

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



B.M.S. COLLEGE OF ENGINEERING

(Autonomous Institution under VTU)

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CERTIFICATE

This is to certify that the Lab work entitled “BIG DATA ANALYTICS” carried out by **AKSHATHA SHIVAKUMAR (1BM19CS011)**, 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.

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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, Hadoopor Spark

DB operations using Cassandra (on Employee):

```
cqlsh> create keyspace mplojee_space WITH REPLICATION = {'class':  
'SimpleStrategy','replication_factor':2};  
  
CREATE TABLE employee_space.employee_info (emp_id int  
PRIMARY KEY,emp_name text,designation text,date_of_joining  
timestamp,salaryfloat,dept_name text);  
  
cqlsh> begin batch INSERT INTO  
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini  
ng,salary,dept_name) VALUES(1,'Damodar','Manager','2022-01-  
24',100000,'Marketing');  
  
... apply batch;  
  
cqlsh> begin batch INSERT INTO  
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini  
ng,salary,dept_name) VALUES(2,'Mahalaxmi','Accountant','2021-01-  
24',200000,'Accounts');  
  
... INSERT INTO  
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini  
ng,salary,dept_name) VALUES(3,'Mahesh','Manager','2021-03-
```

```
24',500000,'Marketing');
```

```
... INSERT INTO
```

```
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini  
ng,salary,dept_name) VALUES(4,'Nidhi','Administrator','2021-05-  
24',500000,'Administration');
```

```
... INSERT INTO
```

```
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini  
ng,salary,dept_name) VALUES(5,'Rahul','Administrator','2009-05-  
24',2000000,'Administration');
```

```
... apply batch;
```

```
cqlsh> use employee_space;
```

```
cqlsh:employee_space> select * from employee_info;
```

```
emp_id | date_of_joining | dept_name | designation |  
emp_name | salary
```

```
.....+.....+.....+.....+.....+.....
```

```
5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |
```

```
Rahul | 2e+06
```

```
1 | 2022-01-23 18:30:00.000000+0000 | Marketing | Manager |
```

```
Damodar | 1e+05
```

```
2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |
```

```
Mahalaxmi | 2e+05
```

```
4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |
```

```
Nidhi | 5e+05
```

```
3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |
```

```
Mahesh | 5e+05
```

(5 rows)

```
cqlsh:employee_space> update employee_info set emp_name='Radha' where  
emp_id=1;
```

```
cqlsh:employee_space> update employee_info set dept_name='Development' where  
emp_id=1;
```

```
cqlsh:employee_space> select * from employee_info;
```

```
emp_id | date_of_joining | dept_name | designation |  
emp_name | salary
```

```
.....+.....+.....+.....+.....+.....
```

```
5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |  
Rahul | 2e+06
```

```
1 | 2022-01-23 18:30:00.000000+0000 | Development | Manager |  
Radha | 1e+05
```

```
2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |  
Mahalaxmi | 2e+05
```

```
4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |  
Nidhi | 5e+05
```

```
3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |  
Mahesh | 5e+05
```

(5 rows)

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

```
cqlsh:employee_space> update employee_info set projects=projects+{'Web  
development','machine learning'} where emp_id=2; cqlsh:employee_space>  
select * from employee_info;
```

```
emp_id | date_of_joining | dept_name | designation |
```

emp_name | projects | salary

.....+.....+.....+.....+.....+.....
.....+.....

5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |

Rahul | null | 2e+06

1 | 2022-01-23 18:30:00.000000+0000 | Development | Manager |

Radha | null | 1e+05

2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |

Mahalaxmi | {'Web development', 'machine learning'} | 2e+05

4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |

Nidhi | null | 5e+05

3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |

Mahesh | null | 5e+05

(5 rows)

cqlsh:employee_space> update employee_info set projects=projects+{'Web
development','machine learning','cybersecurity'} where emp_id=5;

cqlsh:employee_space> select * from employee_info;

emp_id | date_of_joining | dept_name | designation |

emp_name | projects | salary

.....+.....+.....+.....+.....+.....
.....+.....

