

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.



LAB REPORT
on

BIG DATA ANALYTICS **(20CS6PEBDA)**

Submitted by

HARSHITHA RM (1BM19CS060)

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

in
COMPUTER SCIENCE AND ENGINEERING



B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institution under VTU)

BENGALURU-560019

May-2022 to July-2022

B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering



CERTIFICATE

This is to certify that the Lab work entitled “**BIG DATA ANALYTICS**” carried out by **HARSHITHA RM(1BM19CS060)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022. The Lab report has been approved as it satisfies the academic requirements in respect of a **BIG DATA ANALYTICS - (20CS6PEBDA)**work prescribed for the said degree.

ANTARA ROY CHOUDURY
Assistant Professor
Department of CSE
BMSCE, Bengaluru

Dr. Jyothi S Nayak
Professor and Head
Department of CSE
BMSCE, Bengaluru

Index Sheet

Sl. No.	Experiment Title	Page No.
1	Employee Database	5
2	Library	7
3	Mongo (CRUD)	8
4	Hadoop installation	11
5	HDFS Commands	12
6	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	15
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.	20
8	Create a Map Reduce program to demonstrating join operation	23
9	Program to print word count on scala shell and print "Hello world" on scala IDE	28
10	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	29

Course Outcome

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

Lab 1

```
1 cqlsh> create keyspace employee_space WITH REPLICATION = {'class' : 'SimpleStrategy', 'replication_factor':2};
2
3 CREATE TABLE employee_space.employee_info (emp_id int PRIMARY KEY,emp_name text,designation text,date_of_joining timestamp,salary float,dept_name text);
4
5 cqlsh> begin batch INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(1,'Damodar','Manager','2022-01-24',1000000,'Marketing');
6 ... apply batch;
7 cqlsh> begin batch INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(2,'Mahalaxmi','Accountant','2021-01-24',2000000,'Accounts');
8 ... INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(3,'Mahesh','Manager','2021-03-24',500000,'Marketing');
9 ... INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(4,'Nidhi','Administrator','2021-05-24',500000,'Administration');
10 ... INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(5,'Rahul','Administrator','2009-05-24',2000000,'Administration');
11 ... apply batch;
12
13 cqlsh> use employee_space;
14
15 cqlsh:employee_space> select * from employee_info;
16
17 emp_id | date_of_joining          | dept_name | designation | emp_name | salary
18 -----+-----+-----+-----+-----+-----
19 5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | 2e+06
20 1 | 2022-01-23 18:30:00.000000+0000 | Marketing | Manager | Damodar | 1e+05
21 2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant | Mahalaxmi | 2e+05
22 4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | 5e+05
23 3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager | Mahesh | 5e+05
24
25 (5 rows)
26
27
28 cqlsh:employee_space> update employee_info set emp_name='Radha' where emp_id=1;
29
30 cqlsh:employee_space> update employee_info set dept_name='Development' where emp_id=1;
31
32 cqlsh:employee_space> select * from employee_info;
33
34 emp_id | date_of_joining          | dept_name | designation | emp_name | salary
35 -----+-----+-----+-----+-----+-----
36 5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | 2e+06
37 1 | 2022-01-23 18:30:00.000000+0000 | Development | Manager | Radha | 1e+05
38 2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant | Mahalaxmi | 2e+05
39 4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | 5e+05
40 3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager | Mahesh | 5e+05
41
42 (5 rows)
43
44 cqlsh:employee_space> alter table employee_info add projects set<text>;
45
46 cqlsh:employee_space> update employee_info set projects=projects+{'Web development','machine learning'} where emp_id=2;
47
48 cqlsh:employee_space> select * from employee_info;
49
50 emp_id | date_of_joining          | dept_name | designation | emp_name | projects | salary
51 -----+-----+-----+-----+-----+-----+-----
52 5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | null | 2e+06
53 1 | 2022-01-23 18:30:00.000000+0000 | Development | Manager | Radha | null | 1e+05
54 2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant | Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
55 4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | null | 5e+05
56 3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager | Mahesh | null | 5e+05
57
58 (5 rows)
59 cqlsh:employee_space> update employee_info set projects=projects+{'Web development','machine learning','cybersecurity'} where emp_id=5;
60
61 cqlsh:employee_space> select * from employee_info;
62
```

```

63 emp_id | date_of_joining          | dept_name    | designation | emp_name | projects                                     | salary
64 -----+-----+-----+-----+-----+-----+-----
65      5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06
66      1 | 2022-01-23 18:30:00.000000+0000 | Development    | Manager      | Radha | null | 1e+05
67      2 | 2021-01-23 18:30:00.000000+0000 | Accounts       | Accountant   | Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
68      4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | null | 5e+05
69      3 | 2021-03-23 18:30:00.000000+0000 | Marketing      | Manager      | Mahesh | null | 5e+05
70
71 (5 rows)
72
73 cqlsh:employee_space> INSERT INTO employee_space.employee_info(emp_id,emp_name,designation,date_of_joining,salary,dept_name) VALUES(6,'Harshitha','Manager','2022-01-24',10000
74
75 cqlsh:employee_space> select * from employee_info;
76
77 emp_id | date_of_joining          | dept_name    | designation | emp_name | projects                                     | salary
78 -----+-----+-----+-----+-----+-----+-----
79      5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06
80      1 | 2022-01-23 18:30:00.000000+0000 | Development    | Manager      | Radha | null | 1e+05
81      2 | 2021-01-23 18:30:00.000000+0000 | Accounts       | Accountant   | Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
82      4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | null | 5e+05
83      6 | 2022-01-23 18:30:00.000000+0000 | Marketing      | Manager      | Harshitha | null | 1e+05
84      3 | 2021-03-23 18:30:00.000000+0000 | Marketing      | Manager      | Mahesh | null | 5e+05
85
86 (6 rows)
87
88 cqlsh:employee_space> select * from employee_info;
89
90 emp_id | date_of_joining          | dept_name    | designation | emp_name | projects                                     | salary
91 -----+-----+-----+-----+-----+-----+-----
92      5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator | Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06
93      1 | 2022-01-23 18:30:00.000000+0000 | Development    | Manager      | Radha | null | 1e+05
94      2 | 2021-01-23 18:30:00.000000+0000 | Accounts       | Accountant   | Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
95      4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator | Nidhi | null | 5e+05
96      3 | 2021-03-23 18:30:00.000000+0000 | Marketing      | Manager      | Mahesh | null | 5e+05
97

