Summary of "Deep Blue" ***by Levan Iordanishvili***

The Deep Blue paper is a fascinating look into the AI system that defeated chess champion Garry Kasparov. The system described in the paper was created with goal of defeating the best human chess player, it focuses on how the team behind Deep Blue improved the system based on the experiences of its predecessor systems such as Deep Thought and the earlier version of Deep Blue -- one that lost to Gary Kasparov in 1996.

It was fascinating to learn that one of Deep Blue's predecessors, Deep Thought was the first system to beat a Grandmaster in 1988 (58). It took the team 9 more years of development to improve the system to the level where it would be able to defeat Gary Kasparov. The paper focuses on improvements made between the 1996 and 1997 versions of Deep Blue.

The team identified the evaluation function as one of the key candidates for an upgrade, they adjusted the function to address the deficiencies identified in the 1996 loss. The team increased the number of features in the evaluation function from 6400 to 8000 (59). "Large majority" of the 8000 features apparently were not generated automatically -- fascinating, considering the sheer number of features used in the evaluation function (76).

However, the team did use automated tools to identify weaknesses in the features: the paper mentions the use "hill-climbing" as a way of figuring out which features needed improvement (76). The paper describes the use of an automated tool to tune the weights of the features. The descriptions provided for these tools suggest the use of machine-learning-like optimization along the way.

The paper describes the compelling way in which the team parallelized the search, though the algorithm was not changed from the 1996 version and was identified in the paper's conclusion as one of the areas for improvement (79). The Deep Blue searching architecture mixed software and hardware searches, where the software search served as the more complex and flexible search and the hardware search provided a simpler depth-limited search. The hardware search was implemented on the "chess chips" -- the number of which they "more than doubled" in the 1997 version (59).

It was interesting to read that, at its core, the Deep Blue algorithm used the concepts that we have implemented in our Isolation game algorithms. For example, the paper mentions "quiescence search, iterative deepening, and transposition tables" (60). It focuses extensively on the amount of effort the team put into deepening the search once they realized that a human, Mike Valvo, was able to search deeper than one of Deep Blue's predecessors, Deep Thought .

In addition to improving the well-tuned evaluation function and the parallel searching capability, Deep Blue relied on an opening book database developed by Grandmaster Joel Benjamin and others. Interestingly, the opening positions were in fact chosen to "emphasize positions that Deep Blue played well" (76).

In addition to the opening book, Deep Blue also had access to a labeled dataset called the "extended book" (77). Which "summarized the information available at each position of a 700,000 game database." The information was used to provide hints for Deep Blue and help improve the searching. The extended book was used to inform the alpha-beta search algorithm, the team provides an example where a "10 point bonus" obtained from the extended book would "offset the alpha-beta search window by 10 points" (77).

References:

Campbell, Murray, et al. “Deep Blue.” *Artificial Intelligence*, Jan. 2002, pp. 57–83.