5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |

Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06 1

| 2022-01-23 18:30:00.000000+0000 | Development | Manager | Radha |

null | 1e+05

2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |
 Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
 4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |
 Nidhi | null | 5e+05
 3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |
 Mahesh | null | 5e+05

(5 rows)

```
cqlsh:employee_space> INSERT INTO
employee_space.employee_info(emp_id,emp_name,designation,date_of_joini
ng,salary,dept_name) VALUES(6,'Harshitha','Manager','2022-01-
24',100000,'Marketing') using ttl 15;
```

```
cqlsh:employee_space> select * from employee_info;
```

emp_id | date_of_joining | dept_name | designation |
 emp_name | projects | salary

.....+.....+.....+.....+.....+.....
+.....

5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |
 Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06 1
 | 2022-01-23 18:30:00.000000+0000 | Development | Manager | Radha |
 null | 1e+05

2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |
 Mahalaxmi | {'Web development', 'machine learning'} | 2e+05
 4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |
 Nidhi | null | 5e+05
 6 | 2022-01-23 18:30:00.000000+0000 | Marketing | Manager |

Harshitha | null | 1e+05

3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |

Mahesh | null | 5e+05

(6 rows)

cqlsh:employee_space> select * from employee_info;

emp_id | date_of_joining | dept_name | designation |

emp_name | projects | salary

.....+.....+.....+.....+.....+.....
.....+.....

5 | 2009-05-23 18:30:00.000000+0000 | Administration | Administrator |

Rahul | {'Web development', 'cybersecurity', 'machine learning'} | 2e+06 1

| 2022-01-23 18:30:00.000000+0000 | Development | Manager | Radha |

null | 1e+05

2 | 2021-01-23 18:30:00.000000+0000 | Accounts | Accountant |

Mahalaxmi | {'Web development', 'machine learning'} | 2e+05

4 | 2021-05-23 18:30:00.000000+0000 | Administration | Administrator |

Nidhi | null | 5e+05

3 | 2021-03-23 18:30:00.000000+0000 | Marketing | Manager |

Mahesh | null | 5e+05

(5 rows)

DB operations using Cassandra (on Library)

```
cqlsh> create keyspace library_space WITH
REPLICATION={'class':'SimpleStrategy','replication_factor':2};
cqlsh> use library_space;
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,book_name,book_id,date_of_issue));
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='2022-01-30';
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='2022-03-30';
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='2022-05-30';
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='2022-07-30';
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='2022-09-30';
```

```
cqlsh:library_space> select * from library_info;
```

```
stud_id | stud_name | book_name | book_id | date_of_issue |
```

```
counter_value
```

```
.....+.....+.....+.....+.....+.....
```

```
5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 |
```

```
1
```

```
1 | abc | book1 | 11 | 2022-01-29 18:30:00.000000+0000 |
```

```
1
```

```
2 | def | book2 | 12 | 2022-03-29 18:30:00.000000+0000 |
```

```
1
```

```
4 | jkl | book4 | 14 | 2022-07-29 18:30:00.000000+0000 | 1
```

```
3 | ghi | book3 | 13 | 2022-05-29 18:30:00.000000+0000 |
```

```
1
```

```
(5 rows)
```

```
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='2022-09-30';
```

```
cqlsh:library_space> select * from library_info;
```

```
stud_id | stud_name | book_name | book_id | date_of_issue |
```

```
counter_value
```

```
.....+.....+.....+.....+.....+.....
```

```
5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 |
```

```
2
```

```
1 | abc | book1 | 11 | 2022-01-29 18:30:00.000000+0000 |
```

```
1
```

```
2 | def | book2 | 12 | 2022-03-29 18:30:00.000000+0000 |
```

```
1
```

```
4 | jkl | book4 | 14 | 2022-07-29 18:30:00.000000+0000 | 1
```

```
3 | ghi | book3 | 13 | 2022-05-29 18:30:00.000000+0000 |
```

```
1
```

(5 rows)

```
cqlsh:library_space>
```

```
copy
```

```
library_info(stud_id,stud_name,book_name,book_id,date_of_issue,counter_v  
alue) to '/home/bmscecse/Desktop/bda.csv';
```

Using 11 child processes

Starting copy of library_space.library_info with columns [stud_id, stud_name, book_name, book_id, date_of_issue, counter_value].

