Basic Info

The project title, your names, e-mail addresses, UIDs, a link to the project repository.

Title: “Statistics in the Game of Chess”
Names: Solon Grover, Ben Ruckman, Gavin Thomas
Emails: solon.grover@gmail.com, ben.ruckman@live.com, Gsct2002@gmail.com
UIDs: u1331981, u1247760, u1259629
Github Repo

Background and Motivation

Discuss your motivations and reasons for choosing this project, especially any background or research interests that may have influenced your decision.

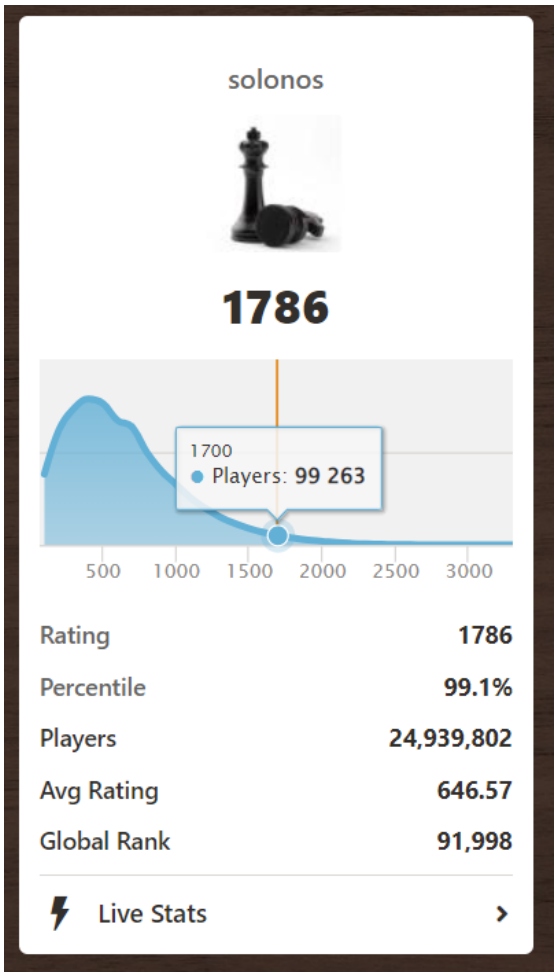
Solon: I've been involved in the chess world since elementary school, and lately the game has begun to pick up a bit in popularity, especially after the pandemic. Chess demographics and statistics such as the average age of grandmasters, average peak rating, average rating progression with time, and other related information are things I find to be very interesting as someone who likes to play and study chess regularly. There is a lot of data floating around in the chess world, almost every online game is put into a database and saved. There's almost infinite variability in the outcomes of a chess game, which can be kind of surprising given that the starting position is, of course, always the same.

Ben: I liked this project idea because I played a lot of chess in Middle School, as well as continuing to play on occasion with family and coworkers today. There's a lot of statistics in different openings and moves, and I would love to dive deeper into visualization of those statistics!

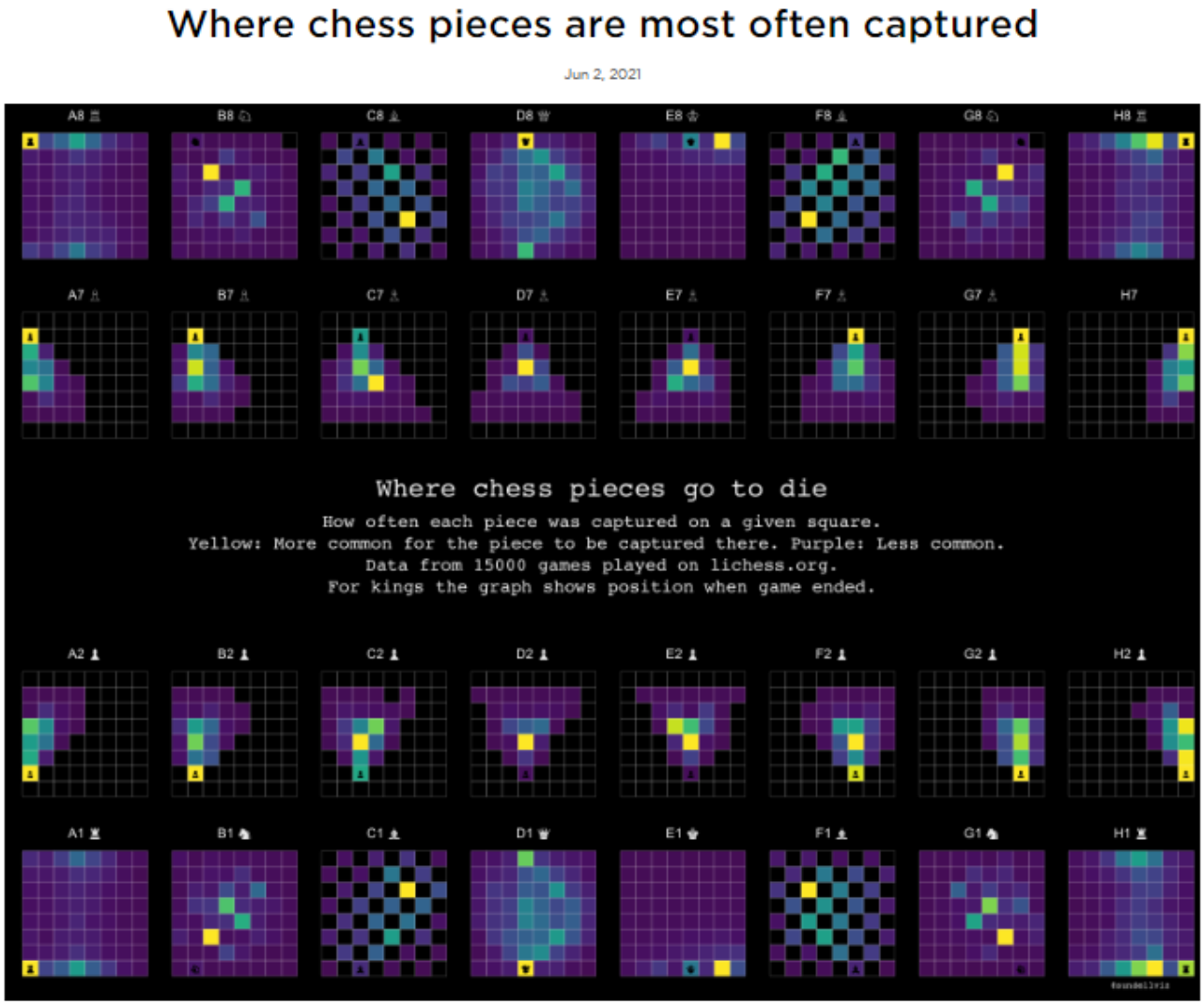
Gavin: Ever since I heard about IBM's Deep Blue beating the chess world champion I've become much more interested in the game. I have always enjoyed playing but after learning more about that and how complicated the game can be, I wanted to learn more about it. I think that the high amount of game states and statistics and the massive amount of history around the game make it a great candidate for a data visualization project.

