

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT
on

BIG DATA ANALYTICS **(20CS6PEBDA)**

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING



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CERTIFICATE

This is to certify that the Lab work entitled “**BIG DATA ANALYTICS**” carried out by **N.AKHILESH KUMAR DUTT(1BM19CS092)**, 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 2022. The Lab report has been approved as it satisfies the academic requirements in respect of a **BIG DATA ANALYTICS - (20CS6PEBDA)** work prescribed for the said degree.

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Course Outcome

CO1	Apply the concept of NoSQL, Hadoop or Spark for a given task
CO2	Analyze the Big Data and obtain insight using data analytics mechanisms.
CO3	Design and implement Big data applications by applying NoSQL, Hadoop or Spark

1. MongoDB- CRUD Demonstration

CRUD (CREATE, READ, UPDATE, DELETE) OPERATIONS

```

> use mydb;
switched to db mydb
> db;
mydb
> show dbs;
admin    0.000GB
config  0.000GB
local    0.000GB
> db.createCollection("student");
{ "ok" : 1 }
> show dbs;
admin    0.000GB
config  0.000GB
local    0.000GB
mydb     0.000GB
> show collections;
student
> db.student.insert({_id:1,name:"Rohit",grade:7,Hobbies:"InternetSurfing"});
WriteResult({ "nInserted" : 1 })
> db.student.find({});
{ "_id" : 1, "name" : "Rohit", "grade" : 7, "Hobbies" : "InternetSurfing" }
> db.student.update({_id:1,name:"Rohit",grade:2,Hobbies:"InternetSurfing"},{upsert:true});
WriteResult({ "nMatched" : 0, "nUpserted" : 0, "nModified" : 0 })
> db.student.find({});
{ "_id" : 1, "name" : "Rohit", "grade" : 7, "Hobbies" : "InternetSurfing" }
> db.student.update({_id:1,name:"Rohit",Hobbies:"InternetSurfing"},{grade:2},{upsert:true});
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
> db.student.find({});
{ "id" : 1, "grade" : 2 }

```

```

> db.student.update({_id:2,name:"Rahul",grade:12,Hobbies:"Surfing"},{upsert:true});
WriteResult({ "nMatched" : 0, "nUpserted" : 0, "nModified" : 0 })
> db.student.find({});
{ "_id" : 2, "name" : "Rahul", "grade" : 10, "Hobbies" : "Surfing" }
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
> db.student.find({}, {name:1, grade:1, _id:0});
{ "name" : "Rahul", "grade" : 10 }
{ "grade" : 10, "name" : "Somu" }
> db.student.find({name:{ $eq: "Somu" }}).pretty();
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
> db.student.find({name : { $in: ['Ram', 'Somu'] }}).pretty();
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
> db.student.find({name:/^R/}).pretty();
{ "_id" : 2, "name" : "Rahul", "grade" : 10, "Hobbies" : "Surfing" }
> db.student.find({name:/m/}).pretty();
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
> db.student.find().sort({name:1}).pretty();
{ "_id" : 2, "name" : "Rahul", "grade" : 10, "Hobbies" : "Surfing" }
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
> db.student.find().sort({name:-1}).pretty();
{ "_id" : 5, "Hobbies" : "Surfing", "grade" : 10, "name" : "Somu" }
{ "id" : 2, "name" : "Rahul", "grade" : 10, "Hobbies" : "Surfing" }

