**Artificial Intelligence Nanodegree - Project 2 – Build a Game-Playing Agent**

Review of ***Deep Blue*** paper

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**Summary of goals and techniques**

The goal of the project was to build a chess-playing computer that could beat a human player. The effort involved a hybrid of hardware and software working together. Improvements were made over multiple generations of the system.

The hardware was impressive:

- A special chess chip the performed fixed-depth searches, including a quiescence search.
- Over 500 processors available for searching
- Capable of processing 500k moves/second
- Use of null-window search in hardware. Null-window searches are like alpha-beta searches, but without the need for a stack of value.
- Use of fast evaluation and slow evaluation techniques
    - Fast evaluation - compute score of a move using easily computed values such as piece placement
    - Slow evaluation – scan the board one column at a time looking using strategies such as square control, pawn structure, passed pawns, trapped pieces, and pins

The software techniques were numerous:

- Massively parallel system with multiple layers of parallelism
- Use of pre-defined moves:
    - A “book” 4000 of opening moves created by grandmasters and tested on Deep Blue itself
    - An endgame database – the complete set of moves with 4-5 pieces remaining on the board
    - A Grandmaster game database
- Ability to analyze and opening move without an opening book
- A move generator the computes one move at a time, but implicitly computes all possible moves before selecting one.
- Use of a “credit” scoring system to evaluate moves
- Use of time controls – important in a live chess competition
- Programmed insurance against simple errors

**Summary of results**

Deep Blue beat Grandmaster Garry Kasparov 3.5-2.5 in 1997 and was awarded the Fredkin prize for defeating a human world champion in a regulation match.