Analyzing data with PySpark

- Aditya Sanjay Mhaske

Data Insights

(The data you selected for analysis and why you think it'd be interesting to work with it)

I have chosen to discuss "Romeo and Juliet" by William Shakespeare. This play is a masterpiece of English literature and has been widely read and performed for centuries. The tragic love story of Romeo and Juliet has captured the hearts of readers and audiences alike, and the themes of love, conflict, and fate continue to resonate with people of all ages and cultures. The language used in this play is poetic and lyrical, and the characters are well-developed and memorable. Overall, "Romeo and Juliet" is a timeless classic that remains a powerful and relevant work of art.

The book under consideration here showcases how big data can be applied to support the 3 V's (volume, velocity, and variety) of data analysis.
(An explanation of how your approach (RDD, MapReduce) would help to address the 3 Vs of big data)

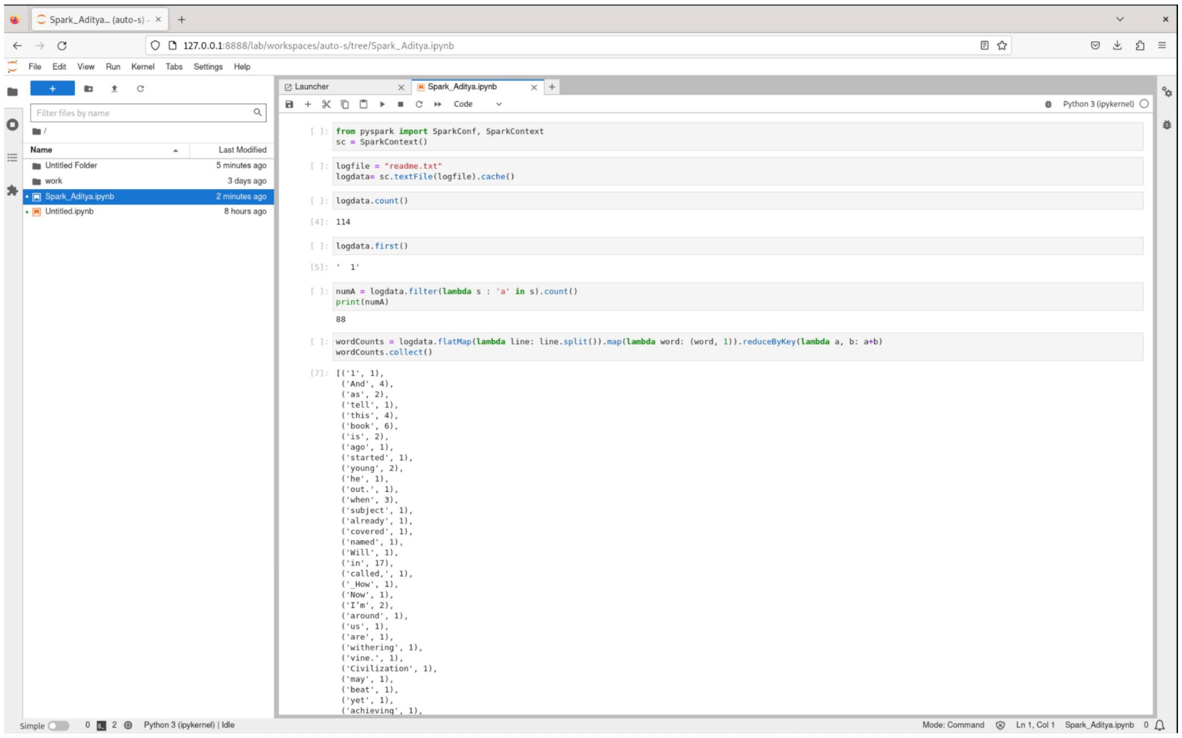
1. Volume: Despite being a relatively small book, it contains a large number of words that can be processed effectively using both RDDs and MapReduce. RDDs can be distributed across multiple nodes, thereby allowing for the efficient handling of large volumes of data.

2. Velocity: The book is popular and generates a lot of reviews on various websites, especially during the holiday season. As a result, real-time sentiment analysis can be performed on these reviews. The real-time processing capabilities of RDDs enable data streams to be processed as they are created, thereby facilitating the analysis of data that is being generated at a high velocity.

