# ARTIFICIAL INTELLIGENCE

Assignment # 3

Deadline: 01 April, 2023

Instructions

1. Assignments are to be done individually. You must complete this assignment by yourself. You cannot work with anyone else in the class or with someone outside of the class.

2. You have to use python programming language.

3. Plagiarism of any kind (copying from others and copying from the internet, etc.,) is not allowed and can result in zero marks in whole assignment category.

4. Any part of the assignment marked **'AI Generated'** by **ZEROGPT** can result zero marks.

5. Your code must be properly commented.

6. Any assignment marked late by google will be considered late.

7. No marks will be assigned if any of the following deliverables are missing.

    a. The source code of the program.

    b. A pdf or word report containing a brief explanation of the steps involved in the program (each question) and the results obtained.

8. Put both source code and report in one folder, ZIP it and submit it. Your folder must be named as ROLLNO_NAME.ZIP

Introduction

Chess is a game of strategy believed to have been invented more then 1500 years ago in India. It is a game for two players, one with the light pieces and one with the dark pieces. The chessboard is eight squares long by eight squares wide. When sitting across the board from another player, the lighter colour square goes on each player's right-hand side ("light on right") and the white queen is placed on a white square and the black queen on the black square
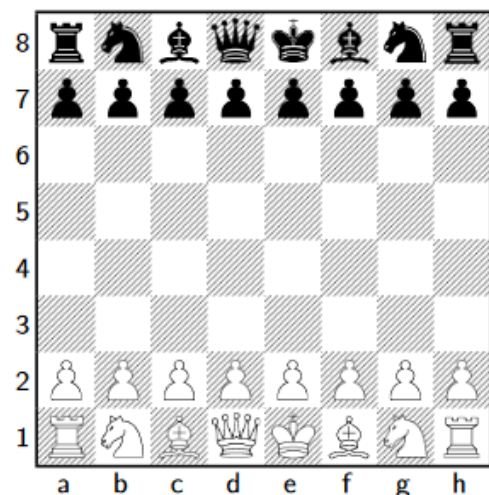
("queen on her own colour"). The starting position of the pieces is shown in the following chessboard. The player with the white pieces moves first and the players then take turns moving. One piece may be moved at each turn except for castling (which is described below).

Queen Moves

The Queen can move in a straight line any number of squares in any one direction - horizontal, vertical, or diagonal as long as its path is not blocked by its own pieces. It can capture a piece of the opposite color in its path. Below, the black Queen can reach any of the highlighed squares shown in this diagram. It can capture the white Rook but its path is blocked in some directions–below by the black King and to the lower right by the black Knight.
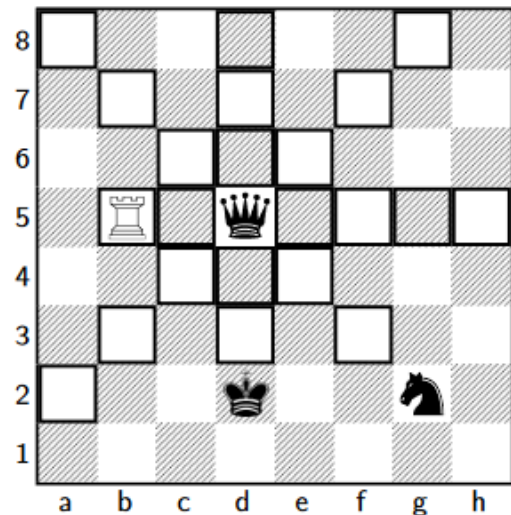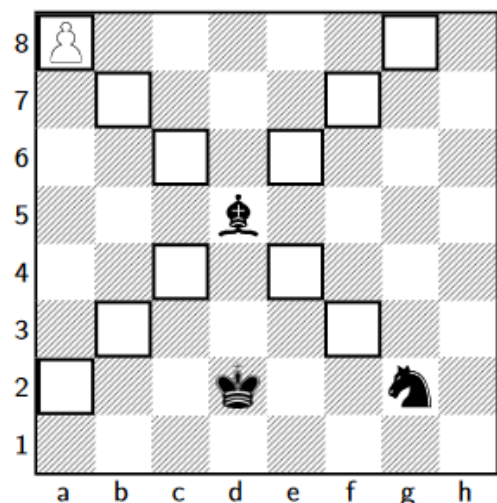
Rook Moves

