STA 220 Assignment 1

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Due January 26, 2024 by 11:59pm. Submit your work by uploading it to Gradescope through Canvas.

Instructions:

1. **Provide your solutions in new cells following each exercise description. Create as many new cells as necessary. Use code cells for your Python scripts and Markdown cells for explanatory text or answers to non-coding questions. Answer all textual questions in complete sentences.**
2. **The use of assistive tools is permitted, but must be indicated. You will be graded on you proficiency in coding. Produce high quality code by adhering to proper programming principles.**
3. **Export the .jpynb as .pdf and submit it on Gradescope in time. To facilitate grading, indicate the area of the solution on the submission. Submissions without indication will be marked down. No late submissions accepted.**
4. **If test cases are given, your solution must be in the same format.**
5. **The total number of points is 10.**

Exercise 1

Answer the following questions by querying Lahman Baseball Database. The 2019 version together with the description (`readme2019.txt`) are on Piazza. Answer the following questions.

The purpose of this assignment is to practice accessing and analyzing data in a database. For full credit for (a) and (b), query the correct table with `pandas.read_sql` and a single SQL query. Unless otherwise specified, return in the same format of the test case.

(a, i) Which pitcher has the second most home runs allowed in the American League? (ii) Which pitcher has the worst home runs allowed per game ratio?

In [114]:

```
import numpy as np
import pandas as pd
import sqlite3 as sql

import io
import geopandas as gpd
import matplotlib.pyplot as plt
from mpl_toolkits.axes_grid1 import make_axes_locatable
import warnings
warnings.filterwarnings("ignore")
import time
```

In [71]:

```
db = sql.connect("lahmansbaseballdb.sqlite")
db
```

Out[71]:

```
<sqlite3.Connection at 0x13cf846d0>
```

Printing the tables present in the database, because some of the tables are not present in README.txt

In [5]:

```
pd.read_sql("SELECT * FROM sqlite_master WHERE type = 'table'", db)
```

Out[5]:

	type	name	tbl_name	rootpage	sql
0	table	allstarfull	allstarfull	2	CREATE TABLE "allstarfull" (\n\t"ID" INTEGER N...
1	table	appearances	appearances	151	CREATE TABLE "appearances" (\n\t"ID" INTEGER N...
2	table	awardsmanagers	awardsmanagers	3436	CREATE TABLE "awardsmanagers" (\n\t"ID" INTEGE...
3	table	awardsplayers	awardsplayers	3445	CREATE TABLE "awardsplayers" (\n\t"ID" INTEGER...
4	table	awardssharemanagers	awardssharemanagers	3603	CREATE TABLE "awardssharemanagers" (\n\t"ID" I...
5	table	awardsshareplayers	awardsshareplayers	3622	CREATE TABLE "awardsshareplayers" (\n\t"ID" IN...
6	table	batting	batting	3757	CREATE TABLE "batting" (\n\t"ID" INTEGER NOT N...
7	table	battingpost	battingpost	6554	CREATE TABLE "battingpost" (\n\t"ID" INTEGER N...
8	table	collegeplaying	collegeplaying	7006	CREATE TABLE "collegeplaying" (\n\t"ID" INTEGE...
9	table	divisions	divisions	7282	CREATE TABLE "divisions" (\n\t"ID" INTEGER NOT...
10	table	fielding	fielding	7285	CREATE TABLE "fielding" (\n\t"ID" INTEGER NOT ...
11	table	fieldingof	fieldingof	10906	CREATE TABLE "fieldingof" (\n\t"ID" INTEGER NO...
12	table	fieldingofsplit	fieldingofsplit	11052	CREATE TABLE "fieldingofsplit" (\n\t"ID" INTEG...
13	table	fieldingpost	fieldingpost	11878	CREATE TABLE "fieldingpost" (\n\t"ID" INTEGER ...
14	table	halloffame	halloffame	12236	CREATE TABLE "halloffame" (\n\t"ID" INTEGER NO...
15	table	homegames	homegames	12316	CREATE TABLE "homegames" (\n\t"ID" INTEGER NOT...
16	table	leagues	leagues	12408	CREATE TABLE "leagues" (\n\t"lgID" CHARACTER(2...
17	table	managers	managers	12410	CREATE TABLE "managers" (\n\t"ID" INTEGER NOT ...
18	table	managershalf	managershalf	12504	CREATE TABLE "managershalf" (\n\t"ID" INTEGER ...
19	table	parks	parks	12508	CREATE TABLE "parks" (\n\t"ID" INTEGER NOT NUL...
20	table	people	people	12513	CREATE TABLE "people" (\n\t"playerID" VARCHAR(...
21	table	pitching	pitching	13457	CREATE TABLE "pitching" (\n\t"ID" INTEGER NOT ...
22	table	pitchingpost	pitchingpost	15025	CREATE TABLE "pitchingpost" (\n\t"ID" INTEGER ...
23	table	salaries	salaries	15209	CREATE TABLE "salaries" (\n\t"ID" INTEGER NOT ...
24	table	schools	schools	15903	CREATE TABLE "schools" (\n\t"schoolID" VARCHAR...
25	table	seriespost	seriespost	15928	CREATE TABLE "seriespost" (\n\t"ID" INTEGER NO...
26	table	teams	teams	15939	CREATE TABLE "teams" (\n\t"ID" INTEGER NOT NUL...
27	table	teamsfranchises	teamsfranchises	16111	CREATE TABLE "teamsfranchises" (\n\t"franchID"...
28	table	teamshalf	teamshalf	16113	CREATE TABLE "teamshalf" (\n\t"ID" INTEGER NOT...

