Lab 6: IMDb

We will use SQL to dive deep into the Internet Movie Database (IMDb) and answer different questions involving movies, actors, and movie ratings.

After running the cell below, you may be prompted to upgrade `jupysql` using `pip`. You do not need to worry about that, no additional cells need to be added by you for this setup.

In [ ]:
```
# Run this cell to set up your notebook; no further action
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.express as px
import seaborn as sns
import sqlalchemy

plt.style.use('fivethirtyeight') # Use plt.style.available
sns.set()
sns.set_context("talk")
np.set_printoptions(threshold=5) # Avoid printing out big
%matplotlib inline
%load_ext sql
```

The IMDB (mini) Dataset

We will explore a miniature version of the IMDb Dataset. This is the same dataset that we used for this week's lab.

- **Caution: Be careful with large SQL queries!!** To avoid printing out 100k-sized tables, **use the LIMIT keyword** (but remember to remove it if not needed).

In [ ]:
```
%%sql
sqlite:///data/imdbmini.db
```

Let's take a look at the table schemas:

In [ ]:
```
%%sql
-- just run this cell --
SELECT * FROM sqlite_master WHERE type='table';
```

```
 * sqlite:///data/imdbmini.db
Done.
```

Out[ ]:

type	name	tbl_name	rootpage	sql
table	Title	Title	2	CREATE TABLE "Title" ("tconst" INTEGER, "titleType" TEXT, "primaryTitle" TEXT, "originalTitle" TEXT, "isAdult" TEXT, "startYear" TEXT, "endYear" TEXT, "runtimeMinutes" TEXT, "genres" TEXT)
table	Name	Name	12	CREATE TABLE "Name" ("nconst" INTEGER, "primaryName" TEXT, "birthYear" TEXT, "deathYear" TEXT, "primaryProfession" TEXT)
table	Role	Role	70	CREATE TABLE "Role" (tconst INTEGER, ordering TEXT, nconst INTEGER, category TEXT, job TEXT, characters TEXT)
table	Rating	Rating	41	CREATE TABLE "Rating" (tconst INTEGER, averageRating TEXT, numVotes TEXT)

From running the above cell, we see the database has 4 tables: `Name`, `Role`, `Rating`, and `Title`.

▼ [**Click to Expand**] See descriptions of each table's schema. We have only included descriptions for columns that could be of potential use in this homework.
`Name` – Contains the following information for names of people. - nconst (integer) - alphanumeric unique identifier of the name/person - primaryName (text) - name by which the person is most often credited - birthYear (text) - in YYYY format - deathYear (text) - in YYYY format **`Role`** – Contains the principal cast/crew for titles. - tconst (integer) - alphanumeric unique identifier of the title - ordering (text) - a number to uniquely identify rows for a given tconst - nconst (integer) - alphanumeric unique identifier of the name/person - category (text) - the category of job that person was in - characters (text) - the name of the character played if applicable, else '\\N' **`Rating`** – Contains the IMDb rating and vote information for titles. - tconst (integer) - alphanumeric unique identifier of the title - averageRating (text) – weighted average of all the individual user ratings - numVotes (text) - number of votes (i.e., ratings) the title has received **`Title`** - Contains the following information for titles. - tconst (integer) - alphanumeric unique identifier of the title - titleType (text) - the type/format of the title - primaryTitle (text) - the more popular title / the title used by the producers on promotional materials at the point of release - isAdult (text) - 0: non-adult title; 1: adult title - startYear (text) - represents the release year of a title. - runtimeMinutes (text) - primary runtime of the title, in minutes

From the above descriptions, we can conclude the following:

- `Name.nconst` and `Title.tconst` are primary keys of the `Name` and `Title` tables, respectively.
- `Role.nconst` and `Role.tconst` are **foreign keys** that point to `Name.nconst` and `Title.tconst`, respectively.

Question 1a

How far back does our data go? Does it only include recent data, or do we have information about older movies and movie stars as well?

List the **10 oldest movie titles** by `startYear` and then `primaryTitle` both in **ascending** order. The output should contain the `startYear`, `primaryTitle`, and `titleType`. In this homework, we define a movie as having `titleType='movie'`. Keep this in mind for later questions as well.

