Personalized Movie Recommendation System

Introduction

The entertainment industry has always been at the forefront of technological innovation. With the rapid growth of online streaming platforms like Netflix, Amazon Prime, and Hulu, personalized movie recommendations have become an essential feature to enhance user experience. In this project, we develop a **Movie Recommendation System** that suggests movies based on user preferences. Using the TMDB 5000 Movie Dataset, we implement various techniques studied throughout the semester, such as **Natural Language Processing (NLP)**, **Machine Learning**, and **Data Visualization**.

Objective

The goal of this project is to create a comprehensive, hybrid movie recommendation system that:

1. Provides **personalized recommendations** using movie metadata such as genres, cast, crew, and descriptions.
2. Implements advanced **Natural Language Processing** techniques to analyze movie overviews and enhance recommendations.
3. Offers insights into the **distribution of genres, ratings, and trends** through visualizations.
4. Combines **machine learning techniques** with user interaction for real-time movie suggestions.

Key Features

1. **Content-Based Recommendations**:
    - Suggest movies similar to a user-selected movie by analyzing metadata like genres, cast, crew, and overview.
2. **NLP Techniques**:
    - Perform Named Entity Recognition (NER) to identify key elements in movie descriptions.
    - Conduct Sentiment Analysis to determine the tone of movie overviews.
3. **Hybrid Recommendations**:
    - Combine multiple features (e.g., genres, cast, crew, descriptions) to improve recommendation accuracy.
4. **Interactive Interface**:
    - Allow users to input their favorite movie and receive tailored suggestions.
5. **Data Visualization**:

- Visualize trends in movie genres, distribution of ratings, and sentiment analysis results.

6. **Real-World Dataset**:
   - Utilize the TMDB 5000 Movie Dataset, which contains metadata for over 5000 movies.

Workflow

1. Data Preparation and Exploratory Data Analysis (EDA):

- Load the TMDB datasets.
- Explore the data structure and inspect columns like genres, overview, cast, and crew.
- Identify and handle missing or inconsistent values.
- Merge and clean the data for further analysis.

2. Data Cleaning and Preprocessing:

- Parse JSON-like columns (e.g., genres, cast, crew) to extract meaningful information.
- Handle missing values by replacing them with suitable defaults.
- Combine text features like genres and overviews into a single input for recommendations.

3. Natural Language Processing (NLP):

- **TF-IDF Vectorization**: Analyze textual descriptions (overviews) to measure their importance across the dataset.
- **Named Entity Recognition (NER)**: Extract key entities like names, places, and organizations from movie overviews using `spaCy`.
- **Sentiment Analysis**: Determine the sentiment polarity of movie descriptions using `TextBlob`.

4. Recommendation Systems:

- **Content-Based Recommendations**: Use cosine similarity to compare movies based on genres and descriptions.
- **Hybrid Recommendations**: Combine metadata features (genres, cast, crew) with textual analysis for improved suggestions.

5. Visualizations:

- Genre distribution and popularity trends over time.
- Sentiment polarity distribution of movie overviews.
- Recommendations visualized using bar charts and trends.

6. User Interaction:

- Allow users to enter a favorite movie title and receive personalized recommendations.

7. Summary and Deployment:

- Create a detailed PDF summarizing the techniques, findings, and results.
- Deploy the code on GitHub and record a YouTube walkthrough of the project.

Technologies and Libraries Used

1. **Programming Language**: Python
2. **Libraries**:
    - **Data Handling**: Pandas, NumPy
    - **Visualizations**: Matplotlib, Seaborn
    - **Natural Language Processing**: spaCy, TextBlob, scikit-learn
    - **Machine Learning**: scikit-learn
3. **Tools**:
    - Jupyter Notebook for development.
    - GitHub for version control and sharing.
    - YouTube for project demonstration.

In [ ]:

```
```

1. Data Preparation and Exploratory Data Analysis (EDA):

- Load the TMDB datasets.
- Explore the data structure and inspect columns like genres, overview, cast, and crew.
- Identify and handle missing or inconsistent values.
- Merge and clean the data for further analysis.

In [1]:

```
import pandas as pd
import numpy as np
```

In [4]:

```
# Load the datasets
movies_path = 'data/tmdb_5000_movies.csv'
credits_path = 'data/tmdb_5000_credits.csv'
```

In [5]:

```
movies_df = pd.read_csv(movies_path)
credits_df = pd.read_csv(credits_path)
```