The Rook is the next most powerful piece. The Rook can move any number of squares in one direction – vertically or horizontally– if its path is not blocked. For example, the squares this black Rook can move to are highlighted in the chessboard below. It can capture the white Pawn to its left but its path is blocked if it wants to move downward–by its black King.
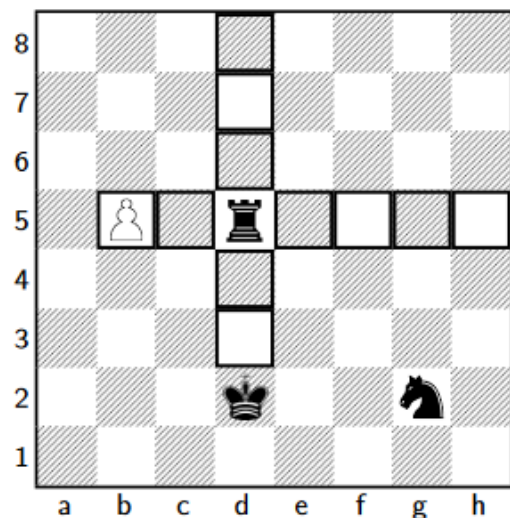
Bishop Moves

The bishop can move any number of squares diagonally if its path is not blocked. Note that this Bishop starts on a light square and can reach only other light squares. At the beginning of the game, you have one" dark-square" Bishop and one" light-square" Bishop. The bishop's moves are shown by the highlighted squares in the following chess-

board. This black Bishop can capture the white pawn but its path is blocked by the black Knight if it wants to move to the lower right.

Knight Moves

The Knight's move is special. It hops directly from its old square to its new square. The Knight can jump over other pieces between its old and new squares. Think of the Knight's move as an" L." It moves two squares horizontally or vertically and then makes a right-angle turn for one more square ("2 then 1"). The Knight always lands on a square opposite in color from its old square.
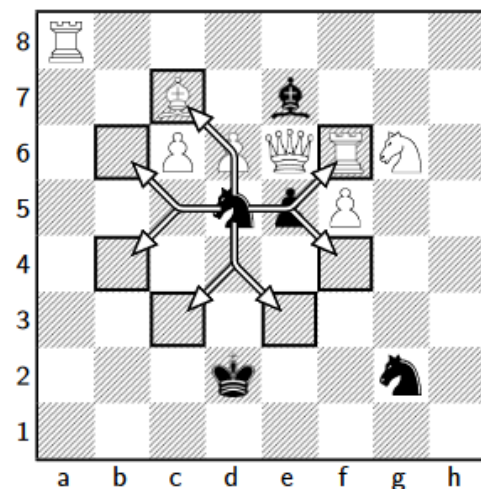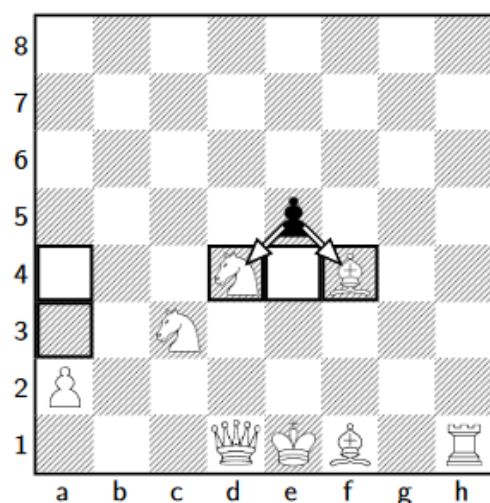
King Moves

The King is the most important piece. When it is trapped, the whole team loses. The King can move one square in any direction - for example, to any of the highlighted squares in this diagram. (An exception is castling, which is explained later.) The King may never move into check - that is, onto a square attacked by an opponent's piece.
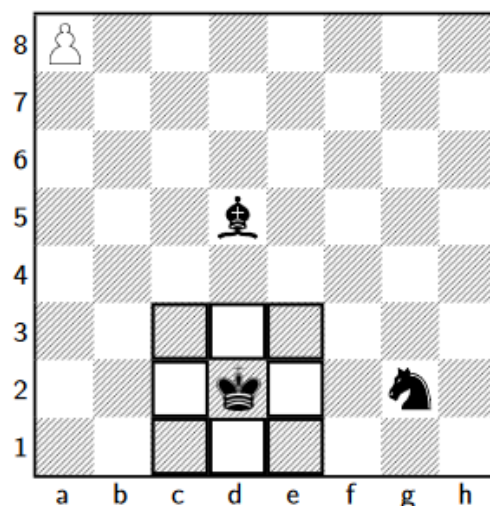
Pawn Moves