```

LAB 2

```
1 cqlsh> create keyspace library_space WITH REPLICATION={ 'class': 'SimpleStrategy', 'replication_factor': 2 };
2
3 cqlsh> use library_space;
4
5 cqlsh:library_space> create table library_info(stud_id int, counter_value counter, stud_name text, book_name text, book_id int, date_of_issue timestamp, PRIMARY KEY(stud_id, stud_name));
6
7 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=1 and stud_name='abc' and book_name='book1' and book_id=11 and date_of_issue='2022-01-29';
8
9 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=2 and stud_name='def' and book_name='book2' and book_id=12 and date_of_issue='2022-03-29';
10
11 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=3 and stud_name='ghi' and book_name='book3' and book_id=13 and date_of_issue='2022-05-29';
12
13 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=4 and stud_name='jkl' and book_name='book4' and book_id=14 and date_of_issue='2022-07-29';
14
15 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=5 and stud_name='mno' and book_name='book5' and book_id=15 and date_of_issue='2022-09-29';
16
17 cqlsh:library_space> select * from library_info;
18
19 stud_id | stud_name | book_name | book_id | date_of_issue | counter_value
20 -----+-----+-----+-----+-----+-----
21 5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 | 1
22 1 | abc | book1 | 11 | 2022-01-29 18:30:00.000000+0000 | 1
23 2 | def | book2 | 12 | 2022-03-29 18:30:00.000000+0000 | 1
24 4 | jkl | book4 | 14 | 2022-07-29 18:30:00.000000+0000 | 1
25 3 | ghi | book3 | 13 | 2022-05-29 18:30:00.000000+0000 | 1
26
27 (5 rows)
28
29 cqlsh:library_space> update library_info set counter_value=counter_value+1 where stud_id=5 and stud_name='mno' and book_name='book5' and book_id=15 and date_of_issue='2022-09-29';
30
31 cqlsh:library_space> select * from library_info;
32
33 stud_id | stud_name | book_name | book_id | date_of_issue | counter_value
34 -----+-----+-----+-----+-----+-----
35 5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 | 2
36 1 | abc | book1 | 11 | 2022-01-29 18:30:00.000000+0000 | 1
37 2 | def | book2 | 12 | 2022-03-29 18:30:00.000000+0000 | 1
38 4 | jkl | book4 | 14 | 2022-07-29 18:30:00.000000+0000 | 1
39 3 | ghi | book3 | 13 | 2022-05-29 18:30:00.000000+0000 | 1
40
41 (5 rows)
42
43 cqlsh:library_space> copy library_info(stud_id,stud_name,book_name,book_id,date_of_issue,counter_value) to '/home/bmscse/Desktop/bda.csv';
44
45 Using 11 child processes
46
47 Starting copy of library_space.library_info with columns [stud_id, stud_name, book_name, book_id, date_of_issue, counter_value].
48 Processed: 5 rows; Rate: 45 rows/s; Avg. rate: 45 rows/s
49 5 rows exported to 1 files in 0.121 seconds.
50
51 cqlsh:library_space> create table library_info_copy(stud_id int, counter_value counter, stud_name text, book_name text, book_id int, date_of_issue timestamp, PRIMARY KEY(stud_id, stud_name));
52
53 cqlsh:library_space> copy library_info_copy(stud_id,stud_name,book_name,book_id,date_of_issue,counter_value) from '/home/bmscse/Desktop/new.csv';
54
55 Using 11 child processes
56
57 Starting copy of library_space.library_info_copy with columns [stud_id, stud_name, book_name, book_id, date_of_issue, counter_value].
58 Processed: 5 rows; Rate: 8 rows/s; Avg. rate: 12 rows/s
59 5 rows imported from 1 files in 0.406 seconds (0 skipped).
60
61 cqlsh:library_space> select * from library_info where counter_value=2 allow filtering;
62
63 stud_id | stud_name | book_name | book_id | date_of_issue | counter_value
64 -----+-----+-----+-----+-----+-----
65 5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 | 2
```

