data_analysis

June 30, 2025

[1]:
```
import pyspark.sql.functions as sf
import pandas as pd
from pyspark.sql import SparkSession
import matplotlib.pyplot as plt
```

[7]:
```
# Create pandas DataFrame
df_pd = pd.read_csv("../metadata_output/combined_metadata.csv")
```

[8]:
```
# Create Spark DataFrame
spark = SparkSession.builder.appName("Data Analysis App").getOrCreate()
df_sp = spark.read.csv('../metadata_output/combined_metadata.csv', header=True,␣
 ↪inferSchema=True)
```

3.1 Descriptive Statistics

[9]:
```
# 1. What is the average duration (in seconds) of all videos in the dataset?
average_duration_pd = df_pd["duration_seconds"].mean()
print(f"[Pandas] Average duration of all videos: {average_duration_pd:.2f}␣
 ↪seconds")

average_duration_sp = df_sp.select(sf.mean("duration_seconds"))
print("[Spark] Average duration of all videos:")
average_duration_sp.show()
```

```
[Pandas] Average duration of all videos: 925.00 seconds
[Spark] Average duration of all videos:
+----------------------+
|avg(duration_seconds)|
+----------------------+
|                 925.0|
+----------------------+
```

[10]:
```
# 2. Which uploader appears most frequently in the dataset?
mode_uploader_pd = df_pd["uploader"].mode()
print(f"[Pandas] Most frequent uploader: {mode_uploader_pd[0]}")

mode_uploader_sp = df_sp.groupBy("uploader").count().orderBy(sf.desc("count")).
 ↪limit(1)
```

```
print("[Spark] Most frequent uploader:")
mode_uploader_sp.show()
```

```
[Pandas] Most frequent uploader: Chappell Roan
[Spark] Most frequent uploader:
+-------------+-----+
|     uploader|count|
+-------------+-----+
|Chappell Roan|    2|
+-------------+-----+
```

[11]:
```
# 3. Which five videos have the highest number of views? List their titles and view counts.
top_views_pd = df_pd.nlargest(5, "view_count")[["title", "view_count"]]
print(f"[Pandas] Top 5 videos by view count: {top_views_pd.to_string(index=False)}")

top_views_sp = df_sp.select("title", "view_count").orderBy(sf.desc("view_count")).limit(5)
print("[Spark] Top 5 videos by view count:")
top_views_sp.show()
```

```
[Pandas] Top 5 videos by view count:
title  view_count
                         Chappell Roan - Pink Pony Club (Official Music Video)
78883923
                   Fleetwood Mac - Silver Springs (Live) (Official Video) [HD]
48858370
                        Charlie Chaplin - Final Speech from The Great Dictator
9752840
                              Chappell Roan - The Giver (Official Lyric Video)
7337351
One of The Greatest Speeches Ever by President Obama | Best Eye Opening Speech
2271503
[Spark] Top 5 videos by view count:
+--------------------+----------+
|               title|view_count|
+--------------------+----------+
|Chappell Roan - P…|  78883923|
|Fleetwood Mac - S…|  48858370|
|Charlie Chaplin -…|   9752840|
|Chappell Roan - T…|   7337351|
|One of The Greate…|   2271503|
+--------------------+----------+
```

[12]:
```
# 4. For each upload year, what is the average number of likes?
average_likes_per_year_pd = df_pd.groupby("year_uploaded")["like_count"].mean().
 ↪reset_index()
average_likes_per_year_pd = average_likes_per_year_pd.
 ↪sort_values(by="like_count", ascending=False)
print(f"[Pandas] Average likes per upload year:\n{average_likes_per_year_pd.
 ↪to_string(index=False)}")

average_likes_per_year_sp = df_sp.groupBy("year_uploaded").agg(sf.
 ↪mean("like_count").alias("average_likes"))
average_likes_per_year_sp = average_likes_per_year_sp.orderBy(sf.
 ↪desc("average_likes"))
print("[Spark] Average likes per upload year:")
average_likes_per_year_sp.show()
```

```
[Pandas] Average likes per upload year:
 year_uploaded  like_count
          2020    705409.0
          2018    366570.0
          2016    270825.0
          2025    108317.0
          2022     19761.5
          2023      3900.0
          2019       811.0
[Spark] Average likes per upload year:
+-------------+-------------+
|year_uploaded|average_likes|
+-------------+-------------+
|         2020|     705409.0|
|         2018|     366570.0|
|         2016|     270825.0|
|         2025|     108317.0|
|         2022|      19761.5|
|         2023|       3900.0|
|         2019|        811.0|
+-------------+-------------+
```

