VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Big Data Analytics (23CS6PCBDA)

Submitted by

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

B.M.S. COLLEGE OF ENGINEERING
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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 (23CS6PCBDA)**" carried out by **Nithin Koushik PV(1BM22CS185),** 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 - (23CS6PCBDA)** work prescribed for the said degree.

Prof. Vikranth BM	**Dr. Kavitha Sooda**
Assistant Professor	Professor and HoD of CSE
BMSCE, Bengaluru	BMSCE, Bengaluru

Index Sheet

7	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
8	Write a Scala program to print numbers from 1 to 100 using for loop.	30

9	Using RDD and FlatMap 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.	31

Course Outcome

CO 1	Apply the concept of NoSQL, Hadoop or Spark for a given task
CO 2	Analyze big data analytics mechanisms that can be applied to obtain solution for a given problem.
CO 3	Design and implement solutions using data analytics mechanisms for a given problem.

Experiment-1

Q) MongoDB- CRUD Operations Demonstration (Practice and Self Study)

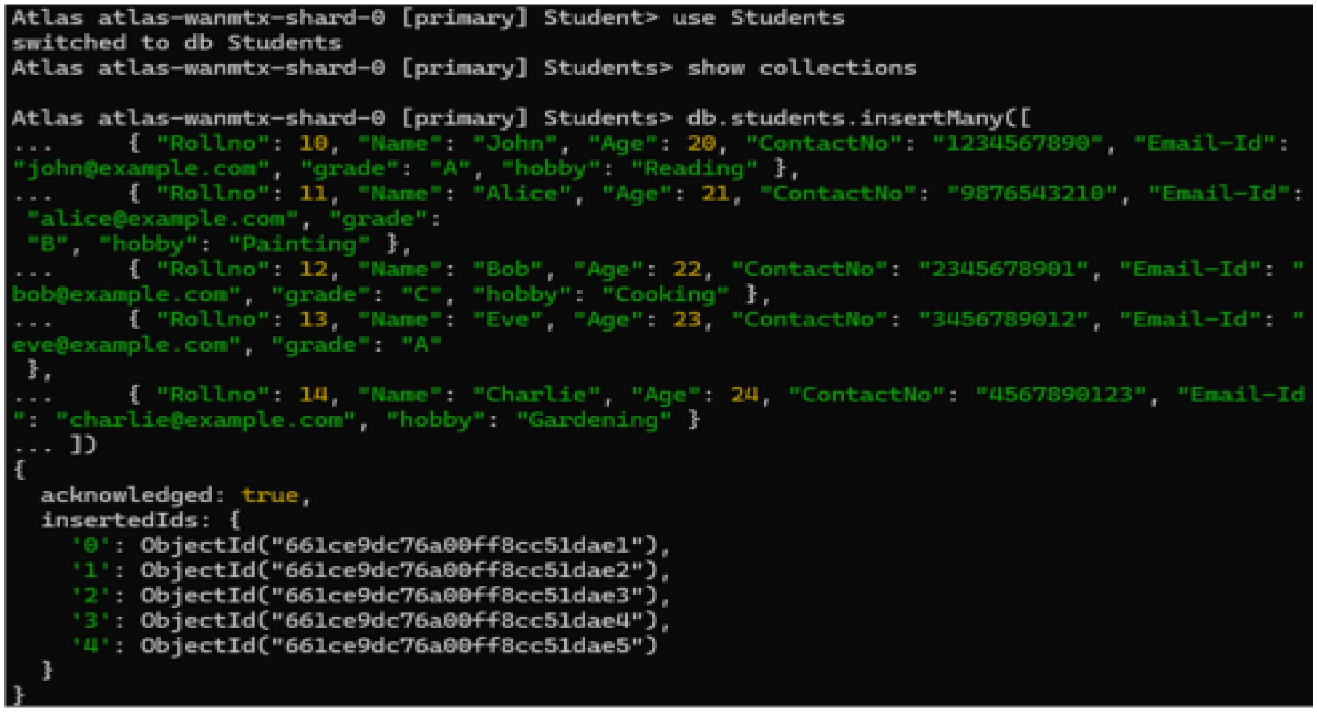
Code & Output:

1. **Create a database “Student” with the following attributes Rollno, Name , Age, ContactNo, Email-Id, grade, hobby:**

```
use Students;
```

2. **Insert 5 appropriate values according to the below queries.**

```
db.students.insertMany([

{ "Rollno": 10, "Name": "John", "Age": 20, "ContactNo": "1234567890",
"Email-Id": "john@example.com", "grade": "A", "hobby": "Reading" },

{ "Rollno": 11, "Name": "Alice", "Age": 21, "ContactNo": "9876543210",
"Email-Id": "alice@example.com", "grade": "B", "hobby": "Painting" },

{ "Rollno": 12, "Name": "Bob", "Age": 22, "ContactNo": "2345678901", "Email-Id":
"bob@example.com", "grade": "C", "hobby": "Cooking" },

{ "Rollno": 13, "Name": "Eve", "Age": 23, "ContactNo": "3456789012", "Email-Id":
"eve@example.com", "grade": "A" },

{ "Rollno": 14, "Name": "Charlie", "Age": 24, "ContactNo": "4567890123",
"Email-Id": "charlie@example.com", "hobby": "Gardening" }
```



```
Atlas atlas-wanmtx-shard-0 [primary] Student> use Students
switched to db Students
Atlas atlas-wanmtx-shard-0 [primary] Students> show collections

Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.insertMany([
...     { "Rollno": 10, "Name": "John", "Age": 20, "ContactNo": "1234567890", "Email-Id":
"john@example.com", "grade": "A", "hobby": "Reading" },
...     { "Rollno": 11, "Name": "Alice", "Age": 21, "ContactNo": "9876543210", "Email-Id":
 "alice@example.com", "grade":
 "B", "hobby": "Painting" },
...     { "Rollno": 12, "Name": "Bob", "Age": 22, "ContactNo": "2345678901", "Email-Id": "
bob@example.com", "grade": "C", "hobby": "Cooking" },
...     { "Rollno": 13, "Name": "Eve", "Age": 23, "ContactNo": "3456789012", "Email-Id": "
eve@example.com", "grade": "A"
 },
...     { "Rollno": 14, "Name": "Charlie", "Age": 24, "ContactNo": "4567890123", "Email-Id
": "charlie@example.com", "hobby": "Gardening" }
... ])
{
  acknowledged: true,
  insertedIds: {
    '0': ObjectId("661ce9dc76a00ff8cc51dae1"),
    '1': ObjectId("661ce9dc76a00ff8cc51dae2"),
    '2': ObjectId("661ce9dc76a00ff8cc51dae3"),
    '3': ObjectId("661ce9dc76a00ff8cc51dae4"),
    '4': ObjectId("661ce9dc76a00ff8cc51dae5")
  }
}
```

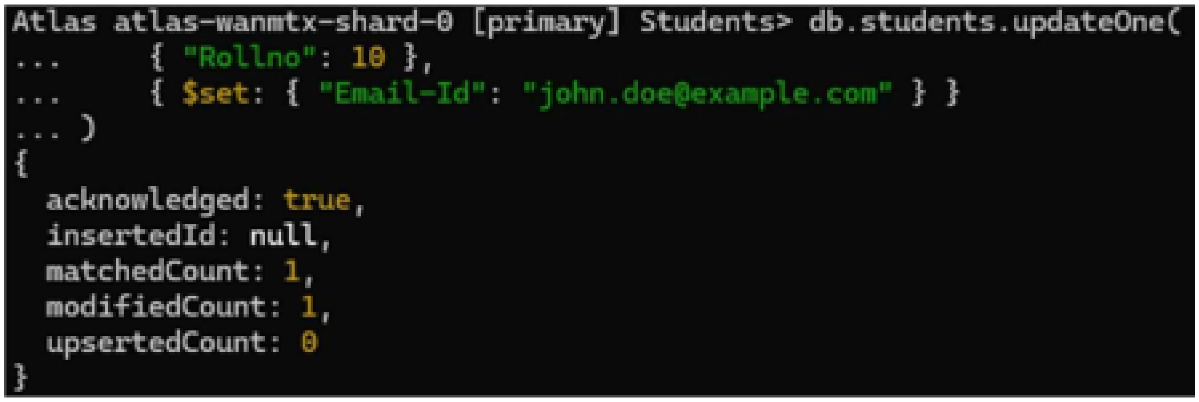
3. Write query to update Email-Id of a student with rollno 10.

db.students.updateOne(

{ "Rollno": 10 },

{ $set: { "Email-Id": "john.doe@example.com" } }

)



```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.updateOne(
...     { "Rollno": 10 },
...     { $set: { "Email-Id": "john.doe@example.com" } }
... )
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
```

