VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT

on

BIG DATA ANALYTICS

Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING

in
COMPUTER SCIENCE AND ENGINEERING

Under the guidance of
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B.M.S. COLLEGE OF ENGINEERING
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CERTIFICATE

This is to certify that the Lab work entitled "LAB COURSE **BIG DATA ANALYTICS**" carried out by **VARUN RAJ S (1BM21CS264),** who is a bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024. The Lab report has been approved as it satisfies the academic requirements in respect of a **Big Data Analytics - (22CS6PEBDA)** work prescribed for the said degree.

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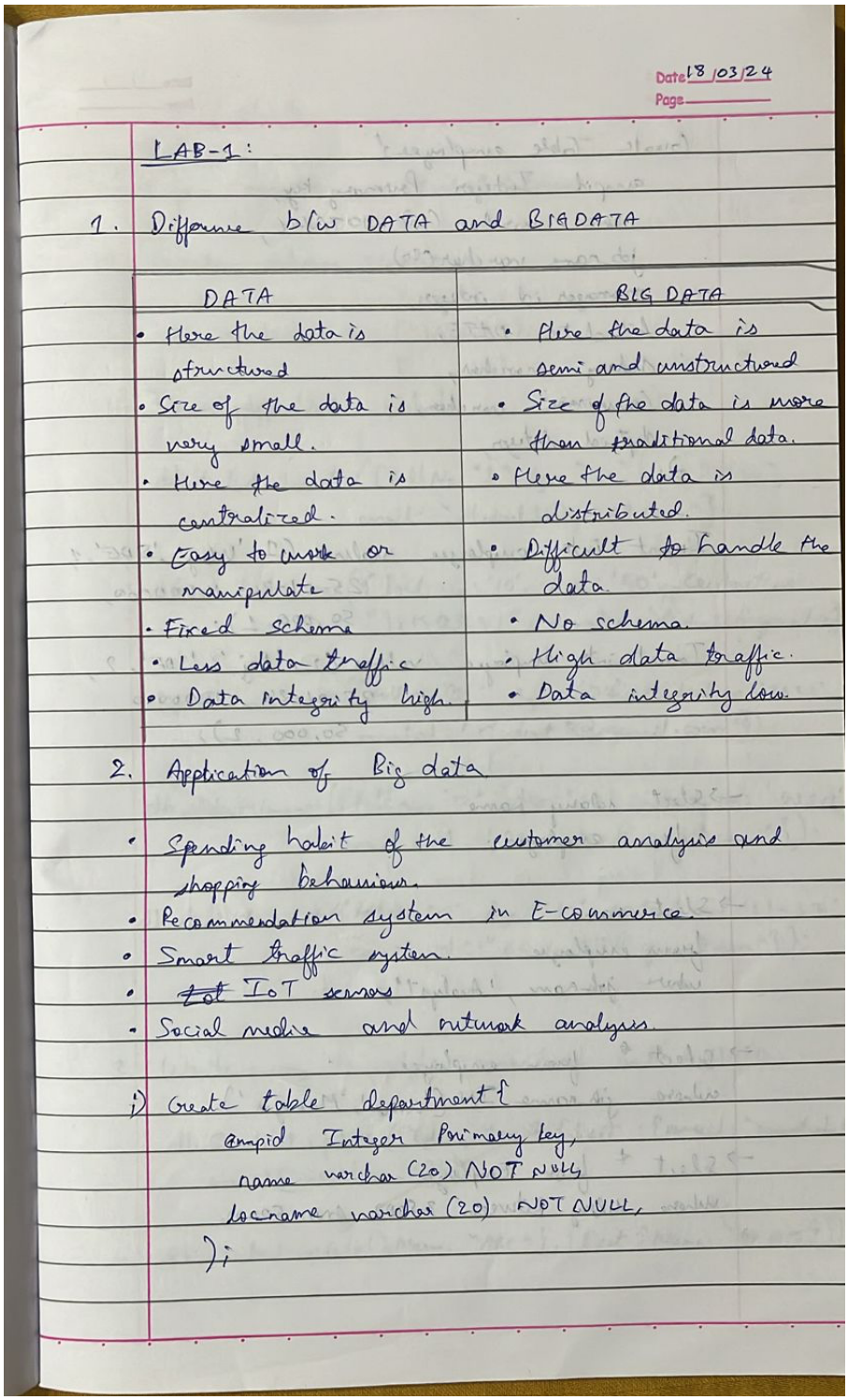
1. QUESTION AND ANSWER

Fig1.: Lab 1 observation



Date 18/03/24
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LAB-1:

1. Diffrence b/w DATA and BIGDATA

DATA	BIG DATA
• Here the data is structured	• Here the data is semi and unstructured
• Size of the data is very small.	• Size of the data is more than traditional data.
• Here the data is centralized.	• Here the data is distributed.
• Easy to work or manipulate	• Difficult to handle the data
• Fixed schema	• No schema.
• Less data traffic	• High data traffic.
• Data integrity high.	• Data integrity low.

2. Application of Big data

- Spending habit of the customer analysis and shopping behaviour.
- Recommendation system in E-commerce.
- Smart traffic system.
- ~~IoT~~ IoT ~~sensors~~
- Social media and network analysis.

i) Create table department {
deptid Integer Primary key,
name varchar (20) NOT NULL
locname varchar (20) NOT NULL,
);

2. MongoDB- CRUD Demonstration

Fig.2: Inserting into database:

```
test> use Student
switched to db Student
Student> db.Student.insert({RollNo:1,Age:21,Cont:9876,email:"antara.de9@gmail.com"});
```

Fig.3: Displaying inserted values

```
}
Student> db.Student.find()
[
  {
    _id: ObjectId('660a86053f257f0a2b66fd9b'),
    RollNo: 1,
    Age: 21,
    Cont: 9876,
    email: 'antara.de9@gmail.com'
  },
  {
    _id: ObjectId('660a86063f257f0a2b66fd9c'),
    RollNo: 2,
    Age: 22,
    Cont: 9976,
    email: 'anushka.de9@gmail.com'
  },
  {
    _id: ObjectId('660a86063f257f0a2b66fd9d'),
    RollNo: 3,
    Age: 21,
    Cont: 5576,
    email: 'anubhav.de9@gmail.com'
  },
  {
    _id: ObjectId('660a86063f257f0a2b66fd9e'),
    RollNo: 4,
    Age: 20,
    Cont: 4476,
    email: 'pani.de9@gmail.com'
  },
  {
    _id: ObjectId('660a86083f257f0a2b66fd9f'),
    RollNo: 10,
    Age: 23,
    Cont: 2276,
    email: 'abhinav@gmail.com'
  }
```

