

Review of Deep Blue

Deep Blue was a breakthrough in the field of AI agent based game playing that paved the way for the modern AI game playing agents like AlphaGo.

The success of Deep Blue in the 1997 match against Gary Kasparov was not the result of any one factor. Its large searching capability, non-uniform search, and complex evaluation function were all critical. However other factors also played a role, e.g., endgame databases, the extended book, and evaluation function tuning. Most of these above features stated were the first of its kind and have since been successfully incorporated in AI spanning a vast range of fields.

IMPLEMENTATION

Deep Blue's success was built on top of the previous success of Deep Blue I and an improved hardware component called a **chess chip**, which had also been used in Deep Blue I. The chess chip had an evaluation function that essentially computed the sum of feature values by recognizing roughly 8000 different "patterns", and each is assigned a value after which the system comes to a decision. A number of the new features were in response to specific problems observed in the 1996 Kasparov games, as well as in test games against Grandmaster Joel Benjamin. The new chip also added hardware repetition detection, a number of specialized move generation modes (e.g., generate all moves that attack the opponent's pieces: see Section 3.1), and some efficiency improvements that increased the per chip search speed to **2–2.5 million positions per second**. The second major change was to more than double the number of chess chips in the system, and use the newer generation of SP computer to support the higher processing demands thereby created. A third change was the development of a set of software tools to aid in debugging and match preparation, e.g., evaluation tuning and visualization tools. Finally, we concluded that the searching ability of Deep Blue was acceptable, and we spent the vast majority of our time between the two matches designing, testing, and tuning the new evaluation function

For its search, the chess chips of Deep Blue used a combination of two distinct types of search that each worked towards their own unique goals in **parallel**:

- Software Search (Flexible C code that explores tree near root. Recursive extensions without quiescence search capabilities. Uses a transposition table and hardware search as dynamic evaluation function)

- Hardware Search (Runs on the chess chips and state machines to explore the tree near leaves. Mostly local extensions that that uses complex quiescence search. Not flexible since it is hardwired, and doesn't use a transposition table)

RESULTS

Deep Blue defeated Garry Kasparov in the 1997 match by a score of **3.5–2.5**. For this victory, the Deep Blue team was awarded the Fredkin prize for defeating the human world champion in a regulation match. As this was the first autonomous system to beat the world's undisputed best of its field, Deep Blue's importance to the field of AI and the amount of breakthroughs it has led to cannot be understated. As stated previously, the success of Deep Blue was a major reason for continued research in other fields as it showed that AI was a feasible avenue for future innovation and products.