VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"JnanaSangama", Belgaum- 590014, Karnataka.

LAB RECORD

on

Big Data Analytics (23CS6PCBDA)

Submitted by

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in partial fulfillment for the award of the degree of

BACHELOR OF ENGINEERING

in

COMPUTER SCIENCE AND ENGINEERING

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

Bull Temple Road, Bangalore 560019
(Affiliated to Visvesvaraya Technological University, Belgaum)

Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "Big Data Analytics" carried out by **M Rajashekar Reddy (1BM22CS138),** who is bonafide student of **B.M.S. College of Engineering.** It is in partial fulfilment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2025. The Lab report has been approved as it satisfies the academic requirements in respect of a Big Data Analytics (23CS6PCBDA) work prescribed for the said degree.

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INDEX

7	20.05.25	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.	22
8	20.05.25	Write a Scala program to print numbers from 1 to 100 using for loop.	26
9	20.05.25	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.	27
10	20.05.25	Write a simple streaming program in Spark to receive text data streams on a particular port, perform basic text cleaning (like white space removal, stop words removal, lemmatization, etc.), and print the cleaned text on the screen. (Open Ended Question).	28

Github Link: https://github.com/Raja3008/BDA-1BM22CS138

Course Outcomes (COs):

CO1	Apply the concept of NoSQL, Hadoop or Spark for a given task
CO2	Analyse big data analytics mechanisms that can be applied to obtain solution for a given problem.
CO3	Design and implement solutions using data analytics mechanisms for a given problem.

LABORATORY PROGRAM – 1

MongoDB- CRUD Operations Demonstration (Practice and Self Study)

Command with output:

```
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.insertOne({_id: 1, StudName: "MichelleJacintha",
 Grade: "VII", Hobbies: "InternetSurfing"})
{ acknowledged: true, insertedId: 1 }
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.updateOne({_id: 2, StudName: 'AryanDavid', Grade
: 'VII'}, {$set: {Hobbies: "Skating"}}, {upsert: true})
{
  acknowledged: true,
  insertedId: 2,
  matchedCount: 0,
  modifiedCount: 0,
  upsertedCount: 1
}
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.insertMany([{_id: 3, StudName: 'Charan', Grade:
'VII'}, {_id: 4, StudName: 'Vibinn', Grade: 'VII'}])
{ acknowledged: true, insertedIds: { '0': 3, '1': 4 } }
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.updateOne({_id: 3}, {$set: {Hobbies: 'Drawing'}}
)
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 1,
  upsertedCount: 0
}
```

```
Atlas atlas-ru5tdz-shard-0 [primary] test> use myDB
switched to db myDB
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db
myDB
Atlas atlas-ru5tdz-shard-0 [primary] myDB> show dbs
admin  232.00 KiB
local   18.01 GiB
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.show()
TypeError: db.show is not a function
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.show
myDB.show
Atlas atlas-ru5tdz-shard-0 [primary] myDB> show collections

Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.createCollection('Student')
{ ok: 1 }
Atlas atlas-ru5tdz-shard-0 [primary] myDB> show collections
Student
```

```
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.updateOne({_id: 2, StudName: 'Charan', Grade: 'V
II'}, {$set: {Hobbies: 'Drawing'}}, {upsert: false})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 0,
  modifiedCount: 0,
  upsertedCount: 0
}
```

```
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.updateMany({_id: 4}, {$set: {Hobbies: 'Drawing'}
})
{
  acknowledged: true,
  insertedId: null,
  matchedCount: 1,
  modifiedCount: 0,
  upsertedCount: 0
}
```

```
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.deleteOne({_id: 1})
{ acknowledged: true, deletedCount: 1 }
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.deleteMany({Hobbies: 'Drawing'})
{ acknowledged: true, deletedCount: 2 }
Atlas atlas-ru5tdz-shard-0 [primary] myDB>
```

```
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.find()
[
  {
    _id: 1,
    StudName: 'MichelleJacintha',
    Grade: 'VII',
    Hobbies: 'InternetSurfing'
  },
  { _id: 2, Grade: 'VII', StudName: 'AryanDavid', Hobbies: 'Skating' },
  { _id: 3, StudName: 'Charan', Grade: 'VII', Hobbies: 'Drawing' },
  { _id: 4, StudName: 'Vibinn', Grade: 'VII', Hobbies: 'Drawing' }
]
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.find({StudName: 'DavidAryan'})

Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.find({StudName: 'AryanDavid'})
[
  { _id: 2, Grade: 'VII', StudName: 'AryanDavid', Hobbies: 'Skating' }
]
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.find({StudName: 'AryanDavid'},{_id: 0})
[ { Grade: 'VII', StudName: 'AryanDavid', Hobbies: 'Skating' } ]
Atlas atlas-ru5tdz-shard-0 [primary] myDB> db.Student.find({Grade: {$eq :'VII'}})
[
  {
    _id: 1,
    StudName: 'MichelleJacintha',
    Grade: 'VII',
    Hobbies: 'InternetSurfing'
  },
  { _id: 2, Grade: 'VII', StudName: 'AryanDavid', Hobbies: 'Skating' },
  { _id: 3, StudName: 'Charan', Grade: 'VII', Hobbies: 'Drawing' },
  { _id: 4, StudName: 'Vibinn', Grade: 'VII', Hobbies: 'Drawing' }
]
```

MongoDB- CRUD Operations Demonstration (Practice and Self Study)

