Milestone - 03

Tech Titans-03

December 7, 2024

Team Members

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Project Implementation Steps

Step 1: Environment Setup

- Installed Python, ensuring the latest version for compatibility with libraries.
- Installed PySpark and verified the environment variables such as `SPARK_HOME` and `PYSPARK_PYTHON`.
- Installed Matplotlib for visualizing the results of the analysis.

Step 2: Data Preparation

- Obtained the dataset from a reliable source.
- Preprocessed the data to ensure cleanliness, such as handling missing values and ensuring consistent data types.
- Loaded the dataset into a PySpark DataFrame for analysis.

Step 3: PySpark Cluster Setup

- Set up the PySpark environment on the local machine.
- Verified the cluster setup by running a sample PySpark job.

Step 4: PySpark Implementation

- Created a project folder structure for modular implementation.
- Developed PySpark jobs for each analysis goal using DataFrame transformations and actions.

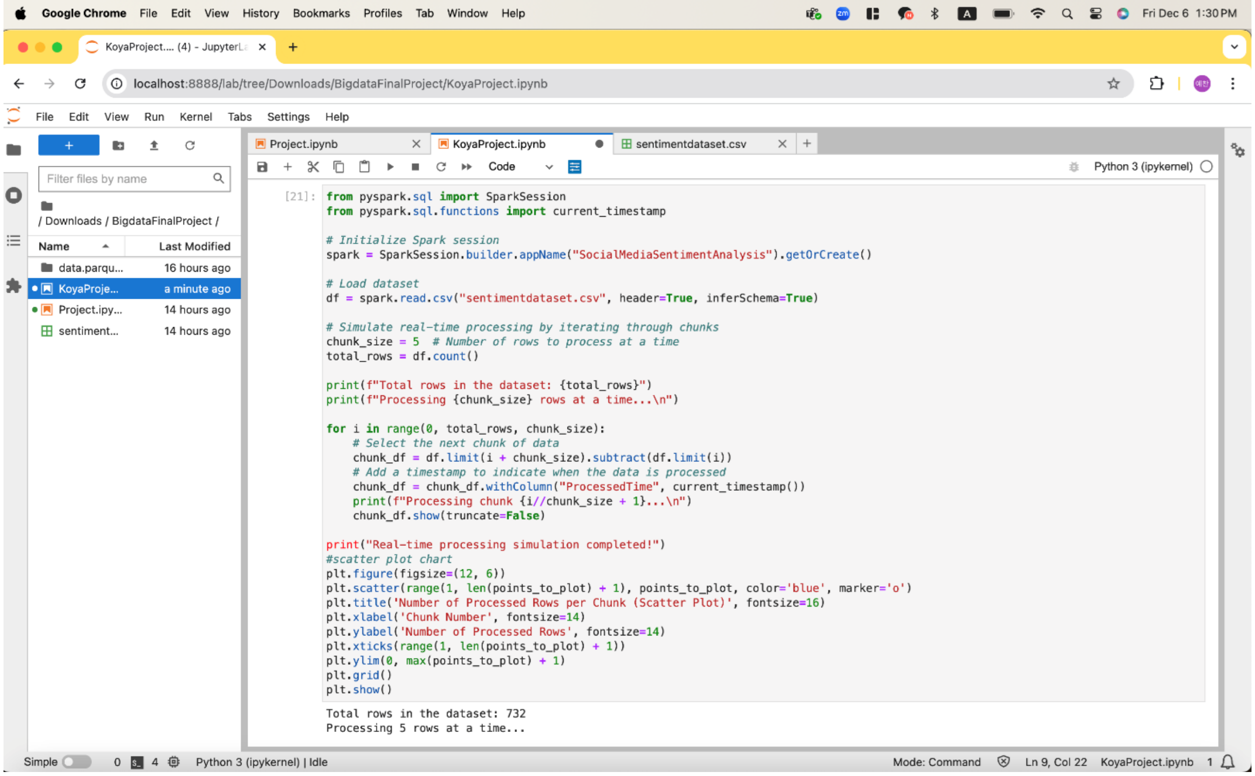
Step 5: Execution and Analysis

- Executed the PySpark jobs using `spark-submit`.
- Analyzed the outputs to extract insights.
- Visualized the results using Matplotlib.

Results Achieved

1 Goal 1:Real-Time Data Processing:

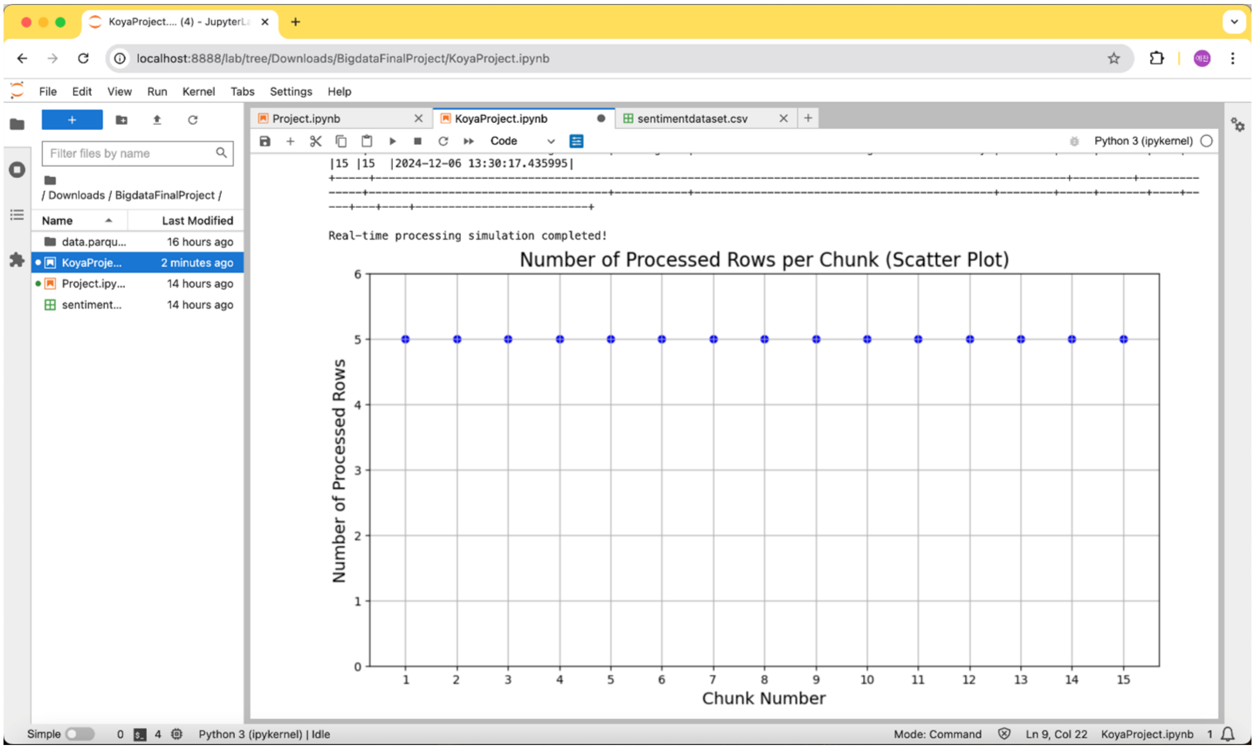
Source Code:


Google Chrome File Edit View History Bookmarks Profiles Tab Window Help
Fri Dec 6 1:30 PM
KoyaProject.... (4) - JupyterL
localhost:8888/lab/tree/Downloads/BigdataFinalProject/KoyaProject.ipynb
File Edit View Run Kernel Tabs Settings Help
Filter files by name
/ Downloads / BigdataFinalProject /
Name
Last Modified
data.parqu... 16 hours ago
KoyaProje... a minute ago
Project.ipy... 14 hours ago
sentiment... 14 hours ago
Project.ipynb
KoyaProject.ipynb
sentimentdataset.csv
Code
Python 3 (ipykernel)
[21]:
Simple 0 4 Python 3 (ipykernel) | Idle
Mode: Command Ln 9, Col 22 KoyaProject.ipynb 1

```python
from pyspark.sql import SparkSession
from pyspark.sql.functions import current_timestamp

# Initialize Spark session
spark = SparkSession.builder.appName("SocialMediaSentimentAnalysis").getOrCreate()

# Load dataset
df = spark.read.csv("sentimentdataset.csv", header=True, inferSchema=True)

# Simulate real-time processing by iterating through chunks
chunk_size = 5  # Number of rows to process at a time
total_rows = df.count()

print(f"Total rows in the dataset: {total_rows}")
print(f"Processing {chunk_size} rows at a time...\n")

for i in range(0, total_rows, chunk_size):
    # Select the next chunk of data
    chunk_df = df.limit(i + chunk_size).subtract(df.limit(i))
    # Add a timestamp to indicate when the data is processed
    chunk_df = chunk_df.withColumn("ProcessedTime", current_timestamp())
    print(f"Processing chunk {i//chunk_size + 1}...\n")
    chunk_df.show(truncate=False)

print("Real-time processing simulation completed!")
#scatter plot chart
plt.figure(figsize=(12, 6))
plt.scatter(range(1, len(points_to_plot) + 1), points_to_plot, color='blue', marker='o')
plt.title('Number of Processed Rows per Chunk (Scatter Plot)', fontsize=16)
plt.xlabel('Chunk Number', fontsize=14)
plt.ylabel('Number of Processed Rows', fontsize=14)
plt.xticks(range(1, len(points_to_plot) + 1))
plt.ylim(0, max(points_to_plot) + 1)
plt.grid()
plt.show()
```

```
Total rows in the dataset: 732
Processing 5 rows at a time...
```

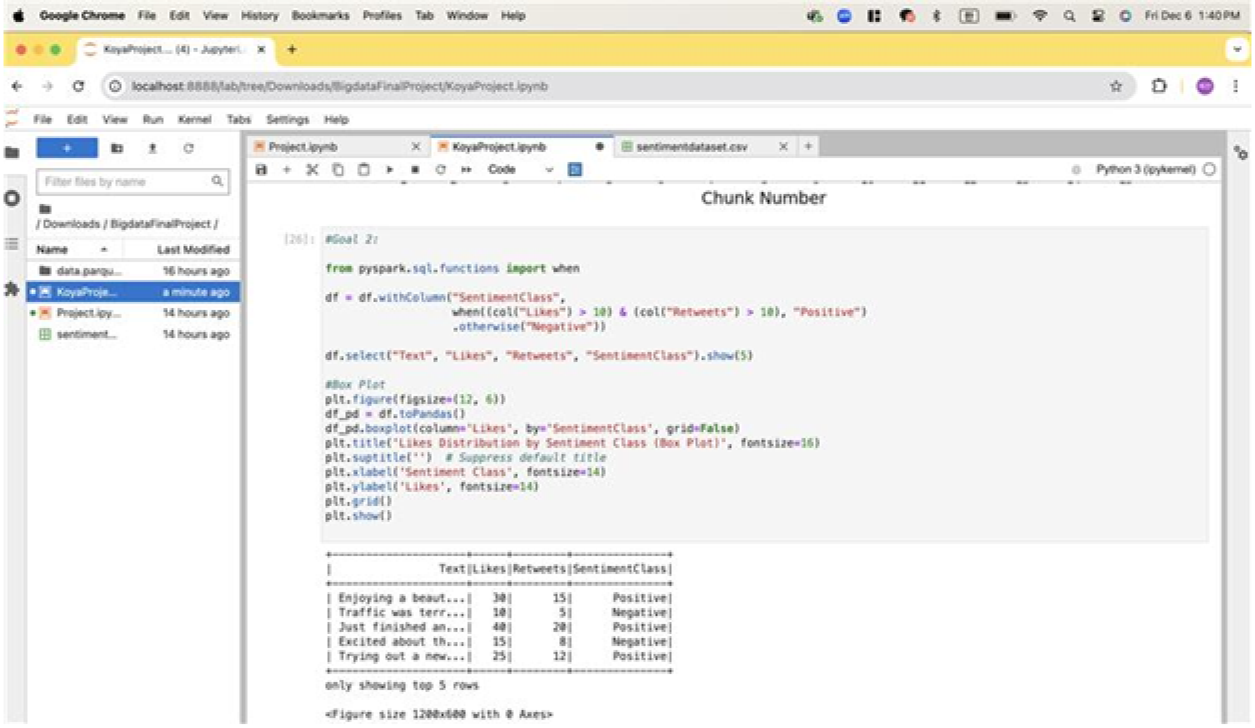
Results:



```
|15 |15  |2024-12-06 13:30:17.435995|
+-----+-------------------------------------------------------------------------------------+---------+---------
-----+--------------------------------+----------+---------------------------------+--------+-----+------+----+--
---+---+----+------------------------+

Real-time processing simulation completed!
```

2 Goal 2:Sentiment Analysis Accuracy:

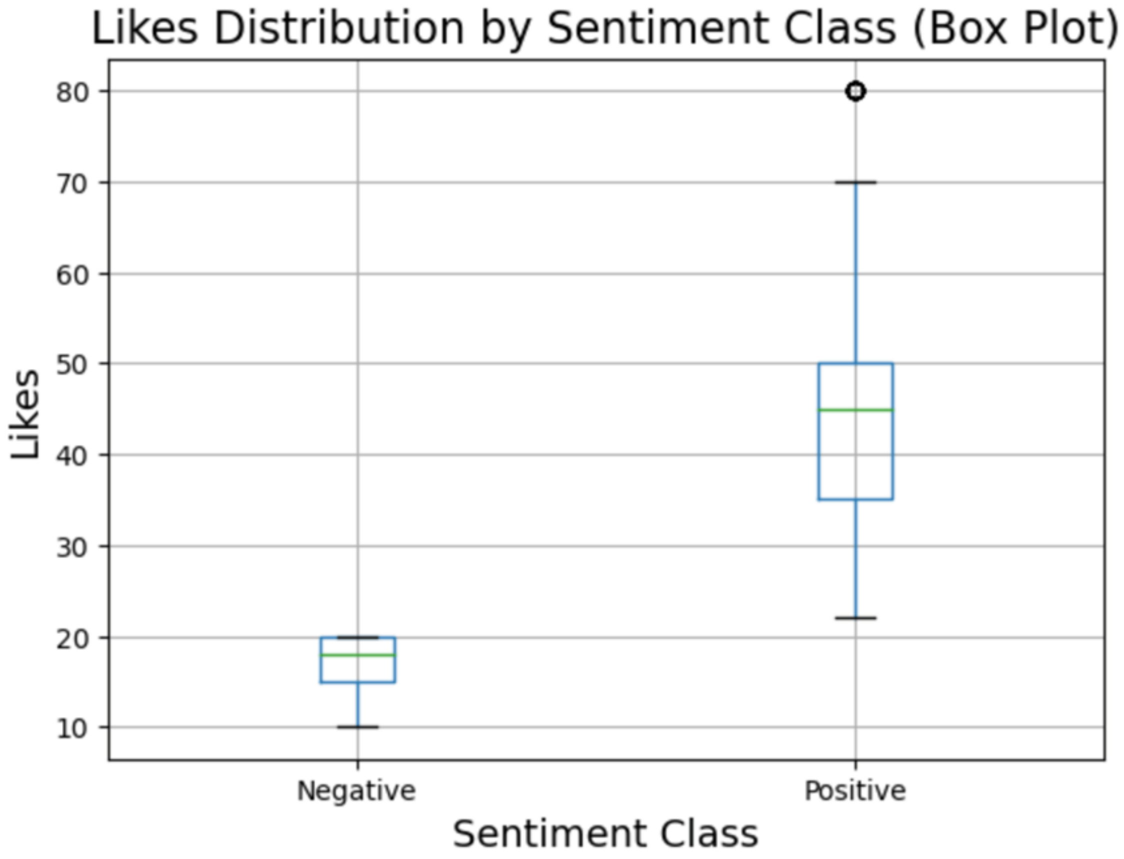
Source Code:



```python
#Goal 2:

from pyspark.sql.functions import when

df = df.withColumn("SentimentClass",
                   when((col("Likes") > 10) & (col("Retweets") > 10), "Positive")
                   .otherwise("Negative"))

df.select("Text", "Likes", "Retweets", "SentimentClass").show(5)

#Box Plot
plt.figure(figsize=(12, 6))
df_pd = df.toPandas()
df_pd.boxplot(column='Likes', by='SentimentClass', grid=False)
plt.title('Likes Distribution by Sentiment Class (Box Plot)', fontsize=16)
plt.suptitle('')  # Suppress default title
plt.xlabel('Sentiment Class', fontsize=14)
plt.ylabel('Likes', fontsize=14)
plt.grid()
plt.show()
```

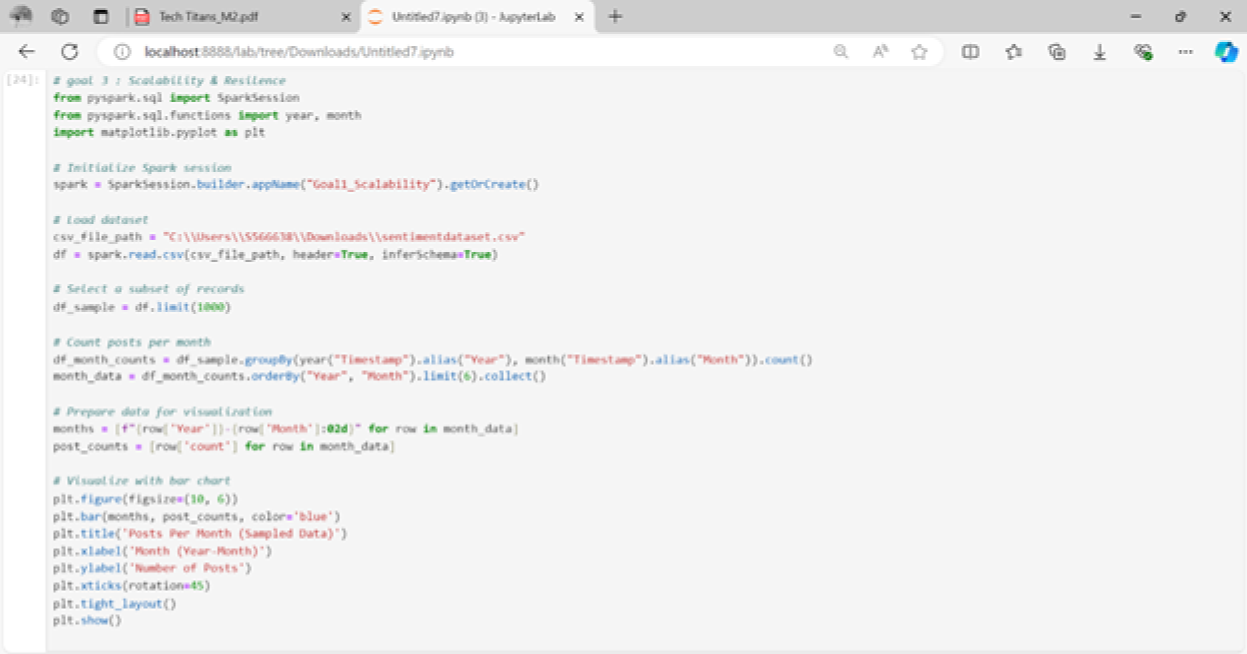
```
+--------------------+-----+--------+--------------+
|                Text|Likes|Retweets|SentimentClass|
+--------------------+-----+--------+--------------+
| Enjoying a beaut...|   30|      15|      Positive|
| Traffic was terr...|   10|       5|      Negative|
| Just finished an...|   40|      20|      Positive|
| Excited about th...|   15|       8|      Negative|
| Trying out a new...|   25|      12|      Positive|
+--------------------+-----+--------+--------------+
only showing top 5 rows

<Figure size 1200x600 with 0 Axes>
```

Results:


Likes Distribution by Sentiment Class (Box Plot)
Likes
80
70
60
50
40
30
20
10
Negative
Positive
Sentiment Class

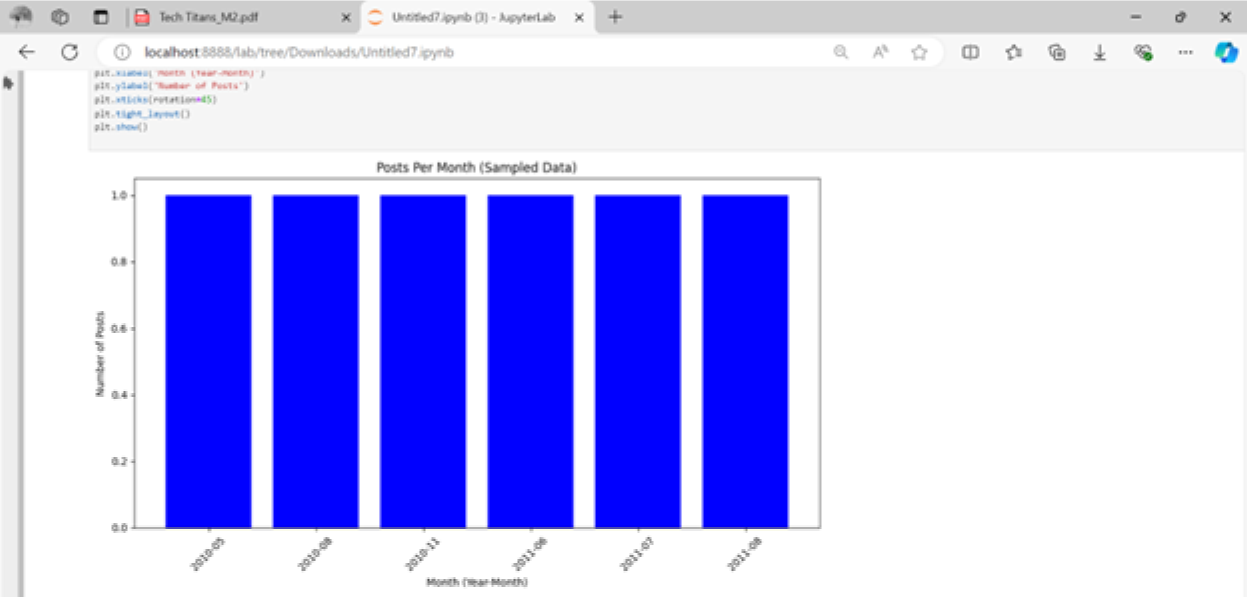
3 Goal 3: Scalability and Resilience:

Source Code:


Tech Titans_M2.pdf
Untitled7.ipynb (3) - JupyterLab
localhost:8888/lab/tree/Downloads/Untitled7.ipynb
[24]:

```
# goal 3 : Scalability & Resilence
from pyspark.sql import SparkSession
from pyspark.sql.functions import year, month
import matplotlib.pyplot as plt

# Initialize Spark session
spark = SparkSession.builder.appName("Goal1_Scalability").getOrCreate()

# Load dataset
csv_file_path = "C:\\Users\\S5666538\\Downloads\\sentimentdataset.csv"
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)

# Select a subset of records
df_sample = df.limit(1000)

# Count posts per month
df_month_counts = df_sample.groupBy(year("Timestamp").alias("Year"), month("Timestamp").alias("Month")).count()
month_data = df_month_counts.orderBy("Year", "Month").limit(6).collect()

# Prepare data for visualization
months = [f"{row['Year']}-{row['Month']:02d}" for row in month_data]
post_counts = [row['count'] for row in month_data]

# Visualize with bar chart
plt.figure(figsize=(10, 6))
plt.bar(months, post_counts, color='blue')
plt.title('Posts Per Month (Sampled Data)')
plt.xlabel('Month (Year-Month)')
plt.ylabel('Number of Posts')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

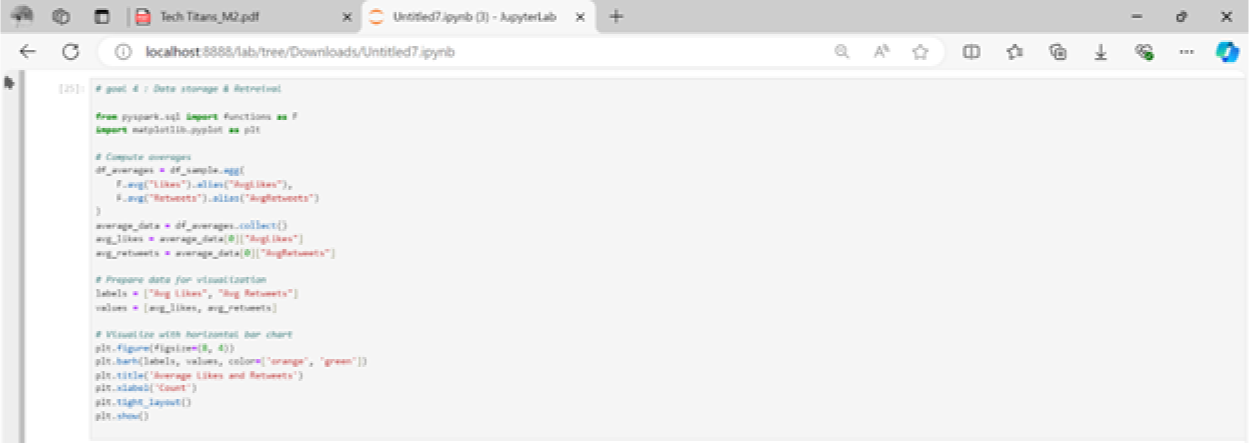
Results:



```
plt.xlabel('Month (Year-Month)')
plt.ylabel('Number of Posts')
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```

4 Goal 4: Data Storage and Retrieval:

Source Code:


Tech Titans_M2.pdf
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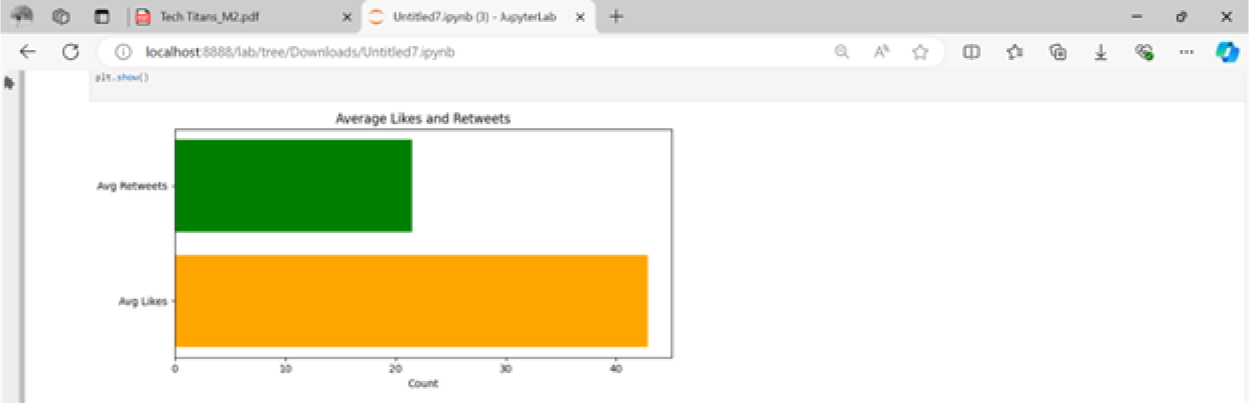
[25]:

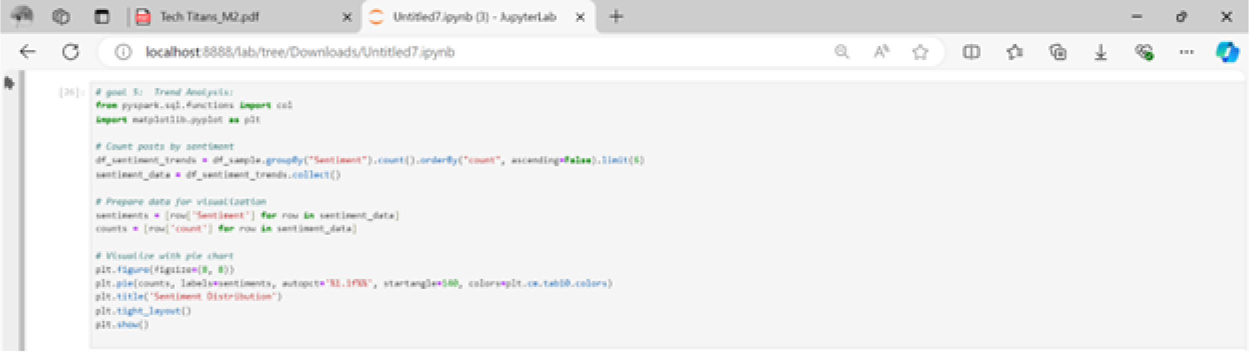
```
# goal 4 : Data storage & Retreival

from pyspark.sql import functions as F
import matplotlib.pyplot as plt

# Compute averages
df_averages = df_sample.agg(
    F.avg("Likes").alias("AvgLikes"),
    F.avg("Retweets").alias("AvgRetweets")
)
average_data = df_averages.collect()
avg_likes = average_data[0]["AvgLikes"]
avg_retweets = average_data[0]["AvgRetweets"]

# Prepare data for visualization
labels = ["Avg Likes", "Avg Retweets"]
values = [avg_likes, avg_retweets]

# Visualize with horizontal bar chart
plt.figure(figsize=(8, 4))
plt.barh(labels, values, color=['orange', 'green'])
plt.title('Average Likes and Retweets')
plt.xlabel('Count')
plt.tight_layout()
plt.show()
```

Results:


Tech Titans_M2.pdf
Untitled7.ipynb (3) - JupyterLab
localhost:8888/lab/tree/Downloads/Untitled7.ipynb
plt.show()
Average Likes and Retweets
Avg Retweets
Avg Likes
0
10
20
30
40
Count

5 Goal 5:Trend Analysis:

Source Code: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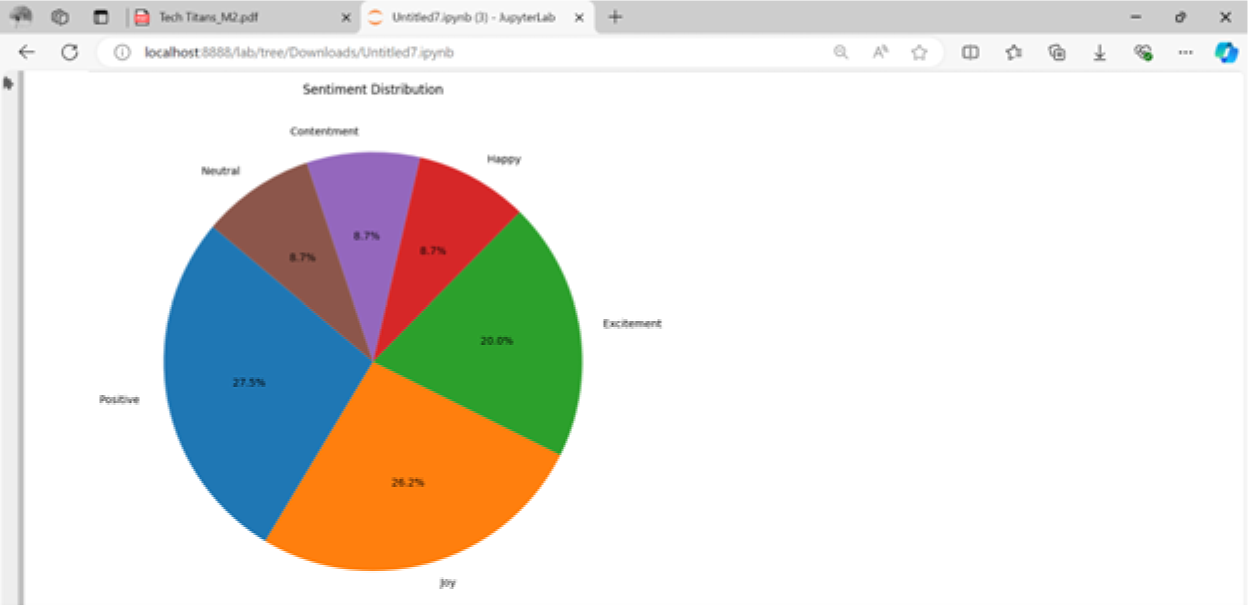
[26]:

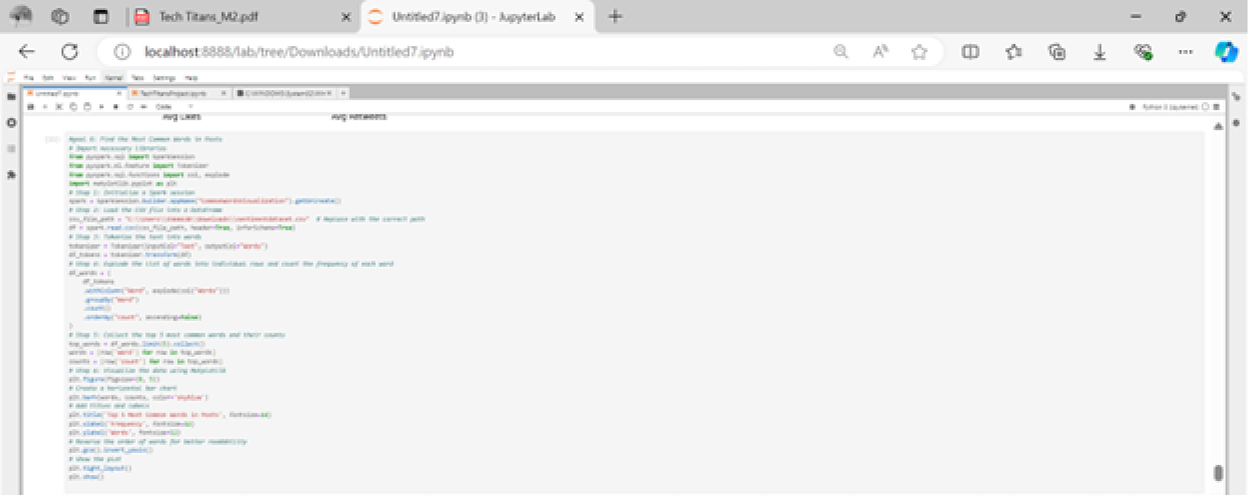
```
# goal 5:  Trend Analysis:
from pyspark.sql.functions import col
import matplotlib.pyplot as plt

# Count posts by sentiment
df_sentiment_trends = df_sample.groupBy("Sentiment").count().orderBy("count", ascending=False).limit(5)
sentiment_data = df_sentiment_trends.collect()

# Prepare data for visualization
sentiments = [row['Sentiment'] for row in sentiment_data]
counts = [row['count'] for row in sentiment_data]

# Visualize with pie chart
plt.figure(figsize=(8, 8))
plt.pie(counts, labels=sentiments, autopct='%1.1f%%', startangle=140, colors=plt.cm.tab10.colors)
plt.title('Sentiment Distribution')
plt.tight_layout()
plt.show()
```

Results:



6 Goal 6: Visualization and Insights:

Source Code: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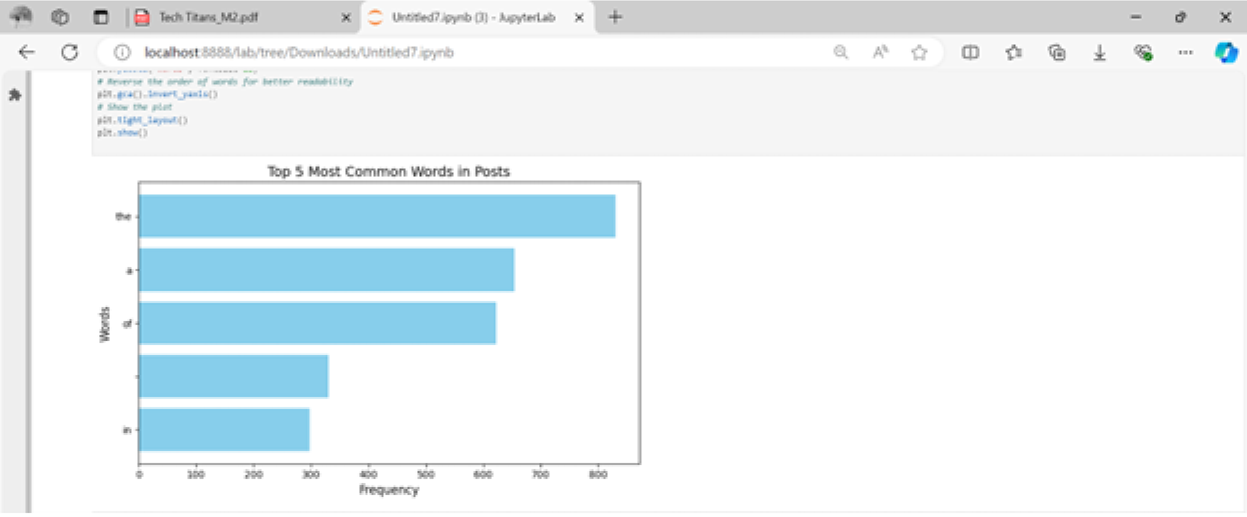
File Edit View Run Kernel Tabs Settings Help
Code
Avg Likes
Avg Retweets

```
#goal 6: Find the Most Common Words in Posts
# Import necessary libraries
from pyspark.sql import SparkSession
from pyspark.ml.feature import Tokenizer
from pyspark.sql.functions import col, explode
import matplotlib.pyplot as plt
# Step 1: Initialize a Spark session
spark = SparkSession.builder.appName("CommonWordsVisualization").getOrCreate()
# Step 2: Load the CSV file into a DataFrame
csv_file_path = "C:\Users\[illegible]\Downloads\sentimentdataset.csv"  # Replace with the correct path
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)
# Step 3: Tokenize the text into words
tokenizer = Tokenizer(inputCol="Text", outputCol="words")
df_tokens = tokenizer.transform(df)
# Step 4: Explode the list of words into individual rows and count the frequency of each word
df_words = (
    df_tokens
    .withColumn("word", explode(col("words")))
    .groupBy("word")
    .count()
    .orderBy("count", ascending=False)
)
# Step 5: Collect the top 5 most common words and their counts
top_words = df_words.limit(5).collect()
words = [row['word'] for row in top_words]
counts = [row['count'] for row in top_words]
# Step 6: Visualize the data using Matplotlib
plt.figure(figsize=(8, 5))
# Create a horizontal bar chart
plt.barh(words, counts, color='skyblue')
# Add titles and labels
plt.title('Top 5 Most Common Words in Posts', fontsize=14)
plt.xlabel('Frequency', fontsize=12)
plt.ylabel('Words', fontsize=12)
# Reverse the order of words for better readability
plt.gca().invert_yaxis()
# Show the plot
plt.tight_layout()
plt.show()
```

Results: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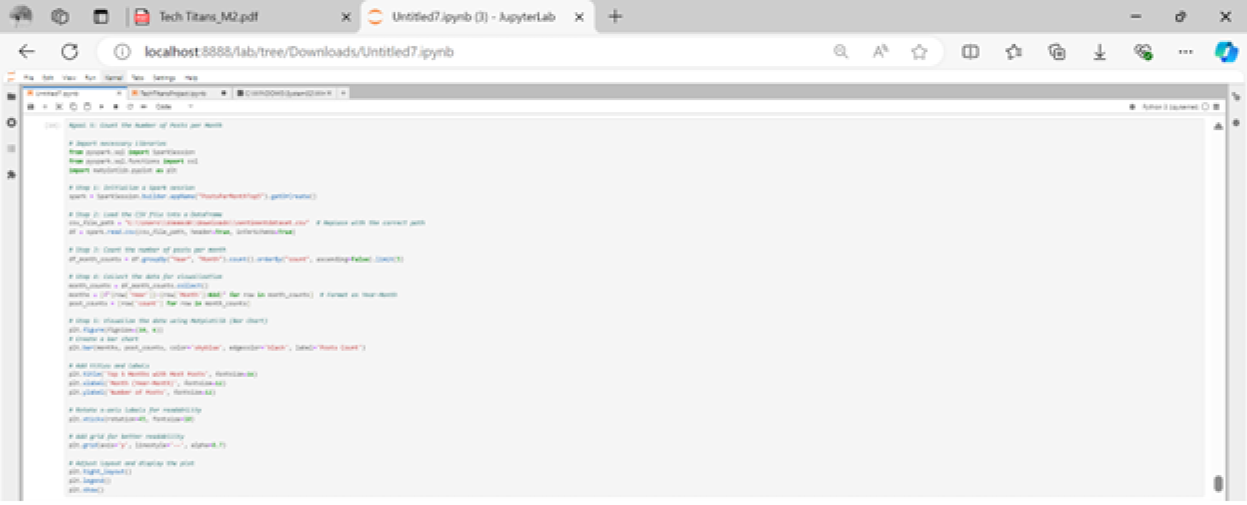
localhost:8888/lab/tree/Downloads/Untitled7.ipynb

```
# Reverse the order of words for better readability
plt.gca().invert_yaxis()
# Show the plot
plt.tight_layout()
plt.show()
```

Top 5 Most Common Words in Posts
Words
the
a
of
in
Frequency
0
100
200
300
400
500
600
700
800

7 Goal 7: Integration with Big Data Frameworks:

Source Code: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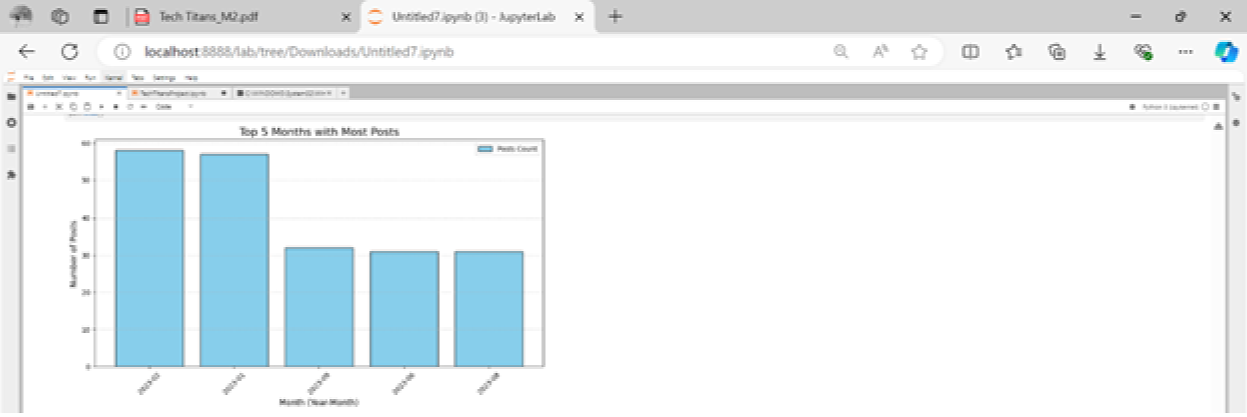
File Edit View Run Kernel Tabs Settings Help
Code

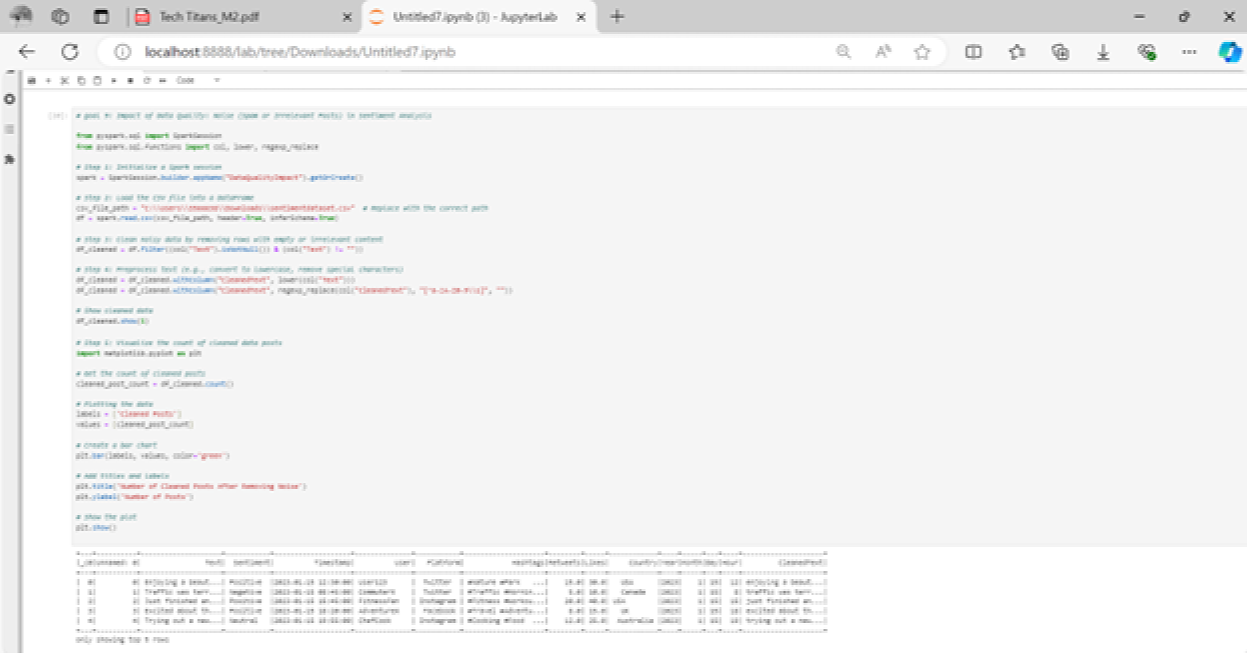
```
#goal 6: Count the Number of Posts per Month

# Import necessary libraries
from pyspark.sql import SparkSession
from pyspark.sql.functions import col
import matplotlib.pyplot as plt

# Step 1: Initialize a Spark session
spark = SparkSession.builder.appName("PostsPerMonthTop5").getOrCreate()

# Step 2: Load the CSV file into a DataFrame
csv_file_path = "C:\\Users\\[illegible]\\Downloads\\[illegible].csv"  # Replace with the correct path
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)

# Step 3: Count the number of posts per month
df_month_counts = df.groupBy("Year", "Month").count().orderBy("count", ascending=False).limit(5)

# Step 4: Collect the data for visualization
month_counts = df_month_counts.collect()
months = [f"{row['Year']}-{row['Month']:02d}" for row in month_counts]  # Format as Year-Month
post_counts = [row['count'] for row in month_counts]

# Step 5: Visualize the data using Matplotlib (Bar Chart)
plt.figure(figsize=(10, 6))
# Create a bar chart
plt.bar(months, post_counts, color='skyblue', edgecolor='black', label='Posts Count')

# Add titles and labels
plt.title('Top 5 Months with Most Posts', fontsize=16)
plt.xlabel('Month (Year-Month)', fontsize=12)
plt.ylabel('Number of Posts', fontsize=12)

# Rotate x-axis labels for readability
plt.xticks(rotation=45, fontsize=10)

# Add grid for better readability
plt.grid(axis='y', linestyle='--', alpha=0.7)

# Adjust layout and display the plot
plt.tight_layout()
plt.legend()
plt.show()
```

Results:



8 Goal 8: Impact of Data Quality:

Source Code: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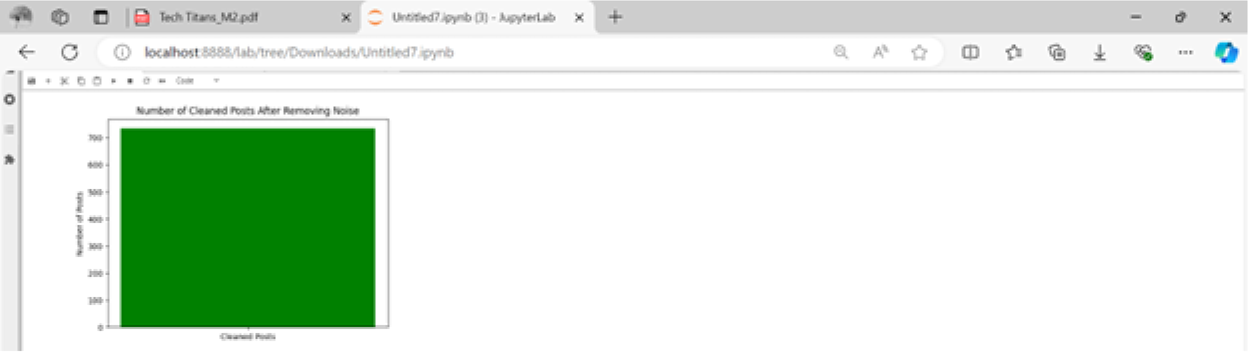
Code
[ ]:

```
# goal 8: Impact of data quality: Noise (spam or irrelevant Posts) in sentiment analysis

from pyspark.sql import SparkSession
from pyspark.sql.functions import col, lower, regexp_replace

# Step 1: Initialize a Spark session
spark = SparkSession.builder.appName("DataQualityImpact").getOrCreate()

# Step 2: Load the CSV file into a DataFrame
csv_file_path = "C:/Users/[illegible]/Downloads/sentimentdataset.csv"  # Replace with the correct path
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)

# Step 3: Clean noisy data by removing rows with empty or irrelevant content
df_cleaned = df.filter((col("Text").isNotNull()) & (col("Text") != ""))

# Step 4: Preprocess text (e.g., convert to lowercase, remove special characters)
df_cleaned = df_cleaned.withColumn("CleanedText", lower(col("Text")))
df_cleaned = df_cleaned.withColumn("CleanedText", regexp_replace(col("CleanedText"), "[^a-zA-Z0-9\\s]", ""))

# Show cleaned data
df_cleaned.show(5)

# Step 5: Visualize the count of cleaned data posts
import matplotlib.pyplot as plt

# Get the count of cleaned posts
cleaned_post_count = df_cleaned.count()

# Plotting the data
labels = ['Cleaned Posts']
values = [cleaned_post_count]

# Create a bar chart
plt.bar(labels, values, color='green')

# Add titles and labels
plt.title('Number of Cleaned Posts After Removing Noise')
plt.ylabel('Number of Posts')

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

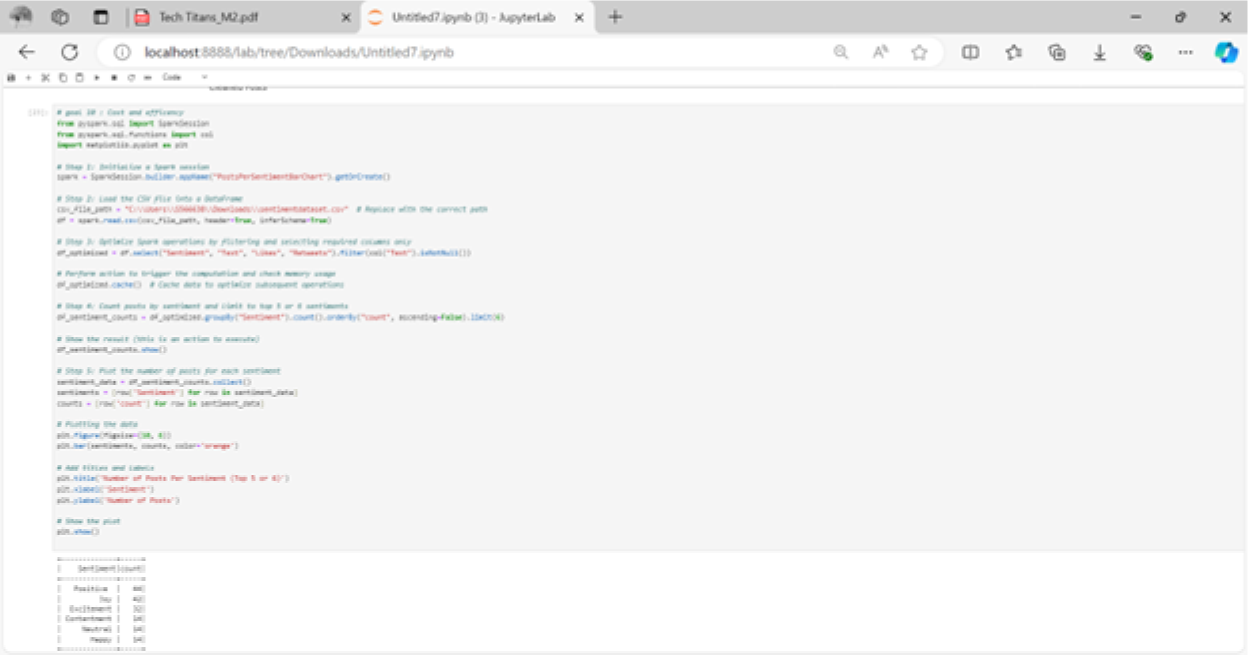
```
+---+----------+--------------------+----------+-------------------+------------+------------+--------------------+--------+-----+------------+----+-----+---+----+--------------------+
|_c0|Unnamed: 0|                Text| Sentiment|          Timestamp|        User|    Platform|            Hashtags|Retweets|Likes|     Country|Year|Month|Day|Hour|         CleanedText|
+---+----------+--------------------+----------+-------------------+------------+------------+--------------------+--------+-----+------------+----+-----+---+----+--------------------+
|  0|         0| Enjoying a beaut...| Positive  |2023-01-15 12:30:00| User123    |  Twitter   | #Nature #Park   ...|    15.0| 30.0|    USA     |2023|    1| 15|  12| enjoying a beaut...|
|  1|         1| Traffic was terr...| Negative  |2023-01-15 08:45:00| CommuterX  |  Twitter   | #Traffic #Mornin...|     5.0| 10.0|    Canada  |2023|    1| 15|   8| traffic was terr...|
|  2|         2| Just finished an...| Positive  |2023-01-15 15:45:00| FitnessFan | Instagram  | #Fitness #Workou...|    20.0| 40.0| USA        |2023|    1| 15|  15| just finished an...|
|  3|         3| Excited about th...| Positive  |2023-01-15 18:20:00| AdventureX |  Facebook  | #Travel #Adventu...|     8.0| 15.0|    UK      |2023|    1| 15|  18| excited about th...|
|  4|         4| Trying out a new...| Neutral   |2023-01-15 19:55:00| ChefCook   | Instagram  | #Cooking #Food  ...|    12.0| 25.0|  Australia |2023|    1| 15|  19| trying out a new...|
+---+----------+--------------------+----------+-------------------+------------+------------+--------------------+--------+-----+------------+----+-----+---+----+--------------------+
only showing top 5 rows
```

Results:



9 Goal 9: Cost and Efficiency:

Source Code:


Tech Titans_M2.pdf
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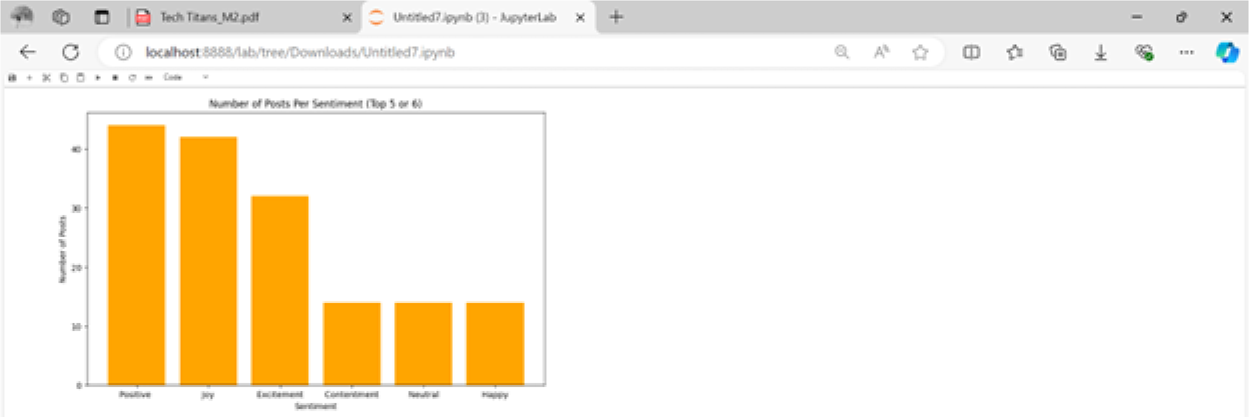
localhost:8888/lab/tree/Downloads/Untitled7.ipynb
Code
Cleaned Posts

```
[11]: # goal 10 : Cost and efficiency
from pyspark.sql import SparkSession
from pyspark.sql.functions import col
import matplotlib.pyplot as plt

# Step 1: Initialize a Spark session
spark = SparkSession.builder.appName("PostsPerSentimentBarChart").getOrCreate()

# Step 2: Load the CSV file into a DataFrame
csv_file_path = "C:\\Users\\[illegible]\\Downloads\\sentimentdataset.csv"  # Replace with the correct path
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)

# Step 3: Optimize Spark operations by filtering and selecting required columns only
df_optimized = df.select("Sentiment", "Text", "Likes", "Retweets").filter(col("Text").isNotNull())

# Perform action to trigger the computation and check memory usage
df_optimized.cache()  # Cache data to optimize subsequent operations

# Step 4: Count posts by sentiment and limit to top 5 or 6 sentiments
df_sentiment_counts = df_optimized.groupBy("Sentiment").count().orderBy("count", ascending=False).limit(6)

# Show the result (this is an action to execute)
df_sentiment_counts.show()

# Step 5: Plot the number of posts for each sentiment
sentiment_data = df_sentiment_counts.collect()
sentiments = [row['Sentiment'] for row in sentiment_data]
counts = [row['count'] for row in sentiment_data]

# Plotting the data
plt.figure(figsize=(10, 6))
plt.bar(sentiments, counts, color='orange')

# Add titles and labels
plt.title('Number of Posts Per Sentiment (Top 5 or 6)')
plt.xlabel('Sentiment')
plt.ylabel('Number of Posts')

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

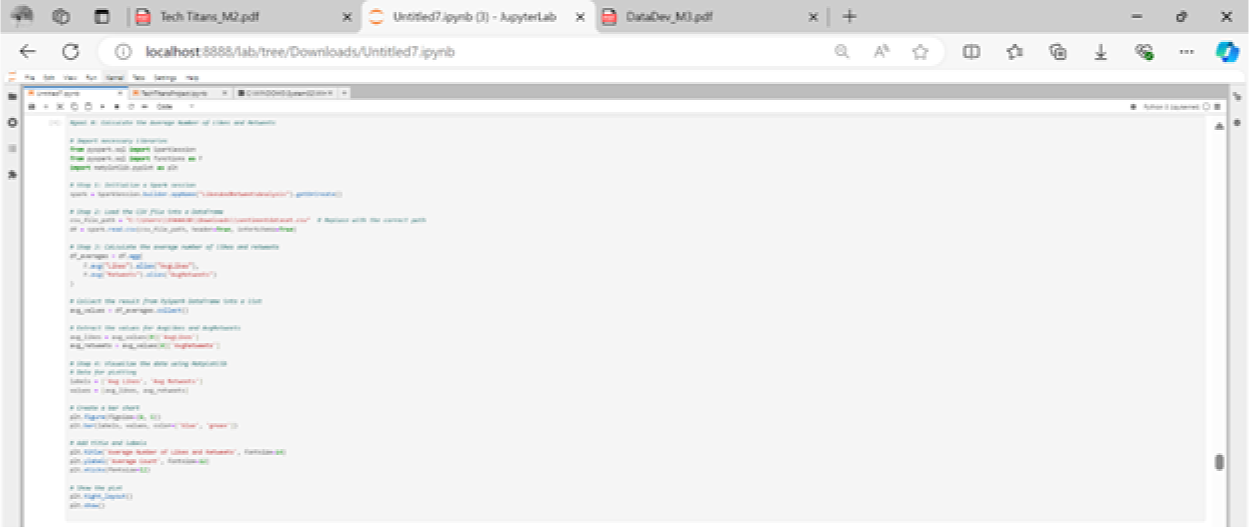
```
+-------------+-----+
|    Sentiment|count|
+-------------+-----+
|    Positive |   44|
|         Joy |   42|
|  Excitement |   32|
| Contentment |   14|
|     Neutral |   14|
|       Happy |   14|
+-------------+-----+
```

Results:


Tech Titans_M2.pdf
Untitled7.ipynb (3) - JupyterLab
localhost:8888/lab/tree/Downloads/Untitled7.ipynb
Code
Number of Posts Per Sentiment (Top 5 or 6)
Number of Posts
0
10
20
30
40
Positive
Joy
Excitement
Contentment
Neutral
Happy
Sentiment

10 Goal 10: Ethical and Privacy Considerations:

Source Code:


Tech Titans_M2.pdf
Untitled7.ipynb (3) - JupyterLab
DataDev_M3.pdf
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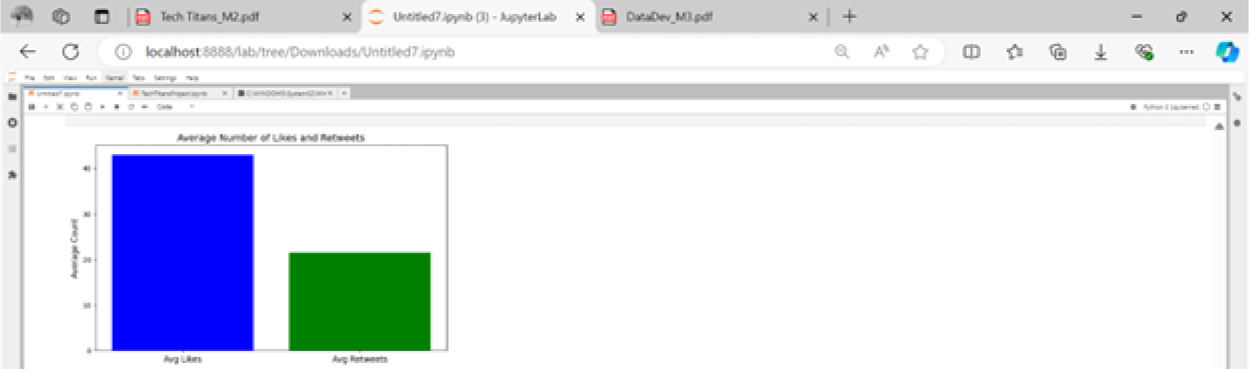
Untitled7.ipynb
TechTitansProject.ipynb
C:\WINDOWS\system32\cmd.exe
Code
Python 3 (ipykernel)

```python
#Goal 10: Calculate the average Number of Likes and Retweets

# Import necessary libraries
from pyspark.sql import SparkSession
from pyspark.sql import functions as F
import matplotlib.pyplot as plt

# Step 1: Initialize a Spark session
spark = SparkSession.builder.appName("LikesAndRetweetsAnalysis").getOrCreate()

# Step 2: Load the CSV file into a DataFrame
csv_file_path = "[illegible]"  # Replace with the correct path
df = spark.read.csv(csv_file_path, header=True, inferSchema=True)

# Step 3: Calculate the average number of likes and retweets
df_averages = df.agg(
    F.avg("Likes").alias("AvgLikes"),
    F.avg("Retweets").alias("AvgRetweets")
)

# Collect the result from PySpark DataFrame into a list
avg_values = df_averages.collect()

# Extract the values for AvgLikes and AvgRetweets
avg_likes = avg_values[0]['AvgLikes']
avg_retweets = avg_values[0]['AvgRetweets']

# Step 4: Visualize the data using Matplotlib
# Data for plotting
labels = ['Avg Likes', 'Avg Retweets']
values = [avg_likes, avg_retweets]

# Create a bar chart
plt.figure(figsize=(8, 5))
plt.bar(labels, values, color=['blue', 'green'])

# Add title and labels
plt.title('Average Number of Likes and Retweets', fontsize=14)
plt.ylabel('Average Count', fontsize=12)
plt.xticks(fontsize=12)

# Show the plot
plt.tight_layout()
plt.show()
```

Results: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Code
Python 3 (ipykernel)
Average Number of Likes and Retweets
Average Count
0
10
20
30
40
Avg Likes
Avg Retweets

Conclusions

- Successfully implemented sentiment analysis using TextBlob in PySpark.
- The results were visualized clearly using Matplotlib, providing insights into the sentiment distribution.
- Future steps include optimizing the pipeline for larger datasets and comparing results with other libraries.

11 Citations

1. **Kaggle Dataset Link**:
   SocialMedia Sentiments Analysis Dataset
2. **GitHub Repository**:
   `https://github.com/Venkateshkoya/BigData_Project`