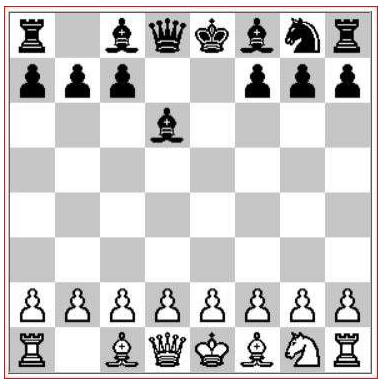
Part 1: Written problem

QUESTION:

One Sunday afternoon you tune in to ESPN to watch a chess championship. Unfortunately, the game is already in progress so you don't know the moves that have happened so far, but you do know that there have been 4 plies (i.e. White has moved 4 times and so has Black). You can also see the current state of the board:

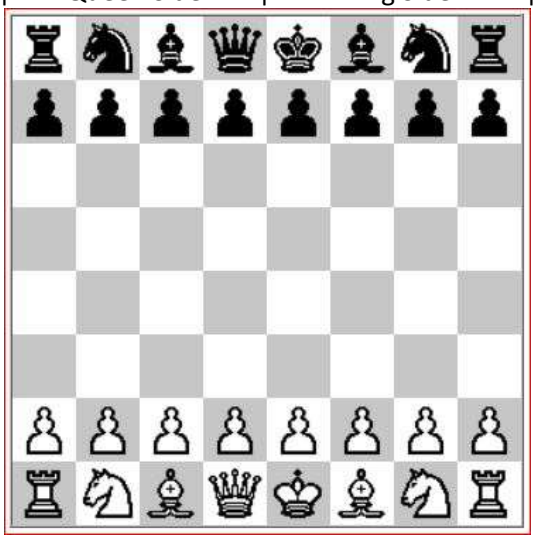


Determine the previous moves performed by each player, with a brief explanation of your answer. Submit this problem as a PDF _le, consisting either of a typed document or a scan of a neatly-written handwritten document.

Part 1: Written problem

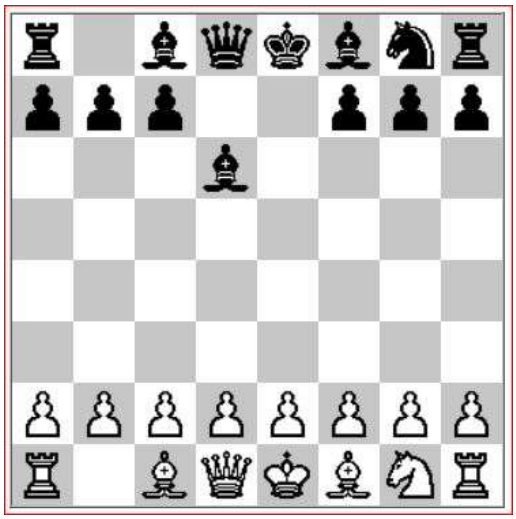
INITIAL STATE: We are given:

| <--- Queen Side ---> | <----- King Side -----> |



| <--- Queen Side ---> | <----- King Side -----> |

GOAL STATE: We are to arrive at



GIVEN INFORMATION:
The **White** has moved 4 times and the **Black** has moved 4 times.

TO FIND:
We are to figure out possible intermediate chess board states between INITIAL STATE and GOAL STATE. In other words, figure out possible moves made by **White** pieces and **Black** pieces.

Part 1: Written problem

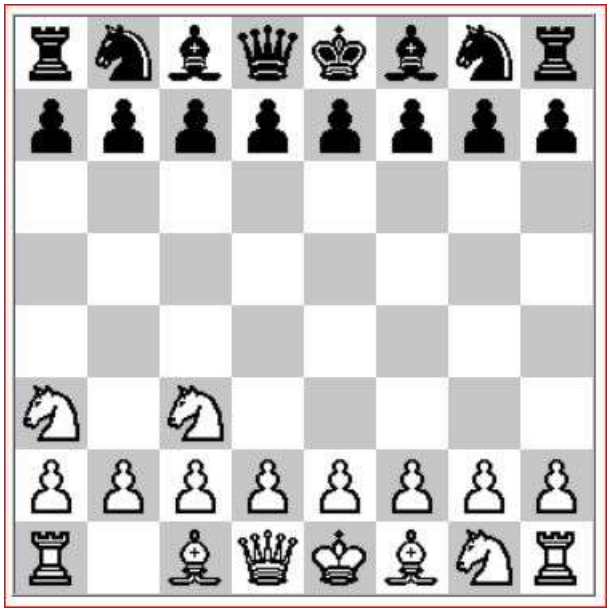
Let **Player-1** is **White**;