Command with output :

```
MyDataBase> use MyDataBase
already on db MyDataBase
MyDataBase> show collections
Customers
NewStudent
Student
MyDataBase> db.Student.find();
[
  {
    _id: 1,
    studName: 'Michellejacintha',
    Grade: 'VII',
    Hobbies: 'InternetSurfing'
  },
  { _id: 3, Grade: 'VII', StudName: 'AryanDavid', Hobbies: 'Skating' },
  { _id: 2, Grade: 'VIII', StudName: 'Ram', Hobbies: 'Learning' }
]
```

```
test> use MyDataBase
switched to db MyDataBase
MyDataBase> show collections
NewStudent
NewStudent2
Student
MyDataBase> db.NewStudent2.drop();
true
MyDataBase> db.createCollection("Customers");
{ ok: 1 }
MyDataBase> db.Customers.insertMany([{cust_id:1,Balance:200, Type:"S"},]);
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d00571207666297fa3b81a') }
}
MyDataBase> db.Customers.insert({cust_id:1,Balance:1000, Type:"Z"})
DeprecationWarning: Collection.insert() is deprecated. Use insertOne, insertMany, or bulkWrite.
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d0058f207666297fa3b81b') }
}
MyDataBase> db.Customers.insert({cust_id:2,Balance:100, Type:"Z"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d0059c207666297fa3b81c') }
}
MyDataBase> db.Customers.insert({cust_id:2,Balance:1000, Type:"C"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d005a5207666297fa3b81d') }
}
MyDataBase> db.Customers.insert({cust_id:2,Balance:500, Type:"C"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d005ad207666297fa3b81e') }
}
MyDataBase> db.Customers.insert({cust_id:2,Balance:50, Type:"S"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d005b2207666297fa3b81f') }
}
MyDataBase> db.Customers.insert({cust_id:3,Balance:500, Type:"Z"});
{
  acknowledged: true,
  insertedIds: { '0': ObjectId('67d005ba207666297fa3b820') }
}
```

```
MyDataBase> db.Customers.aggregate([
...   {
...     $group: {
...       _id: "$cust_id",             // Group by cust_id
...       minAccBal: { $min: "$Balance" }, // Find the minimum Balance
...       maxAccBal: { $max: "$Balance" }  // Find the maximum Balance
...     }
...   }
... ]);
[
  { _id: 3, minAccBal: 500, maxAccBal: 500 },
  { _id: 2, minAccBal: 50, maxAccBal: 1000 },
  { _id: 1, minAccBal: 200, maxAccBal: 1000 }
]
```

```
MyDataBase> db.Customers.aggregate([
...   { $match: { Type: "Z" } },
...   { $group: { _id: "$cust_id", TotAccBal: { $sum: "$Balance" } } },
...   { $match: { TotAccBal: { $gt: 1200 } } }
... ]);
```

```
MyDataBase> db.Customers.aggregate([
...   { $match: { Type: "Z" } },
...   {
...     $group: {
...       _id: "$cust_id",
...       TotAccBal: { $sum: "$Balance" }
...     }
...   },
...   {
...     $match: {
...       TotAccBal: { $gt: 200 }
...     }
...   }
... ]);
[ { _id: 3, TotAccBal: 500 }, { _id: 1, TotAccBal: 1000 } ]
```

```
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ mongoimport --host localhost --db MyDataBase --coll
ection NewStudent2 --type=csv --file /home/bmscecse/Desktop/135.txt --headerline
2025-03-11T14:55:05.192+0530    connected to: mongodb://localhost/
2025-03-11T14:55:05.360+0530    3 document(s) imported successfully. 0 document(s) failed to import.
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ mongoexport --host localhost --db MyDataBase --coll
ection NewStudent2 --type=json --file /home/bmscecse/Desktop/135.txt
2025-03-11T14:55:24.438+0530    error parsing command line options: unknown option "file"
2025-03-11T14:55:24.438+0530    try 'mongoexport --help' for more information
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ mongoexport --host localhost --db MyDataBase --coll
ection NewStudent2 --type=json --out /home/bmscecse/Desktop/135.txt
2025-03-11T14:55:32.771+0530    connected to: mongodb://localhost/
2025-03-11T14:55:32.780+0530    exported 3 records
bmscecse@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$
```

LABORATORY PROGRAM – 2

Perform the following DB operations using Cassandra

Questions:

a) Create a keyspace by name Employee
b) Create a column family by name

- Employee-Info with attributes
- Emp_Id Primary Key, Emp_Name,
- Designation, Date_of_Joining,
- Salary, Dept_Name

c) Insert the values into the table in batch
d) Update Employee name and Department of Emp-Id 121
e) Sort the details of Employee records based on salary
f) Alter the schema of the table Employee_Info to add a column Projects which stores a set of Projects done by the corresponding Employee.
g) Update the altered table to add project names.
h) Create a TTL of 15 seconds to display the values of Employees.

Command with output:

```
cqlsh> CREATE KEYSPACE IF NOT EXISTS Employee
   ... WITH replication = {'class': 'SimpleStrategy', 'replication_factor': 1};
cqlsh> USE Employee;
cqlsh:employee> CREATE TABLE IF NOT EXISTS Employee_Info (
            ...   Emp_Id INT PRIMARY KEY,
            ...   Emp_Name TEXT,
            ...   Designation TEXT,
            ...   Date_of_Joining DATE,
            ...   Salary DOUBLE,
            ...   Dept_Name TEXT
            ... );
cqlsh:employee> BEGIN BATCH
            ... INSERT INTO Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name)
            ... VALUES (121, 'John Doe', 'Manager', '2018-01-01', 90000, 'HR');
            ...
            ... INSERT INTO Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name)
            ... VALUES (122, 'Alice Smith', 'Developer', '2019-05-21', 75000, 'IT');
            ...
            ... INSERT INTO Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name)
            ... VALUES (123, 'Rahul Roy', 'Analyst', '2020-07-15', 65000, 'IT');
            ... APPLY BATCH;
cqlsh:employee> UPDATE Employee_Info
            ... SET Emp_Name = 'John Smith', Dept_Name = 'Finance'
            ... WHERE Emp_Id = 121;
cqlsh:employee> select * from Employee_Info;

 emp_id | date_of_joining | dept_name | designation | emp_name    | salary
--------+-----------------+-----------+-------------+-------------+--------
    123 |      2020-07-15 |        IT |     Analyst |   Rahul Roy |  65000
    122 |      2019-05-21 |        IT |   Developer | Alice Smith |  75000
    121 |      2018-01-01 |   Finance |     Manager |  John Smith |  90000

(3 rows)
```

```
(3 rows)
cqlsh:employee> CREATE TABLE IF NOT EXISTS Employee_By_Dept (
           ...   Dept_Name TEXT,
           ...   Salary DOUBLE,
           ...   Emp_Id INT,
           ...   Emp_Name TEXT,
           ...   Designation TEXT,
           ...   Date_of_Joining DATE,
           ...   PRIMARY KEY (Dept_Name, Salary, Emp_Id)
           ... ) WITH CLUSTERING ORDER BY (Salary DESC, Emp_Id ASC);
cqlsh:employee> BEGIN BATCH
           ... INSERT INTO Employee_By_Dept (Dept_Name, Salary, Emp_Id, Emp_Name, Designation, Date_of_Joining)
           ... VALUES ('HR', 90000, 121, 'John Smith', 'Manager', '2018-01-01');
           ...
           ... INSERT INTO Employee_By_Dept (Dept_Name, Salary, Emp_Id, Emp_Name, Designation, Date_of_Joining)
           ... VALUES ('IT', 75000, 122, 'Alice Smith', 'Developer', '2019-05-21');
           ...
           ... INSERT INTO Employee_By_Dept (Dept_Name, Salary, Emp_Id, Emp_Name, Designation, Date_of_Joining)
           ... VALUES ('IT', 65000, 123, 'Rahul Roy', 'Analyst', '2020-07-15');
           ... APPLY BATCH;
cqlsh:employee> SELECT * FROM Employee_By_Dept WHERE Dept_Name = 'IT';

 dept_name | salary | emp_id | date_of_joining | designation | emp_name
-----------+--------+--------+-----------------+-------------+-------------
        IT |  75000 |    122 |      2019-05-21 |   Developer | Alice Smith
        IT |  65000 |    123 |      2020-07-15 |     Analyst |   Rahul Roy

(2 rows)
cqlsh:employee> ALTER TABLE Employee_Info ADD Projects SET<TEXT>;
cqlsh:employee> UPDATE Employee_Info SET Projects = {'ERP System', 'HR Portal'} WHERE Emp_Id = 121;
cqlsh:employee> INSERT INTO Employee_Info (Emp_Id, Emp_Name, Designation, Date_of_Joining, Salary, Dept_Name)
           ... VALUES (124, 'Sneha Kapoor', 'Tester', '2023-03-10', 55000, 'QA') USING TTL 15;
cqlsh:employee> select * from Employee_Info;

 emp_id | date_of_joining | dept_name | designation | emp_name    | projects                    | salary
--------+-----------------+-----------+-------------+-------------+-----------------------------+--------
    123 |      2020-07-15 |        IT |     Analyst |   Rahul Roy |                        null |  65000
    122 |      2019-05-21 |        IT |   Developer | Alice Smith |                        null |  75000
    121 |      2018-01-01 |   Finance |     Manager |  John Smith | {'ERP System', 'HR Portal'} |  90000

(3 rows)
```

