Title: **Recomendation System - Movies, Music & Books**

Milestone 1 Report: Session-Based Recommendation System

The objective of this project is to build a **session-based recommendation system** that suggests movies, music, and books to users based on their interactions with the interface and preferences. This project will use 3 datasets from Hugging Face. There will be an interactive user-interface of website will be developed for this application.

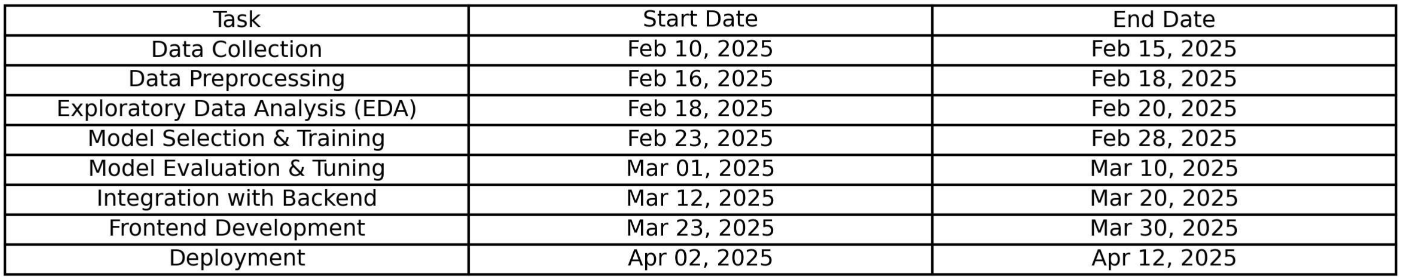
Technology Stack

- **Frontend**: React, CSS
- **Backend**: Flask
- **Machine Learning Frameworks**: PyTorch, transformers
- **Databases**: PostgreSQL / MongoDB (TBD based on requirements)
- **APIs & Libraries**: Hugging Face Transformers, Pandas, NumPy, Matplotlib, Seaborn

Datasets(Hugging Face)

- **Movies**: IMDb Dataset
- **Music**: Spotify Tracklist Dataset
- **Books**: GoodReads Dataset

Project Timeline



Task	Start Date	End Date
Data Collection	Feb 10, 2025	Feb 15, 2025
Data Preprocessing	Feb 16, 2025	Feb 18, 2025
Exploratory Data Analysis (EDA)	Feb 18, 2025	Feb 20, 2025
Model Selection & Training	Feb 23, 2025	Feb 28, 2025
Model Evaluation & Tuning	Mar 01, 2025	Mar 10, 2025
Integration with Backend	Mar 12, 2025	Mar 20, 2025
Frontend Development	Mar 23, 2025	Mar 30, 2025
Deployment	Apr 02, 2025	Apr 12, 2025

Data Loading

```
!pip install datasets
```

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from datasets import load_dataset
```

```
movies_data = load_dataset("ExecuteAutomation/ImdbMovieDataSet")
```

```
/usr/local/lib/python3.11/dist-packages/huggingface_hub/utils/_auth.py:94: UserWarning:
The secret `HF_TOKEN` does not exist in your Colab secrets.
To authenticate with the Hugging Face Hub, create a token in your settings tab (https://huggingface.co/settings/token
You will be able to reuse this secret in all of your notebooks.
Please note that authentication is recommended but still optional to access public models or datasets.
  warnings.warn(
README.md: 100%                                   850/850 [00:00<00:00, 53.5kB/s]
imdb_movies.csv: 100%                             6.72M/6.72M [00:00<00:00, 7.62MB/s]
Generating train split: 100%                      10178/10178 [00:00<00:00, 23689.04 examples/s]
```

```
print(movies_data['train'])
```

```
Dataset({
    features: ['names', 'date_x', 'score', 'genre', 'overview', 'crew', 'orig_title', 'status', 'orig_lang', 'budget_
    num_rows: 10178
})
```

```
music_data = load_dataset("maharshipandya/spotify-tracks-dataset")
```

```
README.md: 100%                                   4.68k/4.68k [00:00<00:00, 101kB/s]
dataset.csv: 100%                                 20.1M/20.1M [00:00<00:00, 60.0MB/s]
Generating train split: 100%                      114000/114000 [00:00<00:00, 152068.66 examples/s]
```

```
print(music_data['train'])
```

```
Dataset({
    features: ['Unnamed: 0', 'track_id', 'artists', 'album_name', 'track_name', 'popularity', 'duration_ms', 'explici
    num_rows: 114000
})
```

```
books_data = load_dataset("Eitanli/goodreads")
```

```
README.md: 100%                                   737/737 [00:00<00:00, 56.8kB/s]
Repo card metadata block was not found. Setting CardData to empty.
WARNING:huggingface_hub.repocard:Repo card metadata block was not found. Setting CardData to empty.
goodreads_data.csv: 100%                          11.7M/11.7M [00:00<00:00, 22.1MB/s]
Generating train split: 100%                      10000/10000 [00:00<00:00, 26659.63 examples/s]
```

```
print(books_data["train"])
```

```
Dataset({
    features: ['Unnamed: 0', 'Book', 'Author', 'Description', 'Genres', 'Avg_Rating', 'Num_Ratings', 'URL'],
    num_rows: 10000
})
```

Movies Dataset Preprocessing & Visualization