Let *Player-2* is *Black*;

BASIC IDEA: Think like a basic MIN-MAX algorithm. MAX is White (** player-1 **) and MIN is Black (** player-2 **). For us the most relevant pieces on the chess board are those that appears as missing from board or that are misplaced from their original position:

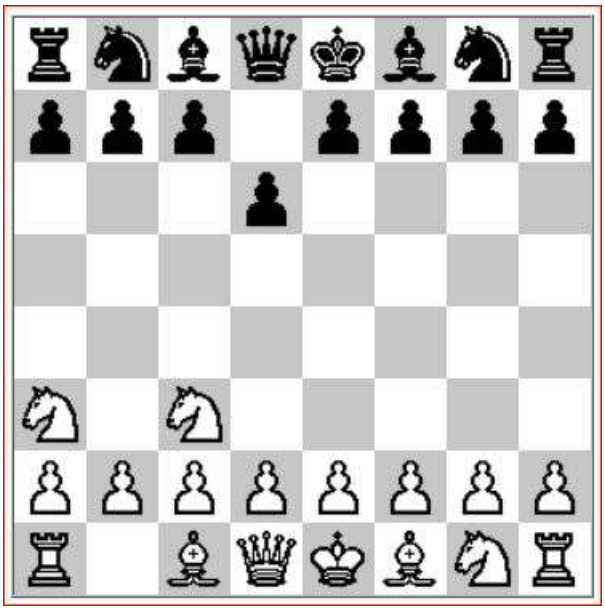
White-Knight	:	on the queen side
Black-Knight	:	on the queen side
Black-Pawn	:	on the queen side
Black-Pawn	:	on the king side

1st **WHITE** MOVES POSSIBILITIES: Among many possible moves, we are considering knight (on queen side) moves only. There are two possibilities for white knight as shown below;

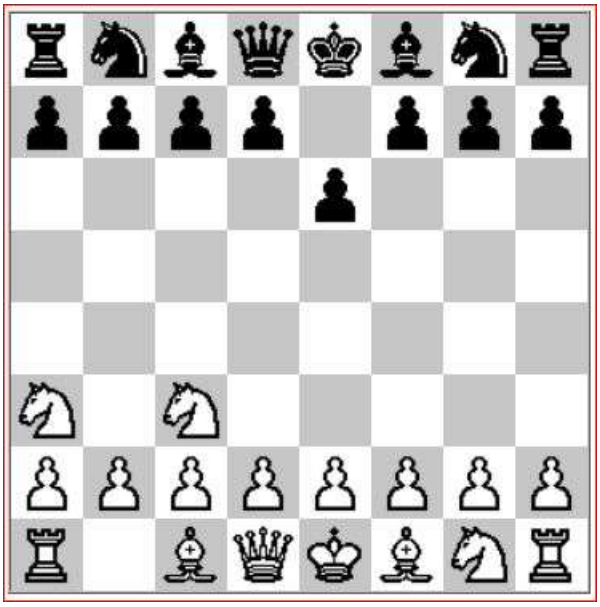


Part 1: Written problem

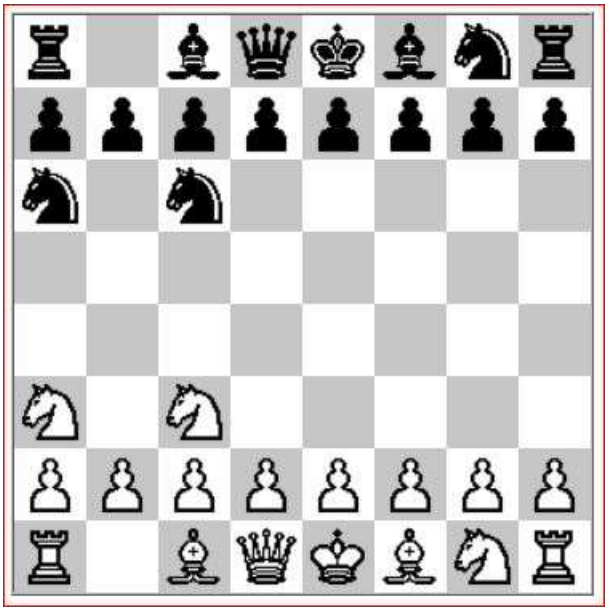
1st **BLACK** MOVES POSSIBILITIES: Among many possible moves, we are considering only knight (on queen side) and pawn (in front of King and Queen) moves. There is one possibility each for two black pawns in front of King and Queen. There are two possibilities for the knight (on the queen side). Possibilities are shown below;



