FROPPY CHESS

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PLAY

OPTIONS

QUIT

Contents

1 Glossary of Terms

- **Attack**: when a piece is moved to a position at which it is able to capture an opposing piece on the following move.

- **Check**: when the King is attacked, but still has at least one of the three following options possible for safety:

    ❖ <u>Three Moves for Escaping Check</u>:
        1) Eliminating the opposing attacker
        2) Putting a friendly piece in the way of the attacker
        3) Moving the King to a safe square

- **Checkmate**: when the king is attacked and has no viable move for escaping.

- **Capture**: to remove an opposing piece from the board by replacing the opposing piece with your own piece

- **Castling**: a special move in which the King moves to the side of the Rook and then the Rook takes the place on the other side of the King.

    ❖ <u>Requirements</u>:
        1) Both the King and Rook must have not been moved previously
        2) the spaces between the two pieces must be empty
        3) the king must not enter or cross over a space that would result in a check

- **En Passant**: a Pawn is captured when it has moved two spaces instead of one. The enemy captures the Pawn in a fashion as if it had only moved one space.

- **File**: column of a chess board (lettered a-h). Not to be confused with office *files*.

- **Forfeit**: to give up the match and take a loss.

- **Insufficient Material (Draw)**: when there are not enough pieces on the board for either player to get a checkmate, such as when the following combinations of pieces remain on the board:
    - king vs. king and knight
    - king vs. king and bishop
    - king vs. king
    - king and bishop vs. king and bishop

- **Piece**: any one of the following 6 chess entities: pawn, bishop, knight, rook, queen, and king. See Table 1 below for descriptions of each chess piece.

- **Ply**: the official name for one player's turn.

- **Promoting**: after a Pawn reaches the opposite end of the board successfully, it can be traded for either a Knight, Bishop, Rook, or Queen.

- **Rank**: row of a chess board (numbered 1-8).

- **Stalemate (Draw)**: when a player can neither move any chess piece (including their king) nor has their king in check, resulting in the game ending in a draw.

- **Three-fold repetition (Draw)**: when all of the positions of the chess pieces have been repeated three times, resulting in the game ending in a draw.

- **50-move rule (Draw)**: when neither players' pawns have moved nor any captures have happened in the last 50 moves, resulting in the game ending in a draw.

Table 1. Chess piece descriptions

Piece	Initials	Visual	Movement Restrictions	Number of Spaces	Capture Method	Special Attributes
Pawn	pw		Toward other end of board	1	Diagonally	Promoting
Rook	rk		Vertically or Horizontally	Any	Vertically or Horizontally	Castling
Bishop	bp		Diagonally	Any	Diagonally	---
Knight	kt		L Shape	3	L Shape	Can move over other pieces on the board
Queen	qn		Vertically, Horizontally, or Diagonally	Any	Vertically, Horizontally, or Diagonally	---
King	kg		Vertically, Horizontally, or Diagonally	1	Vertically, Horizontally, or Diagonally	Castling

2 Usage Scenario

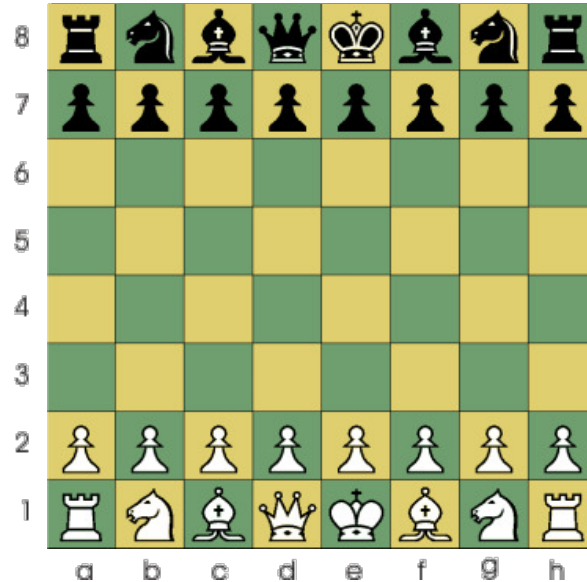Figure 1 below shows a typical representation of initial chess program gameplay.

Figure 1: chess board with chess pieces in starting positions[2,5]

Each space on a chess board is specified by the rank and file of the board according to Figure 1 above. For example, the white queen and black king in Figure 1 above is in the d-file, first rank and e-file, eighth rank, or spaces d1 and e8, respectively[3].

