Thesis Project Portfolio

Checkmate or Stalemate? The Impact of Chess Engines on Player Strategy and Game Integrity

(Technical Report)

Building a Chess Engine: An AI, Problem Solving, and Software Development Journey

(STS Research Paper)

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Angelo Bechtold

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Department of Computer Science

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Executive Summary

The game of chess has captivated players for centuries due to its deep strategic and tactical complexity. As technology advanced, powerful chess engines emerged, significantly impacting the game's landscape. These engines provide an unprecedented depth of analysis and strategic insights but also introduce challenges. The general problem underlying both projects in this thesis portfolio is understanding and addressing the implications of chess engines on various aspects of the game, such as the competitive landscape and player development over time.

In the technical research project, the focus was on developing a custom chess engine using minimax and pruning methods. The aim was to create a functioning engine capable of competing with other (naive) engines and human players at an intermediate level. The chess engine has several essential components. The board representation was designed to efficiently store and manage the state of the game. The move generator facilitated legal move generation for each position, while the search algorithm, using minimax and alpha-beta pruning, explored possible move sequences to identify optimal moves. Lastly, the heuristic evaluation function assessed the desirability of various positions, considering factors such as material balance and piece mobility. During the development process, there were several challenges. Optimizing the search algorithm was crucial, as the balance between search depth and computational resources was difficult to achieve. The design of an effective heuristic evaluation function required accurately assessing the strength and weakness of a given position, considering various chess principles. Handling complex endgames and adapting to different playstyles were also significant challenges. To overcome these challenges, we implemented a range of solutions. Alpha-beta pruning was employed to significantly reduce the number of nodes examined in the search algorithm,

allowing for deeper searches within a reasonable timeframe. An evaluation function was developed that considered multiple factors to provide accurate position assessments. The integration of endgame tablebases enhanced our engine's endgame performance, and the engine's adaptive playstyle allowed it to effectively respond to different strategies.

The STS research project aimed to analyze the socio-cultural impact of AI-driven chess engines on the chess community. This analysis explored the balance between the benefits and potential detriments brought by these engines. Improved study methods and performance were among the advantages, while cheating and over-reliance on technology constituted potential drawbacks.

The project also investigated the perspectives of grandmasters, who expressed concerns about the potential erosion of creativity and intuition in human play due to the pervasive use of chess engines. The research underscored the importance of maintaining a delicate balance between leveraging AI's benefits and preserving the intrinsic human elements of the game.

By exploring the technical creation of a chess engine and its socio-cultural implications, the thesis portfolio provides a substantive understanding of the impact of engines on the game of chess. Both projects contribute to addressing the general problem of understanding and addressing the implications of chess engines on various aspects of the game. The technical project lays the foundation for future work in engine development and game theory. In contrast, the STS research project emphasizes the importance of ongoing exploration of the evolving relationship between humans and engines in chess.

Future researchers should further investigate the rapidly changing dynamics between human and chess engines. Understanding how to maintain a balance between utilizing engine benefits and preserving human creativity and intuition is crucial. Exploring new methods to mitigate the negative aspects, such as cheating and over-reliance on technology, is also important. The work in this thesis portfolio highlights the transformative potential of engines in advancing chess and other fields where strategic thinking and decision-making are paramount while emphasizing the need to address the challenges accompanying its integration.