Lab3

use studentdb switched

to db studentdb

```
db.createCollection("student_details")
```

```
{ "ok" : 1 }
```

```
db.student_details.insert({'name':'abc','rollno':1,'age':19,'contactno':9090909090,'email':'abc@lab.
```

```
com'}})
```

```
WriteResult({ "nInserted" : 1 })
```

```
db.student_details.insert({'name':'mno','rollno':2,'age':20,'contactno':9999900000,'email':'mno@lab.com'}})
```

```
WriteResult({ "nInserted" : 1 })
```

```
db.student_details.insert({'name':'xyz','rollno':3,'age':21,'contactno':9999911111,'email':'xyz@lab.com'}})
```

```
WriteResult({ "nInserted" : 1 })
```

```
db.student_details.find({})
```

```
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19, "contactno" : 9090909090, "email" : "abc@lab.com" }
```

```
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20, "contactno" : 9999900000, "email" : "mno@lab.com" }
```

```
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "xyz", "rollno" : 3, "age" : 21, "contactno" : 9999911111, "email" : "xyz@lab.com" }
```

```
db.student_details.update({'rollno':3},{ $set: {'email':'update@lab.com'}})
```

```
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
```



```
db.student_details.find({'rollno':3})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "xyz", "rollno" : 3, "age" : 21,
"contactno" : 9999911111, "email" : "update@lab.com" }
```

```
db.student_details.update({'name':'xyz'},{$set:{'name':'pqr'}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
db.student_details.find({'name':'pqr'})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "pqr", "rollno" : 3, "age" : 21,
"contactno" : 9999911111, "email" : "update@lab.com" }
```

```
mongoexport --db studentdb --collection student_details --out E:\Desktop\sample.json
2021-05-22T10:43:30.687+0530   connected to: mongodb://localhost/
2021-05-22T10:43:31.026+0530   exported 3 records
```

```
db.getCollection('student_details').drop()
true
```

```
mongoimport --db studentdb --collection student_details --type=json --file=
E:\Desktop\sample.json
2021-05-22T10:46:49.898+0530   connected to: mongodb://localhost/ 2021-05-
22T10:46:50.044+0530   3 document(s) imported successfully. 0 document(s) failed to import.
```

```
db.student_details.find({})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "pqr", "rollno" : 3, "age" : 21,
"contactno" : 9999911111, "email" : "update@lab.com" }
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19,
"contactno" : 9090909090, "email" : "abc@lab.com" }
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20,
"contactno" : 9999900000, "email" : "mno@lab.com" }
```

```
db.student_details.remove({age:{$gt:20}})
```

```
WriteResult({ "nRemoved" : 1 })
```

```
db.student_details.find({})
```

```
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19,
"contactno" : 9090909090, "email" : "abc@lab.com" }
```

```
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20,
"contactno" : 9999900000, "email" : "mno@lab.com" }
```

```
db.student_details.find({})
```

```
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19,
"contactno" : 9090909090, "email" : "abc@lab.com" }
```

```
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20, "contactno" :
9999900000, "email" : "mno@lab.com" }
```

```
> use studentdb
switched to db studentdb
> db.createCollection("student_details")
{ "ok" : 1 }
> db.student_details.insert({'name':'abc','rollno':1,'age':19,'contactno':9090909090,'email':'abc@lab.com'})
WriteResult({ "nInserted" : 1 })
> db.student_details.insert({'name':'mno','rollno':2,'age':20,'contactno':9999900000,'email':'mno@lab.com'})
WriteResult({ "nInserted" : 1 })
> db.student_details.insert({'name':'xyz','rollno':3,'age':21,'contactno':9999911111,'email':'xyz@lab.com'})
WriteResult({ "nInserted" : 1 })
> db.student_details.find({})
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19, "contactno" : 9090909090, "email" : "abc@lab.com" }
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20, "contactno" : 9999900000, "email" : "mno@lab.com" }
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "xyz", "rollno" : 3, "age" : 21, "contactno" : 9999911111, "email" : "xyz@lab.com" }
> db.student_details.update({'rollno':3},{set:{'email':'update@lab.com'}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
> db.student_details.find({'rollno':3})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "xyz", "rollno" : 3, "age" : 21, "contactno" : 9999911111, "email" : "update@lab.com" }
> db.student_details.update({'name':'xyz',{set:{'name':'pqr'}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0, "nModified" : 1 })
> db.student_details.find({'name':'pqr'})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "pqr", "rollno" : 3, "age" : 21, "contactno" : 9999911111, "email" : "update@lab.com" }
```

```
> db.student_details.find({})
{ "_id" : ObjectId("60a88f8ffecf7c8abe76777"), "name" : "pqr", "rollno" : 3, "age" : 21, "contactno" : 9999911111, "email" : "update@lab.com" }
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19, "contactno" : 9090909090, "email" : "abc@lab.com" }
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20, "contactno" : 9999900000, "email" : "mno@lab.com" }
> db.student_details.remove({'age':{'gt':20}})
WriteResult({ "nRemoved" : 1 })
> db.student_details.find({})
{ "_id" : ObjectId("60a88f32ffecf7c8abe76775"), "name" : "abc", "rollno" : 1, "age" : 19, "contactno" : 9090909090, "email" : "abc@lab.com" }
{ "_id" : ObjectId("60a88f7effecf7c8abe76776"), "name" : "mno", "rollno" : 2, "age" : 20, "contactno" : 9999900000, "email" : "mno@lab.com" }
```

