

Project Proposal Report

Tentative project title: The Human-like Chess Bot

Type: Research

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Project summary:

Starting in the 1940s, Chess Bots (CB) have risen to beat even the most advanced Human Players (HP) in every game. Players from around the world play bots every day while trying to hone their chess skills. But the skills learned while playing traditional CB do not transfer to playing humans at the same skill level. HP play chess significantly different from traditional CB. HP use heuristics, intuition, and patterns to plan out their next move, while traditional CB in essence analyze numerous possible future board states and makes a move that maximizes its chance of winning. This is not a fair fight, CB has a significant advantage over human plays in their memory capacity. As a result, HP vs CB often leads to the CB winning. At lower levels, CB is programmed to make mistakes on purpose, leading to a confusing player experience. This makes for an interesting situation where CB is the king of chess, but humans can't adequately learn from it. Can we do better? Our team has found research to make "Human-like Chess Bots". The MAIA models were created by researchers at the University of Toronto. MAIA was training using supervised learning to mimic human decision-making, instead of the traditional methods of using reinforcement learning to train the model. They used the AlphaZero model as their base and achieved significant performance at predicting player moves. Unfortunately, the AlphaZero model is large and requires high-end hardware to run. Stockfish, a relatively small model that can run on laptops, achieves similar performance to AlphaZero, showing that the increase in model size does not lead to a linear increase in performance. The goal of our project is to reduce the size of the model so it can be run on less performant machines. We believe we can achieve similar levels of performance with a Stockfish sized model. We will use the Lichess Dataset, which contains chess games from real players and ELO scores, which is the same dataset that MAIA used in its training. We anticipate we can reach a similar level of performance with a significantly smaller model.

Dataset:

Li-Chess is a popular open source chess website and has published all player games since January 2011. Around 100 million games are played each and every month, and there are currently 8 billion games in the dataset. These games are stored in the popular game notation format (PGN). This format stores all moves in a given game, the ELO of the players, how the game ended, as well as other useful information. In order to turn these into a usable format, we have created a parser that translates these games into tabular board states. There are 68 columns, 64 for the board state, one for whose turn it is, two for the ELO of the players, and one target value of the player's chosen move.

Dataset: <https://database.lichess.org/>

Codebase: none

You can also play against the MAIA bot if you're interested: <https://www.maiachess.com/>

References:

McIlroy-Young, R., Sen, S., Kleinberg, J., & Anderson, A. (2020, August 22). *Aligning superhuman ai with human behavior: Chess as a ...* University of Toronto.
<https://www.cs.toronto.edu/~ashton/pubs/maia-kdd2020.pdf>

Silver, D., Hubert, T., Schrittwieser, J., Antonoglou, I., Lai, M., Guez, A., Lanctot, M., Sifre, L., Kumaran, D., Graepel, T., Lillicrap, T., Simonyan, K., & Hassabis, D. (2018). A general reinforcement learning algorithm that Masters Chess, Shogi, and go through self-play. *Science*, 362(6419), 1140–1144. <https://doi.org/10.1126/science.aar6404>

Stockfish or leela chess zero? A comparison against endgame tablebases. (n.d.).
https://webdocs.cs.ualberta.ca/~mmueller/ps/2023/ACG_2023_Stockfish.pdf

Tang, Z., Jiao, D., McIlroy-Young, R., Kleinberg, J., Sen, S., & Anderson, A. (2024, October 31). *Maia-2: A unified model for human-AI alignment in chess*. arXiv.org.
<https://arxiv.org/abs/2409.20553>