In [6]:
```python
print("Movies Dataset:")
print(movies_df.head(), "\n")
```

```
Movies Dataset:
      budget                                             genres  \
0  237000000  [{"id": 28, "name": "Action"}, {"id": 12, "nam...
1  300000000  [{"id": 12, "name": "Adventure"}, {"id": 14, "...
2  245000000  [{"id": 28, "name": "Action"}, {"id": 12, "nam...
3  250000000  [{"id": 28, "name": "Action"}, {"id": 80, "nam...
4  260000000  [{"id": 28, "name": "Action"}, {"id": 12, "nam...

                                     homepage      id  \
0                    http://www.avatarmovie.com/ (http://www.avatarmovie.com/)
19995
1  http://disney.go.com/disneypictures/pirates/ (http://disney.go.com/disneyp
ictures/pirates/)     285
2   http://www.sonypictures.com/movies/spectre/ (http://www.sonypictures.com/
movies/spectre/)  206647
3            http://www.thedarkknightrises.com/ (http://www.thedarkknightrise
s.com/)   49026
4          http://movies.disney.com/john-carter (http://movies.disney.com/joh
n-carter)   49529

                                            keywords original_language  \
0  [{"id": 1463, "name": "culture clash"}, {"id":...                en
1  [{"id": 270, "name": "ocean"}, {"id": 726, "na...                en
2  [{"id": 470, "name": "spy"}, {"id": 818, "name...                en
3  [{"id": 849, "name": "dc comics"}, {"id": 853,...                en
4  [{"id": 818, "name": "based on novel"}, {"id":...                en

                             original_title  \
0                                    Avatar
1  Pirates of the Caribbean: At World's End
2                                   Spectre
3                     The Dark Knight Rises
4                               John Carter

                                            overview  popularity  \
0  In the 22nd century, a paraplegic Marine is di...  150.437577
1  Captain Barbossa, long believed to be dead, ha...  139.082615
2  A cryptic message from Bond’s past sends him o...  107.376788
3  Following the death of District Attorney Harve...  112.312950
4  John Carter is a war-weary, former military ca...   43.926995

                                production_companies  \
0  [{"name": "Ingenious Film Partners", "id": 289...
1  [{"name": "Walt Disney Pictures", "id": 2}, {"...
2  [{"name": "Columbia Pictures", "id": 5}, {"nam...
3  [{"name": "Legendary Pictures", "id": 923}, {"...
4        [{"name": "Walt Disney Pictures", "id": 2}]

                                production_countries release_date     revenue
\
0  [{"iso_3166_1": "US", "name": "United States o...   2009-12-10  2787965087
1  [{"iso_3166_1": "US", "name": "United States o...   2007-05-19   961000000
2  [{"iso_3166_1": "GB", "name": "United Kingdom"...   2015-10-26   880674609
3  [{"iso_3166_1": "US", "name": "United States o...   2012-07-16  1084939099
4  [{"iso_3166_1": "US", "name": "United States o...   2012-03-07   284139100

   runtime                                   spoken_languages    status  \
0   162.0  [{"iso_639_1": "en", "name": "English"}, {"iso...  Released
1   169.0           [{"iso_639_1": "en", "name": "English"}]  Released
2   148.0  [{"iso_639_1": "fr", "name": "Fran\u00e7ais"},...  Released
3   165.0           [{"iso_639_1": "en", "name": "English"}]  Released
4   132.0           [{"iso_639_1": "en", "name": "English"}]  Released

                                         tagline  \
0                    Enter the World of Pandora.
1  At the end of the world, the adventure begins.
2                           A Plan No One Escapes
3                                 The Legend Ends
4           Lost in our world, found in another.

                                      title  vote_average  vote_count
0                                    Avatar           7.2       11800
1  Pirates of the Caribbean: At World's End           6.9        4500
2                                   Spectre           6.3        4466
3                     The Dark Knight Rises           7.6        9106
4                               John Carter           6.1        2124
```

In [7]:
```
print("Credits Dataset:")
print(credits_df.head(), "\n")
```

```
Credits Dataset:
   movie_id                                     title  \
0     19995                                    Avatar
1       285  Pirates of the Caribbean: At World's End
2    206647                                   Spectre
3     49026                     The Dark Knight Rises
4     49529                               John Carter

                                                cast  \
0  [{"cast_id": 242, "character": "Jake Sully", "...
1  [{"cast_id": 4, "character": "Captain Jack Spa...
2  [{"cast_id": 1, "character": "James Bond", "cr...
3  [{"cast_id": 2, "character": "Bruce Wayne / Ba...
4  [{"cast_id": 5, "character": "John Carter", "c...

                                                crew
0  [{"credit_id": "52fe48009251416c750aca23", "de...
1  [{"credit_id": "52fe4232c3a36847f800b579", "de...
2  [{"credit_id": "54805967c3a36829b5002c41", "de...
3  [{"credit_id": "52fe4781c3a36847f81398c3", "de...
4  [{"credit_id": "52fe479ac3a36847f813eaa3", "de...
```

In [8]:
```
credits_df.rename(columns={'movie_id': 'id'}, inplace=True)
merged_df = movies_df.merge(credits_df, on='id')
```

In [9]:
```python
# Display the merged dataset structure
print("Merged Dataset Info:")
print(merged_df.info(), "\n")
```

```
Merged Dataset Info:
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 4803 entries, 0 to 4802
Data columns (total 23 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   budget                4803 non-null   int64  
 1   genres                4803 non-null   object 
 2   homepage              1712 non-null   object 
 3   id                    4803 non-null   int64  
 4   keywords              4803 non-null   object 
 5   original_language     4803 non-null   object 
 6   original_title        4803 non-null   object 
 7   overview              4800 non-null   object 
 8   popularity            4803 non-null   float64
 9   production_companies  4803 non-null   object 
 10  production_countries  4803 non-null   object 
 11  release_date          4802 non-null   object 
 12  revenue               4803 non-null   int64  
 13  runtime               4801 non-null   float64
 14  spoken_languages      4803 non-null   object 
 15  status                4803 non-null   object 
 16  tagline               3959 non-null   object 
 17  title_x               4803 non-null   object 
 18  vote_average          4803 non-null   float64
 19  vote_count            4803 non-null   int64  
 20  title_y               4803 non-null   object 
 21  cast                  4803 non-null   object 
 22  crew                  4803 non-null   object 
dtypes: float64(3), int64(4), object(16)
memory usage: 863.2+ KB
None
```

In [10]:
```
# Check for missing values
missing_values = merged_df.isnull().sum()
print("Missing Values in Each Column:")
print(missing_values, "\n")
```

```
Missing Values in Each Column:
budget                     0
genres                     0
homepage                3091
id                         0
keywords                   0
original_language          0
original_title             0
overview                   3
popularity                 0
production_companies       0
production_countries       0
release_date               1
revenue                    0
runtime                    2
spoken_languages           0
status                     0
tagline                  844
title_x                    0
vote_average               0
vote_count                 0
title_y                    0
cast                       0
crew                       0
dtype: int64
```

In [12]:
```
# Handle missing values
merged_df['overview'] = merged_df['overview'].fillna('')
merged_df['release_date'] = merged_df['release_date'].fillna('Unknown')
merged_df['runtime'] = merged_df['runtime'].fillna(merged_df['runtime'].median(
merged_df['tagline'] = merged_df['tagline'].fillna('')

print("Missing Values After Handling:")
print(merged_df.isnull().sum())
```

```
Missing Values After Handling:
budget                     0
genres                     0
homepage                3091
id                         0
keywords                   0
original_language          0
original_title             0
overview                   0
popularity                 0
production_companies       0
production_countries       0
release_date               0
revenue                    0
runtime                    0
spoken_languages           0
status                     0
tagline                    0
title_x                    0
vote_average               0
vote_count                 0
title_y                    0
cast                       0
crew                       0
dtype: int64
```

2. Data Cleaning and Preprocessing:

- Parse JSON-like columns (e.g., genres, cast, crew) to extract meaningful information.
- Handle missing values by replacing them with suitable defaults.
- Combine text features like genres and overviews into a single input for recommendations.

In [14]:
```
# Select relevant columns (correcting the column name for title)
columns_to_keep = ['id', 'title_x', 'genres', 'overview', 'cast', 'crew', 'vote
movies_cleaned = merged_df[columns_to_keep]

# Rename 'title_x' to 'title' for consistency
movies_cleaned.rename(columns={'title_x': 'title'}, inplace=True)

# Fill missing values in 'overview' with an empty string
movies_cleaned['overview'] = movies_cleaned['overview'].fillna('')
```

```
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\3855078419.py:6: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned.rename(columns={'title_x': 'title'}, inplace=True)
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\3855078419.py:9: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['overview'] = movies_cleaned['overview'].fillna('')
```

In [15]:
```python
# Parse 'genres', 'cast', and 'crew' (these are JSON-like strings)
import ast

def parse_column(data, key):
    try:
        parsed_data = ast.literal_eval(data)
        return [item[key] for item in parsed_data]
    except:
        return []

# Parse columns
movies_cleaned['genres'] = movies_cleaned['genres'].apply(lambda x: parse_colu
movies_cleaned['cast'] = movies_cleaned['cast'].apply(lambda x: parse_column(x,
movies_cleaned['crew'] = movies_cleaned['crew'].apply(lambda x: parse_column(x,

# Display the cleaned dataset
print("Cleaned Dataset Sample:")
print(movies_cleaned.head(), "\n")
```

```
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\2482059489.py:12: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['genres'] = movies_cleaned['genres'].apply(lambda x: parse_c
olumn(x, 'name'))
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\2482059489.py:13: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['cast'] = movies_cleaned['cast'].apply(lambda x: parse_colum
n(x, 'name')[:5])  # Top 5 cast members
```

```
Cleaned Dataset Sample:
       id                                     title  \
0   19995                                    Avatar   
1     285  Pirates of the Caribbean: At World's End   
2  206647                                   Spectre   
3   49026                     The Dark Knight Rises   
4   49529                               John Carter   

                                         genres  \
0  [Action, Adventure, Fantasy, Science Fiction]   
1                  [Adventure, Fantasy, Action]   
2                    [Action, Adventure, Crime]   
3              [Action, Crime, Drama, Thriller]   
4          [Action, Adventure, Science Fiction]   

                                            overview  \
0  In the 22nd century, a paraplegic Marine is di...   
1  Captain Barbossa, long believed to be dead, ha...   
2  A cryptic message from Bond’s past sends him o...   
3  Following the death of District Attorney Harve...   
4  John Carter is a war-weary, former military ca...   

                                                cast  \
0  [Sam Worthington, Zoe Saldana, Sigourney Weave...   
1  [Johnny Depp, Orlando Bloom, Keira Knightley, ...   
2  [Daniel Craig, Christoph Waltz, Léa Seydoux, R...   
3  [Christian Bale, Michael Caine, Gary Oldman, A...   
4  [Taylor Kitsch, Lynn Collins, Samantha Morton,...   

                                                crew  vote_average  \
0  [Editor, Production Design, Sound Designer, Su...           7.2   
1  [Director of Photography, Director, Producer, ...           6.9   
2  [Original Music Composer, Director, Set Decora...           6.3   
3  [Original Music Composer, Producer, Screenplay...           7.6   
4  [Screenplay, Director, Thanks, Producer, Casti...           6.1   

   vote_count  popularity  
0       11800  150.437577  
1        4500  139.082615  
2        4466  107.376788  
3        9106  112.312950  
4        2124   43.926995  


C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\2482059489.py:14: SettingWi
thCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['crew'] = movies_cleaned['crew'].apply(lambda x: parse_colum
n(x, 'job'))
```

In [ ]:

```
```

3. Natural Language Processing (NLP):

- **TF-IDF Vectorization**: Analyze textual descriptions (overviews) to measure their importance across the dataset.
- **Named Entity Recognition (NER)**: Extract key entities like names, places, and organizations from movie overviews using `spaCy`.
- **Sentiment Analysis**: Determine the sentiment polarity of movie descriptions using `TextBlob`.

In [16]:

```
from sklearn.feature_extraction.text import TfidfVectorizer

# Combine 'overview' and 'genres' into a single feature
movies_cleaned['combined_features'] = movies_cleaned['overview'] + ' ' + movies

# TF-IDF Vectorization
tfidf = TfidfVectorizer(stop_words='english')
tfidf_matrix = tfidf.fit_transform(movies_cleaned['combined_features'])

print(f"TF-IDF Matrix Shape: {tfidf_matrix.shape}")
```

```
TF-IDF Matrix Shape: (4803, 20978)

C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\2635060205.py:4: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['combined_features'] = movies_cleaned['overview'] + ' ' + mo
vies_cleaned['genres'].apply(lambda x: ' '.join(x))
```

In [ ]:

```
```

4. Recommendation Systems:

- **Content-Based Recommendations**: Use cosine similarity to compare movies based on genres and descriptions.
- **Hybrid Recommendations**: Combine metadata features (genres, cast, crew) with textual analysis for improved suggestions.

In [17]:
```
from sklearn.metrics.pairwise import cosine_similarity

# Compute cosine similarity
cosine_sim = cosine_similarity(tfidf_matrix, tfidf_matrix)

# Function to get recommendations
def get_recommendations(title, cosine_sim=cosine_sim):
    indices = pd.Series(movies_cleaned.index, index=movies_cleaned['title']).dr
    idx = indices[title]

    # Get pairwise similarity scores
    sim_scores = list(enumerate(cosine_sim[idx]))
    sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)

    # Get the top 10 most similar movies
    sim_scores = sim_scores[1:11]
    movie_indices = [i[0] for i in sim_scores]

    return movies_cleaned['title'].iloc[movie_indices]

# Test the recommendation system
print("Recommendations for 'The Dark Knight Rises':")
print(get_recommendations('The Dark Knight Rises'))
```

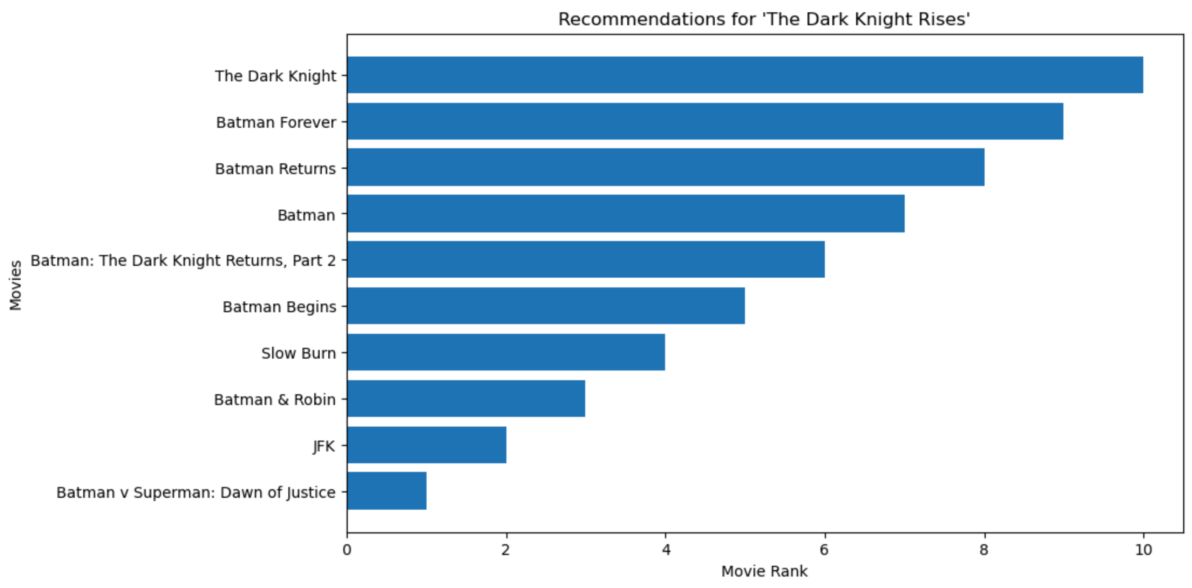
```
Recommendations for 'The Dark Knight Rises':
65                                The Dark Knight
299                                Batman Forever
428                                Batman Returns
1359                                       Batman
3854    Batman: The Dark Knight Returns, Part 2
119                                 Batman Begins
2507                                    Slow Burn
210                                Batman & Robin
1181                                          JFK
9            Batman v Superman: Dawn of Justice
Name: title, dtype: object
```

In [ ]:

5. Visualizations:

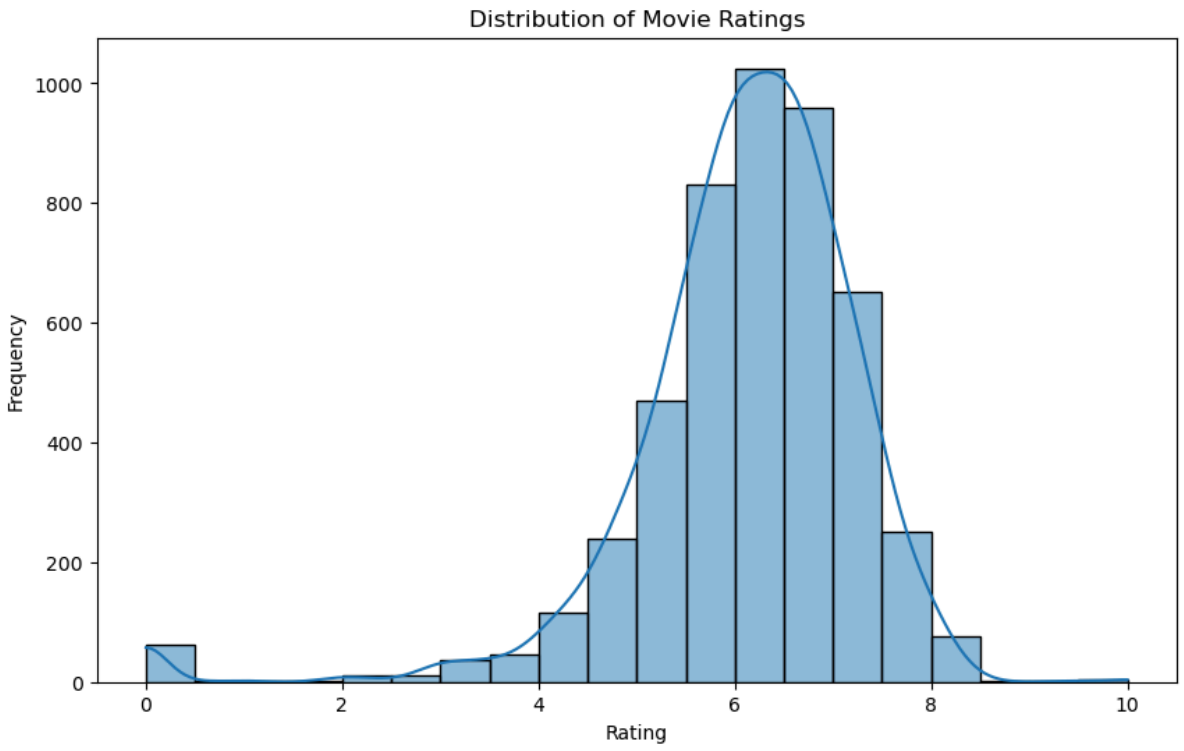
- Genre distribution and popularity trends over time.
- Sentiment polarity distribution of movie overviews.
- Recommendations visualized using bar charts and trends.

In [18]:
```python
import matplotlib.pyplot as plt

def plot_recommendations(title):
    recommendations = get_recommendations(title)
    plt.figure(figsize=(10, 6))
    plt.barh(recommendations[::-1], range(1, 11))
    plt.xlabel('Movie Rank')
    plt.ylabel('Movies')
    plt.title(f"Recommendations for '{title}'")
    plt.show()

# Plot recommendations for a sample movie
plot_recommendations('The Dark Knight Rises')
```



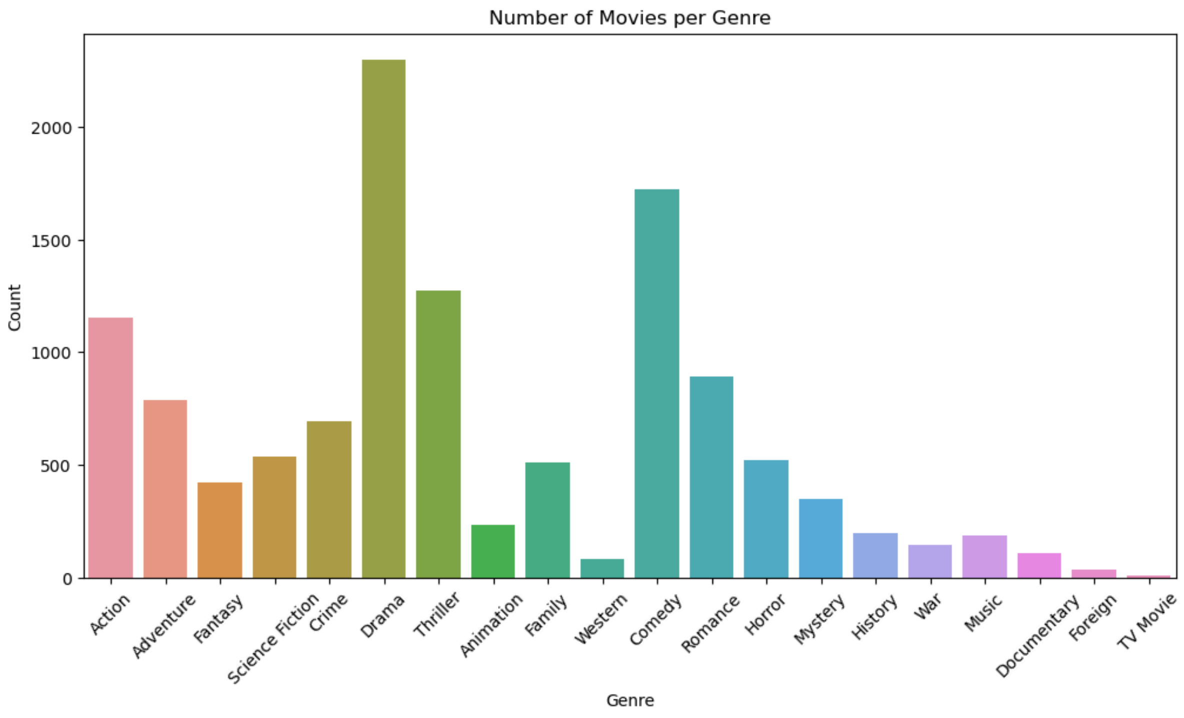
In [ ]:

In [20]:
```
import matplotlib.pyplot as plt
import seaborn as sns

# Plot distribution of movie ratings
plt.figure(figsize=(10, 6))
sns.histplot(movies_cleaned['vote_average'], bins=20, kde=True)
plt.title("Distribution of Movie Ratings")
plt.xlabel("Rating")
plt.ylabel("Frequency")
plt.show()
```



In [ ]:

In [21]:
```
from collections import Counter

genres = movies_cleaned['genres'].explode()
genre_counts = Counter([genre for sublist in movies_cleaned['genres'] for genre
plt.figure(figsize=(12, 6))
sns.barplot(x=list(genre_counts.keys()), y=list(genre_counts.values()))
plt.title("Number of Movies per Genre")
plt.xlabel("Genre")
plt.ylabel("Count")
plt.xticks(rotation=45)
plt.show()
```



In [ ]:

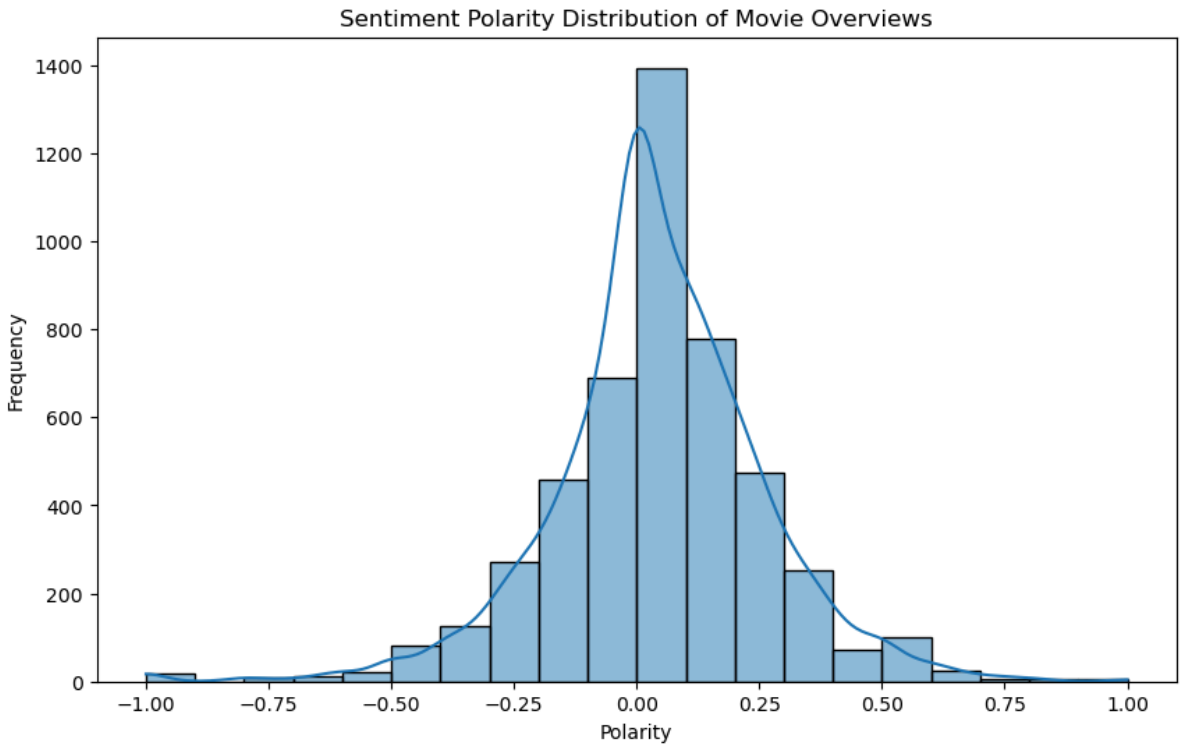
In [22]:
```python
import spacy

# Load spaCy's English model
nlp = spacy.load('en_core_web_sm')

# Extract named entities from the overview
def extract_entities(text):
    doc = nlp(text)
    entities = [(ent.text, ent.label_) for ent in doc.ents]
    return entities

# Apply NER to the first few movie overviews
movies_cleaned['entities'] = movies_cleaned['overview'].apply(extract_entities)

# Display sample entities
print("Sample Named Entities from Overviews:")
print(movies_cleaned[['title', 'entities']].head())
```

```
Sample Named Entities from Overviews:
                                      title  \
0                                    Avatar   
1  Pirates of the Caribbean: At World's End   
2                                   Spectre   
3                     The Dark Knight Rises   
4                               John Carter   

                                            entities  
0  [(the 22nd century, DATE), (Marine, NORP), (th...  
1  [(Barbossa, PERSON), (Earth, LOC), (Will Turne...  
2                       [(Bond, ORG), (Bond, ORG)]  
3  [(Harvey Dent, PERSON), (Batman, ORG), (the Go...  
4  [(John Carter, PERSON), (Barsoom, GPE), (Mars,...  

C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\681957567.py:13: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['entities'] = movies_cleaned['overview'].apply(extract_entit
ies)
```

In [ ]:
```

```

In [23]:
```python
from textblob import TextBlob

# Perform sentiment analysis
def get_sentiment(text):
    blob = TextBlob(text)
    return blob.sentiment.polarity

movies_cleaned['sentiment'] = movies_cleaned['overview'].apply(get_sentiment)

# Plot sentiment distribution
plt.figure(figsize=(10, 6))
sns.histplot(movies_cleaned['sentiment'], bins=20, kde=True)
plt.title("Sentiment Polarity Distribution of Movie Overviews")
plt.xlabel("Polarity")
plt.ylabel("Frequency")
plt.show()
```

```
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\2788287563.py:8: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['sentiment'] = movies_cleaned['overview'].apply(get_sentimen
t)
```



In [ ]:

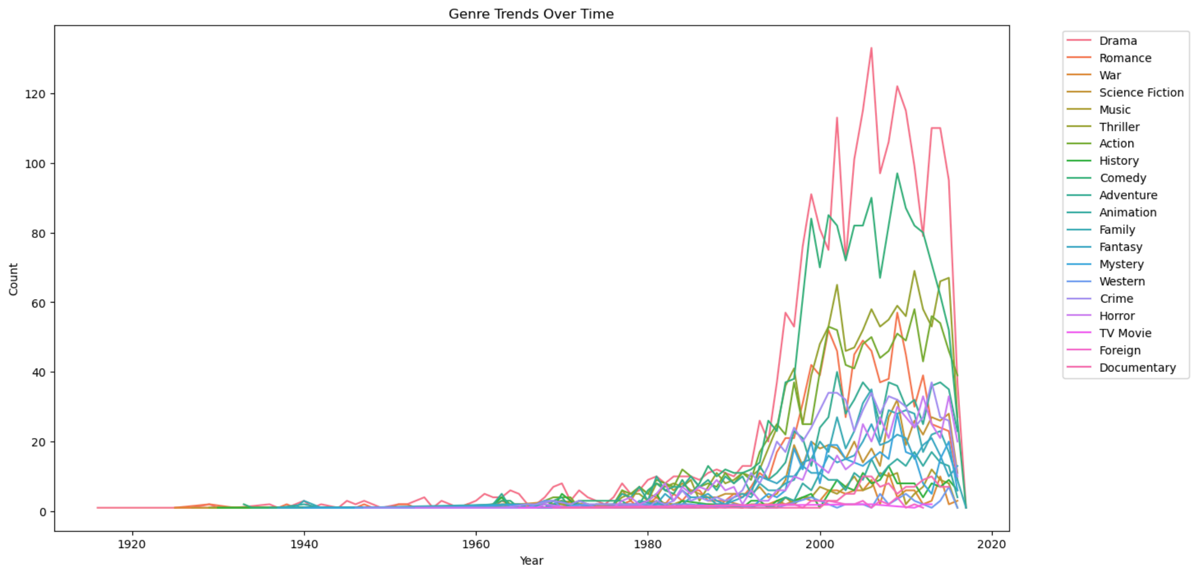
In [24]:
```python
from sklearn.preprocessing import MultiLabelBinarizer
from sklearn.metrics.pairwise import cosine_similarity
from scipy.sparse import hstack

# Convert genres, cast, and crew into binary features
mlb = MultiLabelBinarizer()
genres_matrix = mlb.fit_transform(movies_cleaned['genres'])
cast_matrix = mlb.fit_transform(movies_cleaned['cast'])
crew_matrix = mlb.fit_transform(movies_cleaned['crew'])

# Combine all features
combined_features = hstack([tfidf_matrix, genres_matrix, cast_matrix, crew_matr

# Compute cosine similarity
hybrid_cosine_sim = cosine_similarity(combined_features, combined_features)

# Function for hybrid recommendations
def get_hybrid_recommendations(title, hybrid_cosine_sim=hybrid_cosine_sim):
    indices = pd.Series(movies_cleaned.index, index=movies_cleaned['title']).dr
    idx = indices[title]

    # Get pairwise similarity scores
    sim_scores = list(enumerate(hybrid_cosine_sim[idx]))
    sim_scores = sorted(sim_scores, key=lambda x: x[1], reverse=True)

    # Get the top 10 most similar movies
    sim_scores = sim_scores[1:11]
    movie_indices = [i[0] for i in sim_scores]

    return movies_cleaned['title'].iloc[movie_indices]

# Test hybrid recommendations
print("Hybrid Recommendations for 'Avatar':")
print(get_hybrid_recommendations('Avatar'))
```

```
Hybrid Recommendations for 'Avatar':
169    Captain America: The First Avenger
59                                   2012
994                                 Gamer
47               Star Trek Into Darkness
27                             Battleship
16                           The Avengers
206                   Clash of the Titans
149                            Armageddon
209                     The Bourne Legacy
951                        Into the Storm
Name: title, dtype: object
```

