VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

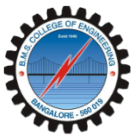
LAB REPORT
on

BIG DATA ANALYTICS

Submitted by

D Gowri Charan (1BM21CS059)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019
Feb-2024 to July-2024

B. M. S. College of Engineering,

Bull Temple Road, Bangalore 560019

(Affiliated To Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "LAB COURSE **BIG DATA ANALYTICS**" carried out by **D Gowri Charan (1BM21CS059),** who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024. The Lab report has been approved as it satisfies the academic requirements in respect of a **BIG DATA ANALYTICS - (22CS6PEBDA)** work prescribed for the said degree.

Rekha G S
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

Index Sheet

	7. Import a given csv dataset from local file system into Cassandra column family	
3	**MongoDB- CRUD Demonstration**	**7 - 9**
4	**Screenshot of Hadoop installed**	**10**
5	**Execution of HDFS Commands for interaction with Hadoop Environment. (Minimum 10 commands to be executed)**	**11 - 13**
6	**Implement WordCount Program on Hadoop framework**	**14 - 17**
7	**From the following link extract the weather data https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all** **Create a Map Reduce program to** **a) find average temperature for each year from NCDC data set.** **b) find the mean max temperature for every month**	**18 - 23**
8	**For a given Text file, create a Map Reduce program to sort the content in an alphabetic order listing only top 10 maximum occurrences of words.**	**24 - 29**

Course Outcome

CO1	Apply the concepts of NoSQL, Hadoop, Spark for a given task
CO2	Analyse data analytic techniques for a given problem
CO3	Conduct experiments using data analytics mechanisms for a given problem.

Program 1

Perform the following DB operations using Cassandra.

1. Create a keyspace by name Employee

2. Create a column family by name Employee-Info with attributes Emp_Id Primary Key, Emp_Name,

Designation, Date_of_Joining, Salary, Dept_Name

3. Insert the values into the table in batch

4. Update Employee name and Department of Emp-Id 121

5. Sort the details of Employee records based on salary

6. Alter the schema of the table Employee_Info to add a column Projects which stores a set of Projects done by the corresponding Employee.

7. Update the altered table to add project names.

8. Create a TTL of 15 seconds to display the values of Employees.

1. Create a keyspace by name Employee

   ```
   CREATE KEYSPACE Employee WITH replication = {'class': 'SimpleStrategy', 'replication_factor': 1};
   ```

2. Create a column family by name Employee-Info

   ```
   CREATE TABLE Employee.Employee_Info (
      Emp_Id int PRIMARY KEY,
      Emp_Name text,
      Designation text,
      Date_of_Joining date,
      Salary decimal,
      Dept_Name text
   );
   ```

3. Insert the values into the table in batch

   ```
   BEGIN BATCH
   INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (121, 'John Doe', 'Software Engineer', '2022-01-15', 70000.00, 'IT');
   ```

INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (122, 'Jane Smith', 'Data Scientist', '2021-05-20', 80000.00, 'Data Science');

INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (123, 'Alice Johnson', 'Project Manager', '2020-07-18', 90000.00, 'Management');

APPLY BATCH;

4. Update Employee name and Department of Emp-Id 121

   UPDATE Employee.Employee_Info SET Emp_Name = 'Johnathon Doe', Dept_Name = 'Software Development' WHERE Emp_Id = 121;

5. Sort the details of Employee records based on salary

   CREATE INDEX ON Employee.Employee_Info (Salary);

6. Alter the schema of the table Employee_Info to add a column Projects

   ALTER TABLE Employee.Employee_Info ADD Projects set<text>;

7. Update the altered table to add project names

   UPDATE Employee.Employee_Info SET Projects = {'Project A', 'Project B'} WHERE Emp_Id = 121;

   UPDATE Employee.Employee_Info SET Projects = {'Project C'} WHERE Emp_Id = 122;

   UPDATE Employee.Employee_Info SET Projects = {'Project D', 'Project E'} WHERE Emp_Id = 123;

8. Create a TTL of 15 seconds to display the values of Employeee

   INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (124, 'Bob Brown', 'Analyst', '2023-01-10', 60000.00, 'Finance') USING TTL 15;

```
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.1.0 | Cassandra 4.1.5 | CQL spec 3.4.6 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE Employee WITH replication = {'class': 'SimpleStrategy', 'replication_factor': 1};
cqlsh> CREATE TABLE Employee.Employee_Info (
   ...     Emp_Id int PRIMARY KEY,
   ...     Emp_Name text,
   ...     Designation text,
   ...     Date_of_Joining date,
   ...     Salary decimal,
   ...     Dept_Name text
   ... );
cqlsh> BEGIN BATCH
   ... INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (121, 'John Doe', '
Software Engineer', '2022-01-15', 70000.00, 'IT');
   ... INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (122, 'Jane Smith',
 'Data Scientist', '2021-05-20', 80000.00, 'Data Science');
   ... INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (123, 'Alice Johnso
n', 'Project Manager', '2020-07-18', 90000.00, 'Management');
   ... APPLY BATCH;
cqlsh> UPDATE Employee.Employee_Info SET Emp_Name = 'Johnathon Doe', Dept_Name =
   ... 'Software Development' WHERE Emp_Id = 121;
cqlsh> CREATE INDEX ON Employee.Employee_Info (Salary);
cqlsh> ALTER TABLE Employee.Employee_Info ADD Projects set<text>;
cqlsh> UPDATE Employee.Employee_Info SET Projects = {'Project A', 'Project B'} WHERE Emp_Id = 121;
cqlsh> UPDATE Employee.Employee_Info SET Projects = {'Project C'} WHERE Emp_Id = 122;
cqlsh> INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (124, 'Bob Brown',
'Analyst', '2023-01-10', 60000.00, 'Finance') USING TTL 15;
cqlsh> SELECT * FROM Employee_Infooooo
   ... SELECT * FROM Employee_Info;
cqlsh> INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Decqlcqlcqlccqlsh>cqlscqlscqlscqlsh>c
cqlsh> INSERT INTO Employee.Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name) VALUES (124, 'Bob Brown',
'Analyst', '2023-01-10', 60000.00, 'Finance') USING TTL 15;S
```

Program 2

Perform the following DB operations using Cassandra.

