Chess Game Program
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Glossary

Bishop (B): The bishop is a piece that starts in the C and F columns. The bishop can move and capture in any square within its diagonal. It cannot move over other pieces.

Black: Black pieces are the second player's pieces. The Black player always goes second.

Capture: A move where a piece takes the spot of and removes the opposing player's piece.

Castling: A move where the king and the rook move at the same time. Can only be done if there are no pieces in between the king and rook, it does not go over a line of a capture, or the king is in check. Can be done either kingside (0-0) or queenside (0-0-0).

Check: If the king is in a position where it can be captured by another piece, it is in check. The player in check is forced to make a move that will put them out of check, such as capturing the opposing piece, moving the king out of way of capture, or placing a piece that blocks the way of capture.

Checkmate: The position where the king is in check and has no possible moves that will get them out of check. The player who is checkmated loses the game.

Draw: The situation where neither player wins/loses. Can be done by agreement or stalemate where neither player has enough pieces to win.

En Passant: A special rule where a pawn can capture another pawn that has moved two squares up and is adjacent to the first pawn.

King (K): The king is a piece that starts in the E column of the chessboard. The king can move and capture in any direction one square away (including diagonal) as long as the move will not put it in check.

Knight (N): The knight is a piece that starts in the B and G columns of the chessboard. They can move and capture in "L" shapes (two squares one direction, one square in the perpendicular direction). The knight can move over other pieces.

Notation: The method to record the moves of the match. All pieces other than the pawn are given uppercase letters to represent them. The notation follows this (Piece)(Column)(Row). If a piece is captured, an "x" is prepended to the destination square (i.e. Kxe6). If a move puts a king in check a "+" is appended to the end. If a move puts a king in checkmate a "#" is appended instead. Castling is represented by either "0-0" or "0-0-0" for kingside and queenside respectively.

Pawn: A pawn is a piece that starts in the row in front of the pieces (Row 2 for White, Row 7 for Black). The pawn can move forward one square and capture one diagonal away. As a first move for a pawn, they can also move up two squares instead. If the pawn reaches the opposing player's back row, it can be promoted to any piece other than a King.

Pin: When a piece is in danger of being captured, but cannot move because it would put the player's King in check.

Queen (Q): The queen is a piece that starts in the D column. The queen can move and capture in any square within its row, column, or diagonals. It cannot move over other pieces.

Rook (R): The rook is a piece that starts in the A and H columns. The rook can move and capture in any square within its row or column. It cannot move over other pieces.

White: White pieces are the first player's pieces. The White player always goes first.

1. Computer Chess

    1.1. Usage Scenario

        To install, please refer to Section 2.

        To open your Chess program, enter the following command in your terminal:

```
.\bin\Chess
```

After this, you will be greeted by the Chess program message. To begin playing, enter 'A'.

```
Would you like to play classic chess or create a custom board to
play?(A for Classic, B for Custom):
```

To play press P. To watch the computer play against itself, press S

```
Would you like to play with this board or spectate a game
(Computer vs Computer) with this board? (P for play, S for
spectate):
```

To play using White, Black, type "W" or "B" respectively into your terminal

```
Which team would you like to play as?(B = Black, W = white):
```

After selecting what side you will be playing on, you will be asked to enter the who will be your opponent.

```
Would you like to play against another human(locally) or a
computer player? (H for Human and C for Computer):
```

If you would like to play with another person by taking turns, enter "H"
If you would like to play against the computer, enter "C"

```
Do you want to go first or second? (1 for first, 2 for second):
```

If you would like to go first then enter 1.
If you would like to go second then enter 2.

Then you are all set, the game should start and you can play chess.

```
        a     b     c     d     e     f     g     h
     +-----+-----+-----+-----+-----+-----+-----+-----+
  8  | bR  | bN  | bB  | bQ  | bK  | bB  | bN  | bR  |  8
     +-----+-----+-----+-----+-----+-----+-----+-----+
  7  | bP  | bP  | bP  | bP  | bP  | bP  | bP  | bP  |  7
     +-----+-----+-----+-----+-----+-----+-----+-----+
  6  |     |     |     |     |     |     |     |     |  6
     +-----+-----+-----+-----+-----+-----+-----+-----+
  5  |     |     |     |     |     |     |     |     |  5
     +-----+-----+-----+-----+-----+-----+-----+-----+
  4  |     |     |     |     |     |     |     |     |  4
     +-----+-----+-----+-----+-----+-----+-----+-----+
  3  |     |     |     |     |     |     |     |     |  3
     +-----+-----+-----+-----+-----+-----+-----+-----+
  2  | wP  | wP  | wP  | wP  | wP  | wP  | wP  | wP  |  2
     +-----+-----+-----+-----+-----+-----+-----+-----+
  1  | wR  | wN  | wB  | wQ  | wK  | wB  | wN  | wR  |  1
     +-----+-----+-----+-----+-----+-----+-----+-----+
        a     b     c     d     e     f     g     h
```

