VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum -590014, Karnataka.

LAB REPORT
on

Big Data and Analytics Lab

Submitted by

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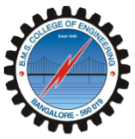
in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING
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B. M. S. College of Engineering,

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Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "Big Data Analytics Lab" carried out by **Arvind Ashok (1BM21CS032),** 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 and Analytics - (22CS6PEBDA)** work prescribed for the said degree.

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Index Sheet

Sl. No.	Experiment Title	Page No.
1.	MongoDB CRUD Operations	4
2.	Cassandra Employee	9
3.	Cassandra Library	11
4.	Hadoop Installation	13
5.	Hadoop Commands	14
6.	Hadoop Word Count	17
7.	Map Reduce Programs	21
8.	Map Reduce Sort	24

Lab 1

Perform the following DB operations using MongoDB

Create a collection by the name blogPosts and it has 3 fields id, title and comments.
In the collection the comments field is an array which consists of user details. Each collection consists of two user details inside the comments array- user name and text

db.createCollection("blogPosts")

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.createCollection("blogPosts")
{ ok: 1 }
Atlas atlas-axcx6s-shard-0 [primary] lab3> show collections
blogPosts
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.insertOne({
...     id: 1,
...     title: "Sample Title",
...     comments: [
...         { user: "User1", text: "Comment1" }
...     ]
... })
{
  acknowledged: true,
  insertedId: ObjectId("660bc8a8c0cf4e885fcbb2e3")
}
```

Demonstrate the following

1. **Adding an element into array**

```
db.blogPosts.insertOne({
   id: 1,
   title: "Sample Title",
   comments: [
      { user: "User1", text: "Comment1" }
   ]
})
```

(Similarly, Insert 4 ids)

```
}
Atlas atlas-57yq38-shard-0 [primary] test> db.blogPosts.find()
[
  {
    _id: ObjectId('660bcdd48adf462691a26f41'),
    id: 1,
    title: 'Sample Title',
    comments: [ { user: 'User1', text: 'Comment1' } ]
  }
]
```

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.find()
[
  {
    _id: ObjectId("660bc8a8c0cf4e885fcbb2e3"),
    id: 1,
    title: 'Sample Title',
    comments: [ { user: 'User1', text: 'Comment1' } ]
  },
  {
    _id: ObjectId("660bc98ac0cf4e885fcbb2e4"),
    id: 2,
    title: 'Title2',
    comments: [ { user: 'User2', text: 'Comment2' } ]
  },
  {
    _id: ObjectId("660bc9cdc0cf4e885fcbb2e5"),
    id: 3,
    title: 'Title3',
    comments: [ { user: 'User3', text: 'Comment3' } ]
  },
  {
    _id: ObjectId("660bc9dec0cf4e885fcbb2e6"),
    id: 4,
    title: 'Title4',
    comments: [ { user: 'User4', text: 'Comment4' } ]
  }
```

2. Display second element

db.blogPosts.find().skip(1).limit(1)

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.find().skip(1).limit(1)
[
  {
    _id: ObjectId("660bc98ac0cf4e885fcbb2e4"),
    id: 2,
    title: 'Title2',
    comments: [ { user: 'User2', text: 'Comment2' } ]
  }
]
```

3. **Display size of the array**

```
db.blogPosts.aggregate([
  { $project: { commentsCount: { $size: "$comments" } } }
])
```

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.aggregate([
...     { $project: { commentsCount: { $size: "$comments" } } }
... ])
[
  { _id: ObjectId("660bc8a8c0cf4e885fcbb2e3"), commentsCount: 1 },
  { _id: ObjectId("660bc98ac0cf4e885fcbb2e4"), commentsCount: 1 },
  { _id: ObjectId("660bc9cdc0cf4e885fcbb2e5"), commentsCount: 1 },
  { _id: ObjectId("660bc9dec0cf4e885fcbb2e6"), commentsCount: 2 }
]
```

4. **Display first two elements of the array**

```
db.blogPosts.aggregate([
  { $project: { firstTwoComments: { $slice: ["$comments", 2] } } }
])
```