1. **Create a keyspace by name Library**

   CREATE KEYSPACE Library WITH replication = { 'class' : 'SimpleStrategy', 'replication_factor' : 3 };

2. **Create a column family by name Library-Info with attributes Stud_Id Primary Key, Counter_value of type Counter, Stud_Name, Book-Name, Book-Id, Date_of_issue**

```
USE Library;

CREATE TABLE Library_Info (
  Stud_Id int PRIMARY KEY,
  Counter_value counter,
  Stud_Name text,
  Book_Name text,
  Book_Id text,
  Date_of_issue timestamp
);
```

3. **Insert the values into the table in batch**

```
BEGIN BATCH;

INSERT INTO Library_Info (Stud_Id, Counter_value, Stud_Name, Book_Name, Book_Id, Date_of_issue)
VALUES (1, 101, 'Alice Smith', 'Introduction to Algorithms', 'B001', '2024-05-01');

INSERT INTO Library_Info (Stud_Id, Counter_value, Stud_Name, Book_Name, Book_Id, Date_of_issue)
VALUES (2, 102, 'Bob Johnson', 'Clean Code', 'B002', '2024-05-02');
```

```
INSERT INTO Library_Info (Stud_Id, Counter_value, Stud_Name, Book_Name, Book_Id, Date_of_issue)
VALUES (3, 103, 'Charlie Brown', 'Design Patterns', 'B003', '2024-05-03');

INSERT INTO Library_Info (Stud_Id, Counter_value, Stud_Name, Book_Name, Book_Id, Date_of_issue)
VALUES (4, 104, 'Diana Prince', 'The Pragmatic Programmer', 'B004', '2024-05-04');

INSERT INTO Library_Info (Stud_Id, Counter_value, Stud_Name, Book_Name, Book_Id, Date_of_issue)
VALUES (5, 105, 'Ethan Hunt', 'Effective Java', 'B005', '2024-05-05');

APPLY BATCH;
```

4. **Display the details of the table created and increase the value of the counter**

```
SELECT * FROM Library_Info;

UPDATE Library_Info SET Counter_value = Counter_value + 1 WHERE Stud_Id = 111;

SELECT * FROM Library_Info;
```

5. **Write a query to show that a student with id 112 has taken a book "BDA" 2 times.**

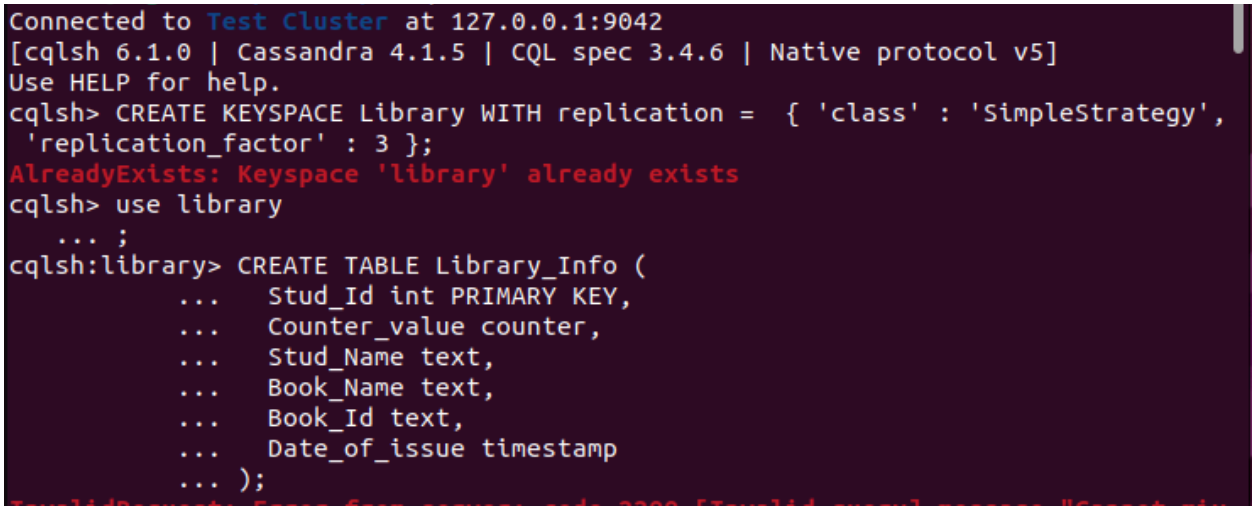
```
SELECT Stud_Name, Book_Name, Counter_value FROM Library_Info
WHERE Stud_Id = 112 AND Book_Name = 'BDA';
```

6. **Export the created column to a csv file**

```
COPY Library_Info TO '/path/to/<lib_info>.csv' WITH DELIMITER = ',' QUOTE = '"' HEADER = TRUE;
```

7. **Import a given csv dataset from local file system into Cassandra column family**

```
COPY Library_Info FROM '/path/to/<filename>.csv' WITH DELIMITER = ',' QUOTE = '"' HEADER = TRUE;
```


Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.1.0 | Cassandra 4.1.5 | CQL spec 3.4.6 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE Library WITH replication = { 'class' : 'SimpleStrategy',
'replication_factor' : 3 };
AlreadyExists: Keyspace 'library' already exists
cqlsh> use library
... ;
cqlsh:library> CREATE TABLE Library_Info (
... Stud_Id int PRIMARY KEY,
... Counter_value counter,
... Stud_Name text,
... Book_Name text,
... Book_Id text,
... Date_of_issue timestamp
...);

