

Research review: Summary of the Deep Blue paper

The goal of the paper is to describe the Deep Blue system and to give some rationale of the design decision.

There were a series of machines that led to Deep Blue: ChipTest, Deep Thought, Deep Thought 2 and Deep Blue I. The improvement in each step made the final Deep Blue possible.

About the system, it had a large searching capacity and the search was highly non-uniform, it also provided insurance against simple errors. The hardware was also able to evaluate positions and the Deepblue had the possibility of a hardware/software (hybrid) search with massive parallel search.

The chess chip had the possibility to generate moves and evaluate position, it also had a search control, the search control could keep track of the repeated moves, so it could avoid it.

The software search looked for forcing moves, forced expectations, fractional extensions, delayed extensions (isolated forced moves) and it preserved the search envelope so it would avoid repeating the search. It also had a way to give credits to the movements.

The credit mechanism is used to each move and its behavior, if the move appears to be good it would give more credit to this move and search deeper, while to bad moves it would search less. The credit generation is complex, for example, in the case of a draw, it would count as positive for move repetition if the machine is striving for a draw and it would count as negative if the machine is trying to avoid a draw.

Hardware search is fast but relatively simple, once the search is initiated the host processor is free to perform other work. The main parameters of the hardware search are the depth of the search and the depth of the offset searches, to detect specific conditions.

The parallel search is also an important had a structured way of calculating the variations with processor hierarchy, control distribution and synchronization. It is interesting to know that the Deep Blue parallel search was not deterministic depending of time and processor job assignments.

The evaluation function had around 8000 features, some were very simple and others very complex. These features could be static, as the beginning of the search, or dynamic, they could change during the search, for example, king safety. The large majority of the evaluation functions were created/tuned by hand.

Just as comments, it worth mentioning that Deep Blue had a large opening book, defining the first moves and variations. It also had an extended book, with games from Grandmasters to play in the absence of the opening book. There was a mechanism to assign bonus (or penalties) for moves played in the Grandmasters database. And it had an endgame database including all chess positions with five or fewer pieces.

The time control had two limits, the first limit was the total time divided by the probable number of moves to play, this time were taken per move. This limit had a time buffer as reserve. The second limit was used as panic button, if the suggested move had a red flag it would be used to improve it.

The main conclusion of the paper is that Deep Blue is the sum of all this factors and not just one of them, everything was important to reach the goal of the project.