LAB4

SCREENSHOT OF HADOOP INSTALLATION

Administrator: Command Prompt

Microsoft Windows [Version 10.0.19043.1766]

(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>start-dfs

C:\WINDOWS\system32>start-yarn
starting yarn daemons

C:\WINDOWS\system32>jps

16520 NameNode

23544 NodeManager

9240 DataNode

11692 Eclipse

16924 Jps

20060 ResourceManager

C:\WINDOWS\system32>hdfs dfs -ls /

Found 3 items

drwxr-xr-x	-	HARSHITHA	RM	supergroup	0	2022-06-20	15:31	/har
------------	---	-----------	----	------------	---	------------	-------	------

drwxr-xr-x	-	HARSHITHA	RM	supergroup	0	2022-07-10	14:18	/rgs
------------	---	-----------	----	------------	---	------------	-------	------

drwx-----	-	HARSHITHA	RM	supergroup	0	2022-07-10	14:20	/tmp
-----------	---	-----------	----	------------	---	------------	-------	------

C:\WINDOWS\system32>hdfs dfs -ls /rgs

Found 1 items

-rw-r--r--	1	HARSHITHA	RM	supergroup	96	2022-07-10	14:18	/rgs/test.txt
------------	---	-----------	----	------------	----	------------	-------	---------------

LAB 5

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

```
c:\hadoop_new\sbin>hdfs dfs -mkdir /temp
```

```
c:\hadoop_new\sbin>hdfs dfs -copyFromLocal E:\Desktop\sample.txt \temp
```

```
c:\hadoop_new\sbin>hdfs dfs -ls \temp
```

Found 1 items

```
-rw-r--r--  1 Admin supergroup    11 2021-06-11 21:12 /temp/sample.txt
```

```
c:\hadoop_new\sbin>hdfs dfs -cat \temp\sample.txt hello
world
```

```
c:\hadoop_new\sbin>hdfs dfs -get \temp\sample.txt E:\Desktop\temp
```

```
c:\hadoop_new\sbin>hdfs dfs -put E:\Desktop\temp \temp
```

```
c:\hadoop_new\sbin>hdfs dfs -ls \temp
```

Found 2 items

```
-rw-r--r--  1 Admin supergroup    11 2021-06-11 21:12 /temp/sample.txt drwxr-xr-x  -
Admin supergroup    0 2021-06-11 21:15 /temp/temp
```

```
c:\hadoop_new\sbin>hdfs dfs -mv \lab1 \temp
```

```
c:\hadoop_new\sbin>hdfs dfs -ls \temp Found 3 items drwxr-xr-x  - Admin
supergroup    0 2021-04-19 15:07 /temp/lab1 -rw-r--r--  1 Admin
```

```
supergroup      11 2021-06-11 21:12 /temp/sample.txt drwxr-xr-x -  
Admin supergroup    0 2021-06-11 21:15 /temp/temp
```

```
c:\hadoop_new\sbin>hdfs dfs -rm /temp/sample.txt
```

```
Deleted /temp/sample.txt
```

```
c:\hadoop_new\sbin>hdfs dfs -ls /temp Found 2 items drwxr-xr-x - Admin
```

```
supergroup      0 2021-04-19 15:07 /temp/lab1 drwxr-xr-x - Admin
```

```
supergroup      0 2021-06-11 21:15 /temp/temp
```

```
c:\hadoop_new\sbin>hdfs dfs -copyFromLocal E:\Desktop\sample.txt /temp
```

```
c:\hadoop_new\sbin>hdfs dfs -ls /temp Found 3 items drwxr-xr-x - Admin
```

```
supergroup      0 2021-04-19 15:07 /temp/lab1 -rw-r--r--  1 Admin supergroup
```

```
11 2021-06-11 21:17 /temp/sample.txt drwxr-xr-x - Admin supergroup      0
```

```
2021-06-11 21:15 /temp/temp
```

```
c:\hadoop_new\sbin>hdfs dfs -copyToLocal /temp/sample.txt E:\Desktop\sample.txt
```

```

c:\hadoop_new\sbin>hdfs dfs -mkdir /temp

c:\hadoop_new\sbin>hdfs dfs -copyFromLocal E:\Desktop\sample.txt \temp

c:\hadoop_new\sbin>hdfs dfs -ls \temp
Found 1 items
-rw-r--r--    1 Admin supergroup          11 2021-06-11 21:12 /temp/sample.txt

c:\hadoop_new\sbin>hdfs dfs -cat \temp\sample.txt
hello world

c:\hadoop_new\sbin>hdfs dfs -get \temp\sample.txt E:\Desktop\temp

c:\hadoop_new\sbin>hdfs dfs -put E:\Desktop\temp \temp

c:\hadoop_new\sbin>hdfs dfs -ls \temp
Found 2 items
-rw-r--r--    1 Admin supergroup          11 2021-06-11 21:12 /temp/sample.txt
drwxr-xr-x    - Admin supergroup          0 2021-06-11 21:15 /temp/temp

c:\hadoop_new\sbin>hdfs dfs -mv \lab1 \temp

c:\hadoop_new\sbin>hdfs dfs -ls \temp
Found 3 items
drwxr-xr-x    - Admin supergroup          0 2021-04-19 15:07 /temp/lab1
-rw-r--r--    1 Admin supergroup          11 2021-06-11 21:12 /temp/sample.txt
drwxr-xr-x    - Admin supergroup          0 2021-06-11 21:15 /temp/temp

c:\hadoop_new\sbin>hdfs dfs -rm /temp/sample.txt
Deleted /temp/sample.txt

c:\hadoop_new\sbin>hdfs dfs -ls \temp
Found 2 items
drwxr-xr-x    - Admin supergroup          0 2021-04-19 15:07 /temp/lab1
drwxr-xr-x    - Admin supergroup          0 2021-06-11 21:15 /temp/temp

c:\hadoop_new\sbin>hdfs dfs -copyFromLocal E:\Desktop\sample.txt \temp

c:\hadoop_new\sbin>hdfs dfs -ls \temp
Found 3 items
drwxr-xr-x    - Admin supergroup          0 2021-04-19 15:07 /temp/lab1
-rw-r--r--    1 Admin supergroup          11 2021-06-11 21:17 /temp/sample.txt
drwxr-xr-x    - Admin supergroup          0 2021-06-11 21:15 /temp/temp

c:\hadoop_new\sbin>hdfs dfs -copyToLocal \temp\sample.txt E:\Desktop\sample.txt