Program 3

MongoDB- CRUD Demonstration

I. Perform the following DB operations using MongoDB.

1. Create a database “Student” with the following attributes Rollno, Age, ContactNo, Email- Id.

```
> use StudentDB
```

2. Insert appropriate values

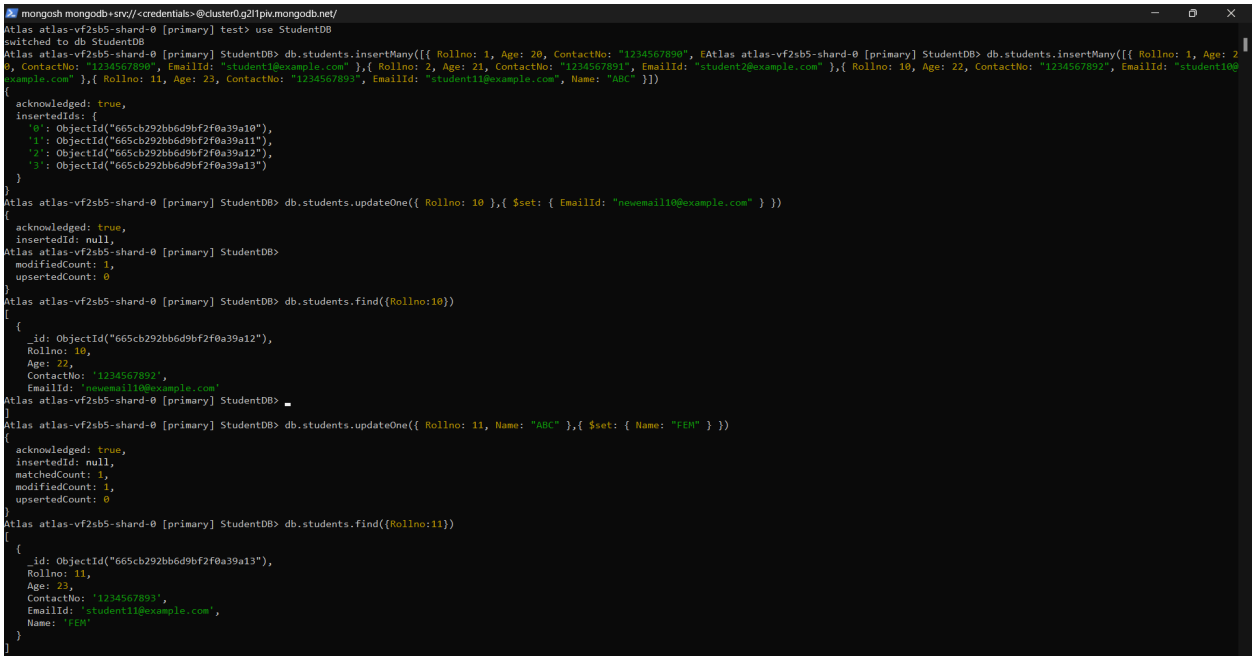
```
> db.students.insertMany([
   { Rollno: 1, Age: 20, ContactNo: "1234567890", EmailId: "student1@example.com" },
   { Rollno: 2, Age: 21, ContactNo: "1234567891", EmailId: "student2@example.com" },
   { Rollno: 10, Age: 22, ContactNo: "1234567892", EmailId: "student10@example.com" },
      { Rollno: 11, Age: 23, ContactNo: "1234567893", EmailId: "student11@example.com",
Name: "ABC" }
])
```

3. Write query to update Email-Id of a student with rollno 10.

```
> db.students.updateOne(
   { Rollno: 10 },
   { $set: { EmailId: "newemail10@example.com" } }
)
```

4. Replace the student’s name from “ABC” to “FEM” of rollno 11

```
> db.students.updateOne(
   { Rollno: 11, Name: "ABC" },
   { $set: { Name: "FEM" } }
)
```



II. Perform the following DB operations using MongoDB.

1. Create a collection by name Customers with the following attributes. Cust_id, Acc_Bal,

   use Bank;

   db.Customers.insertOne({

   Cust_id: 1,

   Acc_Bal: 1000,

   Acc_Type: "A"

   });