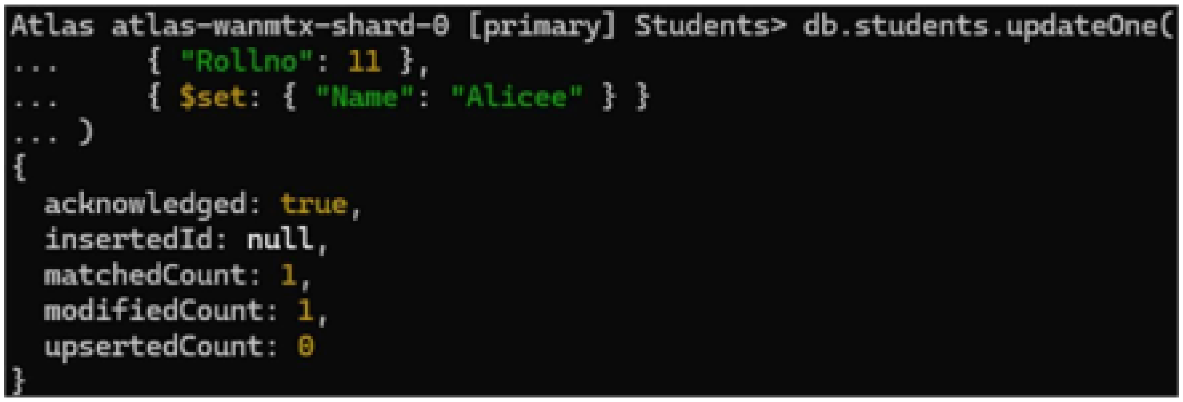
4. Replace the student name from “Alice” to “Alicee” of rollno 11

db.students.updateOne(

{ "Rollno": 11 },

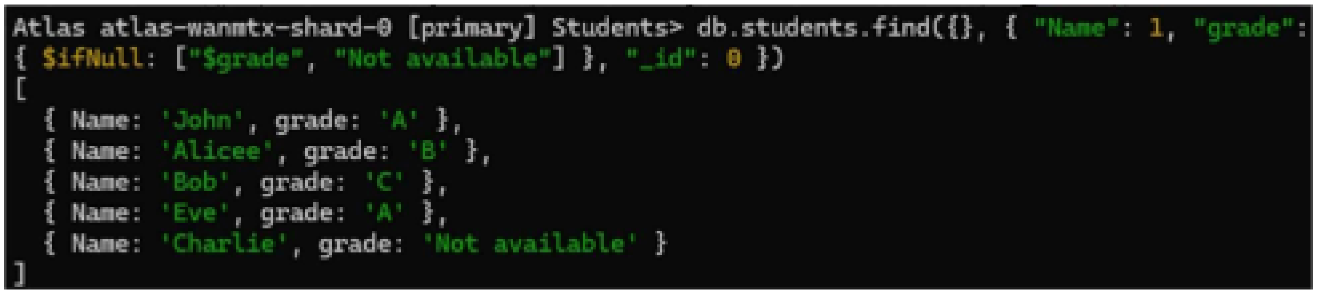
{ $set: { "Name": "Alicee" } }

)


```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.updateOne(
...     { "Rollno": 11 },
...     { $set: { "Name": "Alicee" } }
... )
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
```

5. Display Student Name and grade(Add if grade is not present)where the _id column is 1.

db.students.find({}, { "Name": 1, "grade": { $ifNull: ["$grade", "Not available"] }, "_id": 0 })


```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.find({}, { "Name": 1, "grade":
{ $ifNull: ["$grade", "Not available"] }, "_id": 0 })
[
  { Name: 'John', grade: 'A' },
  { Name: 'Alicee', grade: 'B' },
  { Name: 'Bob', grade: 'C' },
  { Name: 'Eve', grade: 'A' },
  { Name: 'Charlie', grade: 'Not available' }
]
```

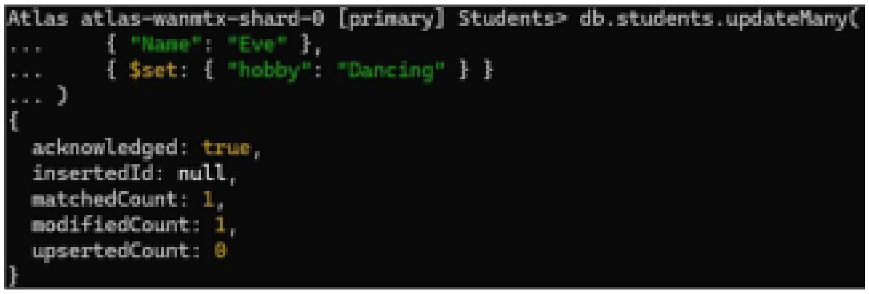
6. Update to add hobbies

db.students.updateMany(

{ "Name": "Eve" },

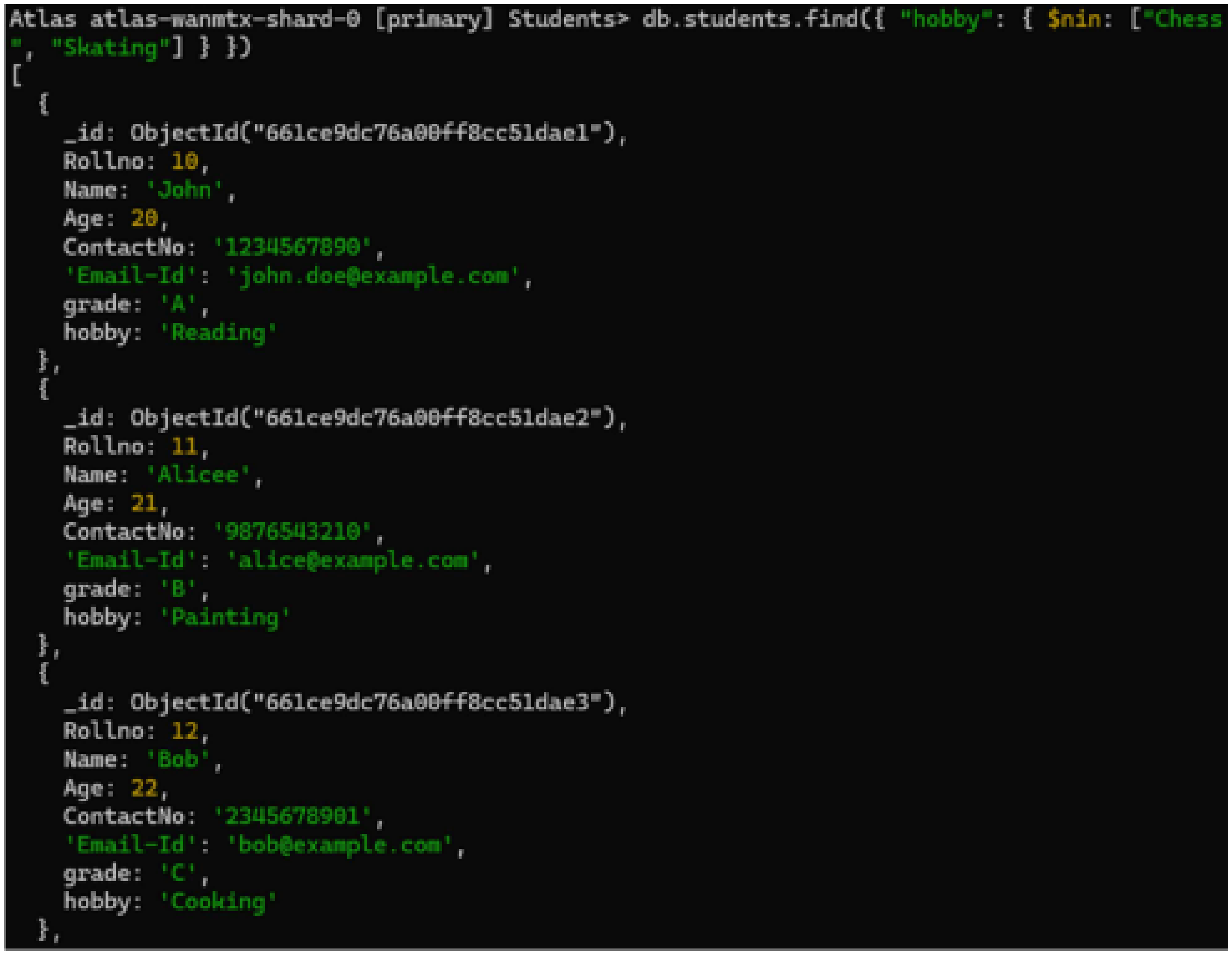
{ $set: { "hobby": "Dancing" } }

)


```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.updateMany(
...     { "Name": "Eve" },
...     { $set: { "hobby": "Dancing" } }
... )
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
```

