Mini Project 3

Optimal Chess KRK-Endgame Position

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Agenda

- Background
- Goals
- Definitions
- Dataset
- EDA
- Model Evaluation
- Summary

Background

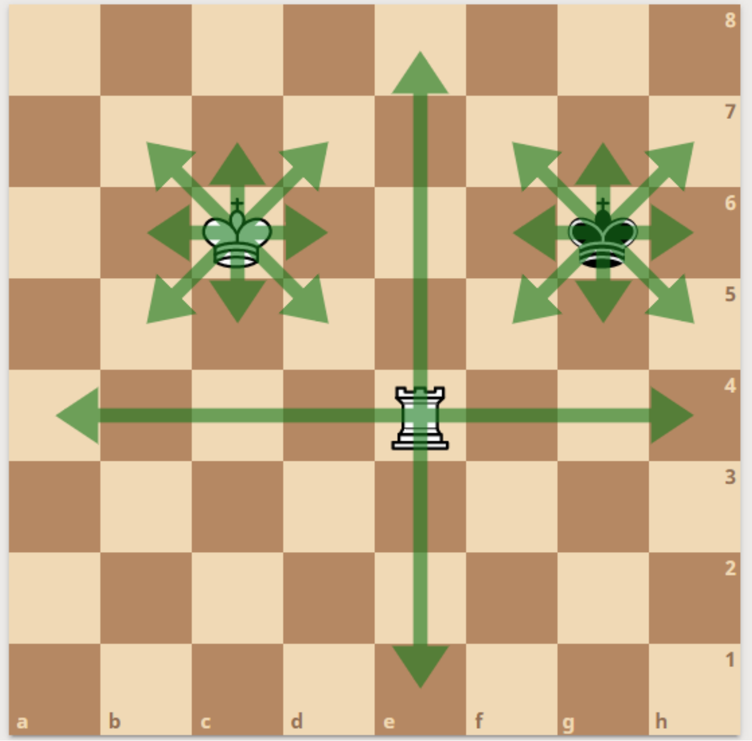
In chess, Endgame refers to the stage that most pieces have been captured and only a few remain.

Positioning is vital in the Endgame since each remaining piece becomes more decisive.

If not handled carefully, the player who has the upper hand may be forced to a draw.

Background

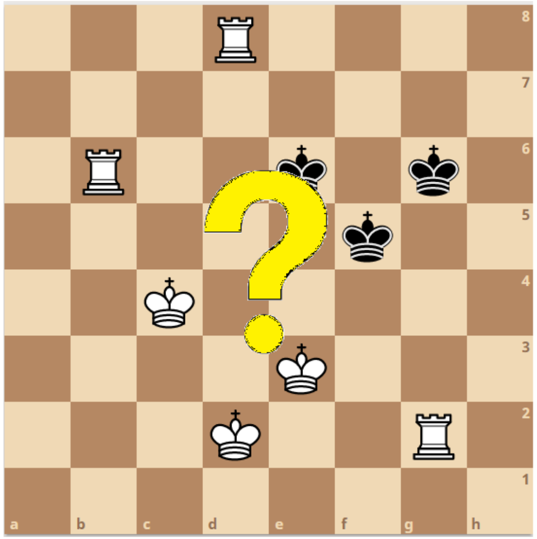
In this project we will look into the Chess Endgame Database to find out the best endgame position for white and black, assuming white has a rook and king left, black only has the king left, and it is black's turn to move.



Goals

1) Find out the best position for White and Black pieces in this particular scenario