```

```
C:\Program Files\MongoDB\Server\5.0\bin>mongoimport --db mydb --collection tests --type csv --headerline --file C:\Users\DELL\Downloads\csv\testdemo.csv
2022-06-05T21:40:11.501+0530   connected to: mongodb://localhost/
2022-06-05T21:40:11.538+0530   4 document(s) imported successfully. 0 document(s) failed to import.

C:\Program Files\MongoDB\Server\5.0\bin>mongoexport --db mydb --collection tests --csv --fieldfile C:\Users\DELL\Downloads\csv\testdemo.csv --out C:\Users\DELL\Downloads\csv\d.csv
2022-06-06T18:30:03.775+0530   csv flag is deprecated; please use --type=csv instead
2022-06-06T18:30:04.462+0530   connected to: mongodb://localhost/
2022-06-06T18:30:04.610+0530   exported 4 records
```

```
> db.Faculty.aggregate({$match : {department : "CSE"} },
... {$group : {_id : "$designation",avgsal : {$avg : "$salary"} }
... },
... {$match : {avgsal : { $gt : 65000} }}});
{ "_id" : "Professor", "avgsal" : 78333.33333333333 }
>
```

2.Perform the following DB operations using Cassandra.

1.Create a key space by name Employee

```
nakhilesh@nakhilesh-VirtualBox:~/Desktop$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.3 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE emp WITH replication = {'class':'SimpleStrategy','replication_factor' : 3};
```

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

```
cqlsh> use emp;
cqlsh:emp> CREATE TABLE emp_info(
    ... emp_id int primary key,
    ... emp_name text,
    ... designation text,
    ... date_of_joining timestamp,
    ... salary int,
    ... dept_name text);
```

3.Insert the values into the table in batch

```
cqlsh:emp> BEGIN BATCH
... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES (1,'Somu','ABC','2022-06-08',25000,'BCD');
... APPLY BATCH;
cqlsh:emp> BEGIN BATCH
... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES (2,'Shekhar','AAA','2022-04-08',35000,'BBB');
... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES (3,'Akshay','CCC','2021-02-08',20000,'DDD');
... APPLY BATCH;
cqlsh:emp> SELECT * from emp_info;
```

emp_id	date_of_joining	dept_name	designation	emp_name
1	2022-06-07 18:30:00.000000+0000	BCD	ABC	Somu
2	2022-04-07 18:30:00.000000+0000	BBB	AAA	Shekhar
3	2021-02-07 18:30:00.000000+0000	DDD	CCC	Akshay

4. Update Employee name and Department of Emp-Id 2

```
(3 rows)
cqlsh:emp> update emp_info set emp_name='Harsha',dept_name='CSE' where emp_id=3;
cqlsh:emp> select * from emp_info;
```

emp_id	date_of_joining	dept_name	designation	emp_name
1	2022-06-07 18:30:00.000000+0000	BCD	ABC	Somu
2	2022-04-07 18:30:00.000000+0000	BBB	AAA	Shekhar
3	2021-02-07 18:30:00.000000+0000	CSE	CCC	Harsha

```
(3 rows)
```


5. Sort the details of Employee records based on salary

```
cqlsh:emp> create table e1_info(e_id int,e_name text,e_designation text,DOJ timestamp,salary int,e_dept_name text,primary key(e_id,salary));
cqlsh:emp> BEGIN BATCH
... INSERT INTO e1_info(e_id,e_name,e_designation,DOJ,salary,e_dept_name
) VALUES (1,'Sal','Manager','2021-04-08',55000,'EEE');
... INSERT INTO e1_info(e_id,e_name,e_designation,DOJ,salary,e_dept_name
) VALUES (2,'Raghav','GM','2021-03-08',15000,'DEF');
... APPLY BATCH;
cqlsh:emp> select * from e1_info;
```

e_id	salary	doj	e_dept_name	e_designation
1	55000	2021-04-07 18:30:00.000000+0000	EEE	Manager
2	15000	2021-03-07 18:30:00.000000+0000	DEF	GM

```
(2 rows)
cqlsh:emp> paging off;
cqlsh:emp> select * from e1_info where e_id in (1,2) order by salary;
```

e_id	salary	doj	e_dept_name	e_designation
2	15000	2021-03-07 18:30:00.000000+0000	DEF	GM
1	55000	2021-04-07 18:30:00.000000+0000	EEE	Manager

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

```
cqlsh:emp> alter table emp_info add projects set<text>;
```