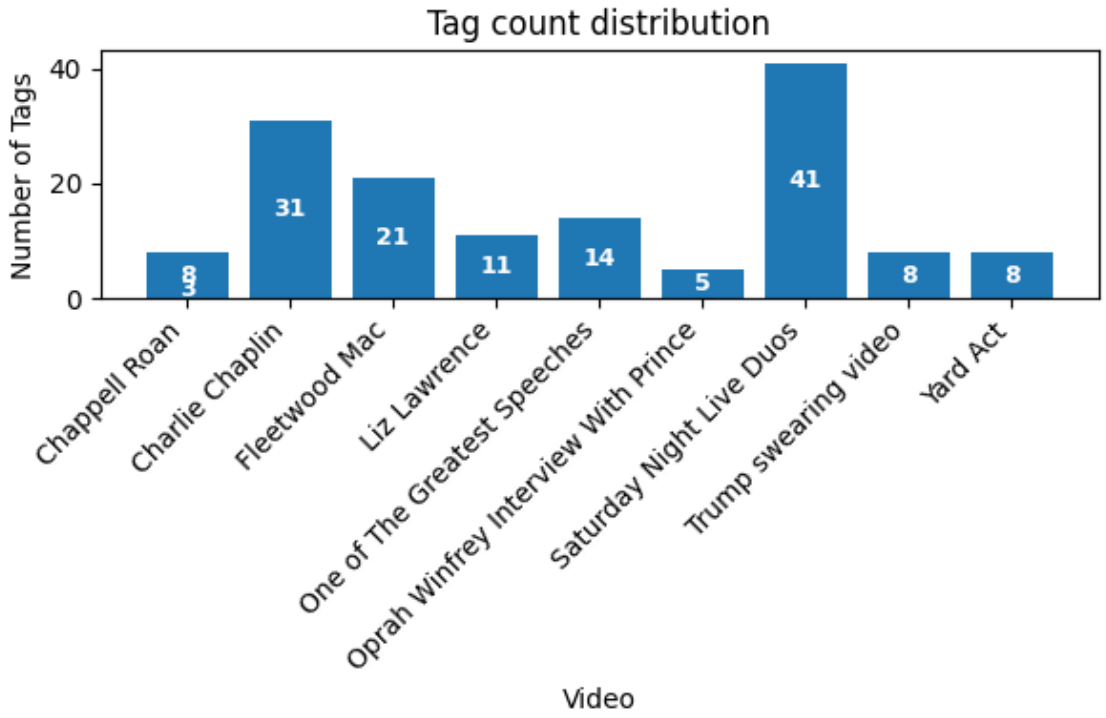
[13]:
```
# 5. How many videos are missing artist information?
missing_artist_count_pd = df_pd["artist"].isnull().sum()
print(f"[Pandas] Number of videos missing artist information:␣
 ↪{missing_artist_count_pd}")

missing_artist_count_sp = df_sp.filter(sf.col("artist").isNull()).count()
print(f"[Spark] Number of videos missing artist information:␣
 ↪{missing_artist_count_sp}")
```

```
[Pandas] Number of videos missing artist information: 10
```

```
[Spark] Number of videos missing artist information: 10
```