In [ ]:
```
%%sql query_q1a  <<
SELECT startYear, primaryTitle, titleType
FROM Title
WHERE titleType = 'movie'
ORDER BY startYear, primaryTitle
LIMIT 10;
```

```
 * sqlite:///data/imdbmini.db
Done.
Returning data to local variable query_q1a
```

In [ ]:
```
query_q1a.DataFrame()
```

Out[ ]:

	startYear	primaryTitle	titleType
0	1915	The Birth of a Nation	movie
1	1920	The Cabinet of Dr. Caligari	movie
2	1921	The Kid	movie
3	1922	Nosferatu	movie
4	1924	Sherlock Jr.	movie
5	1925	Battleship Potemkin	movie
6	1925	The Gold Rush	movie
7	1926	The General	movie
8	1927	Metropolis	movie
9	1927	Sunrise	movie

Question 1b

Next, let's calculate the distribution of movies by year. Write a query that returns the **total** number of movie titles for each `startYear` in the `Title` table as `total`. Keep in mind that some entries may not have a `startYear` listed -- you should filter those out. Order your final results by the `startYear` in **ascending** order. As in `q1a`, remember that movies are defined as having `titleType='movie'`.

The first few records of the table should look like the following (but you should compute the entire table).

startYear	total
1915	1
1920	1
1921	1
1922	1
...	...

In [ ]:
```
%%sql query_q1b <<
SELECT startYear, COUNT(*) AS total
FROM Title
WHERE titleType = 'movie' AND startYear != '\\N'
GROUP BY startYear
ORDER BY startYear;
```

```
 * sqlite:///data/imdbmini.db
Done.
Returning data to local variable query_q1b
```

The following cell should generate an interesting plot of the number of movies that premiered each year. Notice there are fewer movies premiering from the 1920s to the late 1940s. Why might that be? *This question is rhetorical; you do not need to write your answer anywhere.*

In [ ]:
```
# Run this call to generate the bar plot; no further actio
px.bar(query_q1b.DataFrame(), x="startYear", y="total", ti
```

Question 2

Who are the **top 10 most prolific movie actors**?

The term **"movie actor"** is defined as anyone with an `"actor"` or `"actress"` job category role in a `"movie"` title type.

Your SQL query should output exactly two fields named `name` (the movie actor's name) and `total` (the number of movies the movie actor appears in). Order the records by `total` in descending order, and break ties by ordering by `name` in ascending order.

Your result should look something like the following, but without `????`:

name	total
????	64
????	54
????	53
????	49
????	46
????	43
????	41
????	40
????	40
????	39

Hints:

- ***The query should take < 2 minutes to run.***
- Before writing your query, you may wish to review the table descriptions given at the start of the assignment to determine where the information you need is stored

- If you want to include a non-aggregate field in the `SELECT` clause, it must also be included in the `GROUP BY` clause.
- When using multiple conditions in a `WHERE` clause, pay attention to the order of operations.

In [ ]:
```
%%sql query_q2  <<
SELECT Name.primaryName AS name, COUNT(*) AS total
FROM (Name LEFT JOIN Role ON Name.nconst = Role.nconst) LE
WHERE (category = 'actor' OR category = 'actress') AND tit
GROUP BY Name.primaryName
ORDER BY total DESC, name
LIMIT 10;
```

```
 * sqlite:///data/imdbmini.db
Done.
Returning data to local variable query_q2
```

In [ ]:
```
query_q2.DataFrame()
```

Out[ ]:

	name	total
0	Robert De Niro	64
1	Samuel L. Jackson	54
2	Nicolas Cage	53
3	Bruce Willis	49
4	Tom Hanks	46
5	Johnny Depp	43
6	Mark Wahlberg	41
7	Liam Neeson	40
8	Morgan Freeman	40
9	Adam Sandler	39

Question 3: The `CASE` Keyword

The `Rating` table has the `numVotes` and the `averageRating` for each title. A movie is considered a **"big hit"** if there are more than 100,000 votes for the movie. Which `movie` titles were **"big hits"**? Construct a query that generates the following result:

isBigHit	total
no	????
yes	????

Where `????` is replaced with the correct values. The row with `no` should have the count for how many movies **are not** big hits, and the row with `yes` should have the count of how many movies **are** big hits.