Fig. 4: Updating values:

```
Student> db.Student.update({RollNo:10},{$set:{email:"abhinav@gmail.com"}})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
Student> db.Student.update({RollNo:11, Name:"ABC"},{$set:{Name:"FEM"}})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 0,
  modifiedCount: 0,
  upsertedCount: 0
}
```

Fig.5: Creating Customers database and inserting.

```
Student> db.createCollection("Customers");
{ ok: 1 }
Student> db.Customers.insert({cust_id:1,Balance:200, Type:"S"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('660a87f33f257f0a2b66fda0') }
}
Student>

Student> db.Customers.insert({cust_id:1,Balance:1000, Type:"Z"})
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('660a87f33f257f0a2b66fda1') }
}
Student>

Student> db.Customers.insert({cust_id:2,Balance:100, Type:"Z"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('660a87f33f257f0a2b66fda2') }
}
Student>

Student> db.Customers.insert({cust_id:2,Balance:1000, Type:"C"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('660a87f33f257f0a2b66fda3') }
}
Student>

Student> db.Customers.insert({cust_id:2,Balance:500, Type:"C"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('660a87f33f257f0a2b66fda4') }
}
```

Fig.6: Updating

```
Student> db.Customers.aggregate (
...
... {$group : { _id : "$cust_id",
...
... minAccBal :{$min:"$Balance"},
... maxAccBal :{$max:"$Balance"} }});
[
  { _id: 3, minAccBal: 500, maxAccBal: 500 },
  { _id: 2, minAccBal: 50, maxAccBal: 1000 },
  { _id: 1, minAccBal: 200, maxAccBal: 1000 }
]
Student> db.Customers.aggregate(
... {$match:{Type:"Z"}},
... {$group:{_id:"$cust_id",
... TotAccBal:{$sum:"$Balance"}}},
... {$match:{TotAccBal:{$gt:1200}}});
```

3. Perform the following DB operations using Cassandra.

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.
       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';
```

cqlsh:students> Begin batch

```
insert into Students_info(Roll_no, StudName,DateOfJoining, last_exam_Percent)
values(1,'Srivatsa','2023-10-09', 98)
insert into Students_info(Roll_no, StudName,DateOfJoining, last_exam_Percent)
values(2,'Varun','2023-10-10', 97)
insert into Students_info(Roll_no, StudName,DateOfJoining,
last_exam_Percent)
values(3,'Prithvi','2023-10-10', 97.5)
insert into Students_info(Roll_no, StudName,DateOfJoining,
last_exam_Percent)
values(4,'Uday','2023-10-06', 96.5)
apply batch;
```

cqlsh:students> select * from students_info;

```
 roll_no | dateofjoining                  | last_exam_percent | studname
        +                               +                   +
        1 | 2023-10-08 18:30:00.000000+0000 |              98 | Srivatsa
        2 | 2023-10-09 18:30:00.000000+0000 |              97 | Varun
        4 | 2023-10-05 18:30:00.000000+0000 |              96.5 | Uday
        3 | 2023-10-09 18:30:00.000000+0000 |              97.5 | Prithvi
       (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 | Srivatsa
        2 | 2023-10-09 18:30:00.000000+0000 |              97 |Varun
        3 | 2023-10-09 18:30:00.000000+0000 |              97.5 | Prithvi
```

cqlsh:students> select * from students_info where Studname='Uday';

```
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 despite the performance unpredictability, use ALLOW FILTERING"

cqlsh:students> create index on Students_info(StudName);
cqlsh:students> select * from students_info where Studname=Uday;

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

(1 rows)
```

cqlsh:students> select Roll_no,StudName from students_info LIMIT 2;

```
 roll_no | studname
         +
       1 | Srivatsa
       2 |Rohan
      (2 rows)
```

cqlsh:students> SELECT Roll_no as "USN" from Students_info;

```
 USN
   1
   2
   4
   3

(4 rows)
```

cqlsh:students> update students_info set StudName='Shreya' where Roll_no=3;
cqlsh:students> select * from students_info;

```
 roll_no | dateofjoining                  | last_exam_percent | studname
         +                              +                   +
       1 | 2023-10-08 18:30:00.000000+0000 |                98 | Srivatsa
       2 | 2023-10-09 18:30:00.000000+0000 |                97 | Varun
       4 | 2023-10-05 18:30:00.000000+0000 |               96.5 | Uday
       3 | 2023-10-09 18:30:00.000000+0000 |              97.5 | Prithvi

(4 rows)
```

cqlsh:students> update students_info set roll_no=8 where Roll_no=3;
InvalidRequest: Error from server: code=2200 [Invalid query] message="PRIMARY KEY part roll_no found in SET part"

cqlsh:students> delete last_exam_percent from students_info where roll_no=2;
cqlsh:students> select * from students_info;

```
 roll_no | dateofjoining                  | last_exam_percent | studname
        +                               +                   +
       1 | 2023-10-08 18:30:00.000000+0000 |              98 | Srivatsa
       2 | 2023-10-09 18:30:00.000000+0000 |            null | Varun
       4 | 2023-10-05 18:30:00.000000+0000 |            96.5 |  Uday
       3 | 2023-10-09 18:30:00.000000+0000 |            97.5 |  Prithvi
(4 rows)
```

cqlsh:students> delete from students_info where roll_no=2;
cqlsh:students> select * from students_info;

```
 roll_no | dateofjoining                  | last_exam_percent | studname
        +                               +                   +
       1 | 2023-10-08 18:30:00.000000+0000 |              98 | Srivatsa
       4 | 2023-10-05 18:30:00.000000+0000 |            96.5 |  Uday
       3 | 2023-10-09 18:30:00.000000+0000 |            97.5 |  Prithvi

      (3 rows
```

4. Employee Database

Fig.7: Employee commands and queries SS-1:

```
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
```

Fig.8: Employee commands and queries SS-2:

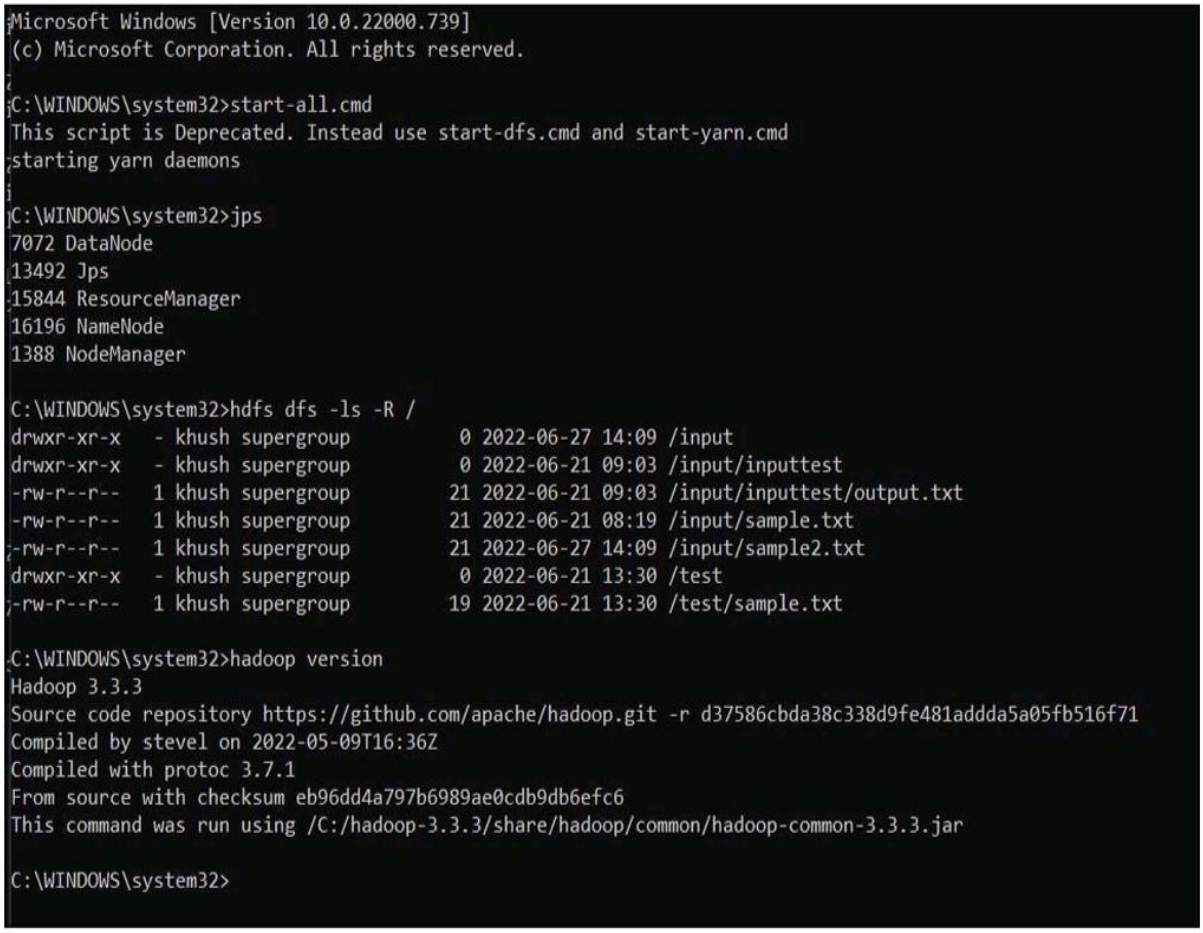
```
cqlsh:employee> update employee_info using ttl 15 set salary = 0 where emp_id = 121;
cqlsh:employee> select * from employee_info;

 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>
```

Fig.9: Employee commands and queries SS-3:

```
   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;
```

5. Hadoop Installation

Fig.10: Hadoop installation commands screenshot:



6. Hadoop Hdfs commands

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ start-all.sh

WARNING: Attempting to start all Apache Hadoop daemons as hadoop in 10 seconds.

WARNING: This is not a recommended production deployment configuration.

WARNING: Use CTRL-C to abort.

Starting namenodes on [localhost]

Starting datanodes

Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]

Starting resourcemanager

Starting nodemanagers

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop dfs -mkdir /sadh WARNING: Use of this script to execute dfs is deprecated.

WARNING: Attempting to execute replacement "hdfs dfs" instead.

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -mkdir /sadh

mkdir: `/sadh': File exists

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

Found 1 items

drwxr-xr-x - hadoop supergroup 0 2024-05-13 14:27 /sadh

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

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

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

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

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

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put /home/hadoop/Desktop/example/Welcome.txt /sadh/WC2.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -getmerge /sadh/WC.txt /sadh/WC2.txt /home/hadoop/Desktop/example/Merge.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -getfacl

/sadh/ # file: /sadh

owner: hadoop

group: supergroup

user::rwx

group::r-x

other::r-x

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mv /sadh /WC2.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /sadh /WC2.txt

ls: `/sadh': No such file or directory

Found 2 items

-rw-r--r-- 1 hadoop supergroup 6 2024-05-13 14:51 /WC2.txt/WC.txt
-rw-r--r-- 1 hadoop supergroup 6 2024-05-13 15:03 /WC2.txt/WC2.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cp /WC2.txt/ /WC.txt

Fig.11: Hadoop commands screenshot-1:

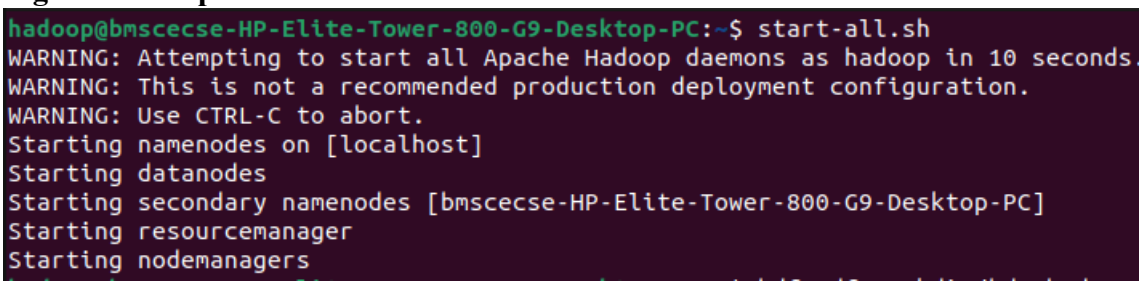


Fig.12: Hadoop commands screenshot-2:

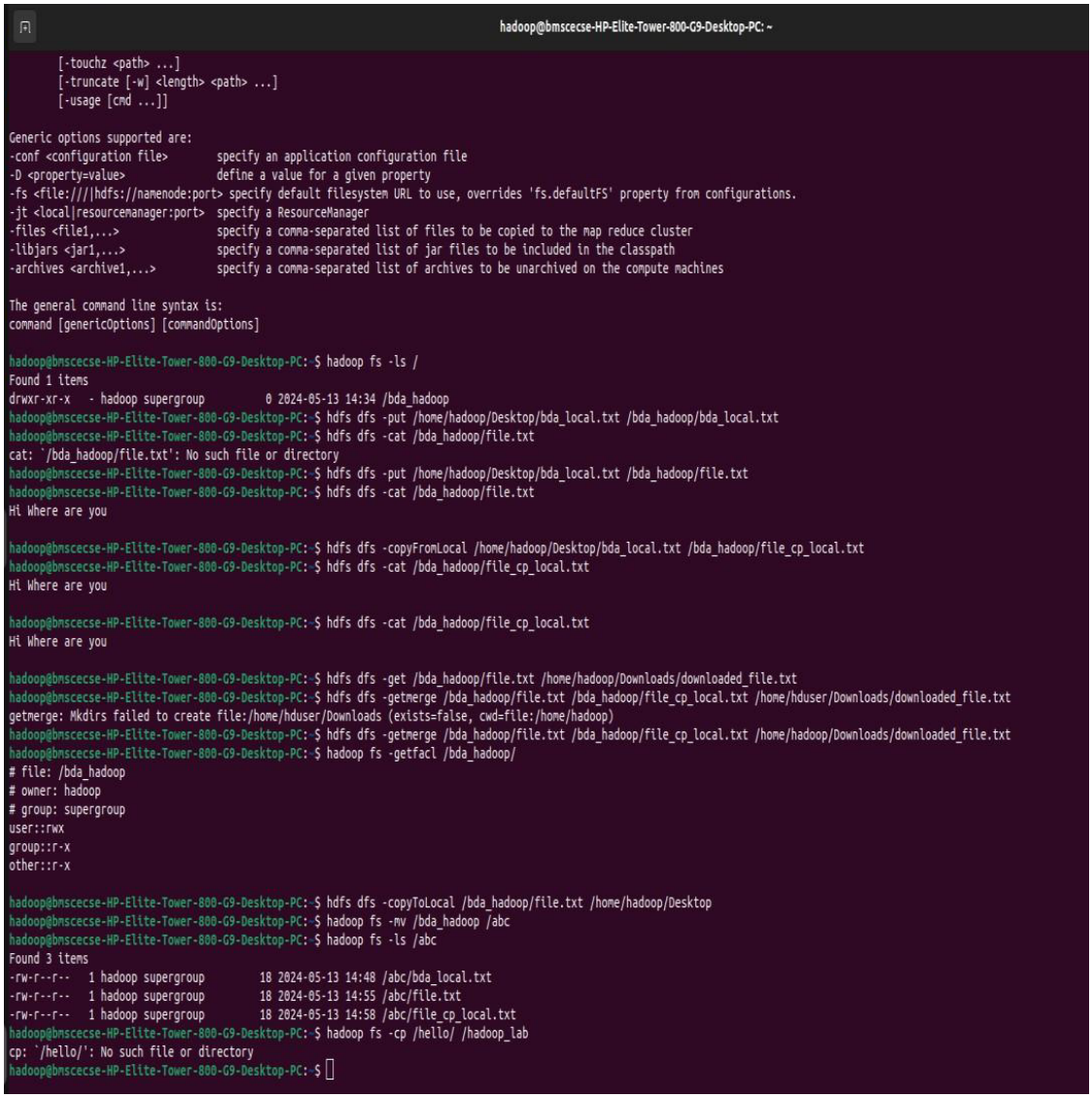
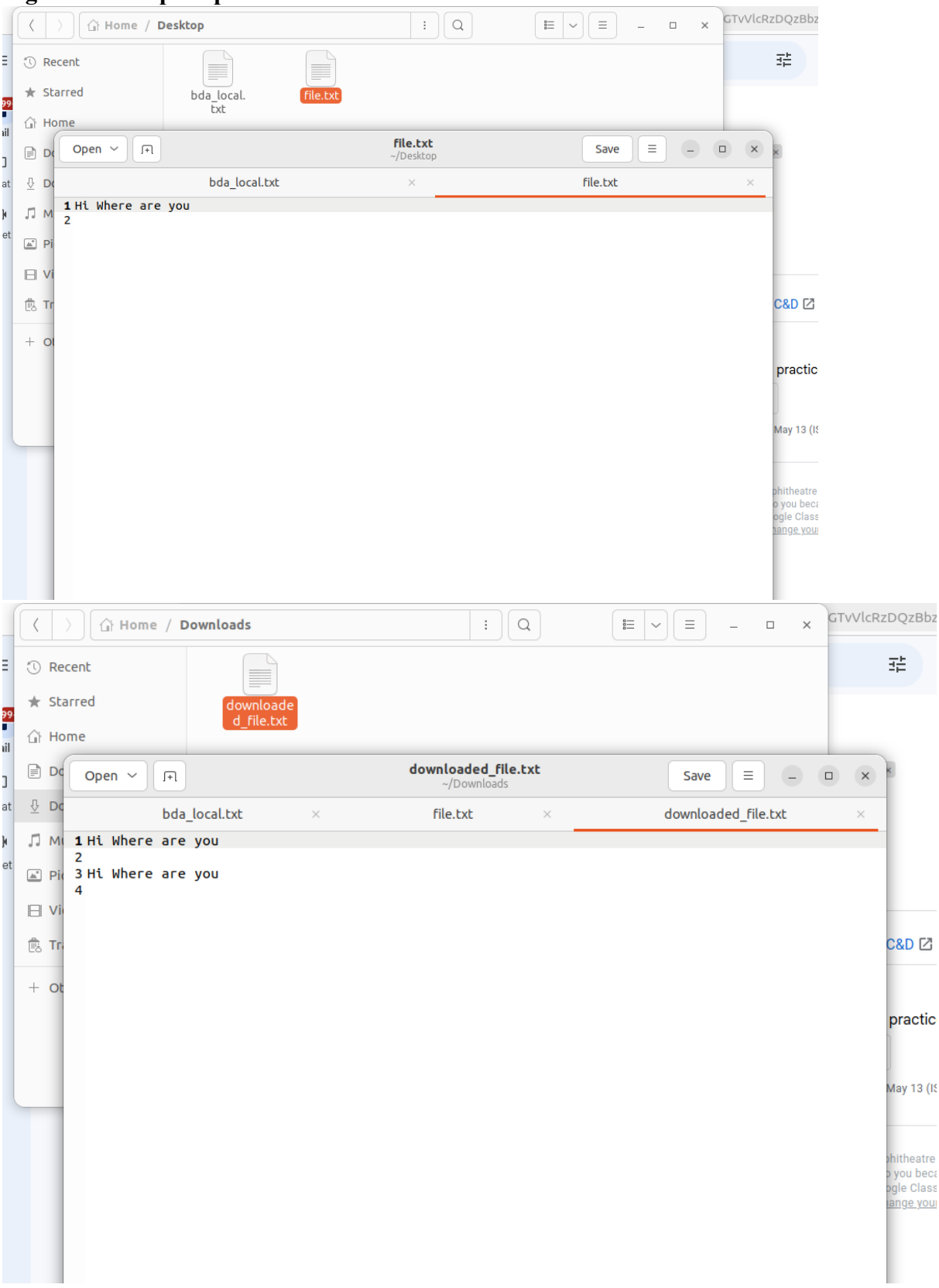


Fig.12: Hadoop output files:



7. Implement WordCount Program on Hadoop framework

Mapper Code:

```
import java.io.IOException;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.LongWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import org.apache.hadoop.mapred.Mapper;
import org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reporter;
public class WCMapper extends MapReduceBase implements Mapper<LongWritable,
Text, Text,
IntWritable> {

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

String line = value.toString();
for (String word : line.split(" "))
{

if (word.length() > 0)

{

output.collect(new Text(word), new IntWritable(1));

}

}

 }

 }
```

Reducer Code:

```
// Importing libraries

import java.io.IOException;
import java.util.Iterator;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.MapReduceBase;
import  org.apache.hadoop.mapred.OutputCollector;
import org.apache.hadoop.mapred.Reducer;
import org.apache.hadoop.mapred.Reporter;

public class WCReducer extends MapReduceBase implements Reducer<Text,
IntWritable, Text, IntWritable> {
// Reduce function

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

{

int count = 0;

// Counting the frequency of each words
while (value.hasNext())
{

IntWritable i = value.next();
count += i.get();
```

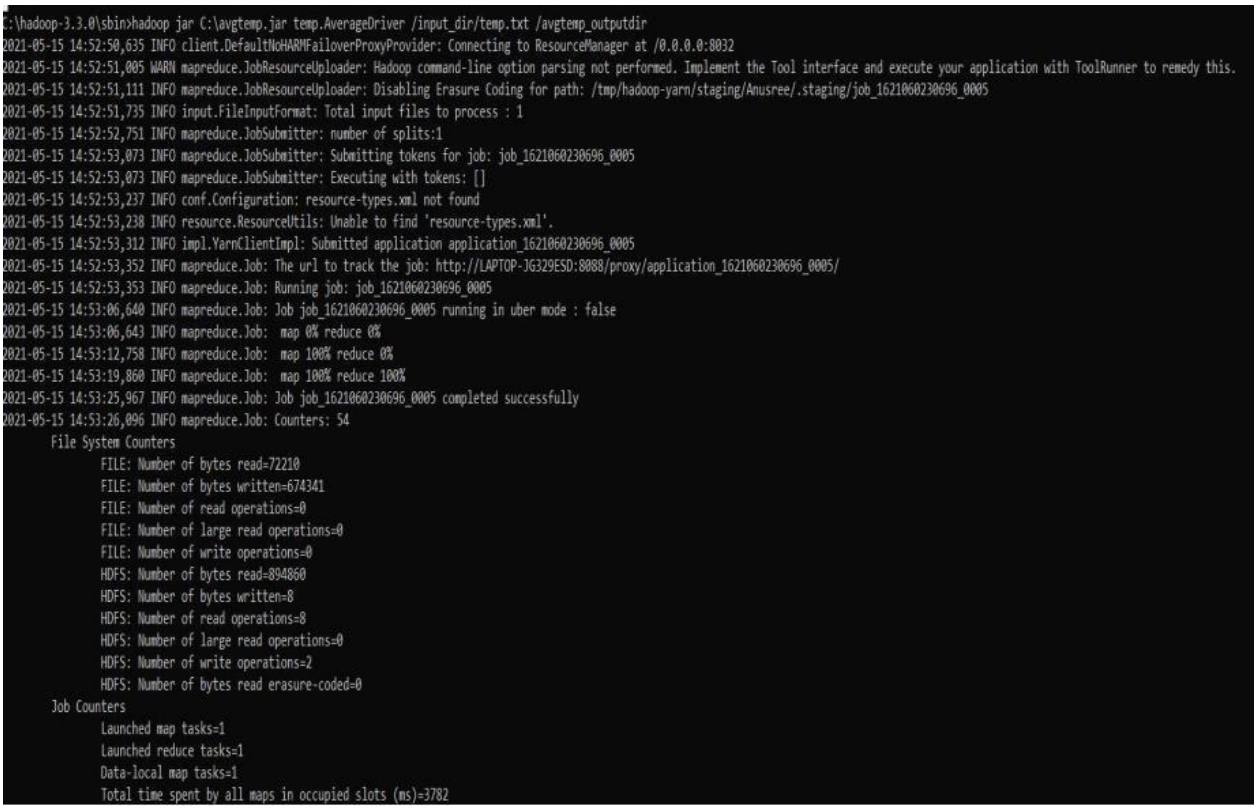
```
}

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

} }
```

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

```
// Importing libraries

import java.io.IOException;

import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.FileInputFormat;
import org.apache.hadoop.mapred.FileOutputFormat;
import org.apache.hadoop.mapred.JobClient;
import org.apache.hadoop.mapred.JobConf;
import org.apache.hadoop.util.Tool;
import org.apache.hadoop.util.ToolRunner;

public class WCDriver extends Configured implements Tool {
public int run(String args[]) throws IOException
{

if (args.length < 2)

{

System.out.println("Please give valid inputs");
return -1;
}
```

```
  JobConf conf = new JobConf(WCDriver.class);
  FileInputFormat.setInputPaths(conf, new Path(args[0]));
  FileOutputFormat.setOutputPath(conf, new Path(args[1]));
  conf.setMapperClass(WCMapper.class);
  conf.setReducerClass(WCReducer.class);
  conf.setMapOutputKeyClass(Text.class);
  conf.setMapOutputValueClass(IntWritable.class);
  conf.setOutputKeyClass(Text.class);
  conf.setOutputValueClass(IntWritable.class);
  JobClient.runJob(conf);
  return 0;

  }

  // Main Method

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

  {

  int exitCode = ToolRunner.run(new WCDriver(), args);
  System.out.println(exitCode);
  }
}
```

Fig.13: Output:



8.From the following link extract the weather data

https://github.com/tomwhite/hadoop-book/tree/master/input/ncdc/all

Create a Map Reduce program to

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

Average Driver

```
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);
  }
  }
```

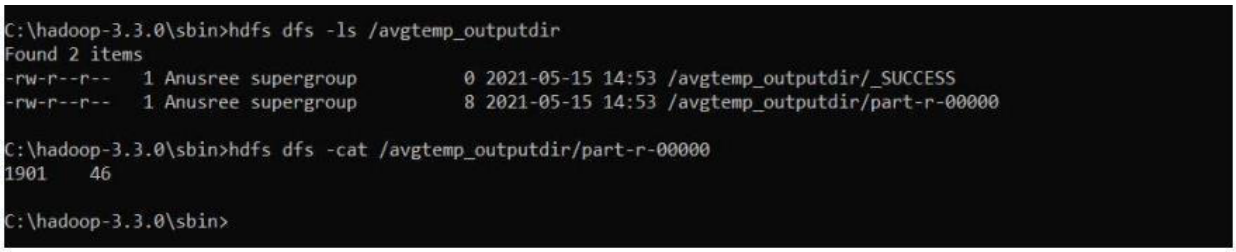
Average Mapper

```
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:

```
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));

}}
```