The Pawn moves straight ahead (never backward), but it captures diagonally. It moves one square at a time, but on its first move it has the option of moving forward one or two squares. In the diagram, the highlighted squares indicate possible destinations for the pawns. The White pawn is on its original square, so it may move ahead either one or two squares. The black Pawn has already moved, so it may move ahead only one square at a time or capture diago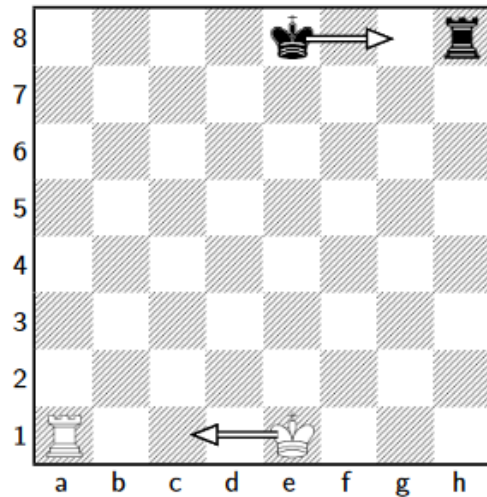nally. The squares on which these black Pawn may capture are indicated by arrows. If a pawn advances all the way to the opposite

end of the board, it is immediately "promoted" to an- other piece, usually a Queen. It may not remain a pawn or become a King. Therefore, it is possible for each player to have more than one Queen or more than two Rooks, Bishops, or Knights on the board at the same time.
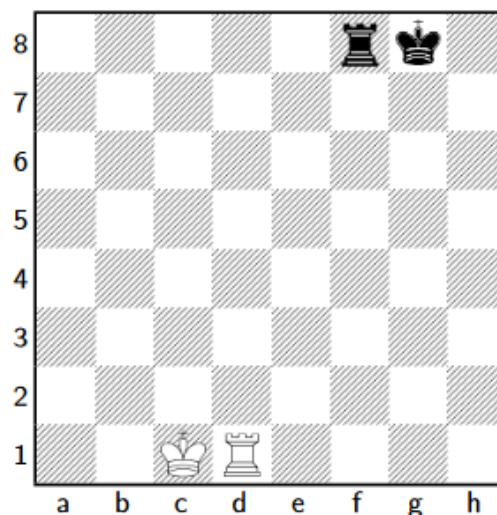
Castling

Each player may castle only once during a game and only when certain conditions are met. Castling is a special move that lets a player move two pieces at once - the King and one Rook. In castling, the player moves his King two squares either to its left or right toward one of his Rooks. At the same time, the Rook involved goes to the square on the other side of the King. In order to castle, neither the King nor the Rook involved may have moved before. Also, the King may not castle out of check, into check, or through check. Further, there may not be pieces of either color between the King and the Rook involved in castling. The chessboard shown below shows the white King before castling queen-side and the black King before castling king-side.

This chessboard shows their position after castling is completed.

Castling is often a very important move because it allows you to place your King in a safe location and also allows the Rook to become more active. When the move is legal, each player has the choice of castling Kingside or Queenside or not at all, no matter what the other player chooses to do.

En Passant

This French phrase is used for a special pawn capture. It means" in passing," and it occurs when one player moves a pawn two squares forward to try to avoid capture by the opponent's pawn. The capture is made exactly as if the player had moved the pawn only one square forward. In the chess- board below, the White pawn moves up two squares from its starting position. On its turn the Black pawn may capture the White pawn as shown by the arrow. If the Black player does not exercise this option immediately –before playing some other move – the White pawn is safe from "en passant" capture for the rest of the game. But new opportunities may arise for each pawn in similar circumstances.
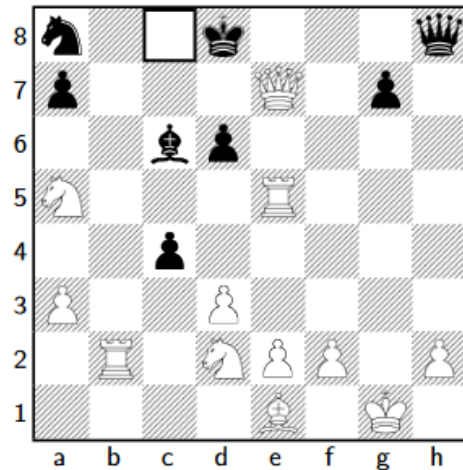
Before White's Move
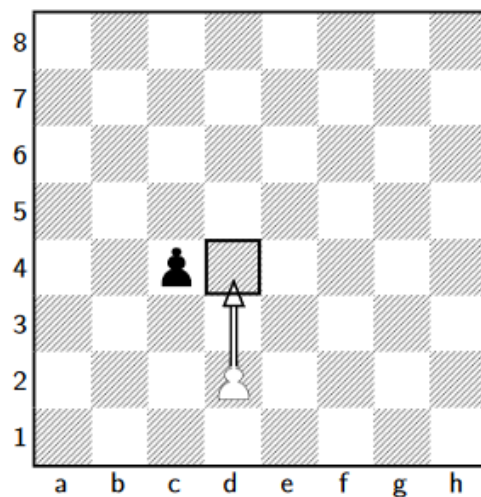
After White's Move
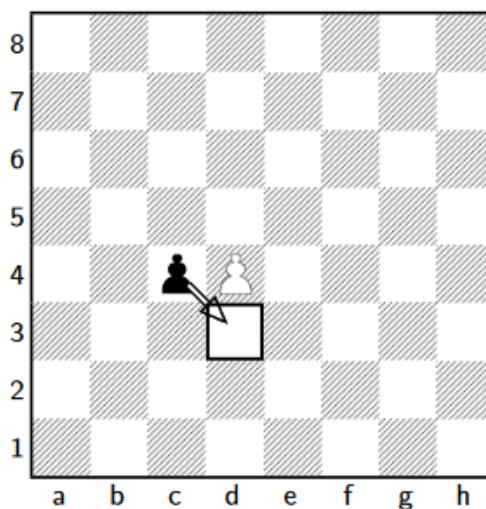
Black Pawn Captures White Pawn