(a, i) Which pitcher has the second most home runs allowed in the American League?

In [11]:

```
# Based on the given definition of home runs allowed, I added the homeruns of a player an
d stored it in the variable `hra`
# Since we want the players of 'American League' and the joining factor of pitching table
and leagues table is lgID (league ID),
# I used INNER JOIN to join pitching, leagues and people table to get name of the player
and then sorted the values using hra in reverse
# order
# `OFFSET 1` is used to get the pitcher who has the second most home runs allowed in the
American League

result = pd.read_sql('''
SELECT SUM(HR) AS hra, *
FROM pitching
INNER JOIN
```

```
people ON people.playerID = pitching.playerID
INNER JOIN
leagues ON leagues.lgID = pitching.lgID
WHERE leagues.league = 'American League'
GROUP BY pitching.playerID
ORDER BY hra desc
LIMIT 1
OFFSET 1
''', db).squeeze()
print(result['nameFirst'] + " " + result['nameLast'] + " (" + str(result["hra"]) + ")")
```

```
Tim Wakefield (401)
```

(a ii) Which pitcher has the worst home runs allowed per game ratio?

In [91]:

```
# I'm joining tables pitching, leagues and people based on the same logic explained above
# Here since we want worst home runs allowed per game ratio, I am calculating this value
by dividing hra with the number of games
# played by the pitcher
# worst home runs for a pitcher would be maximum of Home_runs_allowed/number of games

results = pd.read_sql('''
SELECT SUM(pitching.HR)/sum(pitching.G) AS hra_ratio, *
FROM
pitching INNER JOIN people
ON
people.playerID = pitching.playerID
INNER JOIN leagues
ON
leagues.lgID = pitching.lgID
WHERE leagues.league = 'American League'
GROUP BY pitching.playerID
HAVING hra_ratio = (SELECT MAX(hra_ratio) FROM (
        SELECT SUM(HR) / SUM(G) AS hra_ratio
        FROM pitching
        INNER JOIN leagues ON leagues.lgID = pitching.lgID
        WHERE leagues.league = 'American League'
        GROUP BY pitching.playerID
    ) AS max_hra_ratio)
ORDER BY hra_ratio desc
''', db).squeeze()

for index, result in results.iterrows():
    print(result['nameFirst'] + " " + result['nameLast'] + " (" + str(result["hra_ratio"
]) + ")")
```

```
Chris Booker (3)
Manny Castillo (3)
Beiker Graterol (3)
Brett Jodie (3)
Bob Malloy (3)
Ralph McCabe (3)
Sam Narron (3)
John Perkovich (3)
Ryan Snare (3)
```

In [92]:

```
# To print any one player:
print(results.iloc[-1]['nameFirst'] + " " + results.iloc[-1]['nameLast'] + " (" + str(re
sults.iloc[-1]["hra_ratio"]) + ")")
```

```
Ryan Snare (3)
```

(b, i) Amongst all players in the American League that have passed, report their average lifespan in full years. (ii) Return the six schools with most hall-of-fame alumni. (iii) What fraction of managers have not been professional players?

(b, i) Amongst all players in the American League that have passed, report their average lifespan in full years.

In [142]:

```
# average lifespan for passed players in the American League

# In order to get all the players in American League, I'm searching for all the players w
ho might be present in pitching, batting
# fielding table
# Then calculating the span by substracting the year they were born in from the year they
passed away

print(f"The average lifespan in full years in the American League:")
pd.read_sql('''
SELECT CEILING(AVG(deathYear - birthYear))
FROM people
WHERE
playerID IN (
SELECT playerID
FROM pitching
INNER JOIN
leagues ON
leagues.lgID = pitching.lgID
WHERE leagues.league = 'American League'
)
OR
playerID IN (
SELECT playerID
FROM batting
INNER JOIN
leagues ON
leagues.lgID = batting.lgID
WHERE leagues.league = 'American League'
)
OR
playerID IN (
SELECT playerID
FROM fielding
INNER JOIN
leagues ON
leagues.lgID = fielding.lgID
WHERE leagues.league = 'American League'
)
AND
deathYear > 0
''', db).squeeze()
```

```
The average lifespan in full years in the American League:
```

Out[142]:

```
71.0
```

(b ii) Return the six schools with most hall-of-fame alumni.