(a) More Likely Move as per seeing the goal state



(b) Less likely moves as per seeing the goal state



(c) Less likely moves as per seeing the goal state

Part 1: Written problem

2nd **WHITE** MOVES POSSIBILITIES: Among many possible moves, we are considering knight (on queen side) moves only. There are 5 (= 2+1+2) forward move possibilities for the very same white knight in previous 1st WHITE move. Next possible moves are shown below;

Part 1: Written problem

2nd **BLACK** MOVES POSSIBILITIES: Among many possible moves, we are considering only knight (on queen side) and pawn (in front of King and Queen) moves. Possibilities are shown below;

(a) More likely move as per seeing the goal state

(b) Less likely moves as per seeing the goal state

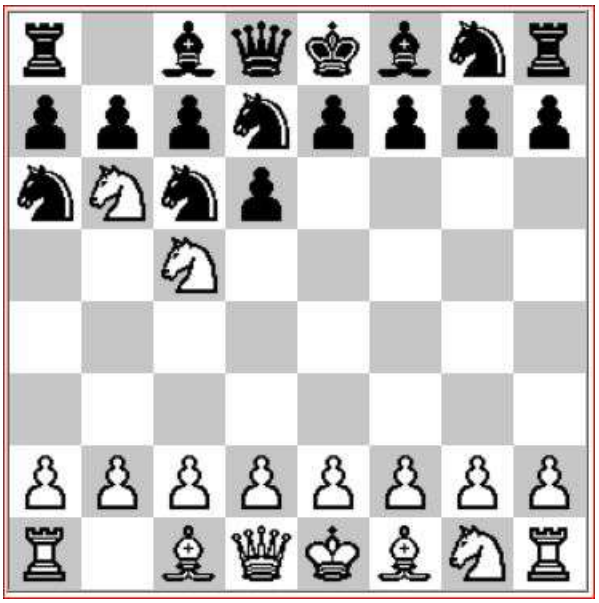
Part 1: Written problem

3rd **WHITE** MOVES POSSIBILITIES: Among many possible moves, we are considering knight (on queen side) moves only.

CURRENT STATE (before making a move):

All possibilities are shown below (for each of previous 5 possibilities):

Next moves for White Knight Possibility #1:



1.1) Less likely moves as per seeing the goal state

Part 1: Written problem

Next moves for White Knight Possibility #2:

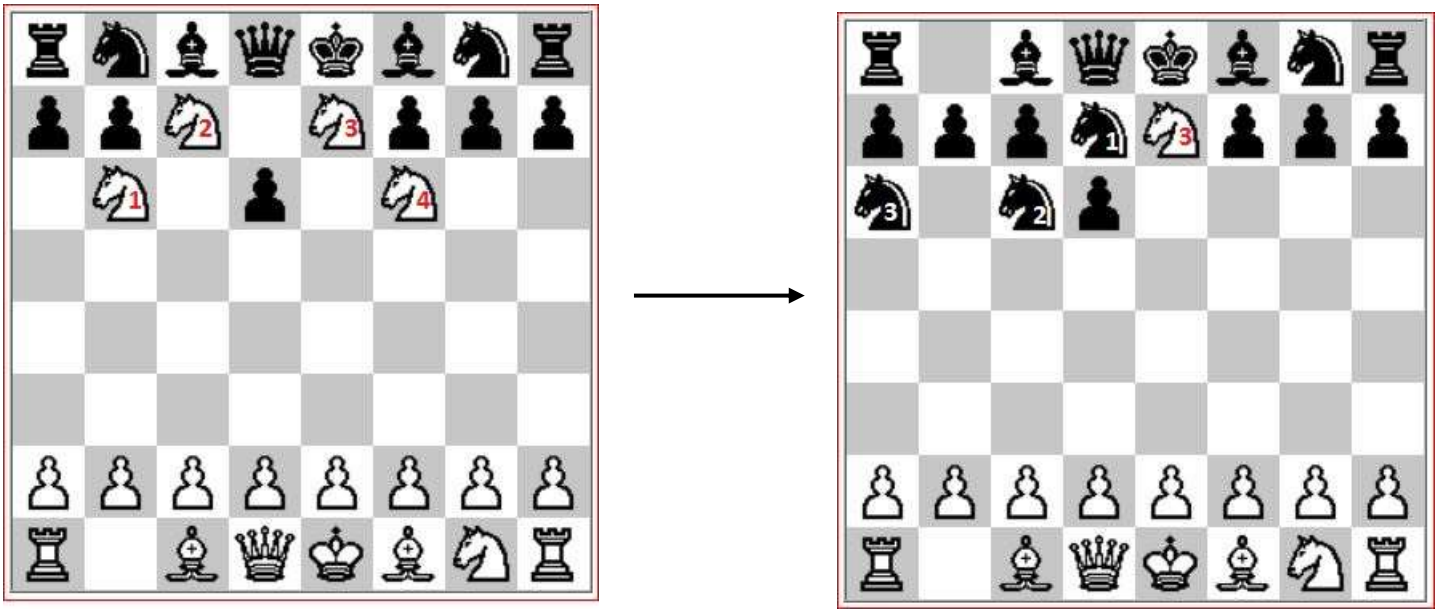
2.1) Less likely moves as per seeing the goal state