```
movies_df = movies_data['train'].to_pandas()
movies_df.head()
```

	names	date_x	score	genre	overview	crew	orig_title	status
0	Creed III	03/02/2023	73.0	Drama, Action	After dominating the boxing world, Adonis Cree...	Michael B. Jordan, Adonis Creed, Tessa Thompso...	Creed III	Released
1	Avatar: The Way of Water	12/15/2022	78.0	Science Fiction, Adventure, Action	Set more than a decade after the events of the...	Sam Worthington, Jake Sully, Zoe Saldaña, Neyt...	Avatar: The Way of Water	Released
2	The Super Mario Bros. Movie	04/05/2023	76.0	Animation, Adventure, Family, Fantasy, Comedy	While working underground to fix a water main,...	Chris Pratt, Mario (voice), Anya Taylor-Joy, P...	The Super Mario Bros. Movie	Released
3	Mummies	01/05/2023	70.0	Animation, Comedy, Family, Adventure, Fantasy	Through a series of unfortunate events, three ...	Óscar Barberán, Thut (voice), Ana Esther Albor...	Momias	Released
4	Supercell	03/17/2023	61.0	Action	Good-hearted teenager William always lived in ...	Skeet Ulrich, Roy Cameron, Anne Heche, Dr Quin...	Supercell	Released

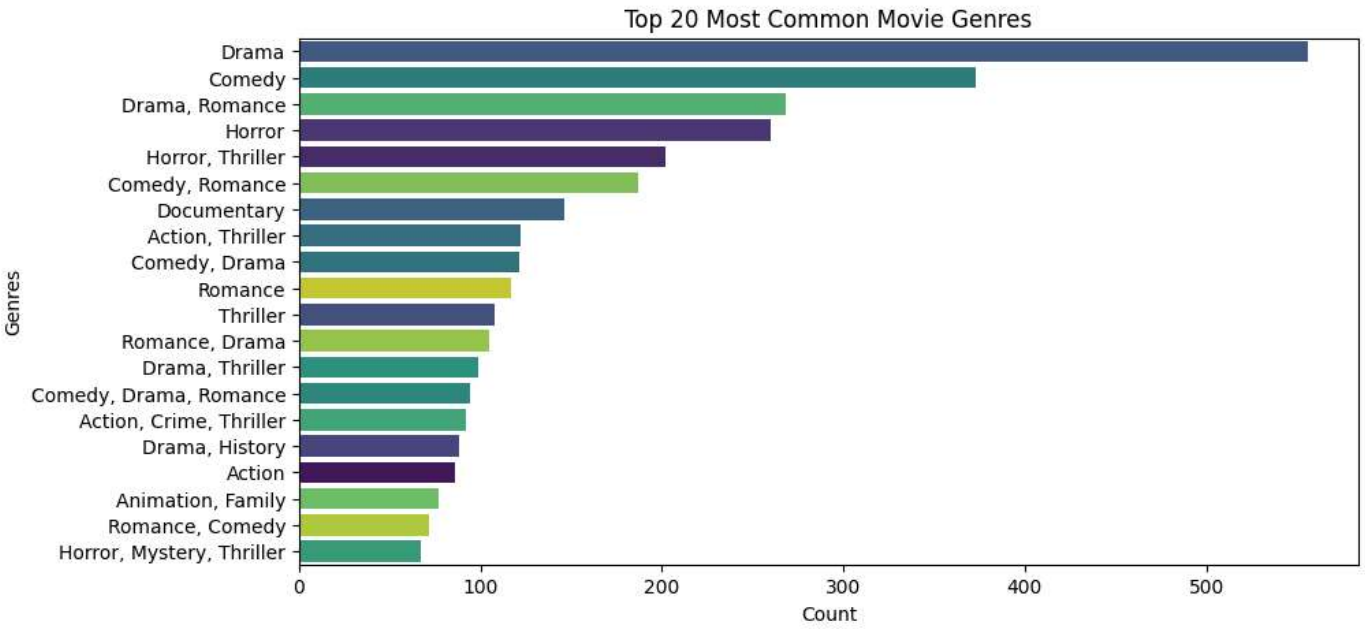
```
movies_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10178 entries, 0 to 10177
Data columns (total 12 columns):
 #   Column      Non-Null Count  Dtype  
---  ------      --------------  -----  
 0   names       10178 non-null  object 
 1   date_x      10178 non-null  object 
 2   score       10178 non-null  float64
 3   genre       10093 non-null  object 
 4   overview    10178 non-null  object 
 5   crew        10122 non-null  object 
 6   orig_title  10178 non-null  object 
 7   status      10178 non-null  object 
 8   orig_lang   10178 non-null  object 
 9   budget_x    10178 non-null  float64
 10  revenue     10178 non-null  float64
 11  country     10178 non-null  object 
dtypes: float64(3), object(9)
memory usage: 954.3+ KB
```

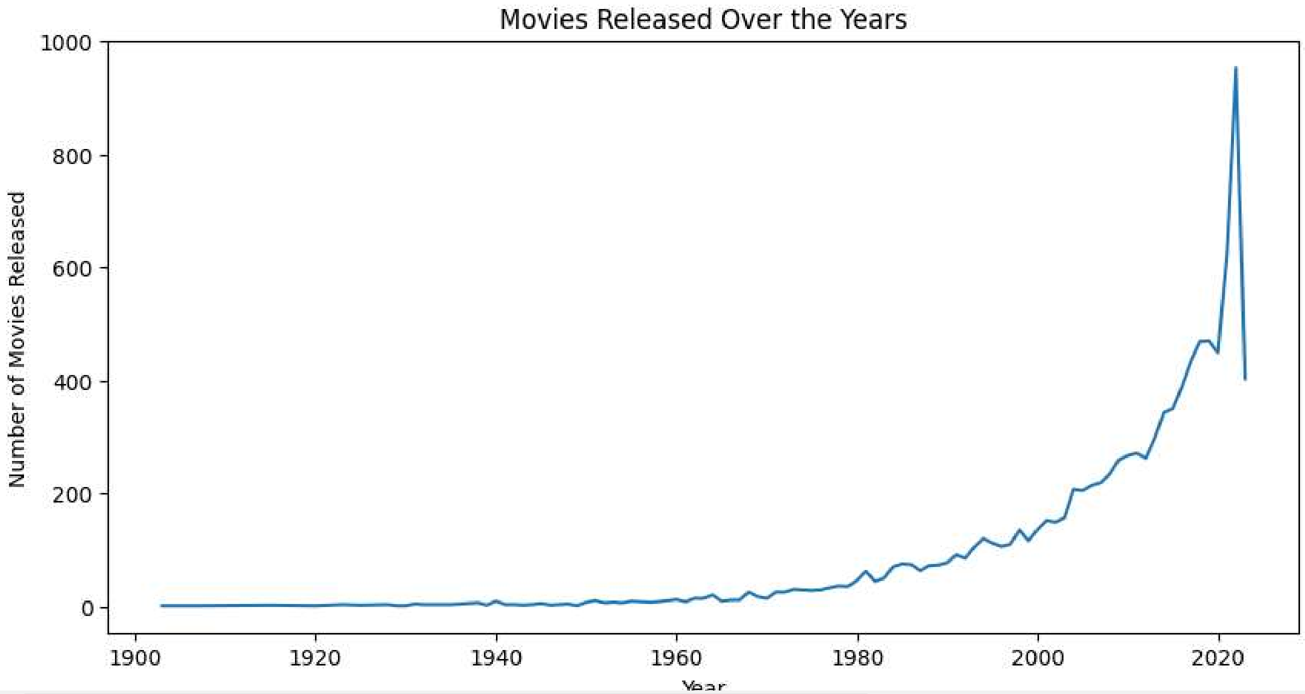
```
movies_df.isna().sum()
```

	0
names	0
date_x	0
score	0
genre	85
overview	0
crew	56
orig_title	0
status	0
orig_lang	0
budget_x	0
revenue	0
country	0

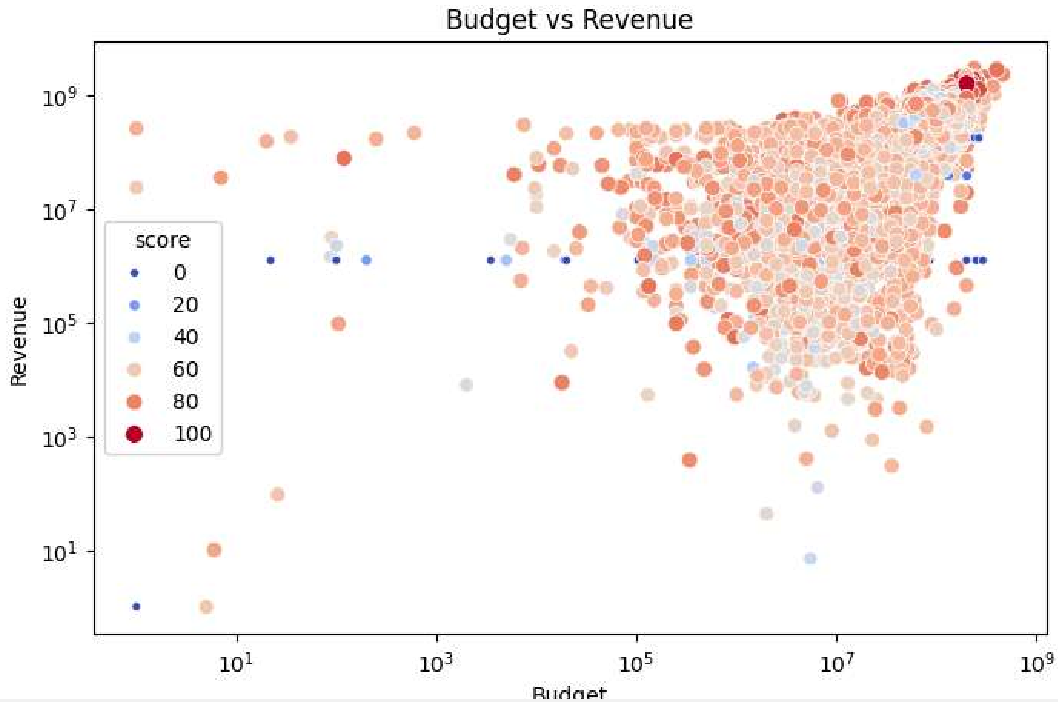
```
# filling NaN values
movies_df["genre"].fillna("Unknown", inplace=True)

movies_df["crew"].fillna("Not Available", inplace=True)