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.aggregate([
...     { $project: { firstTwoComments: { $slice: ["$comments", 2] } } }
... ])
[
  {
    _id: ObjectId("660bc8a8c0cf4e885fcbb2e3"),
    firstTwoComments: [ { user: 'User1', text: 'Comment1' } ]
  },
  {
    _id: ObjectId("660bc98ac0cf4e885fcbb2e4"),
    firstTwoComments: [ { user: 'User2', text: 'Comment2' } ]
  },
  {
    _id: ObjectId("660bc9cdc0cf4e885fcbb2e5"),
    firstTwoComments: [ { user: 'User3', text: 'Comment3' } ]
  },
  {
    _id: ObjectId("660bc9dec0cf4e885fcbb2e6"),
    firstTwoComments: [
      { user: 'User4', text: 'Comment4' },
      [ { user: 'NewUser', text: 'NewComment' } ]
    ]
  }
]
```

5. **Update the document with id 4 and replace the element present in 1st index position of the array with another array**

```
db.blogPosts.updateOne(
  { id: 4 },
  { $set: { "comments.1": [{ user: "NewUser", text: "NewComment" }] } }
)
```

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.updateOne( { id: 4 }, { $set: { "comments.1": [{ user: "NewUser"
, text: "NewComment" }] } } )
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
```

```
Atlas atlas-axcx6s-shard-0 [primary] lab3> db.blogPosts.find()
[
  {
    _id: ObjectId("660bc8a8c0cf4e885fcbb2e3"),
    id: 1,
    title: 'Sample Title',
    comments: [ { user: 'User1', text: 'Comment1' } ]
  },
  {
    _id: ObjectId("660bc98ac0cf4e885fcbb2e4"),
    id: 2,
    title: 'Title2',
    comments: [ { user: 'User2', text: 'Comment2' } ]
  },
  {
    _id: ObjectId("660bc9cdc0cf4e885fcbb2e5"),
    id: 3,
    title: 'Title3',
    comments: [ { user: 'User3', text: 'Comment3' } ]
  },
  {
    _id: ObjectId("660bc9dec0cf4e885fcbb2e6"),
    id: 4,
    title: 'Title4',
    comments: [
      { user: 'User4', text: 'Comment4' },
      [ { user: 'NewUser', text: 'NewComment' } ]
    ]
  }
```

Lab 2

Perform the following DB operations using Cassandra.

1.Create a keyspace by name Employee

```
create keyspace Employee with replication = {'class':'SimpleStrategy',
'replication_factor':1};
use Employee;
```

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

```
create table EmployeeInfo(Emp_Id int primary key, Emp_Name text, Designation
text, Date_of_Joining timestamp, Salary double, Dept_Name text);
```

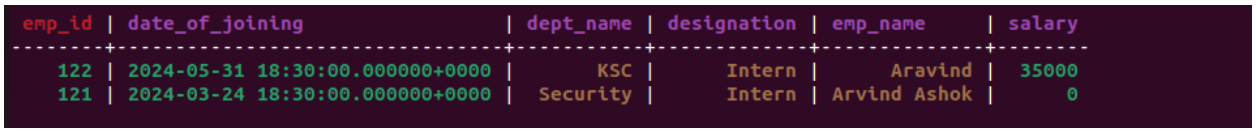
3. Insert the values into the table in batch

```
begin batch
        ... insert into employeeinfo (emp_id, date_of_joining, dept_name,
designation, emp_name, salary)
        ... values (121, '2024-03-25', 'KSC', 'Intern', 'Arvind', 0)
        ... insert into employeeinfo (emp_id, date_of_joining, dept_name,
designation, emp_name, salary)
        ... values (122, '2024-06-01', 'KSC', 'Intern', 'Aravind', 35000)
        ... apply batch;
```

emp_id	date_of_joining	dept_name	designation	emp_name	salary
122	2024-05-31 18:30:00.000000+0000	KSC	Intern	Aravind	35000
121	2024-03-24 18:30:00.000000+0000	KSC	Intern	Arvind	0

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

update employeeinfo set emp_name='Arvind Ashok', dept_name='Security' where emp_id=121;



emp_id	date_of_joining	dept_name	designation	emp_name	salary
122	2024-05-31 18:30:00.000000+0000	KSC	Intern	Aravind	35000
121	2024-03-24 18:30:00.000000+0000	Security	Intern	Arvind Ashok	0

5. Sort the details of Employee records based on salary

cqlsh:employee> select * from Employee_information where emp_id in (1,2,3) order by Salary;

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

cqlsh:employee> alter table employee_info add projects set<text>;