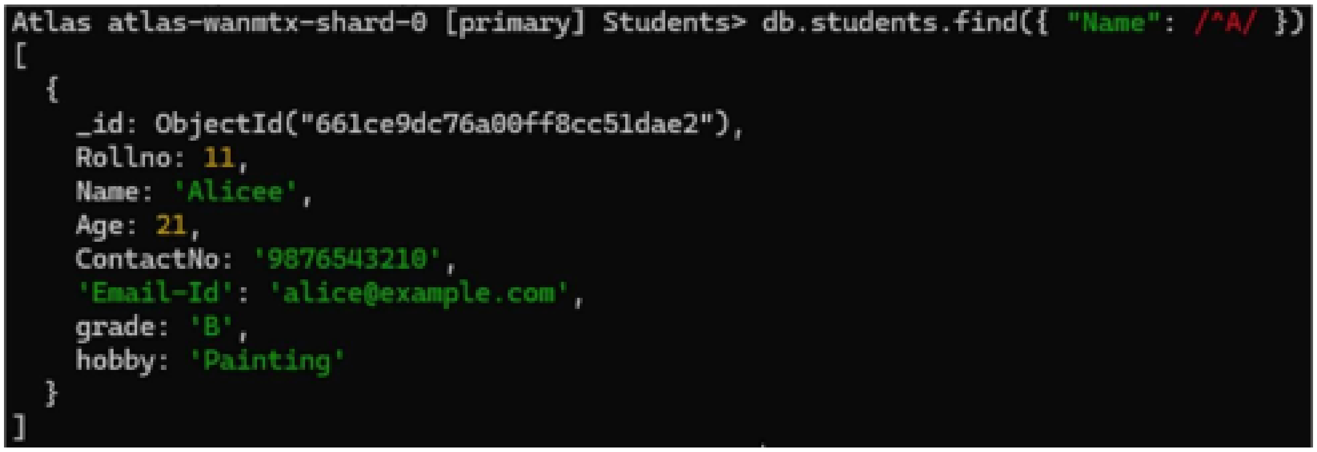
7. Find documents where hobbies is set neither to Chess nor to Skating

db.students.find({ "hobby": { $nin: ["Chess", "Skating"] } })


```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.find({ "hobby": { $nin: ["Chess
", "Skating"] } })
[
  {
    _id: ObjectId("661ce9dc76a00ff8cc51dae1"),
    Rollno: 10,
    Name: 'John',
    Age: 20,
    ContactNo: '1234567890',
    'Email-Id': 'john.doe@example.com',
    grade: 'A',
    hobby: 'Reading'
  },
  {
    _id: ObjectId("661ce9dc76a00ff8cc51dae2"),
    Rollno: 11,
    Name: 'Alicee',
    Age: 21,
    ContactNo: '9876543210',
    'Email-Id': 'alice@example.com',
    grade: 'B',
    hobby: 'Painting'
  },
  {
    _id: ObjectId("661ce9dc76a00ff8cc51dae3"),
    Rollno: 12,
    Name: 'Bob',
    Age: 22,
    ContactNo: '2345678901',
    'Email-Id': 'bob@example.com',
    grade: 'C',
    hobby: 'Cooking'
  },
```

8. Find documents whose name begins with A

db.students.find({ "Name": /^A/ })


```
Atlas atlas-wanmtx-shard-0 [primary] Students> db.students.find({ "Name": /^A/ })
[
  {
    _id: ObjectId("661ce9dc76a00ff8cc51dae2"),
    Rollno: 11,
    Name: 'Alicee',
    Age: 21,
    ContactNo: '9876543210',
    'Email-Id': 'alice@example.com',
    grade: 'B',
    hobby: 'Painting'
  }
]
```

Experiment – 2

Q) Perform the following DB operations using Cassandra

a) Create a keyspace by name **Employee**

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

c) Insert the values into the table in **batch**

d) Update Employee name and Department of **Emp-Id 121**

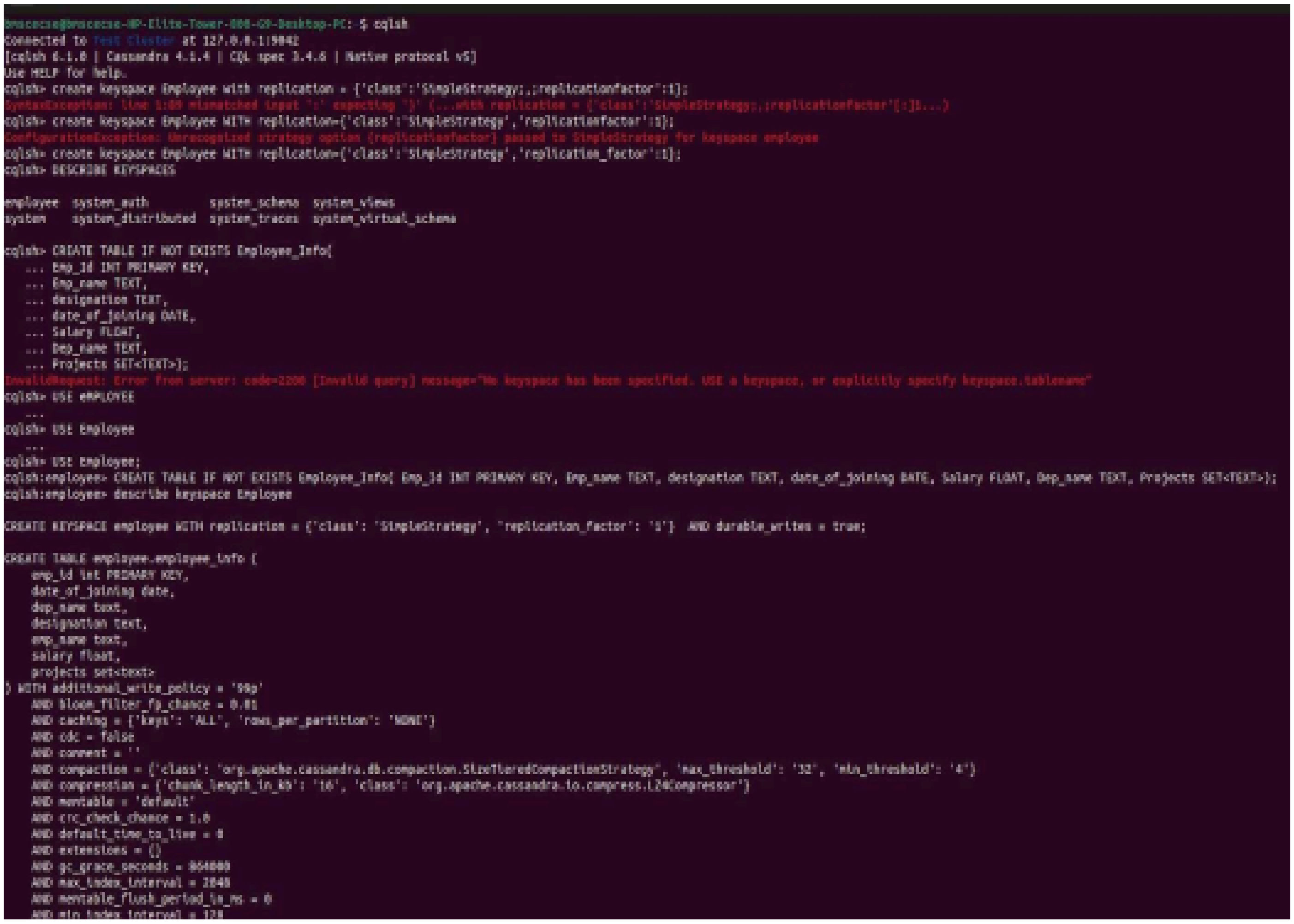
e) Sort the details of Employee records based on **salary**

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

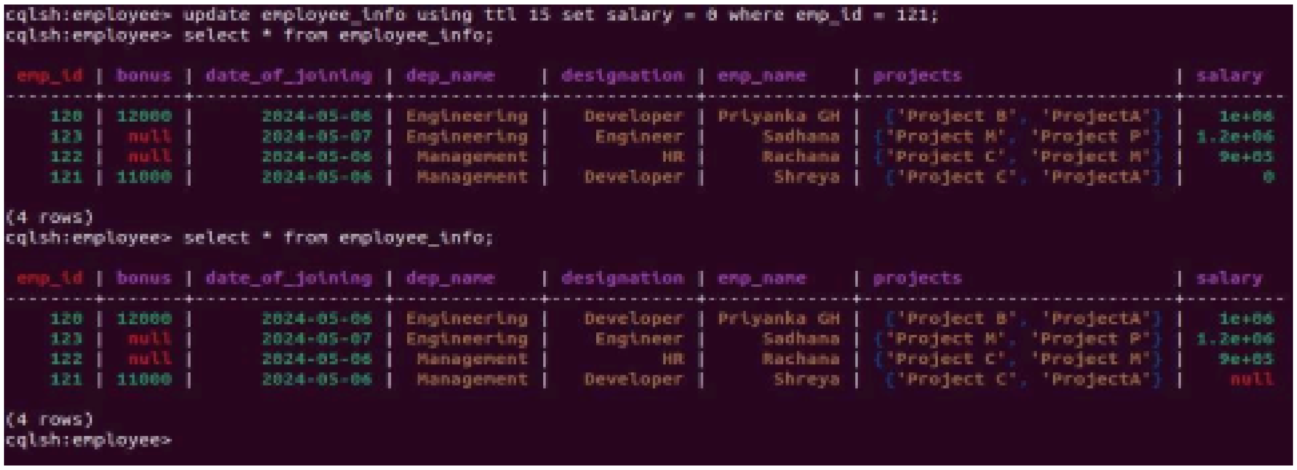
g) Update the altered table to **add project names**

h) Create a **TTL of 15 seconds** to display the values of Employees

Code & Output:

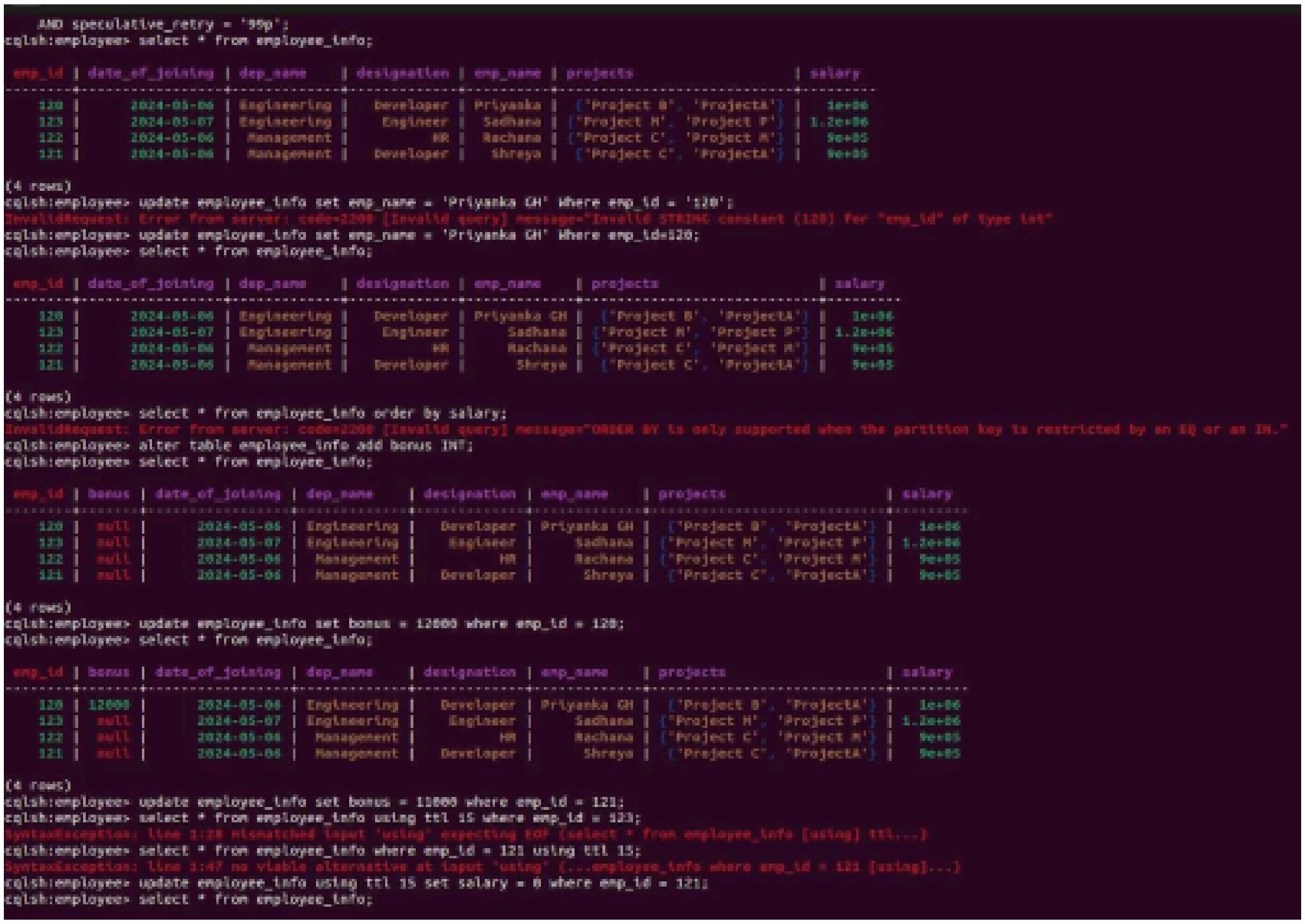


```
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.1.0 | Cassandra 4.1.4 | CQL spec 3.4.6 | Native protocol v5]
Use HELP for help.
cqlsh> create keyspace Employee with replication = {'class':'SimpleStrategy;,;replicationfactor':1};
SyntaxException: line 1:89 mismatched input ':' expecting '}' (...with replication = {'class':'SimpleStrategy;,;replicationfactor'[:]1...)
cqlsh> create keyspace Employee WITH replication={'class':'SimpleStrategy','replicationfactor':1};
ConfigurationException: Unrecognized strategy option {replicationfactor} passed to SimpleStrategy for keyspace employee
cqlsh> create keyspace Employee WITH replication={'class':'SimpleStrategy','replication_factor':1};
cqlsh> DESCRIBE KEYSPACES

employee  system_auth         system_schema  system_views
system    system_distributed  system_traces  system_virtual_schema

cqlsh> CREATE TABLE IF NOT EXISTS Employee_Info(
   ... Emp_id INT PRIMARY KEY,
   ... Emp_name TEXT,
   ... designation TEXT,
   ... date_of_joining DATE,
   ... Salary FLOAT,
   ... Dep_name TEXT,
   ... Projects SET<TEXT>);
InvalidRequest: Error from server: code=2200 [Invalid query] message="No keyspace has been specified. USE a keyspace, or explicitly specify keyspace.tablename"
cqlsh> USE eMPLOYEE
   ...
cqlsh> USE Employee
   ...
cqlsh> USE Employee;
cqlsh:employee> CREATE TABLE IF NOT EXISTS Employee_Info( Emp_id INT PRIMARY KEY, Emp_name TEXT, designation TEXT, date_of_joining DATE, Salary FLOAT, Dep_name TEXT, Projects SET<TEXT>);
cqlsh:employee> describe keyspace Employee

CREATE KEYSPACE employee WITH replication = {'class': 'SimpleStrategy', 'replication_factor': '1'}  AND durable_writes = true;

CREATE TABLE employee.employee_info (
    emp_id int PRIMARY KEY,
    date_of_joining date,
    dep_name text,
    designation text,
    emp_name text,
    salary float,
    projects set<text>
) WITH additional_write_policy = '99p'
    AND bloom_filter_fp_chance = 0.01
    AND caching = {'keys': 'ALL', 'rows_per_partition': 'NONE'}
    AND cdc = false
    AND comment = ''
    AND compaction = {'class': 'org.apache.cassandra.db.compaction.SizeTieredCompactionStrategy', 'max_threshold': '32', 'min_threshold': '4'}
    AND compression = {'chunk_length_in_kb': '16', 'class': 'org.apache.cassandra.io.compress.LZ4Compressor'}
    AND memtable = 'default'
    AND crc_check_chance = 1.0
    AND default_time_to_live = 0
    AND extensions = {}
    AND gc_grace_seconds = 864000
    AND max_index_interval = 2048
    AND memtable_flush_period_in_ms = 0
    AND min_index_interval = 128
```



```
cqlsh:employee> update employee_info using ttl 15 set salary = 0 where emp_id = 121;
cqlsh:employee> select * from employee_info;

 emp_id | bonus | date_of_joining | dep_name    | designation | emp_name    | projects                     | salary
--------+-------+-----------------+-------------+-------------+-------------+------------------------------+---------
    120 | 12000 |      2024-05-06 | Engineering |   Developer | Priyanka GH |  {'Project B', 'ProjectA'}  |   1e+06
    123 |  null |      2024-05-07 | Engineering |    Engineer |     Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |  null |      2024-05-06 |  Management |          HR |     Rachana | {'Project C', 'Project M'} |   9e+05
    121 | 11000 |      2024-05-06 |  Management |   Developer |      Shreya |  {'Project C', 'ProjectA'}  |       0

(4 rows)
cqlsh:employee> select * from employee_info;

 emp_id | bonus | date_of_joining | dep_name    | designation | emp_name    | projects                     | salary
--------+-------+-----------------+-------------+-------------+-------------+------------------------------+---------
    120 | 12000 |      2024-05-06 | Engineering |   Developer | Priyanka GH |  {'Project B', 'ProjectA'}  |   1e+06
    123 |  null |      2024-05-07 | Engineering |    Engineer |     Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |  null |      2024-05-06 |  Management |          HR |     Rachana | {'Project C', 'Project M'} |   9e+05
    121 | 11000 |      2024-05-06 |  Management |   Developer |      Shreya |  {'Project C', 'ProjectA'}  |    null

(4 rows)
cqlsh:employee>
```