Processed: 5 rows; Rate: 45 rows/s; Avg. rate: 45 rows/s

5 rows exported to 1 files in 0.121 seconds.

```
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,book_name,book_id,date_of_issue));
```

```
cqlsh:library_space> copy
```

```
library_info_copy(stud_id,stud_name,book_name,book_id,date_of_issue,coun  
ter_value) from '/home/bmscecse/Desktop/new.csv';
```

Using 11 child processes

Starting copy of library_space.library_info_copy with columns [stud_id,stud_name, book_name, book_id, date_of_issue, counter_value].

Processed: 5 rows; Rate: 8 rows/s; Avg. rate: 12 rows/s

5 rows imported from 1 files in 0.406 seconds (0 skipped).

```
cqlsh:library_space> select * from library_info where counter_value=2 allow  
filtering;
```

```
stud_id | stud_name | book_name | book_id | date_of_issue |  
counter_value
```

```
.....+.....+.....+.....+.....+.....  
5 | mno | book5 | 15 | 2022-09-29 18:30:00.000000+0000 | 2
```

MongoDB- CRUD Demonstration

```
use my_db
```

```
switched to db my_db
```

```
db.Student.insert({_id:1,name:"Michael",grade  
:"VII",hobbies:"reading"})
```

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

```
db.Student.update({_id:1},{ $set:{hobbies:"crick  
et"}},{upsert:true})
```

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

```
db.Student.find()
```

```
{ "_id" : 1, "name" : "Michael", "grade" : "VII",  
"hobbies" : "cricket" }
```

```
db.Student.insert({id:1,name:"Latha",grade:"VII
```

```
I",hobbies:"Singing"})
WriteResult({ "nInserted" : 1
})
db.Student.find({ name:"Latha"}).pretty()
{
  "_id" :
ObjectId("6253f120f7936
958d67f3c07"),
  "id" : 1,
  "name" : "Latha",
  "grade" : "VIII",
  "hobbies" :
  "Singing"
}
db.Student.find({}, { name:1, grade:1, _id:0})
{ "name" : "Michael", "grade" : "VII" }
{ "name" : "Latha", "grade" : "VIII" }
db.Student.find({ grade:{ $eq:"VII" }}).pretty()
{ "_id" : 1, "name" : "Michael", "grade" :
"VII", "hobbies" : "cricket" }
db.Student.find({ name:/^L/}).pretty()
{
  "_id" :
ObjectId("6253f120f7936
958d67f3c07"),
  "id" : 1,
  "name" : "Latha",
```

```
"grade" : "VIII",
"hobbies" :
"Singing"
}
db.Student.find({name:/a/}).pretty()
{ "_id" : 1, "name" : "Michael", "grade" :
"VII", "hobbies" : "cricket" }
{
"_id" :
ObjectId("6253f120f7936
958d67f3c07"),
"id" : 1,
"name" : "Latha",
"grade" : "VIII",
"hobbies" :
"Singing"
}
db.Student.count()
2
db.Student.find().sort({name:1}).pretty()
{
"_id" :
ObjectId("6253f120f7936
958d67f3c07"),
"id" : 1,
"name" : "Latha",
"grade" : "VIII",
```

```
"hobbies" : "Singing"
}
{ "_id" : 1, "name" : "Michael", "grade" : "VII",
"hobbies" : "cricket" }
db.Student.save({name:"Ratan",grade:"VII",_id:
1}))
WriteResult({ "nMatched" : 1, "nUpserted" : 0,
"nModified" : 1 })
db.Student.find()
{ "_id" : 1, "name" : "Ratan", "grade" : "VII" }
{ "_id" :
ObjectId("6253f120f7936958d67f3c07"), "id" :
1, "name" : "Latha", "grade" : "VIII", "hobbies"
:"Singing" }
db.Student.update({_id:1},{ $set:{location:"net
work"}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0,
"nModified" : 1 })
db.Student.update({_id:1},{ $unset:{location:"n
etwork"}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0,
"nModified" : 1 })
db.Student.find({name:/n$/}).pretty()
{ "_id" : 1, "name" : "Ratan", "grade" : "VII" }
db.Student.find({grade:"VII"}).limit(3).pretty()
```



```
{ "_id" : 1, "name" : "Ratan", "grade" : "VII"
}db.Student.count({grade:"VIII"})
```

```
1
```

```
db.Student.find().sort({ name:1 }).pretty()
```

```
{
```

```
"_id" :
```

```
ObjectId("6253f120f7936
```

```
958d67f3c07"),
```

```
"id" : 1,
```

```
"name" : "Latha",
```

```
"grade" : "VIII",
```

```
"hobbies" :
```

```
"Singing"
```

```
}
```

```
{ "_id" : 1, "name" : "Ratan", "grade" : "VII" }
```

```
db.Student.find().sort({ name:-1 }).pretty()
```

```
{ "_id" : 1, "name" : "Ratan", "grade" : "VII" }
```

```
{
```

```
"_id" :
```

```
ObjectId("6253f120f7936
```

```
958d67f3c07"),
```

```
"id" : 1,
```

```
"name" : "Latha",
```

```
"grade" : "VIII",
```

```
"hobbies" :
```

```
"Singing"
```

```
}
```

```
db.Student.find().skip(1).pretty()
{
  "_id" :
  ObjectId("6253f120f7936
958d67f3c07"),
  "id" : 1,
  "name" : "Latha",
  "grade" : "VIII",
  "hobbies" :
  "Singing"
}
db.createCollection("food")
{ "ok" : 1 }
db.food.insert({_id:1,fruits:['grapes','mango']})
WriteResult({ "nInserted" : 1 })
db.food.insert({_id:2,fruits:['grapes','mango','c
herry']})
WriteResult({ "nInserted" : 1 })
db.food.insert({_id:3,fruits:['banana','cherry']})
WriteResult({ "nInserted" : 1 })
db.food.find({ fruits:['grapes','mango']})
{ "_id" : 1, "fruits" : [ "grapes", "mango" ] }
db.food.find({'fruits':{$size:2}})
{ "_id" : 1, "fruits" : [ "grapes", "mango" ] }
{ "_id" : 3, "fruits" : [ "banana", "cherry" ] }
db.food.find({_id:2},{ 'fruits':{$slice:2}})
```

```
{ "_id" : 2, "fruits" : [ "grapes", "mango" ] }
db.food.find({ fruits: { $all: ['grapes', 'mango'] } })
{ "_id" : 1, "fruits" : [ "grapes", "mango" ] }
{ "_id" : 2, "fruits" : [ "grapes", "mango",
"cherry" ] }
db.food.update({_id:3},{ $set:{'fruits.1':'apple'}}
)WriteResult({ "nMatched" : 1, "nUpserted" : 0,
"nModified" : 1 })
db.food.find()
{ "_id" : 1, "fruits" : [ "grapes", "mango" ] }
{ "_id" : 2, "fruits" : [ "grapes",
"mango","cherry" ] }
{ "_id" : 3, "fruits" : [ "banana", "apple" ] }
db.food.update({_id:2},{ $push:{price:{grapes:8
0,mango:200,cherry:100}}})
WriteResult({ "nMatched" : 1, "nUpserted" : 0,
"nModified" : 1 })
```