7. Update the altered table to add project names.

cqlsh:employee> update employee_info set projects=projects+{'project1','project2','project3'} where emp_id=1;

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

begin batch

... insert into Employee_Info(Emp_id,Emp_name,Date_of_Joining,Salary,Dept_Name) values(1,'Khushil','2021-04-23',50000,'CSE') using TTL 15

… apply batch

Lab 3

1. **Create a key space by name Library**

   create keyspace Library with replication = {‘class’:’SimpleStrategy’, ‘replication_factor’:1};

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

   create table Library_info(Stud_id int, COunter_value counter, Stud_name varchar, Book_name varchar, Book_id int, doi date, primary key (Stud_id, Stud_name, Book_id, Book_id, doi));

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

   update Library_info set Counter_value = Counter_value + 1 where Stud_id = 112 and Stud_name = ‘Arvind’ and ‘Book_id’=’123’ and ‘doi’=’2024-06-09’

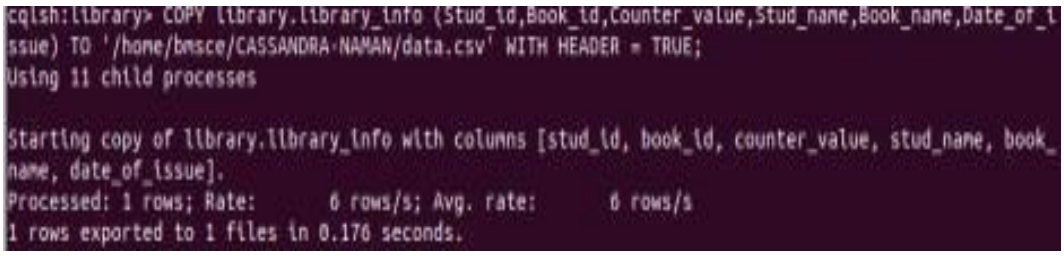
4. **Display the details of the table created and increase the value of the counter**

   update library_info set Counter_value = Counter_value + 1 where Stud_id=112 and Stud_name=’Arvind’ and Book_name=’abc’ and Book_id=’123’ and doi=’2024-05-01’;

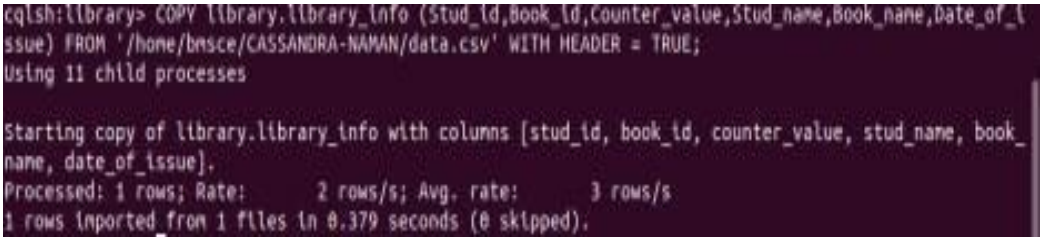
5. **Write a query to show that a student with id 112 has taken a book “BDA” 2 times.**

   select counter_value as borrow_count form Library_info where Stud_if=1 and Book_id=123

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



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



Lab 4

```
arvind@Vasko:~$ /usr/local/hadoop/hadoop-3.4.0/bin/hadoop version
Hadoop 3.4.0
Source code repository git@github.com:apache/hadoop.git -r bd8b77f398f626bb77917
83192ee7a5dfaeec760
Compiled by root on 2024-03-04T06:35Z
Compiled on platform linux-x86_64
Compiled with protoc 3.21.12
From source with checksum f7fe694a3613358b38812ae9c31114e
This command was run using /usr/local/hadoop/hadoop-3.4.0/share/hadoop/common/ha
doop-common-3.4.0.jar
```

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

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

Lab 5

1. **MKDIR**

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

2. **LS**

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -ls /First
```

3. **PUT**

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put
/home/hadoop/Documents/test.txt /First/test.txt
```

4. **CAT**

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /First/test.txt
Hello World!