LABORATORY PROGRAM – 3

Perform the following DB operations using Cassandra

Questions:

a) Create a keyspace by name Library
b) Create a column family by name Library-Info with attributes

- Stud_Id Primary Key,
- Counter_value of type Counter,
- Stud_Name, Book-Name, Book-Id,
- Date_of_issue

c) Insert the values into the table in batch
d) Display the details of the table created and increase the value of the counter
e) Write a query to show that a student with id 112 has taken a book “BDA” 2 times.
f) Export the created column to a csv file
g) Import a given csv dataset from local file system into Cassandra column family

Command with output:

```
cqlsh:employee> CREATE KEYSPACE IF NOT EXISTS Library
           ... WITH replication = {'class': 'SimpleStrategy', 'replication_factor': 1};
cqlsh:employee> USE Library;
cqlsh:library> CREATE TABLE IF NOT EXISTS Library_Info (
          ...   Stud_Id INT PRIMARY KEY,
          ...   Stud_Name TEXT,
          ...   Book_Name TEXT,
          ...   Book_Id TEXT,
          ...   Date_of_issue DATE
          ... );
cqlsh:library> CREATE TABLE IF NOT EXISTS Book_Counter (
          ...   Stud_Id INT,
          ...   Book_Name TEXT,
          ...   Counter_value COUNTER,
          ...   PRIMARY KEY ((Stud_Id), Book_Name)
          ... );
cqlsh:library> BEGIN BATCH
          ... INSERT INTO Library_Info (Stud_Id, Stud_Name, Book_Name, Book_Id, Date_of_issue)
          ... VALUES (112, 'Anjali Rao', 'BDA', 'B101', '2024-10-01');
          ...
          ... INSERT INTO Library_Info (Stud_Id, Stud_Name, Book_Name, Book_Id, Date_of_issue)
          ... VALUES (113, 'Karthik N', 'AI', 'B102', '2024-11-11');
          ... APPLY BATCH;
cqlsh:library> UPDATE Book_Counter SET Counter_value = Counter_value + 1 WHERE Stud_Id = 112 AND Book_Name = 'BDA';
cqlsh:library> UPDATE Book_Counter SET Counter_value = Counter_value + 1 WHERE Stud_Id = 112 AND Book_Name = 'BDA';
cqlsh:library> SELECT * FROM Book_Counter WHERE Stud_Id = 112 AND Book_Name = 'BDA';

 stud_id | book_name | counter_value
---------+-----------+---------------
     112 |       BDA |             4

(1 rows)
```

```
cqlsh:students> DESCRIBE TABLE Students_Info;

CREATE TABLE students.students_info (
    roll_no int PRIMARY KEY,
    dateofjoining timestamp,
    last_exam_percent double,
    studname text
) WITH additional_write_policy = '99p'
    AND bloom_filter_fp_chance = 0.01
    AND caching = {'keys': 'ALL', 'rows_per_partition': 'NONE'}
    AND cdc = false
    AND comment = ''
    AND compaction = {'class': 'org.apache.cassandra.db.compaction.SizeTieredCompactionStrategy', 'max_threshold': '32', 'min_threshold': '4'}
    AND compression = {'chunk_length_in_kb': '16', 'class': 'org.apache.cassandra.io.compress.LZ4Compressor'}
    AND memtable = 'default'
    AND crc_check_chance = 1.0
    AND default_time_to_live = 0
    AND extensions = {}
    AND gc_grace_seconds = 864000
    AND max_index_interval = 2048
    AND memtable_flush_period_in_ms = 0
    AND min_index_interval = 128
    AND read_repair = 'BLOCKING'
    AND speculative_retry = '99p';
cqlsh:students> BEGIN BATCH
           ... INSERT INTO Students_Info (Roll_No, StudName, DateOfJoining, Last_Exam_Percent)
           ... VALUES (1, 'Asha', '2012-03-12', 79.9);
           ... INSERT INTO Students_Info (Roll_No, StudName, DateOfJoining, Last_Exam_Percent)
           ... VALUES (2, 'Kiran', '2012-03-12', 89.9);
           ... INSERT INTO Students_Info (Roll_No, StudName, DateOfJoining, Last_Exam_Percent)
           ... VALUES (3, 'Shanthi', '2012-03-12', 90.9);
           ... INSERT INTO Students_Info (Roll_No, StudName, DateOfJoining, Last_Exam_Percent)
           ... VALUES (4, 'Smith', '2012-03-12', 67.9);
           ... INSERT INTO Students_Info (Roll_No, StudName, DateOfJoining, Last_Exam_Percent)
           ... VALUES (5, 'Rohan', '2012-03-12', 56.9);
           ... APPLY BATCH;
cqlsh:students> SELECT * FROM Students_Info;

 roll_no | dateofjoining                   | last_exam_percent | studname
---------+---------------------------------+-------------------+----------
       5 | 2012-03-11 18:30:00.000000+0000 |              56.9 |    Rohan
       1 | 2012-03-11 18:30:00.000000+0000 |              79.9 |     Asha
       2 | 2012-03-11 18:30:00.000000+0000 |              89.9 |    Kiran
       4 | 2012-03-11 18:30:00.000000+0000 |              67.9 |    Smith
       3 | 2012-03-11 18:30:00.000000+0000 |              90.9 |  Shanthi

(5 rows)
```

```
cqlsh> CREATE KEYSPACE Students WITH REPLICATION =
   ... {'class': 'SimpleStrategy', 'replication_factor': '1'};
cqlsh>
cqlsh> USE Students;
cqlsh:students> DESCRIBE KEYSPACES;

companies  library      products    system              system_traces
company    pro          productss   system_auth         system_views
employe    prod         productsss  system_distributed  system_virtual_schema
employee   productname  students    system_schema

cqlsh:students> CREATE TABLE Students_Info (
            ...     Roll_No int PRIMARY KEY,
            ...     StudName text,
            ...     DateOfJoining timestamp,
            ...     last_exam_Percent double
            ... );
cqlsh:students> SELECT * FROM system.schema_keyspaces;
InvalidRequest: Error from server: code=2200 [Invalid query] message="table schema_keyspaces does not exist"
cqlsh:students>