Hints:

- While SQL sometimes casts data automatically, it is still best practice to cast string data to a numerical data type manually before performing arithmetic operations for the purposes of readability and reproducibility.
- You will need to use some type of `JOIN`.
- You may also consider using a `CASE` statement:

  ```
  CASE
      WHEN ... THEN ...
      ELSE ...
  END
  ```

  `CASE` statements are the SQL equivalent of `Python if... elif... else` statements. To read up on `CASE`, take a look at the following links:
  - https://mode.com/sql-tutorial/sql-case/
  - https://www.w3schools.com/sql/sql_ref_case.asp

In [ ]:
```
%%sql query_q3 <<
SELECT
    CASE WHEN CAST(numVotes AS INT) > 100000 THEN 'yes' EL
    Count(*) AS total
FROM Rating JOIN Title ON Rating.tconst = Title.tconst
WHERE titleType = 'movie'
GROUP BY isBigHit;
```

```
 * sqlite:///data/imdbmini.db
Done.
```

```
Returning data to local variable query_q3
```

Question 4

How does movie length relate to ratings? To answer this question we want to bin `movie` titles by length, compute the average of the average ratings within each length bin, and visualize the relations.

Question 4a

We will group movies by 10-minute increments -- that is, one bin for movies [0, 10) minutes long, another for [10, 20) minutes, another for [20, 30) minutes, and so on. Use the following code snippet to help construct 10-minute bins:

```
ROUND(runtimeMinutes / 10.0 + 0.5) * 10 AS
runtimeBin
```

Construct a query that generates a resulting table containing the `runtimeBin`, the **average** of the **average ratings** (as `averageRating`), the **average number of votes** (as `averageNumVotes`), and the number of `titles` in that **runtimeBin** (as `total`). Only include movies with **at least 8000 votes**. Order the final results by the value of `runtimeBin` in ascending order.

Hint:

- You can use a variable(s) defined in your `SELECT` clause in the later part of your query.

In [ ]:
```
%%sql query_q4  <<
SELECT ROUND(runtimeMinutes / 10.0 + 0.5) * 10 AS runtimeB
    AVG(averageRating) AS averageRating,
    AVG(CAST(numVotes AS INT)) AS averageNumVotes,
    COUNT(*) AS total
FROM Rating JOIN Title ON Rating.tconst = Title.tconst
WHERE titleType = 'movie' AND runtimeMinutes != '\\N' AND
```

```
GROUP BY runtimeBin
ORDER BY runtimeBin;
```

```
 * sqlite:///data/imdbmini.db
Done.
Returning data to local variable query_q4
```

Let us take a look at the current distribution of movie runtimes.

In [ ]:
```
# Run the cell below; no further action is needed
px.bar(query_q4.DataFrame(), x="runtimeBin", y="total", ti
```

Question 4b

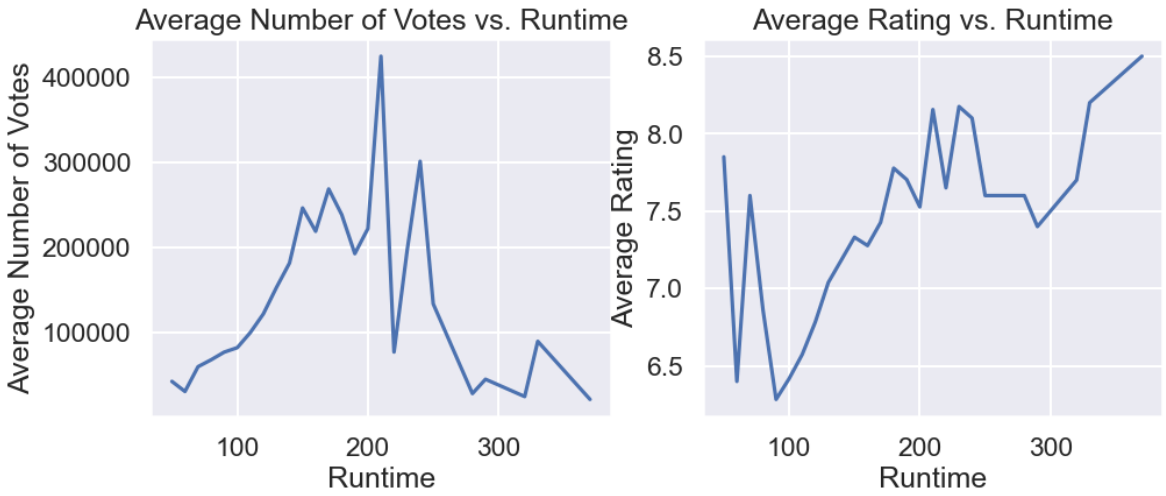
Create two line plots below. The first should show the relationship between average number of votes and runtime; the second should show the relationship between average rating and runtime. The runtime should be on the x-axis for both plots. Use the columns from the table generated in the previous part, `query_q4`. If your SQL query is correct you should get some interesting plots below. This might explain why directors keep going with a particular range of runtimes.