In [140]:

```
#Return the six schools with most hall-of-fame alumni.

# 1) Grouped the data by schoolID to count hall-of-fame alumni for each school
# 2) Ordered the results by the count of hall-of-fame alumni in descending order
# 3) RetrieveD information for the top six schools with the most hall-of-fame alumni
# Here I used DISTINCT keyword to avoid duplicates that may form while joining the tables


result = pd.read_sql('''
SELECT count(DISTINCT collegeplaying.playerID) as cnt, schools.name_full
FROM schools
INNER JOIN
collegeplaying
```

```
ON schools.schoolID = collegeplaying.schoolID
WHERE collegeplaying.playerID IN (
    SELECT DISTINCT playerID FROM halloffame
)
GROUP BY schools.schoolID
ORDER BY cnt desc
LIMIT 6
''', db).squeeze()
result
```

Out[140]:

	cnt	name_full
0	13	University of Southern California
1	8	Arizona State University
2	6	University of California, Los Angeles
3	6	University of Michigan
4	6	University of Miami
5	5	University of Texas at Austin

I've added a filter for 'inducted' = 'Y' to align with the definition of induction found on Google, indicating a person listed in the hall of fame through a voting process. However, it's worth noting that 'inducted' = 'N' might imply inclusion in the hall of fame through other means, as clarification is lacking in the readme.txt file. This adjustment ensures accuracy while considering potential variations in the data.

In [141]:

```
# This SQL query retrieves data related to the count of distinct player IDs from the 'col
legeplaying' table who are inducted into `
# the hall of fame ('halloffame'). The results are grouped by school, ordered by the coun
t in descending order, and limited to the
# top 6 schools.

result = pd.read_sql('''
SELECT count(DISTINCT collegeplaying.playerID) as cnt, schools.name_full
FROM schools
INNER JOIN
collegeplaying
ON schools.schoolID = collegeplaying.schoolID
WHERE collegeplaying.playerID IN (
    SELECT DISTINCT playerID
    FROM halloffame
    WHERE
    inducted = 'Y'
)
GROUP BY schools.schoolID
ORDER BY cnt desc
LIMIT 6
''', db).squeeze()
result
```

Out[141]:

	cnt	name_full
0	3	University of Southern California
1	2	St. Bonaventure University
2	2	San Diego State University
3	2	University of Minnesota
4	2	University of Michigan
5	2	Miami-Dade College, North Campus

INCLUDING THE FOLLOWING CODE JUST FOR THE SAFETY, TO AVAOID CONFUSION WITH THE EXPECTED OUTPUT

In [97]:

```
#Return the six schools with most hall-of-fame alumni.

result = pd.read_sql('''
SELECT count(halloffame.playerID) as cnt, schools.name_full
FROM halloffame
INNER JOIN
collegeplaying
ON collegeplaying.playerID = halloffame.playerID
INNER JOIN
schools
ON schools.schoolID = collegeplaying.schoolID
GROUP BY schools.schoolID
ORDER BY cnt desc
LIMIT 6
''', db).squeeze()
result.head(30)
```

Out[97]:

	cnt	name_full
0	64	University of Southern California
1	63	Concordia Theological Seminary
2	60	Eastern Kentucky University
3	56	University of Alabama
4	56	Oklahoma State University
5	46	University of Notre Dame

(b iii) What fraction of managers have not been professional players?

In [145]:

```
# A manager would not be a professional player if the manager's playerID is not present i
n batting, pitching and fielding tables
# Using this logic, I calculated the number of such playerIDs from the manager's table as
c1 (Again, using DISTINCT keyword to avoid duplicates
# that may be generated while taking playerIDs from three different tables)
# I also calculated the total number of managers as c2 from managers table. (DISTINCT key
word is used because a single manager may be managing
# multiple teams and may be present multiple times)
# then I divided c1 with c2 to calculate the ratio

print(f"Fraction of managers who have not been professional players: ")
result = pd.read_sql('''
SELECT c1*1.0 / c2*1.0 FROM
((SELECT count(DISTINCT playerID) AS c1 FROM managers
WHERE
playerID NOT IN (SELECT playerID FROM batting)
AND
playerID NOT IN (SELECT playerID FROM pitching)
AND
playerID NOT IN (SELECT playerID FROM fielding)) ,
(SELECT count(DISTINCT playerID) AS c2 FROM managers))
''', db).squeeze()
result
```

```
Fraction of managers who have not been professional players:
```

Out[145]:

```
0.17507002801120447
```

(c) Create a world map with a color gradient corresponding to the log-number of players per country in the data set. Use `pandas.read_html` to retrieve the ISO codes from wikipedia, and merge those records as good as you can. Match no more than ten countries to their ISOs manually.