cqlsh:students> SELECT * FROM system_schema.keyspaces;

 keyspace_name      | durable_writes | replication
--------------------+----------------+-----------------------------------------------------------------------------------------
         companies |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
       system_auth |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
     system_schema |           True |                                {'class': 'org.apache.cassandra.locator.LocalStrategy'}
           library |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
          products |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
 system_distributed |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '3'}
            system |           True |                                {'class': 'org.apache.cassandra.locator.LocalStrategy'}
         productsss |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
               prod |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
                pro |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
     system_traces |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '2'}
          students |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
           company |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
          employee |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
       productname |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
           employe |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}
          productss |           True | {'class': 'org.apache.cassandra.locator.SimpleStrategy', 'replication_factor': '1'}

(17 rows)
cqlsh:students> DESCRIBE TABLES;

students_info
```

```
cqlsh:students> SELECT * FROM Students_Info WHERE Roll_No IN (1,2,3);

 roll_no | dateofjoining                   | last_exam_percent | studname
---------+---------------------------------+-------------------+----------
       1 | 2012-03-11 18:30:00.000000+0000 |              79.9 |     Asha
       2 | 2012-03-11 18:30:00.000000+0000 |              89.9 |    Kiran
       3 | 2012-03-11 18:30:00.000000+0000 |              90.9 |  Shanthi

(3 rows)
cqlsh:students> CREATE INDEX ON Students_Info (StudName);
cqlsh:students> SELECT * FROM Students_Info WHERE StudName = 'Asha';

 roll_no | dateofjoining                   | last_exam_percent | studname
---------+---------------------------------+-------------------+----------
       1 | 2012-03-11 18:30:00.000000+0000 |              79.9 |     Asha

(1 rows)
cqlsh:students> SELECT Roll_No, StudName FROM Students_Info LIMIT 2;

 roll_no | studname
---------+----------
       5 |    Rohan
       1 |     Asha

(2 rows)
cqlsh:students> SELECT Roll_No AS USN FROM Students_Info;

 usn
-----
   5
   1
   2
   4
   3

(5 rows)
cqlsh:students> UPDATE Students_Info
           ... SET StudName = 'David Sheen'
           ... WHERE Roll_No = 2;
cqlsh:students> UPDATE Students_Info SET Roll_No = 6 WHERE Roll_No = 3; -- ❌ ERROR!
InvalidRequest: Error from server: code=2200 [Invalid query] message="PRIMARY KEY part roll_no found in SET part"
```

```
cqlsh:students> DELETE Last_Exam_Percent FROM Students_Info WHERE Roll_No = 2;
cqlsh:students> DELETE FROM Students_Info WHERE Roll_No = 2;
cqlsh:students> ALTER TABLE Students_Info ADD hobbies SET<text>;
cqlsh:students> ALTER TABLE Students_Info ADD languages LIST<text>;
cqlsh:students> UPDATE Students_Info
           ... SET hobbies = hobbies + {'Chess', 'Table Tennis'}
           ... WHERE Roll_No = 1;
cqlsh:students> CREATE TABLE library_book (
           ...     counter_value counter,
           ...     book_name text,
           ...     stud_name text,
           ...     PRIMARY KEY(book_name, stud_name)
           ... );
cqlsh:students> UPDATE library_book
           ... SET counter_value = counter_value + 1
           ... WHERE book_name = 'Big Data Analytics' AND stud_name = 'Jeet';
cqlsh:students> CREATE TABLE userlogin (
           ...     userid int PRIMARY KEY,
           ...     password text
           ... );
cqlsh:students> INSERT INTO userlogin (userid, password)
           ... VALUES (1, 'infy') USING TTL 30;
cqlsh:students> SELECT TTL(password) FROM userlogin WHERE userid = 1;

 ttl(password)
---------------
            20

(1 rows)
cqlsh:students> COPY Students_Info TO '/home/bmscecse/Desktop/Student_Info.csv';
Using 16 child processes

Starting copy of students.students_info with columns [roll_no, dateofjoining, hobbies, languages, last_exam_percent, studname].
Processed: 4 rows; Rate:      38 rows/s; Avg. rate:      38 rows/s
4 rows exported to 1 files in 0.124 seconds.
cqlsh:students> COPY Students_Info FROM '/home/bmscecse/Desktop/Student_Info.csv';
Using 16 child processes

Starting copy of students.students_info with columns [roll_no, dateofjoining, hobbies, languages, last_exam_percent, studname].
Processed: 4 rows; Rate:       7 rows/s; Avg. rate:      11 rows/s
4 rows imported from 1 files in 0.377 seconds (0 skipped).
cqlsh:students> COPY person (id, fname, lname) FROM STDIN;
Column family person not found
cqlsh:students> COPY Students_Info TO STDOUT;
5,2012-03-11 18:30:00.000+0000,,,56.9,Rohan
1,2012-03-11 18:30:00.000+0000,"{'Chess', 'Table Tennis'}",,79.9,Asha
4,2012-03-11 18:30:00.000+0000,,,67.9,Smith
3,2012-03-11 18:30:00.000+0000,,,90.9,Shanthi
cqlsh:students>
```