\



```
    AND speculative_retry = '99p';
cqlsh:employee> select * from employee_info;

 emp_id | date_of_joining | dep_name    | designation | emp_name | projects                     | salary
--------+-----------------+-------------+-------------+----------+------------------------------+---------
    120 |      2024-05-06 | Engineering |   Developer | Priyanka |  {'Project B', 'ProjectA'}  |   1e+06
    123 |      2024-05-07 | Engineering |    Engineer |  Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |      2024-05-06 |  Management |          HR |  Rachana | {'Project C', 'Project M'} |   9e+05
    121 |      2024-05-06 |  Management |   Developer |   Shreya |  {'Project C', 'ProjectA'}  |   9e+05

(4 rows)
cqlsh:employee> update employee_info set emp_name = 'Priyanka GH' Where emp_id = '120';
InvalidRequest: Error from server: code=2200 [Invalid query] message="Invalid STRING constant (120) for "emp_id" of type int"
cqlsh:employee> update employee_info set emp_name = 'Priyanka GH' Where emp_id=120;
cqlsh:employee> select * from employee_info;

 emp_id | date_of_joining | dep_name    | designation | emp_name    | projects                     | salary
--------+-----------------+-------------+-------------+-------------+------------------------------+---------
    120 |      2024-05-06 | Engineering |   Developer | Priyanka GH |  {'Project B', 'ProjectA'}  |   1e+06
    123 |      2024-05-07 | Engineering |    Engineer |     Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |      2024-05-06 |  Management |          HR |     Rachana | {'Project C', 'Project M'} |   9e+05
    121 |      2024-05-06 |  Management |   Developer |      Shreya |  {'Project C', 'ProjectA'}  |   9e+05

(4 rows)
cqlsh:employee> select * from employee_info order by salary;
InvalidRequest: Error from server: code=2200 [Invalid query] message="ORDER BY is only supported when the partition key is restricted by an EQ or an IN."
cqlsh:employee> alter table employee_info add bonus INT;
cqlsh:employee> select * from employee_info;

 emp_id | bonus | date_of_joining | dep_name    | designation | emp_name    | projects                     | salary
--------+-------+-----------------+-------------+-------------+-------------+------------------------------+---------
    120 |  null |      2024-05-06 | Engineering |   Developer | Priyanka GH |  {'Project B', 'ProjectA'}  |   1e+06
    123 |  null |      2024-05-07 | Engineering |    Engineer |     Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |  null |      2024-05-06 |  Management |          HR |     Rachana | {'Project C', 'Project M'} |   9e+05
    121 |  null |      2024-05-06 |  Management |   Developer |      Shreya |  {'Project C', 'ProjectA'}  |   9e+05

(4 rows)
cqlsh:employee> update employee_info set bonus = 12000 where emp_id = 120;
cqlsh:employee> select * from employee_info;

 emp_id | bonus | date_of_joining | dep_name    | designation | emp_name    | projects                     | salary
--------+-------+-----------------+-------------+-------------+-------------+------------------------------+---------
    120 | 12000 |      2024-05-06 | Engineering |   Developer | Priyanka GH |  {'Project B', 'ProjectA'}  |   1e+06
    123 |  null |      2024-05-07 | Engineering |    Engineer |     Sadhana | {'Project M', 'Project P'} | 1.2e+06
    122 |  null |      2024-05-06 |  Management |          HR |     Rachana | {'Project C', 'Project M'} |   9e+05
    121 |  null |      2024-05-06 |  Management |   Developer |      Shreya |  {'Project C', 'ProjectA'}  |   9e+05

(4 rows)
cqlsh:employee> update employee_info set bonus = 11000 where emp_id = 121;
cqlsh:employee> select * from employee_info using ttl 15 where emp_id = 123;
SyntaxException: line 1:28 mismatched input 'using' expecting EOF (select * from employee_info [using] ttl...)
cqlsh:employee> select * from employee_info where emp_id = 121 using ttl 15;
SyntaxException: line 1:47 no viable alternative at input 'using' (...employee_info where emp_id = 121 [using]...)
cqlsh:employee> update employee_info using ttl 15 set salary = 0 where emp_id = 121;
cqlsh:employee> select * from employee_info;
```

Experiment – 3

Q) Perform the following DB operations using Cassandra

a) Create a keyspace by name **Library**

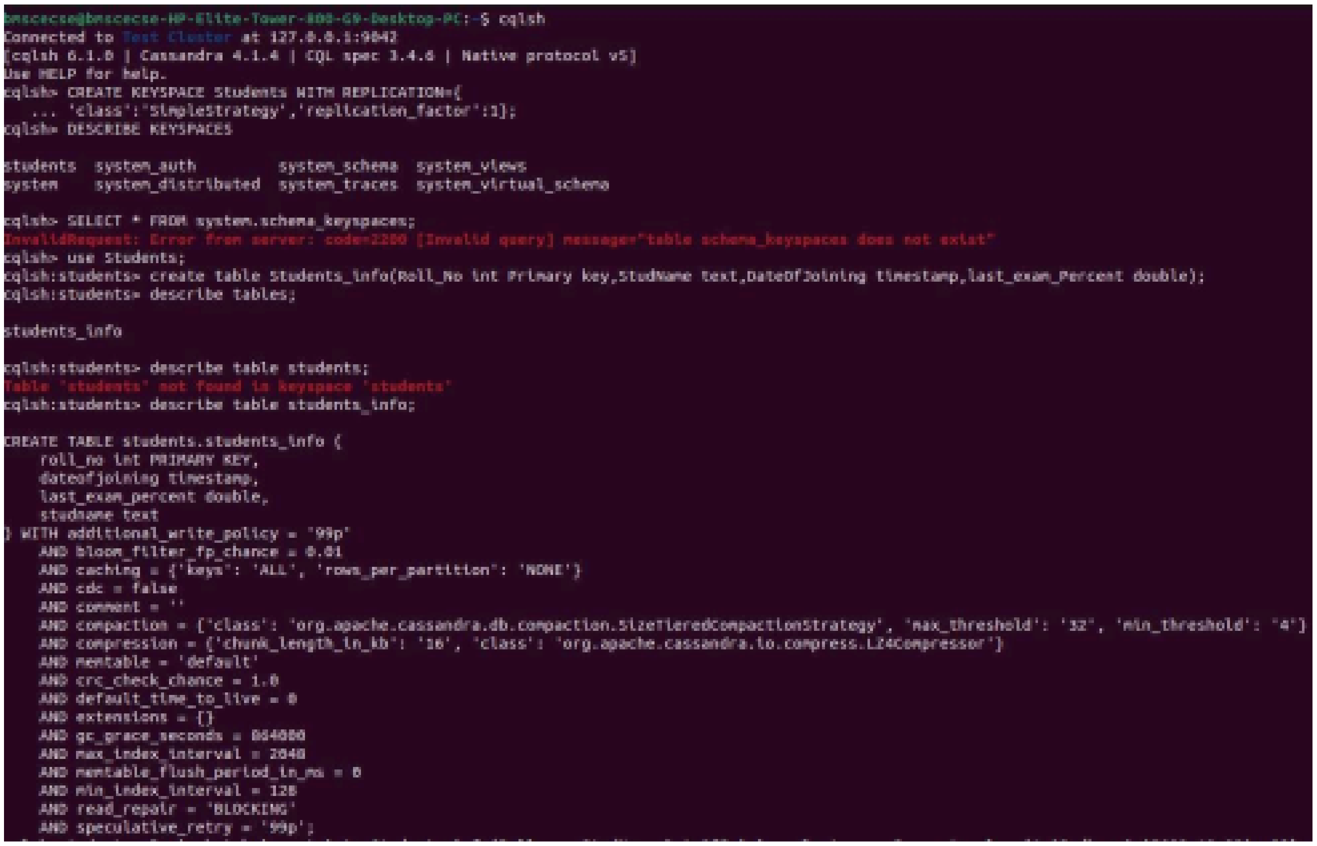
b) Create a column family by name **Library-Info** with attributes
Stud_Id Primary Key,
Counter_value of type **Counter**,
Stud_Name, **Book-Name**, **Book-Id**,
Date_of_issue