Check, Checkmate and Stalemate

The main goal of chess is to checkmate your opponent's King. The King is not actually captured and removed from the board like other pieces. But if the King is attacked, we say it is put in check and threatened with capture. It must get out of check immediately. In the chess position shown below, the black King is in check but there is one move that will move the King away from the attacking Queen and that is one highlighted square to the left.

If there is no way to get out of check, the position is a checkmate and the side that is checkmated loses. In the position shown below, there is no way for the black King to escape the attacking white Queen by moving to the highlighted squares. And since the Queen is protected from attack by the white Rook, white wins.

It is illegal for a king to move into check. If your King is in check, there are three ways of getting out of check:

1. Capturing the attacking piece
2. Placing one of your own pieces between the attacker and your King (impossible if the attacker is a Knight)
3. Moving the King away from the attack.

If a checked player can do none of these, he is checkmated and loses the game. If a King is not in check, and that player can make no legal move, the position is called a stalemate and the game is scored as a draw, or tie, with each player receiving a half point. In the chessboard show below, it is white's turn to move and since there are no moves for the white pawn and every move puts the white King into check, we say the game is a stalemate.
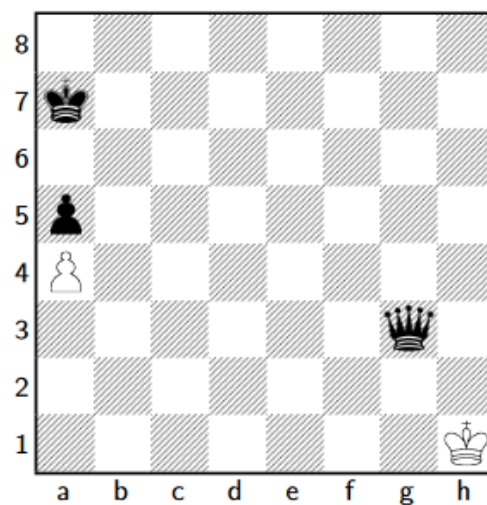
Fool's Mate and Scholar's Mate

Fool's Mate occurs when a player opens up his King to a fatal attack as shown in the following game:
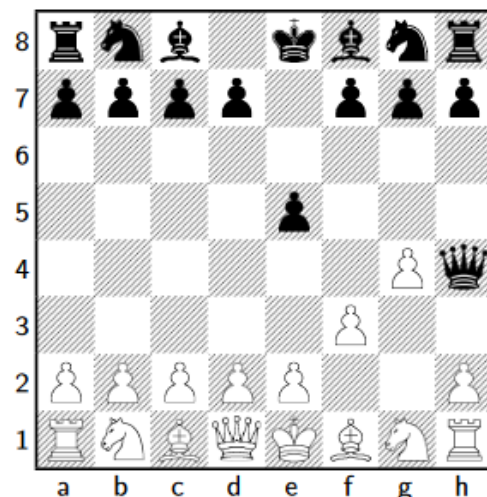
It is rarely a good idea to move the pawns on f2, g2 and h2 so early in the game as the King normally castles on this side and if the pawns have been moved, they can no longer offer him adequate protection. The following game illustrates Scholar's Mate. This is a checkmate whereby the Bishop and Queen attack the weak f7 pawn. This pawn is weak because, in the starting position, it is only protected by the King.
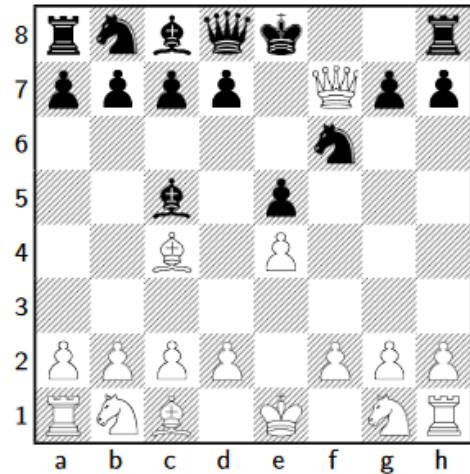
Pins, Forks, and Skewers