Note: Please use `sns` or `plt` functions for plotting. Plotly `px` does not export to the PDF properly. Please include descriptive titles and labels.

In [ ]:
```
plt.figure(figsize=(10, 4))
plt.subplot(1, 2, 1) # DO NOT MODIFY THIS LINE
sns.lineplot(data=query_q4.DataFrame(), x='runtimeBin', y=
plt.title('Average Number of Votes vs. Runtime')
plt.xlabel('Runtime')
plt.ylabel('Average Number of Votes')
plt.subplot(1, 2, 2) # DO NOT MODIFY THIS LINE
sns.lineplot(data=query_q4.DataFrame(), x='runtimeBin', y=
plt.title('Average Rating vs. Runtime')
```

```
plt.xlabel('Runtime')
plt.ylabel('Average Rating')
```

Out[ ]:
```
Text(0, 0.5, 'Average Rating')
```



Question 5

Which **movie actors** have the highest average ratings across all the movies in which they star? Again, define **"movie actor"** as anyone with an `actor` or `actress` job category role in a `movie` title type.

Construct a query that generates a resulting table consisting of the **movie actor's name** (as `name`) and their **average actor rating** (as `actorRating`) computed by rescaling ratings for movies in which they had a role:

$$\text{actorRating} = \frac{\sum_{\text{m}}(\text{averageRating}[\text{m}] * \text{numVotes}[\text{m}])}{\sum_{\text{m}} \text{numVotes}[\text{m}]}$$

In addition, only consider ratings where there are **at least 1000** votes and only consider movie actors that have **at least 20 rated performances**. Present the movie actors with the **top 10** `actorRating` in descending order and break ties alphabetically using the movie actor's name.

Note: DO NOT cast `averageRating` **as an integer**. Doing so reduces the precision of the resulting values, so your table may not

match up exactly with what is shown below.

The results should look something like this but without the `????`, and with higher rating precision.

name	actorRating
????	8.4413...
????	8.2473...
????	8.1383...
????	8.1339...
????	8.0349...
????	7.9898...
????	7.9464...
????	7.9330...
????	7.9261...
????	7.8668...

Note:

- ***The query should take < 3 minutes to run.***
- If an actor/actress has multiple `role` listings for a movie, then that movie will have a bigger impact on the overall average (this is desired).

In [ ]:
```
%%sql  query_q5  <<
SELECT Name.primaryName AS name,
    SUM(averageRating * CAST(numVotes AS INT)) / SUM(CAST(
FROM ((Name LEFT JOIN Role ON Name.nconst = Role.nconst) L
WHERE (category = 'actor' OR category = 'actress') AND tit
GROUP BY Name.primaryName
HAVING COUNT(*) >= 20
ORDER BY actorRating DESC
LIMIT 10;
```

```
 * sqlite:///data/imdbmini.db
Done.
Returning data to local variable query_q5
```

Congratulation for finishing Lab 6!

In [ ]:
```
query_q5.DataFrame()
```

Out[ ]:

	name	actorRating
0	Diane Keaton	8.441302
1	Tim Robbins	8.247318
2	Al Pacino	8.138361
3	Michael Caine	8.133915
4	Leonardo DiCaprio	8.034961
5	Christian Bale	7.989825
6	Robert Duvall	7.946483
7	Jack Nicholson	7.933034
8	Kevin Spacey	7.926158
9	Clint Eastwood	7.866839

Submission

Make sure you have run all cells in your notebook , so that all images/graphs appear in the output.