VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

BIG DATA ANALYTICS (20CS6PEBDA)

Submitted by

N.AKHILESH KUMAR DUTT (1BM19CS092)

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
May-2022 to July-2022

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 "**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.

Dr.Pallavi G B	**Dr. Jyothi S Nayak**
Assistant Professor	Professor and Head
Department of CSE	Department of CSE
BMSCE, Bengaluru	BMSCE, Bengaluru

`

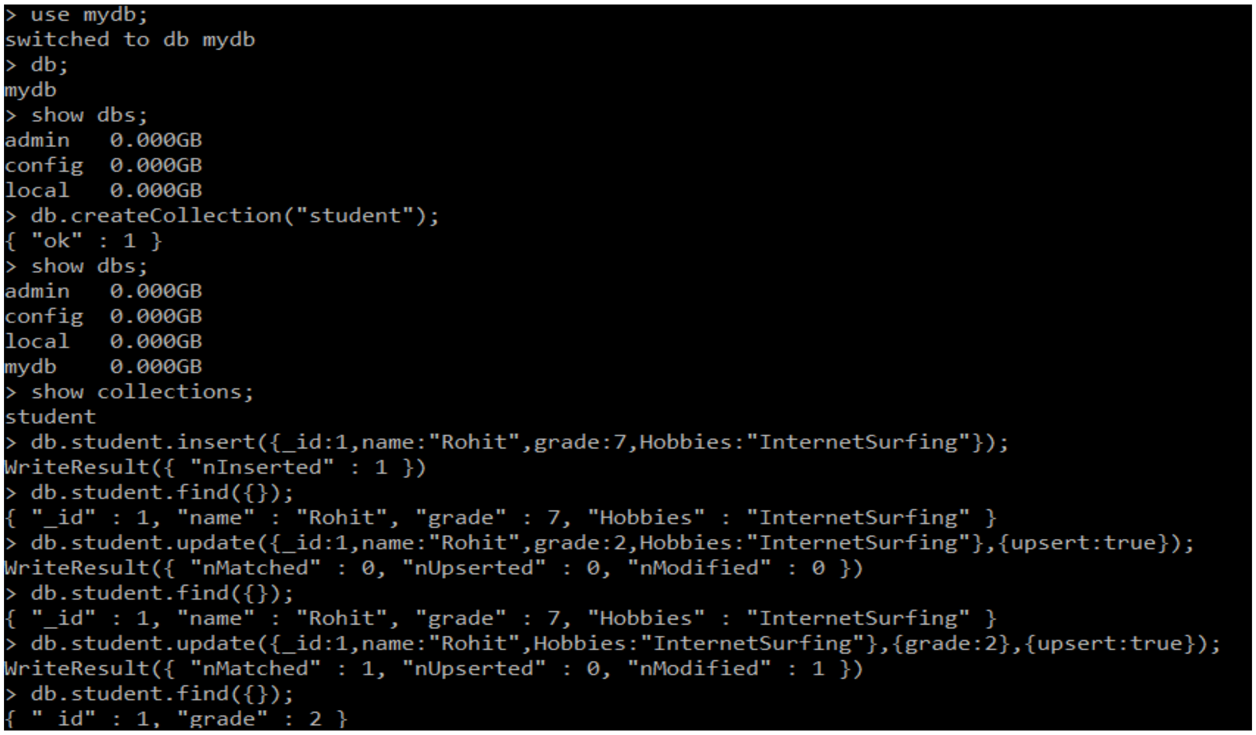
Index Sheet

Course Outcome

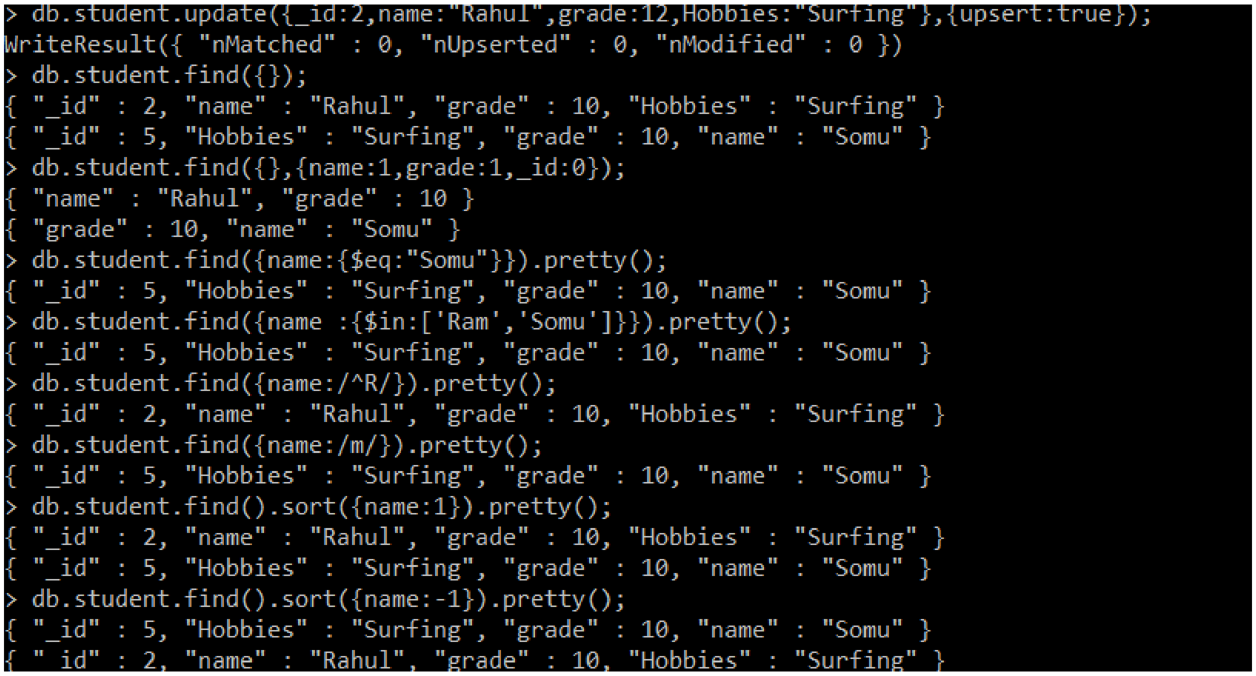
CO1	Apply the concept of NoSQL, Hadoop or Spark for a given task
CO2	Analyze the Big Data and obtain insight using data analytics mechanisms.
CO3	Design and implement Big data applications by applying NoSQL, Hadoop or Spark

1. MongoDB- CRUD Demonstration

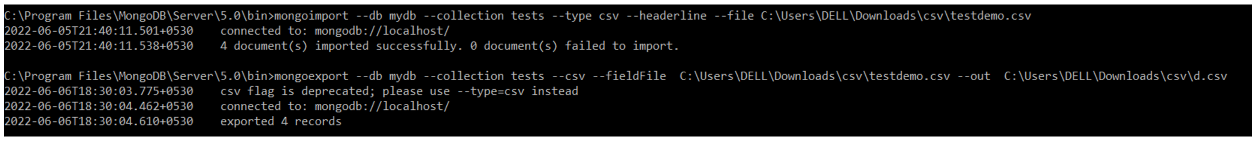
CRUD (CREATE, READ, UPDATE, DELETE) OPERATIONS