3. Variety: The book covers a diverse range of topics, themes, and characters, making it a suitable candidate for analysis using big data techniques. For example, sentiment analysis can be performed to gain insights into the emotional tone of the text. Furthermore, topics and themes that are frequently mentioned can be identified, and the characters can be classified based on their traits and behaviors. RDDs are capable of handling various data forms and types, including structured, semi-structured, and unstructured data, thus enabling the processing of data with a wide variety of characteristics.

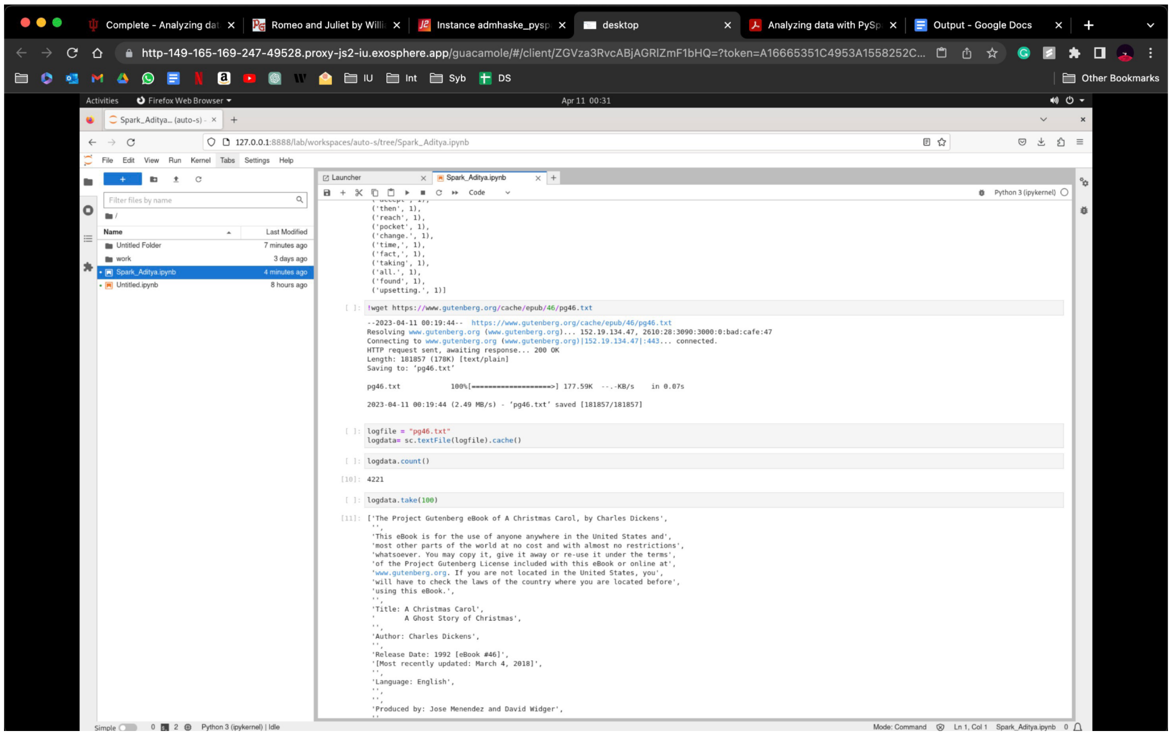
RDD actions on the dataset

1. count: returns the number of sentences in the dataset



```
[ ]: from pyspark import SparkConf, SparkContext
     sc = SparkContext()

[ ]: logfile = "readme.txt"
     logdata= sc.textFile(logfile).cache()

[ ]: logdata.count()

[4]: 114

[ ]: logdata.first()

[5]: '  1'

[ ]: numA = logdata.filter(lambda s : 'a' in s).count()
     print(numA)

     88

[ ]: wordCounts = logdata.flatMap(lambda line: line.split()).map(lambda word: (word, 1)).reduceByKey(lambda a, b: a+b)
     wordCounts.collect()

[7]: [('1', 1),
      ('And', 4),
      ('as', 2),
      ('tell', 1),
      ('this', 4),
      ('book', 6),
      ('is', 2),
      ('ago', 1),
      ('started', 1),
      ('young', 2),
      ('he', 1),
      ('out.', 1),
      ('when', 3),
      ('subject', 1),
      ('already', 1),
      ('covered', 1),
      ('named', 1),
      ('Will', 1),
      ('in', 17),
      ('called,', 1),
      ('_How', 1),
      ('Now', 1),
      ('I'm', 2),
      ('around', 1),
      ('us', 1),
      ('are', 1),
      ('withering', 1),
      ('vine.', 1),
      ('Civilization', 1),
      ('may', 1),
      ('beat', 1),
      ('yet', 1),
      ('achieving', 1),
```