2) Build a model to predict the result based on the position of the pieces



Definitions

White has an upper hand so White would want to win the game

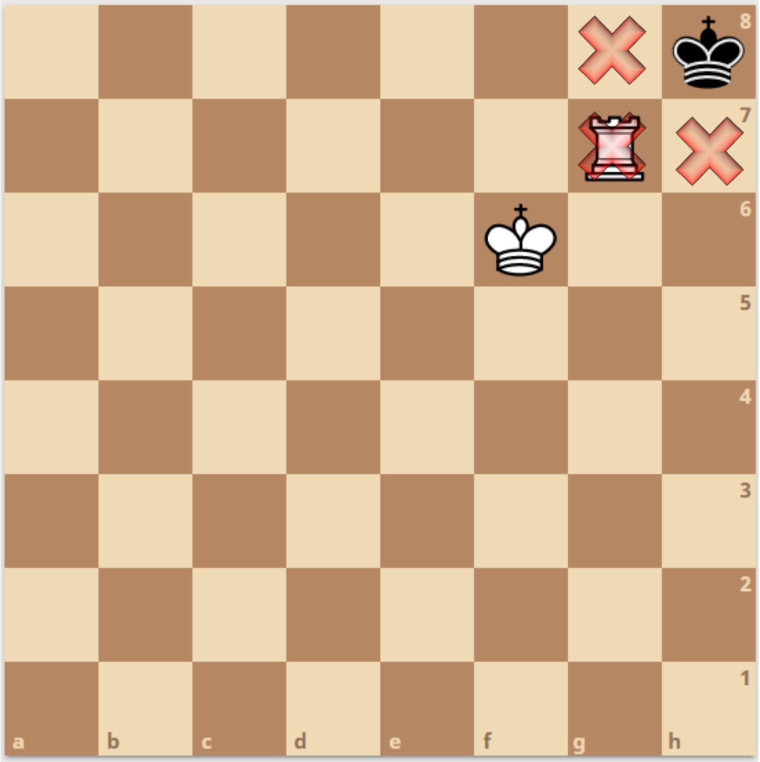
Black has no mean to checkmate White King, so the best Black can do is to force a draw

Definitions

In this study, we define a draw as:

1) White cannot checkmate in 16 moves

2) Black cannot make a move when it is his turn



Dataset

Chess Endgame Database for White King and Rook against Black King (KRK) - Black-to-move Positions Drawn or Lost in N Moves

Source

Creators: Database generated by Michael Bain and Arthur van Hoff at the Turing Institute, Glasgow, UK.

Donor: Michael Bain (mike '@' cse.unsw.edu.au), AI Lab, Computer Science University of New South Wales, Sydney 2052, Australia.

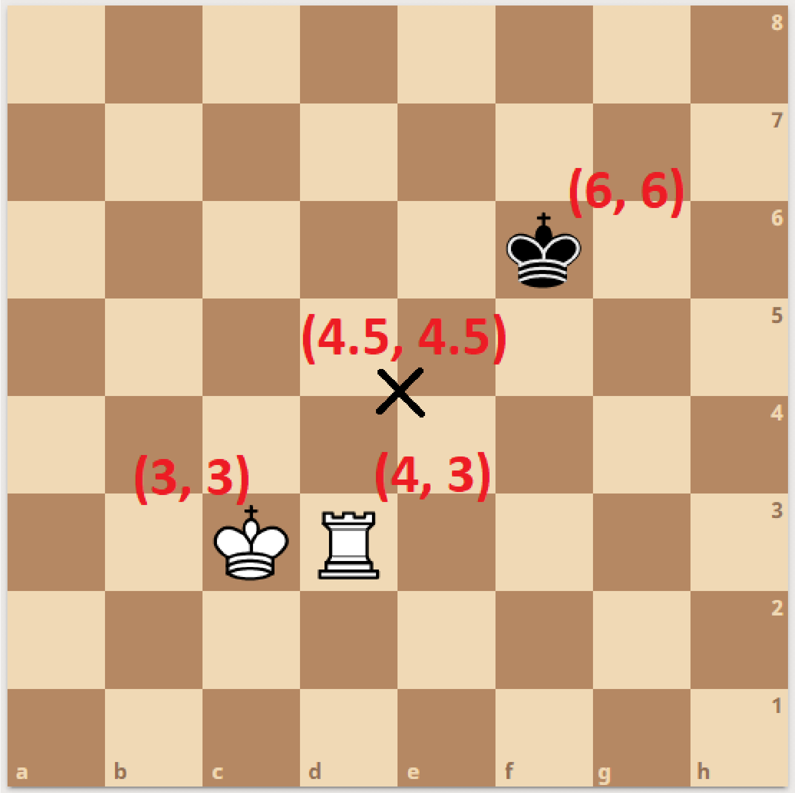
Number of Instances: 28056 (No missing / invalid data)

Attribute Information:

White King file
White King rank
White Rook file
White Rook rank
Black King file
Black King rank
Optimal White winning moves (0-16 or draw)

EDA

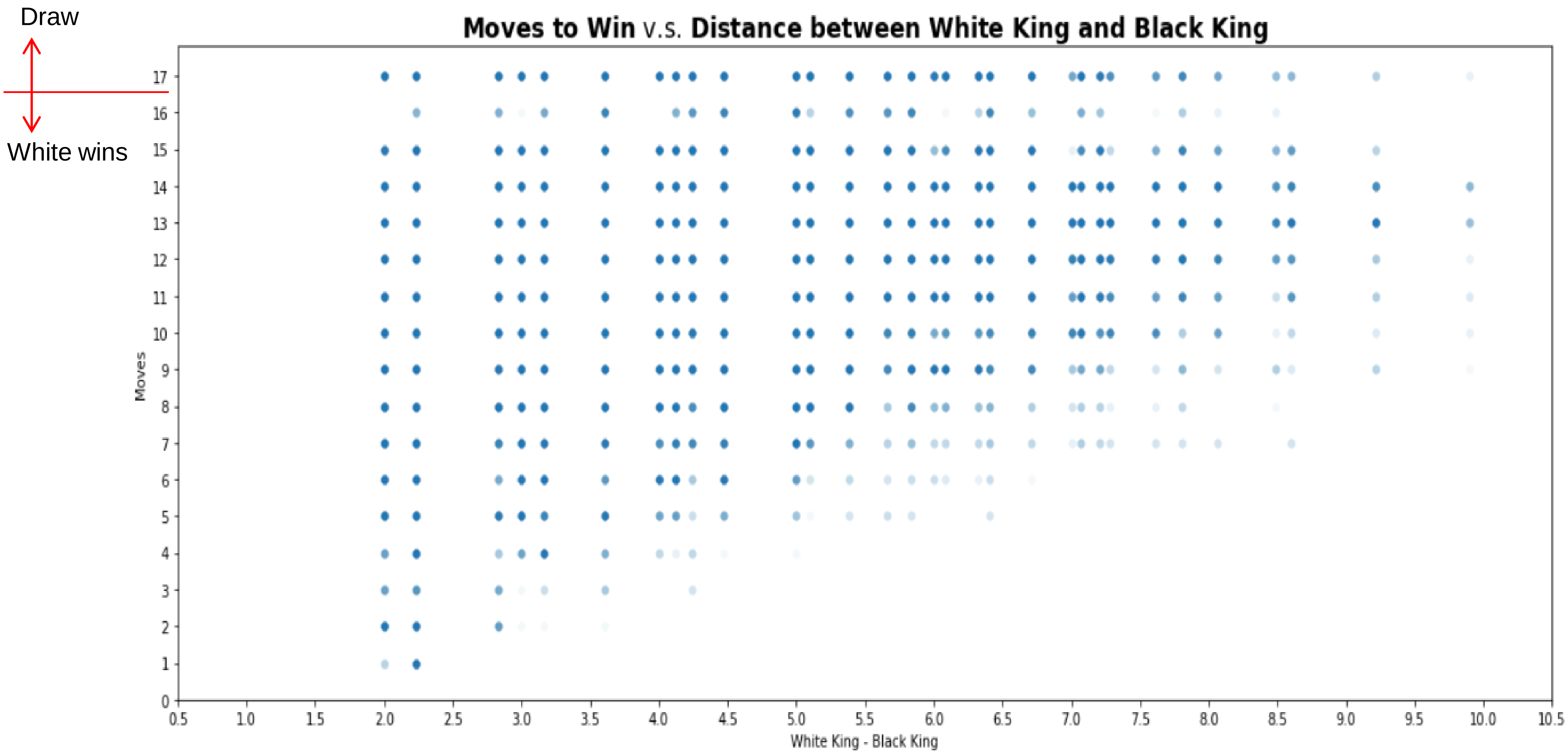
Convert the positions into coordinate to calculate distance between each piece as well as the centre



$$distance = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

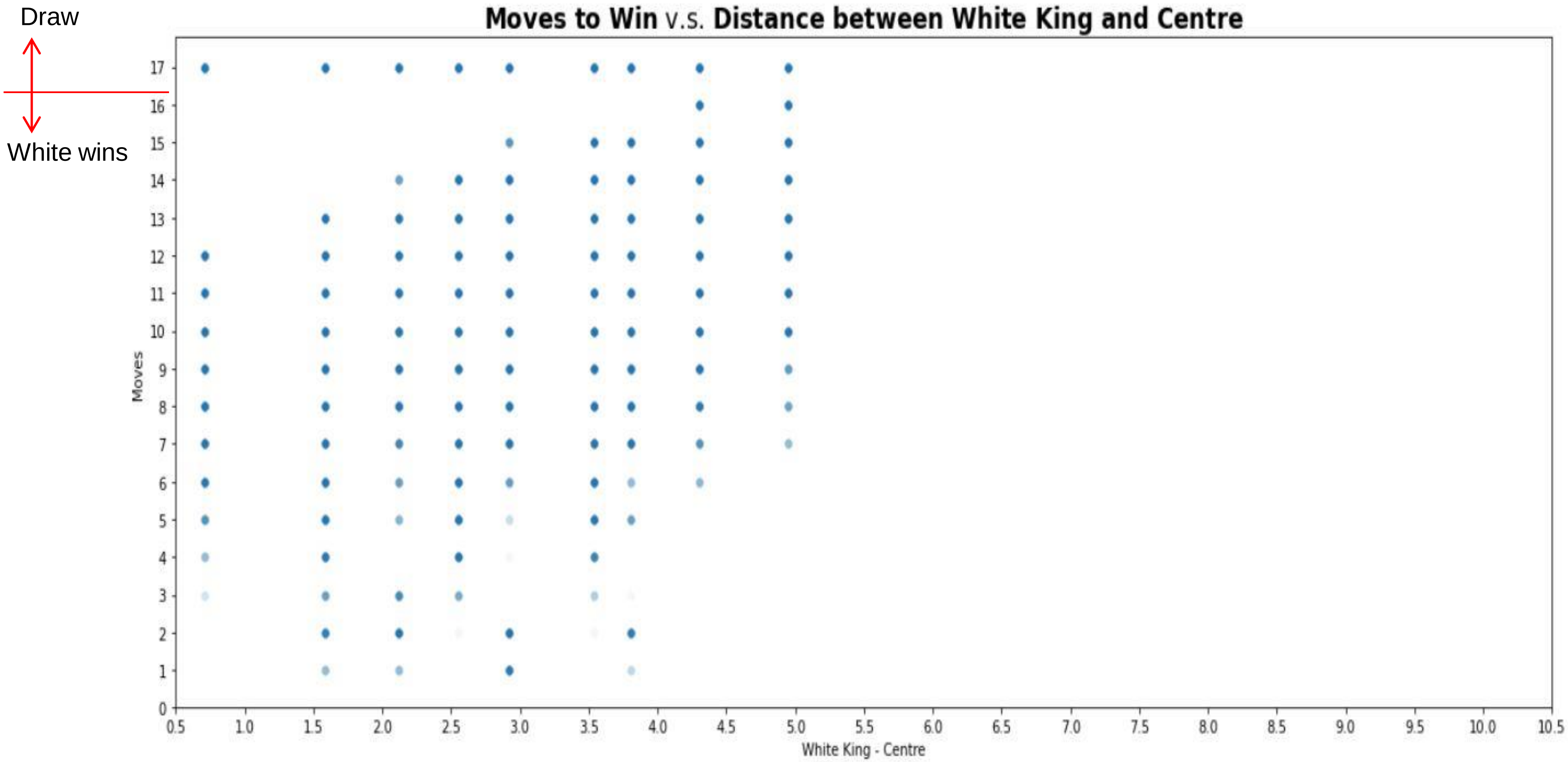
EDA

Convert “draw” into “17” for later use



EDA

Convert “draw” into “17” for later use



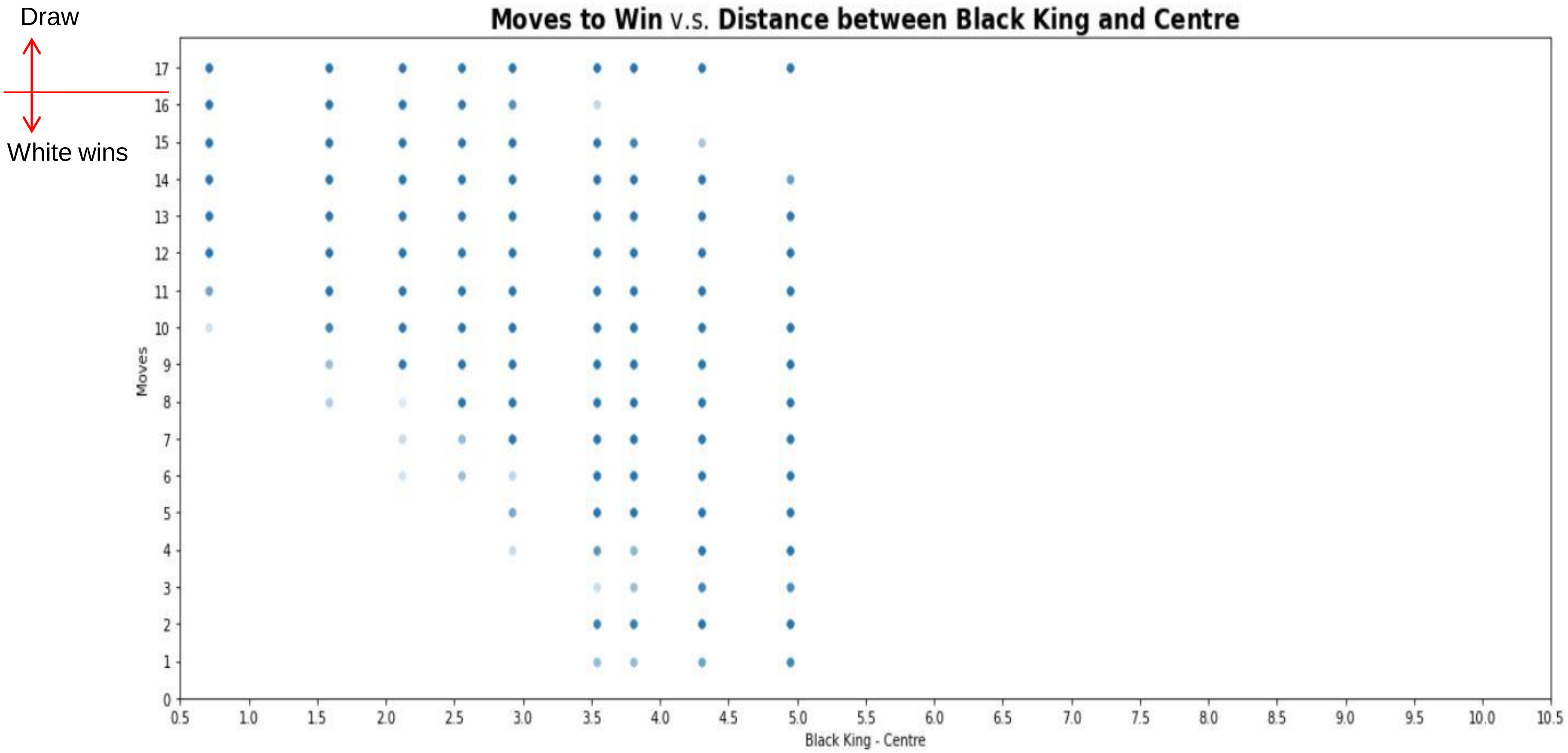
Draw

White wins

Moves to Win v.s. Distance between White King and Centre

EDA

Convert “draw” into “17” for later use



Draw

White wins

Model Evaluation

Features:

Distance of White King – Black King

Distance of White King – Centre

Distance of Black King – Centre

Target:

Result (Winning move in 1-4: easy win

5-12: normal win

13-16: difficult win

No winning move (17): draw

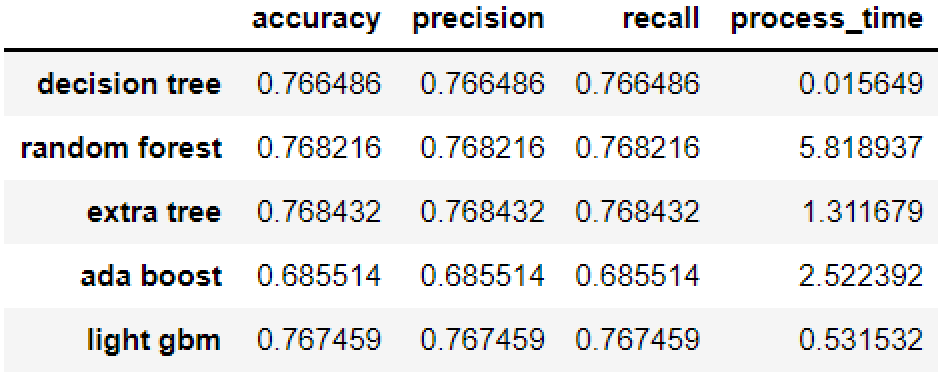
Models:

Decision Tree, Random Forest, Extra Trees, Ada Boost, LightGBM

Model Evaluation

- normal win 13327
- difficult win 11303
- draw 2796
- easy win 603

- Baseline accuracy: 0.48

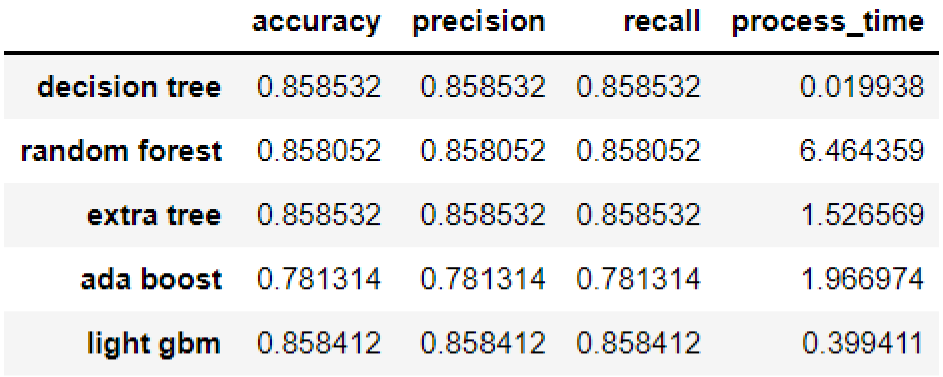


	accuracy	precision	recall	process_time
decision tree	0.766486	0.766486	0.766486	0.015649
random forest	0.768216	0.768216	0.768216	5.818937
extra tree	0.768432	0.768432	0.768432	1.311679
ada boost	0.685514	0.685514	0.685514	2.522392
light gbm	0.767459	0.767459	0.767459	0.531532

Model Evaluation (Ignore draw data)

- normal win 13327
- difficult win 11303
- easy win 603

- Baseline accuracy: 0.53



	accuracy	precision	recall	process_time
decision tree	0.858532	0.858532	0.858532	0.019938
random forest	0.858052	0.858052	0.858052	6.464359
extra tree	0.858532	0.858532	0.858532	1.526569
ada boost	0.781314	0.781314	0.781314	1.966974
light gbm	0.858412	0.858412	0.858412	0.399411

Summary

Black King is more likely to survive for at least 10 moves if it is near the centre of the board.

The further Black King is away from White King, the longer Black King can survive.

White has better chance to win if White King is near the centre since it can easily reach Black King within 4 moves.

The four models **Decision Tree, Random Forest, Extra Tree and Light GBM** have similar accuracy. In contrast, **Ada Boost** is relatively less accurate.

Random Forest and Extra Tree have a **slightly better result**, at the cost of **much longer processing time**.

When not considering "draw" (remove all rows with "draw"), the accuracy has become higher.

Q & A

THE END