Related Work

Chess.com's website contains stats for individual players. Here is an example of a normal curve representing the number of chess.com players at each rating level. The user is able to drag their mouse along the curve, and the exact number of players at that rating threshold is displayed. Other interesting statistics are detailed below the chart, such the player's rating percentile, the total number of players in the whose data is contained in the chart, the average rating, and the global rank of the player.

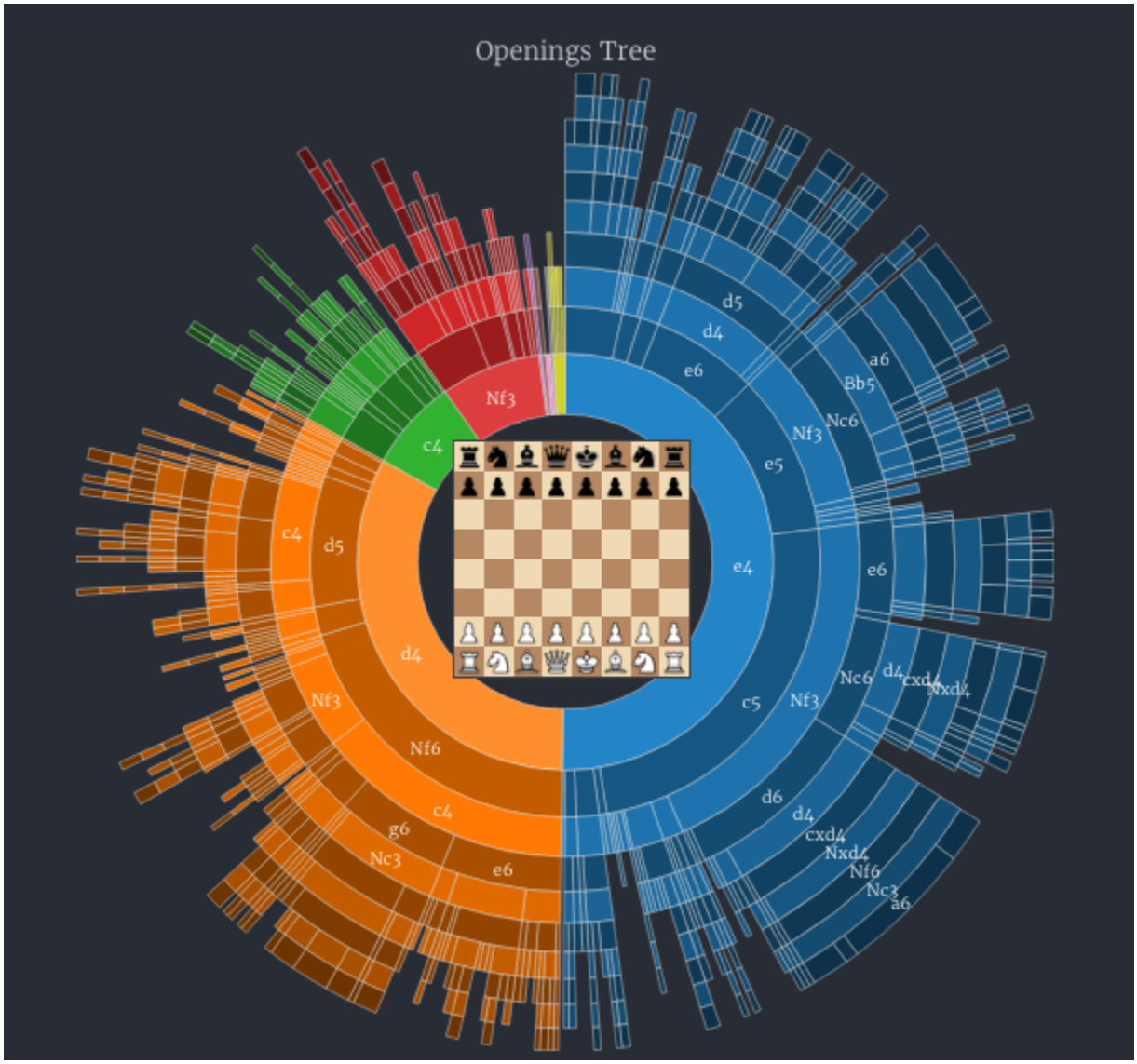


https://flowingdata.com/2021/06/02/where-chess-pieces-are-most-often-captured/
Here is a visualization made which shows where each chess piece most often gets captured. The heat map is something that we're trying to implement as one of our chess board features where we show the most successful and least successful opening moves for white. Additionally, we could also use this type of visualization to show how common these moves are.



https://www.informationisbeautifulawards.com/showcase/1271-a-visual-look-at-2-million-chess-games

This visualization uses concentric rings and shades of these rings to show the proportion of all openings each move is played. With each level, the number of possible moves branches out quickly, showing how the incredible variety of chess game outcomes looks visually. We were thinking of incorporating some move frequency data in our main visualization, and this gives us some inspiration as to how we could display that data.



Project Objectives

Provide the primary questions you are trying to answer with your visualization. What would you like to learn and accomplish? List the benefits.

Questions:
-GM questions
-What is the average age that grandmasters achieve their title?
-How many games has the average grandmaster played?
-What is the average IQ of a grandmaster?
-At what age do grandmasters typically start playing chess?
-What is the average age of an individual's peak rating achievement?

-How long does it take to improve 100 elo rating points given an individual's current rating?
-Does playing chess exclusively result in a better or worse rating than performing puzzles, and studying games alongside regular play?
-What does the average player's chess rating look like over the course of their lifetime?
-What is the male to female ratio of chess players?
-What is the black vs white win/draw/loss ratio (general population vs professionals)?
-What are the openings with the highest win ratio? Openings with the worst win ratio? (We could use a heatmap of the board, where the opening moves have a red to green tint based on how likely they are to result in a win)
-What is the average centi-pawn loss per move at different rating levels?
-Where are chess players located?
-How many turns are in games (Distribution of the ratio of games that end at certain move counts)?