Screenshot of Hadoop installed

```
Administrator: Command Prompt - hdfs namenode -format
Microsoft Windows [Version 10.0.22000.739]
(c) Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>hdfs namenode -format
2022-07-12 20:55:20,913 INFO namenode.NameNode: STARTUP_MSG:
/*****
STARTUP_MSG: Starting NameNode
STARTUP_MSG: host = DESKTOP-TI07KE8/192.168.56.1
STARTUP_MSG: args = [-format]
STARTUP_MSG: version = 3.3.3
STARTUP_MSG: classpath = C:\hadoop-3.3.3\etc\hadoop;C:\hadoop-3.3.3\share\hadoop\common;C:\hadoop-3.3.3\share\hadoop\com
mon\lib\accessors-smart-2.4.7.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\animal-sniffer-annotations-1.17.jar;C:\hadoo
p-3.3.3\share\hadoop\common\lib\asm-5.0.4.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\audience-annotations-0.5.0.jar;C:\
hadoop-3.3.3\share\hadoop\common\lib\avro-1.7.7.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\checker-qual-2.5.2.jar;C:\ha
doo-3.3.3\share\hadoop\common\lib\commons-beanutils-1.9.4.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-cli-1.2.j
ar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-codec-1.15.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-collec
tions-3.2.2.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-compress-1.21.jar;C:\hadoop-3.3.3\share\hadoop\common\li
b\commons-configuration2-2.1.1.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-daemon-1.0.13.jar;C:\hadoop-3.3.3\sha
re\hadoop\common\lib\commons-io-2.8.0.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-lang3-3.12.0.jar;C:\hadoop-3.3
.3\share\hadoop\common\lib\commons-logging-1.1.3.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-math3-3.1.1.jar;C:\
hadoop-3.3.3\share\hadoop\common\lib\commons-net-3.6.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\commons-text-1.4.jar;C\
\hadoop-3.3.3\share\hadoop\common\lib\curator-client-4.2.0.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\curator-framework
-4.2.0.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\curator-recipes-4.2.0.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\dns
java-2.1.7.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\failureaccess-1.0.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\gso
n-2.8.9.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\guava-27.0-jre.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\hadoop-an
notations-3.3.3.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\hadoop-auth-3.3.3.jar;C:\hadoop-3.3.3\share\hadoop\common\li
b\hadoop-shaded-guava-1.1.1.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\hadoop-shaded-protobuf_3_7-1.1.1.jar;C:\hadoo-3
.3.3\share\hadoop\common\lib\httpclient-4.5.13.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\httpcore-4.4.13.jar;C:\hadoo-3
.3.3\share\hadoop\common\lib\j2objc-annotations-1.1.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\jackson-annotations-2.
13.2.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\jackson-core-2.13.2.jar;C:\hadoop-3.3.3\share\hadoop\common\lib\jackson
```

Execution of HDFS Commands for interaction with Hadoop Environment.

\$ start-all.sh

\$ jps

4193 ResourceManager

4691 Jps

3876 SecondaryNameNode

4566 NodeManager

3050 NameNode

3391 DataNode

```
$ hdfs dfs -mkdir /xyz
```

```
$ hadoop fs -ls /
```

```
Found 13 items
```

```
drwxr-xr-x - hduser supergroup      0 2022-06-04 09:48 /FFF
drwxr-xr-x - hduser supergroup      0 2022-06-04 10:10 /abc
drwxr-xr-x - hduser supergroup      0 2022-06-03 14:39 /folder1
drwxr-xr-x - hduser supergroup      0 2022-06-03 15:00 /folder2
drwxr-xr-x - hduser supergroup      0 2022-06-03 15:00 /folder3
drwxr-xr-x - hduser supergroup      0 2022-06-01 14:48 /lab1
drwxr-xr-x - hduser supergroup      0 2019-10-24 11:08 /output
drwxr-xr-x - hduser supergroup      0 2022-06-01 14:48 /pratibha
drwxr-xr-x - hduser supergroup      0 2019-10-24 10:47 /rgs
drwxr-xr-x - hduser supergroup      0 2022-06-03 12:05 /test
drwxrwxr-x - hduser supergroup      0 2019-08-01 16:19 /tmp
x
drwxr-xr-x - hduser supergroup      0 2019-08-01 16:03 /user
drwxr-xr-x - hduser supergroup      0 2022-06-06 11:33 /xyz
```

```
$ hdfs dfs -put /home/hduser/Desktop/welcome.txt /xyz/Wel.txt
```

```
$ hdfs dfs -cat /abc/WC.txt
```

```
Hadoop lab
```

```
$ hdfs dfs -copyFromLocal /home/hduser/Desktop/welcome.txt /xyz/Wel.txt
```

```
copyFromLocal: `/xyz/Wel.txt': File exists
```

```
$ hdfs dfs -get /abc/WC.txt /home/hduser/Downloads/wwc.txt
```

```
$ hdfs dfs -getmerge /abc/WC.txt /abc/WC2.txt  
/home/hduser/Desktop/Merge.txt
```

```
$ hadoop fs -getfacl /abc/
```

```
# file: /abc
```

```
# owner: hduser
```

```
# group: supergroup
```

```
user::rwx
```

```
group::r-
```

```
xother::r-
```

```
x
```

```
$ hdfs dfs -copyToLocal /abc/WC2.txt /home/hduser/Desktop
```

```
$ hadoop fs -mv /abc /FFF
```

```
$ hdfs dfs -ls
```

```
/FFFFound 3
```

```
items
```

```
-rw-r--r--  1 hduser supergroup    11 2022-06-04 09:42 /FFF/WC.txt
```

```
-rw-r--r--  1 hduser supergroup   20 2022-06-04 09:48 /FFF/WC2.txt
```

```
drwxr-xr-x  - hduser supergroup    0 2022-06-04 10:10 /FFF/abc
```

```
$ hadoop fs -cp /FFF/ /xxx
```

```
$ hadoop fs -ls /xxx
```

Found 3 items

```
-rw-r--r--  1 hduser supergroup    11 2022-06-06 12:19 /xxx/WC.txt
-rw-r--r--  1 hduser supergroup    20 2022-06-06 12:19 /xxx/WC2.txt
drwxr-xr-x  - hduser supergroup     0 2022-06-06 12:19 /xxx/abc
```

Create a Map Reduce program to find the average temperature and mean max temperature foreach year from NCDC data set.

Average temperature:

AverageDriver:

```
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("&quot;Please Enter the input and output parameters&quot;");
System.exit(-1);
}
Job job = new Job();
job.setJarByClass(AverageDriver.class);
```

```

job.setJobName("&quot;Max temperature&quot;");
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:
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) throws IOException, InterruptedException {
        int temperature;

        String line = value.toString();

```



```

String year = line.substring(15, 19);
if (line.charAt(87) ==
    '#39;+'#39;) {
    temperature = Integer.parseInt(line.substring(88, 92));
} else {
    temperature = Integer.parseInt(line.substring(87, 92));
}
String quality = line.substring(92, 93);
if (temperature != 9999 && quality.matches("[01459]"))
    context.write(new Text(year), new IntWritable(temperature));
}
}

```

AverageReducer:

```

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));
}
}

```

```

bytes written=0
hduser@bmsce-Precision-T1700:~$ hadoop fs -cat /output_temp/*
1901      46
hduser@bmsce-Precision-T1700:~$ █

```

Mean Max:

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("&quot;Please Enter the input and output parameters&quot;");
    System.exit(-1);
}
Job job = new Job();
job.setJarByClass(MeanMaxDriver.class);
job.setJobName("&quot;Max temperature&quot;");
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) == '+'&#39;+&#39;)
    {
        temperature = Integer.parseInt(line.substring(88, 92));
    } else {
        temperature = Integer.parseInt(line.substring(87, 92));
    }

    String quality = line.substring(92, 93);
    if (temperature != 9999 &amp;&amp; quality.matches("&quot;[01459]&quot;"))
        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));
}
```

```
hduser@bmsce-Precision-T1700:~$ hadoop fs -cat /output_tem/*
01      4
02      0
03      7
04     44
05    100
06    168
07    219
08    198
09    141
10    100
11     19
12      3
hduser@bmsce-Precision-T1700:~$
```

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.

```
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("&quot;Usage: TopN &lt;in> &lt;out>&quot;");
    System.exit(2);
}
    Job job = Job.getInstance(conf);
    job.setJobName("&quot;Top N&quot;");
    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 = "&quot;[_|$\&lt;&gt;\\^=\\[\\]\\*\\/\\,;\\.\\|-
:()?!\\&quot;,&#39;]&quot;";

```

```

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, &quot;
&quot;);
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 = "[_!$%&'()*+,-./:;<=>@^_`{|}~*^/\\.,;'\":()?!&'&#39;]&quot;;
```

```
    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, &quot;
            &quot;);
```