3.2 Tag and content characteristics

[14]:
```
# 1. How many tags does each video have? Visualize the distribution using a␣
 ↪histogram.
plt.figure(figsize=(6, 4))
bars = plt.bar(df_pd["legible_title"], df_pd['tag_count'])
plt.title("Tag count distribution")
plt.xlabel("Video")
plt.ylabel("Number of Tags")
plt.xticks(rotation=45, ha='right')
plt.bar_label(
        bars,
        fmt='%d',
        label_type='center',
        color='white',
        fontsize=9,
        fontweight='bold'
    )
plt.tight_layout()
plt.show()
```



[15]:
```
# 2. What is the total number of views per uploader? Rank the results in␣
 ↪descending order.
total_views_per_uploader_pd = df_pd.groupby("uploader").
 ↪agg(total_views=("view_count", "sum")
).reset_index()
total_views_per_uploader_pd = total_views_per_uploader_pd.
 ↪sort_values(by="total_views", ascending=False)
print(f"[Pandas] Total views per uploader:\n{total_views_per_uploader_pd.
 ↪to_string(index=False)}")

total_views_per_uploader_sp = df_sp.groupBy("uploader").agg(sf.
 ↪sum("view_count").alias("total_views"))
total_views_per_uploader_sp = total_views_per_uploader_sp.orderBy(sf.
 ↪desc("total_views"))
print("[Spark] Total views per uploader:")
total_views_per_uploader_sp.show()
```

```
[Pandas] Total views per uploader:
              uploader  total_views
         Chappell Roan     86221274
         Fleetwood Mac     48858370
       Charlie Chaplin      9752840
STILL I RISE Motivation      2271503
    Saturday Night Live      1268429
              Yard Act       826851
      lizlawrencemusic        49610
    FOX 29 Philadelphia        31701
           Mega Shortz         5772
[Spark] Total views per uploader:
+--------------------+-----------+
|            uploader|total_views|
+--------------------+-----------+
|       Chappell Roan|   86221274|
|       Fleetwood Mac|   48858370|
|     Charlie Chaplin|    9752840|
|STILL I RISE Moti…|    2271503|
| Saturday Night Live|    1268429|
|            Yard Act|     826851|
|    lizlawrencemusic|      49610|
| FOX 29 Philadelphia|      31701|
|         Mega Shortz|       5772|
+--------------------+-----------+
```

[16]:
```
# 3. Which video has the longest duration? List the title and its duration.
longest_video_pd = df_pd.loc[df_pd["duration_seconds"].idxmax(), ["title",␣
 ↪"duration_seconds"]]
```

```
print(f"[Pandas] Longest video: {longest_video_pd['title']} with duration␣
 ↪{longest_video_pd['duration_seconds']} seconds")

longest_video_sp = df_sp.orderBy(sf.desc("duration_seconds")).select("title",␣
 ↪"duration_seconds").limit(1)
print("[Spark] Longest video:")
longest_video_sp.show()
```

```
[Pandas] Longest video: Oprah Winfrey Interview With Prince Harry and Meghan
Markle   Full Interview with duration 5094 seconds
[Spark] Longest video:
+--------------------+----------------+
|               title|duration_seconds|
+--------------------+----------------+
|Oprah Winfrey Int…|            5094|
+--------------------+----------------+

+--------------------+----------------+
|               title|duration_seconds|
+--------------------+----------------+
|Oprah Winfrey Int…|            5094|
+--------------------+----------------+
```