7. Update the altered table to add project names

```
cqlsh:emp> alter table emp_info add projects set<text>;
cqlsh:emp> update emp_info set projects=projects+{'p1','p2'} where emp_id=1;
cqlsh:emp> select * from emp_info;
```

emp_id	date_of_joining	dept_name	designation	emp_name
1	2022-06-07 18:30:00.000000+0000	BCD	ABC	Somu
{ 'p1', 'p2' }	25000			
2	2022-04-07 18:30:00.000000+0000	BBB	AAA	Shekhar
null	35000			
3	2021-02-07 18:30:00.000000+0000	CSE	CCC	Harsha
null	20000			

```
(3 rows)
```


3. Perform the following DB operations using Cassandra.

1. Create a key space by name Library

```
nakhilesh@nakhilesh-VirtualBox:~/Desktop$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.3 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE library WITH replication ={'class' : 'SimpleStrategy','r
eplication_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

```
cqlsh:library> CREATE TABLE library_info(
... stud_id int,
... counter_value counter,
... stud_name text,
... book_name text,
... book_id int,
... date_of_issue timestamp,
... primary key(stud_id,stud_name,book_name,book_id,date_of_issue));
```

3. Insert the values into the table in batch

```
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=1 and stud_name='AKHIL' and book_name='BDA' and date_of_issue='2022-08-09'
and book_id=11;
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=1 and stud_name='BHEEM' and book_name='BBB' and date_of_issue='2022-04-09'
and book_id=12;
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=3 and stud_name='RAM' and book_name='CCC' and date_of_issue='2022-04-06' an
d book_id=13;
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=2 and stud_name='BHEEM' and book_name='BBB' and date_of_issue='2022-04-09'
and book_id=12;
cqlsh:library> select * from library_info;
```

stud_id	stud_name	book_name	book_id	date_of_issue	counter_value
1	AKHIL	BDA	11	2022-08-08 18:30:00.000000+0000	1
1	BHEEM	BBB	12	2022-04-08 18:30:00.000000+0000	1
2	BHEEM	BBB	12	2022-04-08 18:30:00.000000+0000	1
3	RAM	CCC	13	2022-04-05 18:30:00.000000+0000	1

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

```
cqlsh:library> update library_info set counter_value=counter_value+2 where stud_id=2 and stud_name='BHEEM' and book_name='BBB' and date_of_issue='2022-04-09' and book_id=12;
cqlsh:library> select * from library_info;
```

stud_id	stud_name	book_name	book_id	date_of_issue	counter_value
1	AKHIL	BDA	11	2022-08-08 18:30:00.000000+0000	1
1	BHEEM	BBB	12	2022-04-08 18:30:00.000000+0000	1
2	BHEEM	BBB	12	2022-04-08 18:30:00.000000+0000	3
3	RAM	CCC	13	2022-04-05 18:30:00.000000+0000	1

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

```
cqlsh:library> select * from library_info where stud_id=2;
```

stud_id	stud_name	book_name	book_id	date_of_issue	counter_value
2	BHEEM	BBB	12	2022-04-08 18:30:00.000000+0000	3

6. Export the created column to a csv file

```
cqlsh:library> COPY library_info(stud_id,stud_name,book_name,book_id,date_of_issue,counter_value) TO 'e:\library_info.csv';
Using 1 child processes

Starting copy of library.library_info with columns [stud_id, stud_name, book_name, book_id, date_of_issue, counter_value].
Processed: 4 rows; Rate: 44 rows/s; Avg. rate: 14 rows/s
4 rows exported to 1 files in 0.309 seconds.
```

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

```
cqlsh:library> CREATE TABLE lib_info(
... stud_id int,
... counter_value counter,
... stud_name text,
... book_name text,
... date_of_issue timestamp,
... book_id int,
... primary key(stud_id,stud_name,book_name,date_of_issue,book_id));
cqlsh:library> COPY lib_info(stud_id,stud_name,book_name,book_id,date_of_issue,counter_value) TO 'e:\library_info.csv';
Using 1 child processes