```

LAB 6

For the given file, Create a Map Reduce program to

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

```
// AverageDriver.java package temperature;
```

```
import org.apache.hadoop.io.*; import org.apache.hadoop.fs.*; import
org.apache.hadoop.mapreduce.*; 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 package temperature;
```

```
import org.apache.hadoop.io.*; import org.apache.hadoop.mapreduce.*; import java.io.IOException;
```

```
public class AverageMapper extends Mapper <LongWritable, Text, Text, IntWritable>
{ public static final int MISSING = 9999;
```

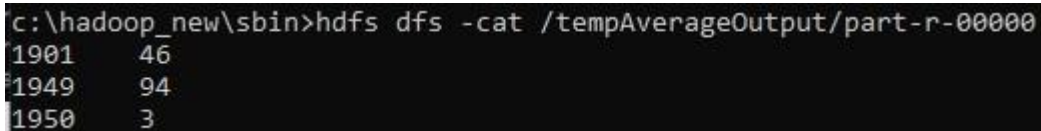
```
public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException
```

```
{
    String line = value.toString();    String year = line.substring(15,19);    int temperature;
    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 != MISSING && quality.matches("[01459]"))
        context.write(new Text(year),new IntWritable(temperature)); }
}
```

```
//AverageReducer.java package temperature;

import org.apache.hadoop.io.IntWritable; import org.apache.hadoop.io.Text; import
org.apache.hadoop.mapreduce.*; import java.io.IOException;

public class AverageReducer extends Reducer <Text, IntWritable,Text, IntWritable>
{
    public void reduce(Text key, Iterable<IntWritable> values, Context context) throws
IOException,InterruptedException
    {
        int max_temp = 0;          int count = 0;
        for (IntWritable value : values)
        {
            max_temp += value.get();
            count+=1;
        }
        context.write(key, new IntWritable(max_temp/count));
    }
}
```



```
c:\hadoop_new\sbin>hdfs dfs -cat /tempAverageOutput/part-r-00000
1901      46
1949      94
1950       3
```

```
//TempDriver.java package
temperatureMax;

import org.apache.hadoop.io.*; import org.apache.hadoop.fs.*; import
org.apache.hadoop.mapreduce.*; import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat; import
org.apache.hadoop.mapreduce.lib.output.FileOutputFormat;

public class TempDriver
{
    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(TempDriver.class);          job.setJobName("Max
    temperature");

    FileInputFormat.addInputPath(job,new Path(args[0]));
    FileOutputFormat.setOutputPath(job,new Path (args[1]));

    job.setMapperClass(TempMapper.class);
    job.setReducerClass(TempReducer.class);

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

//TempMapper.java package
temperatureMax;

import org.apache.hadoop.io.*; import
org.apache.hadoop.mapreduce.*; import
java.io.IOException;

public class TempMapper extends Mapper <LongWritable, Text, Text, IntWritable>
{ public static final int MISSING = 9999;

    public void map(LongWritable key, Text value, Context context) throws IOException,
    InterruptedException
    {