# Split Genres (Multiple genres in one column)
movies_df["genre"] = movies_df["genre"].str.split(",")


movies_df["date_x"] = movies_df["date_x"].str.strip()

movies_df["date_x"].replace("", np.nan, inplace=True)

movies_df["date_x"] = pd.to_datetime(movies_df["date_x"], errors="coerce", format="%m/%d/%Y")



movies_df["year"] = movies_df["date_x"].dt.year


movies_df_exploded = movies_df.explode("genre")


top_20_genres = movies_df_exploded["genre"].value_counts().index[:20]  # Select top 20 genres
y = movies_df_exploded[movies_df_exploded["genre"].isin(top_20_genres)]["genre"]
plt.figure(figsize=(10, 5))
sns.countplot(y=y,
              order=top_20_genres,
              hue=y,
              palette="viridis")
plt.xlabel("Count")
plt.ylabel("Genres")
plt.title("Top 20 Most Common Movie Genres")
plt.show()
```



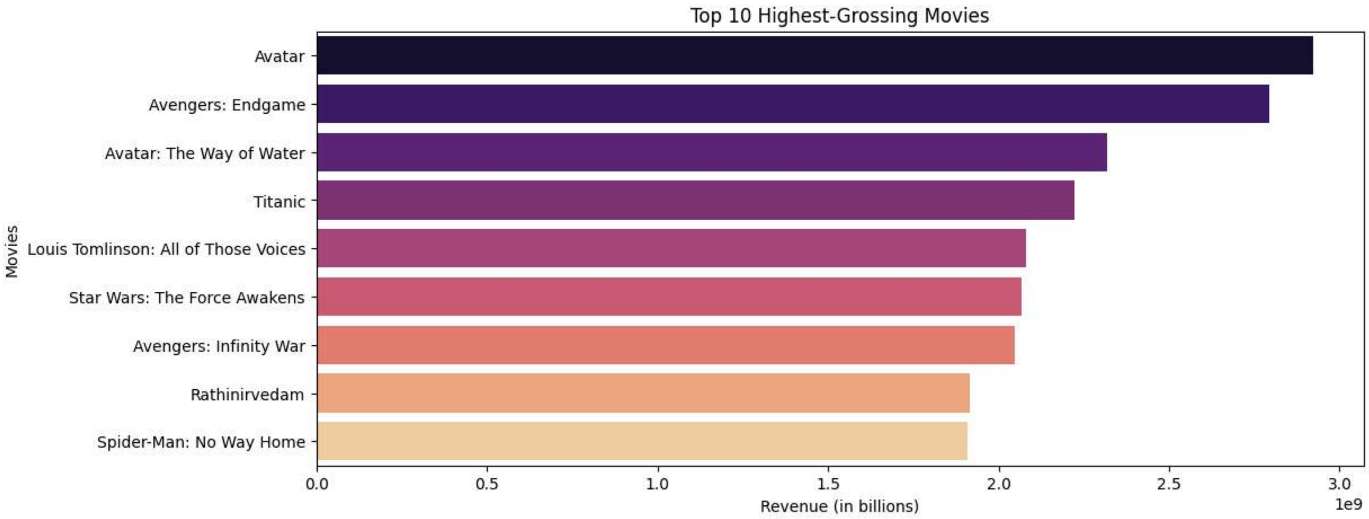
```
plt.figure(figsize=(10, 5))
sns.lineplot(x=movies_df["year"].value_counts().index, y=movies_df["year"].value_counts().values)
plt.xlabel("Year")
plt.ylabel("Number of Movies Released")
plt.title("Movies Released Over the Years")
plt.show()
```



```
plt.figure(figsize=(8, 5))
sns.scatterplot(data=movies_df, x="budget_x", y="revenue", hue="score", size="score", palette="coolwarm")
plt.xlabel("Budget")
plt.ylabel("Revenue")
plt.title("Budget vs Revenue")
plt.xscale("log")
plt.yscale("log")
plt.show()
```



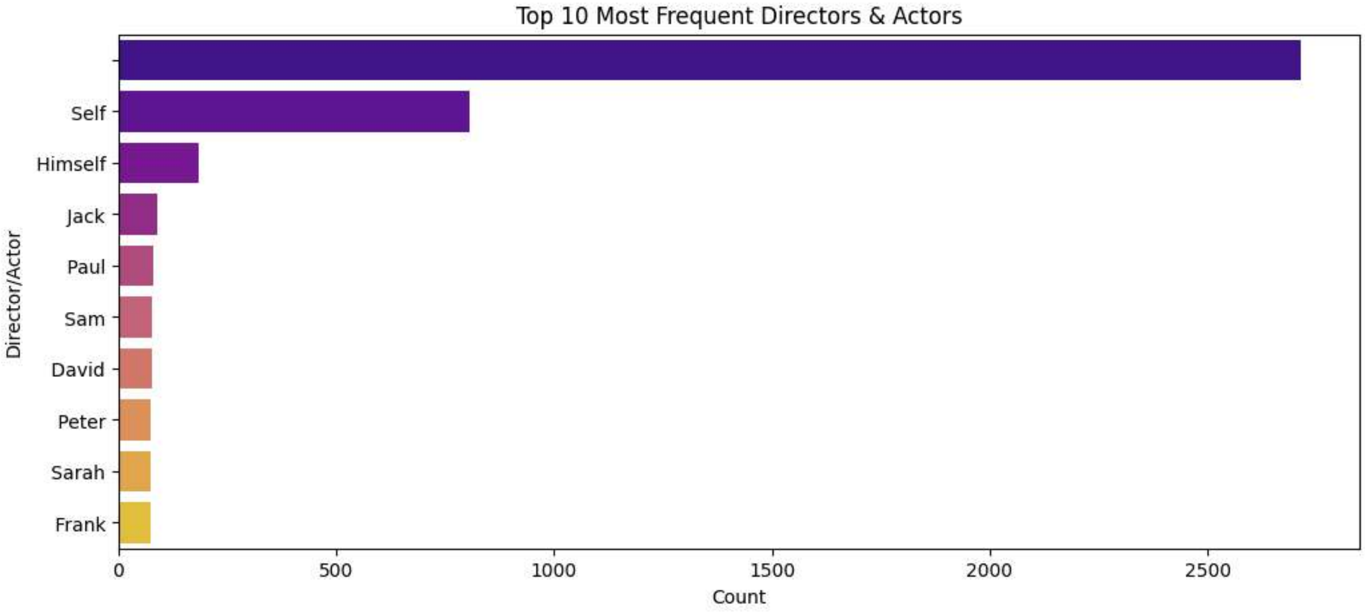
```
top_movies = movies_df.nlargest(10, "revenue")