2. Insert at least 5 values into the table

   > use CustomerDB

   db.customers.insertMany([

   { Cust_id: 1, Acc_Bal: 1500, Acc_Type: 'Z' },

   { Cust_id: 2, Acc_Bal: 800, Acc_Type: 'Y' },

   { Cust_id: 3, Acc_Bal: 2000, Acc_Type: 'Z' },

   { Cust_id: 4, Acc_Bal: 1000, Acc_Type: 'X' },

   { Cust_id: 5, Acc_Bal: 1300, Acc_Type: 'Z' }

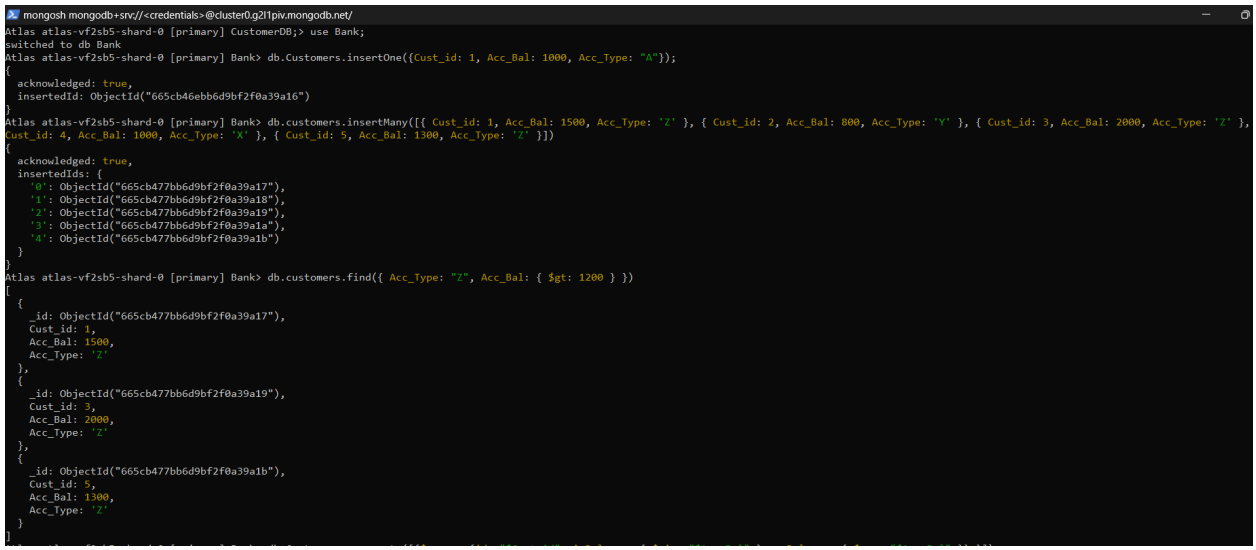
   ])

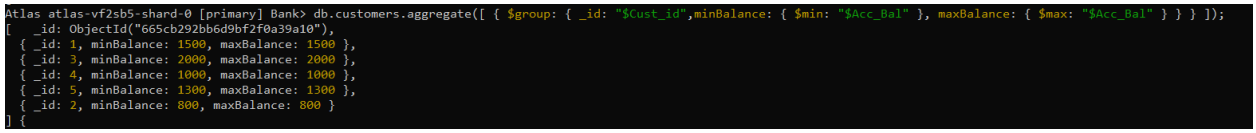
3. Write a query to display those records whose total account balance is greater than 1200 of account type ‘Z’ for each customer_id.

```
db.Customers.find({
   Acc_Type: "Z",
   Acc_Bal: { $gt: 1200 }
});
```

4. Determine Minimum and Maximum account balance for each customer_i

```
db.Customers.aggregate([
   {
      $group: {
         _id: "$Cust_id",
         minBalance: { $min: "$Acc_Bal" },
         maxBalance: { $max: "$Acc_Bal" }
      }
   }
]);
```





Program 4

Screenshot of Hadoop installed

```
Microsoft Windows [Version 10.0.22000.739]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>start-all.cmd
This script is Deprecated. Instead use start-dfs.cmd and start-yarn.cmd
starting yarn daemons

C:\WINDOWS\system32>jps
7072 DataNode
13492 Jps
15844 ResourceManager
16196 NameNode
1388 NodeManager

C:\WINDOWS\system32>hdfs dfs -ls -R /
drwxr-xr-x   - khush supergroup          0 2022-06-27 14:09 /input
drwxr-xr-x   - khush supergroup          0 2022-06-21 09:03 /input/inputtest
-rw-r--r--   1 khush supergroup         21 2022-06-21 09:03 /input/inputtest/output.txt
-rw-r--r--   1 khush supergroup         21 2022-06-21 08:19 /input/sample.txt
-rw-r--r--   1 khush supergroup         21 2022-06-27 14:09 /input/sample2.txt
drwxr-xr-x   - khush supergroup          0 2022-06-21 13:30 /test
-rw-r--r--   1 khush supergroup         19 2022-06-21 13:30 /test/sample.txt

C:\WINDOWS\system32>hadoop version
Hadoop 3.3.3
Source code repository https://github.com/apache/hadoop.git -r d37586cbda38c338d9fe481addda5a05fb516f71
Compiled by stevel on 2022-05-09T16:36Z
Compiled with protoc 3.7.1
From source with checksum eb96dd4a797b6989ae0cdb9db6efc6
This command was run using /C:/hadoop-3.3.3/share/hadoop/common/hadoop-common-3.3.3.jar

C:\WINDOWS\system32>
```

Program 5

Execution of HDFS Commands for interaction with Hadoop Environment. (Minimum 10 commands to be executed)

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ start-all.sh
WARNING: Attempting to start all Apache Hadoop daemons as hadoop in 10 seconds.
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
Starting datanodes
Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]
Starting resourcemanager
Starting nodemanagers
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop dfs -mkdir /sadh
WARNING: Use of this script to execute dfs is deprecated.
WARNING: Attempting to execute replacement "hdfs dfs" instead.

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -mkdir /sadh
mkdir: `/sadh': File exists
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /
Found 1 items
drwxr-xr-x   - hadoop supergroup       0 2024-05-13 14:27 /sadh

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /sadh

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put
/home/hadoop/Desktop/example/Welcome.txt /sadh/WC.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /sadh/WC.txt
hiiii
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /sadh/WC.txt /home/hadoop/Desktop/example/WWC.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /sadh/WC.txt /home/hadoop/Desktop/example/WWC2.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put /home/hadoop/Desktop/example/Welcome.txt /sadh/WC2.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -getmerge /sadh/WC.txt /sadh/WC2.txt /home/hadoop/Desktop/example/Merge.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -getfacl /sadh/
# file: /sadh
# owner: hadoop
# group: supergroup
user::rwx
group::r-x
other::r-x

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mv /sadh /WC2.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /sadh /WC2.txt
ls: `/sadh': No such file or directory
Found 2 items
-rw-r--r--   1 hadoop supergroup          6 2024-05-13 14:51 /WC2.txt/WC.txt
-rw-r--r--   1 hadoop supergroup          6 2024-05-13 15:03 /WC2.txt/WC2.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cp /WC2.txt/ /WC.txt
```

Program 6

Implement WordCount Program on Hadoop framework

Mapper Code:

```
import java.io.IOException;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reporter;
public class WCMapper extends MapReduceBase implements Mapper<LongWritable,
Text, Text,
IntWritable> {
public void map(LongWritable key, Text value, OutputCollector<Text,
IntWritable> output, Reporter rep) throws IOException
{
String line = value.toString();
for (String word : line.split(" "))
{
if (word.length() > 0)
{
output.collect(new Text(word), new IntWritable(1));
} } } }
```

Reducer Code:

```
// Importing libraries
import java.io.IOException;
import java.util.Iterator;
```

```
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reducer;
import org.apache.hadoop.mapred.Reporter;
public class WCReducer extends MapReduceBase implements Reducer<Text,
IntWritable, Text, IntWritable> {
// Reduce function
public void reduce(Text key, Iterator<IntWritable> value,
OutputCollector<Text, IntWritable> output,
Reporter rep) throws IOException
{
int count = 0;
// Counting the frequency of each words
while (value.hasNext())
{
IntWritable i = value.next();
count += i.get();
}
output.collect(key, new IntWritable(count));
} }
```

Driver Code: You have to copy paste this program into the WCDriver Java Class file.

```
// Importing libraries
import java.io.IOException;
import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
```

```
import org.apache.hadoop.mapred.JobClient;
import org.apache.hadoop.mapred.JobConf;
import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;
public class WCDriver extends Configured implements Tool {
public int run(String args[]) throws IOException
{
if (args.length < 2)
{
System.out.println("Please give valid inputs");
return -1;
}
JobConf conf = new JobConf(WCDriver.class);
FileInputFormat.setInputPaths(conf, new Path(args[0]));
FileOutputFormat.setOutputPath(conf, new Path(args[1]));
conf.setMapperClass(WCMapper.class);
conf.setReducerClass(WCReducer.class);
conf.setMapOutputKeyClass(Text.class);
conf.setMapOutputValueClass(IntWritable.class);
conf.setOutputKeyClass(Text.class);
conf.setOutputValueClass(IntWritable.class);
JobClient.runJob(conf);
return 0;
}
// Main Method
public static void main(String args[]) throws Exception
{
int exitCode = ToolRunner.run(new WCDriver(), args);
System.out.println(exitCode);
}
}
```

Program 7

From the following link extract the weather data https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all

Create a Map Reduce program to

a) find average temperature for each year from NCDC data set.

AverageDriver

```
package temp;
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.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
public class AverageDriver {
public static void main(String[] args) throws Exception {
if (args.length != 2) {
System.err.println("Please Enter the input and output parameters");
System.exit(-1);
}
Job job = new Job();
job.setJarByClass(AverageDriver.class);
job.setJobName("Max temperature");
FileInputFormat.addInputPath(job, new Path(args[0]));
```

```
FileOutputFormat.setOutputPath(job, new Path(args[1]));
job.setMapperClass(AverageMapper.class);
job.setReducerClass(AverageReducer.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
}
```

AverageMapper

```
package temp;
import java.io.IOException;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class AverageMapper extends Mapper<LongWritable, Text, Text, IntWritable> {
public static final int MISSING = 9999;
public void map(LongWritable key, Text value, Mapper<LongWritable, Text, Text,
IntWritable>.Context context) throws IOException, InterruptedException {
int temperature;
String line = value.toString();
String year = line.substring(15, 19);
if (line.charAt(87) == '+') {
temperature = Integer.parseInt(line.substring(88, 92));
```

```
} else {
temperature = Integer.parseInt(line.substring(87, 92));
}
String quality = line.substring(92, 93);
if (temperature != 9999 && quality.matches("[01459]"))
context.write(new Text(year), new IntWritable(temperature));
}
}
```

AverageReducer

```
package temp;
import java.io.IOException;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
public class AverageReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values, Reducer<Text, IntWritable,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
int max_temp = 0;
int count = 0;
for (IntWritable value : values) {
max_temp += value.get();
count++;
}
context.write(key, new IntWritable(max_temp / count));
```

}}

```
C:\hadoop-3.3.0\sbin>hadoop jar C:\avgtemp.jar temp.AverageDriver /input_dir/temp.txt /avgtemp_outputdir
2021-05-15 14:52:50,635 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2021-05-15 14:52:51,005 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2021-05-15 14:52:51,111 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/Anusree/.staging/job_1621060230696_0005
2021-05-15 14:52:51,735 INFO input.FileInputFormat: Total input files to process : 1
2021-05-15 14:52:52,751 INFO mapreduce.JobSubmitter: number of splits:1
2021-05-15 14:52:53,073 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1621060230696_0005
2021-05-15 14:52:53,073 INFO mapreduce.JobSubmitter: Executing with tokens: []
2021-05-15 14:52:53,237 INFO conf.Configuration: resource-types.xml not found
2021-05-15 14:52:53,238 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2021-05-15 14:52:53,312 INFO impl.YarnClientImpl: Submitted application application_1621060230696_0005
2021-05-15 14:52:53,352 INFO mapreduce.Job: The url to track the job: http://LAPTOP-JG329ESD:8088/proxy/application_1621060230696_0005/
2021-05-15 14:52:53,353 INFO mapreduce.Job: Running job: job_1621060230696_0005
2021-05-15 14:53:06,640 INFO mapreduce.Job: Job job_1621060230696_0005 running in uber mode : false
2021-05-15 14:53:06,643 INFO mapreduce.Job:  map 0% reduce 0%
2021-05-15 14:53:12,758 INFO mapreduce.Job:  map 100% reduce 0%
2021-05-15 14:53:19,860 INFO mapreduce.Job:  map 100% reduce 100%
2021-05-15 14:53:25,967 INFO mapreduce.Job: Job job_1621060230696_0005 completed successfully
2021-05-15 14:53:26,096 INFO mapreduce.Job: Counters: 54
      File System Counters
            FILE: Number of bytes read=72210
            FILE: Number of bytes written=674341
            FILE: Number of read operations=0
            FILE: Number of large read operations=0
            FILE: Number of write operations=0
            HDFS: Number of bytes read=894860
            HDFS: Number of bytes written=8
            HDFS: Number of read operations=8
            HDFS: Number of large read operations=0
            HDFS: Number of write operations=2
            HDFS: Number of bytes read erasure-coded=0
      Job Counters
            Launched map tasks=1
            Launched reduce tasks=1
            Data-local map tasks=1
            Total time spent by all maps in occupied slots (ms)=3782
```