c) Insert the values into the table in **batch**

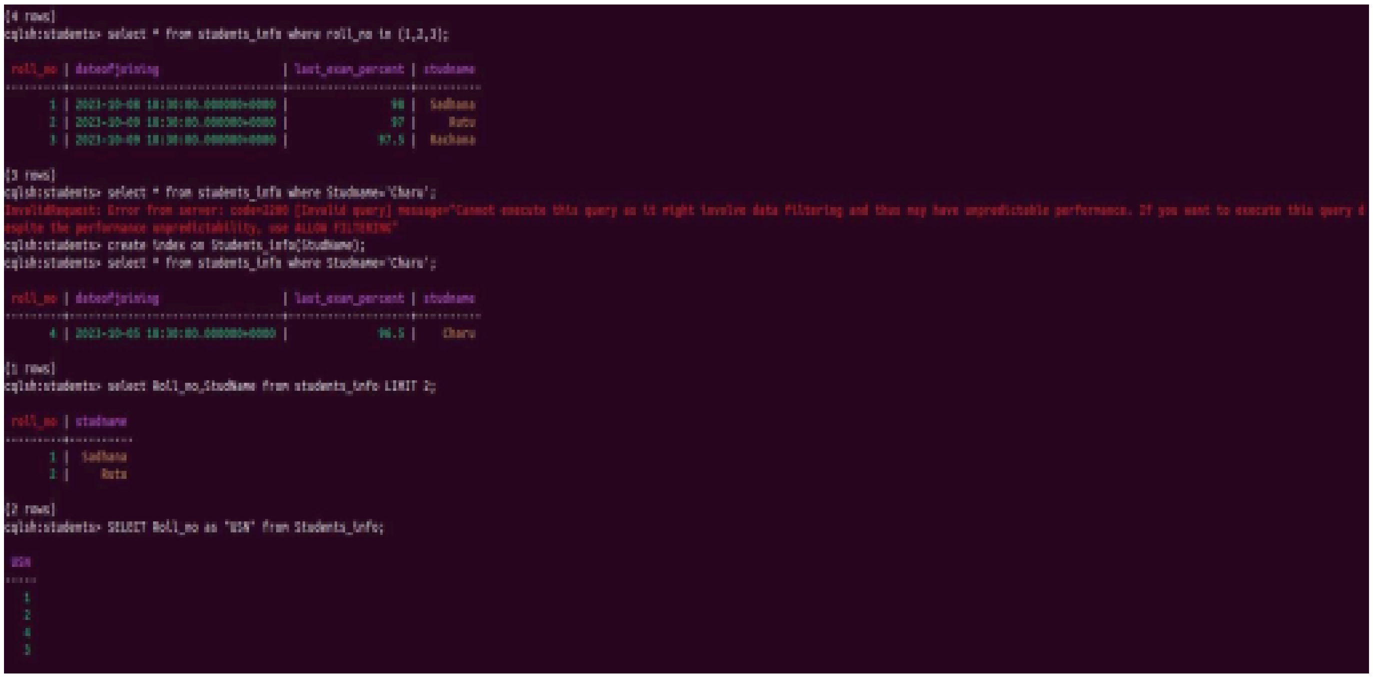
d) Display the details of the table created and **increase the value of the counter**

e) Write a query to show that a student with **id 112** has taken a book **"BDA" 2 times** f) **Export** the created column to a **CSV file**

g) **Import** a given CSV dataset from **local file system** into Cassandra **column family** Code & Output:



```
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ cqlsh
Connected to Test Cluster at 127.0.0.1:9042
[cqlsh 6.1.0 | Cassandra 4.1.4 | CQL spec 3.4.6 | Native protocol v5]
Use HELP for help.
cqlsh> CREATE KEYSPACE Students WITH REPLICATION={
   ... 'class':'SimpleStrategy','replication_factor':1};
cqlsh> DESCRIBE KEYSPACES

students  system_auth         system_schema  system_views
system    system_distributed  system_traces  system_virtual_schema

cqlsh> SELECT * FROM system.schema_keyspaces;
InvalidRequest: Error from server: code=2200 [Invalid query] message="table schema_keyspaces does not exist"
cqlsh> use Students;
cqlsh:students> create table Students_info(Roll_No int Primary key,StudName text,DateOfJoining timestamp,last_exam_Percent double);
cqlsh:students> describe tables;

students_info

cqlsh:students> describe table students;
Table 'students' not found in keyspace 'students'
cqlsh:students> describe table students_info;

CREATE TABLE students.students_info (
    roll_no int PRIMARY KEY,
    dateofjoining timestamp,
    last_exam_percent double,
    studname text
) WITH additional_write_policy = '99p'
    AND bloom_filter_fp_chance = 0.01
    AND caching = {'keys': 'ALL', 'rows_per_partition': 'NONE'}
    AND cdc = false
    AND comment = ''
    AND compaction = {'class': 'org.apache.cassandra.db.compaction.SizeTieredCompactionStrategy', 'max_threshold': '32', 'min_threshold': '4'}
    AND compression = {'chunk_length_in_kb': '16', 'class': 'org.apache.cassandra.io.compress.LZ4Compressor'}
    AND memtable = 'default'
    AND crc_check_chance = 1.0
    AND default_time_to_live = 0
    AND extensions = {}
    AND gc_grace_seconds = 864000
    AND max_index_interval = 2048
    AND memtable_flush_period_in_ms = 0
    AND min_index_interval = 128
    AND read_repair = 'BLOCKING'
    AND speculative_retry = '99p';
```

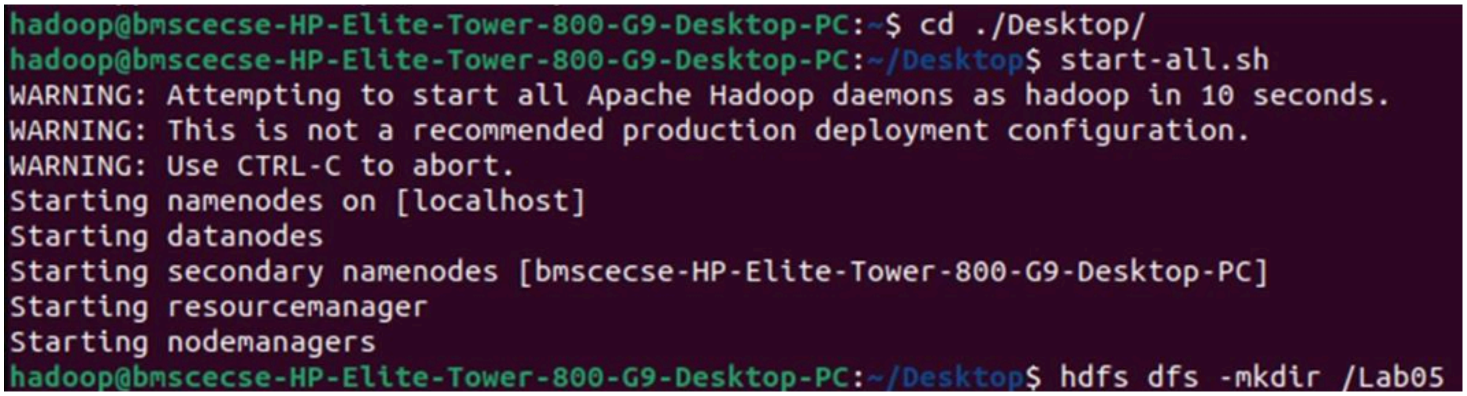


```
(4 rows)
cqlsh:students> select * from students_info where roll_no in (1,2,3);

 roll_no | dateofjoining                   | last_exam_percent | studname
---------+---------------------------------+-------------------+----------
       1 | 2023-10-08 18:30:00.000000+0000 |                98 |  Sadhana
       2 | 2023-10-09 18:30:00.000000+0000 |                97 |     Rutu
       3 | 2023-10-09 18:30:00.000000+0000 |              97.5 |  Rachana

(3 rows)
cqlsh:students> select * from students_info where Studname='Charu';
InvalidRequest: Error from server: code=2200 [Invalid query] message="Cannot execute this query as it might involve data filtering and thus may have unpredictable performance. If you want to execute this query d
espite the performance unpredictability, use ALLOW FILTERING"
cqlsh:students> create index on Students_info(StudName);
cqlsh:students> select * from students_info where Studname='Charu';

 roll_no | dateofjoining                   | last_exam_percent | studname
---------+---------------------------------+-------------------+----------
       4 | 2023-10-05 18:30:00.000000+0000 |              96.5 |    Charu

(1 rows)
cqlsh:students> select Roll_no,StudName from students_info LIMIT 2;

 roll_no | studname
---------+----------
       1 |  Sadhana
       2 |     Rutu

(2 rows)
cqlsh:students> SELECT Roll_no as "USN" from Students_info;

 USN
-----
   1
   2
   4
   3
```