The lower case w corresponds to the color of the piece which is labeled in a capital letter. Please refer to the glossary to know what piece corresponds to what letter. For example, "wB" corresponds to white bishop and "bP" corresponds to black pawn.

Each piece is assigned to a specific square which will be referred to by its row and columns (1-8 = rows, a-h = columns). For example, to refer to the black king (bK), one can refer to it as "e8".

It is important to note that the first player's pieces will be in the lower portion of the chess board. If playing against another *human* player, the next time the board is produced, it will be flipped vertically for the second player to make their move. If playing against the computer, the next time the board is produced, it will not be flipped, but instead updated with the computer's move, ready for the *human* player to make their move. Refer to section 1.2. For information on how to move.

1.2. Goals

The goal of Chess is to move your pieces in a position that places your opponent's King in checkmate. Checkmate is when the king is being threatened by enemy pieces and the player can't make any move to save their

king. Though, there are rules that state how each piece is allowed to move, please refer to the Glossary for information on how each piece is able to move.

1.3. Features

Custom Board

When you first run your Chess program, you are given the option to setup a custom board. To play with a custom board and set up your board, press B and follow the on screen instructions!

Human vs. Human

You can select to play against another human player locally, enter H in the prompt to play against a computer or human.

Artificial Intelligence

Our chess software has spectacular Artificial Intelligence that will put your chess skills to the absolute test! To play against our Artificial Intelligence please refer to section 1.1.

Spectate Mode

Watch two computer players play against each other! Refer to section 1.1 on how spectate.

2. Installation

2.1. System requirements

Red Hat Linux - Linux OS (RHEL-6-x86_64)
Available disk space: 100 MB

2.2. Setup and configuration

Download the latest version of the Chess Game file
Untar/unzip file (tar -zxvf Chess_Beta.tar.gz)
Type ./bin/Chess to run the chess game

2.3. Uninstalling

Type cd .. or cd - to exit out of the Chess_V1.0 directory
Type rm -r Chess_V1.0 to remove the directory and the game

3. Functions and Features

3.1 Implementation of the Official Rules of Chess
-   The 6 unique pieces (pawn, bishop, rook, king, queen, and knight) are represented as abbreviations on the text-based board each with different movement abilities.
-   There are special movement options for certain pieces.
    -   Pawn - En Passant
    -   King + Rook - Castling
-   After every move the game board is checked whether or not the king is in check and forces the player/computer to move in order to prevent their king from being captured