In [66]:

```
# Scraping data from Wikipedia page containing ISO 3166 country codes
tables = pd.read_html("https://en.wikipedia.org/wiki/List_of_ISO_3166_country_codes")[0]

# Selecting specific columns ('ISO 3166[1]', 'Country name[5]') and ('ISO 3166-1[2]', 'A-3 [5]')
df = tables.loc[:, [('ISO 3166[1]', 'Country name[5]'), ('ISO 3166-1[2]', 'A-3 [5]')]]

# Renaming the columns for clarity
df.columns = ['country_name', 'Code']

# Cleaning the 'country_name' column by removing square brackets, parentheses, and leading/trailing whitespaces
df['country_name'] = df['country_name'].str.replace(r'\[.*\]', '', regex=True).str.replace(r'\(.*\)', '', regex=True).str.strip()

# 1) Selecting the logarithm of the count of playerID as log, birthCountry as country_name, and count of playerId as cnt
# 2) Filtering out rows where birth country is NULL
# 3) Grouping the results by birth country
result = pd.read_sql('''
SELECT LOG(count(playerID)) as log, birthCountry as country_name, count(playerId) as cnt
FROM people
WHERE country_name IS NOT NULL
GROUP BY country_name
''', db).squeeze()

# Merging the player statistics DataFrame with the ISO 3166 country codes DataFrame based on the 'country_name' column
merged_df = pd.merge(result, df, on = 'country_name', how = 'left')
merged_df
```

Out[66]:

	log	country_name	cnt	Code
0	0.000000	Afghanistan	1	AFG
1	0.000000	American Samoa	1	ASM
2	0.698970	Aruba	5	ABW
3	0.000000	At Sea	1	NaN
4	1.491362	Australia	31	AUS
5	0.602060	Austria	4	AUT
6	0.778151	Bahamas	6	BHS
7	0.000000	Belgium	1	BEL
8	0.000000	Belize	1	BLZ
9	0.698970	Brazil	5	BRA
10	2.406540	CAN	255	NaN
11	0.000000	China	1	CHN
12	1.380211	Colombia	24	COL
13	2.338456	Cuba	218	CUB
14	1.176091	Curacao	15	NaN
15	0.778151	Czech Republic	6	NaN
16	2.881385	D.R.	761	NaN
17	0.000000	Denmark	1	DNK

	log	country_name	cnt	Code
18	0.000000	Finland	1	FIN
19	0.845098	France	7	FRA
20	1.653213	Germany	45	DEU
21	0.000000	Greece	1	GRC
22	0.301030	Guam	2	GUM
23	0.301030	Honduras	2	HND
24	0.000000	Hong Kong	1	HKG
25	0.000000	Indonesia	1	IDN
26	1.698970	Ireland	50	IRL
27	0.845098	Italy	7	ITA
28	0.602060	Jamaica	4	JAM
29	1.826075	Japan	67	JPN
30	0.000000	Latvia	1	LVA
31	0.000000	Lithuania	1	LTU
32	2.110590	Mexico	129	MEX
33	1.079181	Netherlands	12	NaN
34	1.176091	Nicaragua	15	NIC
35	0.477121	Norway	3	NOR
36	2.428135	P.R.	268	NaN
37	1.799341	Panama	63	PAN
38	0.000000	Peru	1	PER
39	0.000000	Philippines	1	PHL
40	0.698970	Poland	5	POL
41	0.000000	Portugal	1	PRT
42	0.954243	Russia	9	NaN
43	0.301030	Saudi Arabia	2	SAU
44	0.000000	Singapore	1	SGP
45	0.000000	Slovakia	1	SVK
46	0.301030	South Africa	2	ZAF
47	1.361728	South Korea	23	NaN
48	0.602060	Spain	4	ESP
49	0.602060	Sweden	4	SWE
50	0.000000	Switzerland	1	CHE
51	1.204120	Taiwan	16	TWN
52	4.236890	USA	17254	NaN
53	1.707570	United Kingdom	51	NaN
54	1.146128	V.I.	14	NaN
55	2.610660	Venezuela	408	VEN
56	0.000000	Viet Nam	1	VNM

In [67]:

```
# Filtering rows in the DataFrame 'merged_df' where the 'Code' column is NaN

merged_df[merged_df['Code'].isna()]
```

Out[67]:

	log	country_name	cnt	Code
3	0.000000	At Sea	1	NaN
10	2.406540	CAN	255	NaN
14	1.176091	Curacao	15	NaN
15	0.778151	Czech Republic	6	NaN
16	2.881385	D.R.	761	NaN
33	1.079181	Netherlands	12	NaN
36	2.428135	P.R.	268	NaN
42	0.954243	Russia	9	NaN
47	1.361728	South Korea	23	NaN
52	4.236890	USA	17254	NaN
53	1.707570	United Kingdom	51	NaN
54	1.146128	V.I.	14	NaN

In [69]:

```
# Since there are 12 such columns whose iso code could not be matched using code,
# I'm manually mapping 10 countries, because 2 out of 12 country's code wasn't present in
wikipedia page.

manual_iso_mapping = {
    'CAN' : 'CAN',
    'Curacao': 'CUW',
    'Czech Republic': 'CZE',
    'France': 'FRA',
    'Netherlands': 'NLD',
    'Russia': 'RUS',
    'USA': 'USA',
    'United Kingdom': 'GBR',
    'V.I.': 'VIR',
    'South Korea': 'KOR'
}

# Checking the exact column name in merged_df
code_column_name = 'Code'  # Replacing with the correct column name

# Updating the 'Code' column based on the manual ISO mappings
for country, iso_code in manual_iso_mapping.items():
    merged_df.loc[merged_df['country_name'] == country, code_column_name] = iso_code

# Printing the modified DataFrame
merged_df
```