Starting copy of library.lib_info with columns [stud_id, stud_name, book_name, book_id, date_of_issue, counter_value].
Processed: 0 rows; Rate: 0 rows/s; Avg. rate: 0 rows/s
0 rows exported to 1 files in 0.188 seconds.
```

4.Hadoop Installation

```
C:\hadoop-3.3.3\sbin>jps
12372 SparkSubmit
19108 NameNode
19268 ResourceManager
2596 DataNode
2740 Eclipse
5476
11164 NodeManager
14044 Jps
```

5. Execution of HDFS Commands for interaction with Hadoop Environment.

```
C:\hadoop-3.3.3\sbin>hdfs dfs -mkdir /dir
```

```
C:\hadoop-3.3.3\sbin>hdfs dfs -ls /
```

```
Found 8 items
```

```
drwxr-xr-x - DELL supergroup      0 2022-06-22 10:29 /aaa
drwxr-xr-x - DELL supergroup      0 2022-06-19 19:27 /abc
drwxr-xr-x - DELL supergroup      0 2022-07-12 22:17 /dir
drwxr-xr-x - DELL supergroup      0 2022-07-10 11:19 /input
drwxr-xr-x - DELL supergroup      0 2022-07-12 16:43 /input_dir
drwxr-xr-x - DELL supergroup      0 2022-07-12 22:17 /inputdir
drwxr-xr-x - DELL supergroup      0 2022-07-10 11:25 /out
drwx----- - DELL supergroup      0 2022-07-10 11:24 /tmp
```

```
C:\hadoop-3.3.3\sbin>_
```

```
C:\hadoop-3.3.3\sbin>hdfs dfs -put C:\Users\DELL\Downloads\num.txt /dir
```

```
C:\hadoop-3.3.3\sbin>hdfs dfs -ls /dir
```

```
Found 1 items
```

```
-rw-r--r-- 1 DELL supergroup      31 2022-07-12 22:21 /dir/num.txt
```

```
C:\hadoop-3.3.3\sbin>
```

```
C:\hadoop-3.3.3\sbin>hdfs dfs -cat /dir/num.txt
```

```
1
5
7
2
3
10
11
25
6
5
```

```
C:\hadoop-3.3.3\sbin>
```

```
C:\hadoop-3.3.3\sbin>hdfs dfs -copyToLocal /dir/num.txt /C:/Users/DELL/Desktop/num
```

```
C:\hadoop-3.3.3\sbin>ls /C:/Users/DELL/Desktop/num
```

6. For the given file, Create a Map Reduce program to

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

Average Driver Class

```
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);
    }
}

job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
```

Average Mapper Class

```
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;

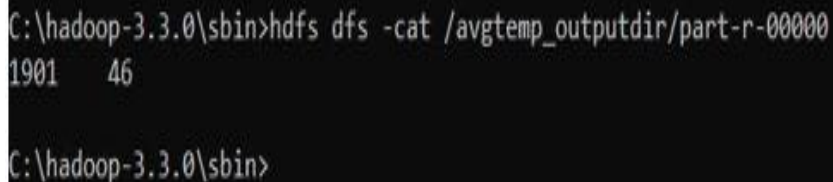
    public void map(LongWritable key, Text value, Mapper<LongWritable, Text,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
        int temperature;
        String line = value.toString();
        String year = line.substring(15, 19);
        if (line.charAt(87) == '+') {
            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));
    }
}
```


Average Reducer class

```
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));
    }
}
```



A terminal window showing a command to cat a file from HDFS. The command is 'C:\hadoop-3.3.0\sbin>hdfs dfs -cat /avgtemp_outputdir/part-r-00000'. The output is '1901 46'. The prompt 'C:\hadoop-3.3.0\sbin>' is shown again on the next line.

```
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

MeanMax driver 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);
    }
}
```

MeanMax Mapper 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));
    }
}
```

MeanMax Reducer 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>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>
```

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

TopN Driver 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);
        }
    }
}

```

TopN Combiner 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));
    }
}
```


TopN Mapper 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);
        }
    }
}
```

TopN Reducer 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>hdfs dfs -cat /output_dir/*
```

```
hello 2
```

```
hadoop 1
```

```
world 1
```

```
bye 1
```

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

8. Create a Map Reduce program to demonstrating join operation.

```
// JoinDriver.java

import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.*;
import org.apache.hadoop.mapred.libMultipleInputs;
import org.apache.hadoop.util.*;

public class JoinDriver extends Configured implements Tool {

    public static class KeyPartitioner implements Partitioner<TextPair, Text> {

        @Override
        public void configure(JobConf job) {}

        @Override
        public int getPartition(TextPair key, Text value, int numPartitions) {
            return (key.getFirst().hashCode() & Integer.MAX_VALUE) %
                numPartitions;
        }
    }

    @Override
    public int run(String[] args) throws Exception {
```

```
if (args.length != 3) {
    System.out.println("Usage: <Department Emp Strength input>

    <Department Name input> <output>");
    return -1;
}

JobConf conf = new JobConf(getConf(), getClass());

conf.setJobName("Join 'Department Emp Strength input' with 'Department Name
input");

Path AInputPath = new Path(args[0]);
Path BInputPath = new Path(args[1]);
Path outputPath = new Path(args[2]);

MultipleInputs.addInputPath(conf, AInputPath, TextInputFormat.class,

Posts.class);

MultipleInputs.addInputPath(conf, BInputPath, TextInputFormat.class,

User.class);

FileOutputFormat.setOutputPath(conf, outputPath);
```

```
conf.setPartitionerClass(KeyPartitioner.class);

conf.setOutputValueGroupingComparator(TextPair.FirstComparator.class);

conf.setMapOutputKeyClass(TextPair.class);

conf.setReducerClass(JoinReducer.class);

conf.setOutputKeyClass(Text.class);

JobClient.runJob(conf);

return 0;
}

public static void main(String[] args) throws Exception {

    int exitCode = ToolRunner.run(new JoinDriver(), args);
    System.exit(exitCode);
}

// JoinReducer.java
import java.io.IOException;
import java.util.Iterator;
```

```
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.*;

public class JoinReducer extends MapReduceBase implements Reducer<TextPair,
Text, Text,
Text> {

    @Override
    public void reduce (TextPair key, Iterator<Text> values, OutputCollector<Text,
Text>
output, Reporter reporter)

        throws IOException
    {

        Text nodeId = new Text(values.next());
        while (values.hasNext()) {

            Text node = values.next();
            Text outValue = new Text(nodeId.toString() + "\t\t" + node.toString());
            output.collect(key.getFirst(), outValue);
        }
    }
}
```



```
// User.java

import java.io.IOException;
import java.util.Iterator;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.FSDataInputStream;
import org.apache.hadoop.fs.FSDataOutputStream;
import org.apache.hadoop.fs.FileSystem;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.*;

import org.apache.hadoop.io.IntWritable;

public class User extends MapReduceBase implements Mapper<LongWritable,
Text, TextPair,
Text> {

    @Override
    public void map(LongWritable key, Text value, OutputCollector<TextPair, Text>
output,
    Reporter reporter)

    throws IOException

    {
```

```
String valueString = value.toString();
```

```
String[] SingleNodeData = valueString.split("\t");
```

```
output.collect(new TextPair(SingleNodeData[0], "1"), new
```

```
Text(SingleNodeData[1]));
```

```
}
```

```
}
```

```
//Posts.java
```

```
import java.io.IOException;
```

```
import org.apache.hadoop.io.*;
```

```
import org.apache.hadoop.mapred.*;
```

```
public class Posts extends MapReduceBase implements Mapper<LongWritable,  
Text, TextPair,
```