3.2 Chess Board
-   The chess board is represented with a grid of squares. The pieces lie on top of those squares.
-   The user selects the piece they want to move by typing in the location of the piece.
-   After selecting the piece, the user can enter where they want the piece to go by entering the final location of the piece. If the final location has an enemy piece then it will automatically capture that piece once the player enters the command.
-   Example:

```
        a     b     c     d     e     f     g     h
     +-----+-----+-----+-----+-----+-----+-----+-----+
  8  | bR  | bN  | bB  | bQ  | bK  | bB  | bN  | bR  |   8
     +-----+-----+-----+-----+-----+-----+-----+-----+
  7  | bP  | bP  | bP  | bP  | bP  | bP  | bP  | bP  |   7
     +-----+-----+-----+-----+-----+-----+-----+-----+
  6  |     |     |     |     |     |     |     |     |   6
     +-----+-----+-----+-----+-----+-----+-----+-----+
  5  |     |     |     |     |     |     |     |     |   5
     +-----+-----+-----+-----+-----+-----+-----+-----+
  4  |     |     |     |     |     |     |     |     |   4
     +-----+-----+-----+-----+-----+-----+-----+-----+
  3  |     |     |     |     |     |     |     |     |   3
     +-----+-----+-----+-----+-----+-----+-----+-----+
  2  | wP  | wP  | wP  | wP  | wP  | wP  | wP  | wP  |   2
     +-----+-----+-----+-----+-----+-----+-----+-----+
  1  | wR  | wN  | wB  | wQ  | wK  | wB  | wN  | wR  |   1
     +-----+-----+-----+-----+-----+-----+-----+-----+
        a     b     c     d     e     f     g     h

Turn 1: Player 1's Turn Team: (W) (Human)
Select a piece by entering its location: a2

Enter the end location (enter 00 to de-select the current piece):a4

For Turn 1, Team (W) (H) moved Pawn from a2 to a4

        a     b     c     d     e     f     g     h
     +-----+-----+-----+-----+-----+-----+-----+-----+
  8  | bR  | bN  | bB  | bQ  | bK  | bB  | bN  | bR  |   8
     +-----+-----+-----+-----+-----+-----+-----+-----+
  7  | bP  | bP  | bP  | bP  | bP  | bP  | bP  | bP  |   7
     +-----+-----+-----+-----+-----+-----+-----+-----+
  6  |     |     |     |     |     |     |     |     |   6
     +-----+-----+-----+-----+-----+-----+-----+-----+
  5  |     |     |     |     |     |     |     |     |   5
     +-----+-----+-----+-----+-----+-----+-----+-----+
  4  | wP  |     |     |     |     |     |     |     |   4
     +-----+-----+-----+-----+-----+-----+-----+-----+
  3  |     |     |     |     |     |     |     |     |   3
     +-----+-----+-----+-----+-----+-----+-----+-----+
  2  |     | wP  | wP  | wP  | wP  | wP  | wP  | wP  |   2
     +-----+-----+-----+-----+-----+-----+-----+-----+
  1  | wR  | wN  | wB  | wQ  | wK  | wB  | wN  | wR  |   1
     +-----+-----+-----+-----+-----+-----+-----+-----+
        a     b     c     d     e     f     g     h

Turn 2: Player 2's Turn Team: (B) (Human)
Select a piece by entering its location: b7
```

```
Enter the end location (enter 00 to de-select the current piece):b5

For Turn 2, Team (B) (H) moved Pawn from b7 to b5
a4  b5
          a     b     c     d     e     f     g     h
       +-----+-----+-----+-----+-----+-----+-----+-----+
8      | bR  | bN  | bB  | bQ  | bK  | bB  | bN  | bR  |   8