Out[69]:

	log	country_name	cnt	Code
0	0.000000	Afghanistan	1	AFG
1	0.000000	American Samoa	1	ASM
2	0.698970	Aruba	5	ABW
3	0.000000	At Sea	1	NaN
4	1.491362	Australia	31	AUS
5	0.602060	Austria	4	AUT
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7	0.000000	Belgium	1	BEL
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9	0.698970	Brazil	5	BRA
10	2.406540	CAN	255	CAN

	log	country_name	cnt	Code
11	0.000000	Chile	1	CHL
12	1.380211	Colombia	24	COL
13	2.338456	Cuba	218	CUB
14	1.176091	Curacao	15	CUW
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16	2.881385	D.R.	761	NaN
17	0.000000	Denmark	1	DNK
18	0.000000	Finland	1	FIN
19	0.845098	France	7	FRA
20	1.653213	Germany	45	DEU
21	0.000000	Greece	1	GRC
22	0.301030	Guam	2	GUM
23	0.301030	Honduras	2	HND
24	0.000000	Hong Kong	1	HKG
25	0.000000	Indonesia	1	IDN
26	1.698970	Ireland	50	IRL
27	0.845098	Italy	7	ITA
28	0.602060	Jamaica	4	JAM
29	1.826075	Japan	67	JPN
30	0.000000	Latvia	1	LVA
31	0.000000	Lithuania	1	LTU
32	2.110590	Mexico	129	MEX
33	1.079181	Netherlands	12	NLD
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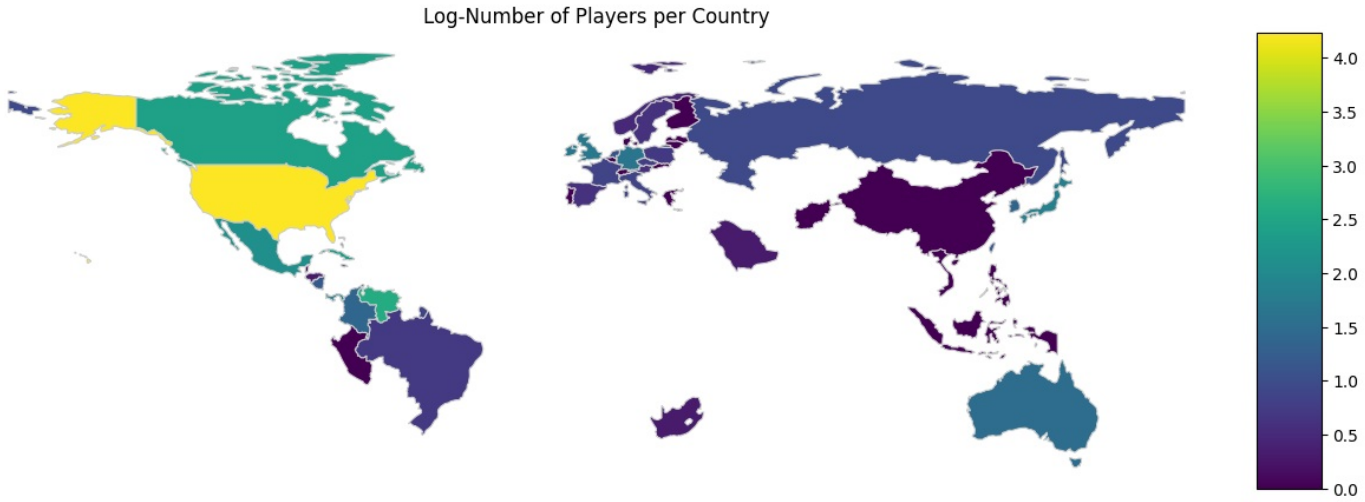
35	0.477121	Norway	3	NOR
36	2.428135	P.R.	268	NaN
37	1.799341	Panama	63	PAN
38	0.000000	Peru	1	PER
39	0.000000	Philippines	1	PHL
40	0.698970	Poland	5	POL
41	0.000000	Portugal	1	PRT
42	0.954243	Russia	9	RUS
43	0.301030	Saudi Arabia	2	SAU
44	0.000000	Singapore	1	SGP
45	0.000000	Slovakia	1	SVK
46	0.301030	South Africa	2	ZAF
47	1.361728	South Korea	23	KOR
48	0.602060	Spain	4	ESP
49	0.602060	Sweden	4	SWE
50	0.000000	Switzerland	1	CHE
51	1.204120	Taiwan	16	TWN
52	4.236890	USA	17254	USA
53	1.707570	United Kingdom	51	GBR
54	1.146128	V.I.	14	VIR
55	2.610660	Venezuela	408	VEN