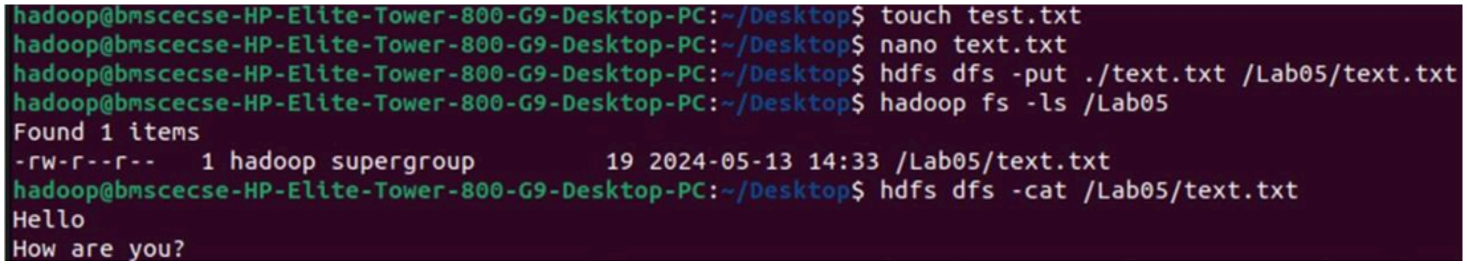
Experiment - 4

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

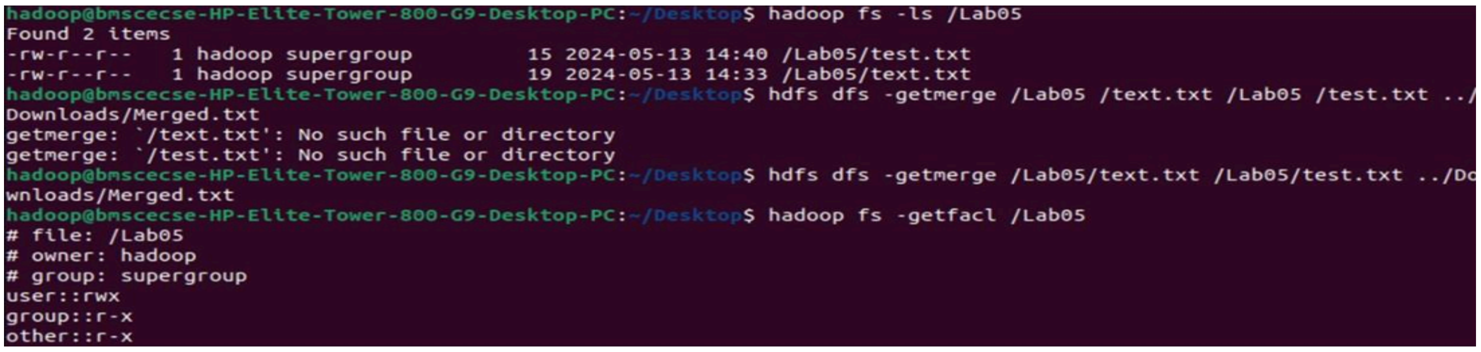
Code & Output:



```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ cd ./Desktop/
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ 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:~/Desktop$ hdfs dfs -mkdir /Lab05
```



```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ touch test.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ nano text.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -put ./text.txt /Lab05/text.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -ls /Lab05
Found 1 items
-rw-r--r--   1 hadoop supergroup         19 2024-05-13 14:33 /Lab05/text.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -cat /Lab05/text.txt
Hello
How are you?
```



```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -ls /Lab05
Found 2 items
-rw-r--r--   1 hadoop supergroup         15 2024-05-13 14:40 /Lab05/test.txt
-rw-r--r--   1 hadoop supergroup         19 2024-05-13 14:33 /Lab05/text.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -getmerge /Lab05 /text.txt /Lab05 /test.txt ../
Downloads/Merged.txt
getmerge: `/text.txt': No such file or directory
getmerge: `/test.txt': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -getmerge /Lab05/text.txt /Lab05/test.txt ../Do
wnloads/Merged.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -getfacl /Lab05
# file: /Lab05
# owner: hadoop
# group: supergroup
user::rwx
group::r-x
other::r-x
```

Experiment - 5

Q) Implement Wordcount program on Hadoop framework

Code & Output:

Mapper Code: WCMapper.java

java

CopyEdit

```
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: WCReducer.java

java

CopyEdit

```
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> {

 public void reduce(Text key, Iterator<IntWritable> value, OutputCollector<Text, IntWritable> output,
Reporter rep) throws IOException {

 int count = 0;

 while (value.hasNext()) {

 IntWritable i = value.next();

 count += i.get();

 }

 output.collect(key, new IntWritable(count));

 }

}
```

Driver Code: WCDriver.java

java

CopyEdit

```
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;
 }

 public static void main(String args[]) throws Exception {
 int exitCode = ToolRunner.run(new WCDriver(), args);
 System.out.println(exitCode);
 }
}
```

Input File -> big data hadoop big data analytics

```
            map reduce big data
```

Output:

```
(big, 1)
(data, 1)
(hadoop, 1)
(big, 1)
(data, 1)
(analytics, 1)
(map, 1)
(reduce, 1)
(big, 1)
(data, 1)
```

Experiment – 6

Q) From the following link extract the weather data
https://github.com/tomwhite/hadoopbook/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.

Code & Output:

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

AverageDriver.java

java

CopyEdit

```
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.java

java

CopyEdit

```
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.java

java

CopyEdit

```
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));
}
}
```

b) Find the mean max temperature for every month

MeanMaxDriver.java

java

CopyEdit

```
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.java

java

CopyEdit

```
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;
```

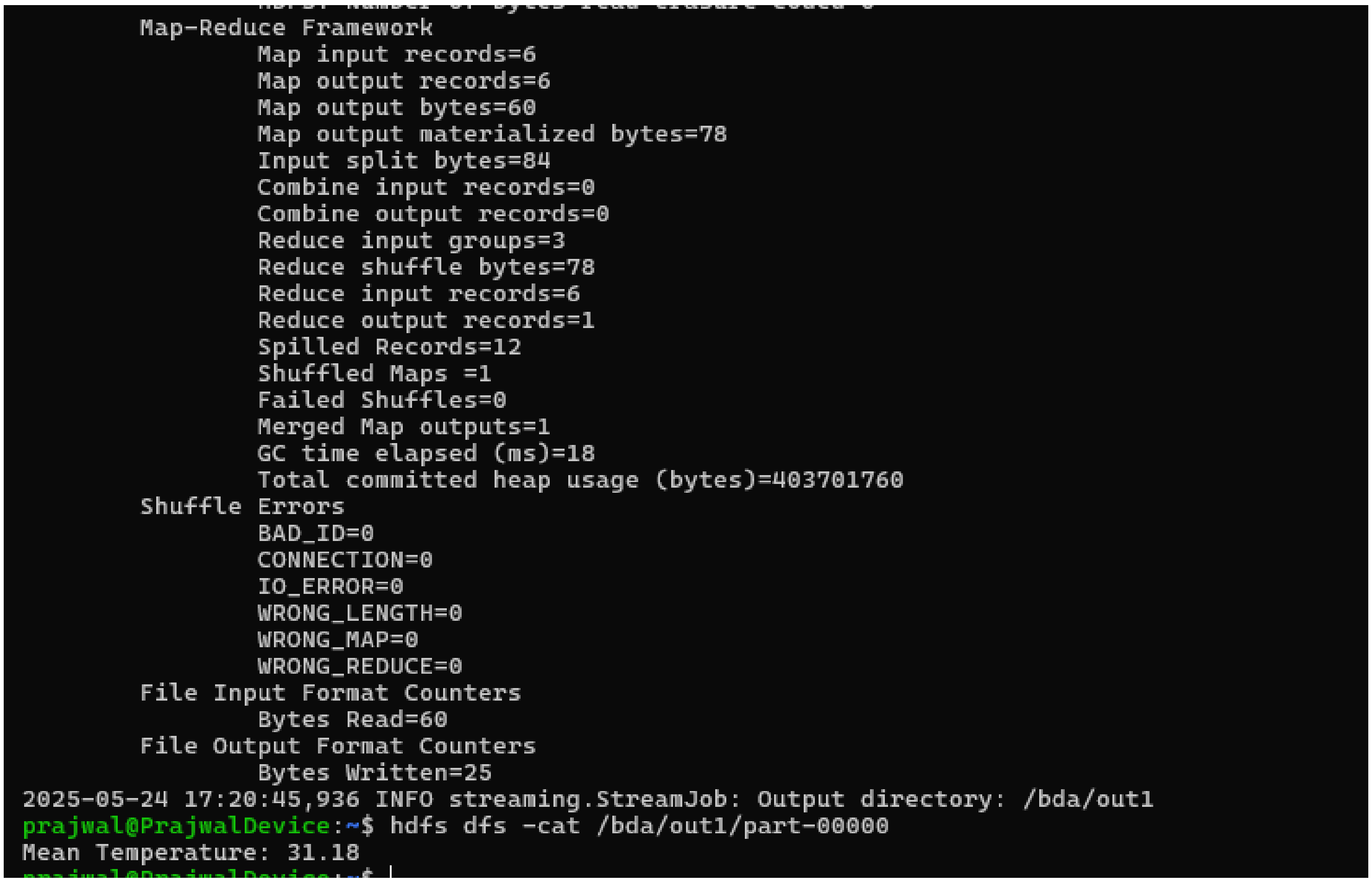
```
 public void map(LongWritable key, Text value,
 Mapper<LongWritable, Text, Text, IntWritable>.Context context)
 throws IOException, InterruptedException {

 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.java

java

CopyEdit

```
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> { 25
 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));
}
}
```



```
        Map-Reduce Framework
                Map input records=6
                Map output records=6
                Map output bytes=60
                Map output materialized bytes=78
                Input split bytes=84
                Combine input records=0
                Combine output records=0
                Reduce input groups=3
                Reduce shuffle bytes=78
                Reduce input records=6
                Reduce output records=1
                Spilled Records=12
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=18
                Total committed heap usage (bytes)=403701760
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=60
        File Output Format Counters
                Bytes Written=25
2025-05-24 17:20:45,936 INFO streaming.StreamJob: Output directory: /bda/out1
prajwal@PrajwalDevice:~$ hdfs dfs -cat /bda/out1/part-00000
Mean Temperature: 31.18
```

Experiment – 7

Q) 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.

Code & Output:

Top N Words Using MapReduce

TopN.java (Driver)

java

CopyEdit

```
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.java

java

CopyEdit

```
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.java

java

CopyEdit

```
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.java

java

CopyEdit

```
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));
 }
 }
```

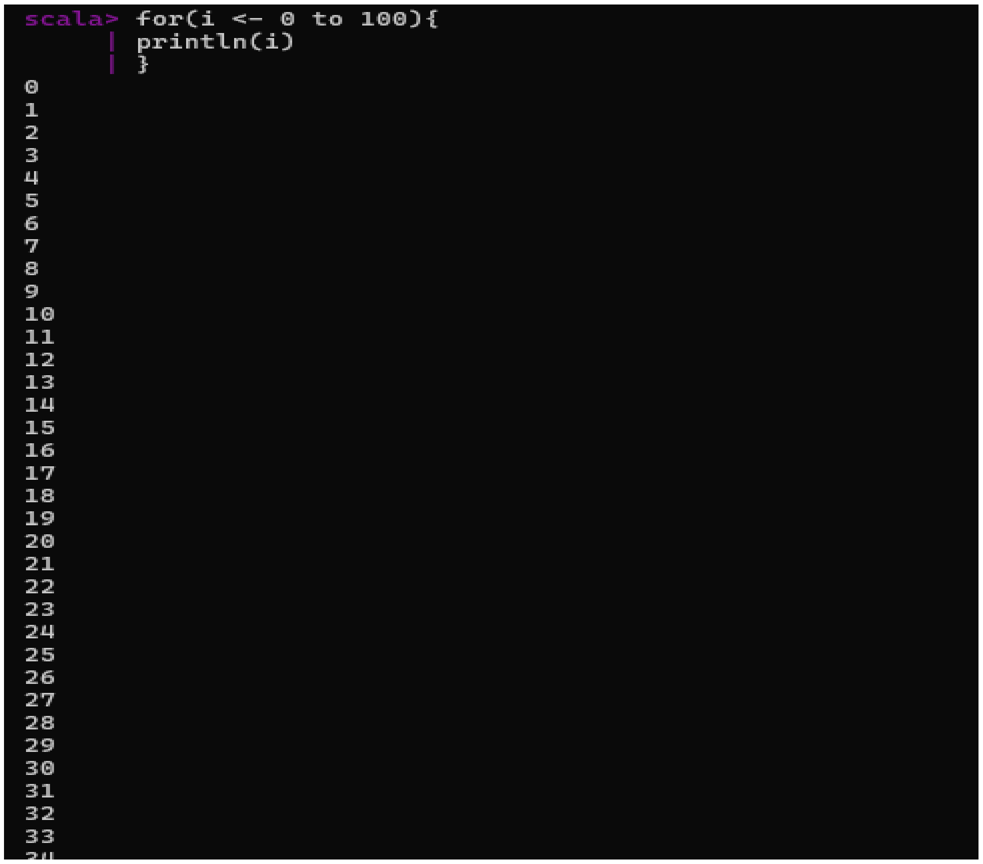
Experiment – 8

Q) Write a Scala program to print numbers from 1 to 100 using for loop.

Code

```
object PrintNumbers {
 def main(args: Array[String]): Unit = {
 for (i <- 1 to 100) {
 println(i)
 }
 }
}
```

Output:



```
scala> for(i <- 0 to 100){
     | println(i)
     | }
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
```

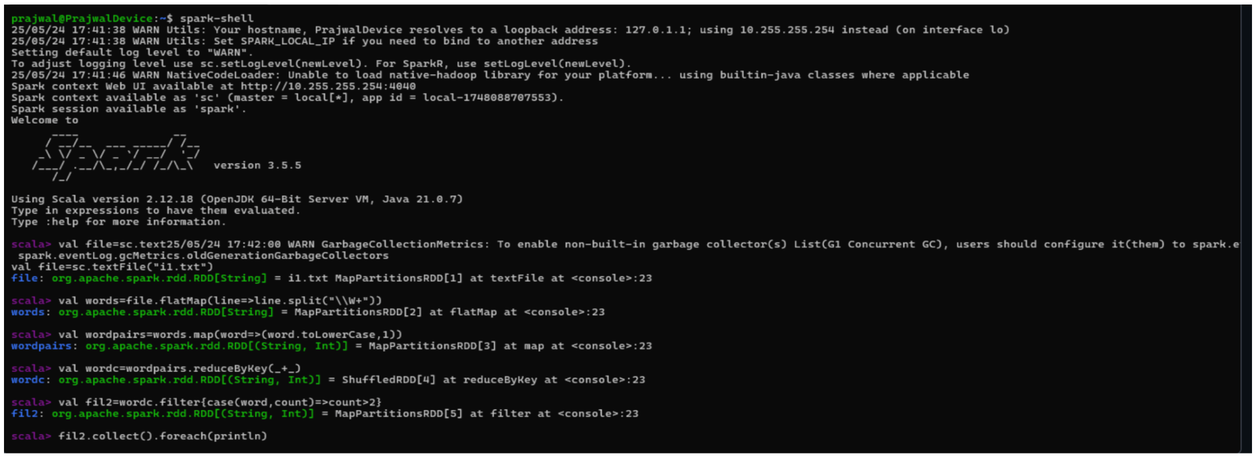
Experiment – 9

Q) Using RDD and FlatMap 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

Code:

```
from pyspark.sql import SparkSession

from pyspark.sql.functions import udf, col, trim, lower

from pyspark.sql.types import ArrayType, StringType

import nltk

from nltk.corpus import stopwords

from nltk.stem import WordNetLemmatizer


# Download nltk data (run once)

nltk.download('stopwords')

nltk.download('wordnet')


# Initialize Spark session

spark = SparkSession.builder \

 .appName("SimpleTextStreamingCleaning") \

 .getOrCreate()


# Set log level to WARN to reduce verbosity

spark.sparkContext.setLogLevel("WARN")


# Define host and port to listen for streaming text data

host = "localhost"

port = 9999

# Read streaming data from socket

lines = spark.readStream.format("socket") \
 .option("host", host) \
 .option("port", port) \
 .load()
# Convert each line to lowercase and trim whitespace
lines_cleaned = lines.select(trim(lower(col("value"))).alias("line"))
# Define stop words set
stop_words_set = set(stopwords.words('english'))
# Initialize lemmatizer
lemmatizer = WordNetLemmatizer()
# Define UDF for tokenization, stop words removal, and lemmatization
def clean_text(line):
 if not line:
 return []
 tokens = line.split()
 tokens = [word for word in tokens if word not in stop_words_set]
 lemmas = [lemmatizer.lemmatize(word) for word in tokens]
 return lemmas
clean_text_udf = udf(clean_text, ArrayType(StringType()))
# Apply cleaning UDF to each line
cleaned = lines_cleaned.withColumn("cleaned_tokens", clean_text_udf(col("line")))
# Convert tokens back to string for display
from pyspark.sql.functions import concat_ws
final_output = cleaned.select(concat_ws(" ", col("cleaned_tokens")).alias("cleaned_line"))

# Write stream to console
query = final_output.writeStream \
 .outputMode("append") \
 .format("console") \
 .option("truncate", False) \
 .start()
query.awaitTermination()
```

Output:



```
prajwal@PrajwalDevice:~$ spark-shell
25/05/24 17:41:38 WARN Utils: Your hostname, PrajwalDevice resolves to a loopback address: 127.0.1.1; using 10.255.255.254 instead (on interface lo)
25/05/24 17:41:38 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
25/05/24 17:41:46 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Spark context Web UI available at http://10.255.255.254:4040
Spark context available as 'sc' (master = local[*], app id = local-1748088707553).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 3.5.5
      /_/

Using Scala version 2.12.18 (OpenJDK 64-Bit Server VM, Java 21.0.7)
Type in expressions to have them evaluated.
Type :help for more information.

scala> val file=sc.text25/05/24 17:42:00 WARN GarbageCollectionMetrics: To enable non-built-in garbage collector(s) List(G1 Concurrent GC), users should configure it(them) to spark.e
 spark.eventLog.gcMetrics.oldGenerationGarbageCollectors
val file=sc.textFile("i1.txt")
file: org.apache.spark.rdd.RDD[String] = i1.txt MapPartitionsRDD[1] at textFile at <console>:23

scala> val words=file.flatMap(line=>line.split("\\W+"))
words: org.apache.spark.rdd.RDD[String] = MapPartitionsRDD[2] at flatMap at <console>:23

scala> val wordpairs=words.map(word=>(word.toLowerCase,1))
wordpairs: org.apache.spark.rdd.RDD[(String, Int)] = MapPartitionsRDD[3] at map at <console>:23

scala> val wordc=wordpairs.reduceByKey(_+_)
wordc: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[4] at reduceByKey at <console>:23

scala> val fil2=wordc.filter{case(word,count)=>count>2}
fil2: org.apache.spark.rdd.RDD[(String, Int)] = MapPartitionsRDD[5] at filter at <console>:23

scala> fil2.collect().foreach(println)
```