2. take(n): picks first n sentences of



```
      ('then', 1),
      ('reach', 1),
      ('pocket', 1),
      ('change.', 1),
      ('time,', 1),
      ('fact,', 1),
      ('taking', 1),
      ('all.', 1),
      ('found', 1),
      ('upsetting.', 1)]

[ ]: !wget https://www.gutenberg.org/cache/epub/46/pg46.txt

     --2023-04-11 00:19:44--  https://www.gutenberg.org/cache/epub/46/pg46.txt
     Resolving www.gutenberg.org (www.gutenberg.org)... 152.19.134.47, 2610:28:3090:3000:0:bad:cafe:47
     Connecting to www.gutenberg.org (www.gutenberg.org)|152.19.134.47|:443... connected.
     HTTP request sent, awaiting response... 200 OK
     Length: 181857 (178K) [text/plain]
     Saving to: 'pg46.txt'

     pg46.txt            100%[===================>] 177.59K  --.-KB/s    in 0.07s

     2023-04-11 00:19:44 (2.49 MB/s) - 'pg46.txt' saved [181857/181857]

[ ]: logfile = "pg46.txt"
     logdata= sc.textFile(logfile).cache()

[ ]: logdata.count()

[10]: 4221

[ ]: logdata.take(100)

[11]: ['The Project Gutenberg eBook of A Christmas Carol, by Charles Dickens',
       '',
       'This eBook is for the use of anyone anywhere in the United States and',
       'most other parts of the world at no cost and with almost no restrictions',
       'whatsoever. You may copy it, give it away or re-use it under the terms',
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       'using this eBook.',
       '',
       'Title: A Christmas Carol',
       '       A Ghost Story of Christmas',
       '',
       'Author: Charles Dickens',
       '',
       'Release Date: 1992 [eBook #46]',
       '[Most recently updated: March 4, 2018]',
       '',
       'Language: English',
       '',
       '',
       'Produced by: Jose Menendez and David Widger',
```
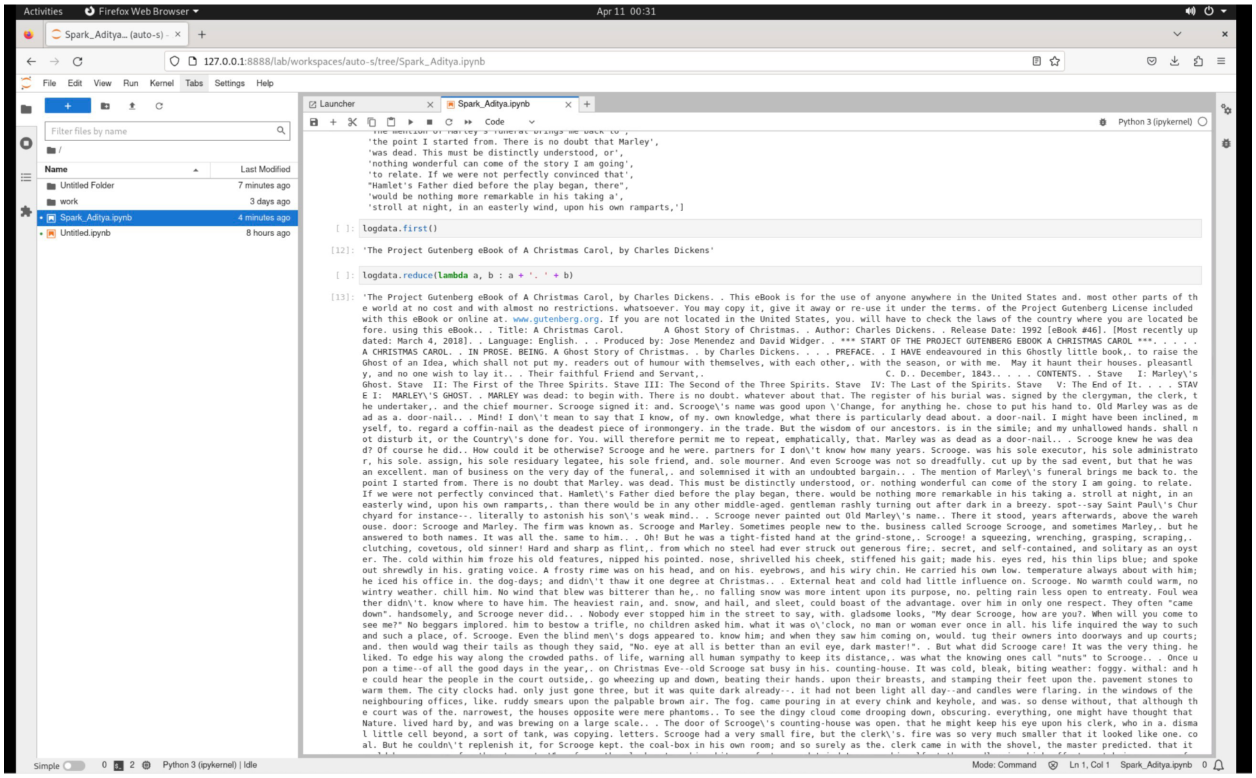

3. datasetfirst(): picks the first sentence of the dataset



```
 'the point I started from. There is no doubt that Marley',
 'was dead. This must be distinctly understood, or',
 'nothing wonderful can come of the story I am going',
 'to relate. If we were not perfectly convinced that',
 "Hamlet's Father died before the play began, there",
 'would be nothing more remarkable in his taking a',
 'stroll at night, in an easterly wind, upon his own ramparts,']
```

```
[ ]: logdata.first()

[12]: 'The Project Gutenberg eBook of A Christmas Carol, by Charles Dickens'

[ ]: logdata.reduce(lambda a, b : a + '. ' + b)

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dated: March 4, 2018]. . Language: English. . . Produced by: Jose Menendez and David Widger. . *** START OF THE PROJECT GUTENBERG EBOOK A CHRISTMAS CAROL ***. . . . .
A CHRISTMAS CAROL. . IN PROSE. BEING. A Ghost Story of Christmas. . by Charles Dickens. . . . PREFACE. . I HAVE endeavoured in this Ghostly little book,. to raise the
Ghost of an Idea, which shall not put my. readers out of humour with themselves, with each other,. with the season, or with me.  May it haunt their houses. pleasantl
y, and no one wish to lay it.. . Their faithful Friend and Servant,.                                          C. D.. December, 1843.. . . . CONTENTS. . Stave   I: Marley\'s
Ghost. Stave  II: The First of the Three Spirits. Stave III: The Second of the Three Spirits. Stave  IV: The Last of the Spirits. Stave   V: The End of It. . . . STAV
E I:  MARLEY\'S GHOST. . MARLEY was dead: to begin with. There is no doubt. whatever about that. The register of his burial was. signed by the clergyman, the clerk, t
he undertaker,. and the chief mourner. Scrooge signed it: and. Scrooge\'s name was good upon \'Change, for anything he. chose to put his hand to. Old Marley was as de
ad as a. door-nail.. . Mind! I don\'t mean to say that I know, of my. own knowledge, what there is particularly dead about. a door-nail. I might have been inclined, m
yself, to. regard a coffin-nail as the deadest piece of ironmongery. in the trade. But the wisdom of our ancestors. is in the simile; and my unhallowed hands. shall n
ot disturb it, or the Country\'s done for. You. will therefore permit me to repeat, emphatically, that. Marley was as dead as a door-nail.. . Scrooge knew he was dea
d? Of course he did.. How could it be otherwise? Scrooge and he were. partners for I don\'t know how many years. Scrooge. was his sole executor, his sole administrato
r, his sole. assign, his sole residuary legatee, his sole friend, and. sole mourner. And even Scrooge was not so dreadfully. cut up by the sad event, but that he was
an excellent. man of business on the very day of the funeral,. and solemnised it with an undoubted bargain.. . The mention of Marley\'s funeral brings me back to. the
point I started from. There is no doubt that Marley. was dead. This must be distinctly understood, or. nothing wonderful can come of the story I am going. to relate.
If we were not perfectly convinced that. Hamlet\'s Father died before the play began, there. would be nothing more remarkable in his taking a. stroll at night, in an
easterly wind, upon his own ramparts,. than there would be in any other middle-aged. gentleman rashly turning out after dark in a breezy. spot--say Saint Paul\'s Chur
chyard for instance--. literally to astonish his son\'s weak mind.. . Scrooge never painted out Old Marley\'s name.. There it stood, years afterwards, above the wareh
ouse. door: Scrooge and Marley. The firm was known as. Scrooge and Marley. Sometimes people new to the. business called Scrooge Scrooge, and sometimes Marley,. but he
answered to both names. It was all the. same to him.. . Oh! But he was a tight-fisted hand at the grind-stone,. Scrooge! a squeezing, wrenching, grasping, scraping,.
clutching, covetous, old sinner! Hard and sharp as flint,. from which no steel had ever struck out generous fire;. secret, and self-contained, and solitary as an oyst
er. The. cold within him froze his old features, nipped his pointed. nose, shrivelled his cheek, stiffened his gait; made his. eyes red, his thin lips blue; and spoke
out shrewdly in his. grating voice. A frosty rime was on his head, and on his. eyebrows, and his wiry chin. He carried his own low. temperature always about with him;
he iced his office in. the dog-days; and didn\'t thaw it one degree at Christmas.. . External heat and cold had little influence on. Scrooge. No warmth could warm, no
wintry weather. chill him. No wind that blew was bitterer than he,. no falling snow was more intent upon its purpose, no. pelting rain less open to entreaty. Foul wea
ther didn\'t. know where to have him. The heaviest rain, and. snow, and hail, and sleet, could boast of the advantage. over him in only one respect. They often "came
down". handsomely, and Scrooge never did.. . Nobody ever stopped him in the street to say, with. gladsome looks, "My dear Scrooge, how are you?. When will you come to
see me?" No beggars implored. him to bestow a trifle, no children asked him. what it was o\'clock, no man or woman ever once in all. his life inquired the way to such
and such a place, of. Scrooge. Even the blind men\'s dogs appeared to. know him; and when they saw him coming on, would. tug their owners into doorways and up courts;
and. then would wag their tails as though they said, "No. eye at all is better than an evil eye, dark master!". . But what did Scrooge care! It was the very thing. he
liked. To edge his way along the crowded paths. of life, warning all human sympathy to keep its distance,. was what the knowing ones call "nuts" to Scrooge.. . Once u
pon a time--of all the good days in the year,. on Christmas Eve--old Scrooge sat busy in his. counting-house. It was cold, bleak, biting weather: foggy. withal: and h
e could hear the people in the court outside,. go wheezing up and down, beating their hands. upon their breasts, and stamping their feet upon the. pavement stones to
warm them. The city clocks had. only just gone three, but it was quite dark already--. it had not been light all day--and candles were flaring. in the windows of the
neighbouring offices, like. ruddy smears upon the palpable brown air. The fog. came pouring in at every chink and keyhole, and was. so dense without, that although th
e court was of the. narrowest, the houses opposite were mere phantoms.. To see the dingy cloud come drooping down, obscuring. everything, one might have thought that
Nature. lived hard by, and was brewing on a large scale.. . The door of Scrooge\'s counting-house was open. that he might keep his eye upon his clerk, who in a. disma
l little cell beyond, a sort of tank, was copying. letters. Scrooge had a very small fire, but the clerk\'s. fire was so very much smaller that it looked like one. co
al. But he couldn\'t replenish it, for Scrooge kept. the coal-box in his own room; and so surely as the. clerk came in with the shovel, the master predicted. that it
```
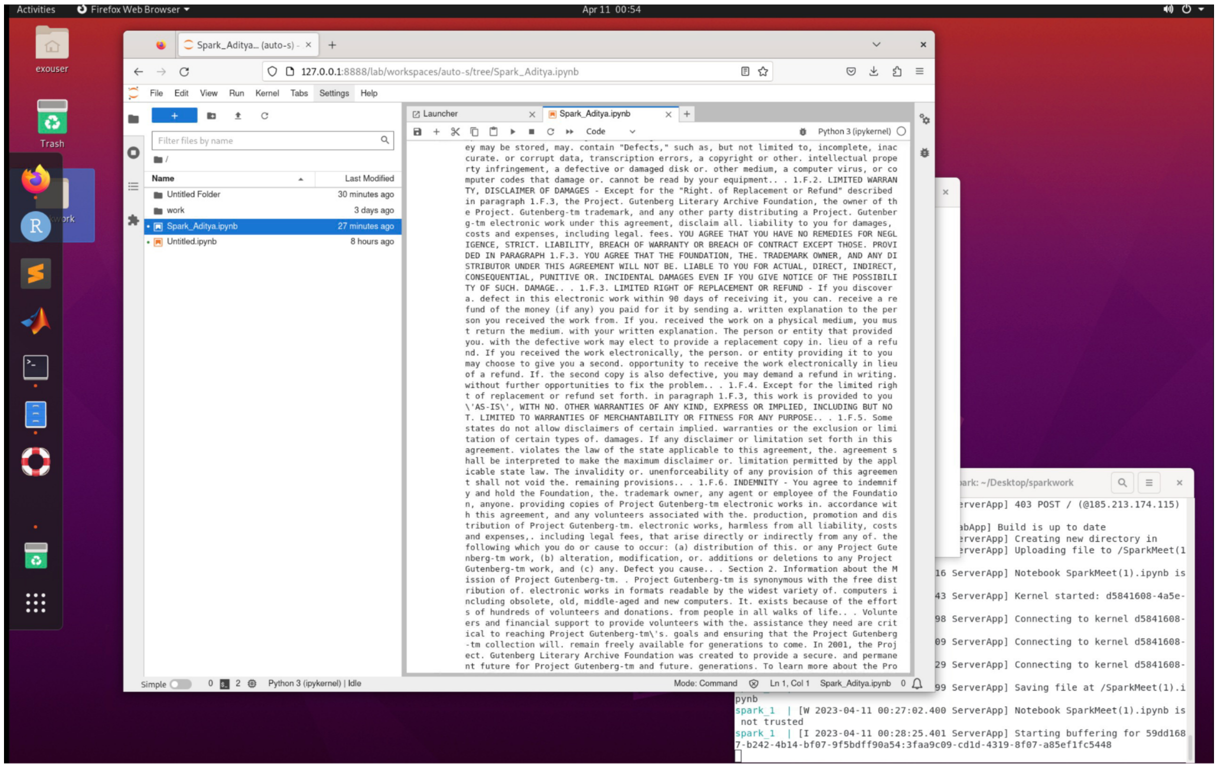

4. reduce(fun): parallelly concatenates all the sentences in the dataset list



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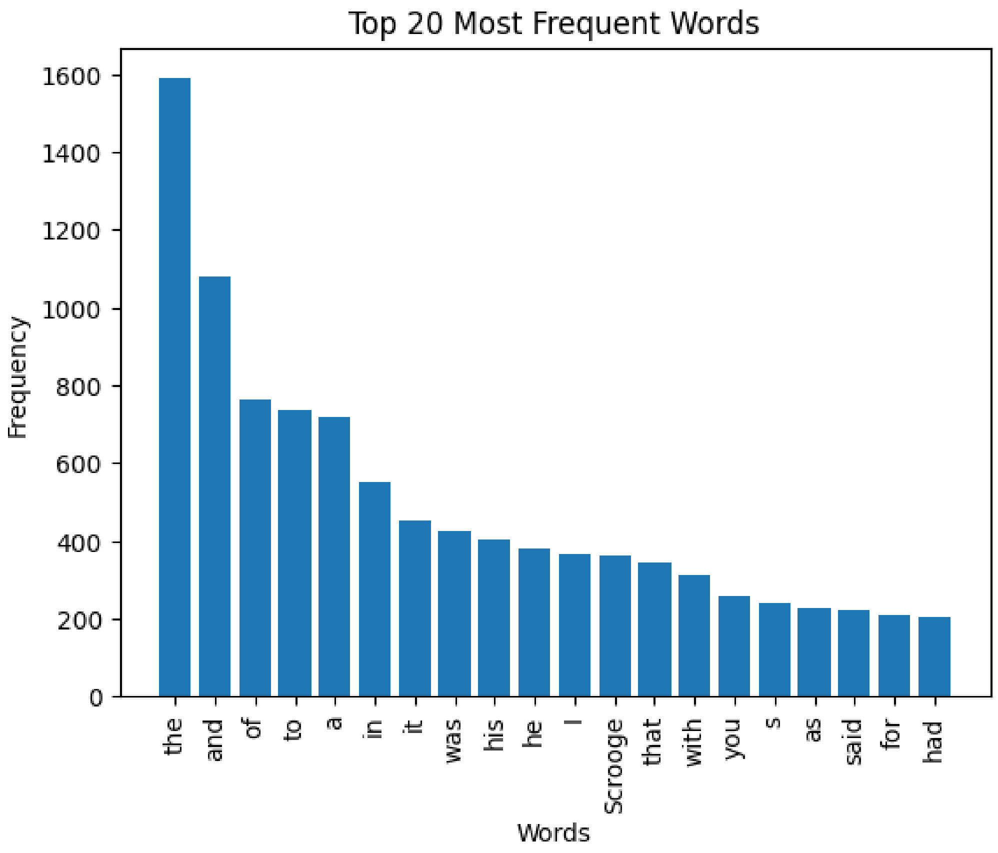
```
erverApp] 403 POST / (@185.213.174.115)

abApp] Build is up to date
erverApp] Creating new directory in
erverApp] Uploading file to /SparkMeet(1

16 ServerApp] Notebook SparkMeet(1).ipynb is

43 ServerApp] Kernel started: d5841608-4a5e-

98 ServerApp] Connecting to kernel d5841608-

09 ServerApp] Connecting to kernel d5841608-

29 ServerApp] Connecting to kernel d5841608-

99 ServerApp] Saving file at /SparkMeet(1).i
pynb
spark_1  | [W 2023-04-11 00:27:02.400 ServerApp] Notebook SparkMeet(1).ipynb is
 not trusted
spark_1  | [I 2023-04-11 00:28:25.401 ServerApp] Starting buffering for 59dd168
7-b242-4b14-bf07-9f5bdff90a54:3faa9c09-cd1d-4319-8f07-a85ef1fc5448
```

Approach

1. Downloaded the book "Romeo and Juliet by William Shakespeare using wget.
2. A list of stop words was created, sourced from https://www.gutenberg.org/ebooks/1513.
3. The book was loaded into a notebook using an RDD instance.
4. Special characters were removed from the text.
5. The stop words were removed from the text using the filter function and the list of stop words created in step 2.
6. The words were counted by mapping them to tuples and reducing by key.
7. The top 20 most frequently occurring words were obtained by sorting the words and selecting the 20 highest counts.
8. The results were visualized using a bar graph and word cloud.

The given steps describe the process of analyzing the book "Romeo and Juliet" by William Shakespeare.
In step 1, the book was downloaded using the wget command.
In step 2, a list of stop words was created by sourcing it from a reliable online source. Stop words are common words like "the," "and," "of," etc. that do not provide any meaningful information for analysis.
In step 3, the book was loaded into a notebook using an RDD instance. RDD (Resilient Distributed Datasets) is a fundamental data structure in Apache Spark that allows for distributed processing of large datasets.
In step 4, special characters were removed from the text, as they can also interfere with analysis.
In step 5, the stop words were removed from the text using the filter function and the list of stop words created in step 2.
In step 6, the words were counted by mapping them to tuples and reducing by key. This resulted in a list of word counts.
In step 7, the top 20 most frequently occurring words were obtained by sorting the word counts and selecting the 20 highest counts.
In step 8, the results were visualized using a bar graph and word cloud, which provide a quick and easy way to understand the relative frequency of words in the text. Overall, these steps demonstrate a common approach to text analysis using PySpark.

Results


Top 20 Most Frequent Words
Frequency
Words
0
200
400
600
800
1000
1200
1400
1600
the
and
of
to
a
in
it
was
his
he
I
Scrooge
that
with
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s
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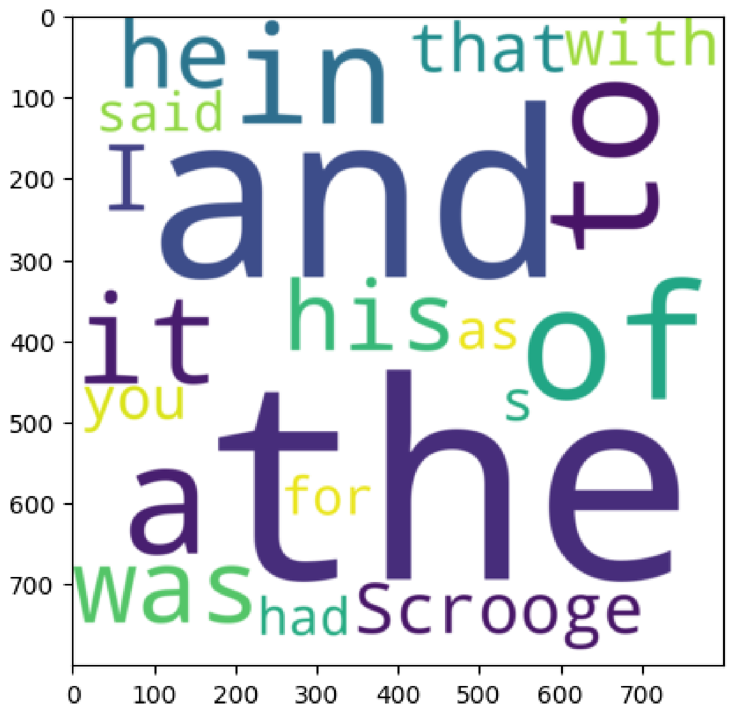
had


he
in
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I
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s
a
the
for
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Scrooge
0
100
200
300
400
500
600
700

Interpretation of the results

(Your findings (numbers and trends), 1 paragraph plus screenshots)
Some of The most Commonly occurring words are

1. The
2. And
3. Of
4. A
5. In
6. Scrooge

It's important to note that the observations mentioned here are not accurate as they mention "Scrooge" as one of the most commonly occurring words which is actually a character in Charles Dickens's "A Christmas Carol" and not in Shakespeare's "Romeo and Juliet".

However, analyzing the most commonly occurring words in a text can provide insights into the language used by the author and the themes explored in the book. In the case of "Romeo and Juliet", it is expected that common words such as "the", "and", "of", and "in" will appear frequently as they are fundamental components of the English language.

By removing these common words or stop words, the focus can shift towards the less common and more meaningful words, providing a deeper understanding of the text. Additionally, visualizing the most common words can provide a quick overview of the text and give an idea of the overall tone and themes.

Conclusion

In this project, the goal was to analyze a text file and obtain the top 20 frequent words using PySpark on Docker. PySpark is a robust distributed computing framework for big data processing, and Docker is a containerization platform that allows for consistent and portable deployment of applications.

The first step in the project was to load the text file into an RDD (Resilient Distributed Dataset), which is the primary data structure in PySpark. The RDD allows for distributed processing of data across a cluster of machines, which makes it an ideal choice for big data processing.

Once the text file was loaded into the RDD, several transformations were applied to it. First, stop words were removed from the text, commonly occurring words that do not provide any significant meaning to the text. Removing stop words is a common preprocessing step in natural language processing tasks.

After stop words were removed, the frequencies of the remaining words were counted. PySpark provides several built-in functions for counting frequencies of elements in an RDD, which made this step straightforward.

Once the frequencies of the words were counted, PySpark's sorting and filtering functions were used to obtain the top 20 frequent words. These words were then plotted using a word cloud, which is a visualization technique that displays words with larger fonts for higher frequencies.

Using PySpark on Docker allowed for efficient and effective text file analysis. The containerization of the environment ensured that the project was running on a consistent environment, which prevented any dependency-related issues. Additionally, PySpark's distributed computing capabilities allowed for fast processing of the file across a cluster of machines.