```

```

        String line = value.toString();    String month = line.substring(19,21);
int temperature;        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 != MISSING &&
quality.matches("[01459]"))        context.write(new Text(month),new
IntWritable(temperature)); }

}

//TempReducer.java package
temperatureMax;

import org.apache.hadoop.io.*; import
org.apache.hadoop.mapreduce.*; import
java.io.IOException;

public class TempMapper extends Mapper <LongWritable, Text, Text, IntWritable>
{ public static final int MISSING = 9999;

public void map(LongWritable key, Text value, Context context) throws IOException,
InterruptedException
{
        String line = value.toString();    String month = line.substring(19,21);
int temperature;        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 != MISSING &&
quality.matches("[01459]"))        context.write(new Text(month),new
IntWritable(temperature));

```

```
}  
}
```

```
c:\hadoop_new\sbin>hdfs dfs -cat /tempMaxOutput/part-r-00000  
01      44  
02      17  
03     111  
04     194  
05     256  
06     278  
07     317  
08     283  
09     211  
10     156  
11      89  
12     117
```

LAB 7

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

```
// TopN.java package sortWords;

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.Reducer; import
org.apache.hadoop.mapreduce.lib.input.FileInputFormat; import
org.apache.hadoop.mapreduce.lib.output.FileOutputFormat; import
org.apache.hadoop.util.GenericOptionsParser; import utils.MiscUtils;

import java.io.IOException; import java.util.*;

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.setCombinerClass(TopNReducer.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);
    }

    /**
     * The mapper reads one line at the time, splits it into an array of single words and emits every    *
     word to the reducers with the value of 1.
     */
    public static class TopNMapper extends Mapper<Object, Text, Text, IntWritable> {

        private final static IntWritable one = new IntWritable(1);    private Text word = new Text();
        private String tokens = "[_!$#<>\\^=\\[\\]\\|\\*\\/\\\\\\.,;\\.\\-:()?!\"'"]";

        @Override
        public void map(Object key, Text value, Context context) throws IOException,
```

```

InterruptedException {
    String cleanLine = value.toString().toLowerCase().replaceAll(tokens, " ");
    = new StringTokenizer(cleanLine); while (itr.hasMoreTokens()) {
        word.set(itr.nextToken().trim()); context.write(word, one);
    }
}

/**
 * The reducer retrieves every word and puts it into a Map: if the word already exists in the * map,
 * increments its value, otherwise sets it to 1.
 */
public static class TopNReducer extends Reducer<Text, IntWritable, Text, IntWritable> {

    private Map<Text, IntWritable> countMap = new HashMap<>();

    @Override
    public void reduce(Text key, Iterable<IntWritable> values, Context context) throws IOException,
    InterruptedException {

        // computes the number of occurrences of a single word int sum = 0; for
        (IntWritable val : values) { sum += val.get();
        }
        // puts the number of occurrences of this word into the map.
        // We need to create another Text object because the Text instance
        // we receive is the same for all the words countMap.put(new Text(key), new
        IntWritable(sum));
    }
    @Override
    protected void cleanup(Context context) throws IOException, InterruptedException {

        Map<Text, IntWritable> sortedMap = MiscUtils.sortByValues(countMap);

        int counter = 0; for (Text key : sortedMap.keySet()) { if (counter++ == 3) {
        break;
        }
        context.write(key, sortedMap.get(key));
        }
    }

    /**
     * The combiner retrieves every word and puts it into a Map: if the word already exists in the *
     * map, increments its value, otherwise sets it to 1.
     */
    public static class TopNCombiner extends Reducer<Text, IntWritable, Text, IntWritable> {

        @Override

```

```

    public void reduce(Text key, Iterable<IntWritable> values, Context context) throws IOException,
    InterruptedException {

```

```

        // computes the number of occurrences of a single word
        (IntWritable val : values) {
            sum += val.get();
        }
        context.write(key, new IntWritable(sum));
    }
}

```

```

// MiscUtils.java package utils;

```

```

import java.util.*;

```

```

public class MiscUtils {

```

```

    /**
    sorts the map by values. Taken from:
    http://javarevisited.blogspot.it/2012/12/how-to-sort-hashmap-java-by-key-and-value.html
    */
    public static <K extends Comparable, V extends Comparable> Map<K, V> sortByValues(Map<K, V>
    map) {
        List<Map.Entry<K, V>> entries = new LinkedList<Map.Entry<K, V>>(map.entrySet());

        Collections.sort(entries, new Comparator<Map.Entry<K, V>>() {

            @Override      public int compare(Map.Entry<K, V> o1, Map.Entry<K, V> o2) {      return
            o2.getValue().compareTo(o1.getValue());
        }
    });

    //LinkedHashMap will keep the keys in the order they are inserted
    //which is currently sorted on natural ordering
    Map<K, V> sortedMap = new LinkedHashMap<K, V>();
    for (Map.Entry<K, V> entry : entries) {
        sortedMap.put(entry.getKey(), entry.getValue());
    }

    return sortedMap;
}

```

```

C:\hadoop_new\share\hadoop\mapreduce>hdfs dfs -cat \sortwordsOutput\part-r-00000
car      7
deer     6
bear     3