Benefits: For players and those interested to gain a better understanding of the demographics and related statistics of the game of chess. There will be some grandmaster data, which most people find interesting, since grandmasters are extreme outliers amongst the general population.

Data

From where and how are you collecting your data? If appropriate, provide a link to your data sources.

Chess.com has an api to view a ton of chess data.
https://www.chess.com/news/view/published-data-api#pubapi-general

Lichess has a ton of games that we can download to get average stats.
https://database.lichess.org/#standard_games

Large grandmaster/top 100 database about the actual players (birthday, etc).
https://fide.com/

https://www.pnas.org/doi/10.1073/pnas.2006653117
https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/DZC0MT

Data Processing

Do you expect to do substantial data cleanup? What quantities do you plan to derive from your data? How will data processing be implemented?

We are going to have to do a substantial amount of data cleanup, as chess.com's main way to get stats is going directly through player ids. Then we would want to aggregate those stats, and display them in a nice way to users.

Lichess has a ton of games (almost 5 billion) available to download. There would be a lot of data processing required to get the data/stats we want out of it. We can split up the games based on rating to give us rating specific data that we can use.

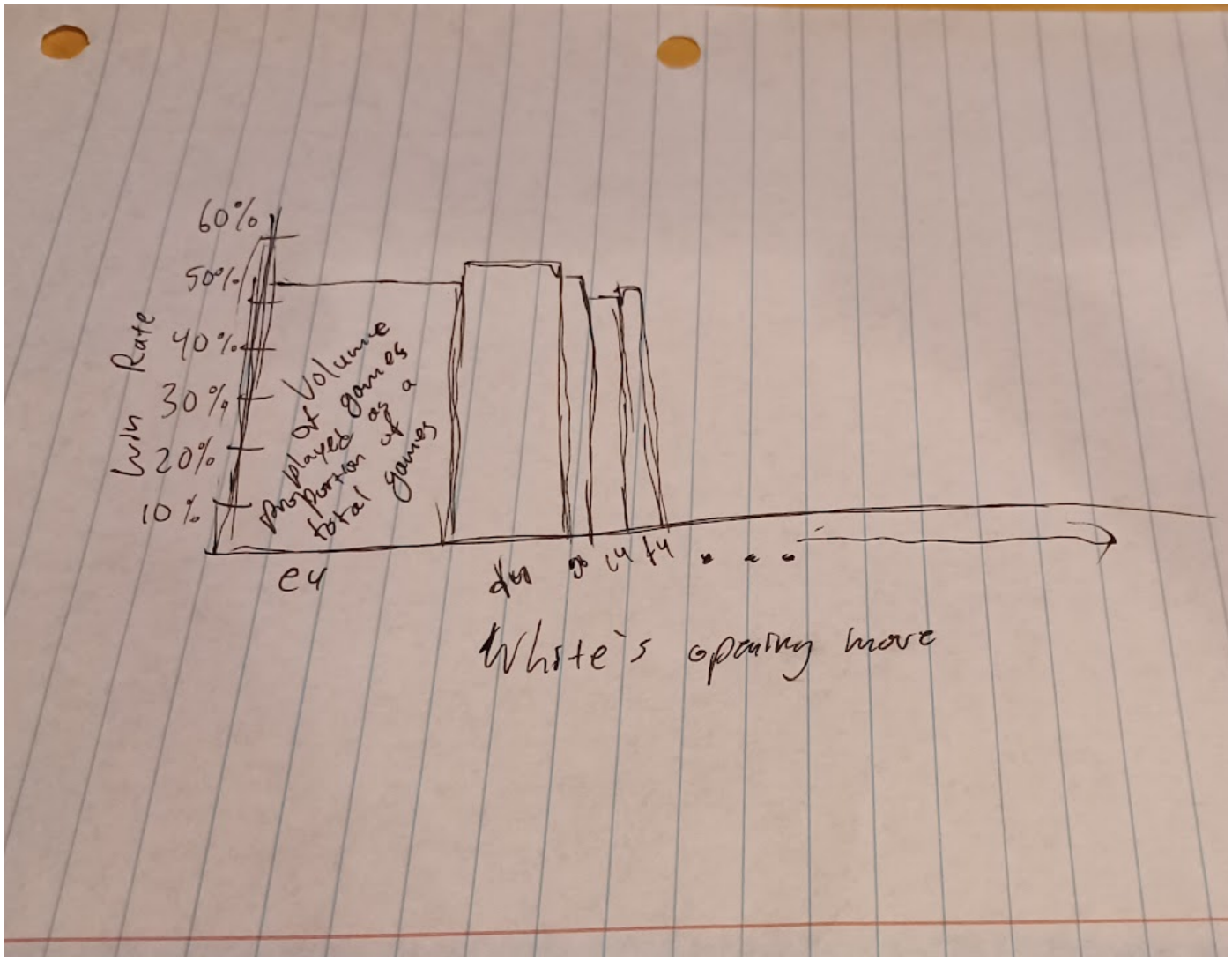
Most of our data processing thus far has been processing the lichess data. We are doing this in python, by loading the files into our code, and then creating dictionaries of aggregate statistics per month, and writing these dictionaries to files to be used by the frontend. Another way we have tried processing data is by creating a Python Pandas dataframe with columns for each attribute we need. We can then more easily process the data and perform operations on it to export to the front end.

