Research Review

Deep Blue

Deep Blue is the chess machine that defeated then-reigning World Chess Champion Garry Kasparov in a six-game match in 1997.

Factors that contributed to this success include

- **Single chip chess search engine**. This chip had a completely redesigned evaluation function, going from around 6400 features to over 8000.
- **Massively parallel system** with multiple levels of parallelism, with over 500 processors available to participate in the game tree search.
- **Significant search extensions**. Search was non-uniform so that it can search as deep as human players. Even without pruning and highly selective search deep blue had sufficient searching power to avoid simple errors.
- In addition to software search Deep Blue also performed **hardware search**. It is that part of the Deep Blue search that takes place on the chess chip. It is fast but relatively simple. To strike a balance between the speed of the hardware search and the efficiency and complexity of the software search, the chips only carried out shallow searches.
- **Complex evaluation function**. It is essentially a sum of feature values. Each of the roughly 8000 or so features is assigned a value either statically or dynamically during the search.
- **Opening book** was created by hand, openings chosen to emphasize positions that Deep Blue played well. In general this included tactically complex openings.
- Deep Blue had a large **extended book** that allowed a large Grandmaster game database to influence and direct Deep Blue's play in the absence of opening book information.
- Effective use of a Grandmaster game database. The **endgame database** included all chess positions with five or fewer pieces on the board as well as positions with 6 pieces that included a pair of blocked pawns.
- **Time control** has a normal time target and a panic time target if the situation is not normal.

The authors conclude their research listing out areas for additional improvement. Parallel search efficiency increase, adding pruning mechanisms to search, evaluation function tuning, flexible hardware search are some of the enhancements that could be done on Deep Blue.

Reference:

https://pdfs.semanticscholar.org/ad2c/1efffcd7c3b7106e507396bdaa5fe00fa597.pdf