```
        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));
}

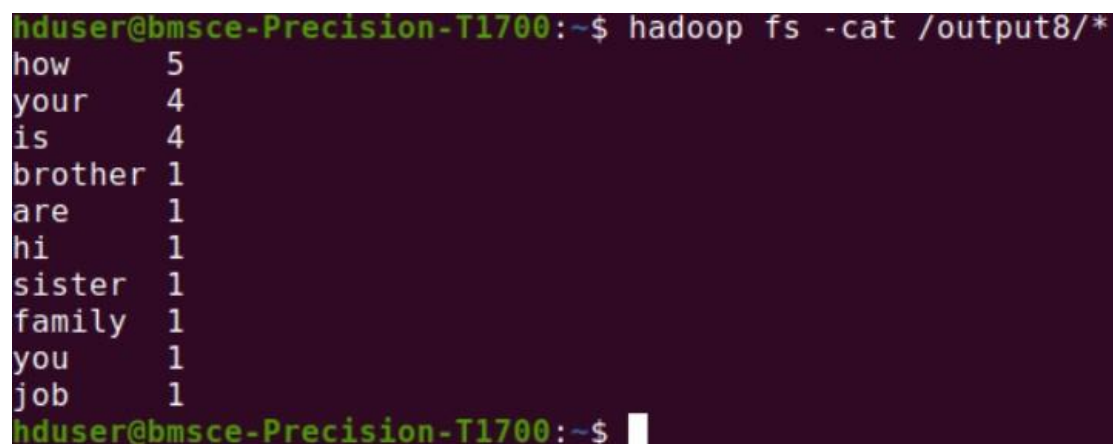
protected void cleanup(Reducer<Text, IntWritable, Text,
IntWritable> context)
throws IOException, InterruptedException {

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));
}
}
}

```



A terminal window showing the output of the command `hadoop fs -cat /output8/*`. The output lists words and their counts: how 5, your 4, is 4, brother 1, are 1, hi 1, sister 1, family 1, you 1, job 1. The prompt is `hduser@bmsce-Precision-T1700:~$`.

```

hduser@bmsce-Precision-T1700:~$ hadoop fs -cat /output8/*
how      5
your     4
is       4
brother  1
are      1
hi       1
sister   1
family   1
you      1
job      1
hduser@bmsce-Precision-T1700:~$

```

Create a Map Reduce program to demonstrating join operation

```
// JoinDriver.java

import org.apache.hadoop.conf.Configured;
import org.apache.hadoop.fs.Path;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapred.*;
import org.apache.hadoop.mapred.libMultipleInputs;
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 &#39;Department Emp Strength input&#39; with
&#39;Department Name
input&#39;&quot;);
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() + "<br>\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 + "&quot;\t&quot;" + 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 =
newText.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);
}
} }

```

```

hduser@bmsce-Precision-T1700:~$ hadoop fs -cat /output_mapreduce/*
A11      50      Finance
B12      100     HR
C13      250     Manufacturing
Dept_ID  Total_Employee  Dept_Name
hduser@bmsce-Precision-T1700:~$

```

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

Word Count:

```
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;
```

```
scala> reducedata.collect;
res8: Array[(String, Int)] = Array(("",1), (hello,5), (lab,3), (begin,3), (spark,5), (9,1))
```

Hello World:

```
object ExPrint {
    def main(args: Array[String])
        { println(“Hello World!”);
    }
}
```

```
package word_count

object count {
  def main(args : Array[String]){
    println("Hello World!");
  }
}
```

Problems Tasks Console

<terminated> count\$ [Scala Application] /usr/lib/jvm/java: Hello World!

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

```
val textFile = sc.textFile("/home/bhoom/Desktop/wc.txt")

val counts = textFile.flatMap(line => line.split(" ")).map(word =>
(word,1)).reduceByKey(_ + _)

import scala.collection.immutable.ListMap

val sorted=ListMap(counts.collect.sortWith(_. _2 > _. _2):_*)// sort in descending
order based
on values

println(sorted)
```

```
for((k,v)<-sorted)
```

```
{
```

```
if(v>4)
```

```
{
```

```
print(k+", "
```

```
)print(v)
```

```
println()
```

```
}
```

```
}
```

```
scala> println(sorted)
```

```
Map(hello -> 5, spark -> 5, lab -> 3, begin -> 3,  -> 1, 9 -> 1)
```

```
scala> for((k,v)<-sorted)
```

```
| {
```

```
| if(v>4)
```

```
| {
```

```
| print(k+", "
```

```
| print(v)
```

```
| println()
```

```
| }
```

```
| }
```

```
hello,5
```

```
spark,5
```