plt.figure(figsize=(12, 5))
sns.barplot(y=top_movies["names"], x=top_movies["revenue"], hue=top_movies["names"], palette="magma", legend=False)
plt.xlabel("Revenue (in billions)")
plt.ylabel("Movies")
plt.title("Top 10 Highest-Grossing Movies")
plt.show()
```



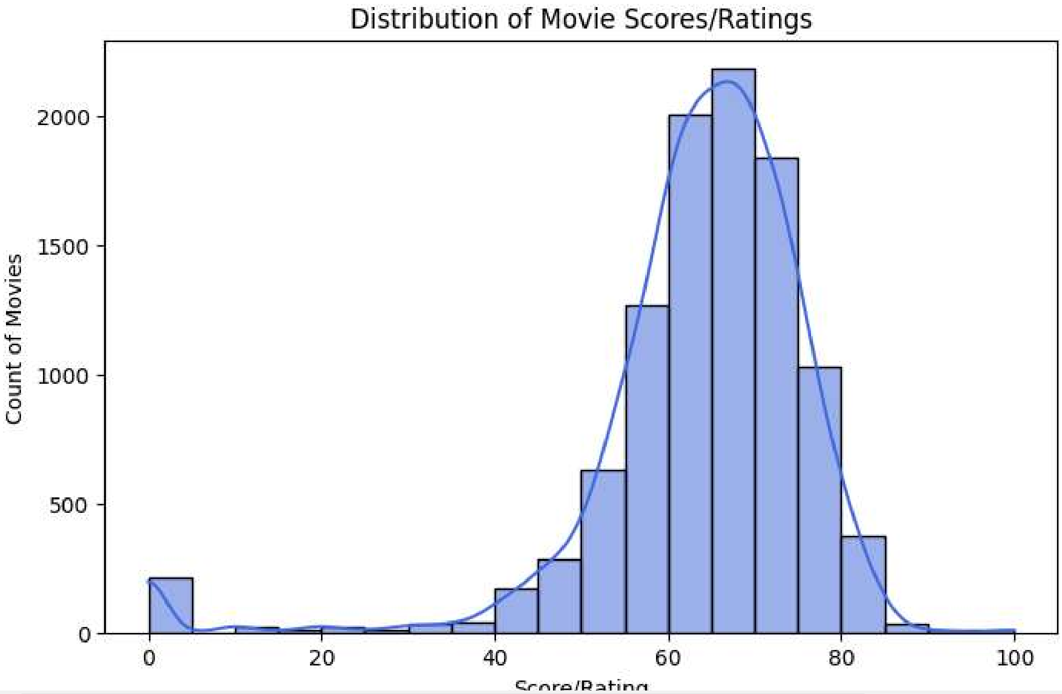
```
from collections import Counter
```

```
# Flatten list of crew members
crew_list = movies_df["crew"].dropna().str.split(",").explode()
top_crew = pd.DataFrame(Counter(crew_list).most_common(10), columns=["Name", "Count"])

plt.figure(figsize=(12, 5))
sns.barplot(y=top_crew["Name"], x=top_crew["Count"], palette="plasma")
plt.xlabel("Count")
plt.ylabel("Director/Actor")
plt.title("Top 10 Most Frequent Directors & Actors")
plt.show()
```

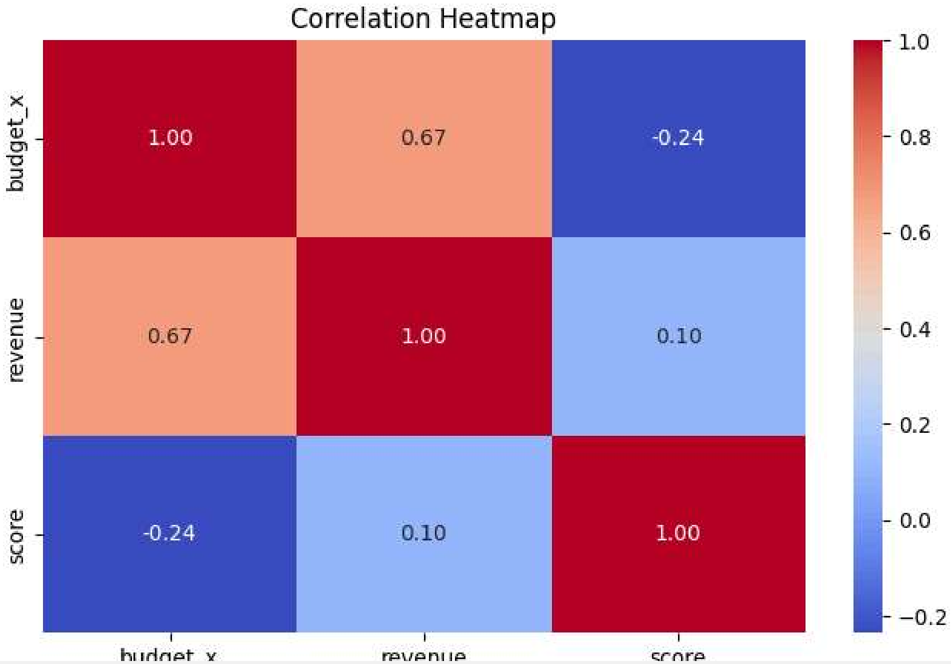
```
<ipython-input-28-aca4fd3874a2>:9: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign the `y` variable to `h

  sns.barplot(y=top_crew["Name"], x=top_crew["Count"], palette="plasma")
```



```
plt.figure(figsize=(8, 5))
sns.histplot(movies_df["score"], bins=20, kde=True, color="royalblue")
plt.xlabel("Score/Rating")
plt.ylabel("Count of Movies")
plt.title("Distribution of Movie Scores/Ratings")
plt.show()
```



```
plt.figure(figsize=(8, 5))
sns.heatmap(movies_df[["budget_x", "revenue", "score"]].corr(), annot=True, cmap="coolwarm", fmt=".2f")
plt.title("Correlation Heatmap")
plt.show()
```



Music Dataset Preprocessing & Visualizations