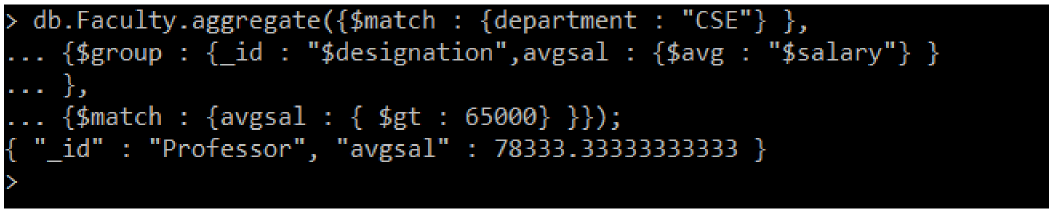
```
> use mydb;
switched to db mydb
> db;
mydb
> show dbs;
admin   0.000GB
config  0.000GB
local   0.000GB
> db.createCollection("student");
{ "ok" : 1 }
> show dbs;
admin   0.000GB
config  0.000GB
local   0.000GB
mydb    0.000GB
> show collections;
student
> db.student.insert({_id:1,name:"Rohit",grade:7,Hobbies:"InternetSurfing"});
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" }
```



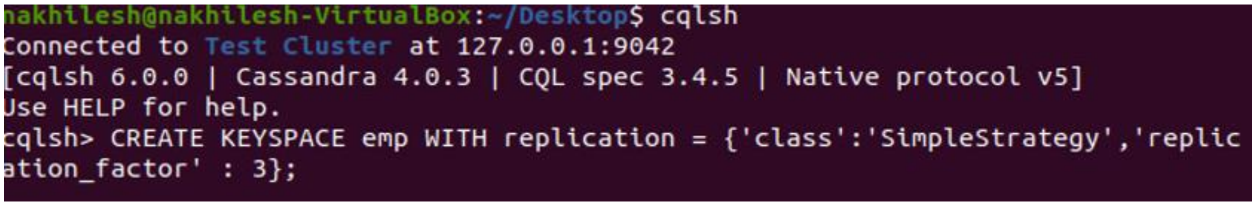
```
C:\Program Files\MongoDB\Server\5.0\bin>mongoimport --db mydb --collection tests --type csv --headerline --file C:\Users\DELL\Downloads\csv\testdemo.csv
2022-06-05T21:40:11.501+0530    connected to: mongodb://localhost/
2022-06-05T21:40:11.538+0530    4 document(s) imported successfully. 0 document(s)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

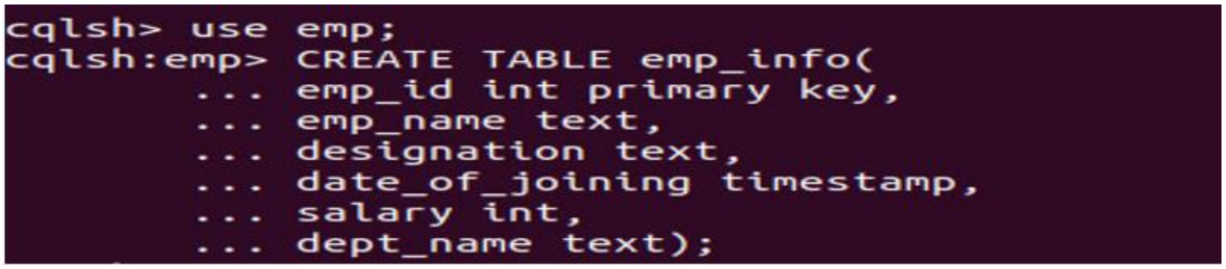
2.Perform the following DB operations using Cassandra.

1.Create a key space by name Employee



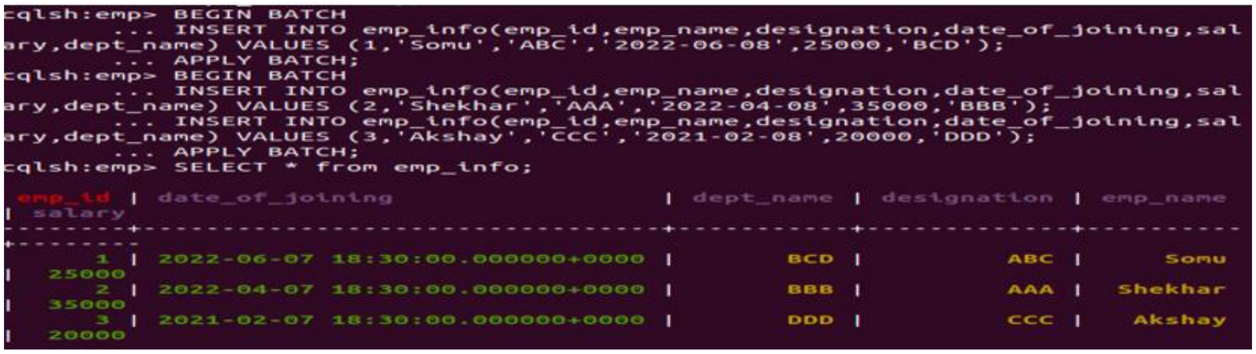
```
nakhilesh@nakhilesh-VirtualBox:~/Desktop$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.3 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE emp WITH replication = {'class':'SimpleStrategy','replic
ation_factor' : 3};
```

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



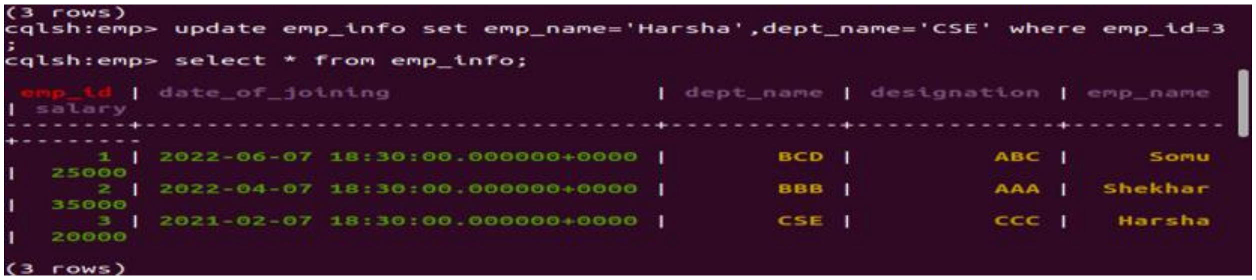
```
cqlsh> use emp;
cqlsh:emp> CREATE TABLE emp_info(
       ... emp_id int primary key,
       ... emp_name text,
       ... designation text,
       ... date_of_joining timestamp,
       ... salary int,
       ... dept_name text);
```

3.Insert the values into the table in batch



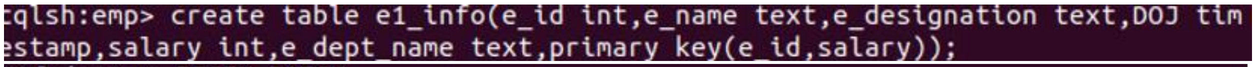
```
cqlsh:emp> BEGIN BATCH
       ... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,sal
ary,dept_name) VALUES (1,'Somu','ABC','2022-06-08',25000,'BCD');
       ... APPLY BATCH;
cqlsh:emp> BEGIN BATCH
       ... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,sal
ary,dept_name) VALUES (2,'Shekhar','AAA','2022-04-08',35000,'BBB');
       ... INSERT INTO emp_info(emp_id,emp_name,designation,date_of_joining,sal
ary,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
| salary
--------+---------------------------------+-----------+-------------+----------
+--------
      1 | 2022-06-07 18:30:00.000000+0000 |       BCD |         ABC |      Somu
|   25000
      2 | 2022-04-07 18:30:00.000000+0000 |       BBB |         AAA |   Shekhar
|   35000
      3 | 2021-02-07 18:30:00.000000+0000 |       DDD |         CCC |    Akshay
|   20000
```

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

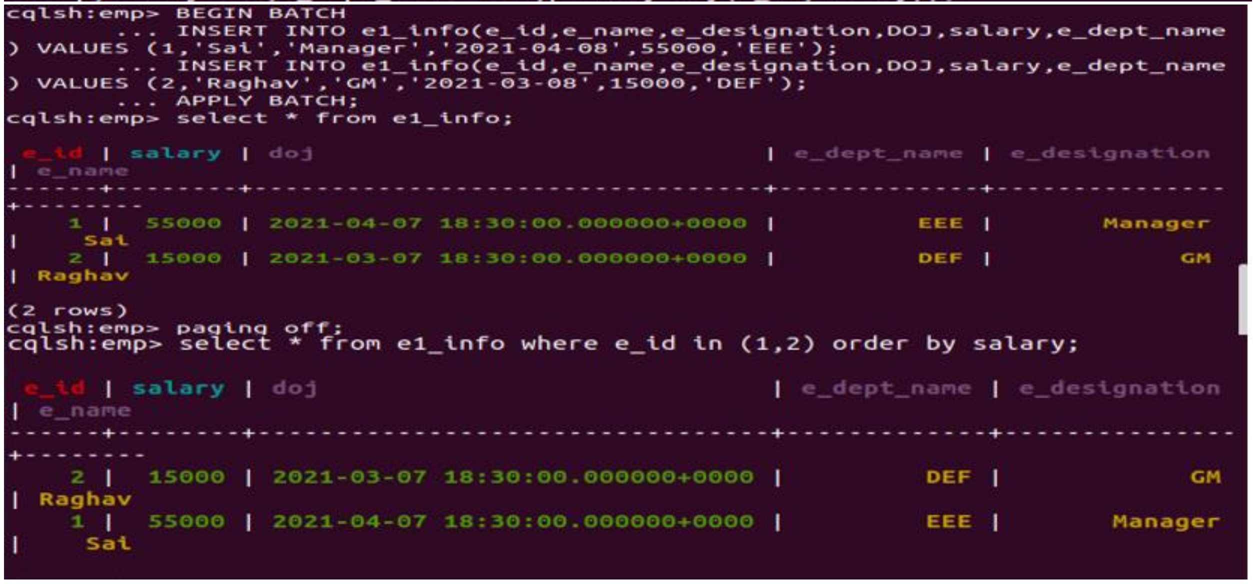