The game begins with the user pressing Play on the menu shown in Figure 2 below, which will launch a chess board and a text interface for interacting with the chess board and the computer.

Each ply is specified by the initials of the piece, the current position of the piece, and the end position of the piece, separated by a single space. For example, according to Figure 1, either "kn b1 a3" or "kn b1 c3" as well as "kn g1 f3" or "kn g1 h3" would be a valid ply. Figures 2a and 2b illustrate an example of gameplay.

The game ends when either of the following occur (see Glossary for explanations):
- Checkmate
- Stalemate
- Insufficient Material
- Three-fold repetition
- 50-move rule
- Forfeit

3 Goals

- Create an AI Chess program for humans to play against.
- All aspects of gameplay will be played according to official rules of chess.
- AI's strategy engine will be neural network-based.
- Provide a graphical user interface (GUI) for easier user interaction.

4 Features

This chess program will:

- Provide a user-interactive menu to start the game
- Display the game board and allow the user to make moves
- Enable a human user to play against this chess program
- Allow the user to choose which side (Black or White) to play
- Log all the moves throughout a game, which can be accessible to the user
- Limit each AI move to a minute or less

5 Installation

5.1 System Requirements:
- Linux operating system (e.g. RHEL-6-x86_64)
- gcc, version 4.4.7 or later
- Make utility

5.2 Setup and Configuration:
1) Download the source code file
2) Open a command prompt
3) Run `make chess`
4) Run `./chess`
5) Start playing!
6) Keep the command prompt open to interact with the chess program

5.3 Uninstallation
1) Run `make uninstall` in the command prompt

6 Chess Program Functions and Features

- **Menu**: User can choose to begin the game by pressing "Play", configure settings in "Options", or exit the game with "Quit", illustrated in Figure 2 below.

Figure 2. Froppy Chess graphical user interface (GUI)

- **Gameplay**: User inputs a move, as shown in Figures 2a and 2b below.
  *Note: Illegal moves will result in error messages and prompt the user for a redo.
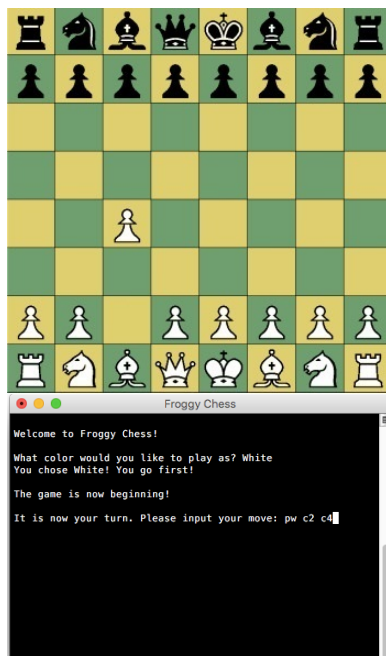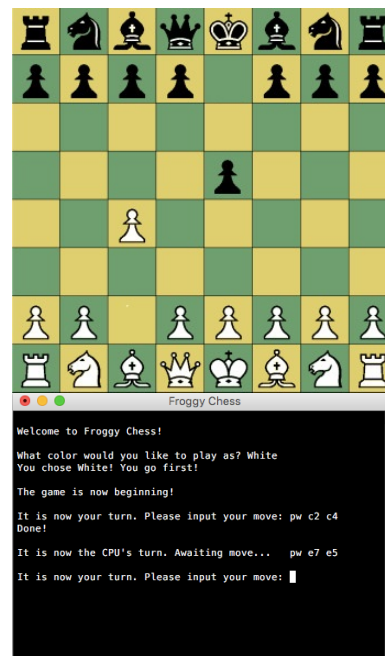

Figure 2a. User input

Figure 2b. Computer move

- **Game End**: If either player gets a checkmate, a congratulatory message pops up and the game ends. If it is a draw or if either player forfeits, there is a notification popup and the game ends.

7 References

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7. Lai, Matthew. "Giraffe: Using Deep Reinforcement Learning to Play Chess." Advanced Computing of Imperial College London, 14 Sept. 2015. <https://arxiv.org/pdf/1509.01549v2.pdf>

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8 Error Messages

- "You have entered an illegal move. Please enter another one"
- "Warning: You have been idle for too long."
- "You cannot move on the opponent's turn. Wait for opponent to complete their turn before inputting your move."
- "Cannot complete Castle. Either Rook or King has previously been moved."
- "Moving King to that position would result in a Check!"

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