       +-----+-----+-----+-----+-----+-----+-----+-----+
7      | bP  |     | bP  | bP  | bP  | bP  | bP  | bP  |   7
       +-----+-----+-----+-----+-----+-----+-----+-----+
6      |     |     |     |     |     |     |     |     |   6
       +-----+-----+-----+-----+-----+-----+-----+-----+
5      |     | bP  |     |     |     |     |     |     |   5
       +-----+-----+-----+-----+-----+-----+-----+-----+
4      | wP  |     |     |     |     |     |     |     |   4
       +-----+-----+-----+-----+-----+-----+-----+-----+
3      |     |     |     |     |     |     |     |     |   3
       +-----+-----+-----+-----+-----+-----+-----+-----+
2      |     | wP  | wP  | wP  | wP  | wP  | wP  | wP  |   2
       +-----+-----+-----+-----+-----+-----+-----+-----+
1      | wR  | wN  | wB  | wQ  | wK  | wB  | wN  | wR  |   1
       +-----+-----+-----+-----+-----+-----+-----+-----+
          a     b     c     d     e     f     g     h

Turn 3: Player 1's Turn Team: (W) (Human)
Select a piece by entering its location: a4

Enter the end location (enter 00 to de-select the current piece):b5

For Turn 3, Team (W) (H) moved Pawn from a4 to b5

          a     b     c     d     e     f     g     h
       +-----+-----+-----+-----+-----+-----+-----+-----+
8      | bR  | bN  | bB  | bQ  | bK  | bB  | bN  | bR  |   8
       +-----+-----+-----+-----+-----+-----+-----+-----+
7      | bP  |     | bP  | bP  | bP  | bP  | bP  | bP  |   7
       +-----+-----+-----+-----+-----+-----+-----+-----+
6      |     |     |     |     |     |     |     |     |   6
       +-----+-----+-----+-----+-----+-----+-----+-----+
5      |     | wP  |     |     |     |     |     |     |   5
       +-----+-----+-----+-----+-----+-----+-----+-----+
4      |     |     |     |     |     |     |     |     |   4
       +-----+-----+-----+-----+-----+-----+-----+-----+
3      |     |     |     |     |     |     |     |     |   3
       +-----+-----+-----+-----+-----+-----+-----+-----+
2      |     | wP  | wP  | wP  | wP  | wP  | wP  | wP  |   2
       +-----+-----+-----+-----+-----+-----+-----+-----+
1      | wR  | wN  | wB  | wQ  | wK  | wB  | wN  | wR  |   1
       +-----+-----+-----+-----+-----+-----+-----+-----+
          a     b     c     d     e     f     g     h

Turn 4: Player 2's Turn Team: (B) (Human)
Select a piece by entering its location:
```
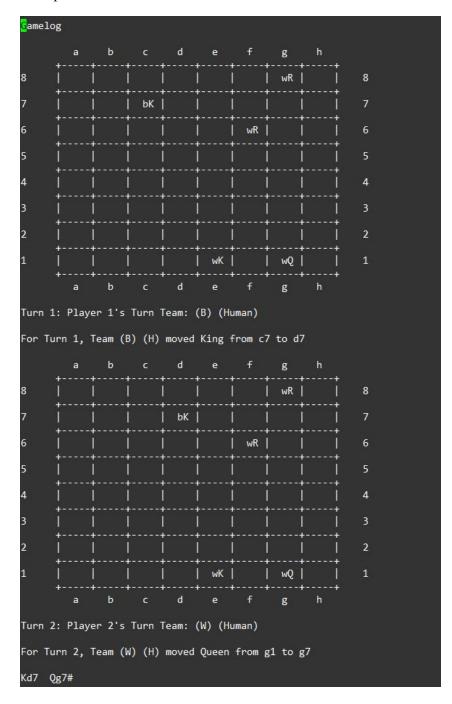
3.3 Human and AI Players
- After the side selection, the game will prompt the user if they want to play against a human or AI player. The user will always be player one while the opponent will always be player two.
- If the user selects AI then the user will play against a computer that will automatically do moves once the user's turn ends every time until checkmate or a king is captured.
- If the user selects a human then the user will play against another human opponent. This chess game only supports one device so in order to play with another player, the user will have to trade off the computer to the other player so they can make their move.
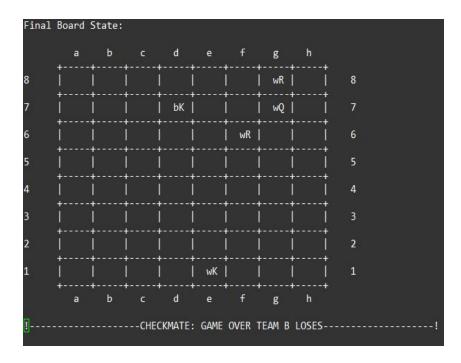- The user can also spectate a match by watching two computer players play against each other