```
(3 rows)
cqlsh:emp> update emp_info set emp_name='Harsha',dept_name='CSE' where emp_id=3
;
cqlsh:emp> select * from emp_info;

 emp_id | date_of_joining                 | dept_name | designation | emp_name
| salary
--------+---------------------------------+-----------+-------------+----------
+--------
      1 | 2022-06-07 18:30:00.000000+0000 |       BCD |         ABC |      Somu
|   25000
      2 | 2022-04-07 18:30:00.000000+0000 |       BBB |         AAA |   Shekhar
|   35000
      3 | 2021-02-07 18:30:00.000000+0000 |       CSE |         CCC |    Harsha
|   20000

(3 rows)
```

5. Sort the details of Employee records based on salary

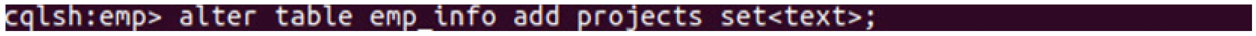


```
:qlsh:emp> create table e1_info(e_id int,e_name text,e_designation text,DOJ tim
estamp,salary int,e_dept_name text,primary key(e_id,salary));
```



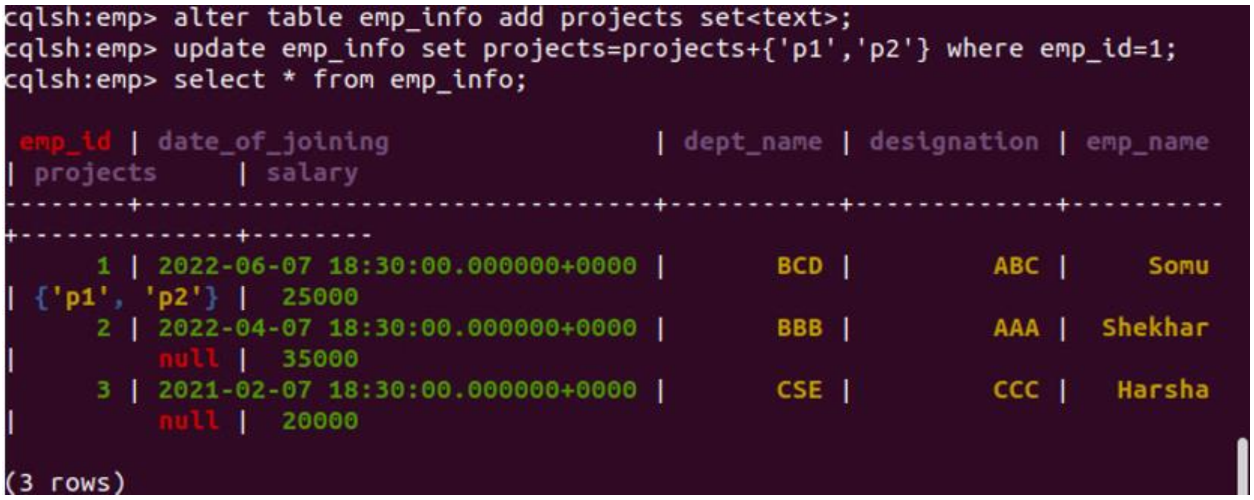
```
cqlsh:emp> BEGIN BATCH
       ... INSERT INTO e1_info(e_id,e_name,e_designation,DOJ,salary,e_dept_name
) VALUES (1,'Sai','Manager','2021-04-08',55000,'EEE');
       ... INSERT INTO e1_info(e_id,e_name,e_designation,DOJ,salary,e_dept_name
) VALUES (2,'Raghav','GM','2021-03-08',15000,'DEF');
     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

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

(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
| e_name
------+--------+---------------------------------+-------------+---------------
+--------
    2 |  15000 | 2021-03-07 18:30:00.000000+0000 |         DEF |            GM
| Raghav
    1 |  55000 | 2021-04-07 18:30:00.000000+0000 |         EEE |       Manager
|    Sai
```

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>;
```