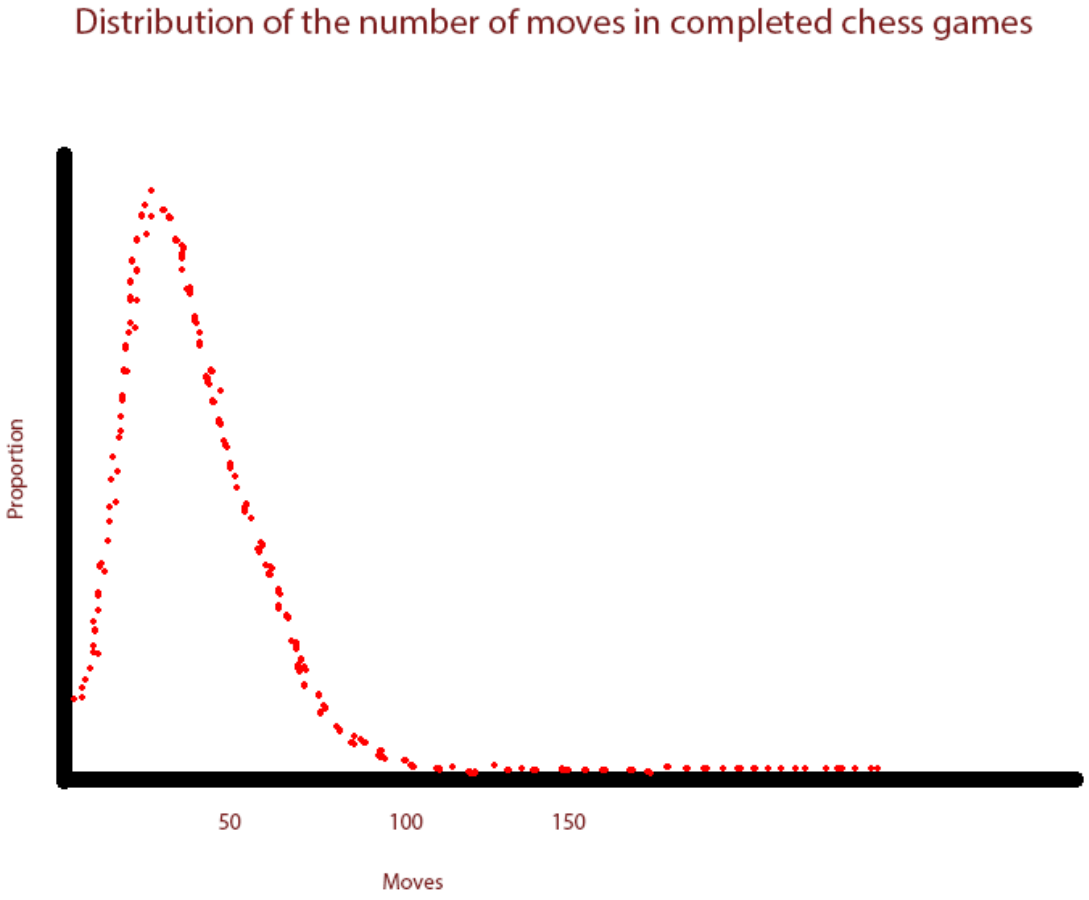
Because of the sheer number of games, and size of the files, it takes a lot of time, memory, and compute to go through all of the games in each file, and we are only up to 2015 (starting in 2013) as of October 28th. It's possible we won't be able to get through all of the data through present day before the end of the project.

Visualization Design

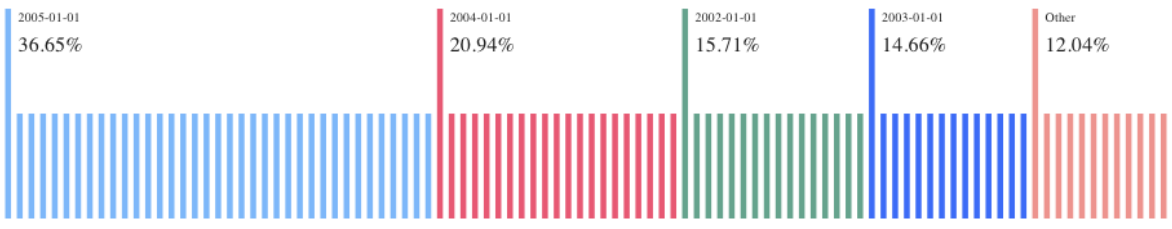
How will you display your data? Provide some general ideas that you have for the visualization design. Develop three alternative prototype designs for your visualization. Create one final design that incorporates the best of your three designs. Describe your designs and justify your choices of visual encodings. We recommend you use the [Five Design Sheet Methodology].

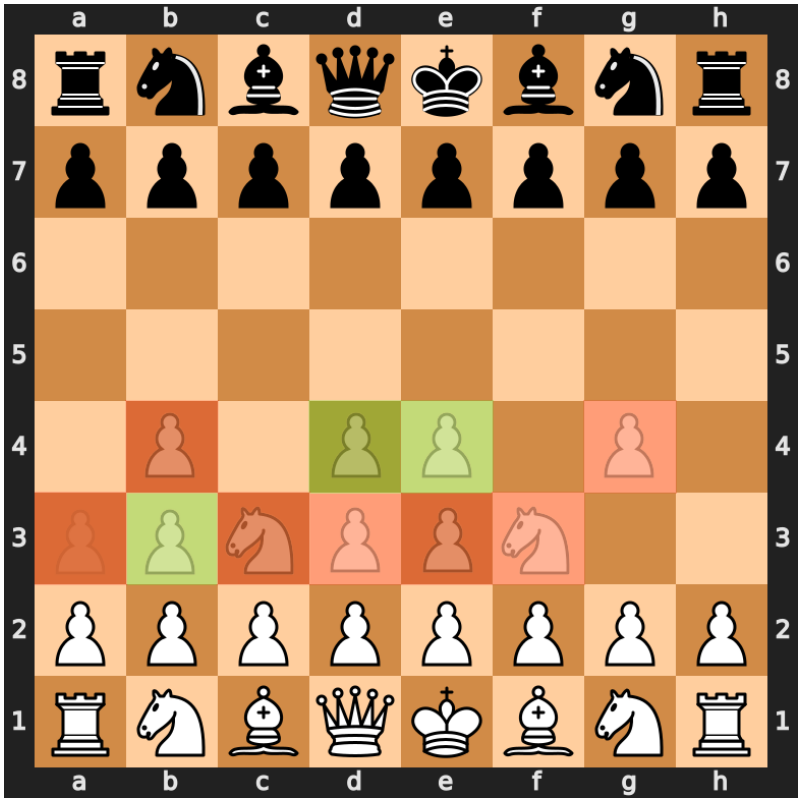
How many turns are in games (Distribution of the ratio of games that end at certain move counts)?