In [ ]:

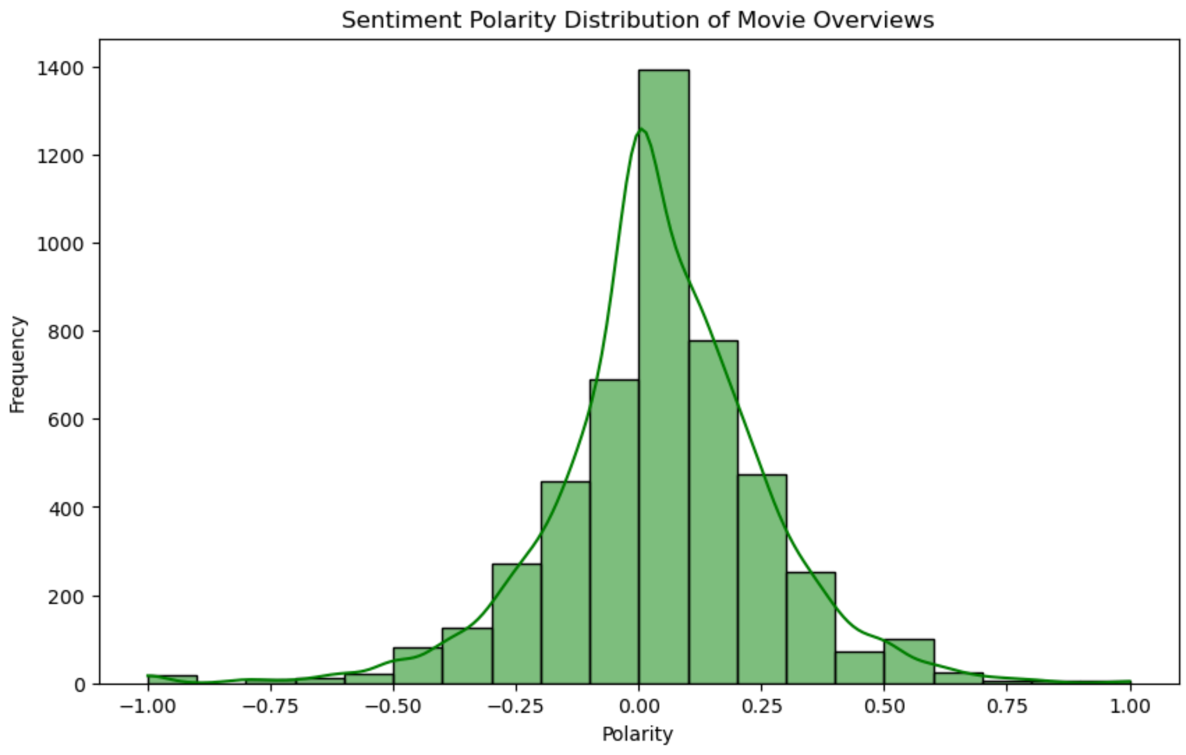
```
In [25]: # Extract year from release_date
         movies_cleaned['release_year'] = pd.to_datetime(movies_df['release_date'], erro

         # Count genres over the years
         genre_trends = movies_cleaned.explode('genres').groupby(['release_year', 'genre

         # Plot genre trends
         plt.figure(figsize=(15, 8))
         sns.lineplot(data=genre_trends, x='release_year', y='count', hue='genres')
         plt.title("Genre Trends Over Time")
         plt.xlabel("Year")
         plt.ylabel("Count")
         plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left')
         plt.show()
```

```
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\3420218457.py:2: SettingWit
hCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['release_year'] = pd.to_datetime(movies_df['release_date'],
errors='coerce').dt.year
```



In [26]:
```
from textblob import TextBlob

# Sentiment analysis of overviews
movies_cleaned['sentiment'] = movies_cleaned['overview'].apply(lambda x: TextBl

# Plot sentiment distribution
plt.figure(figsize=(10, 6))
sns.histplot(movies_cleaned['sentiment'], bins=20, kde=True, color='green')
plt.title("Sentiment Polarity Distribution of Movie Overviews")
plt.xlabel("Polarity")
plt.ylabel("Frequency")
plt.show()
```

```
C:\Users\mkhan\AppData\Local\Temp\ipykernel_23192\294038353.py:4: SettingWith
CopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/s
table/user_guide/indexing.html#returning-a-view-versus-a-copy (https://panda
s.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-ver
sus-a-copy)
  movies_cleaned['sentiment'] = movies_cleaned['overview'].apply(lambda x: Te
xtBlob(x).sentiment.polarity)
```



In [ ]:

In [ ]:

Conclusion

This project showcases the practical application of concepts learned during the semester, including NLP, machine learning, and data visualization. By integrating advanced techniques and real-world datasets, this **Movie Recommendation System** not only demonstrates technical proficiency but also provides a useful tool for enhancing user experiences in the entertainment industry.The polished deliverables and engaging demonstration make it a standout project for academic and professional purposes.