```
C:\hadoop-3.3.0\sbin>hdfs dfs -ls /avgtemp_outputdir
Found 2 items
-rw-r--r--   1 Anusree supergroup          0 2021-05-15 14:53 /avgtemp_outputdir/_SUCCESS
-rw-r--r--   1 Anusree supergroup          8 2021-05-15 14:53 /avgtemp_outputdir/part-r-00000

C:\hadoop-3.3.0\sbin>hdfs dfs -cat /avgtemp_outputdir/part-r-00000
1901    46

C:\hadoop-3.3.0\sbin>
```

b) find the mean max temperature for every month

MeanMaxDriver.class

```
package meanmax;

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.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
public class MeanMaxDriver {
public static void main(String[] args) throws Exception {
if (args.length != 2) {
System.err.println("Please Enter the input and output parameters");
System.exit(-1);
}
Job job = new Job();
job.setJarByClass(MeanMaxDriver.class);
job.setJobName("Max temperature");
FileInputFormat.addInputPath(job, new Path(args[0]));
FileOutputFormat.setOutputPath(job, new Path(args[1]));
job.setMapperClass(MeanMaxMapper.class);
job.setReducerClass(MeanMaxReducer.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
}
```

MeanMaxMapper.class

```
package meanmax;
import java.io.IOException;
```

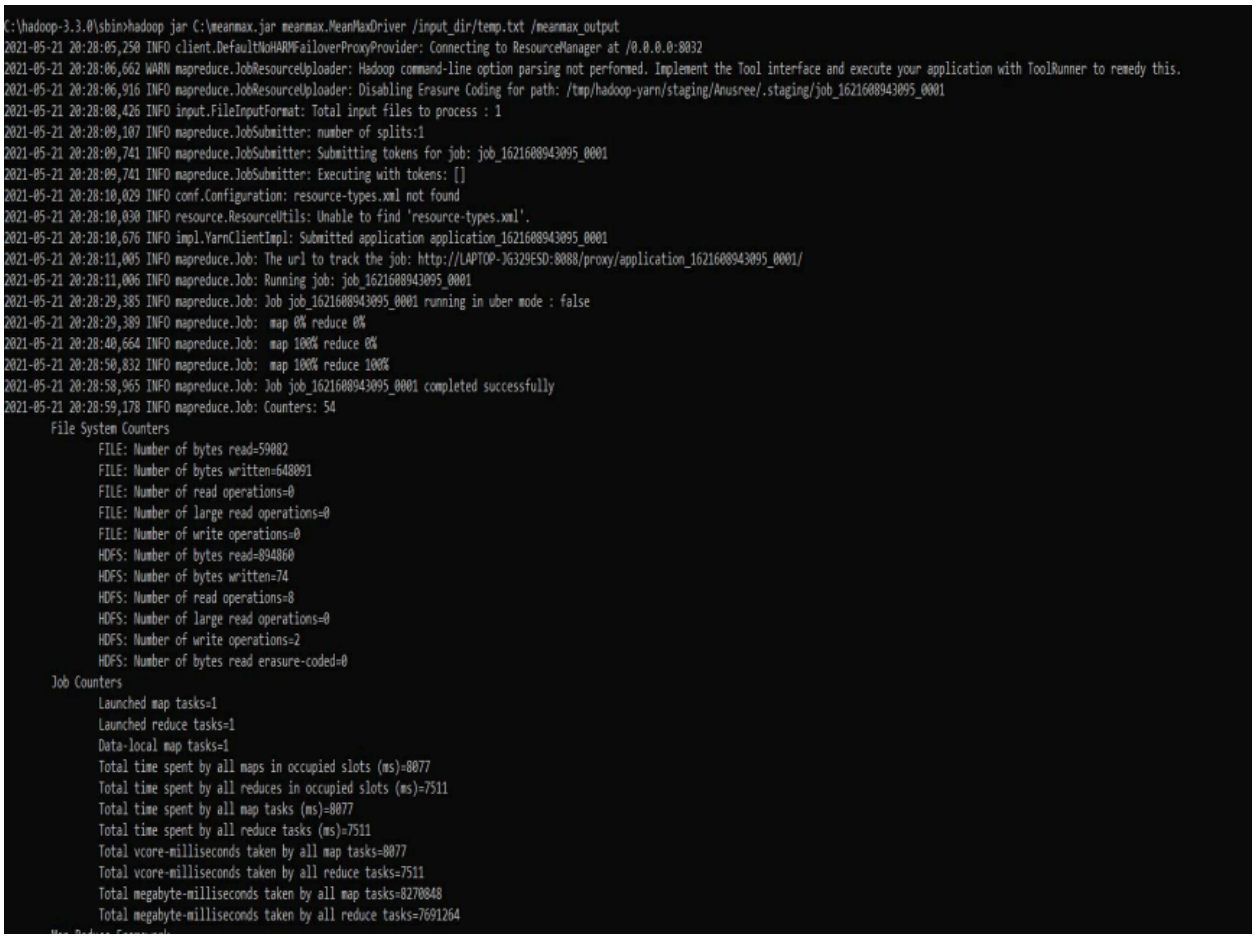
```
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class MeanMaxMapper extends Mapper<LongWritable, Text, Text, IntWritable> {
public static final int MISSING = 9999;
public void map(LongWritable key, Text value, Mapper<LongWritable, Text, Text,
IntWritable>.Context context) throws IOException, InterruptedException {
int temperature;
String line = value.toString();
String month = line.substring(19, 21);
if (line.charAt(87) == '+') {
temperature = Integer.parseInt(line.substring(88, 92));
} else {
temperature = Integer.parseInt(line.substring(87, 92));
}
String quality = line.substring(92, 93);
if (temperature != 9999 && quality.matches("[01459]"))
context.write(new Text(month), new IntWritable(temperature));
}
}
```

MeanMaxReducer.class

```
package meanmax;
import java.io.IOException;
```

```
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
public class MeanMaxReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values, Reducer<Text, IntWritable,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
int max_temp = 0;
int total_temp = 0;
int count = 0;
int days = 0;
for (IntWritable value : values) {
int temp = value.get();
if (temp > max_temp)
max_temp = temp;
count++;
if (count == 3) {
total_temp += max_temp;
max_temp = 0;
count = 0;
days++;
}
}
context.write(key, new IntWritable(total_temp / days));
}
```

}


C:\hadoop-3.3.0\sbin>hadoop jar C:\meanmax.jar meanmax.MeanMaxDriver /input_dir/temp.txt /meanmax_output
2021-05-21 20:28:05,250 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2021-05-21 20:28:06,662 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2021-05-21 20:28:06,916 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/Anusree/.staging/job_1621608943095_0001
2021-05-21 20:28:08,426 INFO input.FileInputFormat: Total input files to process : 1
2021-05-21 20:28:09,107 INFO mapreduce.JobSubmitter: number of splits:1
2021-05-21 20:28:09,741 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1621608943095_0001
2021-05-21 20:28:09,741 INFO mapreduce.JobSubmitter: Executing with tokens: []
2021-05-21 20:28:10,029 INFO conf.Configuration: resource-types.xml not found
2021-05-21 20:28:10,030 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2021-05-21 20:28:10,676 INFO impl.YarnClientImpl: Submitted application application_1621608943095_0001
2021-05-21 20:28:11,005 INFO mapreduce.Job: The url to track the job: http://LAPTOP-JG329ESD:8088/proxy/application_1621608943095_0001/
2021-05-21 20:28:11,006 INFO mapreduce.Job: Running job: job_1621608943095_0001
2021-05-21 20:28:29,385 INFO mapreduce.Job: Job job_1621608943095_0001 running in uber mode : false
2021-05-21 20:28:29,389 INFO mapreduce.Job: map 0% reduce 0%
2021-05-21 20:28:40,664 INFO mapreduce.Job: map 100% reduce 0%
2021-05-21 20:28:50,832 INFO mapreduce.Job: map 100% reduce 100%
2021-05-21 20:28:58,965 INFO mapreduce.Job: Job job_1621608943095_0001 completed successfully
2021-05-21 20:28:59,178 INFO mapreduce.Job: Counters: 54
File System Counters
FILE: Number of bytes read=59082
FILE: Number of bytes written=648091
FILE: Number of read operations=0
FILE: Number of large read operations=0
FILE: Number of write operations=0
HDFS: Number of bytes read=894860
HDFS: Number of bytes written=74
HDFS: Number of read operations=8
HDFS: Number of large read operations=0
HDFS: Number of write operations=2
HDFS: Number of bytes read erasure-coded=0
Job Counters
Launched map tasks=1
Launched reduce tasks=1
Data-local map tasks=1
Total time spent by all maps in occupied slots (ms)=8077
Total time spent by all reduces in occupied slots (ms)=7511
Total time spent by all map tasks (ms)=8077
Total time spent by all reduce tasks (ms)=7511
Total vcore-milliseconds taken by all map tasks=8077
Total vcore-milliseconds taken by all reduce tasks=7511
Total megabyte-milliseconds taken by all map tasks=8270848
Total megabyte-milliseconds taken by all reduce tasks=7691264

```
C:\hadoop-3.3.0\sbin>hdfs dfs -cat /meanmax_output/*
01      4
02      0
03      7
04      44
05      100
06      168
07      219
08      198
09      141
10      100
11      19
12      3

C:\hadoop-3.3.0\sbin>
```

Program 8

For a given Text file, create a Map Reduce program to sort the content in an alphabetic order listing only top 10 maximum occurrences of words.

Driver-TopN.class

```
package samples.topn;

import java.io.IOException;

import java.util.StringTokenizer;

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.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.util.GenericOptionsParser;
public class TopN {
public static void main(String[] args) throws Exception {
Configuration conf = new Configuration();
String[] otherArgs = (new GenericOptionsParser(conf, args)).getRemainingArgs();
if (otherArgs.length != 2) {
System.err.println("Usage: TopN <in> <out>");
System.exit(2);
}
Job job = Job.getInstance(conf);
job.setJobName("Top N");
job.setJarByClass(TopN.class);
job.setMapperClass(TopNMapper.class);
job.setReducerClass(TopNReducer.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
FileInputFormat.addInputPath(job, new Path(otherArgs[0]));
FileOutputFormat.setOutputPath(job, new Path(otherArgs[1]));
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
public static class TopNMapper extends Mapper<Object, Text, Text, IntWritable> {
private static final IntWritable one = new IntWritable(1);
```

