Implementing a Chess program, with a game tree-based AI

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The objective of chess is to checkmate the opponents king by placing it under an inescapable threat of capture, whilst protecting one's own king. During the game, play typically involves exchanging pieces to essentially engineer an opportunity to trade advantageously or to get a better position. There are also several ways that a game can end in a draw.

Board

A chess board is composed of 64 tiles presented as an 8x8 grid. The board is internally represented as a single 1D Tile array. Only a single instance of the board (singleton) class can exist at any time.

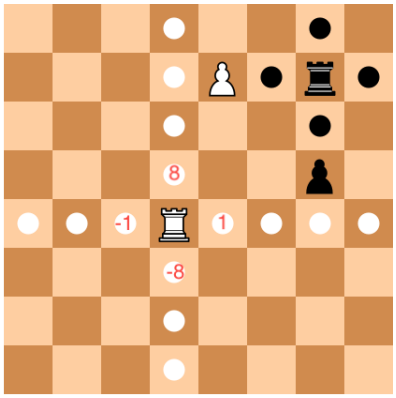
Tile

A tile is associated to a tile coordinate (0 to 63) and respective label. For instance, tile 0 is given the label 'a1'. A tile can be empty or occupied; an occupied tile returns the occupant piece. Whereas, an empty tile returns null.

Piece Interface

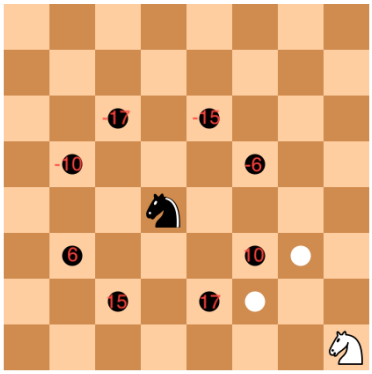
The Piece interface is a blueprint for what all pieces can do. In chess there are 6 distinct pieces; Rook, Knight, Bishop, King, Queen, Pawn. Each player begins with 16 pieces; 2 rooks, 2 knight, 2 bishop, 1 king, 1 queen and 8 pawns.

Rook Implements Piece



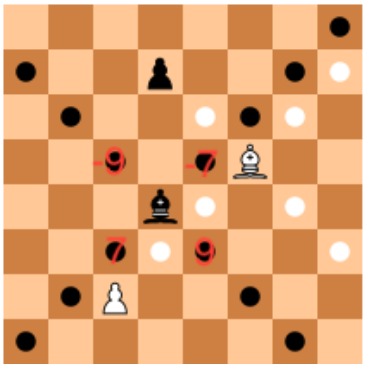
The Rook takes its current position and adds the set of legal offsets (-8, -1, 1, 8) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. There are a few exceptions to the rule, if the current position is in the first and eighth column the –1, 1 offset, respectively are not considered legal moves. Image from https://en.wikipedia.org/wiki/Rook_(chess)

Knight Implements Piece



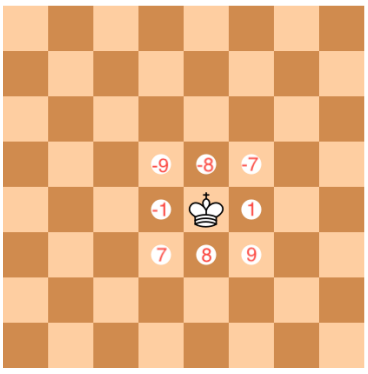
The Knight takes its current position and adds the set of legal offsets (-6, -10, -15, -17, 6, 10, 15, 17) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. There are a few exceptions to the rule, if the current position is in the first column and the offsets are -17, -10, 6, 15 are not considered legal moves. If the current position is in the second (with offset -10, 6), seventh (with offset -6, 10) or eighth (with offset -6, -15, 17) column are not considered legal moves. Image from https://en.wikipedia.org/wiki/Knight_(chess)

Bishop Implements Piece



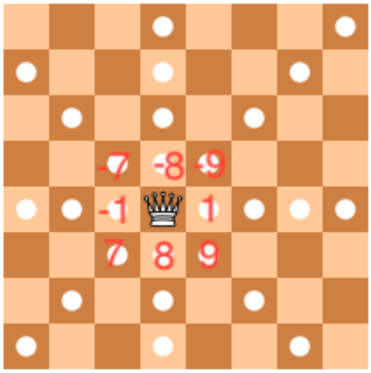
The Bishop takes its current position and adds the set of legal offsets (-9, -7, 7, 9) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. There are a few exceptions to the rule, if the current position is in the first (with offsets -9, 7) and eighth (with offsets -7, 9) column are not considered legal moves. Image from https://en.wikipedia.org/wiki/Bishop_(chess)