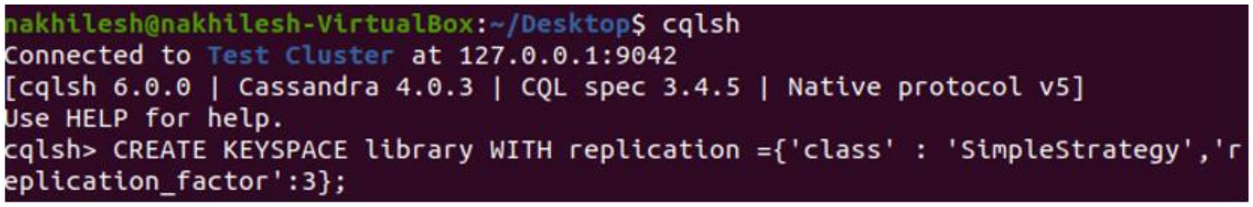
7. Update the altered table to add project names



```
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
| projects     | salary
--------+---------------------------------+-----------+-------------+----------
+--------------+--------
      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

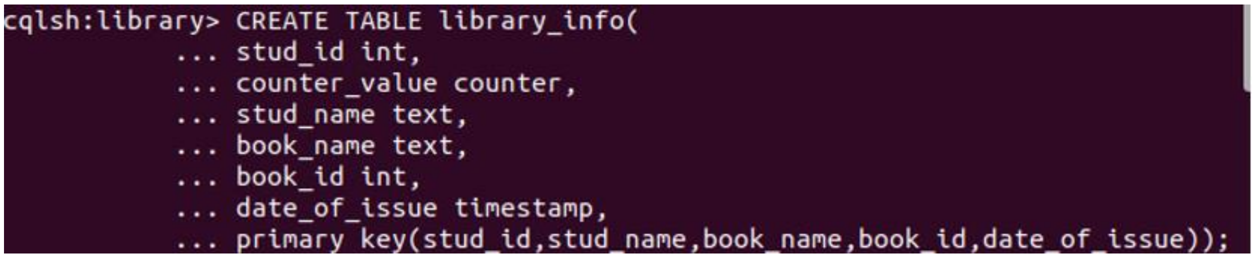


```
nakhilesh@nakhilesh-VirtualBox:~/Desktop$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.0.0 | Cassandra 4.0.3 | CQL spec 3.4.5 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE library WITH replication ={'class' : 'SimpleStrategy','r
eplication_factor':3};
```

2. Create a column family by name Library-Info with attributes Stud_Id Primary Key,

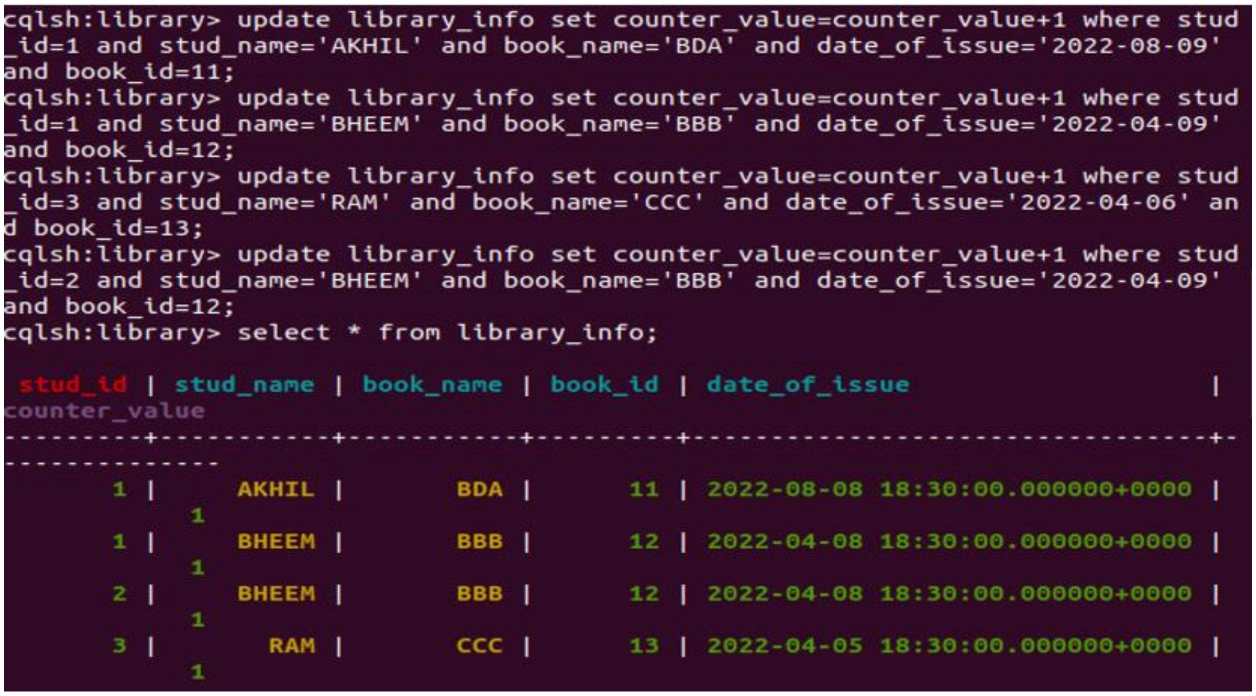
Counter_value of type Counter,

Stud_Name, Book-Name, Book-Id, Date_of_issue



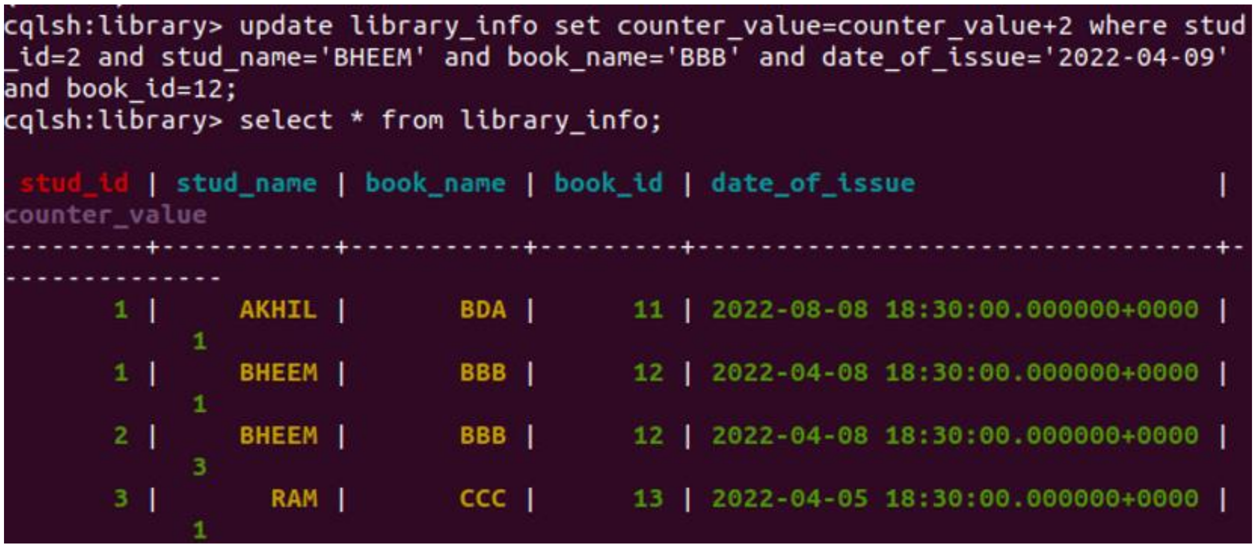
```
cqlsh:library> CREATE TABLE library_info(
           ... stud_id int,
           ... counter_value counter,
           ... stud_name text,
           ... book_name text,
           ... book_id int,
           ... date_of_issue timestamp,
           ... primary key(stud_id,stud_name,book_name,book_id,date_of_issue));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