[17]:
```
# 4. How many videos were uploaded in each year? Present the results sorted by␣
 ↪year.
videos_per_year_pd = df_pd["year_uploaded"].value_counts().reset_index()
videos_per_year_pd.columns = ["year_uploaded", "video_count"]
videos_per_year_pd = videos_per_year_pd.sort_values(by="year_uploaded")
print(f"[Pandas] Number of videos uploaded per year:\n{videos_per_year_pd.
 ↪to_string(index=False)}")

videos_per_year_sp = df_sp.groupBy("year_uploaded").count().
 ↪orderBy("year_uploaded")
print("[Spark] Number of videos uploaded per year:")
videos_per_year_sp.show()
```

```
[Pandas] Number of videos uploaded per year:
 year_uploaded  video_count
          2016            1
          2018            1
          2019            1
          2020            1
          2022            2
          2023            2
          2025            2
[Spark] Number of videos uploaded per year:
+-------------+-----+
```

```
|year_uploaded|count|
+-------------+-----+
|         2016|    1|
|         2018|    1|
|         2019|    1|
|         2020|    1|
|         2022|    2|
|         2023|    2|
|         2025|    2|
+-------------+-----+
```

[18]:
```python
# 5. Is there a correlation between the number of views and the number of likes?
 ↪ Feel free to drop or filter rows with missing or zero values before␣
 ↪computing correlation.
correlation_pd = df_pd[["view_count", "like_count"]].dropna().corr().iloc[0, 1]

if correlation_pd > 0.8:
    assessment_pd = "strong positive correlation"
elif correlation_pd < -0.8:
    assessment_pd = "strong negative correlation"
else:
    assessment_pd = "weak or no correlation"

print(f"[Pandas] The correlation between views and likes is {correlation_pd:.
 ↪2f}, this is a {assessment_pd}.")

correlation_sp = df_sp.select("view_count", "like_count").na.drop()
correlation_sp = correlation_sp.stat.corr("view_count", "like_count")

if correlation_sp > 0.8:
    assessment_sp = "strong positive correlation"
elif correlation_sp < -0.8:
    assessment_sp = "strong negative correlation"
else:
    assessment_sp = "weak or no correlation"
print(f"[Spark] The correlation between views and likes is {correlation_sp:.
 ↪2f}, this is a {assessment_sp}.")
```

```
[Pandas] The correlation between views and likes is 0.95, this is a strong
positive correlation.
[Spark] The correlation between views and likes is 0.95, this is a strong
positive correlation.
```

3.3 Derived Metrics & Custom Analysis

[19]:
```python
# 1. Which video has the highest number of likes per second of duration?
highest_likes_per_second_pd = df_pd.assign(
```

```
    likes_per_second=lambda x: x["like_count"] / x["duration_seconds"]
).loc[df_pd["like_count"] > 0].nlargest(1, "likes_per_second")[["title",␣
 ↪"likes_per_second"]]
print(f"[Pandas] Video with highest likes per second:␣
 ↪{highest_likes_per_second_pd['title'].values[0]} with␣
 ↪{highest_likes_per_second_pd['likes_per_second'].values[0]:.2f} likes/second.
 ↪")

highest_likes_per_second_sp = df_sp.withColumn(
    "likes_per_second", sf.col("like_count") / sf.col("duration_seconds"))
highest_likes_per_second_sp = highest_likes_per_second_sp.filter(sf.
 ↪col("like_count") > 0)
highest_likes_per_second_sp = highest_likes_per_second_sp.orderBy(sf.
 ↪desc("likes_per_second")).select("title", "likes_per_second").limit(1)
print("[Spark] Video with highest likes per second:")
highest_likes_per_second_sp.show()
```

```
[Pandas] Video with highest likes per second: Chappell Roan - Pink Pony Club
(Official Music Video) with 2519.32 likes/second.
[Spark] Video with highest likes per second:
+--------------------+-----------------+
|               title| likes_per_second|
+--------------------+-----------------+
|Chappell Roan - P…|2519.317857142857|
+--------------------+-----------------+
```