```

LAB 8

Create a Hadoop Map Reduce program to combine information from the users file along with Information from the posts file by using the concept of join and display user_id, Reputation and Score.

```
// JoinDriver.java import org.apache.hadoop.conf.Configured; import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text; import org.apache.hadoop.mapred.*; import
org.apache.hadoop.mapred.lib.TextInputFormat; import org.apache.hadoop.util.*;
```

```
public class JoinDriver extends Configured implements Tool {

    public static class KeyPartitioner implements Partitioner<TextPair, Text> {
        @Override
        public void configure(JobConf job) {}

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

    @Override public int run(String[] args) throws Exception {
        if (args.length != 3) {
            System.out.println("Usage: <Department Emp Strength input>
            <Department Name input> <output>");
            return -1;
        }

        JobConf conf = new JobConf(getConf(), getClass());
        conf.setJobName("Join
        'Department Emp Strength input' with 'Department Name input'");

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

        MultipleInputs.addInputPath(conf, AInputPath, TextInputFormat.class,
        Posts.class);
        MultipleInputs.addInputPath(conf, BInputPath, TextInputFormat.class,
        User.class);

        FileOutputFormat.setOutputPath(conf, outputPath);

        conf.setPartitionerClass(KeyPartitioner.class);
        conf.setOutputValueGroupingComparator(TextPair.FirstComparator.class);

        conf.setMapOutputKeyClass(TextPair.class);
    }
}
```

```

        conf.setReducerClass(JoinReducer.class);

        conf.setOutputKeyClass(Text.class);

        JobClient.runJob(conf);

        return 0;
    }

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

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

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

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

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

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

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

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

import org.apache.hadoop.io.IntWritable;

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

    @Override

```



```

public void map(LongWritable key, Text value, OutputCollector<TextPair, Text> output, Reporter
reporter)
    throws IOException
{
    String valueString = value.toString();
    String[] SingleNodeData = valueString.split("\t");
    output.collect(new TextPair(SingleNodeData[0], "1"), new
Text(SingleNodeData[1]));
}
}

//Posts.java import java.io.IOException;

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

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

    @Override
    public void map(LongWritable key, Text value, OutputCollector<TextPair, Text> output, Reporter
reporter)
        throws IOException
    {
        String valueString = value.toString();
        String[] SingleNodeData = valueString.split("\t");
        output.collect(new
TextPair(SingleNodeData[3], "0"), new
Text(SingleNodeData[9]));
    }
}

// TextPair.java import java.io.*;

import org.apache.hadoop.io.*;
public class TextPair implements WritableComparable<TextPair> {

    private Text first; private Text second;

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

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

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

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

```

```

public Text getFirst() { return first;
}

public Text getSecond() { return second;
}

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

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

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

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

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

@Override
public int compareTo(TextPair tp) { int cmp = first.compareTo(tp.first); if (cmp != 0) { return
cmp;
}
return second.compareTo(tp.second);
}
// ^^ TextPair

// vv TextPairComparator public static class Comparator extends WritableComparator {

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

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

@Override public int compare(byte[] b1, int s1, int l1, byte[] b2, int s2, int l2) {
try {
int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1); int firstL2 =
WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2); int cmp =
TEXT_COMPARATOR.compare(b1, s1, firstL1, b2, s2, firstL2); if (cmp != 0) { return cmp;
}
return TEXT_COMPARATOR.compare(b1, s1 + firstL1, l1 - firstL1,

```

```

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

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

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

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

    @Override    public int compare(byte[] b1, int s1, int l1,                byte[] b2, int s2, int l2) {
        try {
            int firstL1 = WritableUtils.decodeVIntSize(b1[s1]) + readVInt(b1, s1);    int firstL2 =
WritableUtils.decodeVIntSize(b2[s2]) + readVInt(b2, s2);    return TEXT_COMPARATOR.compare(b1,
s1, firstL1, b2, s2, firstL2);
        } catch (IOException e) {        throw new IllegalArgumentException(e);
        }
    }

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