	log	country_name	cnt	Code
56	0.000000	Viet Nam	1	VNM

In [70]:

```
# 1) Selecting the logarithm of the count of playerID as log, birthCountry, and count of
playerId as cnt
# 2) Excluding rows where birth country is NULL
# 3) Grouping the results by birth country

result = pd.read_sql('''
SELECT LOG(count(playerID)) as log, birthCountry, count(playerId) as cnt
FROM people
WHERE birthCountry IS NOT NULL
GROUP BY birthCountry
''', db).squeeze()


# Assuming 'world' is a GeoDataFrame with world country boundaries
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))

# Merging data with GeoDataFrame
merged_data = world.merge(merged_df, how='left', left_on='iso_a3', right_on='Code')
# merged_data['log'] = merged_data['log'].fillna(-1)

# Creating the map
fig, ax = plt.subplots(1, 1, figsize=(15, 10))
divider = make_axes_locatable(ax)
cax = divider.append_axes("right", size="5%", pad=0.1)

# Plotting the map with a color gradient
merged_data.plot(column='log', cmap='viridis', linewidth=0.8, ax=ax, edgecolor='0.8', le
gend=True, cax=cax)

# Customizing plot
ax.set_title('Log-Number of Players per Country')
ax.set_axis_off()

# Showing the plot
plt.show()
```



In [152]:

```
# Closing the database connection
db.close()
```

Exercise 2

We will use the [lichess](#) API to retrieve some information about the current state of chess in the world. In order to answer below questions, make precise and economical requests. You may use:

```
import requests
import json
```

```
import pandas

from datetime import datetime
```

In [100]:

```
# Importing the required libraries

import requests
import json
import pandas

from datetime import datetime
import json
import io
```

(a) What is the real name of the leader of the blitz leaderboard?

In [104]:

```
# Making a GET request to the Lichess API to retrieve the top player in the blitz leaderb
oard
response = requests.get("https://lichess.org/api/player/top/1/blitz")

# Parsing the response as JSON to obtain the leaderboard data
leaderboard = response.json()

# Extracting the Lichess user ID of the top player from the leaderboard data
leaderboard['users'][0]['id']

# Defining the URL for the Lichess API to retrieve user information
url = "https://lichess.org/api/users"

# Replacing with the actual user IDs separated by commas
user_ids = leaderboard['users'][0]['id']

# Making the POST request with the user IDs in the request body
response = requests.post(url, data=user_ids)

# Raising an exception if the request was not successful
response.raise_for_status()

# Parsing the response as JSON to obtain user information
result = response.json()

# Printing the real name of the top player in the blitz leaderboard
print(f"Real name of the leader of the blitz leaderboard: '{result[0]['profile']['firstNa
me']} {result[0]['profile']['lastName']}'")
```

```
Real name of the leader of the blitz leaderboard: 'Vladislav Artemiev'
```

(b, i) Get the username of the last player that played a rapid game against user `athena-pallada`. (ii) In all games against this user, how many times did `athena-pallada` win? ***(Provide code that answers the question in case more than just a single game is returned)***

In [111]:

```
# This function, ndjson_to_list, takes an NDJSON (Newline Delimited JSON) string as input
and converts it into a list of dictionaries.
# It uses the io.StringIO class to simulate a file-like object and the json.loads() metho
d to parse each line of the NDJSON string.
# The comments provide a clear explanation of each step within the function.

def ndjson_to_list(ndjson_string):
    # Creating a list to store parsed JSON objects
    parsed_objects = []
```

```
    # Using StringIO to simulate a file-like object
    buffer = io.StringIO(ndjson_string)

    # Iterating through lines in the ndjson string
    for line in buffer:
        # Parsing each line and append the result to the list
        parsed_objects.append(json.loads(line))

    return parsed_objects
```

(b, i) Get the username of the last player that played a rapid game against user `athena-pallada`.

In [113]:

```
# Initializing an empty string variable to store the answer
answer = ""

# Defining the URL for retrieving the latest rapid game played by the user 'athena-pallad
a'
url = "https://lichess.org/api/games/user/athena-pallada"

# Setting parameters for the API request, specifying the performance type as 'rapid' and
maximum number of games as 1 beacuse
# the results retrieved are sorted by deafult giving the information about the latest gam
e played
params = {
    "perfType" : "rapid",
    "max": 1
}

# Specifying headers to accept the response in x-ndjson format
headers = {'Accept': 'application/x-ndjson'}

# Making the POST request with the user IDs in the request body
response = requests.get(url, params = params, headers = headers)

# Converting x-ndjson to list of dictionaries
parsed_objects = ndjson_to_list(response.text)

# Sorting the list of games based on the 'lastMoveAt' timestamp in reverse order
sorted_answer = sorted(parsed_objects, key=lambda x: x['lastMoveAt'], reverse=True)

# Determining the opponent's username based on the color of the player in the latest game
if sorted_answer[0]['players']['white']['user']['name'] != 'athena-pallada':
    answer = sorted_answer[0]['players']['white']['user']['name']
else:
    answer = sorted_answer[0]['players']['black']['user']['name']

print(f"The username of the last player that played a rapid game against user `athena-pal
lada` is '{answer}'")
```

```
The username of the last player that played a rapid game against user `athena-pallada` is
'Bacio129'
```