```
Text> {
```

```
@Override
```

```
public void map(LongWritable key, Text value, OutputCollector<TextPair, Text>  
output,
```

```
Reporter reporter)
```

```
throws IOException
```

```
{
```

```
String valueString = value.toString();
String[] SingleNodeData = valueString.split("\t");
output.collect(new TextPair(SingleNodeData[3], "0"), new
```

```
Text(SingleNodeData[9]));
}
}
```

```
// TextPair.java
```

```
import java.io.*;
```

```
import org.apache.hadoop.io.*;
```

```
public class TextPair implements WritableComparable<TextPair> {
```

```
    private Text first;
```

```
    private Text second;
```

```
    public TextPair() {
        set(new Text(), new Text());
    }
```

```
    public TextPair(String first, String second) {
        set(new Text(first), new Text(second));
    }
```

```
public TextPair(Text first, Text second) {  
    set(first, second);  
}
```

```
public void set(Text first, Text second) {  
    this.first = first;  
    this.second = second;  
}
```

```
public Text getFirst() {  
    return first;  
}
```

```
public Text getSecond() {  
    return second;  
}
```

```
@Override  
public void write(DataOutput out) throws IOException {  
    first.write(out);  
    second.write(out);  
}
```

```
@Override  
public void readFields(DataInput in) throws IOException {  
    first.readFields(in);
```

```
second.readFields(in);  
}
```

```
@Override  
public int hashCode() {  
    return first.hashCode() * 163 + second.hashCode();  
}
```

```
@Override  
public boolean equals(Object o) {  
    if (o instanceof TextPair) {  
        TextPair tp = (TextPair) o;  
        return first.equals(tp.first) && second.equals(tp.second);  
    }  
    return false;  
}
```

```
@Override  
public String toString() {  
    return first + "\t" + second;  
}
```

```
@Override  
public int compareTo(TextPair tp) {  
    int cmp = first.compareTo(tp.first);  
    if (cmp != 0) {
```

```

return cmp;
}
return second.compareTo(tp.second);
}
// ^^ TextPair

// vv TextPairComparator
public static class Comparator extends WritableComparator {

private static final Text.Comparator TEXT_COMPARATOR = new
Text.Comparator();

public Comparator() {
super(TextPair.class);
}

@Override
public int compare(byte[] b1, int s1, int l1,
byte[] b2, int s2, int l2) {

try {
int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1);
int firstL2 = WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2);
int cmp = TEXT_COMPARATOR.compare(b1, s1, firstL1, b2, s2, firstL2);
if (cmp != 0) {
return cmp;

```

```

    }
    return TEXT_COMPARATOR.compare(b1, s1 + firstL1, l1 - firstL1,

    b2, s2 + firstL2, l2 - firstL2);
    } catch (IOException e) {
    throw new IllegalArgumentException(e);
    }
    }
    }

    static {
    WritableComparator.define(TextPair.class, new Comparator());
    }

    public static class FirstComparator extends WritableComparator {

    private static final Text.Comparator TEXT_COMPARATOR = new
    Text.Comparator();

    public FirstComparator() {
    super(TextPair.class);
    }

    @Override
    public int compare(byte[] b1, int s1, int l1,
    byte[] b2, int s2, int l2) {

```



```

try {
    int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1);
    int firstL2 = WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2);
    return TEXT_COMPARATOR.compare(b1, s1, firstL1, b2, s2, firstL2);
} catch (IOException e) {
    throw new IllegalArgumentException(e);
}
}

```

@Override

```

public int compare(WritableComparable a, WritableComparable b) {
    if (a instanceof TextPair && b instanceof TextPair) {
        return ((TextPair) a).first.compareTo(((TextPair) b).first);
    }
    return super.compare(a, b);
}
}

```



```

C:\hadoop-3.3.0\sbin>hdfs dfs -cat /join8_output/part-00000
"100005361"      "2"      "36134"
"100018705"      "2"      "76"
"100022094"      "0"      "6354"

```

9. Program to print word count on scala shell and print “Hello world” on scala IDE