```

```

c:\hadoop_new\share\hadoop\mapreduce>hdfs dfs -cat \joinOutput\part-00000
"100005361"    "2"    "36134"
"100018705"    "2"    "76"
"100022094"    "0"    "6354"

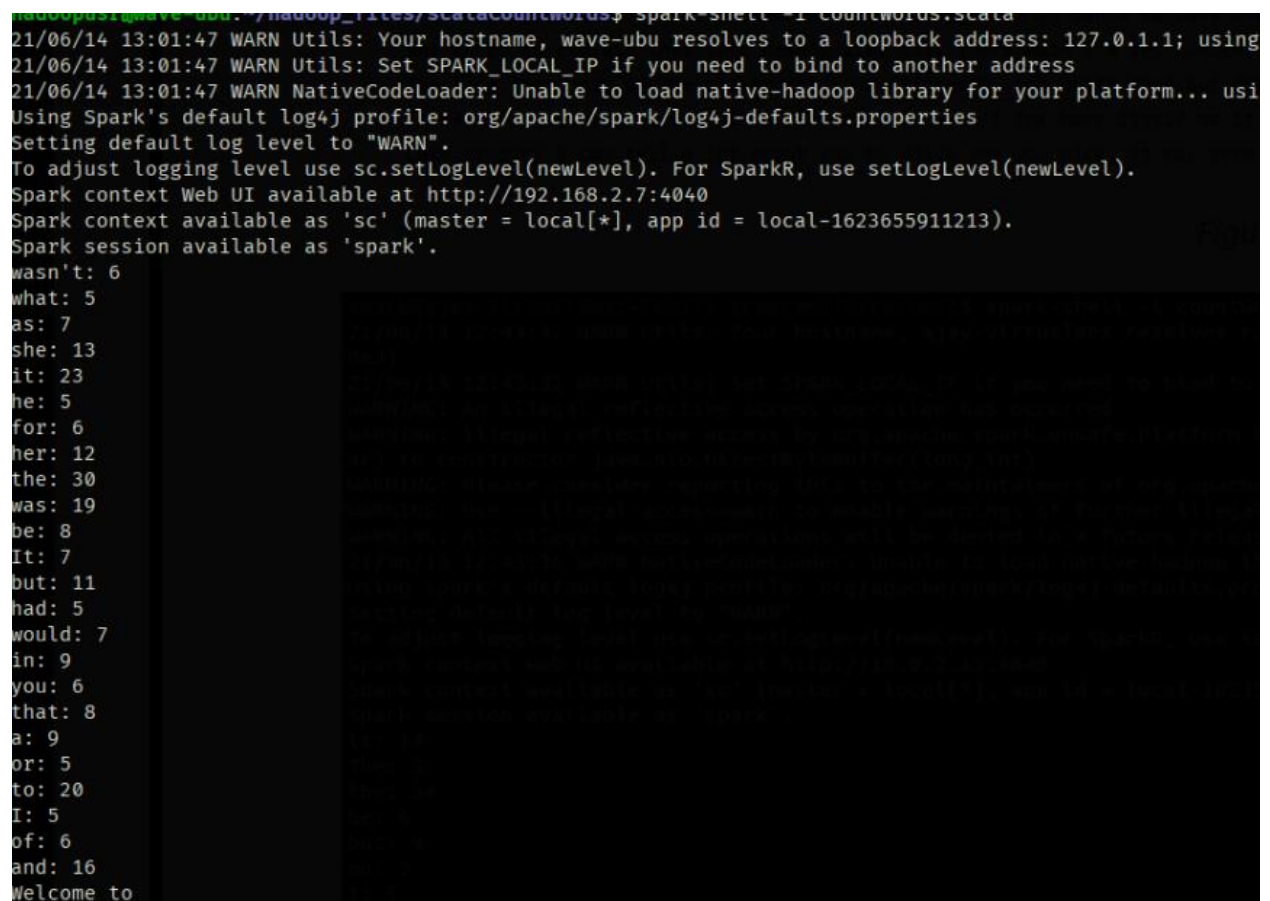
```

LAB 9

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

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

```
val data=sc.textFile("sparkdata.txt")  
data.collect;  
val splitdata = data.flatMap(line => line.split(" "));  
splitdata.collect;  
val mapdata = splitdata.map(word => (word,1));  
mapdata.collect;  
val reducedata = mapdata.reduceByKey(_+_);  
reducedata.collect;
```



The screenshot shows a terminal window with the following content:

```
wave-ubu: ~/hadoop_files/scalacountwords$ spark-shell -i CountWords.scala  
21/06/14 13:01:47 WARN Utils: Your hostname, wave-ubu resolves to a loopback address: 127.0.1.1; using  
21/06/14 13:01:47 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address  
21/06/14 13:01:47 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... usi  
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties  
Setting default log level to "WARN".  
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).  
Spark context Web UI available at http://192.168.2.7:4040  
Spark context available as 'sc' (master = local[*], app id = local-1623655911213).  
Spark session available as 'spark'.  
wasn't: 6  
what: 5  
as: 7  
she: 13  
it: 23  
he: 5  
for: 6  
her: 12  
the: 30  
was: 19  
be: 8  
It: 7  
but: 11  
had: 5  
would: 7  
in: 9  
you: 6  
that: 8  
a: 9  
or: 5  
to: 20  
I: 5  
of: 6  
and: 16  
Welcome to
```

LAB 10

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

```
scala> val textfile = sc.textFile("/home/sam/Desktop/abc.txt")
textfile: org.apache.spark.rdd.RDD[String] = /home/sam/Desktop/abc.txt MapPartitionsRDD[8] at textFile at <console>:25

scala> val counts = textfile.flatMap(line => line.split(" ")).map(word => (word,1)).reduceByKey(_+_ )
counts: org.apache.spark.rdd.RDD[(String, Int)] = ShuffledRDD[11] at reduceByKey at <console>:26

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

scala> val sorted = ListMap(counts.collect.sortWith(_. _2>_. _2):_*)
sorted: scala.collection.immutable.ListMap[String,Int] = ListMap(hello -> 3, apple -> 2, unicorn -> 1, world -> 1)

scala> println(sorted)
ListMap(hello -> 3, apple -> 2, unicorn -> 1, world -> 1)
```