Next moves for White Knight Possibility #3:

3.1) Less likely moves as per seeing the goal state

Part 1: Written problem

Next moves for White Knight Possibility #4:



4.1) Here 1, 2, & 3 are less likely moves as per seeing the goal state;
Because white knight cannot capture Black-Pawn in the 3rd Move;

4.2) Here 3 is more likely move as per seeing the goal state; so we can go ahead with move position 3 in the 4th MOVE. Resulting chess board state on the right is showing the possible White-Knight position + all the past move possibilities for Black-Knight (** still to decided which one to select **);

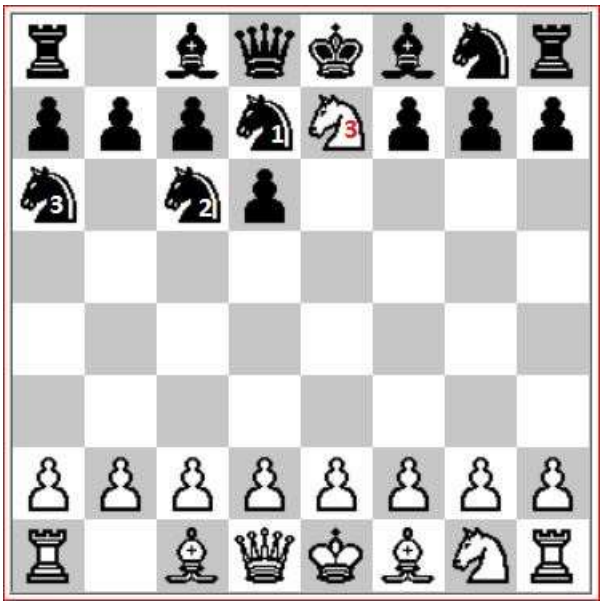
Next moves for White Knight Possibility #5:

5.1) Less likely moves as per seeing the goal state; White-Knight is not able to capture either a Black-Pawn or a Black-Knight in first three moves.

Part 1: Written problem

3rd **BLACK** MOVES POSSIBILITIES: Among many possible moves, we are considering only knight (on queen side) and pawn (in front of King and Queen) moves.

CURRENT STATE (before making a move):



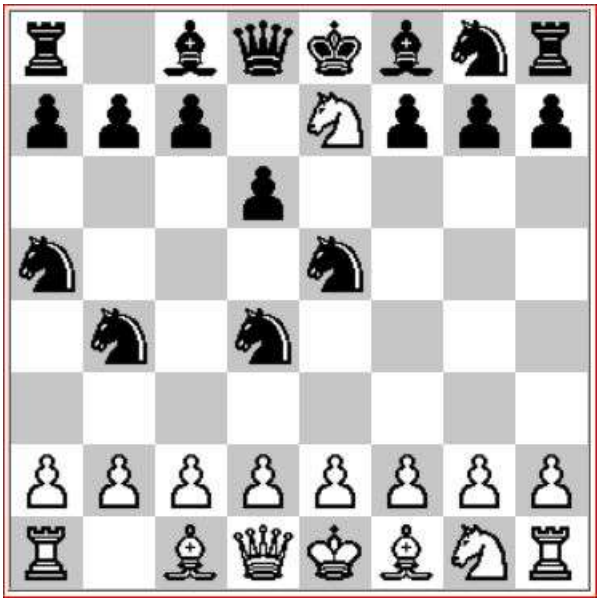
Possibilities are shown below;