```
music_df = music_data["train"].to_pandas()
music_df.head()
```

	Unnamed: 0	track_id	artists	album_name	track_name	popularity	duration_ms	explicit	dan
0	0	5SuOikwiRyPMVoIQDJUgSV	Gen Hoshino	Comedy	Comedy	73	230666	False	
1	1	4qPNDBW1i3p13qLCt0Ki3A	Ben Woodward	Ghost (Acoustic)	Ghost - Acoustic	55	149610	False	
2	2	1iJBSr7s7jYXzM8EGcbK5b	Ingrid Michaelson;ZAYN	To Begin Again	To Begin Again	57	210826	False	
3	3	6lfxq3CG4xtTiEg7opyCyx	Kina Grannis	Crazy Rich Asians (Original Motion Picture Sou...	Can't Help Falling In Love	71	201933	False	
4	4	5vjLSffimiIP26QG5WcN2K	Chord Overstreet	Hold On	Hold On	82	198853	False	

5 rows × 21 columns

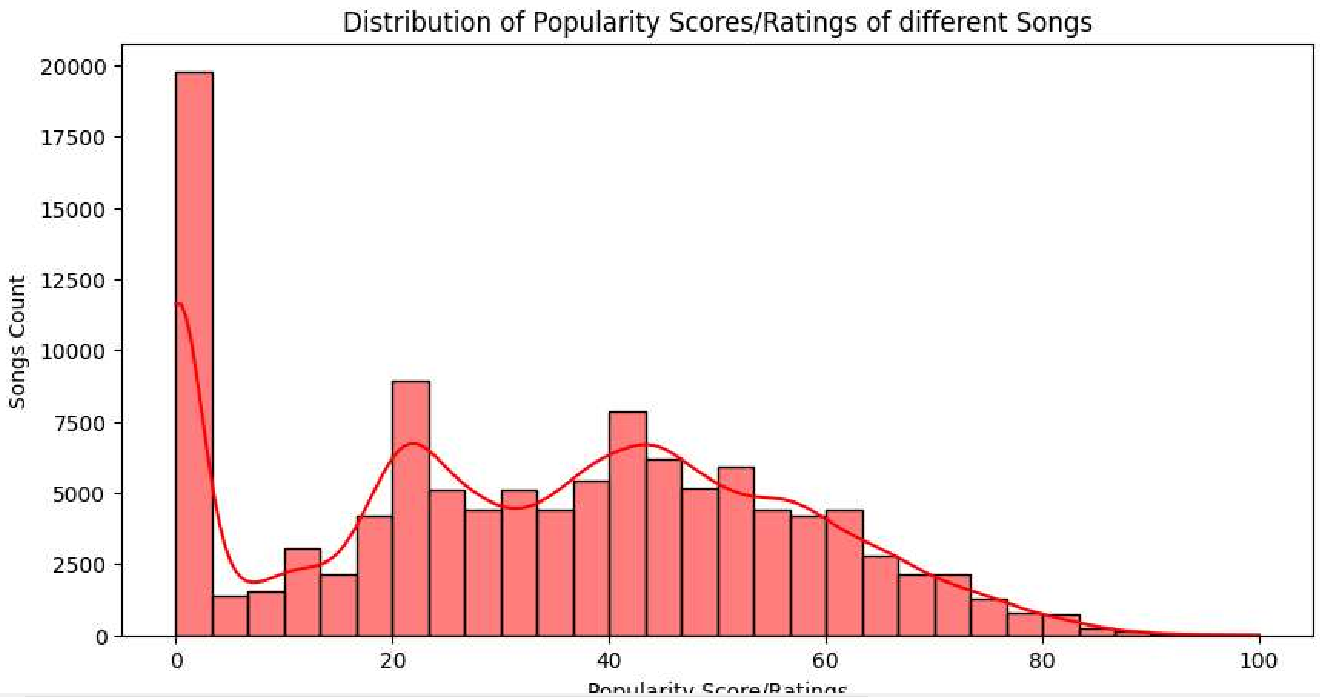
```
music_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 114000 entries, 0 to 113999
Data columns (total 21 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   Unnamed: 0        114000 non-null  int64  
 1   track_id          114000 non-null  object 
 2   artists           113999 non-null  object 
 3   album_name        113999 non-null  object 
 4   track_name        113999 non-null  object 
 5   popularity        114000 non-null  int64  
 6   duration_ms       114000 non-null  int64  
 7   explicit          114000 non-null  bool   
 8   danceability      114000 non-null  float64
 9   energy            114000 non-null  float64
 10  key               114000 non-null  int64  
 11  loudness          114000 non-null  float64
 12  mode              114000 non-null  int64  
 13  speechiness       114000 non-null  float64
 14  acousticness      114000 non-null  float64
 15  instrumentalness  114000 non-null  float64
 16  liveness          114000 non-null  float64
 17  valence           114000 non-null  float64
 18  tempo             114000 non-null  float64
 19  time_signature    114000 non-null  int64  
 20  track_genre       114000 non-null  object 
dtypes: bool(1), float64(9), int64(6), object(5)
memory usage: 17.5+ MB
```

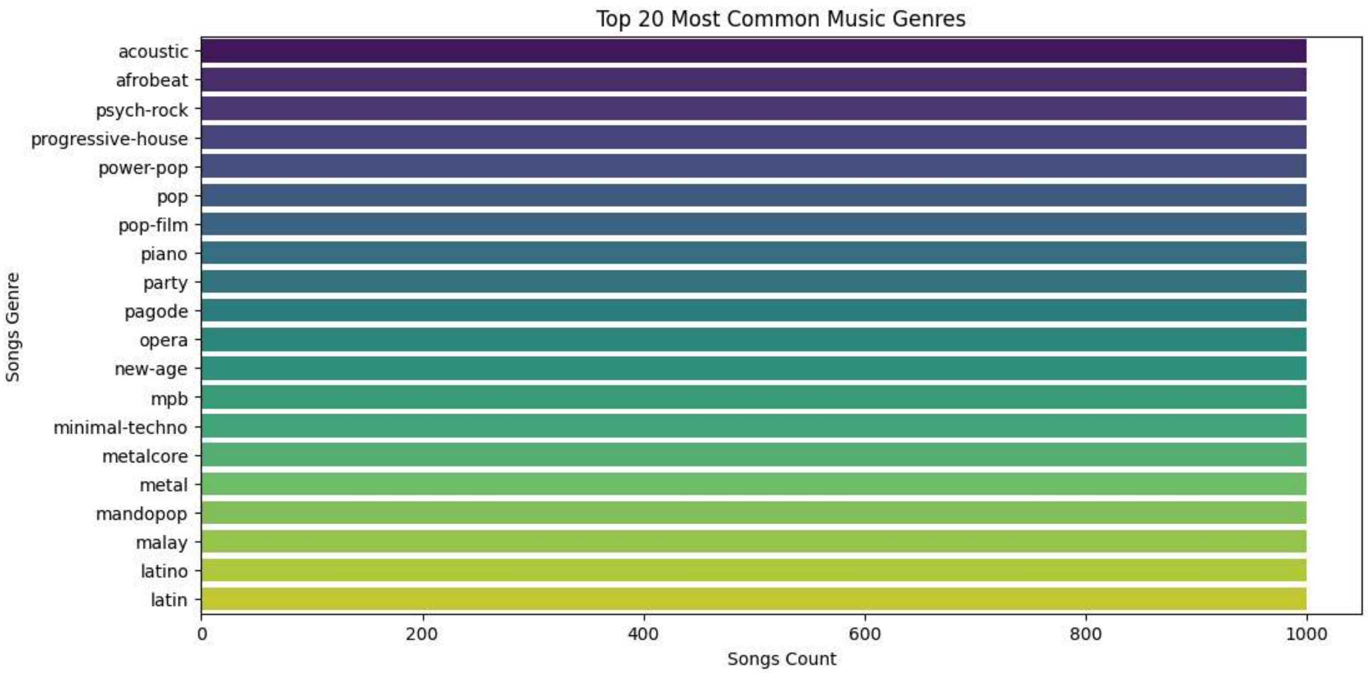
```
music_df.isna().sum()
```

	0
Unnamed: 0	0
track_id	0
artists	1
album_name	1
track_name	1
popularity	0
duration_ms	0
explicit	0
danceability	0
energy	0
key	0
loudness	0
mode	0
speechiness	0
acousticness	0
instrumentalness	0
liveness	0
valence	0
tempo	0
time_signature	0
track_genre	0