3. Insert the values into the table in batch



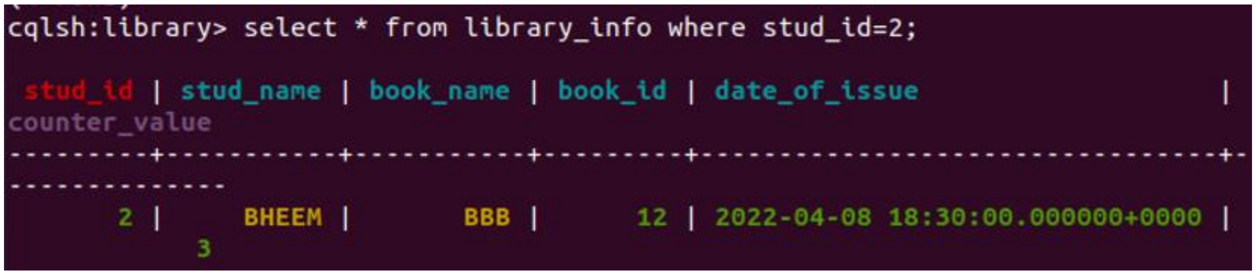
```
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=1 and stud_name='AKHIL' and book_name='BDA' and date_of_issue='2022-08-09'
and book_id=11;
cqlsh:library> update library_info set counter_value=counter_value+1 where stud
_id=1 and stud_name='BHEEM' and book_name='BBB' 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



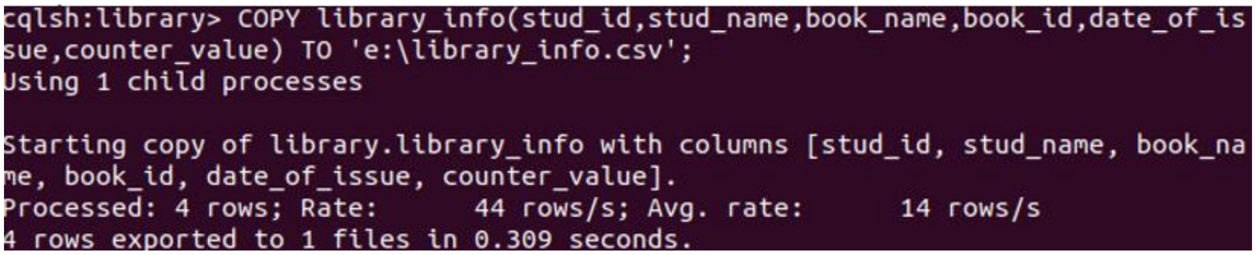
```
cqlsh:library> update library_info set counter_value=counter_value+2 where stud
_id=2 and stud_name='BHEEM' and book_name='BBB' and date_of_issue='2022-04-09'
and book_id=12;
cqlsh:library> select * from library_info;

 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.



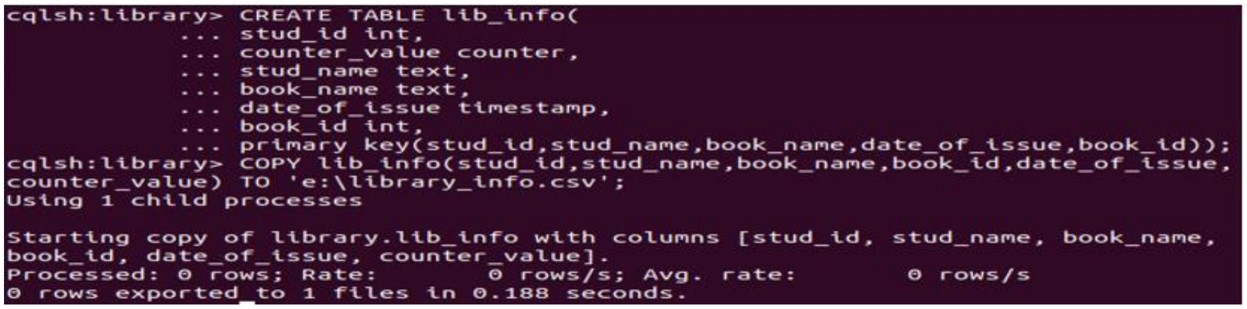
```
cqlsh:library> select * from library_info where stud_id=2;

 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



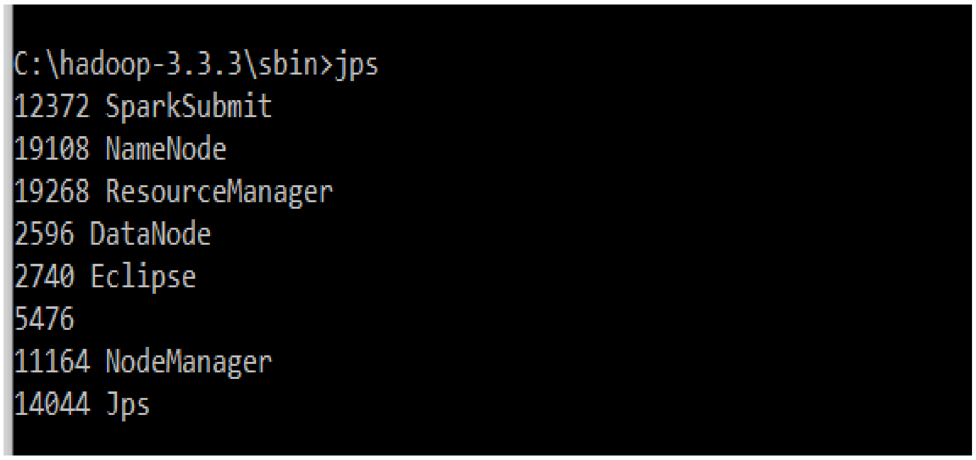
```
cqlsh:library> COPY library_info(stud_id,stud_name,book_name,book_id,date_of_is
sue,counter_value) TO 'e:\library_info.csv';
Using 1 child processes

Starting copy of library.library_info with columns [stud_id, stud_name, book_na
me, 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