```
private Text word = new Text();
private String tokens = "[_|$#<>\\^=\\[\\]\\*/\\\\,;,.\\-:()?!\"']";
public void map(Object key, Text value, Mapper<Object, Text, Text, IntWritable>.Context
context) throws IOException, InterruptedException {
String cleanLine = value.toString().toLowerCase().replaceAll(this.tokens, " ");
StringTokenizer itr = new StringTokenizer(cleanLine);
while (itr.hasMoreTokens()) {
this.word.set(itr.nextToken().trim());
context.write(this.word, one);
}
}
}
}
```

TopNCombiner.class

```
package samples.topn;
import java.io.IOException;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
public class TopNCombiner extends Reducer<Text, IntWritable, Text, IntWritable> {
public void reduce(Text key, Iterable<IntWritable> values, Reducer<Text, IntWritable,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
int sum = 0;
for (IntWritable val : values)
```

```
sum += val.get();
context.write(key, new IntWritable(sum));
}
}
```

TopNMapper.class

```
package samples.topn;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class TopNMapper extends Mapper<Object, Text, Text, IntWritable> {
private static final IntWritable one = new IntWritable(1);
private Text word = new Text();
private String tokens = "[_|$#<>\\^=\\[\\]\\*/\\\\,;,.\\-:()?!\"']";
public void map(Object key, Text value, Mapper<Object, Text, Text, IntWritable>.Context
context) throws IOException, InterruptedException {
String cleanLine = value.toString().toLowerCase().replaceAll(this.tokens, " ");
StringTokenizer itr = new StringTokenizer(cleanLine);
while (itr.hasMoreTokens()) {
this.word.set(itr.nextToken().trim());
context.write(this.word, one);
}
}
```

```
}
```

TopNReducer.class

```
package samples.topn;
import java.io.IOException;
import java.util.HashMap;
import java.util.Map;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
import utils.MiscUtils;
public class TopNReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
private Map<Text, IntWritable> countMap = new HashMap<>();
public void reduce(Text key, Iterable<IntWritable> values, Reducer<Text, IntWritable,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
int sum = 0;
for (IntWritable val : values)
sum += val.get();
this.countMap.put(new Text(key), new IntWritable(sum));
}
protected void cleanup(Reducer<Text, IntWritable, Text, IntWritable>.Context context)
throws IOException, InterruptedException {
Map<Text, IntWritable> sortedMap = MiscUtils.sortByValues(this.countMap);
int counter = 0;
for (Text key : sortedMap.keySet()) {
```

```
if (counter++ == 20)
break;
context.write(key, sortedMap.get(key));
}
}
}
```

```
C:\hadoop-3.3.0\sbin>jps
11072 DataNode
20528 Jps
5620 ResourceManager
15532 NodeManager
6140 NameNode

C:\hadoop-3.3.0\sbin>hdfs dfs -mkdir /input_dir

C:\hadoop-3.3.0\sbin>hdfs dfs -ls /
Found 1 items
drwxr-xr-x   - Anusree supergroup          0 2021-05-08 19:46 /input_dir

C:\hadoop-3.3.0\sbin>hdfs dfs -copyFromLocal C:\input.txt /input_dir

C:\hadoop-3.3.0\sbin>hdfs dfs -ls /input_dir
Found 1 items
-rw-r--r--   1 Anusree supergroup         36 2021-05-08 19:48 /input_dir/input.txt

C:\hadoop-3.3.0\sbin>hdfs dfs -cat /input_dir/input.txt
hello
world
hello
hadoop
bye
```

```
C:\hadoop-3.3.0\sbin>hadoop jar C:\sort.jar samples.topn.TopN /input_dir/input.txt /output_dir
2021-05-08 19:54:54,582 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2021-05-08 19:54:55,291 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/Anusree/.staging/job_1620483374279_0001
2021-05-08 19:54:55,821 INFO input.FileInputFormat: Total input files to process : 1
2021-05-08 19:54:56,261 INFO mapreduce.JobSubmitter: number of splits:1
2021-05-08 19:54:56,552 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1620483374279_0001
2021-05-08 19:54:56,552 INFO mapreduce.JobSubmitter: Executing with tokens: []
2021-05-08 19:54:56,843 INFO conf.Configuration: resource-types.xml not found
2021-05-08 19:54:56,843 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2021-05-08 19:54:57,387 INFO impl.YarnClientImpl: Submitted application application_1620483374279_0001
2021-05-08 19:54:57,507 INFO mapreduce.Job: The url to track the job: http://LAPTOP-JG329ESD:8088/proxy/application_1620483374279_0001/
2021-05-08 19:54:57,508 INFO mapreduce.Job: Running job: job_1620483374279_0001
2021-05-08 19:55:13,792 INFO mapreduce.Job: Job job_1620483374279_0001 running in uber mode : false
2021-05-08 19:55:13,794 INFO mapreduce.Job:  map 0% reduce 0%
2021-05-08 19:55:20,020 INFO mapreduce.Job:  map 100% reduce 0%
2021-05-08 19:55:27,116 INFO mapreduce.Job:  map 100% reduce 100%
2021-05-08 19:55:33,199 INFO mapreduce.Job: Job job_1620483374279_0001 completed successfully
2021-05-08 19:55:33,334 INFO mapreduce.Job: Counters: 54
       File System Counters
              FILE: Number of bytes read=65
              FILE: Number of bytes written=530397
              FILE: Number of read operations=0
              FILE: Number of large read operations=0
              FILE: Number of write operations=0
              HDFS: Number of bytes read=142
              HDFS: Number of bytes written=31
              HDFS: Number of read operations=8
              HDFS: Number of large read operations=0
              HDFS: Number of write operations=2
              HDFS: Number of bytes read erasure-coded=0
```

```
C:\hadoop-3.3.0\sbin>hdfs dfs -cat /output_dir/*
hello   2
hadoop  1
world   1
bye     1

C:\hadoop-3.3.0\sbin>
```