

Deep Blue

For many, chess can be a standard for intelligence as it requires an acumen to develop complex strategies involving different pieces to best the opponent. Around 1963, Hubert Dreyfus asserted that artificial intelligence will never be able to play chess, let alone defeat a human opponent. However, he was proven wrong by the Greenblatt chess machine. Now that artificial intelligence has proven to be capable of defeating a human opponent, the next challenge was to determine if it is able to best a world champion. In 1997, Deep Blue defeated world champion Garry Kasparov in a six-game match.

Deep Blue is the product of a series of chess-playing machines which included ChipTest, Deep Thought, and Deep Thought 2. In order to play the game of chess, the first systems implemented a single-chip chess search engine which was able to identify 500,000 – 700,000 chess positions per second. With more development, Deep Thought 2 was able to use larger RAMs which facilitated data management in a more time efficient manner. In addition, parallel search was improved to be able to search through the chess game tree more efficiently. Deep Blue inherited these tools and improved some. It was able to use an enhanced chess chip which exercised a redesigned evaluation function. Finally, Deep Blue was also able to use more chess chips in the system to increase the searching capacity.

Deep Blue improved parallel search by dividing work into three divisions which bracketed the work. The top layer was designated the “master” which searched the top levels of the chess game tree to select certain “leaves” for the other 29 nodes to look further into. The second layer would then search a few more additional levels to select “leaves” for their respective 16 chess chips to search through. Deep Blue was incredibly quick as it was able to search 126 million positions per second. As chess has an incredibly large tree to search through, it was imperative for Deep Blue to search through this tree in the most efficient manner minimizing time and maximizing the possibility of victory. The search was guided by several principles which prioritized forced pairs of moves which are an important part of tactics. Deep Blue was able to recognize the importance of a series of forced pairs of moves which could then be capitalized on to take advantage in the game.

The Deep Blue evaluation function was the sum of values given from the multiple chess chips. Each chess chip would search 8000 chess boards and assign a value to each pattern. Each of these values would then be given to the master node to determine the best move choice. In addition, Deep Blue implemented an opening book, an extended book, as well as an endgame database to assist the selection process for Deep Blue. Each of these books were influenced by Grandmasters and were evaluated by Deep Blue.

Deep Blue proved to be successful in that it proved that artificial intelligence was able to best a world champion chess player through the implementation of chess chip search engines, a massive parallel system, an effective evaluation function, and the influence of Grandmaster move databases. However, it is not perfect in that the parallel search efficiency can be improved as well as developing different pruning mechanisms. And here is where exploration can take place to develop a more efficient chess-playing machine.