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /First
Found 1 items
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /First/test.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -ls /First
Found 1 items
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /First/test.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ jps
7297 Jps
3860 ResourceManager
4020 NodeManager
3306 DataNode
3149 NameNode
3581 SecondaryNameNode
```

5. **GET**

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /First/test/txt
/home/hadoop/Documents/got.txt
get: `/First/test/txt': No such file or directory

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /First/test.txt
/home/hadoop/Documents/got.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ cat
home/hadoop/Documents/got.txt

cat: home/hadoop/Documents/got.txt: No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ cat
home/hadoop/Documents/got.txt
```

cat: home/hadoop/Documents/got.txt: No such file or directory

6. PUT

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put /home/hadoop/Documents/test.txt /First/test1.txt

7. GETMERGE

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -getmerge /First/test.txt /First/test1.txt /home/hadoop/Documents/new.txt

8. GETFACL

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -getfacl /First/
# file: /First
# owner: hadoop
# group: supergroup
user::rwx
group::r-x
other::r-x
```

9. COPYTOLOCAL

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -copyToLocal /First/test1.txt /home/hadoop/Documents

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /First/test1.txt
Hello World!

10. MV

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mv /First /FFF
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /First /FFF
ls: `/First': No such file or directory
Found 2 items
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /FFF/test.txt
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:44 /FFF/test1.txt
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /FFF /First
Found 2 items
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /FFF/test.txt
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:44 /FFF/test1.txt
```

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -ls /First
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put /home/hadoop/Documents/test.txt /First/test.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /First/test.txt
Hello World!

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /First
Found 1 items

```
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /First/test.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -ls /First
Found 1 items
-rw-r--r--   1 hadoop supergroup         13 2024-05-14 14:22 /First/test.txt

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ jps
7297 Jps
3860 ResourceManager
4020 NodeManager
3306 DataNode
3149 NameNode
3581 SecondaryNameNode

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /First/test.txt
/home/hadoop/Documents/got.txt
```

Lab 6

Word Count

Implement WordCount Program on Hadoop framework

WCMapper Java Class file.

```
// Importing libraries 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> {


// Map function

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

{

String line = value.toString();


// Splitting the line on spaces 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:

// 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);

}
```

Lab 7

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

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);    }

}
```

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));

}

}
```

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));

}

}
```

Lab 8

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

Mapper.py

```
import sys
# Read input from STDIN
for line in sys.stdin:
    # Remove leading and trailing whitespace
    line = line.strip()
    # Split the line into words
    words = line.split()
    # Emit the word along with a count of 1
    for word in words:
        print(f"{word}\t1")
```

Reducer.py

```
import sys
from collections import defaultdict
word_counts = defaultdict(int)
# Read input from STDIN
for line in sys.stdin:
    # Remove leading and trailing whitespace
    line = line.strip()
    # Parse the input we got from mapper.py
    word, count = line.split('\t', 1)
```

```
    # Convert count from string to int
    try:
        count = int(count)
    except ValueError:
        continue
    # Increment word count
    word_counts[word] += count

# Sort words alphabetically
sorted_words = sorted(word_counts.items(), key=lambda x: x[0])

# Emit the top 10 words with the highest counts
for word, count in sorted(sorted_words, key=lambda x: -x[1])[:10]:
    print(f"{word}\t{count}")
```

Driver.py

```
import os
import subprocess

def run_mapreduce(input_path, output_path, mapper_path, reducer_path):
    # Hadoop streaming jar path - you may need to adjust this based on your Hadoop installation
    hadoop_streaming_jar = '/usr/lib/hadoop/hadoop-streaming.jar'

    # Construct the Hadoop streaming command
```

```
    hadoop_command = [
        'hadoop', 'jar', hadoop_streaming_jar,
        '-input', input_path,
        '-output', output_path,
        '-mapper', mapper_path,
        '-reducer', reducer_path,
        '-combiner', reducer_path,
        '-file', mapper_path,
        '-file', reducer_path
    ]

    try:
        # Run the Hadoop streaming command
        subprocess.run(hadoop_command, check=True)
        print(f"MapReduce job completed successfully. Output is stored in
{output_path}")
    except subprocess.CalledProcessError as e:
        print(f"MapReduce job failed with error: {e}")

if __name__ == "__main__":
    # Paths to input and output directories in HDFS
    input_path = '/path/to/input.txt'
    output_path = '/path/to/output'

    # Paths to the mapper and reducer scripts
```

```
mapper_path = 'mapper.py'
reducer_path = 'reducer.py'

# Run the MapReduce job
run_mapreduce(input_path, output_path, mapper_path, reducer_path)
```