[20]:
```
# 2. Which uploader has the longest total duration of all their uploaded videos␣
 ↪combined?
longest_total_duration_uploader_pd = df_pd.
 ↪groupby("uploader")["duration_seconds"].sum().reset_index()
longest_total_duration_uploader_pd = longest_total_duration_uploader_pd.
 ↪loc[longest_total_duration_uploader_pd["duration_seconds"].idxmax()]
print(f"[Pandas] Uploader with longest total duration:␣
 ↪{longest_total_duration_uploader_pd['uploader']} with␣
 ↪{longest_total_duration_uploader_pd['duration_seconds']} seconds.")

longest_total_duration_uploader_sp = df_sp.groupBy("uploader").agg(sf.
 ↪sum("duration_seconds").alias("total_duration"))
longest_total_duration_uploader_sp = longest_total_duration_uploader_sp.
 ↪orderBy(sf.desc("total_duration")).select("uploader", "total_duration").
 ↪limit(1)
print("[Spark] Uploader with longest total duration:")
longest_total_duration_uploader_sp.show()
```

```
[Pandas] Uploader with longest total duration: Mega Shortz with 5094 seconds.
[Spark] Uploader with longest total duration:
```

```
+-----------+--------------+
|   uploader|total_duration|
+-----------+--------------+
|Mega Shortz|          5094|
+-----------+--------------+
```

[25]:

```
# 3. What is the ratio of views to likes for each video?
views_to_likes_ratio_pd = df_pd.assign(
    views_to_likes_ratio=lambda x: x["view_count"] / x["like_count"]
).loc[df_pd["like_count"] > 0][["title", "views_to_likes_ratio"]].round(2)
print(f"[Pandas] Views to likes ratio for each video:\n{views_to_likes_ratio_pd.
 ↪to_string(index=False)}")

views_to_likes_ratio_sp = df_sp.withColumn(
    "views_to_likes_ratio", sf.round(sf.col("view_count") / sf.
 ↪col("like_count"), 2))
views_to_likes_ratio_sp = views_to_likes_ratio_sp.filter(sf.col("like_count") >␣
 ↪0)
views_to_likes_ratio_sp = views_to_likes_ratio_sp.select("title",␣
 ↪"views_to_likes_ratio")
print("[Spark] Views to likes ratio for each video:")
views_to_likes_ratio_sp.show(truncate=False)
```

```
[Pandas] Views to likes ratio for each video:
                                                                      title
views_to_likes_ratio
                         Chappell Roan - Pink Pony Club (Official Music Video)
111.83
                              Chappell Roan - The Giver (Official Lyric Video)
33.90
                          Charlie Chaplin - Final Speech from The Great Dictator
36.01
                   Fleetwood Mac - Silver Springs (Live) (Official Video) [HD]
133.29
                                              Liz Lawrence - None Of My Friends
61.17
One of The Greatest Speeches Ever by President Obama | Best Eye Opening Speech
81.97
  Oprah Winfrey Interview With Prince Harry and Meghan Markle   Full Interview
274.86
                                              Saturday Night Live Duos - SNL
163.06
Trump swearing video: Says Iran, Israel ‘don’t know what the f-’ they’re doing
142.16
                                                    Yard Act - 100% Endurance
70.00
[Spark] Views to likes ratio for each video:
```

```
+--------------------------------------------------------------------------------
+--------------------+
|title
|views_to_likes_ratio|
+--------------------------------------------------------------------------------
+--------------------+
|Chappell Roan - Pink Pony Club (Official Music Video)
|111.83              |
|Chappell Roan - The Giver (Official Lyric Video)
|33.9                |
|Charlie Chaplin - Final Speech from The Great Dictator
|36.01               |
|Fleetwood Mac - Silver Springs (Live) (Official Video) [HD]
|133.29              |
|Liz Lawrence - None Of My Friends
|61.17               |
|One of The Greatest Speeches Ever by President Obama | Best Eye Opening
Speech|81.97               |
|Oprah Winfrey Interview With Prince Harry and Meghan Markle   Full Interview
|274.86              |
|Saturday Night Live Duos - SNL
|163.06              |
|Trump swearing video: Says Iran, Israel ‘don’t know what the f-’ they’re
doing|142.16              |
|Yard Act - 100% Endurance
|70.0                |
+--------------------------------------------------------------------------------
+--------------------+
```

[ ]: