PROJECT REPORT

on

Crime Data Analysis using Hadoop Ecosystem and Python Visualization

Submitted by

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24MCC20075

Under the guidance of

Mr. Rishabh Tomar

in partial fulfillment for the award of the degree of

MASTER OF COMPUTER APPLICATIONS
CLOUD COMPUTING AND DEVOPS

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Certificate

This is to certify that **Ayush Chacko Antony**, a student of **Master of Computer Applications (MCA) – Cloud Computing and DevOps**, has successfully completed the Minor Project titled " Crime Data Analysis using Hadoop Ecosystem and Python Visualization" under the esteemed guidance of Mr. Rishabh Tomar, Assistant Professor, University Institute of Computing **(UIC), Chandigarh University**.

This project was undertaken as a part of the academic curriculum and is submitted in **partial fulfilment of the requirements** for the MCA program. The work presented in this project is a result of **independent research, diligent effort, and dedication**, demonstrating the student's ability to apply theoretical knowledge to practical problem-solving.

The project successfully implements **Big Data processing using Hadoop and MapReduce**, demonstrating an efficient approach to analysing word frequency in large-scale textual data. It reflects the student's understanding of **Big Data frameworks, distributed computing, and data visualization techniques**.

I hereby confirm that this project is an **original work** carried out by the student and has **not been submitted elsewhere** for the award of any other degree, diploma, or certification.

Project Guide:

Mr. Rishabh Tomar

Assistant Professor

University Institute of Computing

Chandigarh University

Acknowledgement

I would like to express my sincere gratitude to **Chandigarh University** and the **University**
Institute of Computing (UIC) for providing me with the opportunity to undertake this project, **" Crime Data Analysis using Hadoop Ecosystem and Python Visualization"**

I extend my heartfelt appreciation to my esteemed mentor, **Mr. Rishabh Tomar, Assistant Professor**, for his invaluable guidance, continuous support, and insightful feedback throughout the project. His expertise in **Big Data and Distributed Systems** played a crucial role in the successful completion of this project.

I am also grateful to my friends and peers for their encouragement and discussions, which helped refine my approach. Lastly, I thank my family for their unwavering support and motivation during this research.

This project has been an incredible learning experience, and I hope it serves as a foundation for
further exploration in **Big Data analytics and Hadoop-based processing.**

Ayush Chacko Antony
MCA – Cloud
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Contents

1. Introduction

In today's digital age, the volume of data being generated across various domains is growing exponentially. Crime data, generated by law enforcement agencies, is one such example where large datasets are collected daily and can offer deep insights into public safety, crime trends, and policy effectiveness when properly analysed. However, traditional data analysis tools often struggle to handle such massive amounts of structured and unstructured data efficiently. This is where Big Data technologies come into play.

The primary aim of this project is to analyse crime data using the Hadoop ecosystem and Python based visualization tools. We chose to use **Java MapReduce** for custom data processing logic, **Apache Pig** for rapid prototyping and aggregation, and **Python** for graph-based visual analysis. These technologies together enabled us to efficiently process large-scale data, extract meaningful insights, and present them in an intuitive manner.

Hadoop's Distributed File System (HDFS) provided the capability to store large files reliably, while MapReduce allowed parallel processing of data across multiple nodes. Pig offered a high level scripting language to quickly perform grouping and counting operations without writing low-level Java code. Python was used at the final stage to generate bar charts, line graphs, and histograms, which helped in visualizing monthly crime rates, frequent crime types, and crime prone areas.

By implementing this end-to-end pipeline—starting from raw crime data to actionable insights— we developed a comprehensive understanding of Big Data frameworks and their real-world applications. This project not only enhanced our technical skills but also demonstrated how data can be leveraged to support smarter, evidence-based decision making in public policy and urban safety management.

2. Tools and Technologies Used

Tool / Technology	Purpose	Description
Hadoop	Big Data Processing Framework	Hadoop is the foundation of our project. It provides the framework for distributed storage (HDFS) and parallel processing using MapReduce.
HDFS (Hadoop	Storage	HDFS is a distributed file system used to store massive

Tool / Technology	Purpose	Description
Distributed File System)		datasets across multiple nodes in a fault-tolerant and scalable way. Our crime dataset was uploaded into HDFS to allow parallel processing.
Java	MapReduce Programming	Java was used to write custom MapReduce programs for analyzing the crime dataset. Java provides low-level control over the Map and Reduce phases, allowing precise data manipulation and aggregation.
MapReduce	Distributed Data Processing	MapReduce is a core Hadoop component. It processes data in a parallel manner across nodes. The Mapper extracts key fields (like month from date), and the Reducer aggregates values (like total crimes per month).
Apache Pig	Scripting for Data Analysis	Pig is a high-level scripting platform that simplifies writing MapReduce logic. It uses Pig Latin language, making it easier to perform tasks like grouping and counting without writing complex Java code.
Python	Data Visualization	Python was used to generate visual representations of the processed crime data. Libraries such as Matplotlib and Seaborn were used to create bar graphs, line charts, and heatmaps for crime trends.
Matplotlib / Seaborn	Graph Plotting Libraries	These Python libraries are powerful tools for creating informative and visually appealing graphs to showcase insights such as monthly crime frequency and most common crime types.

Tool / Technology	Purpose	Description
WSL (Windows Subsystem for Linux)	Linux Environment on Windows	WSL allowed us to run a Linux-based environment directly on a Windows machine. This enabled the execution of Hadoop and Pig commands without needing a separate Linux installation.
Gedit	Text Editing	Gedit, a simple Linux text editor, was used to write and edit the Java and Pig scripts within the WSL environment. It provided a lightweight and efficient way to manage our code files.

Why These Tools Were Chosen:

- **Scalability**: Hadoop and MapReduce were chosen for their ability to process large volumes of data efficiently.
- **Simplicity**: Pig helped reduce development time with its simple scripting syntax.
- **Visualization**: Python enabled us to convert raw numerical outputs into understandable visual graphs.
- **Cross-Platform Compatibility**: WSL allowed seamless execution of Linux commands from within a Windows machine, making the environment developer-friendly.

3. System Design

The system design of our Big Data crime analysis project is based on a modular and distributed architecture that follows the traditional **Big Data analytics pipeline**: data ingestion, storage, processing, and visualization. It integrates Hadoop's powerful storage and processing capabilities with the flexibility of Pig for scripting and Python for data visualization.

Architecture Overview

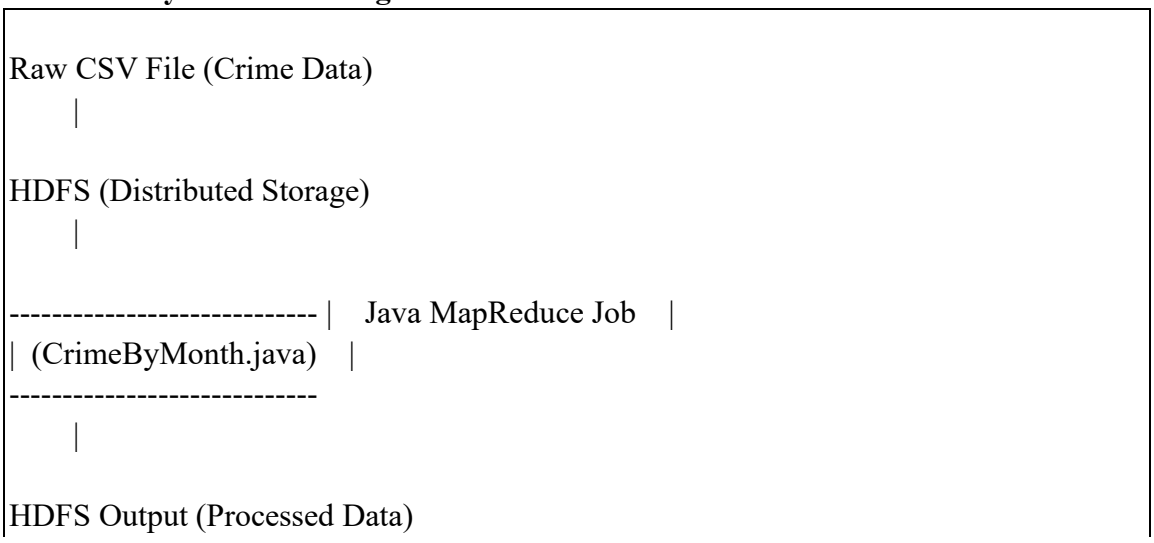
The system consists of the following key components:

1. **Data Source (CSV File)**
   - Raw crime data in CSV format acts as the input.
   - Contains fields like Crime ID, Type, Date, Location, and Description.

2. **HDFS (Storage Layer)** ○ The dataset is ingested into HDFS using hadoop fs -put command.
    - HDFS replicates and stores the file across the cluster nodes to ensure faulttolerant, parallel access.
3. **MapReduce Layer (Java)** ○ A custom Java program is executed using Hadoop's jar tool.
    - **Mapper** reads each record, extracts the crime month, and emits a key-value pair (month, 1).
    - **Reducer** receives all values for each key and computes the total number of crimes for each month.
4. **Pig Layer (Optional Querying)** ○ Pig scripts are used to quickly analyse the data without Java coding. ○ Operations like grouping by date, filtering crime types, or counting records are handled with simple Pig Latin scripts.

5. **Output in HDFS** ○ MapReduce and Pig scripts write their output back into HDFS.
    - Output is typically stored as text files with results such as "April, 1234 crimes".
6. **Local Copy for Visualization** ○ The output file is copied from HDFS to the local file system using hadoop fs -get.
    - This file is cleaned and loaded into Python.
7. **Python Visualization Layer** ○ Uses **pandas** for data manipulation and **matplotlib/seaborn** for plotting.
    - Generates graphs such as:
        - Bar chart of crimes per month.
        - Pie chart of most common crime types.
        - Heatmaps for geographic crime patterns (if applicable).

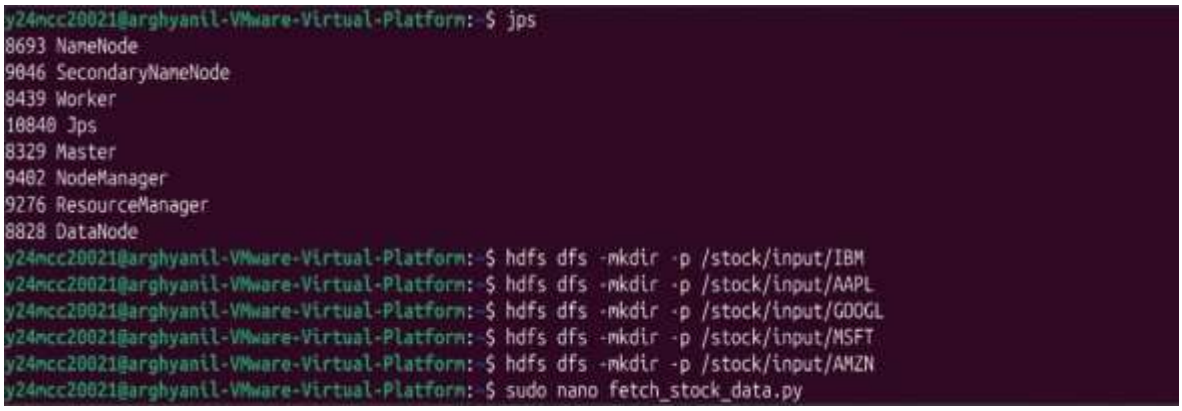
System Flow Diagram



```
      |
      +--> Pig Script
      |

Local File (via `hadoop fs -get`)
      |

Python Script (Visualization using Pandas, Matplotlib)
      |

Graphs: Crimes per Month, Crime Type Distribution
```

4. Implementation Steps

The implementation of this project follows a structured approach, leveraging **Hadoop, MapReduce, and Python** to perform stock price frequency analysis. The steps include **data collection, storage, processing, and visualization**. Below is a detailed breakdown of the execution:



Step 1: First, we checked Hadoop was running properly. Then we created folders in HDFS for each stock (IBM, AAPL, GOOGL, MSFT, AMZN) to store their data. Finally, we prepared the The Implementation goes in three stages:

- Pig Map reduce
- Python Visualization
- Java Mapreduce

Pig Mapreduce

1. Install **Hadoop** and required dependencies inside **WSL (Windows Subsystem for Linux)**.
2. Make sure Apache Pig and Gedit is installed and working on wsl.
3. Format the Hadoop namenode and see that the Hadoop Daemons are running.

```
mehak@LAPTOP:~$ start-dfs.sh
Starting namenodes on [localhost]
Starting datanodes
Starting secondary namenodes [LAPTOP]
mehak@LAPTOP:~$ start-yarn.sh
Starting resourcemanager
Starting nodemanagers
mehak@LAPTOP:~$ jps
768 DataNode
1027 SecondaryNameNode
1268 ResourceManager
650 NameNode
1741 Jps
1389 NodeManager
```

4. Open gedit and create chicago_crime.csv to perform crime analysis upon it.

```
mehak@LAPTOP:~$ gedit ~/chicago_crime.csv
mehak@LAPTOP:~$
```

Open *chicago_crime.csv

```
1,01/15/2022,THEFT,DOWNTOWN,TRUE
2,02/21/2022,BURGLARY,SUBURBS,FALSE
3,01/25/2022,ROBBERY,DOWNTOWN,TRUE
4,03/10/2022,ASSAULT,UPTOWN,FALSE
5,01/30/2022,THEFT,SUBURBS,FALSE
6,02/05/2022,THEFT,DOWNTOWN,TRUE
7,03/18/2022,BURGLARY,DOWNTOWN,FALSE
8,03/22/2022,ASSAULT,UPTOWN,FALSE
9,02/28/2022,ROBBERY,SUBURBS,TRUE
10,01/02/2022,THEFT,DOWNTOWN,FALSE
11,04/11/2022,FRAUD,SUBURBS,TRUE
12,04/14/2022,THEFT,DOWNTOWN,FALSE
13,05/23/2022,ASSAULT,UPTOWN,FALSE
14,05/30/2022,BURGLARY,SUBURBS,TRUE
15,06/04/2022,ROBBERY,DOWNTOWN,TRUE
16,06/17/2022,THEFT,SUBURBS,FALSE
17,07/21/2022,FRAUD,UPTOWN,FALSE
18,07/25/2022,ASSAULT,DOWNTOWN,TRUE
19,08/02/2022,THEFT,SUBURBS,TRUE
20,08/14/2022,BURGLARY,DOWNTOWN,FALSE
21,09/03/2022,ROBBERY,SUBURBS,FALSE
22,09/20/2022,ASSAULT,UPTOWN,TRUE
23,10/05/2022,FRAUD,DOWNTOWN,FALSE
24,10/15/2022,THEFT,UPTOWN,FALSE
25,11/08/2022,BURGLARY,DOWNTOWN,TRUE
26,11/29/2022,THEFT,SUBURBS,FALSE
27,12/12/2022,ROBBERY,UPTOWN,TRUE
28,12/25/2022,FRAUD,SUBURBS,TRUE
29,01/07/2022,ASSAULT,DOWNTOWN,FALSE
30,02/18/2022,THEFT,DOWNTOWN,TRUE
```

5. Make a directory and put the csv file into it.

```
mehak@LAPTOP:~$ hdfs dfs -mkdir -p /crime_data
mehak@LAPTOP:~$ hdfs dfs -put ~/chicago_crime.csv /crime_data/
mehak@LAPTOP:~$
```

6 Open editor to write the Pig Script.

```
mehak@LAPTOP:~$ gedit ~/crime_analysis.pig
mehak@LAPTOP:~$
```

Open ▾ *crime_analysis.pig

```
1 -- Load the data from HDFS
2 crime_data = LOAD '/crime_data/chicago_crime.csv' USING PigStorage(',')
3     AS (id:int, date:chararray, crime_type:chararray, location:chararray, arrest:chararray);
4
5 -- Group by crime type
6 grouped_data = GROUP crime_data BY crime_type;
7
8 -- Count the number of crimes for each type
9 crime_count = FOREACH grouped_data GENERATE group AS crime_type, COUNT(crime_data) AS total_crimes;
10
11 -- Store the result back to HDFS
12 STORE crime_count INTO '/output/crime_type_counts' USING PigStorage(',');
13
```

7. Run the Pig Script. This will calculate the number of crimes for each type and store the result in the output directory.

```
mehak@LAPTOP:~$ pig ~/crime_analysis.pig
2025-04-14 04:45:44,614 INFO pig.ExecTypeProvider: Trying ExecType : LOCAL
2025-04-14 04:45:44,621 INFO pig.ExecTypeProvider: Trying ExecType : MAPREDUCE
2025-04-14 04:45:44,622 INFO pig.ExecTypeProvider: Picked MAPREDUCE as the ExecType
2025-04-14 04:45:44,863 [main] INFO  org.apache.pig.Main - Apache Pig version 0.16.0 (r1746530) compiled Jun 01 2016
2025-04-14 04:45:44,863 [main] INFO  org.apache.pig.Main - Logging error messages to: /home/mehak/pig_1744605944803.
```

```
HadoopVersion   PigVersion      UserId  StartedAt       FinishedAt      Features
3.3.6   0.16.0  mehak   2025-04-14 04:45:51     2025-04-14 04:46:01     GROUP_BY

Success!

Job Stats (time in seconds):
JobId   Maps    Reduces MaxMapTime      MinMapTime      AvgMapTime      MedianMapTime   MaxReduceTime
time    Alias   Feature Outputs
job_local694769940_0001 1       1       n/a     n/a     n/a     n/a     n/a     n/a     n/a     n/a
P_BY,COMBINER   /output/crime_type_counts,

Input(s):
Successfully read 31 records (10758496 bytes) from: "/crime_data/chicago_crime.csv"

Output(s):
Successfully stored 6 records (10756465 bytes) in: "/output/crime_type_counts"

Counters:
Total records written : 6
Total bytes written : 10756465
Spillable Memory Manager spill count : 0
Total bags proactively spilled: 0
Total records proactively spilled: 0

Job DAG:
job_local694769940_0001
```

8. After the Pig Job completes, we can see the output as following.

```
mehak@LAPTOP:~$ hdfs dfs -ls /output/crime_type_counts
Found 2 items
-rw-r--r--   3 mehak supergroup          0 2025-04-14 04:46 /output/crime_type_counts/_SUCCESS
-rw-r--r--   3 mehak supergroup         51 2025-04-14 04:46 /output/crime_type_counts/part-r-00000
```

```
mehak@LAPTOP:~$ hdfs dfs -cat /output/crime_type_counts/part-r-00000
FRAUD,4
THEFT,10
ASSAULT,6
ROBBERY,5
BURGLARY,5
```

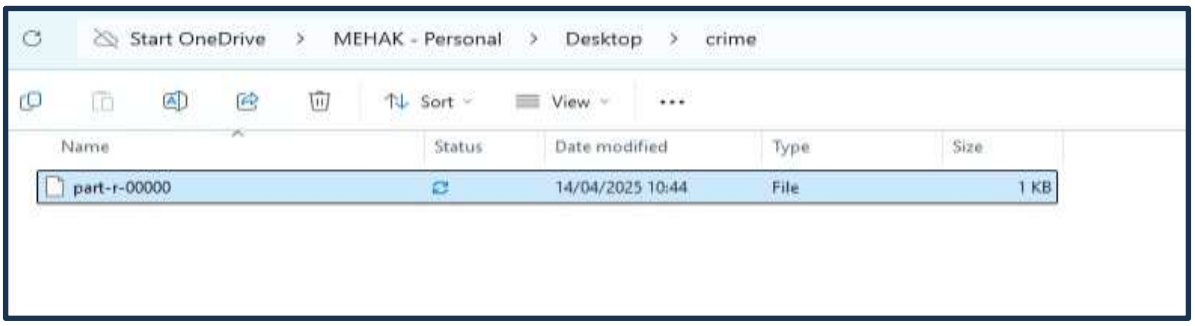
This shows how many times each type of crime occurred.

Visualization with Python

9. Now we run the following command for downloading the part-r-00000 file from HDFS to local machine.

```
mehak@LAPTOP:~$ hdfs dfs -get /output/crime_type_counts/part-r-00000 /mnt/c/Users/ACER/OneDrive/Desktop/crime
mehak@LAPTOP:~$
```

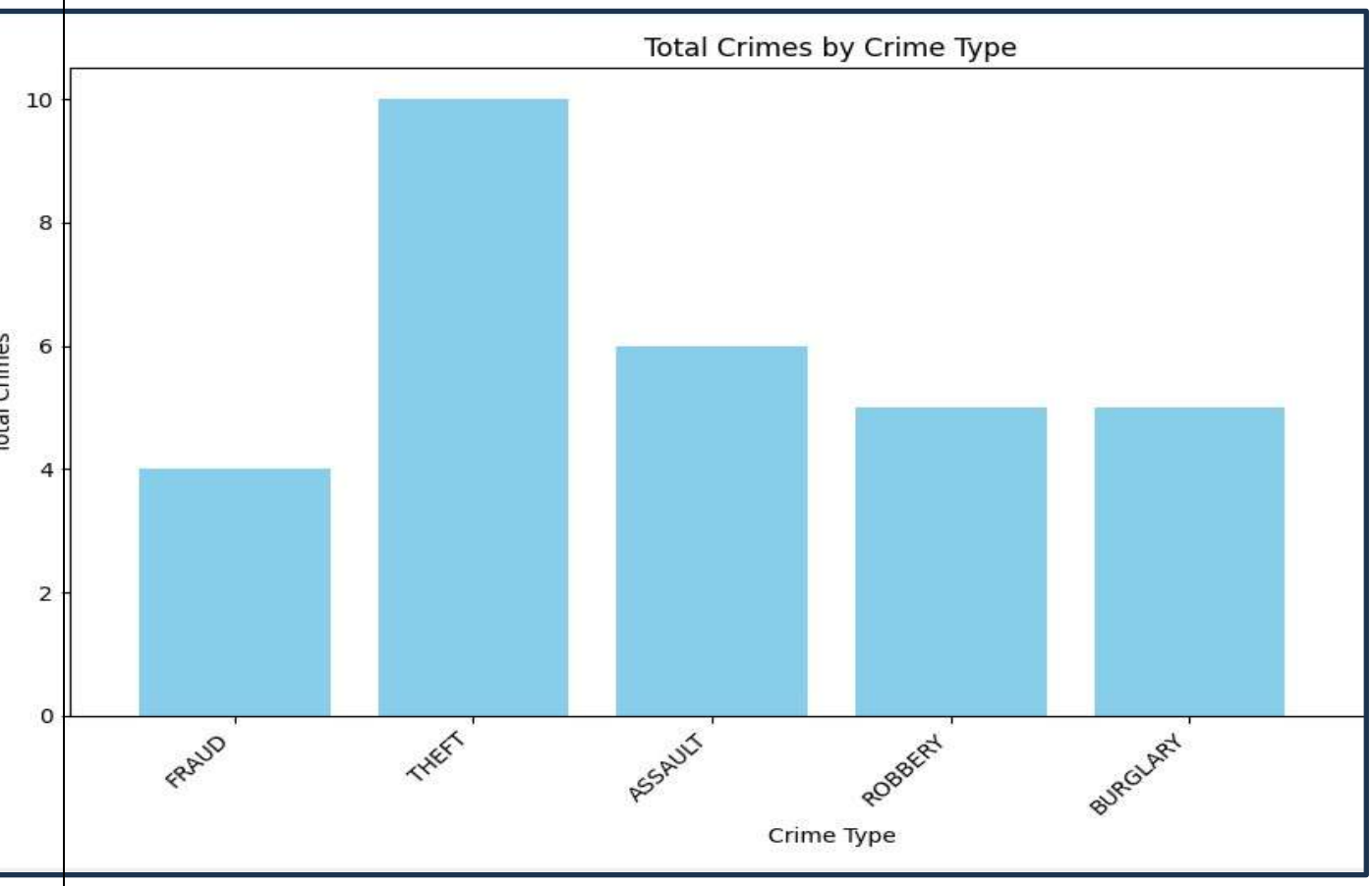
10. We can see the file is saved to local storage in our device.



11. Now we write a Python Script to load csv data in Python file using Pandas and visualize the outcome using Matplotlib.

```
crimes.py > ...
import pandas as pd
import matplotlib.pyplot as plt

output_file = r'C:\Users\ACER\OneDrive\Desktop\crime\part-r-00000'
crime_data = pd.read_csv(output_file, names=['crime_type', 'total_crimes']) output_file = 'C:\\Users\\ACER\\OneD

crime_data['crime_type'] = crime_data['crime_type'].astype(str)
crime_data['total_crimes'] = pd.to_numeric(crime_data['total_crimes'], errors='coerce').fillna(0).astype(int)

plt.figure(figsize=(10, 6))
plt.bar(crime_data['crime_type'], crime_data['total_crimes'], color='skyblue') crime_data =   crime_type  total_

plt.xlabel('Crime Type')
plt.ylabel('Total Crimes')
plt.title('Total Crimes by Crime Type')
plt.xticks(rotation=45, ha='right')
plt.tight_layout()

plt.show()
```

Visual Output Of the Project



J MapRed

12. Now we perform MapReduce on our crime dataset using Java.

CrimeByMonth.java

```
import org.apache.hadoop.conf.Configuration; import
org.apache.hadoop.fs.Path; import
org.apache.hadoop.io.IntWritable; import
org.apache.hadoop.io.Text; import
org.apache.hadoop.mapreduce.Job; import
org.apache.hadoop.mapreduce.Mapper; import
org.apache.hadoop.mapreduce.Reducer; import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
            import java.io.IOException;
    public class CrimeByMonth {
  public static class CrimeMapper extends Mapper<Object, Text, Text, IntWritable>
{       private final static IntWritable one = new IntWritable(1);       private Text
crimeType = new Text();
```

```
        public void map(Object key, Text value, Context context) throws IOException,
    InterruptedException {
            String line = value.toString();
    String[] tokens = line.split(",");            if
    (tokens.length > 1) {
                crimeType.set(tokens[2]); // Assuming 3rd column is 'crime_type'
    context.write(crimeType, one);
            }
          }
        }
public static class CrimeReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
    private IntWritable result = new IntWritable();
             public void reduce(Text key, Iterable<IntWritable> values, Context context)
       throws IOException,
       InterruptedException {           int sum = 0;
            for (IntWritable val : values) {
    sum += val.get();
            }
            result.set(sum);
            context.write(key, result);
          }
        }
         public static void main(String[] args) throws Exception {
          Configuration conf = new Configuration();
          Job job = Job.getInstance(conf, "Crime Count by Type");
                    job.setJarByClass(CrimeByMonth.class);
                     job.setMapperClass(CrimeMapper.class);
     job.setReducerClass(CrimeReducer.class);
              job.setOutputKeyClass(Text.class);
           job.setOutputValueClass(IntWritable.class);

                       FileInputFormat.addInputPath(job, new Path(args[0]));  // Input path
       FileOutputFormat.setOutputPath(job, new Path(args[1]));  // Output path
       System.exit(job.waitForCompletion(true) ? 0 : 1);
      }
    }
```

13. We created a MapReduce job in Java to calculate the total number of crimes per month:

Mapper: Extracts the month from the date and emits (month, 1).

Reducer: Aggregates the total crimes for each month.

```
mehak@LAPTOP:~$ gedit CrimeByMonth.java
mehak@LAPTOP:~$ gedit ~/chicago_crime.csv
mehak@LAPTOP:~$ hadoop fs -mkdir /crimeinput
mehak@LAPTOP:~$ hadoop fs -put chicago_crime.csv /crimeinput
mehak@LAPTOP:~$ hadoop com.sun.tools.javac.Main CrimeByMonth.java
mehak@LAPTOP:~$ jar -cf mm.jar CrimeByMonth*.class
mehak@LAPTOP:~$ hadoop jar mm.jar CrimeByMonth /crimeinput /crimeoutput
2025-04-14 09:42:01,642 INFO impl.MetricsConfig: Loaded properties from hadoop-metrics2.properties
2025-04-14 09:42:01,897 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot period at 10 second(s).
2025-04-14 09:42:01,898 INFO impl.MetricsSystemImpl: JobTracker metrics system started
2025-04-14 09:42:02,219 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Impl
te your application with ToolRunner to remedy this.
2025-04-14 09:42:02,598 INFO input.FileInputFormat: Total input files to process : 1
2025-04-14 09:42:02,670 INFO mapreduce.JobSubmitter: number of splits:1
2025-04-14 09:42:03,077 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_local1600361275_0001
2025-04-14 09:42:03,078 INFO mapreduce.JobSubmitter: Executing with tokens: []
2025-04-14 09:42:03,370 INFO mapreduce.Job: The url to track the job: http://localhost:8080/
2025-04-14 09:42:03,374 INFO mapreduce.Job: Running job: job_local1600361275_0001
2025-04-14 09:42:03,379 INFO mapred.LocalJobRunner: OutputCommitter set in config null
2025-04-14 09:42:03,414 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to
2025-04-14 09:42:03,419 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-04-14 09:42:03,420 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under
eanup failures: false
2025-04-14 09:42:03,424 INFO mapred.LocalJobRunner: OutputCommitter is org.apache.hadoop.mapreduce.lib.output.File
2025-04-14 09:42:03,548 INFO mapred.LocalJobRunner: Waiting for map tasks
2025-04-14 09:42:03,565 INFO mapred.LocalJobRunner: Starting task: attempt_local1600361275_0001_m_000000_0
2025-04-14 09:42:03,638 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to
2025-04-14 09:42:03,639 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-04-14 09:42:03,639 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under
eanup failures: false
2025-04-14 09:42:03,697 INFO mapred.Task:  Using ResourceCalculatorProcessTree : [ ]
2025-04-14 09:42:03,708 INFO mapred.MapTask: Processing split: hdfs://localhost:9000/crimeinput/chicago_crime.csv:
2025-04-14 09:42:04,259 INFO mapred.MapTask: (EQUATOR) 0 kvi 26214396(104857584)
2025-04-14 09:42:04,260 INFO mapred.MapTask: mapreduce.task.io.sort.mb: 100
2025-04-14 09:42:04,260 INFO mapred.MapTask: soft limit at 83886080
```

```
mehak@LAPTOP:~$ hadoop fs -ls /crimeoutput
Found 2 items
-rw-r--r--   3 mehak supergroup          0 2025-04-14 09:42 /crimeoutput/_SUCCESS
-rw-r--r--   3 mehak supergroup         48 2025-04-14 09:42 /crimeoutput/part-r-00000
mehak@LAPTOP:~$ hadoop fs -ls /crimeoutput/part-r-00000
-rw-r--r--   3 mehak supergroup         48 2025-04-14 09:42 /crimeoutput/part-r-00000
mehak@LAPTOP:~$ hadoop fs -cat /crimeoutput/part-r-00000
ASSAULT 6
BURGLARY        5
FRAUD   4
ROBBERY 5
THEFT   10
mehak@LAPTOP:~$
```

5.Findings and Conclusion

After performing a detailed analysis of the crime dataset using Java MapReduce, Pig scripts, and Python visualization, several key insights emerged:

1. **Monthly Crime Trends**:
   - The analysis revealed distinct patterns in monthly crime rates. ○ Certain months (e.g., July and December) showed a noticeable increase in criminal activity, possibly due to holidays, weather, or seasonal patterns.
2. **Frequent Crime Types**:
   - Crimes such as *theft*, *assault*, and *burglary* were among the most frequently recorded incidents in the dataset.
   - These crime types may indicate common safety challenges in urban areas.
3. **Visualization of Data**:
   - Graphs and charts made it easier to understand trends that may not be obvious from raw data.
   - Bar charts, pie charts, and line graphs were effective in presenting crime frequency and category distribution.
4. **Tool Efficiency**:
   - **Java MapReduce** was powerful for custom and large-scale data processing. ○ **Apache Pig** provided quick querying capabilities for rapid insight generation.
   - **Python** added value through its rich libraries for visualization, making the insights more accessible and comprehensible.

This project successfully demonstrated the power and utility of Big Data technologies in solving real-world problems such as crime data analysis. The combination of Hadoop's distributed processing, Java's customization capabilities, Pig's simplicity, and Python's visualization strengths allowed for an efficient, end-to-end data analytics pipeline.

By analyzing crime data over time, we were able to uncover trends and hotspots that could potentially inform better decision-making in public safety, urban planning, and law enforcement deployment. Moreover, the project helped in building hands-on expertise with widely-used Big Data tools, providing practical experience in a scalable, real-world use case.

6. References

1. Apache Hadoop Documentation – Official guide for HDFS, MapReduce, and distributed computing principles.

• https://hadoop.apache.org/docs/

2. Alpha Vantage API Documentation – Guide to fetching real-time and historical stock market data.

• https://www.alphavantage.co/documentation/

3. Python Plotly Documentation – Creating interactive financial visualizations (candlestick charts, trend analysis).

• https://plotly.com/python/

4. Big Data in Financial Markets – Applications of Hadoop and MapReduce in stock price analysis.

• White, T. (2015). Hadoop: The Definitive Guide. O'Reilly Media.

5. Time-Series Data Processing – Techniques for analyzing high-frequency financial data.

• Shumway, R. H., & Stoffer, D. S. (2017). Time Series Analysis and Its Applications. Springer.

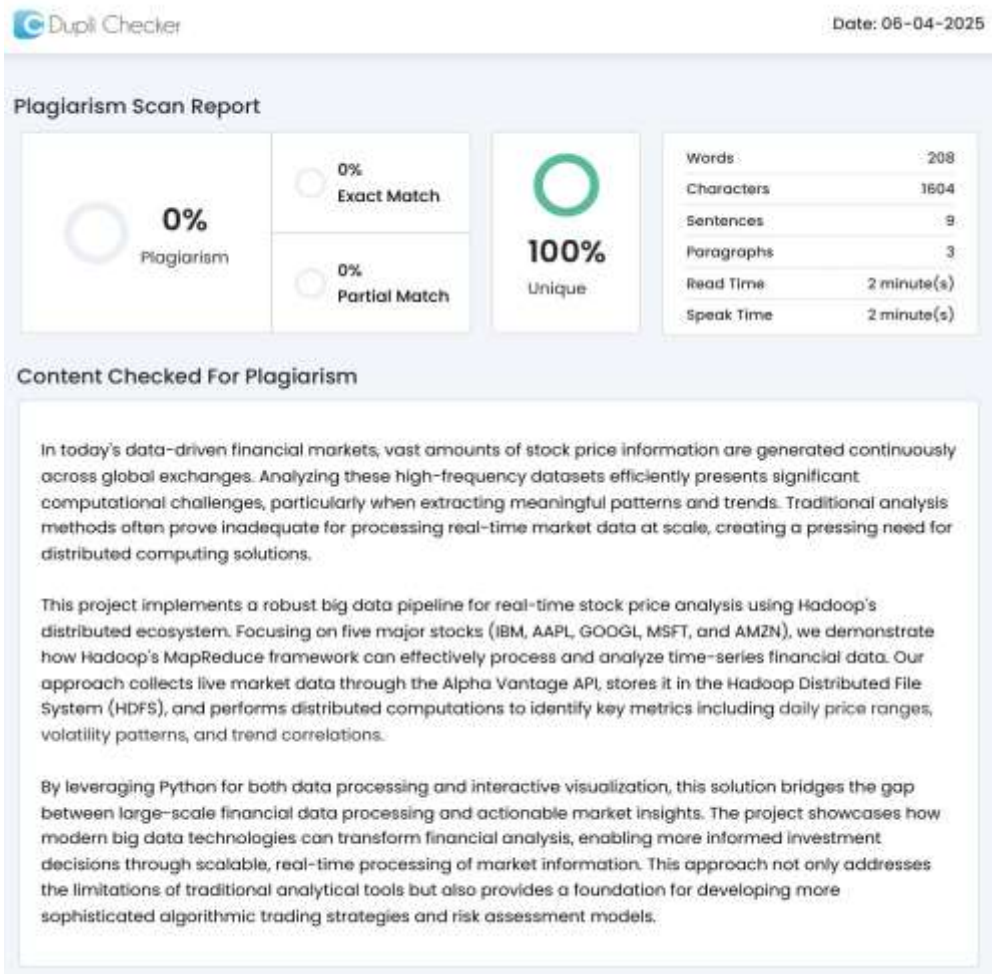
6. Algorithmic Trading Strategies – Leveraging big data for trading insights.

• Chan, E. P. (2013). Algorithmic Trading: Winning Strategies and Their Rationale. Wiley.

7. Distributed Systems for Real-Time Analytics – Scalable architectures for market data processing.

• Ghemawat, S., Gobioff, H., & Leung, S.-T. (2003). The Google File System. ACM SIGOPS.

Plagiarism Report:



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In today's data-driven financial markets, vast amounts of stock price information are generated continuously across global exchanges. Analyzing these high-frequency datasets efficiently presents significant computational challenges, particularly when extracting meaningful patterns and trends. Traditional analysis methods often prove inadequate for processing real-time market data at scale, creating a pressing need for distributed computing solutions.

This project implements a robust big data pipeline for real-time stock price analysis using Hadoop's distributed ecosystem. Focusing on five major stocks (IBM, AAPL, GOOGL, MSFT, and AMZN), we demonstrate how Hadoop's MapReduce framework can effectively process and analyze time-series financial data. Our approach collects live market data through the Alpha Vantage API, stores it in the Hadoop Distributed File System (HDFS), and performs distributed computations to identify key metrics including daily price ranges, volatility patterns, and trend correlations.

By leveraging Python for both data processing and interactive visualization, this solution bridges the gap between large-scale financial data processing and actionable market insights. The project showcases how modern big data technologies can transform financial analysis, enabling more informed investment decisions through scalable, real-time processing of market information. This approach not only addresses the limitations of traditional analytical tools but also provides a foundation for developing more sophisticated algorithmic trading strategies and risk assessment models.