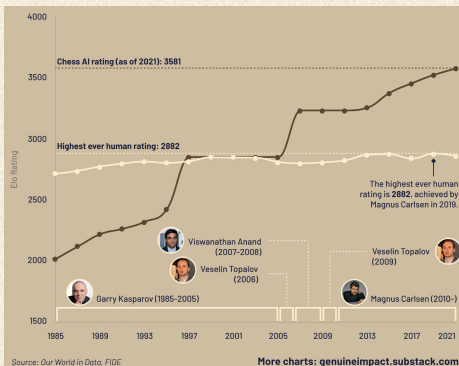# HermOni Chess Bot

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Introduction

The structured environment provided by chess makes for an ideal environment for the development of ai algorithms to make complex decisions. The purpose of this project is to create a chess bot that will utilise ai techniques, algorithms and computational power to simulate strategic thinking in a human way.

Problem Statement

Ai is not a new concept to the chess world, with the top level engines having surpassed peak human performance decades ago (Wikipedia, 2024). However, these top level engines are practically useless to the majority of players who won't learn anything from playing against an opponent it has no chance of beating. The number of lower level bots available to players is much lower, especially the ones that can be played for free. This project intends to offer a lower level of performance than the top engines so that games against it can be both engaging and informative.

Chess AI rating (as of 2021): 3581

Highest ever human rating: 2882

The highest ever human rating is **2882**, achieved by Magnus Carlsen in 2019.

Viswanathan Anand (2007-2008)

Veselin Topalov (2006)

Veselin Topalov (2009)

Garry Kasparov (1985-2005)

Magnus Carlsen (2010–)

Source: Our World in Data, FIDE

More charts: genuineimpact.substack.com

Ai and Human Elo over time (Genuine Impact, 2023)

Design

Chess bots require complex algorithms to be performed quickly due to time constraints in the game. For this reason, the HermOni engine will be written in C++ due to its computation speed.

HermOni will use a minimax algorithm combined with alpha-beta pruning in order to efficiently determine the next best move to make. This algorithm works by recursively looking at potential next moves and evaluating the position after that move is made. If a worse position is found after one move, the value moves after that initial move are not considered (Chessprogramming, 2024).

Bitboards will be used to keep track of the current position and track what moves are made. A bitboard is a data structure representing the chess board, 1 bits are used to represent the existence of a piece on the board in a certain position. Bitboards for each piece can be compared and combined to establish the position after each move (Chessprogramming, 2024).
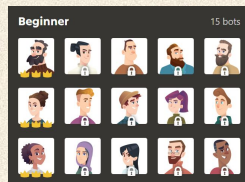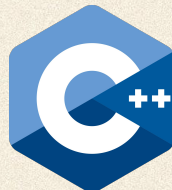
Implementation & Features

HermOni will be available on Lichess.org. Lichess.org is a free, open-source chess server. It is one of the most popular chess websites in the world with over five million games played per day (Lichess, n.d.). Lichess offers the ability to create a bot account powered by an engine, facilitated by its bot API. The Lichess bot API is written in Python and through using Universal Chess Interface (UCI) can send commands, process responses and correctly integrate a C++ executable.

UCI is an open communication protocol used for chess engines. It allows them to communicate with other programs such as graphical user interfaces (GUI) (Chessprogramming, 2024).

The API also allows for the use of opening books and endgame tablebases. An opening book is a database of common opening lines for a chess game that allows a bot to follow common openings without having to calculate each move (Chessprogramming, 2024). An endgame tablebase is a database detailing the best moves to end the game once there are only a certain number of pieces remaining. The most robust tablebase is the Syzygy tablebase and contains moves for up to seven remaining pieces (Chessprogramming, 2024).

A user will be able to play against HermOni by searching for it as an opponent by name. HermOni will be capable of playing against both human users and other engines using bot accounts on the site.
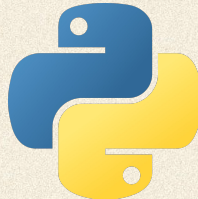
Existing Bots

Stockfish is the strongest chess bot in the world with an estimated Elo rating of 3642 (Wikipedia, 2024). In comparison the highest Elo rating achieved by a human was 2882 by Magnus Carlsen in 2019 (Square Off, 2023). Other top level bots include Leela Chess Zero and AlphaZero.

In terms of bots at a lower level, that could be used as practice for lower rated players, chess.com only offers 9 bots below 1500 Elo for free, while lichess only offers 8 levels of stockfish across all ratings. This leaves beginner and intermediate players with very few challenging but fairly matched bots.

Beginner — 15 bots

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