Fig.14: Program a) output:



b) Find the mean max temperature for every month

MeanMaxDriver.class:

```
package meanmax;

import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;

import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;

import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class MeanMaxDriver {
public static void main(String[] args) throws Exception {
if (args.length != 2) {
System.err.println("Please Enter the input and output
parameters"); System.exit(-1);
}

Job job = new Job();
job.setJarByClass(MeanMaxDriver.class);
job.setJobName("Max temperature");
FileInputFormat.addInputPath(job, new Path(args[0]));
FileOutputFormat.setOutputPath(job, new Path(args[1]));
job.setMapperClass(MeanMaxMapper.class);
job.setReducerClass(MeanMaxReducer.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
System.exit(job.waitForCompletion(true) ? 0 : 1);
}

}
```

MeanMaxMapper.class

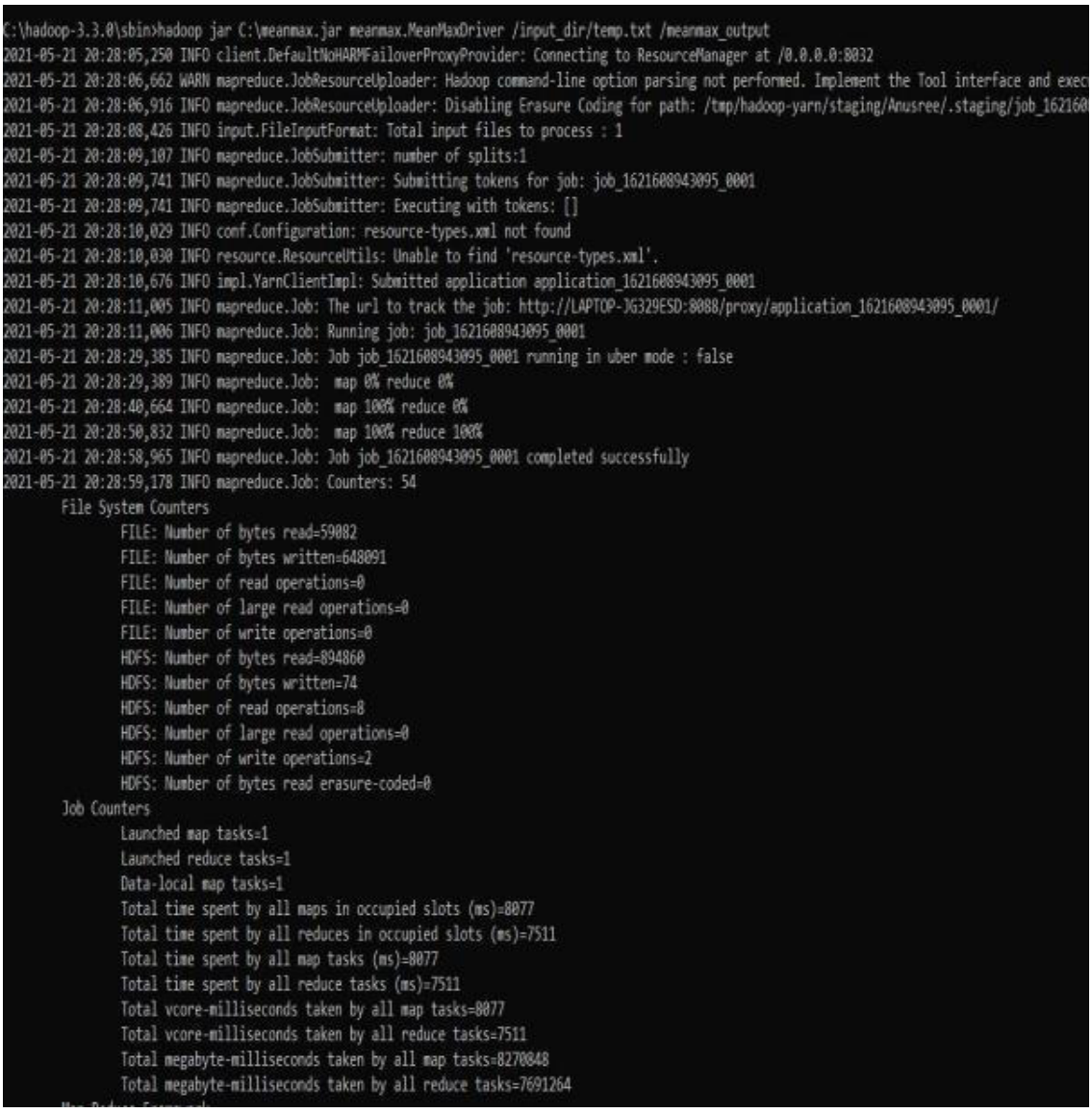
```
package meanmax;

import java.io.IOException;

import org.apache.hadoop.io.IntWritable; import org.apache.hadoop.io.LongWritable
 import org.apache.hadoop.io.Text;

 import org.apache.hadoop.mapreduce.Mapper;

 public class MeanMaxMapper extends Mapper<LongWritable, Text, Text, IntWritable> {

 public static final int MISSING = 9999;

 public void map(LongWritable key, Text value, Mapper<LongWritable, Text, Text,

 IntWritable>.Context context) throws IOException, InterruptedException {

 int temperature;

 String line = value.toString();

 String month = line.substring(19, 21);

 if (line.charAt(87) == '+') {

 temperature = Integer.parseInt(line.substring(88, 92));

 } else {

 temperature = Integer.parseInt(line.substring(87, 92));

 }

 String quality = line.substring(92, 93);

 if (temperature != 9999 && quality.matches("[01459]"))

 context.write(new Text(month), new IntWritable(temperature));

 }
```