A pin occurs when a piece is attacked and if it moves, a piece of greater value will be under attack. So, the piece is said to be pinned to its position. A fork occurs when a piece (not always a knight!) attacks two or more pieces at the same time as shown in the following diagram:
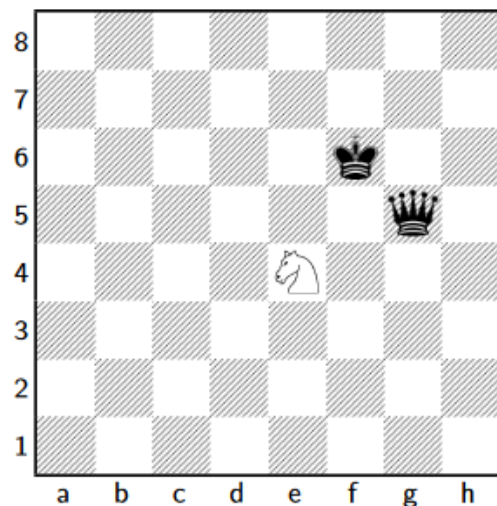
A skewer is similar to a pin except in this case the piece of greater value (for example, the King, Queen or Rook) is in front. An enemy piece attacks the piece and when this piece moves away, it leaves a piece of lesser value exposed to capture. Below the Bishop is Skewering the Black King and Queen. The King must move out of check and the White Bishop captures the Black Queen!
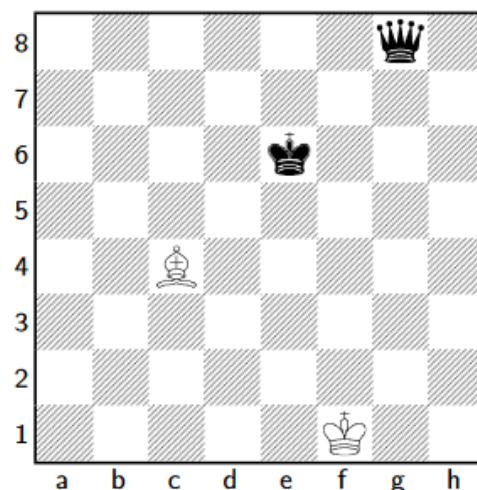
Basic Opening Strategy

1. Control the center squares. Open with one of the two center pawns, the pawns in front of your king and queen. The idea is simple: every early move should try to take better control over the center of the board.

2. All of your early moves should aim to develop a piece, preferably in a way that threatens something; perhaps an opponent's piece or to take firm control over the center.

3. A general rule of thumb is to bring out your Knights before your Bishops. Most of the time, it is fairly clear where the knights ought to be developed. The best squares for the bishops become apparent only a bit later.

4. Try not to move a piece more than once in the opening unless you can capture something or gain something important. In other words, don't start attacking until all or at least most of your pieces are developed.

5. Do not bring your queen out early. If you do, you may lose it or at best lose time moving it around when your opponent attacks it. Wait with your queen until you are sure you know where it's going.

6. And do not sacrifice material until you know you are getting something valuable for it.

Problem Statement

In this assignment, you will be implementing a chess game using the Min-Max Algorithm with Alpha-Beta Pruning. Chess is a two-player board game that is played on an 8x8 chessboard. The game involves moving pieces across the board in an effort to capture the opponent's king. The player who successfully captures the opponent's king wins the game.

Requirements:

1. Implement a chess game that can be played against the computer.
2. The computer will use the Min-Max Algorithm with Alpha-Beta Pruning to make its moves.
3. The game should display the chessboard and pieces after each move.
4. The game should keep track of the moves made by both players.
5. The game should detect checkmate and declare the winner.
6. The game should detect stalemate and declare a draw.
7. The game should have a command line-based user interface to display the chessboard and pieces. Good Luck! 😊