King Implements Piece



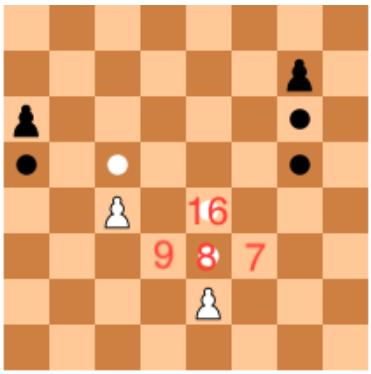
The King takes its current position and adds the set of legal offsets (-9, -8, -7, -1, 1, 7, 8, 9) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. There are a few exceptions to the rule, if the current position is in the first (with offsets -9, 7, and -1) and eighth (with offsets -7, 1, and 9) column are not considered legal moves. Image from https://en.wikipedia.org/wiki/King_(chess)

Queen Implements Piece



The Queen takes its current position and adds the set of legal offsets (-9, -8, -7, -1, 1, 7, 8, 9) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. There are a few exceptions to the rule, if the current position is in the first (with offsets -9, 7, and -1) and eighth (with offsets -7, 1, and 9) column are not considered legal moves. Image from https://en.wikipedia.org/wiki/Queen_(chess)

Pawn Implements Piece



The Pawn takes its current position and adds the set of legal offsets (8, 16, 9, 7) to its current position, so long as the destination position does not reach an invalid destination coordinate. All legal moves are added to the list of possible legal moves. The offset 16 can only be applied if the respective pawn has not moved before. The 7 and 9 offsets are attacking move offsets and can only be applied if the offset locations contain an enemy piece. There are a few exceptions to the rule, if the current position is in the first column (white piece with offset 9 or black piece with offset 7) or eighth column (white piece with offset 7 or black piece with offset 9) are not considered legal moves. Image from https://en.wikipedia.org/wiki/pawn_(chess)

Player

Chess is a two-player game; consists of a white player (you) and a black player (AI). The white player goes first. The player class as a make move method that takes in the player, opponent, board with the start and end positions. After the start and end positions are validated, they are passed through this method. The method decides whether this is an attacking move, a move that forces the current player to acquire an opponent piece or a non-attacking move.

White/Black Player extends Player

Both the white and black player have a set (white or black) and name (human or ai). Each player keeps track of one's pieces and records when the current player acquires an opponent piece. There can only be a single instance of each player, this is done by setting a static whiteplayer/blackplayer instance to null and changing the player instance to a new WhitePlayer() or new BlackPlayer() instance, using the singleton class format. Each player also keeps track of one's player king.

Move

Prior to making the move a validation check must occur, the start to end position must exist between [0, 63]. The start position must possess a piece in order to make requested move. This includes the fact that the piece must exist as an active piece with the player. In other words, you cannot move your opponent's pieces.

Non-Attacking Move

The non- attacking move takes the start position and the end position and moves the piece from the start to end position on the board. The input command by the user must be

Attacking Move

The attacking move takes the start tile position and the destination position. Before making the move the piece at destination position is stored in a temp piece variable. The piece is than added to the current players captured pieces which is a list that stores the acquired pieces. This also requires an update to the opponent active pieces – must be removed from the opponent's active pieces. The piece with the piece position of the start position is then moved to the end position or the destination position.

Pawn Promotion

If the piece that is being moved is a PAWN and the player set (WHITE or BLACK) is equal to the pawns set (WHITE or BLACK) and has a destination location of row 1 or row 8 then the pawn is eligible for an upgrade. The user is prompted with the following message: "Yippeee! What should i become? (Q, R, N, B) " You must choose which piece you would like to upgrade to.

Check

The player class contains the piece position of the king. The most important piece in the game. The method takes the piece position and gets all the opponents' active pieces. It then takes all the legal moves for the active pieces. The set of all legal moves is then compared to the king position and if the set of legal moves contains the king position than the king is in check. Checkmate is the equivalent to check with the only difference being that the king is unable to get away from the check state. Stale mate is also related to check, but the king can get away from check and does it for a consecutive set of moves.