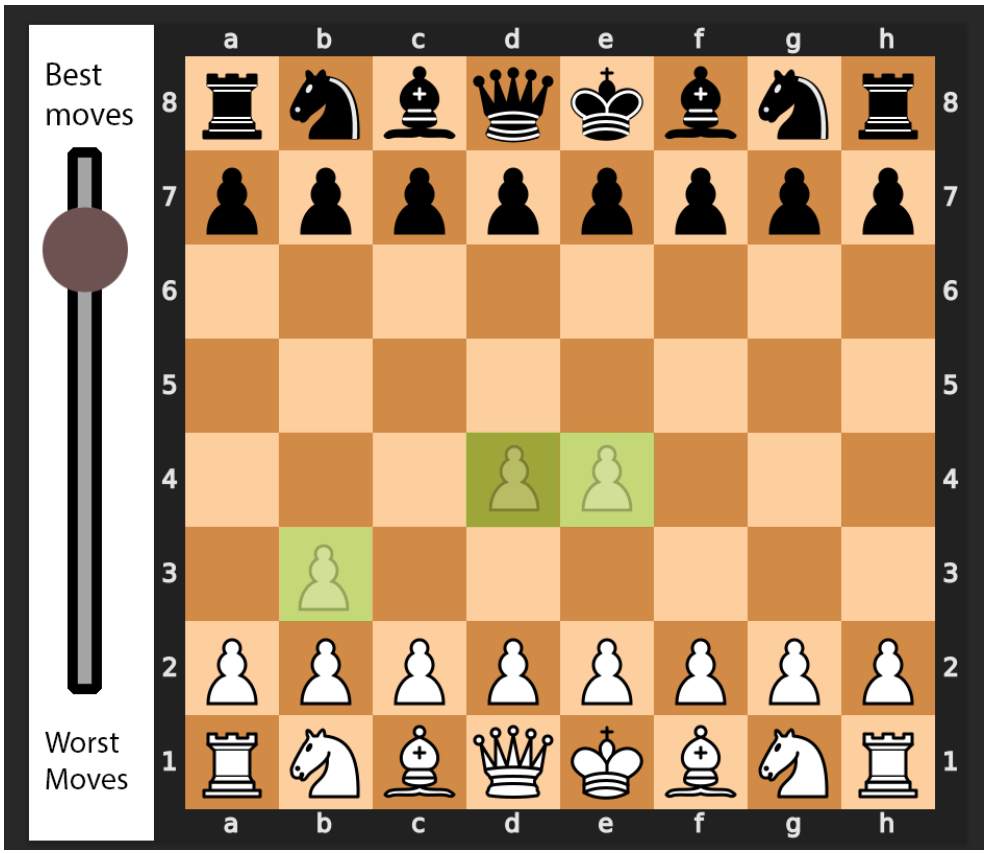


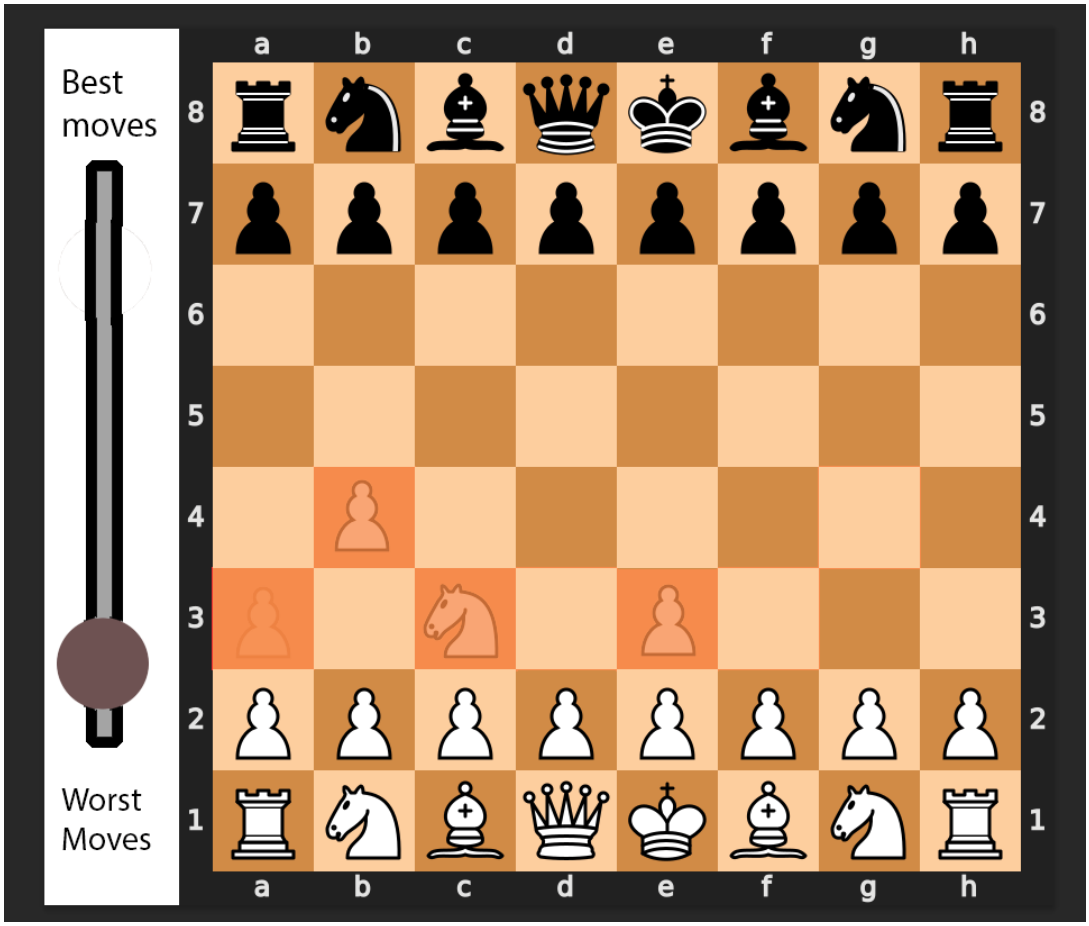

Distribution of the number of moves in completed chess games
Proportion
50
100
150
Moves

Ruler Chart


2005-01-01
36.65%
2004-01-01
20.94%
2002-01-01
15.71%
2003-01-01
14.66%
Other
12.04%


a b c d e f g h
8 7 6 5 4 3 2 1


Best moves
Worst Moves
a b c d e f g h
8 7 6 5 4 3 2 1

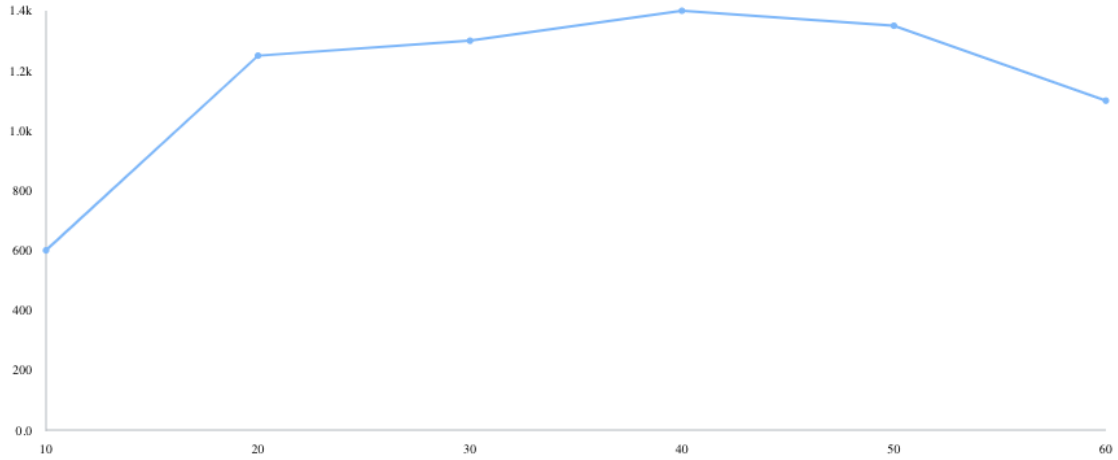


Some visualizations we have might be a heatmap on a chess board, to display “the best openings”, or other interesting stats about chess moves. This can be shown as the opening moves having a red to green tint based on how likely they are to result in a win. We could do multiple boards, perhaps one highlighting all the pawn moves and knight moves in the other. We could also do this with responses from black given a particular white move.

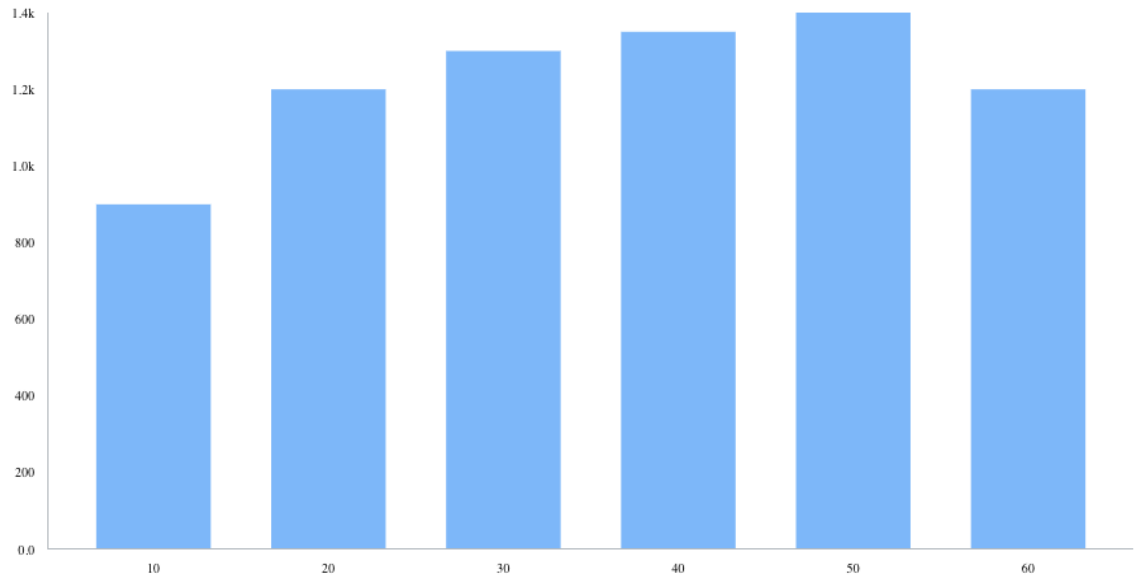
We can add a “Filter by ranking” picker to the side of the chess board visualization, that would allow the user to see what the best opening moves are by ranking.

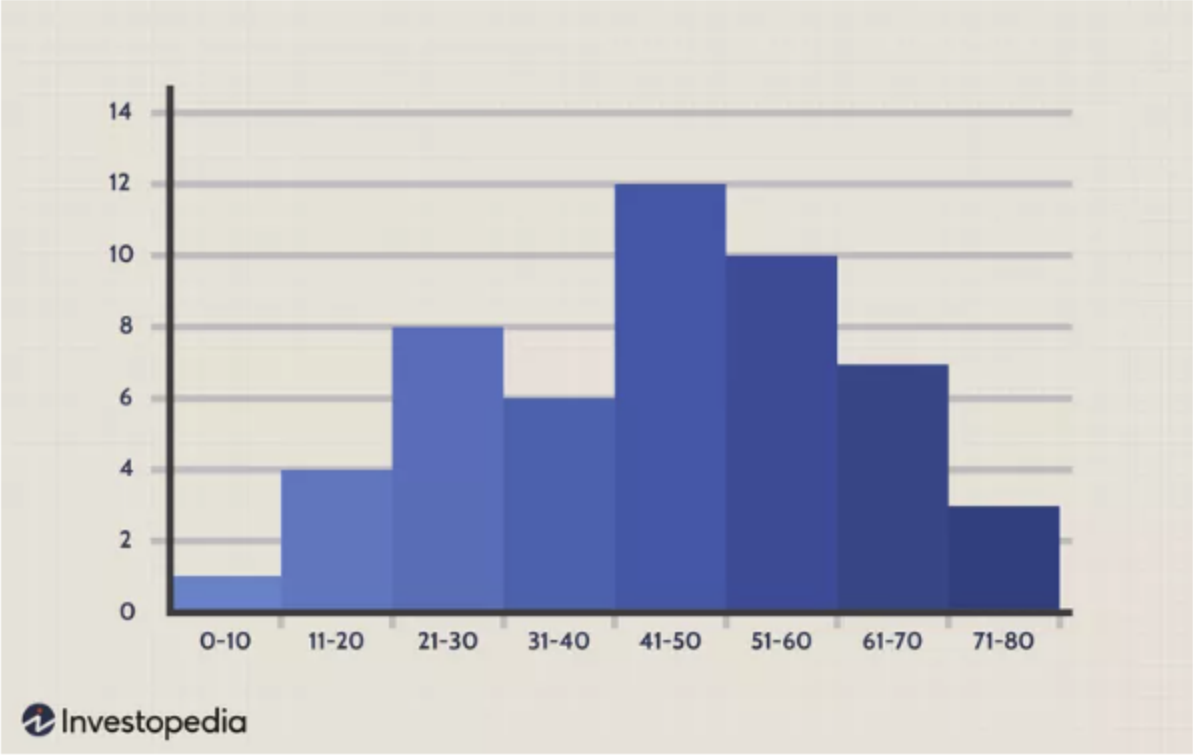
We would also want to use a generic bar/line chart for some of these stats, to visualize the distribution of turn counts, and average rating over the average ages.

