

Herm0ni Chess Bot

Functional Specification 2024-2025

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# Introduction

Herm0ni is an artificial intelligence (Ai) chess bot designed to calculate the position of a chess game, the next best move to make, and make that move without the need of human input. This functional specification will go into detail about the key features and objectives of this chess bot.

# Problem and Proposition

## Problem Statement

The structured environment of complex situations makes chess a great environment for the application of algorithms. The use of Ai in chess is not a new concept, with the first fully automated chess engine being created in 1957 (Wikipedia contributors, 2024a). At the top level, chess engines surpassed human performance decades ago (Wikipedia contributors, 2024b). Top level chess engines even compete in their own designated tournaments. Chess bots can also be useful for learning, by being able to play games against an estimated Elo rating without the pressure of a timer or the risk of losing Elo. However, with so much time and effort being put into these top-level engines, the use of Ai for learning at a beginning or intermediate level has not seen the same level of effort. Chess.com offers multiple lower-level bots for players to play against, but without paying for a subscription, the number of bots below 1500 Elo rating is a mere nine. This causes the jump in difficulty from one bot to the next to be too steep. Having more of these lower rated bots would allow for more gradual progress and stop players from having to chose between a bot that is too easy and a bot that is too hard.

## Value Proposition

The Herm0ni bot is an attempt to resolve the issue outlined previously, by offering a playable bot of multiple levels of difficulty. The idea of this bot is to fill in some of the large Elo gaps caused by the lack of many lower rated bots currently. Herm0ni will offer various levels of difficulty to provide players of various skill levels with a fair level of competition.

## Project Scope

The Herm0ni bot will be available a bot account on lichess.org, playable by searching the name of the bot. Different bot accounts can be created to allow for various levels of difficulty. As it is on the lichess site, the bot will not display any evaluation or feedback on the site itself. The bot will be playable by any player account on lichess but searching for the bot as an opponent.

## Project Objectives

The primary objective of this project is to create a fully automated chess engine that can evaluate a position to effectively determine the next move at a reasonably high skill level. The engine will have a bot account on lichess.org that is playable by searching for its name in the opponent field.

A secondary objective is to create multiple different bot accounts with differing skill levels to allow users to play against a bot that is most suitable to them.

A tertiary objective of this project is personal development. Creating complex algorithms to analyse a chess position and find solutions quick enough to be able to play under time constraints will be a challenging task that I believe will enhance my programming skills.

# System Overview

## System Context Diagram

A diagram of a flowchart

Description automatically generated

This context diagram shows the communication flow from the user to the engine through the lichess.org website and the lichess bot Api.

## Assumptions and Dependencies

**Assumptions:**

* Users have a lichess.org account that they can use to challenge the bot.
* User knows the rules of chess.

**Dependencies:**

* Wi-Fi connection to use the website.
* Lichess.org is operational.
* Lichess Api token.

# User Characteristics

## User Summary

**Users wanting to improve**

Beginner to intermediate chess players who are looking for an evenly matched bot that they can play against without the stress of losing Elo.

**Users interested in bot vs bot games**

Users, possibly other developers, who are interested in seeing chess matches between two different engines.

# Requirements

This section of the specification will explain all functional and non-functional requirements of the Herm0ni chess bot.

## Functionality

### Core Features

**Start Game**

The Herm0ne bot must be able to recognise that there is a request to start a game being sent to it and have the ability to accept this request.

**Evaluate Position**

Using bitboards, the current position of a game can be evaluated based on things such as material count, pawn structure, control of key squares and king safety.

**Move Generation**

Using a minimax algorithm and alpha-beta pruning, the position after possible moves can be evaluated to determine the next best move to make. The bot must always make a legal move.

**Game Logic and Rules**

The bot must be aware of a game ending due to checkmate, timeout, resignation or draw conditions.

**Time Control**

The bot must be aware of the time controls set on a game. For shorter games such as bullet or blitz, less time should be used per move.

### Additional Features

**Opening Book Use**

An opening book can be used to recognise various openings and play a pre-determined set of moves to follow the opening.

**Tablebase Use**

A tablebase can be looked at once there are at most seven pieces left on the board to ensure that the best move is played.

## Usability

As Herm0ni is just the engine that calculates the moves, all UI/UX features are handled by lichess.org. the bot should be able to be used just by searching its name as an opponent and challenging it to a game.

## Reliability

Herm0ni must be able to play to the same level consistently. Playing against a bot will not be effective as a practice tool if it isn’t consistent in its difficulty. Any average Elo specified for the bot should be accurately represented.

## Performance

Due to the variety of time constraint formats available for chess games, Herm0ni must be capable of performing its algorithms in a short amount of time, as to not lose on time and to not have the user waiting too long for a move.

## Security

As Herm0ni is not an application itself, and is just a bot on lichess.org, no additional security measures need to be considered.

# Use Case Diagram

A diagram of a computer game

Description automatically generated

# Brief Use Cases

# Detailed Use Cases

# References

Wikipedia contributors (2024a). *History of chess engines.* Wikipedia, The Free Encyclopedia. Available at: <https://en.wikipedia.org/wiki/History_of_chess_engines> (Accessed: 21 October 2024).

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