Data Operations & Management

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Task 1: Define scenario of your choice and Extract relevant unstructured data from any source (database, warehouse etc) and provide Evidence?

Github Link: https://github.com/poojavats/Spark_Analyzing_-Popular_-New-_York-_Times-Articles

Scenario: Analyzing Popular New York Times Articles.

I have Analysis on Analyzing Popular New York Times Articles, I have extract the data from below mentioned website by using Free API method and add the unstructured data by using spark and Anaconda

Website-> https://developer.nytimes.com/

Tools and technology-> Spark, Anaconda(Jyupter Notebook), Python, Java

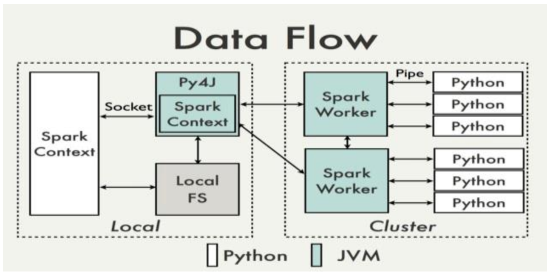
Task 2: Design complete ELT data pipeline using Apache Spark and analyse the data and get a meaningful insight from the data

Dataset: The dataset "Analyzing Popular New York Times Articles" contains information about popular articles from The New York Times. It likely includes details such as article titles, authors, descriptions, publishers, and Amazon product URLs. The dataset enables analysis and exploration of popular articles, allowing insights into trends, popular authors, and publishing patterns. By leveraging this dataset, one can gain a better understanding of the characteristics and popularity of articles published by The New York Times.

Execution and pipelining:

PySpark leverages Spark's Java API as its foundation, allowing data processing in Python while utilizing JVM for caching and shuffling. PySpark enables transformation pipelines by composing functions, and each PySpark stage aligns with a Spark scheduler stage, with a one-to-one correspondence, where each PySpark stage corresponds to a PipelinedRDD instance.

Architecture of Data Flow:



Picture Reference- https://stackoverflow.com/questions/42333861/py4jnetworkerror-symbol-lookup-error-undefined-symbol-cblas-daxpy

Fig 1: Data Flow Architecture of Spark

Extract Data-> Extract data using Python and Spark:

Step 1: Launch a Python environment, such as Jupyter Notebook, using Anaconda.

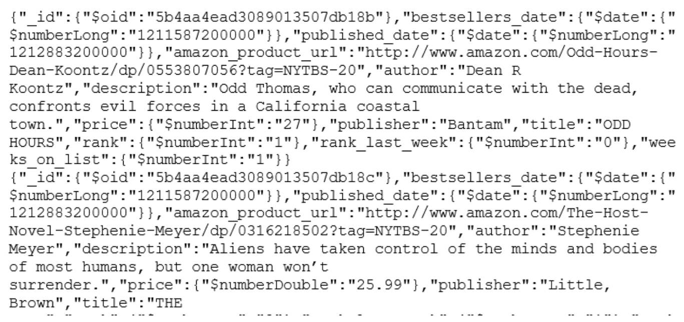
Step 2: Import the required libraries and set up a SparkSession to work with Spark.

Step 3: Make API requests to the New York Times API using the requests library.

Step 4: Parse the JSON responses received from the API and extract the relevant data using Spark Library in Jupyter Notebook.

Step 5: Store the extracted data in an appropriate format (CSV) for further analysis.

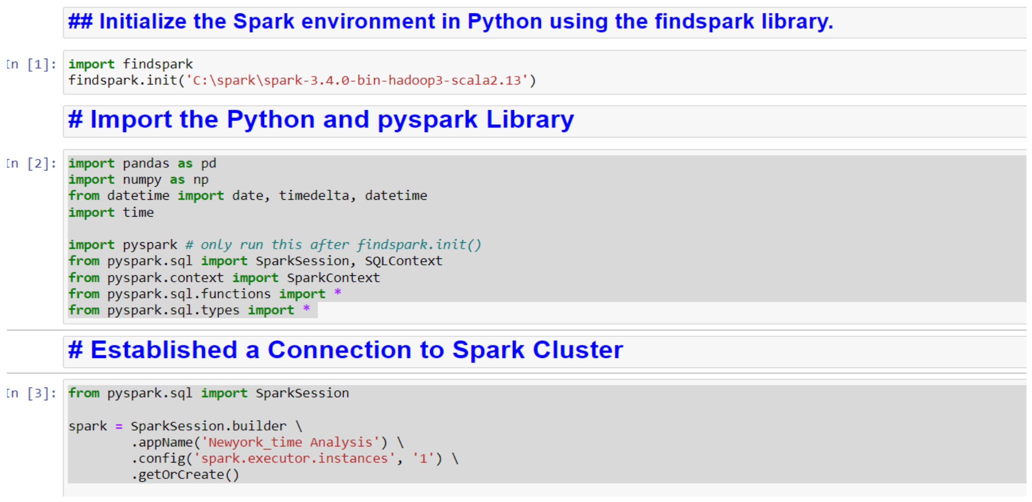
Snippet of Unstructured data:



```
{"_id":{"$oid":"5b4aa4ead3089013507db18b"},"bestsellers_date":{"$date":{"
$numberLong":"1211587200000"}},"published_date":{"$date":{"$numberLong":"
1212883200000"}},"amazon_product_url":"http://www.amazon.com/Odd-Hours-
Dean-Koontz/dp/0553807056?tag=NYTBS-20","author":"Dean R
Koontz","description":"Odd Thomas, who can communicate with the dead,
confronts evil forces in a California coastal
town.","price":{"$numberInt":"27"},"publisher":"Bantam","title":"ODD
HOURS","rank":{"$numberInt":"1"},"rank_last_week":{"$numberInt":"0"},"wee
ks_on_list":{"$numberInt":"1"}}
{"_id":{"$oid":"5b4aa4ead3089013507db18c"},"bestsellers_date":{"$date":{"
$numberLong":"1211587200000"}},"published_date":{"$date":{"$numberLong":"
1212883200000"}},"amazon_product_url":"http://www.amazon.com/The-Host-
Novel-Stephenie-Meyer/dp/0316218502?tag=NYTBS-20","author":"Stephenie
Meyer","description":"Aliens have taken control of the minds and bodies
of most humans, but one woman won't
surrender.","price":{"$numberDouble":"25.99"},"publisher":"Little,
Brown","title":"THE
```

Fig 2: Snippet of Unstructured data

Step 6:



Initialize the Spark environment in Python using the findspark library.

```
In [1]: import findspark
        findspark.init('C:\spark\spark-3.4.0-bin-hadoop3-scala2.13')
```

Import the Python and pyspark Library

```
In [2]: import pandas as pd
        import numpy as np
        from datetime import date, timedelta, datetime
        import time

        import pyspark # only run this after findspark.init()
        from pyspark.sql import SparkSession, SQLContext
        from pyspark.context import SparkContext
        from pyspark.sql.functions import *
        from pyspark.sql.types import *
```

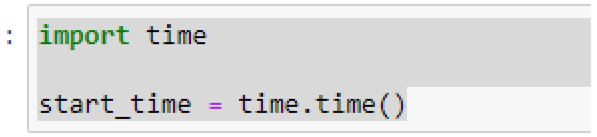
Established a Connection to Spark Cluster

```
In [3]: from pyspark.sql import SparkSession

        spark = SparkSession.builder \
                .appName('Newyork_time Analysis') \
                .config('spark.executor.instances', '1') \
                .getOrCreate()
```

Fig 3. Spark and Library Setup

Explain: The code initializes and configures Spark to run with a specific version (3.4.0) and location (C:\spark\spark-3.4.0-bin-hadoop3-scala2.13), and then imports necessary libraries for data manipulation and Spark operations. This code creates a SparkSession with the specified application name ("Newyork_time Analysis") and configuration for the number of executor instances (4), or retrieves an existing SparkSession if available.

Step 7: Import the time Module



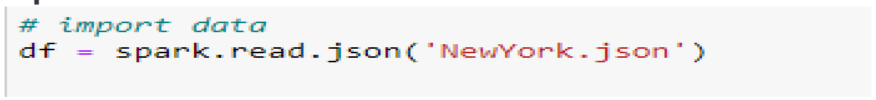
```
import time

start_time = time.time()
```

Fig 4: Time Module

Explain: This code records the current time as the start time for measuring the execution duration of a program or a specific code block.

Start_time=time.time()-> this code Assign the current time for the time measurement**.**

Step 8:



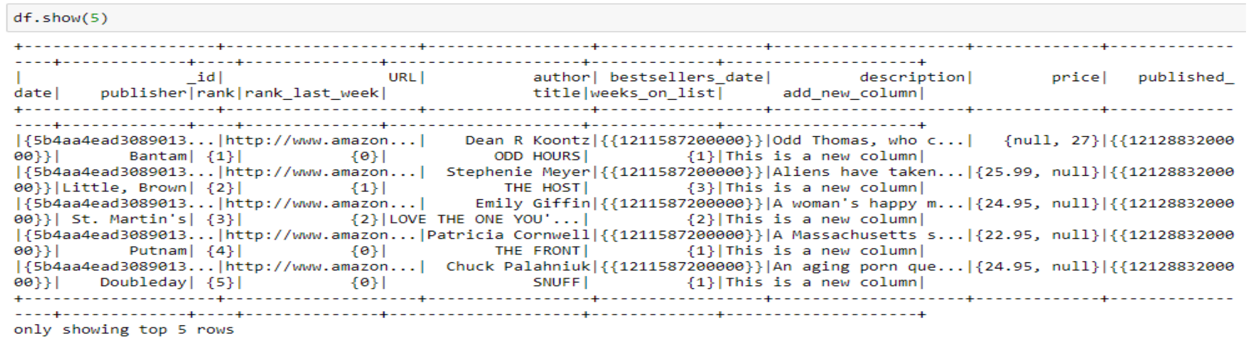
```
# import data
df = spark.read.json('NewYork.json')
```

Fig 5: Import data

This code reads the JSON file 'NewYork.json' and creates a DataFrame named 'df' in Spark.

Spark.read.json-> This method reads the json file name and inferes the schema also that is based on data, where my file name “NewYork.json”

Step 9: First 5 rows of the data frame.

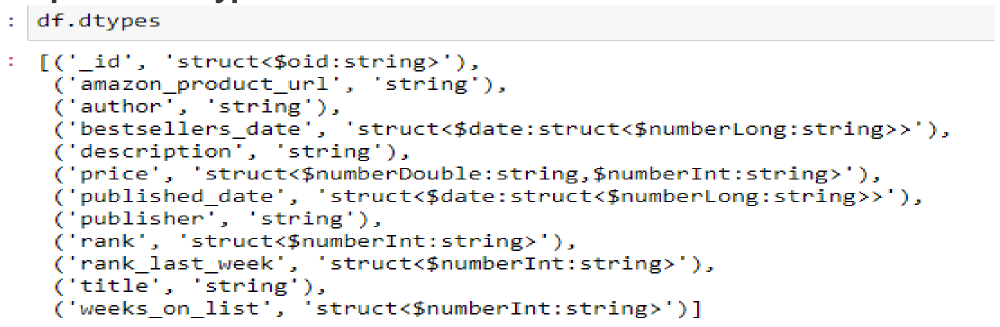


```
df.show(5)
```

```
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+-------------
----+-------------+----+--------------+--------------------+-------------+--------------------+
|                 _id|                 URL|           author| bestsellers_date|         description|        price|   published_
date|    publisher|rank|rank_last_week|               title|weeks_on_list|      add_new_column|
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+-------------
----+-------------+----+--------------+--------------------+-------------+--------------------+
|{5b4aa4ead3089013...|http://www.amazon...|    Dean R Koontz|{{1211587200000}}|Odd Thomas, who c...|   {null, 27}|{{12128832000
00}}|       Bantam| {1}|           {0}|           ODD HOURS|          {1}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|  Stephenie Meyer|{{1211587200000}}|Aliens have taken...|{25.99, null}|{{12128832000
00}}|Little, Brown| {2}|           {1}|            THE HOST|          {3}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|     Emily Giffin|{{1211587200000}}|A woman's happy m...|{24.95, null}|{{12128832000
00}}| St. Martin's| {3}|           {2}|LOVE THE ONE YOU'...|          {2}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|Patricia Cornwell|{{1211587200000}}|A Massachusetts s...|{22.95, null}|{{12128832000
00}}|       Putnam| {4}|           {0}|           THE FRONT|          {1}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|  Chuck Palahniuk|{{1211587200000}}|An aging porn que...|{24.95, null}|{{12128832000
00}}|    Doubleday| {5}|           {0}|               SNUFF|          {1}|This is a new column|
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+-------------
----+-------------+----+--------------+--------------------+-------------+--------------------+
only showing top 5 rows
```

Fig 6: *display the 5 rows of data*

Step 10: Data Types of the Columns of DataFrame



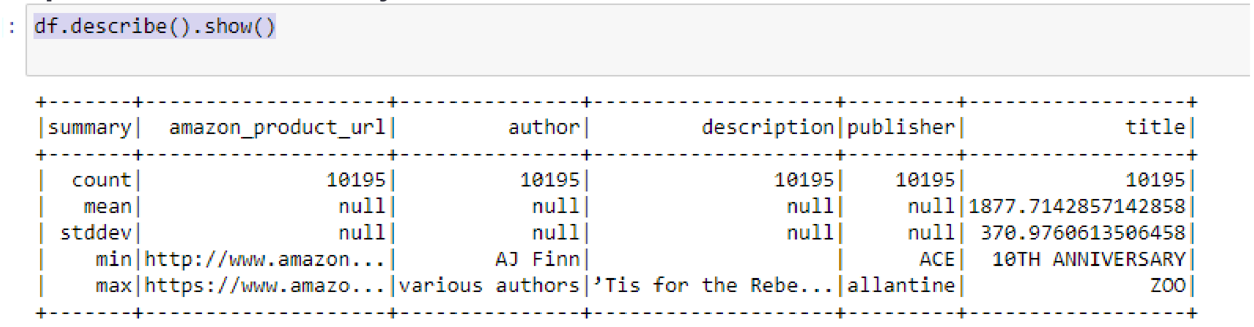
```
: df.dtypes
```

```
: [('_id', 'struct<$oid:string>'),
   ('amazon_product_url', 'string'),
   ('author', 'string'),
   ('bestsellers_date', 'struct<$date:struct<$numberLong:string>>'),
   ('description', 'string'),
   ('price', 'struct<$numberDouble:string,$numberInt:string>'),
   ('published_date', 'struct<$date:struct<$numberLong:string>>'),
   ('publisher', 'string'),
   ('rank', 'struct<$numberInt:string>'),
   ('rank_last_week', 'struct<$numberInt:string>'),
   ('title', 'string'),
   ('weeks_on_list', 'struct<$numberInt:string>')]
```

Fig 7: *display the datatypes of dataframe*

This code retrieves the data types of each column in the DataFrame 'df'.

Step 11: Statistical Summary of the Dataset



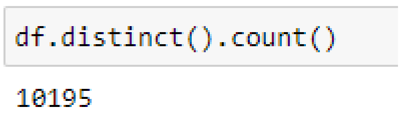
```
: df.describe().show()
```

```
+-------+--------------------+---------------+--------------------+---------+------------------+
|summary|  amazon_product_url|         author|         description|publisher|             title|
+-------+--------------------+---------------+--------------------+---------+------------------+
|  count|               10195|          10195|               10195|    10195|             10195|
|   mean|                null|           null|                null|     null|1877.7142857142858|
| stddev|                null|           null|                null|     null| 370.9760613506458|
|    min|http://www.amazon...|        AJ Finn|                    |      ACE|   10TH ANNIVERSARY|
|    max|https://www.amazo...|various authors|'Tis for the Rebe...|allantine|               ZOO|
+-------+--------------------+---------------+--------------------+---------+------------------+
```

Fig 8: *Statistical Summary of the Dataset*

The output provides summary statistics for each column in the DataFrame 'df'. It includes the count, mean, standard deviation, minimum value, and maximum value for each column. This information helps to understand the distribution and range of values in the dataset.

Step 12: Calculate the count of distinct rows



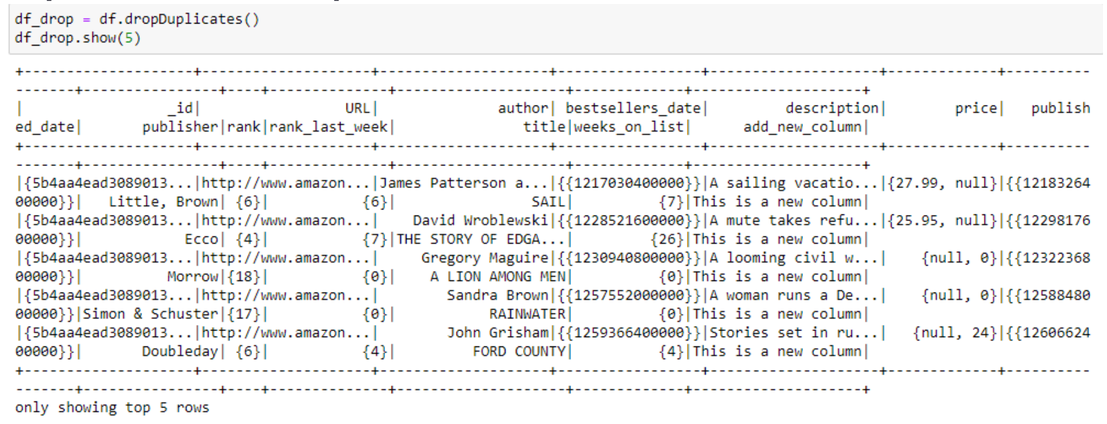
```
df.distinct().count()
```

```
10195
```

Fig 9: distinct count

This code calculates the count of distinct rows in the DataFrame 'df'.

Step 13: Remove the Duplicates values



```
df_drop = df.dropDuplicates()
df_drop.show(5)
```

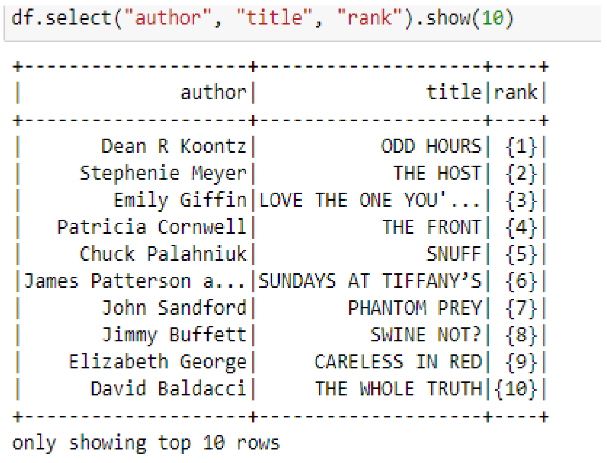
```
+--------------------+--------------------+--------------------+-----------------+--------------------+-------------+---------
--------+----------------+----+--------------+--------------------+-------------+--------------------+
|                 _id|                 URL|              author| bestsellers_date|         description|        price|   publish
ed_date|       publisher|rank|rank_last_week|               title|weeks_on_list|      add_new_column|
+--------------------+--------------------+--------------------+-----------------+--------------------+-------------+---------
--------+----------------+----+--------------+--------------------+-------------+--------------------+
|{5b4aa4ead3089013...|http://www.amazon...|James Patterson a...|{{1217030400000}}|A sailing vacatio...|{27.99, null}|{{12183264
00000}}|   Little, Brown| {6}|           {6}|                SAIL|          {7}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|    David Wroblewski|{{1228521600000}}|A mute takes refu...|{25.95, null}|{{12298176
00000}}|            Ecco| {4}|           {7}|THE STORY OF EDGA...|         {26}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|     Gregory Maguire|{{1230940800000}}|A looming civil w...|    {null, 0}|{{12322368
00000}}|          Morrow|{18}|           {0}|    A LION AMONG MEN|          {0}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|        Sandra Brown|{{1257552000000}}|A woman runs a De...|    {null, 0}|{{12588480
00000}}|Simon & Schuster|{17}|           {0}|           RAINWATER|          {0}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|        John Grisham|{{1259366400000}}|Stories set in ru...|   {null, 24}|{{12606624
00000}}|       Doubleday| {6}|           {4}|         FORD COUNTY|          {4}|This is a new column|
+--------------------+--------------------+--------------------+-----------------+--------------------+-------------+---------
--------+----------------+----+--------------+--------------------+-------------+--------------------+
only showing top 5 rows
```

Fig 10: remove duplicate value

This code removes duplicate rows from the DataFrame 'df' and displays the first 5 rows of the resulting DataFrame 'df_drop'.

Step 14: Shows the ten entries of "Author","Title" and "rank"

Where the df represent the dataframe and select is used to represent the specific columns from the dataset.



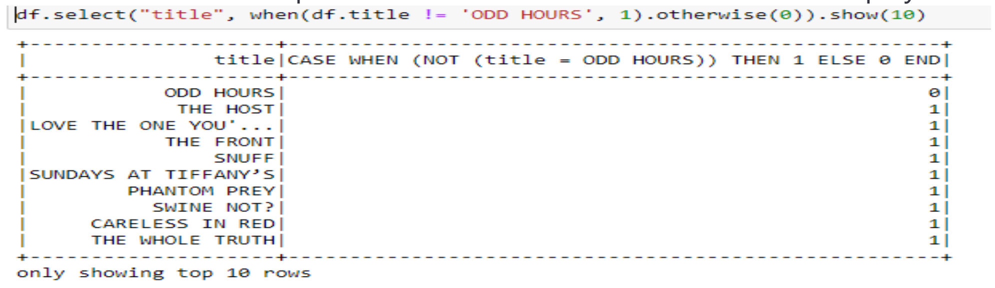
```
df.select("author", "title", "rank").show(10)
```

```
+--------------------+--------------------+----+
|              author|               title|rank|
+--------------------+--------------------+----+
|        Dean R Koontz|           ODD HOURS| {1}|
|     Stephenie Meyer|            THE HOST| {2}|
|        Emily Giffin|LOVE THE ONE YOU'...| {3}|
|    Patricia Cornwell|           THE FRONT| {4}|
|     Chuck Palahniuk|               SNUFF| {5}|
|James Patterson a...|SUNDAYS AT TIFFANY'S| {6}|
|        John Sandford|        PHANTOM PREY| {7}|
|        Jimmy Buffett|          SWINE NOT?| {8}|
|    Elizabeth George|     CARELESS IN RED| {9}|
|      David Baldacci|     THE WHOLE TRUTH|{10}|
+--------------------+--------------------+----+
only showing top 10 rows
```

Fig 11: Shows entry of columns("author,title,rank")

Step 15: df.select("title", when(df.title != 'ODD HOURS', 1).otherwise(0)).show(10)

selects the "title" column from the DataFrame df and creates a new column that indicates whether each title is equal to 'ODD HOURS' or not. The result is displayed for the first 10 rows.

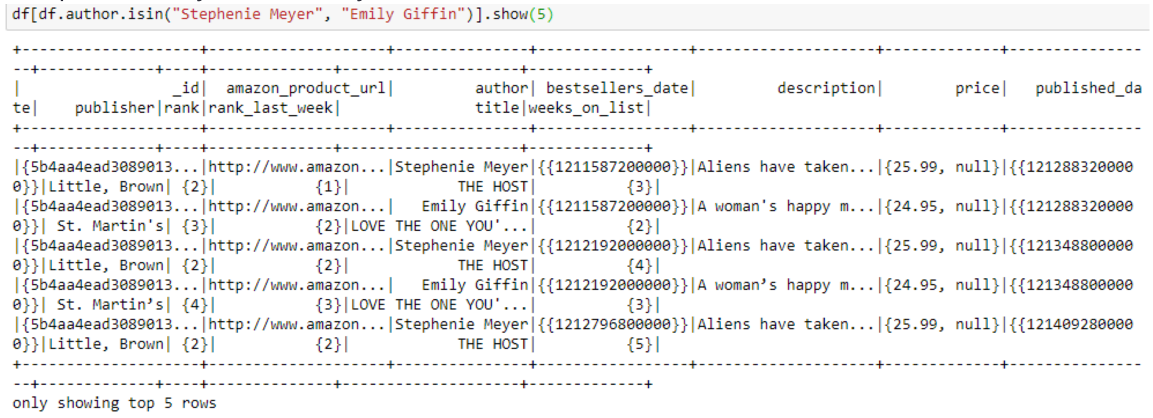


```
df.select("title", when(df.title != 'ODD HOURS', 1).otherwise(0)).show(10)
```

```
+--------------------+-----------------------------------------------------+
|               title|CASE WHEN (NOT (title = ODD HOURS)) THEN 1 ELSE 0 END|
+--------------------+-----------------------------------------------------+
|           ODD HOURS|                                                    0|
|            THE HOST|                                                    1|
|LOVE THE ONE YOU'...|                                                    1|
|           THE FRONT|                                                    1|
|               SNUFF|                                                    1|
|SUNDAYS AT TIFFANY'S|                                                    1|
|        PHANTOM PREY|                                                    1|
|          SWINE NOT?|                                                    1|
|     CARELESS IN RED|                                                    1|
|     THE WHOLE TRUTH|                                                    1|
+--------------------+-----------------------------------------------------+
only showing top 10 rows
```

Fig 12: Create New Columns to check the titles

Step 16: Based on step 13 and 14 pick the names of authors display the result df[df.author.isin("Stephenie Meyer", "Emily Giffin")].show(5)-> where expression checks that if the values in the "author" column of the DataFrame match any of the specified values ("Stephenie Meyer" or "Emily Giffin").

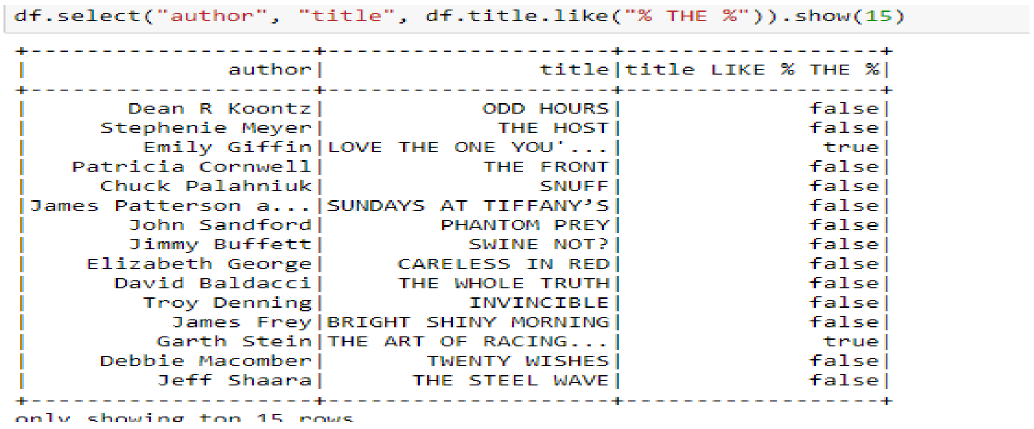


```
df[df.author.isin("Stephenie Meyer", "Emily Giffin")].show(5)
```

```
+--------------------+--------------------+---------------+-----------------+--------------------+-------------+---------------
--+-------------+----+--------------+--------------------+-------------+
|                 _id|  amazon_product_url|         author| bestsellers_date|         description|        price|   published_da
te|    publisher|rank|rank_last_week|               title|weeks_on_list|
+--------------------+--------------------+---------------+-----------------+--------------------+-------------+---------------
--+-------------+----+--------------+--------------------+-------------+
|{5b4aa4ead3089013...|http://www.amazon...|Stephenie Meyer|{{1211587200000}}|Aliens have taken...|{25.99, null}|{{121288320000
0}}|Little, Brown| {2}|           {1}|            THE HOST|          {3}|
|{5b4aa4ead3089013...|http://www.amazon...|   Emily Giffin|{{1211587200000}}|A woman's happy m...|{24.95, null}|{{121288320000
0}}| St. Martin's| {3}|           {2}|LOVE THE ONE YOU'...|          {2}|
|{5b4aa4ead3089013...|http://www.amazon...|Stephenie Meyer|{{1212192000000}}|Aliens have taken...|{25.99, null}|{{121348800000
0}}|Little, Brown| {2}|           {2}|            THE HOST|          {4}|
|{5b4aa4ead3089013...|http://www.amazon...|   Emily Giffin|{{1212192000000}}|A woman's happy m...|{24.95, null}|{{121348800000
0}}| St. Martin's| {4}|           {3}|LOVE THE ONE YOU'...|          {3}|
|{5b4aa4ead3089013...|http://www.amazon...|Stephenie Meyer|{{1212796800000}}|Aliens have taken...|{25.99, null}|{{121409280000
0}}|Little, Brown| {2}|           {2}|            THE HOST|          {5}|
+--------------------+--------------------+---------------+-----------------+--------------------+-------------+---------------
--+-------------+----+--------------+--------------------+-------------+
only showing top 5 rows
```

Fig 13: Display the author name with the data

Step 17: This code represents that show the author and title is true if the title has "the words" in titles.

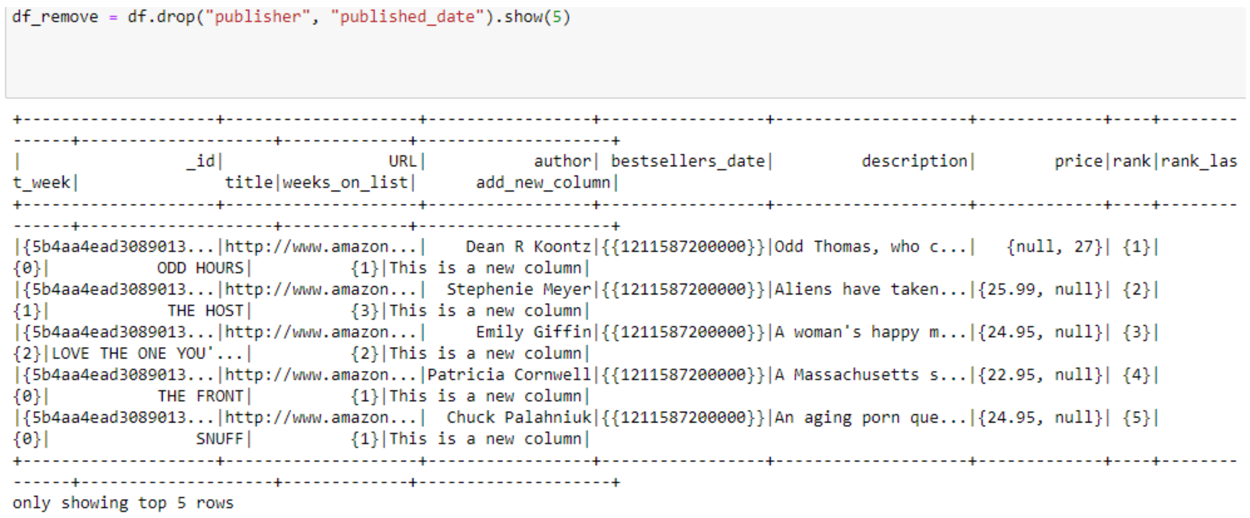


```
df.select("author", "title", df.title.like("% THE %")).show(15)
```

```
+--------------------+--------------------+------------------+
|              author|               title|title LIKE % THE %|
+--------------------+--------------------+------------------+
|       Dean R Koontz|           ODD HOURS|             false|
|     Stephenie Meyer|            THE HOST|             false|
|        Emily Giffin|LOVE THE ONE YOU'...|              true|
|   Patricia Cornwell|           THE FRONT|             false|
|     Chuck Palahniuk|               SNUFF|             false|
|James Patterson a...|SUNDAYS AT TIFFANY'S|             false|
|       John Sandford|        PHANTOM PREY|             false|
|       Jimmy Buffett|          SWINE NOT?|             false|
|    Elizabeth George|     CARELESS IN RED|             false|
|      David Baldacci|     THE WHOLE TRUTH|             false|
|        Troy Denning|          INVINCIBLE|             false|
|          James Frey|BRIGHT SHINY MORNING|             false|
|         Garth Stein|THE ART OF RACING...|              true|
|     Debbie Macomber|      TWENTY WISHES|             false|
|         Jeff Shaara|      THE STEEL WAVE|             false|
+--------------------+--------------------+------------------+
only showing top 15 rows
```

Fig 14: Display the code of true and false condition based on "the" title.

Step 18: Remove Columns

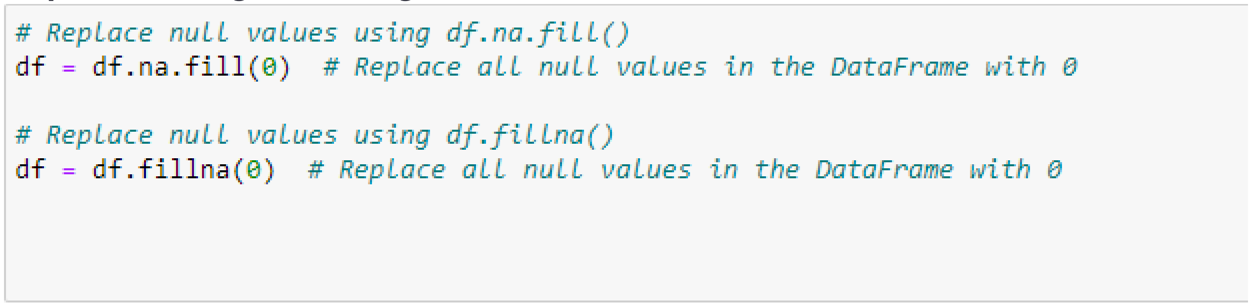


```
df_remove = df.drop("publisher", "published_date").show(5)
```

```
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+----+--------
------+--------------------+-------------+--------------------+
|                 _id|                 URL|           author| bestsellers_date|         description|        price|rank|rank_las
t_week|               title|weeks_on_list|      add_new_column|
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+----+--------
------+--------------------+-------------+--------------------+
|{5b4aa4ead3089013...|http://www.amazon...|    Dean R Koontz|{{1211587200000}}|Odd Thomas, who c...|   {null, 27}| {1}|
{0}|           ODD HOURS|            {1}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|  Stephenie Meyer|{{1211587200000}}|Aliens have taken...|{25.99, null}| {2}|
{1}|            THE HOST|            {3}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|     Emily Giffin|{{1211587200000}}|A woman's happy m...|{24.95, null}| {3}|
{2}|LOVE THE ONE YOU'...|            {2}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|Patricia Cornwell|{{1211587200000}}|A Massachusetts s...|{22.95, null}| {4}|
{0}|           THE FRONT|            {1}|This is a new column|
|{5b4aa4ead3089013...|http://www.amazon...|  Chuck Palahniuk|{{1211587200000}}|An aging porn que...|{24.95, null}| {5}|
{0}|               SNUFF|            {1}|This is a new column|
+--------------------+--------------------+-----------------+-----------------+--------------------+-------------+----+--------
------+--------------------+-------------+--------------------+
only showing top 5 rows
```

Fig 15: Drop the publisher and published date columns

Step 19: Handling the missing values



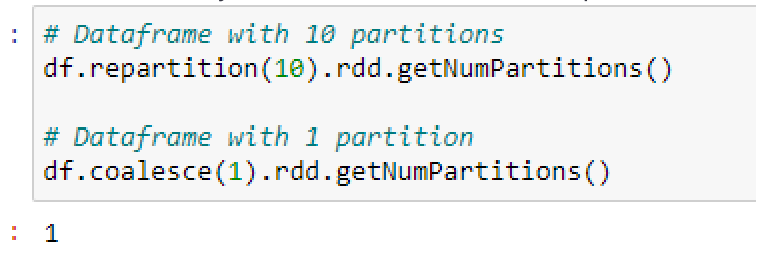
```
# Replace null values using df.na.fill()
df = df.na.fill(0)  # Replace all null values in the DataFrame with 0

# Replace null values using df.fillna()
df = df.fillna(0)  # Replace all null values in the DataFrame with 0
```

Fig 16: handling the missing values

This code replaces all null values in the DataFrame 'df' with 0 using two different methods: 'na.fill(0)' and 'fillna(0)'.

Step 20: Partitions the dataframe with 10 and 1 partitions.

Two different ways to control the number of partitions in a DataFrame in Apache Spark.



```
: # Dataframe with 10 partitions
  df.repartition(10).rdd.getNumPartitions()

  # Dataframe with 1 partition
  df.coalesce(1).rdd.getNumPartitions()

: 1
```

Fig 17: Partitions the dataframe

- df.repartition(10).rdd.getNumPartitions(): This code repartitions the DataFrame df into 10 partitions using the repartition() method. It redistributes the data across the specified number of partitions.
- The getNumPartitions() method called on the RDD (Resilient Distributed Dataset) representation of the DataFrame returns the number of partitions in the resulting RDD.
- df.coalesce(1).rdd.getNumPartitions(): This code reduces the number of partitions in the DataFrame df to 1 using the coalesce() method.

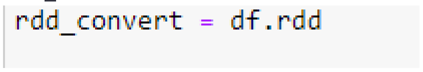
- repartition() is used to increase or decrease the number of partitions in a DataFrame by shuffling the data across partitions.
- coalesce() is used to decrease the number of partitions in a DataFrame by minimizing data movement and merging partitions whenever possible.

Note: The number of partitions affects how the data is distributed across the cluster and can impact parallelism and performance in Spark operations

Step 21: Converting dataframe into an RDD

The RDD represents the data in a distributed manner, allowing for parallel processing in Apache Spark. Converting a DataFrame into an RDD can be useful in scenarios where you need to apply RDD-specific operations or transformations that are not available directly on DataFrames.

rdd_convert = df.rdd

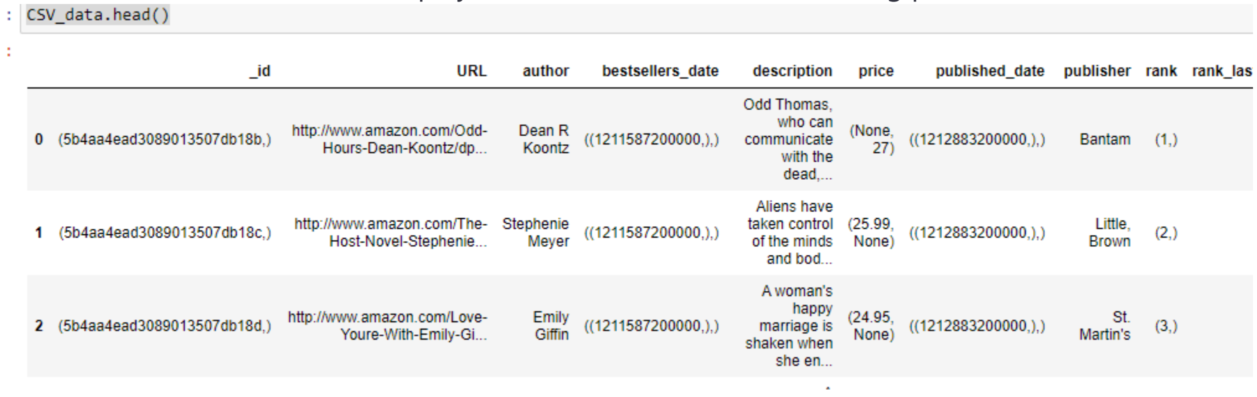


```
rdd_convert = df.rdd
```

Fig 18: Converting dataframe in to RDD

Step 22: Create Content of Dataframe in pandas

CSV_data=df.toPandas() and display the data in structed format using pandas.

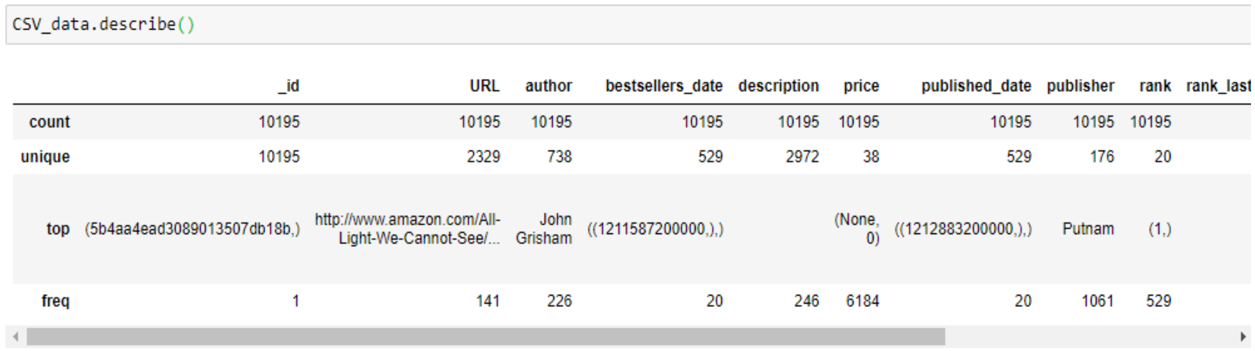


```
: CSV_data.head()
```

	_id	URL	author	bestsellers_date	description	price	published_date	publisher	rank	rank_las
0	(5b4aa4ead3089013507db18b,)	http://www.amazon.com/Odd-Hours-Dean-Koontz/dp...	Dean R Koontz	((1211587200000,),)	Odd Thomas, who can communicate with the dead,...	(None, 27)	((1212883200000,),)	Bantam	(1,)	
1	(5b4aa4ead3089013507db18c,)	http://www.amazon.com/The-Host-Novel-Stephenie...	Stephenie Meyer	((1211587200000,),)	Aliens have taken control of the minds and bod...	(25.99, None)	((1212883200000,),)	Little, Brown	(2,)	
2	(5b4aa4ead3089013507db18d,)	http://www.amazon.com/Love-Youre-With-Emily-Gi...	Emily Giffin	((1211587200000,),)	A woman's happy marriage is shaken when she en...	(24.95, None)	((1212883200000,),)	St. Martin's	(3,)	

Fig 19: Display the dataframe in pandas

Step 23: statistical summary of pandas dataframe



```
CSV_data.describe()
```

	_id	URL	author	bestsellers_date	description	price	published_date	publisher	rank	rank_last
count	10195	10195	10195	10195	10195	10195	10195	10195	10195	
unique	10195	2329	738	529	2972	38	529	176	20	
top	(5b4aa4ead3089013507db18b,)	http://www.amazon.com/All-Light-We-Cannot-See/...	John Grisham	((1211587200000,),)		(None, 0)	((1212883200000,),)	Putnam	(1,)	
freq	1	141	226	20	246	6184	20	1061	529	

Fig 20: Statistical Summary of Pandas dataframe

Step 24: Display the Top Authors by Number of Books

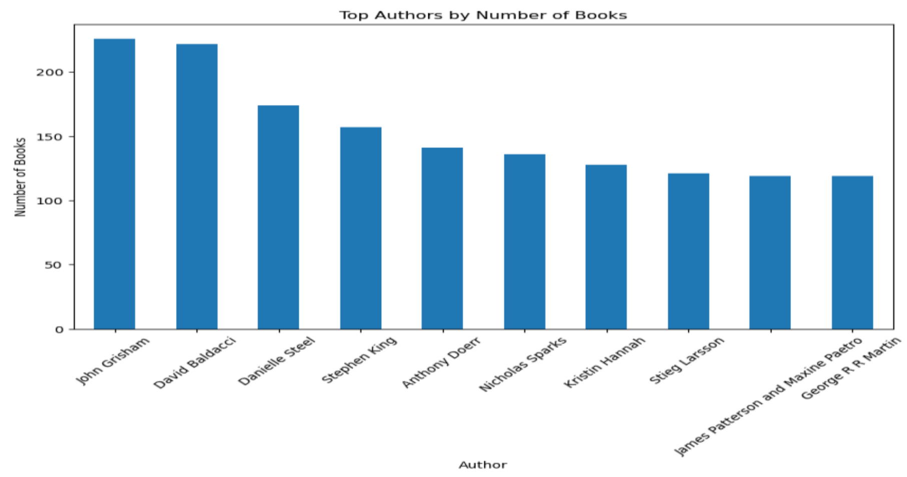
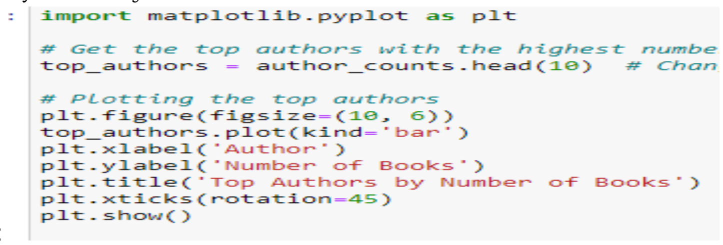


Fig 21: Top Authors by Numbers of books

Code Snippet:

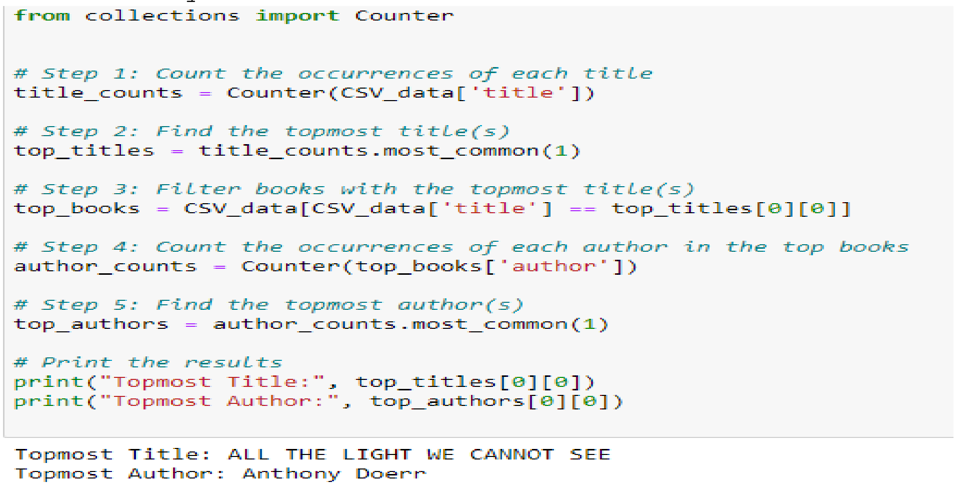


```
import matplotlib.pyplot as plt

# Get the top authors with the highest numbe
top_authors = author_counts.head(10)  # Chan

# Plotting the top authors
plt.figure(figsize=(10, 6))
top_authors.plot(kind='bar')
plt.xlabel('Author')
plt.ylabel('Number of Books')
plt.title('Top Authors by Number of Books')
plt.xticks(rotation=45)
plt.show()
```

Fig 22: code for top authors by numbers of books

Step 25: As per Analysis we find that the Topmost Title-> “ALL THE LIGHT WE CANNOT SEE” **And top most Author->** “Anthony Doerr”

Code Snippet:



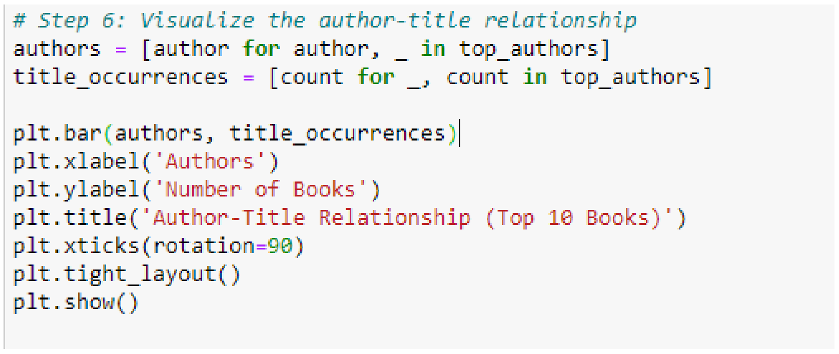
```
from collections import Counter


# Step 1: Count the occurrences of each title
title_counts = Counter(CSV_data['title'])

# Step 2: Find the topmost title(s)
top_titles = title_counts.most_common(1)

# Step 3: Filter books with the topmost title(s)
top_books = CSV_data[CSV_data['title'] == top_titles[0][0]]

# Step 4: Count the occurrences of each author in the top books
author_counts = Counter(top_books['author'])

# Step 5: Find the topmost author(s)
top_authors = author_counts.most_common(1)

# Print the results
print("Topmost Title:", top_titles[0][0])
print("Topmost Author:", top_authors[0][0])
```

```
Topmost Title: ALL THE LIGHT WE CANNOT SEE
Topmost Author: Anthony Doerr
```

Fig 23: Display the topmost title and author

Explain:This code counts the occurrences of titles and authors in a CSV dataset. It then identifies the most common title and author, and prints the results.

Step 26: Represent the Author and Title relationship



```
# Step 6: Visualize the author-title relationship
authors = [author for author, _ in top_authors]
title_occurrences = [count for _, count in top_authors]

plt.bar(authors, title_occurrences)
plt.xlabel('Authors')
plt.ylabel('Number of Books')
plt.title('Author-Title Relationship (Top 10 Books)')
plt.xticks(rotation=90)
plt.tight_layout()
plt.show()
```

Code Snippet:

Fig24: Represent the code for author and title relationship

Explain:This code visualizes the relationship between authors and the number of books they have in the top 10 books. It creates a bar plot with authors on the x-axis and the number of books on the y-axis.

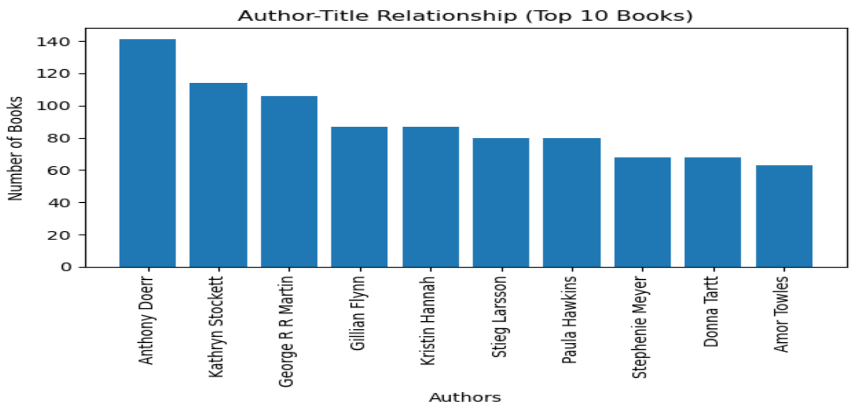
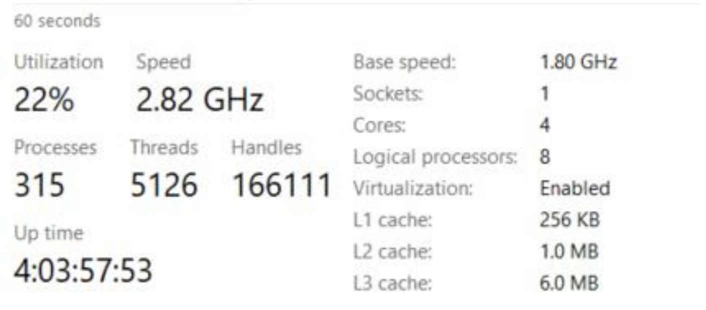


Fig25: Relationship of author and number of books

Task 4: scalability analysis: Scalability analysis in Spark refers to evaluating the performance and efficiency of Spark applications as the size of the data and the computing resources increase over time. It helps identify bottlenecks, optimize resource allocation, and ensure that Spark can handle larger workloads efficiently.

Performance Analysis of Computer:

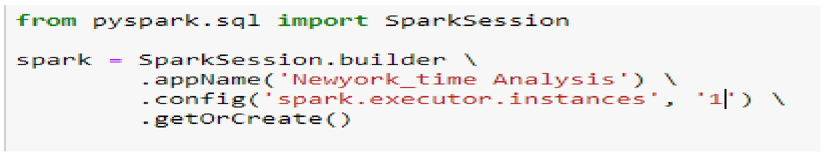


60 seconds

Utilization	Speed		Base speed:	1.80 GHz
22%	2.82 GHz		Sockets:	1
			Cores:	4
Processes	Threads	Handles	Logical processors:	8
315	5126	166111	Virtualization:	Enabled
Up time			L1 cache:	256 KB
			L2 cache:	1.0 MB
4:03:57:53			L3 cache:	6.0 MB

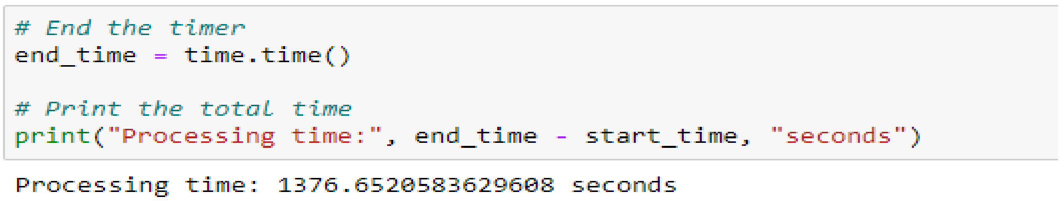
Fig26: Performance Analysis of computer

Instance 1



```
from pyspark.sql import SparkSession

spark = SparkSession.builder \
        .appName('Newyork_time Analysis') \
        .config('spark.executor.instances', '1') \
        .getOrCreate()
```

Fig 27: Create app name and showing the configuration of core

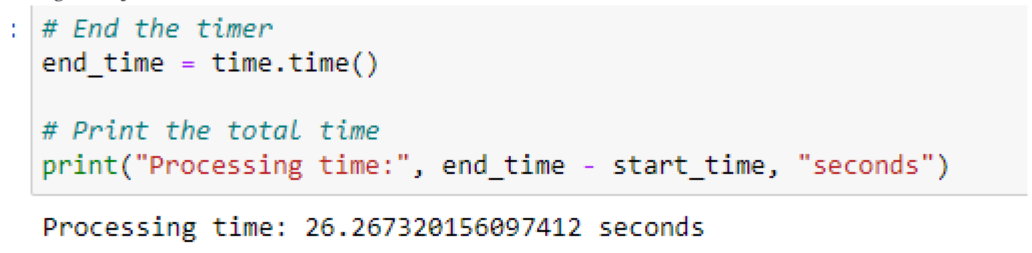


```
# End the timer
end_time = time.time()

# Print the total time
print("Processing time:", end_time - start_time, "seconds")
```

```
Processing time: 1376.6520583629608 seconds
```

Instance 1->

Fig 28: Total processing time of Instance 1

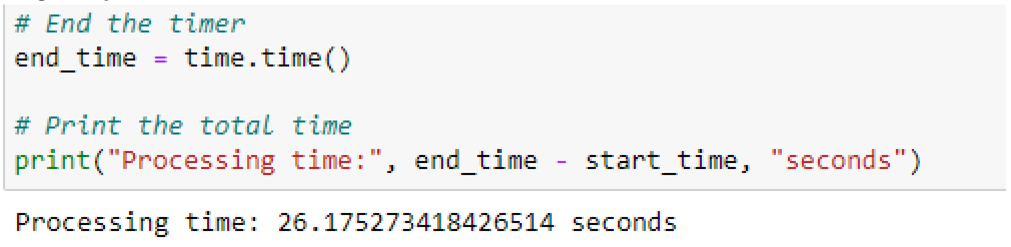


```
# End the timer
end_time = time.time()

# Print the total time
print("Processing time:", end_time - start_time, "seconds")
```

```
Processing time: 26.267320156097412 seconds
```

Instance 2:

Fig 29: Total Processing time of Instance 2



```
# End the timer
end_time = time.time()

# Print the total time
print("Processing time:", end_time - start_time, "seconds")
```

```
Processing time: 26.175273418426514 seconds
```

Instance 3:

Fig 30: Total processing time of instance 3

Conclusions:

The topmost title in the dataset is "**ALL THE LIGHT WE CANNOT SEE**" with the topmost author name being "**Anthony Doerr**". This suggests that "ALL THE LIGHT WE CANNOT SEE" is a popular book in the dataset, and "**Anthony Doerr**" is the author associated with it. Among all the authors in the dataset, "**John Grisham**" stands out with the highest number of books. He has a total of **250** books associated with his name. This indicates that Anthony Doerr is a prolific author within the dataset, having contributed significantly to the collection of books. The total processing time of the dataset and analysis on Instance one was **1376.65 seconds**, on Instance 2 it was **26.26 seconds**, and on Instance 3 it was **26.17 seconds**. This suggests that Instance 1 had the longest processing time, while Instances 2 and 3 were significantly faster.The difference in processing time across instances indicates variations in computational resources or workload distribution. Instance 1 might have lower processing capabilities or be overloaded with other tasks, resulting in slower performance. Instances 2 and 3, on the other hand, showed better performance and efficiency. It is important to consider the computational resources and workload distribution when performing data analysis. In summary, the conclusions highlight the popularity of the book "ALL THE LIGHT WE CANNOT SEE" by Anthony Doerr, the prolific nature of Anthony Doerr's contributions to the dataset, and the significance of selecting appropriate computational resources and optimizing workload distribution for efficient data processing and analysis.