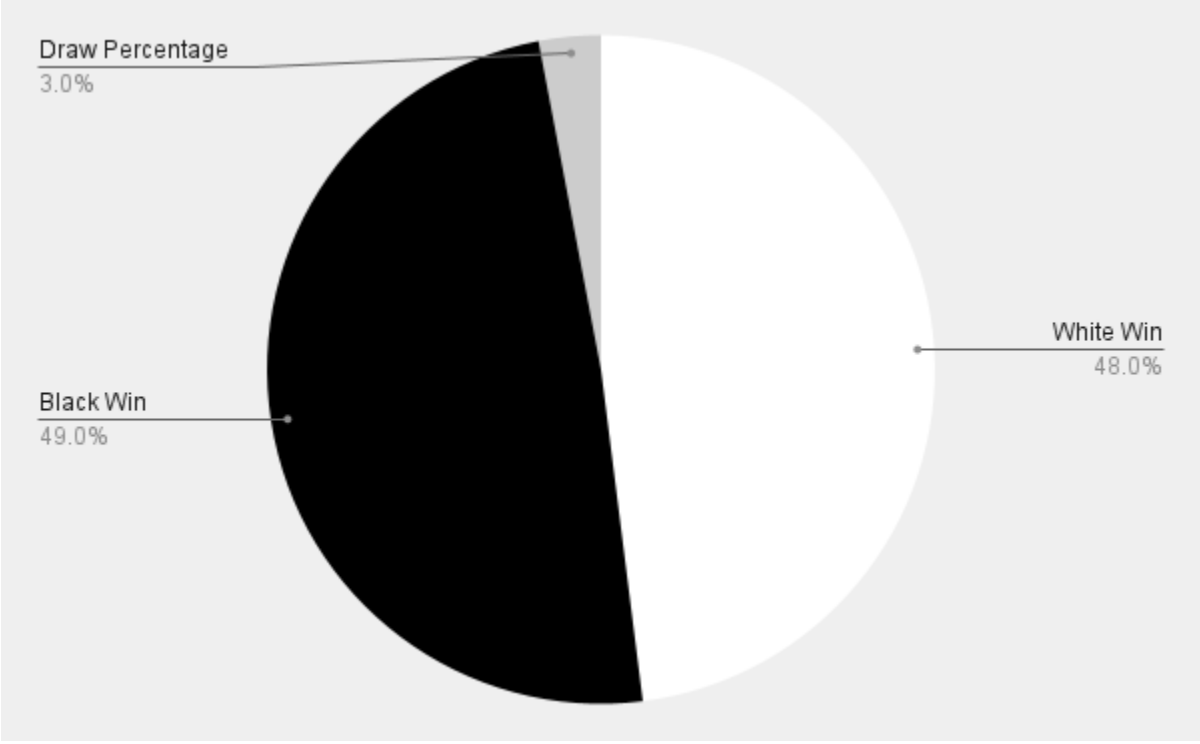
Player Elo by Ages



Average Player Elo by Ages



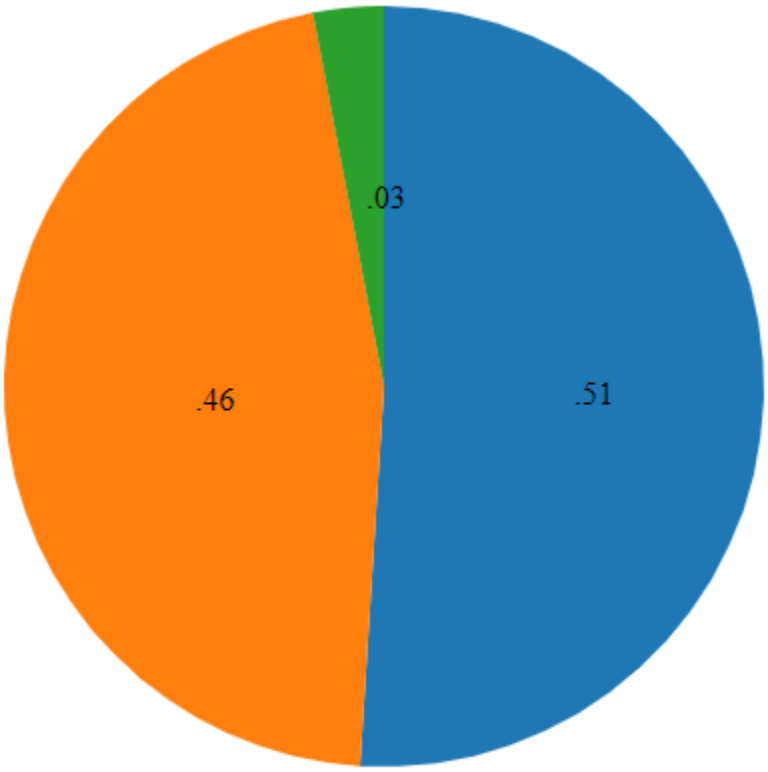

14
12
10
8
6
4
2
0
0-10
11-20
21-30
31-40
41-50
51-60
61-70
71-80
Investopedia


Draw Percentage
3.0%
White Win
48.0%
Black Win
49.0%

Design Evolution

What are the different visualizations you considered? Justify the design decisions you made using the perceptual and design principles you learned in the course. Did you deviate from your proposal?

First iteration of the pie chart!