MeanMaxReducer.class

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

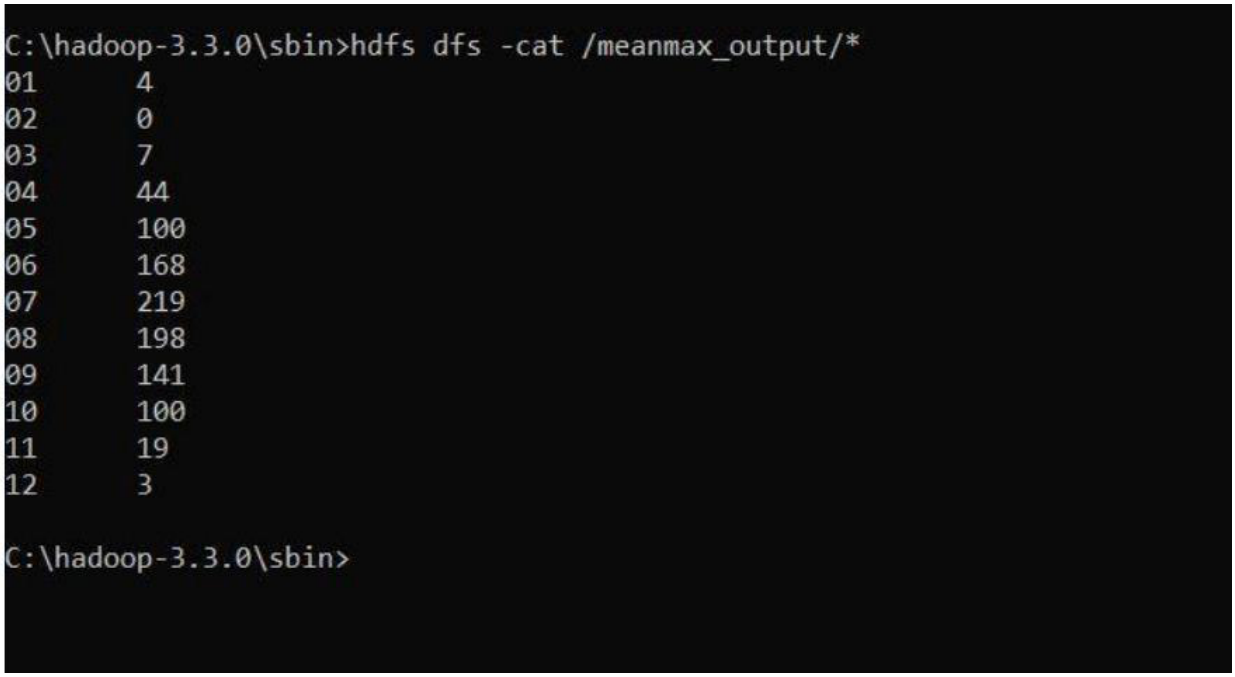
```
}
context.write(key, new IntWritable(total_temp / days));
}
}
```

Fig.15: Program b) Output:



```
C:\hadoop-3.3.0\sbin>hadoop jar C:\meanmax.jar meanmax.MeanMaxDriver /input_dir/temp.txt /meanmax_output
2021-05-21 20:28:05,250 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager at /0.0.0.0:8032
2021-05-21 20:28:06,662 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and exec
2021-05-21 20:28:06,916 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/hadoop-yarn/staging/Anusree/.staging/job_162160
2021-05-21 20:28:08,426 INFO input.FileInputFormat: Total input files to process : 1
2021-05-21 20:28:09,107 INFO mapreduce.JobSubmitter: number of splits:1
2021-05-21 20:28:09,741 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1621608943095_0001
2021-05-21 20:28:09,741 INFO mapreduce.JobSubmitter: Executing with tokens: []
2021-05-21 20:28:10,029 INFO conf.Configuration: resource-types.xml not found
2021-05-21 20:28:10,030 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2021-05-21 20:28:10,676 INFO impl.YarnClientImpl: Submitted application application_1621608943095_0001
2021-05-21 20:28:11,005 INFO mapreduce.Job: The url to track the job: http://LAPTOP-JG329ESD:8088/proxy/application_1621608943095_0001/
2021-05-21 20:28:11,006 INFO mapreduce.Job: Running job: job_1621608943095_0001
2021-05-21 20:28:29,385 INFO mapreduce.Job: Job job_1621608943095_0001 running in uber mode : false
2021-05-21 20:28:29,389 INFO mapreduce.Job:  map 0% reduce 0%
2021-05-21 20:28:40,664 INFO mapreduce.Job:  map 100% reduce 0%
2021-05-21 20:28:50,832 INFO mapreduce.Job:  map 100% reduce 100%
2021-05-21 20:28:58,965 INFO mapreduce.Job: Job job_1621608943095_0001 completed successfully
2021-05-21 20:28:59,178 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=59082
                FILE: Number of bytes written=648091
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=894860
                HDFS: Number of bytes written=74
                HDFS: Number of read operations=8
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=1
                Launched reduce tasks=1
                Data-local map tasks=1
                Total time spent by all maps in occupied slots (ms)=8077
                Total time spent by all reduces in occupied slots (ms)=7511
                Total time spent by all map tasks (ms)=8077
                Total time spent by all reduce tasks (ms)=7511
                Total vcore-milliseconds taken by all map tasks=8077
                Total vcore-milliseconds taken by all reduce tasks=7511
                Total megabyte-milliseconds taken by all map tasks=8270848
                Total megabyte-milliseconds taken by all reduce tasks=7691264
```

Fig.16: output continued:



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

Driver-TopN.class

```
package samples.topn;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.conf.Configuration;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Job;
import org.apache.hadoop.mapreduce.Mapper;
import org.apache.hadoop.mapreduce.lib.input.FileInputFormat;
import org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;
import org.apache.hadoop.util.GenericOptionsParser;
public class TopN {
public static void main(String[] args) throws Exception {
Configuration conf = new Configuration();
String[] otherArgs = (new GenericOptionsParser(conf, args)).getRemainingArgs();
if (otherArgs.length != 2) {
System.err.println("Usage: TopN <in> <out>");
System.exit(2);
}
Job job = Job.getInstance(conf);
```

```
job.setJobName("Top N");
job.setJarByClass(TopN.class);
job.setMapperClass(TopNMapper.class);
job.setReducerClass(TopNReducer.class);
job.setOutputKeyClass(Text.class);
job.setOutputValueClass(IntWritable.class);
FileInputFormat.addInputPath(job, new Path(otherArgs[0]));
FileOutputFormat.setOutputPath(job, new Path(otherArgs[1]));
System.exit(job.waitForCompletion(true) ? 0 : 1);
}
public static class TopNMapper extends Mapper<Object, Text, Text, IntWritable> {
private static final IntWritable one = new IntWritable(1);
private Text word = new Text();
private String tokens = "[_|$#<>\\^=\\[\\]\\*/\\\\,;,.\\-:()?!\"']";
public void map(Object key, Text value, Mapper<Object, Text, Text, IntWritable>.Context
context) throws IOException, InterruptedException {
String cleanLine = value.toString().toLowerCase().replaceAll(this.tokens, " ");
StringTokenizer itr = new StringTokenizer(cleanLine);
while (itr.hasMoreTokens()) {
this.word.set(itr.nextToken().trim());
context.write(this.word, one);
}
}
}
```

```
}
```

TopNCombiner.class

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

TopNMapper.class

```
package samples.topn;
import java.io.IOException;
import java.util.StringTokenizer;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Mapper;
public class TopNMapper extends Mapper<Object, Text, Text, IntWritable> {
```