LABORATORY PROGRAM – 4

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

Command with output:

```
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
localhost: namenode is running as process 7043.  Stop it first and ensure /tmp/hadoop-hadoop-namenode.pid file is empty before retry.
Starting datanodes
localhost: datanode is running as process 7227.  Stop it first and ensure /tmp/hadoop-hadoop-datanode.pid file is empty before retry.
Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]
bmscecse-HP-Elite-Tower-800-G9-Desktop-PC: secondarynamenode is running as process 7521.  Stop it first and ensure /tmp/hadoop-hadoop-secondarynamenode.pid file is empty before retry.
Starting resourcemanager
resourcemanager is running as process 7808.  Stop it first and ensure /tmp/hadoop-hadoop-resourcemanager.pid file is empty before retry.
Starting nodemanagers
localhost: nodemanager is running as process 7969.  Stop it first and ensure /tmp/hadoop-hadoop-nodemanager.pid file is empty before retry.
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -mkdir /Lab06
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ nano file1.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -mkdir /rgs
mkdir: `/rgs': File exists
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -mkdir /abc
mkdir: `/abc': File exists
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /
Found 5 items
drwxr-xr-x   - hadoop supergroup          0 2025-04-15 14:27 /Lab06
drwxr-xr-x   - hadoop supergroup          0 2024-05-14 14:45 /abc
drwxr-xr-x   - hadoop supergroup          0 2024-05-14 14:46 /hadoop_lab
drwxr-xr-x   - hadoop supergroup          0 2024-05-21 14:56 /output
drwxr-xr-x   - hadoop supergroup          0 2025-04-15 14:34 /rgs
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -put /home/hadoop/Desktop/welcome.txt /abc/WC.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -copyFromLocal /home/hadoop/Desktop/welcome.txt /abc/WC.t
copyFromLocal: `/abc/WC.txt': File exists
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -get /abc/WC.txt /home/hadoop/Downloads/WWC.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -getmerge /abc/ /home/hadoop/Desktop/Merge.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -getfacl /abc/
# file: /abc
# owner: hadoop
# group: supergroup
user::rwx
group::r-x
other::r-x

hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -copyToLocal /abc/WC.txt /home/hadoop/Desktop
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /abc/WC.txt
hadoop is an open source platform
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mv /abc/FFF /FFF
mv: `/abc/FFF': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -mkdir /FFF
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mv /abc /FFF
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cp /CSE/ /LLL
cp: `/CSE/': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cp /abc/ /LLL
cp: `/abc/': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cp /FFF/ /LLL
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$
```

LABORATORY PROGRAM – 5

Implement Wordcount program on Hadoop framework

Code & command with output:

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);
        conf.setJobName("WordCount");

        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("Job Exit Code: " + exitCode);
    }
}
```

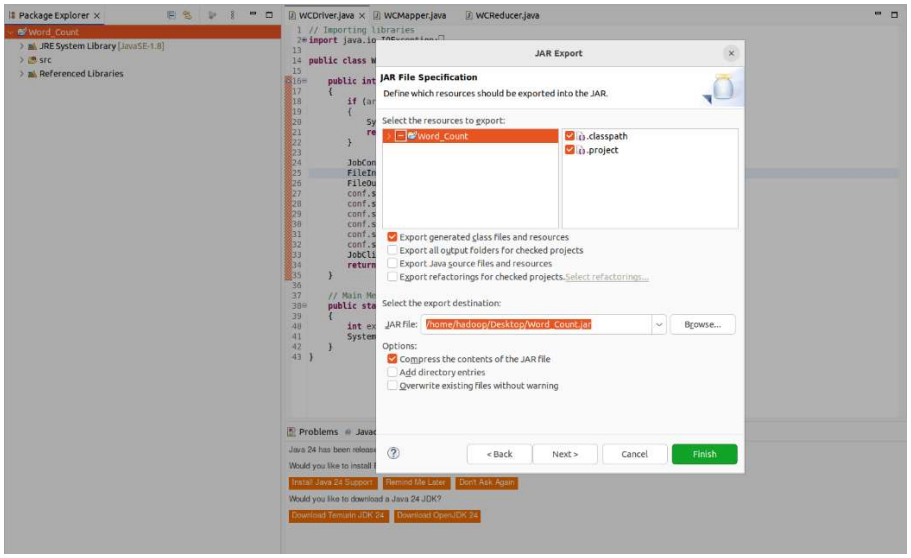
Mapper Code:

```
// 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 reporter)
         throws IOException {
      String line = value.toString();

      // Splitting the line on whitespace
      for (String word : line.split("\\s+")) {
         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> values,
                  OutputCollector<Text, IntWritable> output,
                  Reporter reporter) throws IOException {
      int count = 0;

      // Counting the frequency of each word
      while (values.hasNext()) {
         count += values.next().get();
      }