```
scala> println("Hello World!");  
Hello World!
```

```
val data=sc.textFile("C:\Users\DELL\Downloads\new.txt ")  
data.collect;  
val splitdata = data.flatMap(line => line.split(" "));  
splitdata.collect;  
val mapdata = splitdata.map(word => (word,1));  
mapdata.collect;  
val reducedata = mapdata.reduceByKey(_+_);  
reducedata.collect;
```

```
scala> val data=sc.textFile("C:/Users/DELL/Downloads/new.txt")  
data: org.apache.spark.rdd.RDD[String] = C:/Users/DELL/Downloads/new.txt MapPartitionsRDD[18] at textFile at <console>:24  
  
scala> data.collect;  
res14: Array[String] = Array(hi, how, hello, how, bye, how, hello, hi, how, how)  
  
scala> val splitdata = data.flatMap(line => line.split(" "));  
splitdata: org.apache.spark.rdd.RDD[String] = MapPartitionsRDD[19] at flatMap at <console>:25  
  
scala> splitdata.collect;  
res15: Array[String] = Array(hi, how, hello, how, bye, how, hello, hi, how, how)  
  
scala> val mapdata = splitdata.map(word => (word,1));  
mapdata: org.apache.spark.rdd.RDD[(String, Int)] = MapPartitionsRDD[20] at map at <console>:25  
  
scala> mapdata.collect;  
res16: Array[(String, Int)] = Array((hi,1), (how,1), (hello,1), (how,1), (bye,1), (how,1), (hello,1), (hi,1), (how,1), (how,1))  
  
scala> val reducedata = mapdata.reduceByKey(_+_);  
reducedata: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[21] at reduceByKey at <console>:25  
  
scala> reducedata.collect;  
res17: Array[(String, Int)] = Array((how,5), (hello,2), (bye,1), (hi,2))  
  
scala> _
```

```
package helloWorld

object hello {
  def main (args: Array[String]) {
    println("Hello World")
  }
}
```

Problems Tasks Console

<terminated> hello\$ [Scala Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (12-Jul-2022, 11:11:36 PM)
Hello World

10. Using RDD and Flat Map count how many times each word appears in a file and write out a list of words whose count is strictly greater than 4 using Spark

```
val textFile = sc.textFile("C:\\Users\\DELL\\Downloads\\new.txt ")
val counts = textFile.flatMap(line => line.split(" ")).map(word => (word,
1)).reduceByKey(_ + _)
import scala.collection.immutable.ListMap
val sorted=ListMap(counts.collect.sortWith(_. _2 > _. _2))
println(sorted)
for((k,v)<-sorted)
{
  if(v>4)
  {
    print(k+",")
    print(v)
    println()
  }
}
```

```
scala> val textFile = sc.textFile("C:/Users/DELL/Downloads/new.txt")
textFile: org.apache.spark.rdd.RDD[String] = C:/Users/DELL/Downloads/new.txt MapPartitionsRDD[23] at textFile at <console>:24

scala> val counts = textFile.flatMap(line => line.split(" ")).map(word => (word, 1)).reduceByKey(_ + _)
counts: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[26] at reduceByKey at <console>:25

scala> import scala.collection.immutable.ListMap
import scala.collection.immutable.ListMap

scala> val sorted=ListMap(counts.collect.sortWith(_. _2 > _. _2):_*)// sort in descending order based on values
sorted: scala.collection.immutable.ListMap[String,Int] = ListMap(how -> 5, hello -> 2, hi -> 2, bye -> 1)

scala> println(sorted)
ListMap(how -> 5, hello -> 2, hi -> 2, bye -> 1)

scala> for((k,v)<-sorted)
| {
|   if(v>4)
|   {
|     print(k+",")
|     print(v)
|     println()
|   }
| }
how,5
```