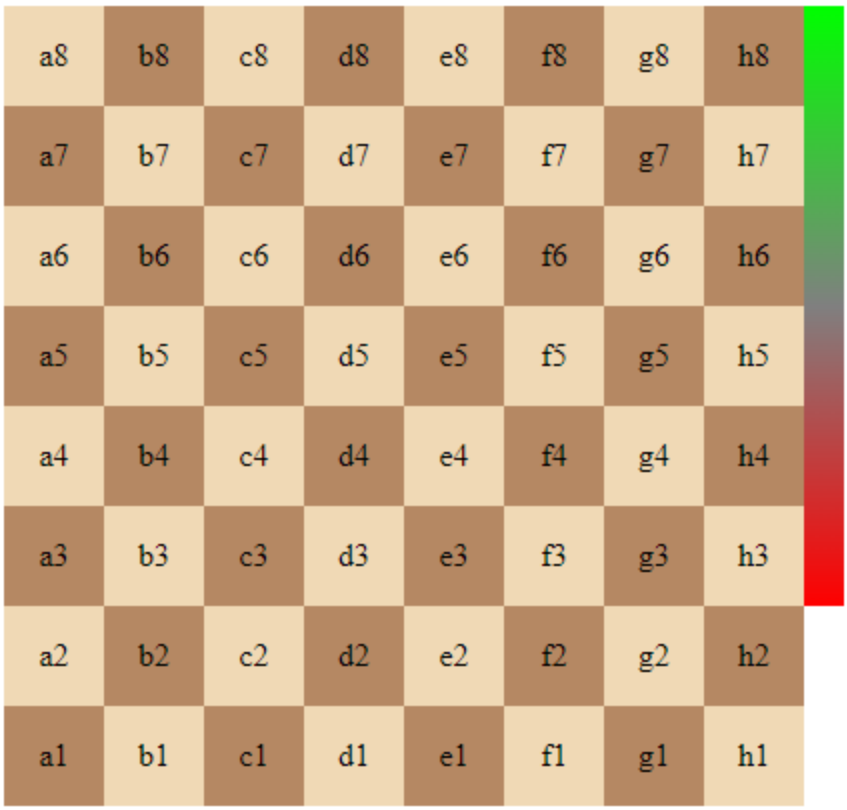


First iteration of the chess board

a8	b8	c8	d8	e8	f8	g8	h8
a7	b7	c7	d7	e7	f7	g7	h7
a6	b6	c6	d6	e6	f6	g6	h6
a5	b5	c5	d5	e5	f5	g5	h5
a4	b4	c4	d4	e4	f4	g4	h4
a3	b3	c3	d3	e3	f3	g3	h3
a2	b2	c2	d2	e2	f2	g2	h2
a1	b1	c1	d1	e1	f1	g1	h1

Chess board with slider

Talking with the TA for our project proposal gave us the idea to show the most popular moves over time periods, as well as to show specific time periods “best moves”



First iteration of aggregated data example


```
 "11, 27": {
   "count": 257,
   "wins": 1
 },
…
```


Current aggregated data format


```
{
 "12, 28": {
   "count": 579,
   "wins": 284,
   "win_percentage": 0.4905008635578584
 },
 "11, 27": {
   "count": 257,
   "wins": 164,
   "win_percentage": 0.6381322957198443
 },
 …
```


Dataframe created to represent each game

	Date	AverageElo	Result	Opening	NumMoves
0	2012.12.31	1521.0	White	French Defense: Normal Variation	25
1	2012.12.31	1786.5	White	Queen's Pawn Game: Colle System, Anti-Colle	35
2	2012.12.31	1695.0	White	Four Knights Game: Italian Variation	21
3	2012.12.31	1898.5	Black	Caro-Kann Defense: Goldman Variation	94
4	2012.12.31	1790.0	Black	French Defense: La Bourdonnais Variation	46
5	2012.12.31	1482.0	White	Owen Defense	63
6	2012.12.31	1520.5	Black	Italian Game: Classical Variation, Giuoco Pianissimo	38
7	2012.12.31	1758.5	White	English Opening: The Whale	55
8	2012.12.31	1307.0	White	Old Benoni Defense	73
9	2012.12.31	1475.0	Black	Englund Gambit Complex: Hartlaub-Charlick Gambit	90
10	2012.12.31	1594.0	Black	Modern Defense	74
11	2012.12.31	1856.0	Black	French Defense: Classical Variation, Richter Attack	93
12	2012.12.31	1734.0	White	Giuoco Piano	49
13	2012.12.31	1471.0	White	Ruy Lopez: Cozio Defense	69
14	2012.12.31	1909.0	Draw	Sicilian Defense: McDonnell Attack	117

[{"Date":"2012.12.31","AverageElo":1521.0,"Result":"White","Opening":"French Defense: Normal Variation","NumMoves":25},

Length of games aggregated data
[
{"length": 53, "frequency": 1877},
{"length": 55, "frequency": 1807},
…

Must-Have Features

List the features without which you would consider your project to be a failure.

Visualizations that answer the following questions
-What is the black vs white win/draw/loss ratio (general population vs professionals)?
-What are the openings with the highest win ratio? Openings with the worst win ratio?
-How many turns are in games (Distribution of the ratio of games that end at certain move counts)? Should look something like this

Optional Features

List the features which you consider to be nice to have, but not critical.

GM questions
-What is the average age that grandmasters achieve their title?
-How many games has the average grandmaster played?
-What is the average IQ of a grandmaster?
-At what age do grandmasters typically start playing chess?

-What is the male to female ratio of chess players?
-What is the average centi-pawn loss per move at different rating levels?
-Where are chess players located?

Average Elo over average age line graph to answer:
-What does the average player's chess rating look like over the course of their lifetime?
-What is the average age of an individual's peak rating achievement?
-How long does it take to improve 100 elo rating points given an individual's current rating?

-Does playing chess exclusively result in a better or worse rating than performing puzzles, and studying games alongside regular play?

Implementation

Describe the intent and functionality of the interactive visualizations you implemented. Provide clear and well-referenced images showing the key design and interaction elements.

#TODO

Project Schedule

Make sure that you plan your work so that you can avoid a big rush right before the final project deadline, and delegate different modules and responsibilities among your team members. Write this in terms of weekly deadlines.

Meeting at 10am every Saturday
Written standup on Wednesday - couple sentences what you're doing, any blockers etc.

Week 4 - Figure out primary data sources, how we want to structure the data, how we're going to use the data to build the visualizations
Week 5 - Collect data and build visualizations for **primary** features
Week 6 - Collect data and build visualizations for **primary** features
Week 7 - Collect data and build visualizations for **optional** features
Week 8 - Fall Break
Week 9 - Finish ui visualizations and retrieving data
Week 10 - Begin using collected data on the visualizations
Week 11 - Finish hooking up data to visualizations
Week 12 - Setup the website, put visualizations with real data there
Week 13 - Website should be "done"
Week 14 - Thanksgiving Break
Week 15 - QA

Things we need to do:
Build ui for visualizations - Solon and Ben
Get data from various API's and downloads, and structure/clean it - Ben and Gavin
Use data to build visualizations we want - Gavin and Ben
Set up basic website to show the visualizations on - Solon and Gavin
Process book - Everyone!

Evaluation

What did you learn about the data by using your visualizations? How did you answer your questions? How well does your visualization work, and how could you further improve it?

#TODO