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




```
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
localhost: namenode is running as process 7043.  Stop it first and ensure /tmp/hadoop-hadoop-namenode.pid file is empty before retry.
Starting datanodes
localhost: datanode is running as process 7227.  Stop it first and ensure /tmp/hadoop-hadoop-datanode.pid file is empty before retry.
Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]
bmscecse-HP-Elite-Tower-800-G9-Desktop-PC: secondarynamenode is running as process 7521.  Stop it first and ensure /tmp/hadoop-hadoop-secondarynamenode.pid file is empty before retry.
Starting resourcemanager
resourcemanager is running as process 7808.  Stop it first and ensure /tmp/hadoop-hadoop-resourcemanager.pid file is empty before retry.
Starting nodemanagers
localhost: nodemanager is running as process 7969.  Stop it first and ensure /tmp/hadoop-hadoop-nodemanager.pid file is empty before retry.
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hdfs dfs -mkdir /Lab06
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ nano file1.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -mkdir /rgs
mkdir: `/rgs': File exists
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -copyFromLocal -f /home/hadoop/Desktop/file1.txt /rgs/test.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop jar /home/hadoop/Desktop/WordCount.jar wordcount.WordCount /rgs/test.txt /output
JAR does not exist or is not a normal file: /home/hadoop/Desktop/WordCount.jar
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop jar /home/hadoop/Desktop/WordCount.jar wordcount.WordCount /rgs/test.txt /output
JAR does not exist or is not a normal file: /home/hadoop/Desktop/WordCount.jar
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop jar /home/hadoop/Desktop/WordCount.jar wordcount.Word_Count /rgs/test.txt /output
JAR does not exist or is not a normal file: /home/hadoop/Desktop/WordCount.jar
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop jar /home/hadoop/Desktop/Word_Count.jar wordcount.WordCount /rgs/test.txt /output
Exception in thread "main" java.lang.ClassNotFoundException: wordcount.WordCount
        at java.base/java.net.URLClassLoader.findClass(URLClassLoader.java:476)
        at java.base/java.lang.ClassLoader.loadClass(ClassLoader.java:594)
        at java.base/java.lang.ClassLoader.loadClass(ClassLoader.java:527)
        at java.base/java.lang.Class.forName0(Native Method)
        at java.base/java.lang.Class.forName(Class.java:398)
        at org.apache.hadoop.util.RunJar.run(RunJar.java:321)
        at org.apache.hadoop.util.RunJar.main(RunJar.java:241)
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -cat /output/part-00000
are     1
brother 1
family  1
hi      1
how     5
is      4
job     1
sister  1
you     1
your    4
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$ hadoop fs -ls /output
Found 2 items
-rw-r--r--   1 hadoop supergroup          0 2024-05-21 14:56 /output/_SUCCESS
-rw-r--r--   1 hadoop supergroup         69 2024-05-21 14:56 /output/part-00000
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~/Desktop$
```

LABORATORY PROGRAM – 6

Implement Weather program on Hadoop framework

Questions:

From the following link extract the weather data
https://github.com/tomwhite/hadoopbook/tree/master/input/ncdc/all
a) Create a MapReduce program to find average temperature for each year from NCDC data set.
b) find the mean max temperature for every month.

Code& command with output:

Driver Code:

```
package temp;

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.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 both input and output parameters.");
         System.exit(-1);
      }

      // Creating a configuration and job instance
      Configuration conf = new Configuration();
      Job job = Job.getInstance(conf, "Average Calculation");

      job.setJarByClass(AverageDriver.class);

      // Input and output paths
      FileInputFormat.addInputPath(job, new Path(args[0]));
      FileOutputFormat.setOutputPath(job, new Path(args[1]));

      // Setting mapper and reducer classes
      job.setMapperClass(AverageMapper.class);
      job.setReducerClass(AverageReducer.class);

      // Output key and value types
      job.setOutputKeyClass(Text.class);
      job.setOutputValueClass(IntWritable.class);

      // Submitting the job and waiting for it to complete
      System.exit(job.waitForCompletion(true) ? 0 : 1);
   }
}
```

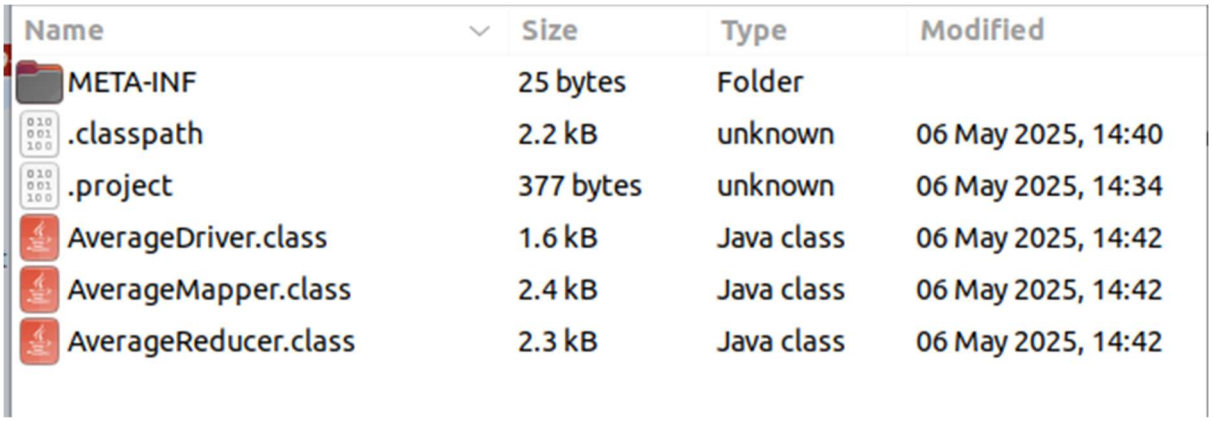
Mapper Code:

```
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;

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

      String line = value.toString();

      // Extract year from fixed position
      String year = line.substring(15, 19);
      int temperature;

      // Determine if there's a '+' sign
      if (line.charAt(87) == '+') {
         temperature = Integer.parseInt(line.substring(88, 92));
      } else {
         temperature = Integer.parseInt(line.substring(87, 92));
      }

      // Quality check character
      String quality = line.substring(92, 93);

      // Only emit if data is valid
      if (temperature != MISSING && quality.matches("[01459]")) {
         context.write(new Text(year), new IntWritable(temperature));
      }
   }
}
```

Reducer Code:

```
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> {

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

      int sumTemp = 0;
      int count = 0;

      for (IntWritable value : values) {
         sumTemp += value.get();
         count++;
      }

      if (count > 0) {
```

```
            int average = sumTemp / count;
            context.write(key, new IntWritable(average));
        }
    }
}
```



Name	Size	Type	Modified
META-INF	25 bytes	Folder	
.classpath	2.2 kB	unknown	06 May 2025, 14:40
.project	377 bytes	unknown	06 May 2025, 14:34
AverageDriver.class	1.6 kB	Java class	06 May 2025, 14:42
AverageMapper.class	2.4 kB	Java class	06 May 2025, 14:42
AverageReducer.class	2.3 kB	Java class	06 May 2025, 14:42