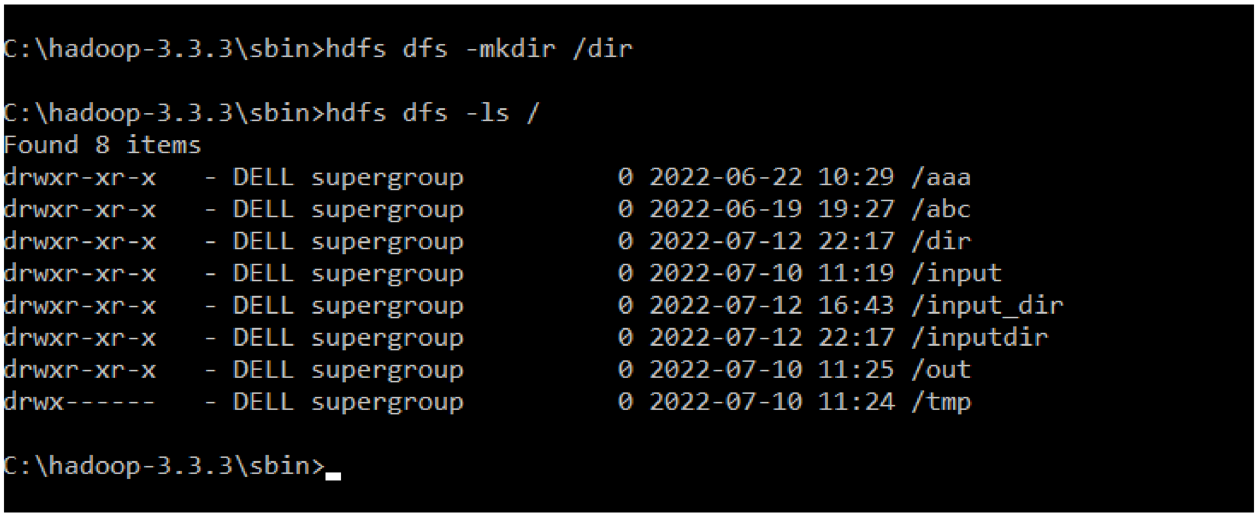
```
cqlsh:library> CREATE TABLE lib_info(
           ... stud_id int,
           ... counter_value counter,
           ... stud_name text,
           ... book_name text,
           ... date_of_issue timestamp,
           ... book_id int,
           ... primary key(stud_id,stud_name,book_name,date_of_issue,book_id));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

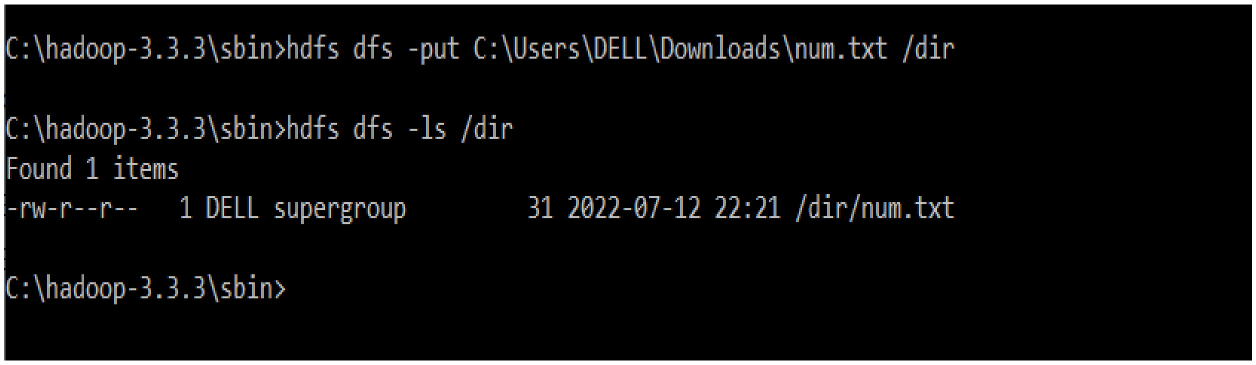


```
C:\hadoop-3.3.3\sbin>jps
12372 SparkSubmit
19108 NameNode
19268 ResourceManager
2596 DataNode
2740 Eclipse
5476
11164 NodeManager
14044 Jps
```

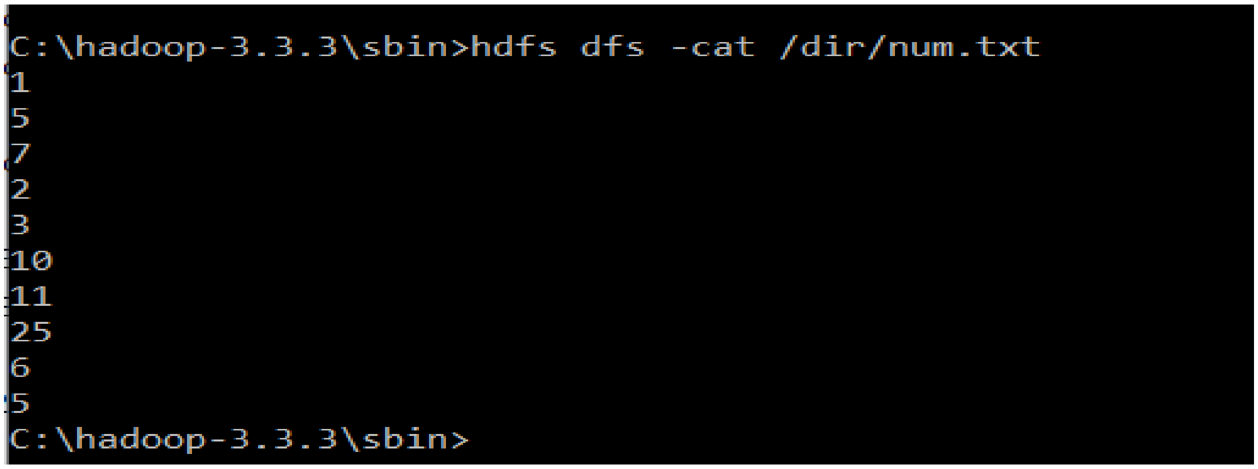
5. Execution of HDFS Commands for interaction with Hadoop Environment.



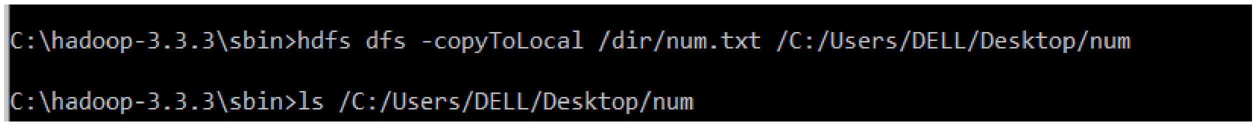
```
C:\hadoop-3.3.3\sbin>hdfs dfs -mkdir /dir

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

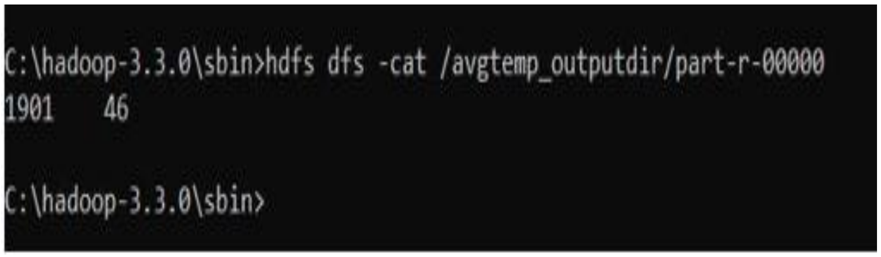
```
package temp;

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));
  }
}
```



```
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

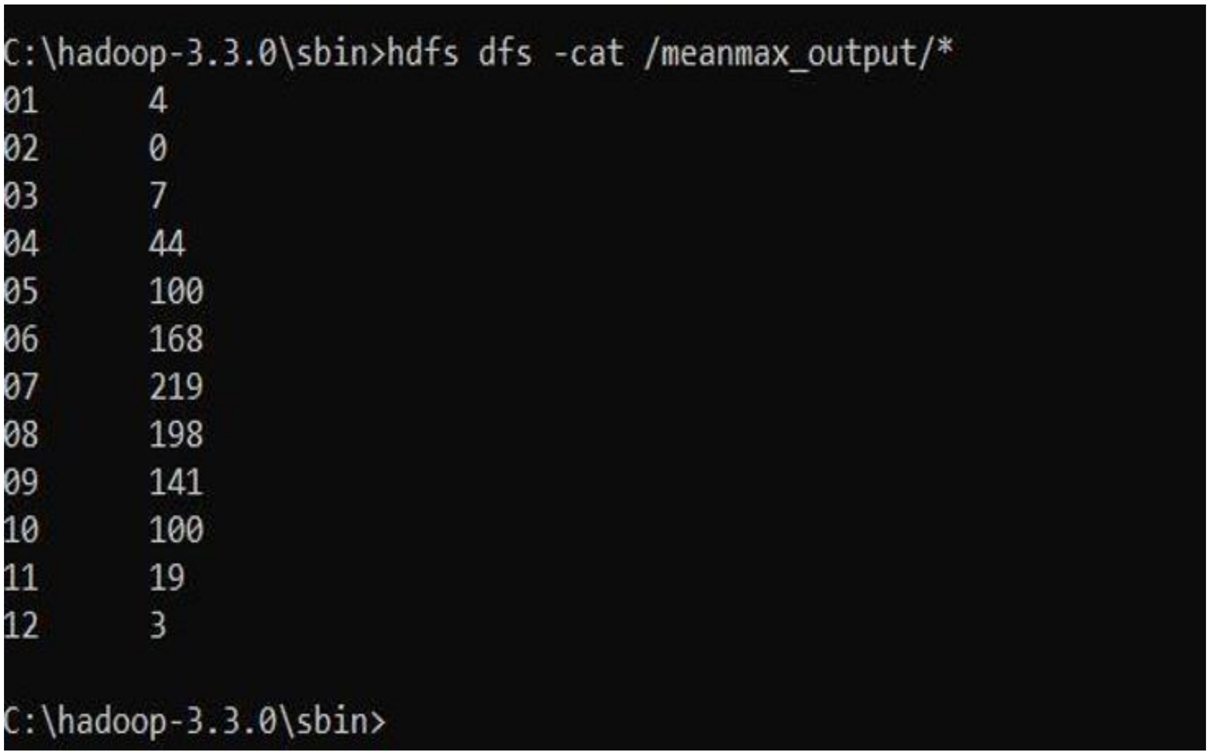
```
package meanmax;