(b ii) In all games against this user, how many times did `athena-pallada` win? *(Provide code that answers the question in case more than just a single game is returned)*

In [144]:

```
# Constructing the URL for the Lichess API to retrieve the crosstable information for gam
es between 'athena-pallada' and the latest opponent
url = f"https://lichess.org/api/crosstable/athena-pallada/{answer}"

# Making a GET request to the Lichess API with additional parameters for matchup informat
ion
response = requests.get(url, params = {
    "matchup" : True,
})
```

```
# Raising an exception if the request was not successful
response.raise_for_status()

# Parsing the response as JSON to obtain crosstable information
result = response.json()

# Extracting and printing the username of the last player that played a rapid game agains
t user 'athena-pallada'
print(f"In all games against `Bacio129`, `athena-pallada` won '{result['users']['athena-p
allada']}' times")
```

```
In all games against `Bacio129`, `athena-pallada` won '2' times
```

(c) Consider the top ten players in the bullet leaderboard. (i) Which player has the most bullet games overall? (ii) Which player has played the most bullet games relative to account age in days? (iii) Which player has the worst win-to-loss ratio over all formats?

In [120]:

```
# Defining the URL for the Lichess API to retrieve the top 10 players in bullet
url = "https://lichess.org/api/player/top/10/bullet"

# Making a GET request to the Lichess API to get the top 10 players
response = requests.get(url)

# Raising an exception if the request was not successful
response.raise_for_status()

# Parsing the response as JSON to obtain player information
result = response.json()

# Extract relevant data and creating a DataFrame (df1)
data = [
    {'id': user['id'], 'username': user['username'],
     'rating': user['perfs']['bullet']['rating'] if 'perfs' in user and 'bullet' in user
['perfs'] else None,
     'progress': user['perfs']['bullet']['progress'] if 'perfs' in user and 'bullet' in
user['perfs'] else None,
    }
    for user in result['users']
]

df1 = pd.DataFrame(data)

##########################################################################################
############################

# Initializing an empty list to store individual performance data
data = []


# Iterating through rows of df1 and making API requests to get individual performance sta
tistics
for index, row in df1.iterrows():
    # Introducing a small delay to avoid rate limiting
    time.sleep(0.05)
    response = requests.get(f"https://lichess.org/api/user/{row['username']}/perf/bullet"
)

    result = response.json()
    user_data = {
        'username': row['username'],
        'win': result['stat']['count']['win'],
        'loss': result['stat']['count']['loss'],
        'all': result['stat']['count']['all']
    }
    data.append(user_data)

# Creating a new DataFrame (df2) with individual performance data
df2 = pd.DataFrame(data)
```

```
##############################################################################################
############################

# Merging the two DataFrames on the 'username' column
merged_df = pd.merge(df1, df2, on='username')

##############################################################################################
############################

# Initializing an empty list to store additional user data
data = []

# Defining the URL for retrieving detailed user information
url = "https://lichess.org/api/users"

# Iterating through rows of merged_df and making API requests to get detailed user inform
ation
for index, row in merged_df.iterrows():
    # Introducing a small delay to avoid rate limiting
    time.sleep(0.05)
    response = requests.post(url, row['id'])

    result = response.json()
    user_data = {
        'username': row['username'],
        'createdAt': result[0]['createdAt'],
    }
    data.append(user_data)

# Creating a new DataFrame (df3) with additional user data
df3 = pd.DataFrame(data)

##############################################################################################
############################
# Merging the two DataFrames on the 'username' column to create final dataframe
final_df = pd.merge(merged_df, df3, on='username')
final_df
```

Out[120]:

	id	username	rating	progress	win	loss	all	createdAt
0	ediz_gurel	Ediz_Gurel	3301	26	3378	1475	5259	1678897786697
1	redwarrior25	RedWarrior25	3223	-20	576	128	739	1559415053040
2	mishka_the_great	Mishka_The_Great	3204	20	36665	21636	61543	1517595616793
3	v_m	V_M	3171	16	1495	828	2491	1459879941051
4	klari64	klari64	3167	23	1556	1043	2813	1545320573092
5	yulkaaa	Yulkaaa	3165	8	462	226	767	1673030428077
6	hooligan64	Hooligan64	3163	-21	2148	1171	3541	1650532129100
7	watneg	Watneg	3158	9	2517	1238	4242	1545684336272
8	aaryan_varshney	aaryan_varshney	3150	29	4844	2266	7774	1555866544962
9	lastgladiator2	LastGladiator2	3142	8	1732	1099	3006	1597157317472

In [132]:

```
# This function, get_user_name, takes a Lichess username as input, makes a request to the
Lichess API to retrieve detailed user information,
# and returns the JSON response containing the user details. The comments provide a brief
explanation of each step in the function.

def get_user_name(username):
    url = "https://lichess.org/api/users"
    response=requests.get(f"https://lichess.org/api/user/{username}")
    result = response.json()
    return result
```

(c) Consider the top ten players in the bullet leaderboard. (i) Which player has the most bullet games overall?