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ start-all.sh
WARNING: Attempting to start all Apache Hadoop daemons as hadoop in 10 seconds.
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
Starting datanodes
Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]
Starting resourcemanager
Starting nodemanagers
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ jps
7056 DataNode
7332 SecondaryNameNode
7638 ResourceManager
8231 Jps
5883 org.eclipse.equinox.launcher_1.6.1000.v20250227-1734.jar
7804 NodeManager
6877 NameNode
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /\
> ^C
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /
Found 4 items
drwxr-xr-x   - hadoop supergroup          0 2025-04-15 15:00 /FFF
drwxr-xr-x   - hadoop supergroup          0 2025-04-15 15:34 /LLL
drwxr-xr-x   - hadoop supergroup          0 2024-05-13 14:46 /file
drwxr-xr-x   - hadoop supergroup          0 2024-05-13 15:18 /newDataFlair
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /weather
ls: `/weather': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -mkdir /weather
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -copyFromLocal /home/hadoop/Desktop/1901.txt /weather/test.txt
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop jar /home/hadoop/Desktop/AverageTemperature.jar AverageDriver /weather/test.txt /weather/output
2025-05-06 14:59:23,239 INFO impl.MetricsConfig: Loaded properties from hadoop-metrics2.properties
2025-05-06 14:59:23,279 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot period at 10 second(s).
2025-05-06 14:59:23,279 INFO impl.MetricsSystemImpl: JobTracker metrics system started
2025-05-06 14:59:23,340 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2025-05-06 14:59:23,393 INFO input.FileInputFormat: Total input files to process : 1
2025-05-06 14:59:23,422 INFO mapreduce.JobSubmitter: number of splits:1
2025-05-06 14:59:23,487 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_local91822813_0001
2025-05-06 14:59:23,488 INFO mapreduce.JobSubmitter: Executing with tokens: []
2025-05-06 14:59:23,560 INFO mapreduce.Job: The url to track the job: http://localhost:8080/
2025-05-06 14:59:23,560 INFO mapreduce.Job: Running job: job_local91822813_0001
2025-05-06 14:59:23,561 INFO mapred.LocalJobRunner: OutputCommitter set in config null
2025-05-06 14:59:23,564 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to FileOutputCommitterFactory
2025-05-06 14:59:23,565 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-05-06 14:59:23,565 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: false
2025-05-06 14:59:23,565 INFO mapred.LocalJobRunner: OutputCommitter is org.apache.hadoop.mapreduce.lib.output.FileOutputCommitter
2025-05-06 14:59:23,602 INFO mapred.LocalJobRunner: Waiting for map tasks
2025-05-06 14:59:23,603 INFO mapred.LocalJobRunner: Starting task: attempt_local91822813_0001_m_000000_0
2025-05-06 14:59:23,615 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to FileOutputCommitterFactory
2025-05-06 14:59:23,615 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-05-06 14:59:23,615 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: false
2025-05-06 14:59:23,622 INFO mapred.Task:  Using ResourceCalculatorProcessTree : [ ]
2025-05-06 14:59:23,624 INFO mapred.MapTask: Processing split: hdfs://localhost:9000/weather/test.txt:0+888190
2025-05-06 14:59:23,658 INFO mapred.MapTask: (EQUATOR) 0 kvi 26214396(104857584)
2025-05-06 14:59:23,658 INFO mapred.MapTask: mapreduce.task.io.sort.mb: 100
2025-05-06 14:59:23,658 INFO mapred.MapTask: soft limit at 83886080
2025-05-06 14:59:23,658 INFO mapred.MapTask: bufstart = 0; bufvoid = 104857600
2025-05-06 14:59:23,658 INFO mapred.MapTask: kvstart = 26214396; length = 6553600
2025-05-06 14:59:23,660 INFO mapred.MapTask: Map output collector class = org.apache.hadoop.mapred.MapTask$MapOutputBuffer
```

```
2025-05-06 14:59:24,581 INFO mapreduce.Job: Counters: 36
        File System Counters
                FILE: Number of bytes read=153118
                FILE: Number of bytes written=1493804
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=1776380
                HDFS: Number of bytes written=8
                HDFS: Number of read operations=15
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=4
                HDFS: Number of bytes read erasure-coded=0
        Map-Reduce Framework
                Map input records=6565
                Map output records=6564
                Map output bytes=59076
                Map output materialized bytes=72210
                Input split bytes=103
                Combine input records=0
                Combine output records=0
                Reduce input groups=1
                Reduce shuffle bytes=72210
                Reduce input records=6564
                Reduce output records=1
                Spilled Records=13128
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=0
                Total committed heap usage (bytes)=1266679808
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=888190
        File Output Format Counters
                Bytes Written=8
```

```
                Bytes Written=8
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /weather
Found 2 items
drwxr-xr-x   - hadoop supergroup          0 2025-05-06 14:59 /weather/output
-rw-r--r--   1 hadoop supergroup     888190 2025-05-06 14:50 /weather/test.txt
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /weather/output
Found 2 items
-rw-r--r--   1 hadoop supergroup          0 2025-05-06 14:59 /weather/output/_SUCCESS
-rw-r--r--   1 hadoop supergroup          8 2025-05-06 14:59 /weather/output/part-r-00000
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cat /weather/output/part-r-00000
1901    46
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$
```

Code& command with output :

Driver Code

```
package meanmax;

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

public class MeanMaxDriver {

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

      if (args.length != 2) {
         System.err.println("Please enter both input and output parameters.");
         System.exit(-1);
      }

      Configuration conf = new Configuration();
      Job job = Job.getInstance(conf, "Mean and Max Temperature");

      job.setJarByClass(MeanMaxDriver.class);

