CS 4850 - Fall 2024

SP-14 GREEN - Novel Chess Game

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Professor and Date:

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Project Website:

https://sp-14-green.tiiny.site/

GitHub Repository:

https://github.com/S-14Chess-p/Senior-Project-ChessAI

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1.0 Introduction

1.1 Overview

The Software Requirements Document (SRS) highlights the functional, design, and performance requirements of the project. The SRS contains important information regarding the performance and design constraints of the project, which will be followed closely to ensure the project remains on track. The SRS also briefly touches on the UI/UX of the project so that we have a guideline to follow.

1.2 Project Goals

1. Develop the game chess using the programming language C#

2. Create an AI that knows how to play the game but is not trained well, it will always win.

3. If there is time add difficulty selection options for the AI.

4. Develop a way for people to play online

1.3 Definitions and Acronyms

Artificial Intelligence (AI): In the context of this document, AI refers to the entity that controls the side not chosen by the player and makes moves in adaptation to those taken by the player.

Graphics User Interface (GUI): How the user will interface with the program in an easily accessible manner.

2.0 Design Constraints

2.1 Environment

We have set our own small list of constraints

- C# will be used to program the logic
- Html will be used to program the UI
- C# is server-side so it can't directly run in a browser to work with an html file, so we will use the ASP.net framework to bypass this issue.

2.2 User Characteristics

Each user needs a mouse to play our game. When the user clicks on a piece it will highlight every valid move that piece can make the user can then click on the highlighted square to move that piece or a different piece to show other possible moves.

2.3 System

Windows 10 Operating System (OS). Internet connection possibly required.

3.0 Functional Requirements

3.1 Overview

Like all html projects this program will be able to run in a browser. The user will be presented with 3 pages labeled Home, Rules, and Play. The home page will give an overview of the project. The rules page will present the user with a read-only version of the ruleset. The play page will have three options: Online Player vs Player, Local Player vs player, and Player vs AI. Each of them will do exactly what they sound like they do. Player vs Player will allow 2 players to play against each other locally or online. Player vs AI will allow a Single player to play against an AI that uses the minimax algorithm to run.

3.2 Chess Game Modes

A chess game has different modes of play, and the modes are:

3.2.1 Player vs Player

Player vs Player (PVP): When two human players compete against each other in the game of chess.

3.2.2 Player vs Environment

Player vs Environment (PVE): When a human player competes against an AI in the game of chess.

3.3 Chess Game Pieces

In the chess game, there are 6 different types of pieces that can be moved.

On game start, each player starts with a certain number of pieces on the board:

- Eight Pawns
- Two Knights
- Two Rooks
- Two Bishops
- One Queen
- One King

Each piece has a certain number of values called points, and some pieces are worth more points than others. Players use a system that keeps track of the chess pieces' worth.

3.3.1 Pawn (1 point)

The Pawn is the most basic piece and the least powerful piece in the game. Each side starts with eight pawns, and they all start at the second row (or ranks) from the player's side. If it is a pawn's first move, it can move forward one or two squares, but if a pawn has already moved, then it can move forward one square at a time. A pawn threatens or captures the opponent's piece each square diagonally. A pawn has a special move when it encounters the opponent's pawn's first move known as the En Passant. See 3.4.14 for more details on En Passant.

3.3.2 Bishop (3 point)

Bishops can move diagonally in any number of unoccupied spaces, as long as it is not blocked by its own pieces. An easy way to remember how the bishop can move is it moves like an "X" shape. The bishop can capture an opponent's piece by moving to the occupied square where the piece is on. Each bishop starts on a colored square and can only move on that type of square for the rest of the game.

3.3.3 Knight (3 point)

Knight can move two spaces in a cardinal direction, then 1 space in a left or right manner, OR it can move one space in a cardinal direction, then two spaces in a left or right manner. An easy way to remember how the knight can move is it moves in an "L-shape." Knight is the only piece that can move over other pieces, whether ally or enemy. Knight can capture the enemy pieces only where it lands on, not what it jumps over. Since knight can jump over pieces, it is the only piece that can be moved in the first 2 turns of the game along with the pawn. Knights start between the Bishops and Rooks

3.3.4 Rook (5 point)

Rook is a powerful, major piece that can move any number of unoccupied spaces in the cardinal directions (as long as it isn't blocked by other pieces). An easy way to remember how a rook moves is that it moves like a "+" sign. The rook can capture an enemy piece in their direction. Rook starts in

both corners of the player's side. Rooks are powerful pieces whose main weakness is their lack of early game mobility, as it is a weak move to move the pawns that block the Rooks in early in the game. Rooks typically take multiple moves to get into relevant play. Rooks are unique in that they can perform the Castle maneuver along with the King. See 3.4.17 for more details on Castling.

3.3.5 Queen (9 point)

Queen is the most powerful, major piece in chess. The queen has the movement properties of the Bishop and Rook combined. The queen can move horizontally, vertically, or diagonally in any number of squares. The Queen can capture any square it can move to. With proper positioning, it can threaten or capture any pieces without retaliation.

3.3.6 King (infinitely valuable)

The King is the most important piece in chess. Like the Queen, the King can move in any direction except it can only move 1 space at a time. The king cannot move into any threatened squares, and when the King is in check, no other moves can be taken unless it brings the King out of check (whether by moving the King, blocking the threat with another piece, or by capturing the threatening piece). As a result of this, the player's and the opponent's kings cannot threaten each other directly. In traditional chess, the king cannot be captured. Instead, if the King were able to be captured after a turn of check, a checkmate is declared. The king can perform the Castling maneuver with a rook. See 3.4.17 for more details on Castling.

3.4 Game Rule

When and where a piece can move.

3.4.1 Capture

The term for when a piece takes another piece off the board.

3.4.2 Check

The term for when a King is threatened. When this occurs, the player controlling the threatened king cannot make any moves that do not solve the threat. Valid options are to move the King, Block the threat with another piece (which cannot be done against Knights), and to capture the opposing piece. The king is allowed to capture pieces that threaten him if able, but only if they are not protected by another piece.

3.4.3 Checkmate

The state of the game where a check would occur, but the player in check is not able to protect the king in 1 move. The game is over at this point with the player in checkmate being the loser and the one who put them in checkmate being the victor.

3.4.4 Draw by Consent

When neither player can claim victory, they can make the agreement of all players or occur due to a stalemate.

3.4.5 Draw by Stalemate

A Draw forced upon the players due to the game state. Occurs when a King is NOT in Check, but no other piece can be moved and the King itself could only move into threatened squares. Some rulesets declare this to be a victory for one player, generally either the one who has the most points remaining or the one who forced the stalemate on another player.

3.4.6 Draw by Repetition

A Draw that can be claimed by either player when the same game state repeats 3 times in a row (i.e. all pieces have been in their exact location at least 3 times in the game). The other player does not have to consent to the draw.

3.4.7 Draw by Fifty-Move Rule

A Draw that can be claimed by either player which occurs when 2 criteria have been met:

1. A pawn has not been moved in 50 consecutive moves
2. A piece has not been captured for 50 Consecutive moves.

3.4.8 Threatened

The squares a piece could capture another one if they were to move.

3.4.9 Protected

When a piece is 'Threatened' by an ally piece, make sure that if the protected piece is captured the protecting piece can retaliate.

3.4.10 Pin

Pin occurs when a less valuable piece is being threatened but cannot move without exposing the more valuable piece behind it.

3.4.11 Skewer

Skewer occurs when a more valuable piece is being threatened but cannot move without exposing the less valuable piece behind it.

3.4.12 Fork

Fork occurs when a single piece threatens two other pieces at the same time

3.4.13 Stuck piece

A piece that has no valid move.

3.4.14 En Passant

A special capture mechanic exclusive to pawns. To perform this capture, you must take your opponent's pawn as if it had moved just one square. You move your pawn diagonally to an adjacent square, one rank farther from where it had been, on the same file where the enemy's pawn is, and remove the opponent's pawn from the board.

There are a few requirements for this move to be legal:

1. The player's pawn must advance exactly three squares (or ranks) to perform this move
2. The opponent's pawn must move two squares in one move, landing right next to the player's pawn
3. The en passant capture must be performed on the turn immediately after the pawn being captured moves. If the player does not perform en passant on that turn, they can no longer do it on the next turn and the turn after.

3.4.15 Promotion

When a pawn reaches the opponent's back row, it can be turned into a major or minor piece.

3.4.16 Underpromotion

The term for when a pawn is promoted into a piece other than the queen. Done for strategic purposes.

3.4.17 Castle

A maneuver where a King can move two squares to the left or right towards the chosen rook, and the chosen rook jumps across to the other side of the king, all in one move.

This move can only be possible under these conditions:

1. Your king can not have moved.

   Once your king moves, you can no longer castle, even if you return the king to its starting square.

2. Your rook can not have moved.

   If you move your rook, you can not castle on that side anymore, even if you return the rook to its starting square

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3. Your king can not be in check.

   You can not castle while your king is threatened. Once you are out of check, you can castle. Being checked does not remove the ability to castle later.

4. Your king can not pass through check

   If any square the king moves onto would put the king in a threatened position, you can not castle. You will have to deal with the attacking piece first.

5. No pieces can be between the king and rook.

   All the spaces between the king and rook must be empty. It is important to develop your pieces into the game as soon as possible.

3.5 Board Layout

Chess is played on a board of 8 x 8 squares arranged in vertical rows called "files" and horizontal rows called "ranks". These squares alternate between two colors in a checkered pattern. Each square is identified by its row and column coordinates. The files are listed from "a" to "h", and the ranks are listed from "1" to "8".

It's important to orient the board in the right direction, so the chess pieces for each side will be set up correctly. The board should be positioned so that each player has a light-colored square in their bottom-right corner.

Pawns are set up on the second row of the player's side.

Rooks are placed in the corners.

Knights are placed next to the player's rooks.

Bishops are placed next to the player's knights.

The player's queen should be placed on the same color square as her army. The white queen should go on the light square and the black queen should go on the dark square.

Lastly, the king should be placed next to the queen.

3.6 Chess Game Play

The player opens the chess game and then the player is allowed to choose which color (black or white) to choose. Once the player or both players choose their color, the board layout will be set up with chess pieces on both sides, and both players are given a clock.

In chess, the player with the white pieces always moves first. Once the white piece player moves, the turn is over for the white piece player, making them inactive at this point, and they can no longer move. Then, the timer starts for the player with the black piece, and it becomes their turn to move.

Once the black piece player makes the move, their turn is over, and the timer pauses for the black piece player, becoming inactive during the white piece player's turn.

This gameplay will continue until the player checkmates the opponent's king, it becomes stalemate, meaning one player can no longer make action and neither side can win or make progress, one player surrenders, or the timer runs out for one player, resulting in a loss and a win for the other player.