```
music_df.drop({"Unnamed: 0"}, axis=1, inplace=True)

# Drop missing values
music_df.dropna(inplace=True)

# Convert duration from milliseconds to minutes
music_df["duration_min"] = music_df["duration_ms"] / 60000


plt.figure(figsize=(10, 5))
sns.histplot(music_df["popularity"], bins=30, kde=True, color="red")
plt.xlabel("Popularity Score/Ratings")
plt.ylabel("Songs Count")
plt.title("Distribution of Popularity Scores/Ratings of different Songs")
plt.show()
```

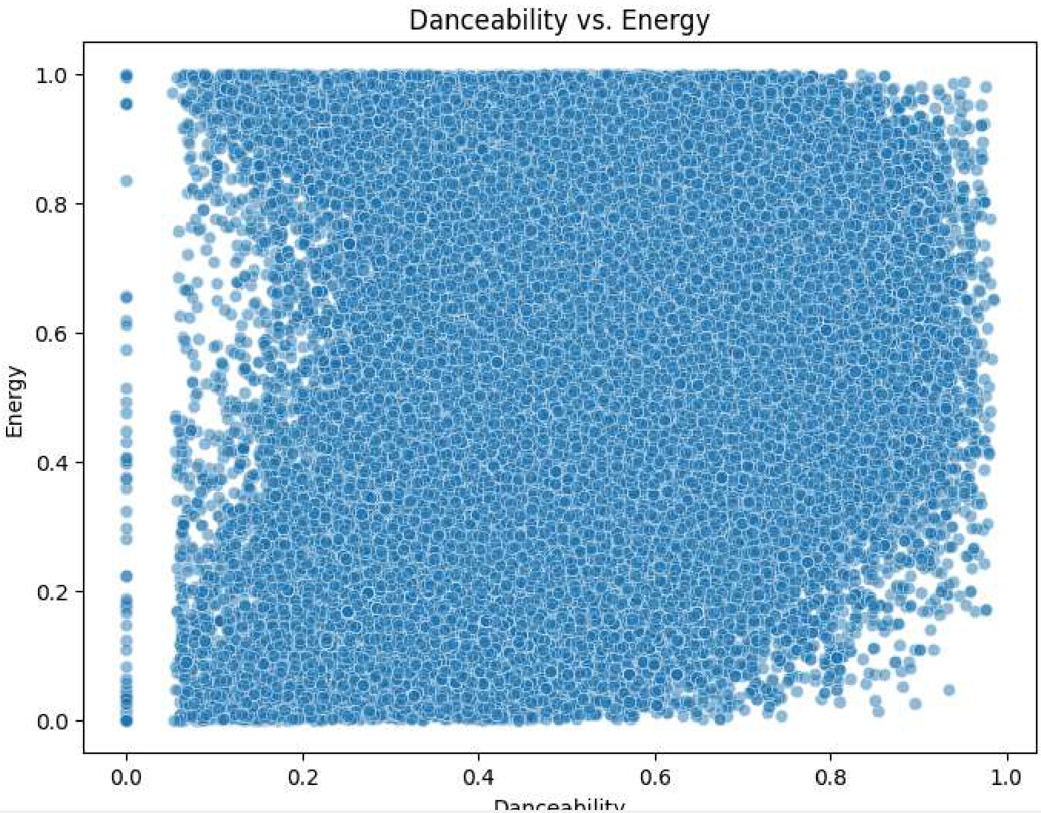


```
plt.figure(figsize=(12, 6))
top_genres = music_df["track_genre"].value_counts().head(20)
sns.barplot(x=top_genres.values, y=top_genres.index, hue=top_genres.index, palette="viridis", legend=False)
plt.xlabel("Songs Count")
plt.ylabel("Songs Genre")
plt.title("Top 20 Most Common Music Genres")
plt.show()
```

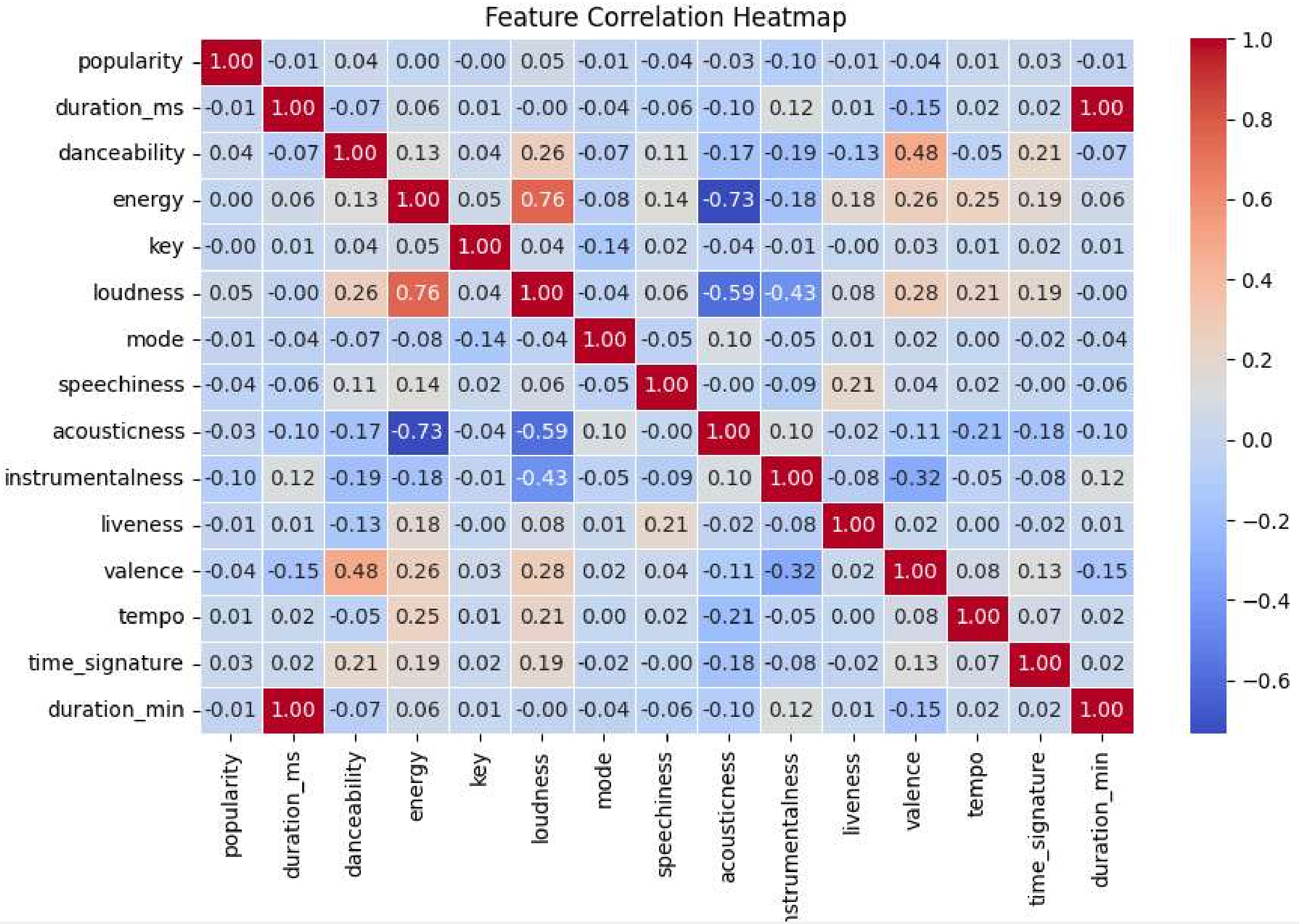