In [146]:

```
# Finding the player with the most bullet games overall in the final_df DataFrame
most_games_player = final_df.loc[final_df['all'].idxmax(), 'username']

# Defining the URL for detailed user information
url = "https://lichess.org/api/users"

# To get detailed user information for the player with the most games
result = get_user_name(most_games_player )

# Printing information about the player with the most bullet games overall
print(f'''The player with the most bullet games overall is: "{most_games_player}" with {f
inal_df.loc[final_df['all'].idxmax(), 'all']} Games
The full name is: "{result['profile']['firstName']} {result['profile']['lastName']}"''')
```

```
The player with the most bullet games overall is: "Mishka_The_Great" with 61543 Games
The full name is: "Mieszko Miś"
```

(c) Consider the top ten players in the bullet leaderboard. (ii) Which player has played the most bullet games relative to account age in days?

In [147]:

```
# Converting 'created_at' to datetime
final_df['createdAt'] = pd.to_datetime(final_df['createdAt'], unit='ms')

# Calculating account age in days
final_df['account_age_days'] = (pd.to_datetime('now') - final_df['createdAt']).dt.days

# Calculating the ratio of bullet games to account age in days
final_df['games_ratio'] = final_df['all'] / final_df['account_age_days']

# Finding the player with the highest games ratio
most_relative_games_player = final_df.loc[final_df['games_ratio'].idxmax(), 'username']

# To get detailed user information for the player with the most bullet games relative to
account age in days
result = get_user_name(most_relative_games_player)

print(f'''The player who played the most relative to account age is: "{most_relative_game
s_player}"
with relative account age as: {final_df.loc[final_df['games_ratio'].idxmax(), 'games_rati
o']}
The full name is: "{result['profile']['firstName']} {result['profile']['lastName']}"''')
```

```
The player who played the most relative to account age is: "Mishka_The_Great"
with relative account age as: 28.179029304029303
The full name is: "Mieszko Miś"
```

(c) Consider the top ten players in the bullet leaderboard. (iii) Which player has the worst win-to-loss ratio over all formats?

In [148]:

```
# Calculating win-to-loss ratio
final_df['win_loss_ratio'] = final_df['win'] / final_df['loss']

# Finding the player with the worst win-to-loss ratio
worst_ratio_player = final_df.loc[final_df['win_loss_ratio'].idxmin(), 'username']

# To get detailed user information for the player who has the worst win-to-loss ratio
result = get_user_name(worst_ratio_player)


print(f'''The player with the worst win-to-loss ratio is: "{worst_ratio_player}".
```

```
win:loss ratio : {final_df.loc[final_df['win_loss_ratio'].idxmin(), 'win_loss_ratio']}
The full name is: "{result['profile']['firstName']} {result['profile']['lastName']}"''')
```

```
The player with the worst win-to-loss ratio is: "klari64".
win:loss ratio : 1.491850431447747
The full name is: "Tobias Kölle"
```

(d) Get all games from user `manwithavan`. Group them by opening and print the ten most popular.

In [139]:

```
# Defining the URL for retrieving games played by the user 'manwithavan' with opening inf
ormation
url = "https://lichess.org/api/games/user/manwithavan"

# Setting parameters for the API request, including the option to include opening informa
tion
params = {
    "opening" : True
}

# Specifying headers to accept the response in x-ndjson format
headers = {
    "Accept" : "application/x-ndjson"
}

# Making a GET request to the Lichess API with the specified parameters and headers
response = requests.get("https://lichess.org/api/games/user/manwithavan" , params = param
s, headers = headers)

# Converting x-ndjson to list of dictionaries
parsed_objects = ndjson_to_list(response.text)

# Extracting opening information and creating a DataFrame
data = []

for obj in parsed_objects:
    if 'opening' in obj:
        data.append(obj['opening'])

df = pd.DataFrame(data)

# Displaying the top 10 most frequently played openings
df['name'].value_counts().head(10)
```

Out[139]:

```
name
Van't Kruijs Opening                                7
Nimzo-Larsen Attack: Modern Variation               7
Pirc Defense                                        6
Mieses Opening                                      6
Caro-Kann Defense: Breyer Variation                 5
Modern Defense                                      5
Queen's Pawn Game                                   5
Nimzo-Larsen Attack                                 5
Zukertort Opening: Queenside Fianchetto Variation   5
Zukertort Opening: Kingside Fianchetto              5
Name: count, dtype: int64
```

In [295]:

```
openings.value_counts().head(2)
```

Out[295]:

```
Van't Kruijs Opening                    7
Nimzo-Larsen Attack: Modern Variation   7
dtype: int64
```

In [ ]:

In [ ]:

In [ ]:

Acknowledgment

I received assistance from `ChatGPT` while working on certain questions in this notebook. I want to clarify that I independently completed the majority of the tasks, seeking help only in instances where I encountered challenges or felt lost. The collaboration with ChatGPT was instrumental in providing guidance and insights during those moments. ChatGpt: https://chat.openai.com/

--- Nikita Bhrugumaharshi Emberi

In [ ]: