Chess Engines/AI and Human Chess Improvement

STS 4500 Prospectus

Computer Science

Computer Science B.S.

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Overview

As an avid chess player, I have participated in tournaments, watched chess-related content, and studied the game for over 10 years. In these 10 years, I have witnessed the rise of use in chess engines, or AI meant to solve chess, in the community. I will perform a literature review to examine the effect that chess engines have on how humans improve in chess by reviewing various articles and research papers that are related to this topic. By analyzing various related works, I hope to combine the aforementioned works into a more unified finding on how chess engines affect human improvement, then use the findings to design a policy regarding chess engines that protects values of various stakeholders in the chess community.

Problematization

Because of their impressive speed and strength of play, engines have become widely used in the chess community. Players will use engines to analyze their play by finding where they went wrong and discover stronger moves suggested by these engines. They are often used during tournament coverage to give viewers a better sense of the position – engine evaluations offer an objective score of the current position. However, their prevalence can have various drawbacks. For one, there has been a rise in cheating in chess, which occurs when players use engines in matches in which they are banned (Menon 3, 2022). This cheating is very prevalent in online chess. Chess.com, one of the most popular sites for online chess, has reported that around 17,000 accounts are closed per month due to cheating from 6,000 before the COVID-19 pandemic. Some have also argued that they stunt improvement because an overreliance prevents players from exercising critical thinking skills necessary when engines are not present (e.g. in tournament matches).

Guiding Question

Has the use of chess engines has influenced the chess community and one's ability to improve at chess?

Projected Outcomes

My research aims to give people a better understanding of the role of AI in chess by explaining how it can impact players and how to properly use AI in chess. I will also provide evidence for the effect of AI on human behavior, which can have implications for many fields that could be impacted from learning about human behavior and AI, such as psychology, investment banking, education, etc.

Technical Project Description:

I will be pursuing the capstone requirement variant in which I take an extra elective alongside the CS writing seminar. The elective class will be titled Artificial Intelligence. In the past, I have worked with code that uses an existing chess engine (Stockfish) to develop a chess engine that has a different ruleset for chess. This consisted of writing Python code to manipulate chess positions that were fed into an existing chess engine, thereby influencing the output of my code. I have worked with basic AI, writing code that performs image classification for frogs and airplanes.

Preliminary Literature Review & Findings

The issue of chess engines in the community is a relatively unresearched field. Database searches overwhelmingly point people towards articles regarding the technical aspects of building a chess engine, which is only tangential to this topic. With few papers on this topic, it is possible that the sources tend to be biased, as researchers may be motivated to produce conclusive links between chess engines and human play. Chess professionals, who were involved

in some research and discussion, actively use engines, so they may be biased for engine use.

Those who have explored the topic mainly consist of PhD candidates and university professors working with AI, human-computer interaction, explainable AI, and education (Lappo et al., 2023; Lepri et al., 2005; Das & Chernova, 2020). From preliminary research, researchers working in this area have found that the use of engines has improved human play over the past few decades. However, engines are not currently in a place to directly teach players, as there is little way to interpret an engine's output. Engines only provide an objective score (e.g. +1.12) and the best continuations for both sides, excluding any explanation as to why one continuation is better than the rest. Being able to know why one continuation is stronger than the rest is a key aspect to chess improvement, thus making engine output insufficient for an improving player. To address this issue, engineers have devised devices that can better interpret a chess engine. Rather than just reporting the best move in a position, these explainable AI devices can produce rationale and encouragement, which can help a player improve without a human coach.

Current research papers do not provide enough context to capture the full history of AI in chess. Others may be too technical and are only fully interpretable with a chess background. Therefore, this paper will combine them to form a longer timeline of AI in chess while making its concepts accessible to the general public.

STS Project Proposal

The goal of STS is to analyze how technology influences society and vice versa, through various lenses. This research constitutes an STS project because it examines the effect of technology, chess engines, on society, seen through human chess players and their improvement. More broadly, this research concerns itself with how chess culture has changed since the advent of superhuman engines. AI's impact on chess culture can be seen in the change in how

competitive chess is conducted and what types of strategies players employ. Some examples of change can be seen in tournament procedure changes, opening (the first few moves of a chess game) choices, and overall shifts in playstyle from aggressiveness to defensiveness.