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);
  }
}
```

<u>MeanMax Mapper class</u>

```
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));
  }
}
```

<u>MeanMax Reducer Class</u>

```
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

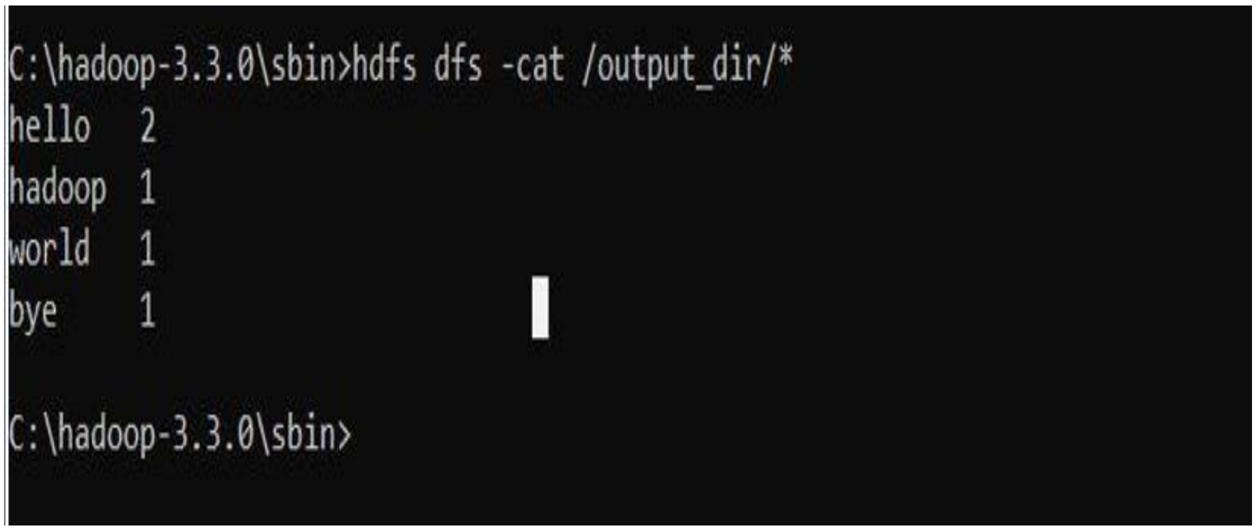
```
package samples.topn;

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 vo```\\id 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.lib.MultipleInputs;
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
{
```

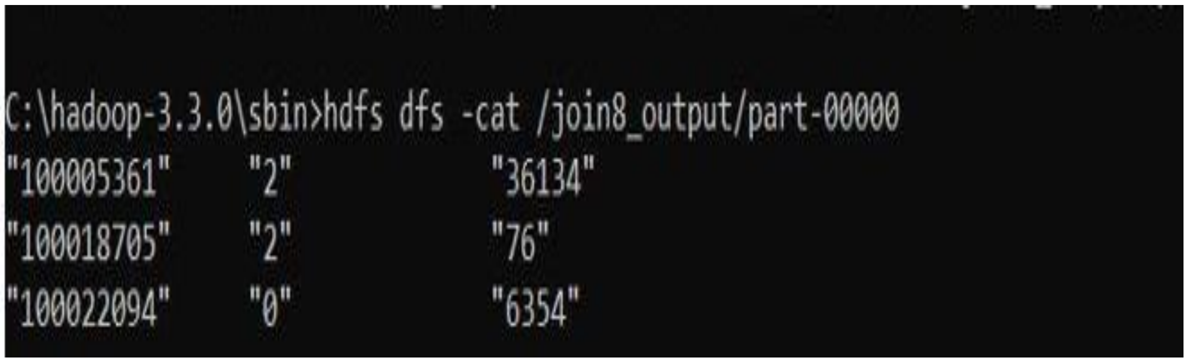
```
String valueString = value.toString();
String[] SingleNodeData = valueString.split("\t");
output.collect(new TextPair(SingleNodeData[3], "0"), new

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);
}
}  }
```

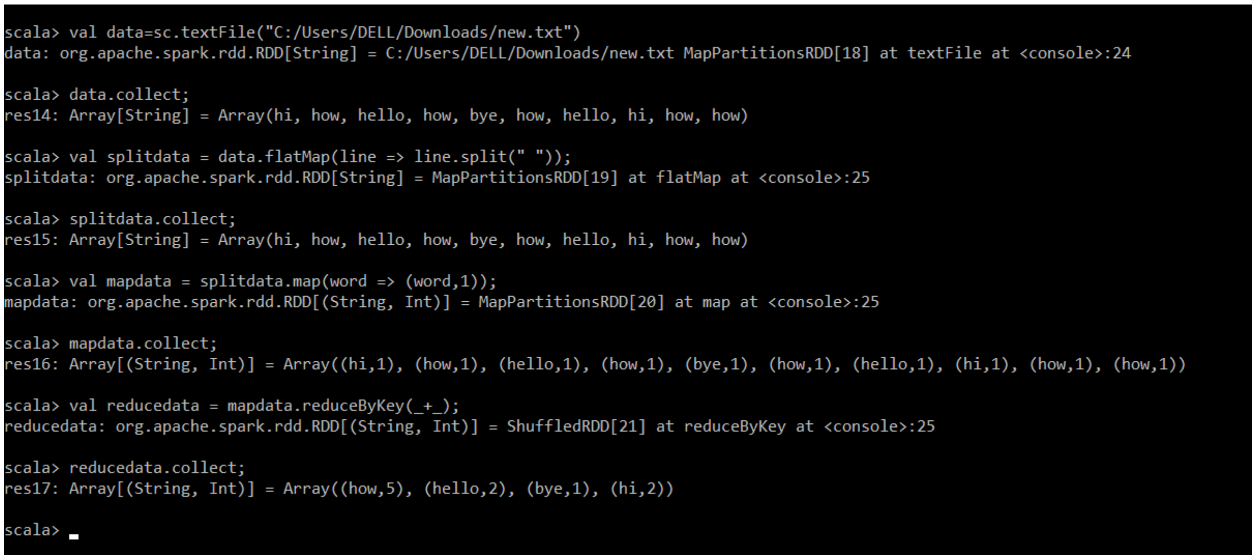


```
C:\hadoop-3.3.0\sbin>hdfs dfs -cat /join8_output/part-00000
"100005361"     "2"             "36134"
"100018705"     "2"             "76"
"100022094"     "0"             "6354"
```