```
plt.figure(figsize=(8, 6))
sns.scatterplot(x=music_df["danceability"], y=music_df["energy"], alpha=0.5)
```

```
plt.xlabel("Danceability")
plt.ylabel("Energy")
plt.title("Danceability vs. Energy")
plt.show();
```



```
numeric_cols = music_df.select_dtypes(include=['number'])

plt.figure(figsize=(10, 6))
sns.heatmap(numeric_cols.corr(), annot=True, cmap="coolwarm", fmt=".2f", linewidths=0.5)
plt.title("Feature Correlation Heatmap")
plt.show()
```



	popularity	duration_ms	danceability	energy	key	loudness	mode	speechiness	acousticness	nstrumentalness	liveness	valence	tempo	time_signature	duration_min
popularity	1.00	-0.01	0.04	0.00	-0.00	0.05	-0.01	-0.04	-0.03	-0.10	-0.01	-0.04	0.01	0.03	-0.01
duration_ms	-0.01	1.00	-0.07	0.06	0.01	-0.00	-0.04	-0.06	-0.10	0.12	0.01	-0.15	0.02	0.02	1.00
danceability	0.04	-0.07	1.00	0.13	0.04	0.26	-0.07	0.11	-0.17	-0.19	-0.13	0.48	-0.05	0.21	-0.07
energy	0.00	0.06	0.13	1.00	0.05	0.76	-0.08	0.14	-0.73	-0.18	0.18	0.26	0.25	0.19	0.06
key	-0.00	0.01	0.04	0.05	1.00	0.04	-0.14	0.02	-0.04	-0.01	-0.00	0.03	0.01	0.02	0.01
loudness	0.05	-0.00	0.26	0.76	0.04	1.00	-0.04	0.06	-0.59	-0.43	0.08	0.28	0.21	0.19	-0.00
mode	-0.01	-0.04	-0.07	-0.08	-0.14	-0.04	1.00	-0.05	0.10	-0.05	0.01	0.02	0.00	-0.02	-0.04
speechiness	-0.04	-0.06	0.11	0.14	0.02	0.06	-0.05	1.00	-0.00	-0.09	0.21	0.04	0.02	-0.00	-0.06
acousticness	-0.03	-0.10	-0.17	-0.73	-0.04	-0.59	0.10	-0.00	1.00	0.10	-0.02	-0.11	-0.21	-0.18	-0.10
instrumentalness	-0.10	0.12	-0.19	-0.18	-0.01	-0.43	-0.05	-0.09	0.10	1.00	-0.08	-0.32	-0.05	-0.08	0.12
liveness	-0.01	0.01	-0.13	0.18	-0.00	0.08	0.01	0.21	-0.02	-0.08	1.00	0.02	0.00	-0.02	0.01
valence	-0.04	-0.15	0.48	0.26	0.03	0.28	0.02	0.04	-0.11	-0.32	0.02	1.00	0.08	0.13	-0.15
tempo	0.01	0.02	-0.05	0.25	0.01	0.21	0.00	0.02	-0.21	-0.05	0.00	0.08	1.00	0.07	0.02
time_signature	0.03	0.02	0.21	0.19	0.02	0.19	-0.02	-0.00	-0.18	-0.08	-0.02	0.13	0.07	1.00	0.02
duration_min	-0.01	1.00	-0.07	0.06	0.01	-0.00	-0.04	-0.06	-0.10	0.12	0.01	-0.15	0.02	0.02	1.00

Books Dataset Preprocesssing & Visualizations

```
books_df = books_data["train"].to_pandas()
books_df.head()
```

	Unnamed: 0	Book	Author	Description	Genres	Avg_Rating	Num_Ratings	
0	0	To Kill a Mockingbird	Harper Lee	The unforgettable novel of a childhood in a sl...	['Classics', 'Fiction', 'Historical Fiction', ...	4.27	5,691,311	https://www.goodreads.com/book/show/2
1	1	Harry Potter and the Philosopher's Stone (Harr...	J.K. Rowling	Harry Potter thinks he is an ordinary boy - un...	['Fantasy', 'Fiction', 'Young Adult', 'Magic',...	4.47	9,278,135	https://www.goodreads.com/book/show/7
2	2	Pride and Prejudice	Jane Austen	Since its immediate success in 1813, Pride and...	['Classics', 'Fiction', 'Romance', 'Historical...	4.28	3,944,155	https://www.goodreads.com/book/show/'
3	3	The Diary of a Young Girl	Anne Frank	Discovered in the attic in which she spent the...	['Classics', 'Nonfiction', 'History', 'Biograp...	4.18	3,488,438	https://www.goodreads.com/book/show/48

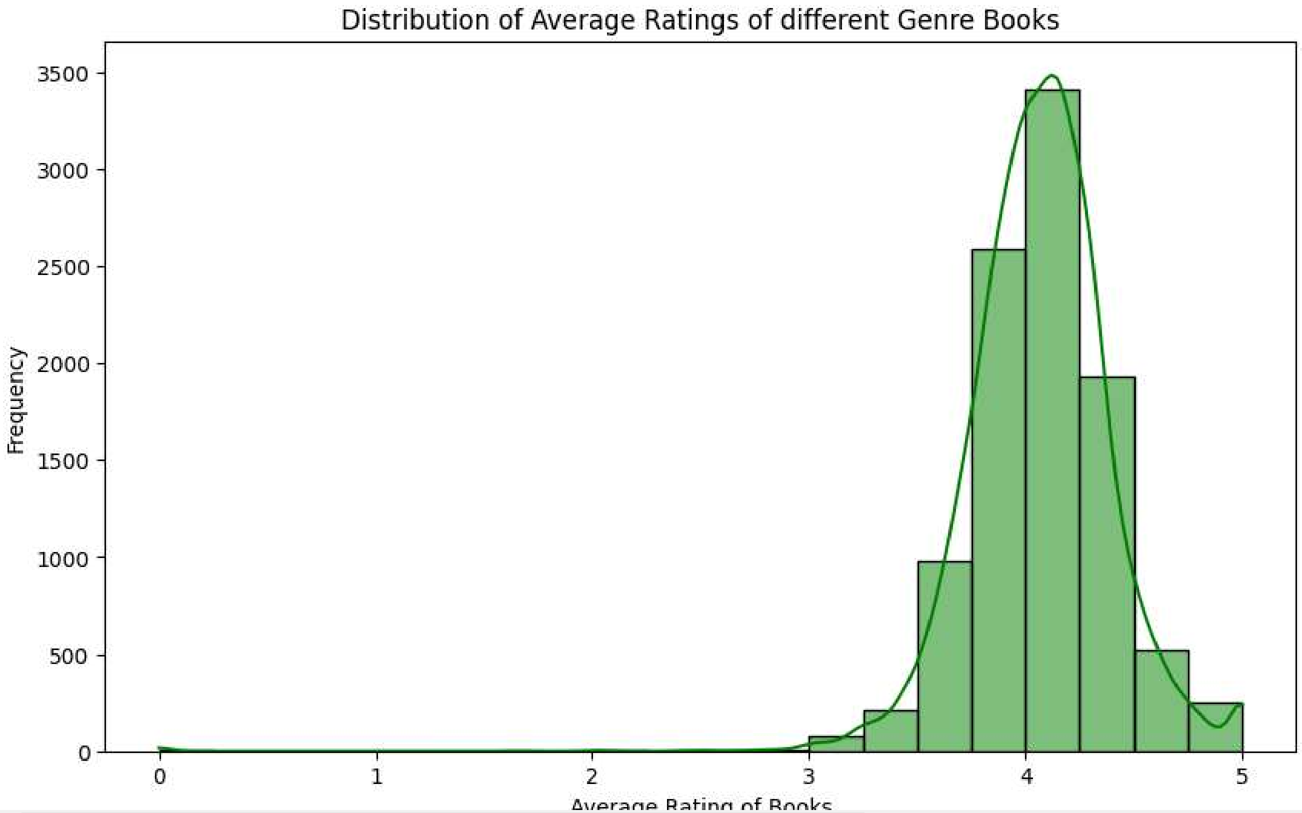
Next steps: View recommended plots New interactive sheet