Possibilities for Black-Knight at position #3:

Less likely moves as per seeing the goal state

Part 1: Written problem

Possibilities for Black-Knight at position #2:



Less likely moves as per seeing the goal state

Possibilities for Black-Knight at position #1:

Some likely moves as per seeing the goal state

1.1) Position 1 here is showing a possibility to reach to a goal state under the assumption that White-Knight captures the Black-Knight (on King Side) in the 4th Move, followed by Black-Knight (from queen side) captures the White-Knight in the 4th Move;
Resulting chess board state on the right is showing the possible Black-Knight position + the past favorable possibility for White-Knight (** still to decided where it will go in the 4th Move **);

1.2) It is already a 3rd Move and the positions 2, 3 & 4 are not showing the possibility to reach to the goal state in the 4th Move

Part 1: Written problem

4th **WHITE** MOVES POSSIBILITIES: Among many possible moves, we are considering knight (on queen side) moves only.

CURRENT STATE (before making a move):

All forward move possibilities for the next move of White-Knight are shown below:

a) Likely move as per seeing the goal state; Current chess-board state appears closer to the goal state; we are still to evaluate next possible moves of the black knight in its 4th Move.

Part 1: Written problem

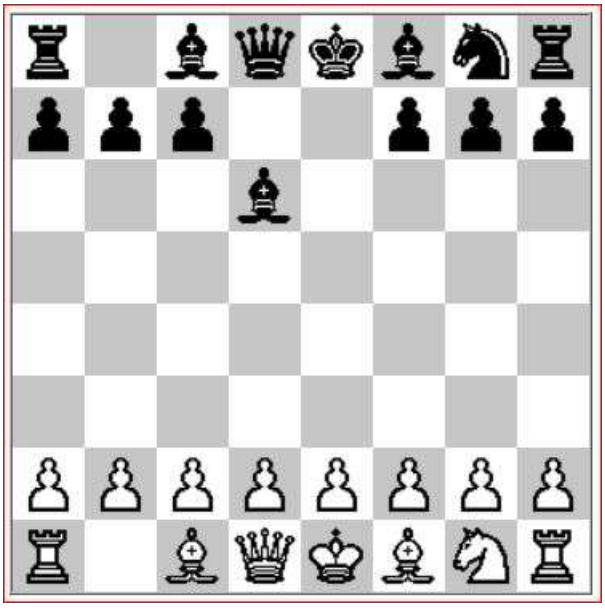
b) Black-Bishop is captured by White-Knight in this chess board state; this state is not going to be similar to the goal state; this state can be ignored now;

Part 1: Written problem

4th **BLACK** MOVES POSSIBILITIES: Among many possible moves, we are considering knight (on queen side) moves only.

CURRENT STATE (before making a move):

All possibilities for the next move of Black-Knight (to attain goal state) are shown below:



a) It is 4th Black Move and position 1 attains the goal state, hence it will be returned as part of the success path; resulting chess board state on the right is showing the goal state attained by selecting the position 1.
Positions 2, 3, 4, 5, 6, & 7 are not able to attain a goal state at 4th Black-Move and these will be discarded;

Part 1: Written problem

REFERENCES:

- Online Chess Editor: http://www.apronus.com/chess/wbeditor.php
- MS Paint Software for Image Edits
- Adobe Captivate For Creating Video Demos present on https://iu.box.com/b551-mjaglan
- For knowing formal names of chess pieces: https://en.wikipedia.org/wiki/Chess_piece

ROUGH WORK:

Direct link to Solution Demo: https://iu.box.com/a2p1q1

Hit and trial of multiple moves. All chess trials are at https://iu.box.com/b551-mjaglan

Chess 1.0 - Kind of optimal play but it is not the goal state

Chess 2.0 - It is a goal state but 4+4 moves limit exceeded

Chess 3.0 - It is a goal state in 4+4 moves with sub-optimal play;
WEIRD: Min Player could have chosen to capture white knight
instead the game went according to the goal state achieved.

HOW WE LEARNED THAT WHAT RIGHT PATH TO CHOOSE FOR KNOWING THE GOAL STATE IN 4+4 MOVES:

Considering different Possibilities at black moves #3 and #2 such that black pawn + black horse dies at white moves of #4 and #3.