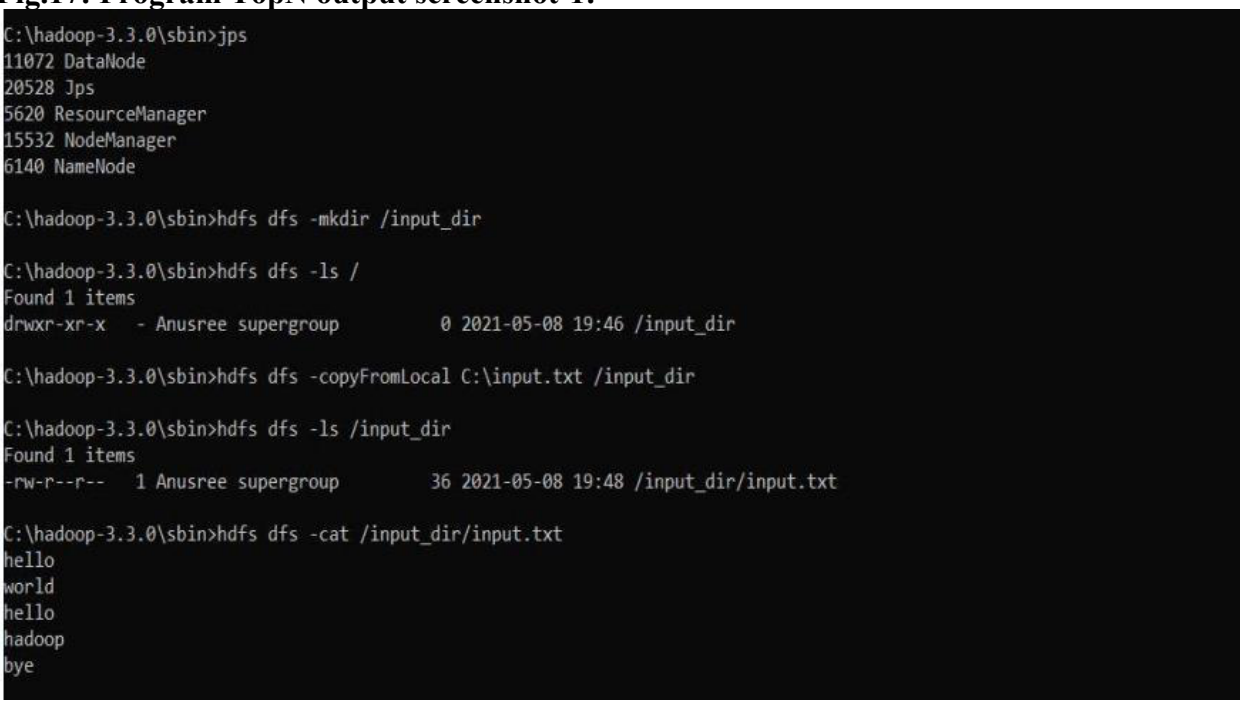
```
private static final IntWritable one = new IntWritable(1);
private Text word = new Text();
private String tokens = "[_|$#<>\\^=\\[\\]\\*/\\\\,;,.\\-:()?!\"']";
public void map(Object key, Text value, Mapper<Object, Text, Text, IntWritable>.Context
context) throws IOException, InterruptedException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

TopNReducer.class

```
package samples.topn;
import java.io.IOException;
import java.util.HashMap;
import java.util.Map;
import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;
import utils.MiscUtils;
public class TopNReducer extends Reducer<Text, IntWritable, Text, IntWritable> {
private Map<Text, IntWritable> countMap = new HashMap<>();
```

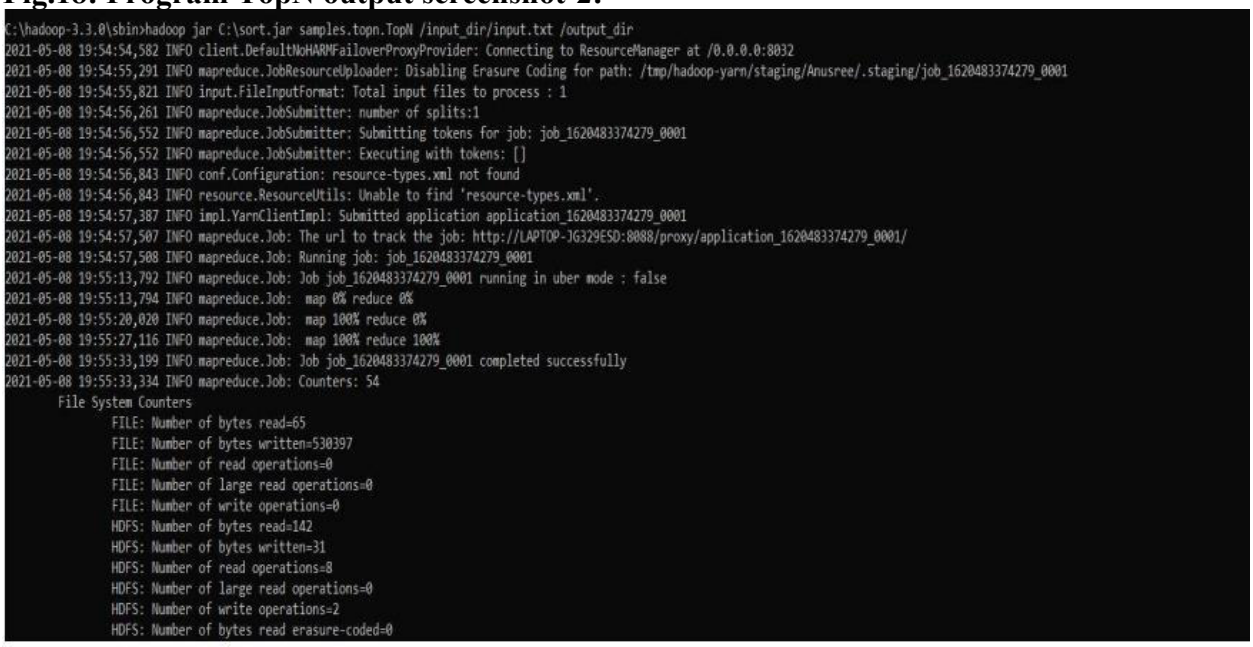
```
public void reduce(Text key, Iterable<IntWritable> values, Reducer<Text, IntWritable,
Text, IntWritable>.Context context) throws IOException, InterruptedException {
int sum = 0;
for (IntWritable val : values)
sum += val.get();
this.countMap.put(new Text(key), new IntWritable(sum));
}
protected void cleanup(Reducer<Text, IntWritable, Text, IntWritable>.Context context)
throws IOException, InterruptedException {
Map<Text, IntWritable> sortedMap = MiscUtils.sortByValues(this.countMap);
int counter = 0;
for (Text key : sortedMap.keySet()) {
if (counter++ == 20)
break;
context.write(key, sortedMap.get(key));
}
}
}
```

Fig.17: Program TopN output screenshot-1:



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

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

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

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

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

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

Fig.18: Program TopN output screenshot-2:



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