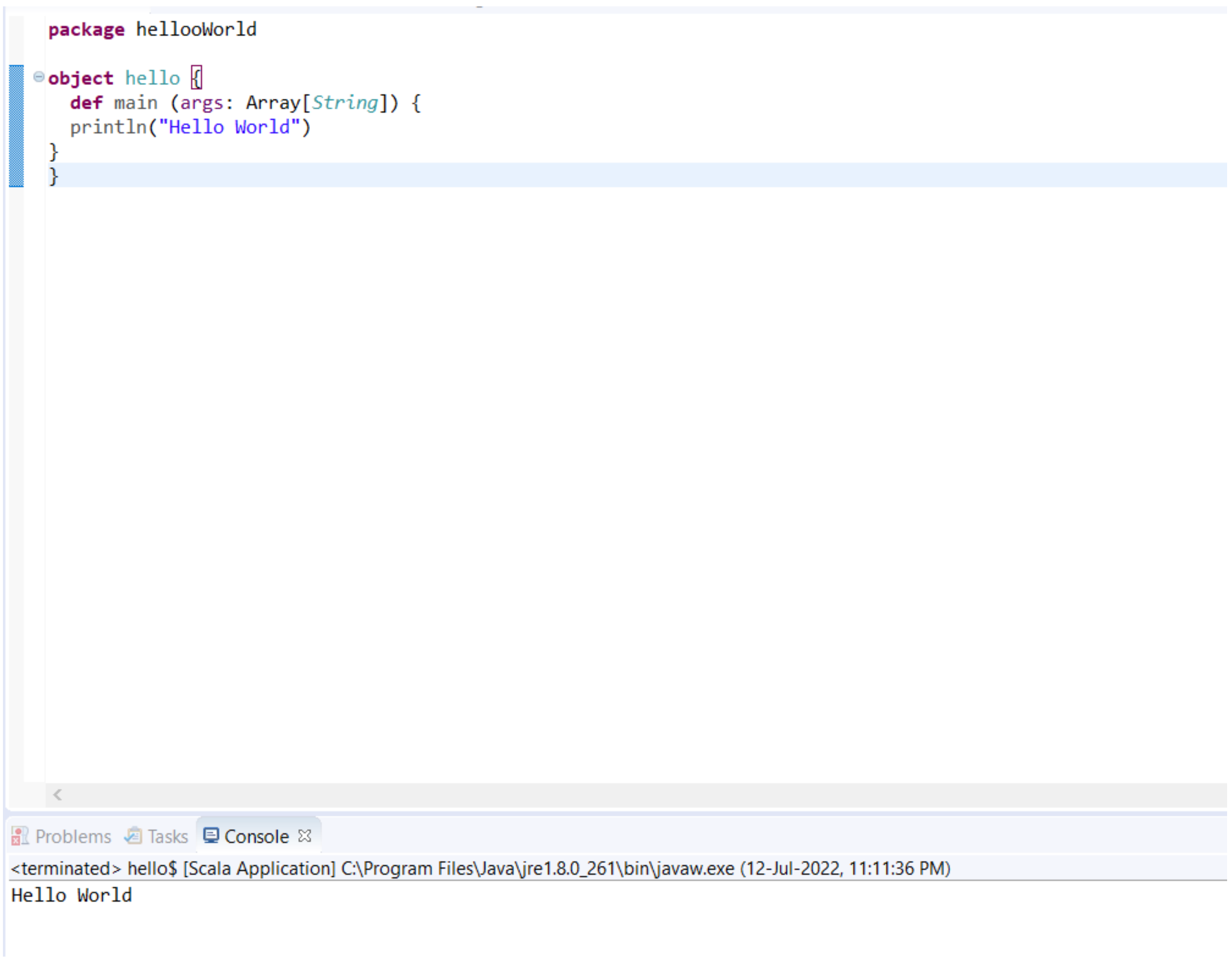
9. Program to print word count on scala shell and print "Hello world" on scala IDE

```
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> 
```



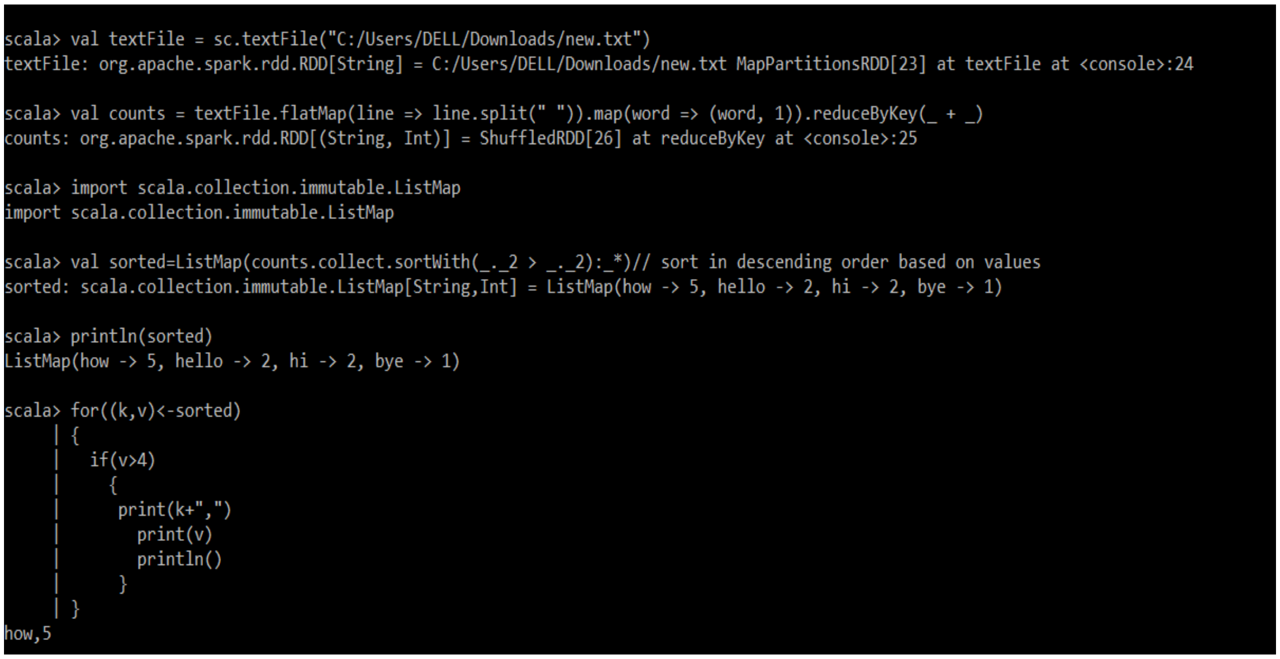
```
package hellooWorld

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
```