3.4 Side Selection
- Before the chess game starts, the user will have the option to choose a side, black or white.
- Once the decision is made, the opponent will automatically be the other color.

3.5 Game Log
- The program will keep track of all moves made by the player and the opponent on the board.
- Once the game ends, a log file will be generated with all of the moves made in order.
- Example:

```
Gamelog

          a     b     c     d     e     f     g     h
       +-----+-----+-----+-----+-----+-----+-----+-----+
8      |     |     |     |     |     |     | wR  |     |      8
       +-----+-----+-----+-----+-----+-----+-----+-----+
7      |     |     | bK  |     |     |     |     |     |      7
       +-----+-----+-----+-----+-----+-----+-----+-----+
6      |     |     |     |     |     | wR  |     |     |      6
       +-----+-----+-----+-----+-----+-----+-----+-----+
5      |     |     |     |     |     |     |     |     |      5
       +-----+-----+-----+-----+-----+-----+-----+-----+
4      |     |     |     |     |     |     |     |     |      4
       +-----+-----+-----+-----+-----+-----+-----+-----+
3      |     |     |     |     |     |     |     |     |      3
       +-----+-----+-----+-----+-----+-----+-----+-----+
2      |     |     |     |     |     |     |     |     |      2
       +-----+-----+-----+-----+-----+-----+-----+-----+
1      |     |     |     |     | wK  |     | wQ  |     |      1
       +-----+-----+-----+-----+-----+-----+-----+-----+
          a     b     c     d     e     f     g     h

Turn 1: Player 1's Turn Team: (B) (Human)

For Turn 1, Team (B) (H) moved King from c7 to d7

          a     b     c     d     e     f     g     h
       +-----+-----+-----+-----+-----+-----+-----+-----+
8      |     |     |     |     |     |     | wR  |     |      8
       +-----+-----+-----+-----+-----+-----+-----+-----+
7      |     |     |     | bK  |     |     |     |     |      7
       +-----+-----+-----+-----+-----+-----+-----+-----+
6      |     |     |     |     |     | wR  |     |     |      6
       +-----+-----+-----+-----+-----+-----+-----+-----+
5      |     |     |     |     |     |     |     |     |      5
       +-----+-----+-----+-----+-----+-----+-----+-----+
4      |     |     |     |     |     |     |     |     |      4
       +-----+-----+-----+-----+-----+-----+-----+-----+
3      |     |     |     |     |     |     |     |     |      3
       +-----+-----+-----+-----+-----+-----+-----+-----+
2      |     |     |     |     |     |     |     |     |      2
       +-----+-----+-----+-----+-----+-----+-----+-----+
1      |     |     |     |     | wK  |     | wQ  |     |      1
       +-----+-----+-----+-----+-----+-----+-----+-----+
          a     b     c     d     e     f     g     h

Turn 2: Player 2's Turn Team: (W) (Human)

For Turn 2, Team (W) (H) moved Queen from g1 to g7

Kd7   Qg7#
```

```
Final Board State:

        a     b     c     d     e     f     g     h
     +-----+-----+-----+-----+-----+-----+-----+-----+
  8  |     |     |     |     |     |     | wR  |     |  8
     +-----+-----+-----+-----+-----+-----+-----+-----+
  7  |     |     |     | bK  |     |     | wQ  |     |  7
     +-----+-----+-----+-----+-----+-----+-----+-----+
  6  |     |     |     |     |     | wR  |     |     |  6
     +-----+-----+-----+-----+-----+-----+-----+-----+
  5  |     |     |     |     |     |     |     |     |  5
     +-----+-----+-----+-----+-----+-----+-----+-----+
  4  |     |     |     |     |     |     |     |     |  4
     +-----+-----+-----+-----+-----+-----+-----+-----+
  3  |     |     |     |     |     |     |     |     |  3
     +-----+-----+-----+-----+-----+-----+-----+-----+
  2  |     |     |     |     |     |     |     |     |  2
     +-----+-----+-----+-----+-----+-----+-----+-----+
  1  |     |     |     |     | wK  |     |     |     |  1
     +-----+-----+-----+-----+-----+-----+-----+-----+
        a     b     c     d     e     f     g     h

!-----------------CHECKMATE: GAME OVER TEAM B LOSES-------------------!
```

3.6 AI Player Details
- The AI player is designed to make moves quickly and does moves that benefit it the most
- The algorithm works by evaluating each piece's ability to move and selects the one with the best scoring.
- In terms of priority for movements the AI player focuses on:
  - Keeping the king out of check
  - Moving pieces out of danger/Capturing pieces beneficially
  - Capturing pieces beneficially/Moving pieces out of danger
  - Random movement
- The AI player will shift between being defensive(moving pieces out of danger) and offensive(capturing pieces beneficially) to serve as a more engaging opponent
- For what the algorithm considers a beneficial capture, it evaluates based on the worth of the pieces. A pawn capturing a bishop is much more beneficial than a rook capturing a pawn.

Error Messages

"Invalid Move! Please re-enter a legal move"

- You have chosen an illegal move or a move that places you in check. You will get prompted to enter in a move again.

"Invalid Input!"

- Given when the choice of board input is not A or B. Enter 'A' for Classic and 'B' for a custom board, not something else.

"Invalid Input!"

- You have entered something that is not 'B' or 'W', please enter the proper characters.

"Invalid Input!"

- You have entered a character that is not 'H' or 'C', please enter the proper characters.

"Out of bounds!"

- You have entered a row+column that is not part of the chess board, please enter a column and row that is shown on the board.

"There's no piece at that location!"

- You have tried to select a piece that does not exist on the board at the requested row and column. Please enter the proper row and column.

"Whoa there partner, you tried selecting the other team's piece!"

- You have tried to select the opponent's piece to move when it is your turn. Please select your own team pieces.

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