.

The major performance bottleneck of the *Deep Blue* system was a configurable master processor helping to abort long-running hardware searches and optimally assign searches for featured values to worker nodes. An evaluation function generator on the master node helped with intelligent abstraction to keep tasks manageable and dictate relationships between groups of related features. On top of that, the evaluation function weights, endgame databases and the extended book helped *Deep Blue II* to defeat the then-reigning World Chess Champion Garry Kasparov.