```
books_df.info()
```

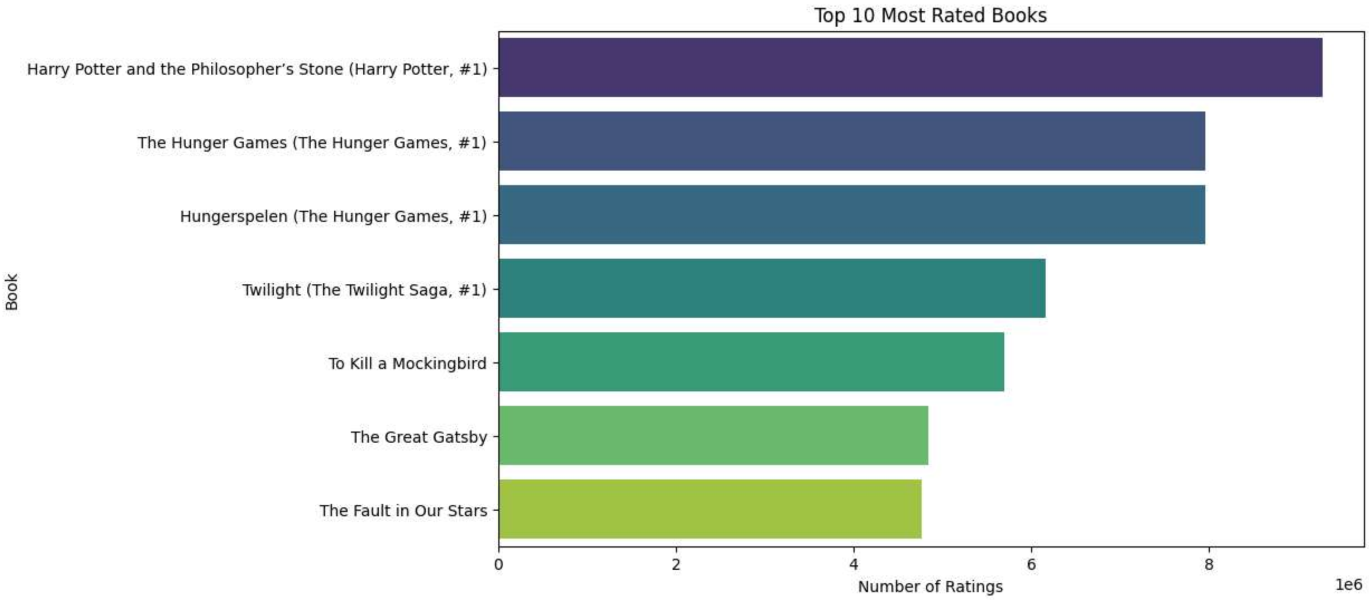
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10000 entries, 0 to 9999
Data columns (total 8 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   Unnamed: 0   10000 non-null  int64  
 1   Book         10000 non-null  object 
 2   Author       10000 non-null  object 
 3   Description  9923 non-null   object 
 4   Genres       10000 non-null  object 
 5   Avg_Rating   10000 non-null  float64
 6   Num_Ratings  10000 non-null  object 
 7   URL          10000 non-null  object 
dtypes: float64(1), int64(1), object(6)
memory usage: 625.1+ KB
```

```
import ast
books_df['Num_Ratings'] = books_df['Num_Ratings'].apply(lambda x: int(x.replace(',', '')))

books_df.fillna({'Description':"No Description Available"}, inplace=True)

books_df['Genres'] = books_df['Genres'].apply(lambda x: ast.literal_eval(x))

genres_exploded = books_df.explode('Genres')
```

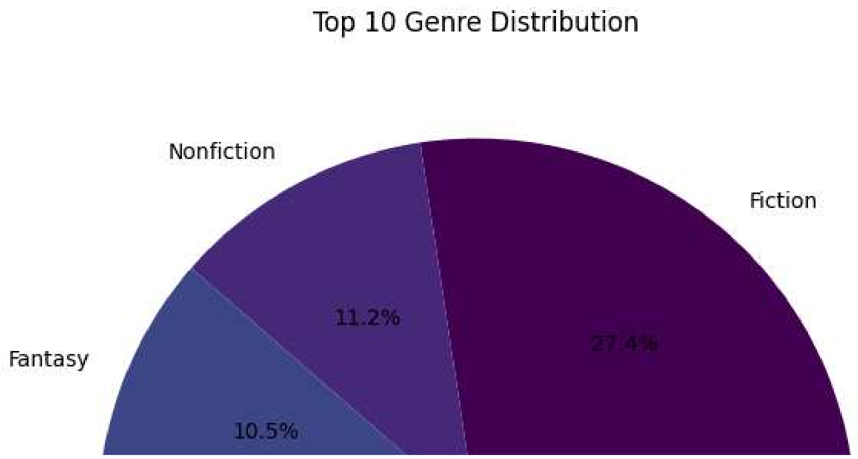
```
plt.figure(figsize=(10, 6))
sns.histplot(books_df['Avg_Rating'], bins=20, kde=True, color='green')
plt.title('Distribution of Average Ratings of different Genre Books')
plt.xlabel('Average Rating of Books')
plt.ylabel('Frequency')
plt.show()
```



```
top_rated_books = books_df.nlargest(10, 'Num_Ratings')

plt.figure(figsize=(10, 6))
sns.barplot(x='Num_Ratings', y='Book', data=top_rated_books,hue="Book", palette='viridis', legend=False)
plt.title('Top 10 Most Rated Books')
plt.xlabel('Number of Ratings')
plt.ylabel('Book')
plt.show()
```



```
# Genre Distribution (Top 10 genres)
top_genres_pie = books_df['Genres'].explode().value_counts().nlargest(10)
plt.figure(figsize=(8, 8))
top_genres_pie.plot.pie(autopct='%1.1f%%', cmap='viridis', legend=False)
plt.title('Top 10 Genre Distribution')
plt.ylabel('')
plt.show()
```



```
top_authors = books_df['Author'].value_counts().nlargest(20)
plt.figure(figsize=(10, 6))
sns.barplot(x=top_authors.values, y=top_authors.index, hue=top_authors.index, palette='viridis', legend=False)
plt.title('Top 20 Authors by Number of Books')
plt.xlabel('Number of Books')
plt.ylabel('Author')
plt.show()
```

Top 20 Authors by Number of Books
Stephen King
William Shakespeare
Terry Pratchett
Agatha Christie