I am approaching this problem from a policy and ethics oriented standpoint, for I am determining a policy that will better integrate chess engines into chess society and minimize ethical concerns. If it is found that engines have an overall positive effect on chess play, I will suggest a policy that uses engines most effectively to help people improve and avoid engine misuse. If the opposite effect is true, I will report on methods to avoid engine use in chess. Either way, I will draw heavily from Lappo et al. and McGrath et al., as these sources include AlphaZero (a revolutionary chess AI developed by Google and DeepMind) developers, a former world chess champion Vladimir Kramnik, and other machine learning experts who have written extensively about the effect of AlphaZero and AI on chess (2023, 2022). Reliance on AlphaZero developers is important, as it is not available to the public, so there are few people with expert knowledge about it.

Because my work will have many implications for human improvement, psychologists will likely benefit from this research, especially for those who study human improvement, as this may have implications for how human learning may change in the future. For example, if chess AI is beneficial for human improvement, they may be used to help teach material currently taught in schools in the future. Any findings may change a wide range of fields that have begun using AI to improve decision making, because given the outcome of this research, many may push harder for or against the introduction of AI in their fields. For example, investment and trading firms, educators, banks, healthcare providers, marketing firms, insurance companies, etc. all have begun using AI to assist in their decision making, the use of which may be altered

depending on the results of this research. Preliminary research yields a paper by Krakowski et al., who find centaur chess, or the combined thinking of humans and engines, can result in stronger chess than play entirely by humans or machines (pp. 19-20, 2021). However, it is difficult to draw complete parallels to the aforementioned fields. As Krakowski et al. find, machines are limited by little data and unpredictable outcomes, which are not barriers for chess engines. With uncertainty in the real world, human intuition may be more reliable than a machine's (p. 20, 2021). In a personal interview with Jane Street, one of their employees mentioned that because the stock market is so volatile and unpredictable, Jane Street believes that machine learning is likely not viable in the foreseeable future in this area.

To analyze chess engines in the context of the chess community, I am using the Social Construction of Technology (SCOT) as defined by Bijker, Hughes and Pinch (Douglas, 1987). Douglas presents SCOT as a framework to analyze how technology and society are intertwined, by viewing technology as a reflection of society and vice versa. For example, one example used to demonstrate this was the shift from the use of the penny-farthing to the safety bicycle; initially, the penny-farthing was developed to convey masculinity and power, as those who could operate it were typically male. However, as society became more reliant on bicycles, the utility of the penny-farthing was diminished, as society wanted more safe, easy-to-ride, bicycles. Thus, the penny-farthing gave way to the safety bicycle, which was more popular. As chess engines have improved, they have been shaped by and have shaped the chess community in many ways, through playstyles, tournament logistics, overall skill, and more. Therefore, viewing chess culture as a product of the community and vice versa yields insight into how and why chess engines are used.

Through literature analysis, I will find previous papers written about chess engines and

how they influence the community. However, the lack of research in this area will likely result in synthesizing adjacent research into a more unified finding. Most research will likely be found in journals concerning machine learning and AI, as these fields will give the most insight on chess AI. Sociology-related research papers may also offer more general insight of the effect of AI on society.

I will then approach the issue of fairness of chess engines by taking a value-sensitive design approach – considering the values of various stakeholders in the chess community is important to ensure that chess engines are not abused by one party. Stakeholders include casual and competitive players, businesses involved in chess (e.g. Chess.com, tournament streaming sites, tournament organizers, national and international chess federations), and the wider chess audience (e.g. chess stream viewers, tournament viewers). Because these parties, and their subsets, can have differing uses for chess engines, it is important to consider all of their needs when designing policy or protocol regarding the use of engines. This policy will draw from the aforementioned literature review to analyze what various stakeholders want from the use of chess engines.

A more unified policy would align with the aforementioned STS ideals, as suggesting a better methodology to reconcile chess engines with human chess falls within analysis of technology's effect on society.

Barriers to Research

My research suffers from a limitation in knowledge in various disciplines and languages. These limitations include lack of knowledge in psychology, neuroscience, and artificial intelligence. Also, without a lot of financial support, it is difficult to directly talk to influential chess figures who have more experience in this matter (e.g. grandmasters Garry Kasparov,

Daniel Naroditsky), as they are less likely to speak to me without financial incentive. This is doubly important, as more experienced chess players will use engines more often, likely in a manner more useful for improvement. Because chess is so internationally popular, there is a language barrier that prevents me from viewing non-English sources. As a result, my research is likely biased by articles in only English. With such few resources that were difficult to find, a time barrier has made it difficult to find relevant articles to assemble case studies. Another barrier is present in the trustworthiness of research found online; many researchers are often not experienced in chess, meaning their lack of knowledge of chess principles can contribute to incorrect findings. Thus, I placed more time into verifying that people with input have enough experience in chess engines and/or human chess improvement. Lastly, another limitation was that almost all of the relevant articles found were in support of AI in chess due to a scarcity in opposing articles.

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