      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);
   }
}
```

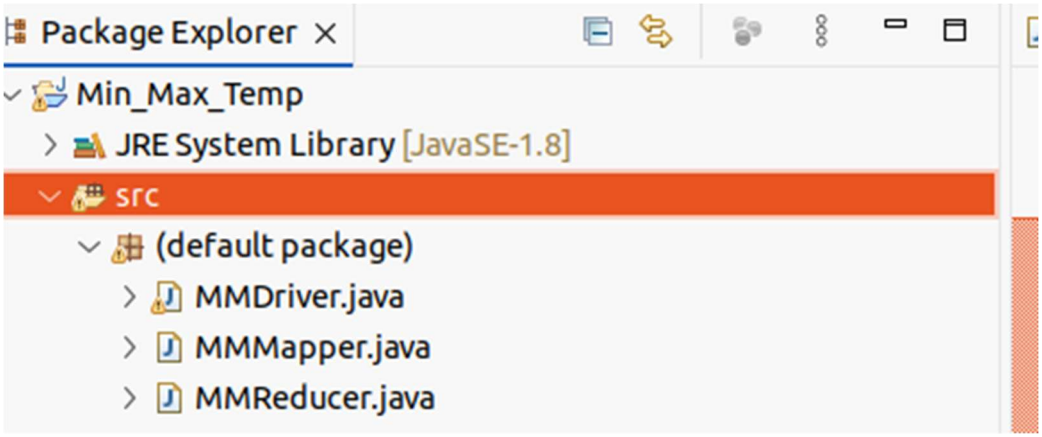
Mapper Code

```
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;

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

      String line = value.toString();

      // Extract month from positions 19-20
      String month = line.substring(19, 21);
      int temperature;
```

```
        // Extract temperature considering optional '+'
        if (line.charAt(87) == '+') {
            temperature = Integer.parseInt(line.substring(88, 92));
        } else {
            temperature = Integer.parseInt(line.substring(87, 92));
        }

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

        if (temperature != MISSING && quality.matches("[01459]")) {
            context.write(new Text(month), new IntWritable(temperature));
        }
    }
}
```

Reducer Code

```
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, Text> {

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

        int sumTemp = 0;
        int count = 0;
        int maxTemp = Integer.MIN_VALUE;

        for (IntWritable value : values) {
            int temp = value.get();
            sumTemp += temp;
            count++;

            if (temp > maxTemp) {
                maxTemp = temp;
            }
        }

        if (count > 0) {
            int avgTemp = sumTemp / count;
            String result = "mean=" + avgTemp + " max=" + maxTemp;
            context.write(key, new Text(result));
        }
    }
}
```




```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ start-all.sh
WARNING: Attempting to start all Apache Hadoop daemons as hadoop in 10 seconds.
WARNING: This is not a recommended production deployment configuration.
WARNING: Use CTRL-C to abort.
Starting namenodes on [localhost]
localhost: namenode is running as process 5478.  Stop it first and ensure /tmp/hadoop-hadoop-namenode.pid file is empty before retry.
Starting datanodes
localhost: datanode is running as process 5644.  Stop it first and ensure /tmp/hadoop-hadoop-datanode.pid file is empty before retry.
Starting secondary namenodes [bmscecse-HP-Elite-Tower-800-G9-Desktop-PC]
bmscecse-HP-Elite-Tower-800-G9-Desktop-PC: secondarynamenode is running as process 5931.  Stop it first and ensure /tmp/hadoop-hadoop-secondarynamenode.pid file is empty before retry.
Starting resourcemanager
resourcemanager is running as process 6214.  Stop it first and ensure /tmp/hadoop-hadoop-resourcemanager.pid file is empty before retry.
Starting nodemanagers
localhost: nodemanager is running as process 6375.  Stop it first and ensure /tmp/hadoop-hadoop-nodemanager.pid file is empty before retry.
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -copyFromLocal /home/hadoop/Desktop/1901 /rgs/temp
copyFromLocal: `/rgs/temp': File exists
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -mkdir -p /rgs
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -copyFromLocal /home/hadoop/Desktop/1901 /rgs/1903
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop jar /home/hduser/Downloads/Mean_Max_Temp.jar MMDriver /rgs/avtemp.txt /out8
JAR does not exist or is not a normal file: /home/hduser/Downloads/Mean_Max_Temp.jar
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop jar /home/hduser/Downloads/Min_Max_Temp.jar MMDriver /rgs/avtemp.txt /out8
JAR does not exist or is not a normal file: /home/hduser/Downloads/Min_Max_Temp.jar
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop jar /home/hadoop/Desktop/Min_Max_Temp.jar MMDriver /rgs/avtemp.txt /out8
2025-05-06 15:23:05,430 INFO impl.MetricsConfig: Loaded properties from hadoop-metrics2.properties
2025-05-06 15:23:05,471 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot period at 10 second(s).
2025-05-06 15:23:05,471 INFO impl.MetricsSystemImpl: JobTracker metrics system started
2025-05-06 15:23:05,531 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2025-05-06 15:23:05,575 INFO mapreduce.JobSubmitter: Cleaning up the staging area file:/tmp/hadoop/mapred/staging/hadoop1762005270/.staging/job_local1762005270_0001
Exception in thread "main" org.apache.hadoop.mapreduce.lib.input.InvalidInputException: Input path does not exist: hdfs://localhost:9000/rgs/avtemp.txt
        at org.apache.hadoop.mapreduce.lib.input.FileInputFormat.singleThreadedListStatus(FileInputFormat.java:340)
        at org.apache.hadoop.mapreduce.lib.input.FileInputFormat.listStatus(FileInputFormat.java:279)
        at org.apache.hadoop.mapreduce.lib.input.FileInputFormat.getSplits(FileInputFormat.java:404)
        at org.apache.hadoop.mapreduce.JobSubmitter.writeNewSplits(JobSubmitter.java:310)
        at org.apache.hadoop.mapreduce.JobSubmitter.writeSplits(JobSubmitter.java:327)
        at org.apache.hadoop.mapreduce.JobSubmitter.submitJobInternal(JobSubmitter.java:200)
        at org.apache.hadoop.mapreduce.Job$11.run(Job.java:1678)
        at org.apache.hadoop.mapreduce.Job$11.run(Job.java:1675)
        at java.base/java.security.AccessController.doPrivileged(Native Method)
        at java.base/javax.security.auth.Subject.doAs(Subject.java:423)
        at org.apache.hadoop.security.UserGroupInformation.doAs(UserGroupInformation.java:1899)
        at org.apache.hadoop.mapreduce.Job.submit(Job.java:1675)
        at org.apache.hadoop.mapreduce.Job.waitForCompletion(Job.java:1696)
        at MMDriver.main(MMDriver.java:40)
        at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke0(Native Method)
        at java.base/jdk.internal.reflect.NativeMethodAccessorImpl.invoke(NativeMethodAccessorImpl.java:62)
        at java.base/jdk.internal.reflect.DelegatingMethodAccessorImpl.invoke(DelegatingMethodAccessorImpl.java:43)
        at java.base/java.lang.reflect.Method.invoke(Method.java:566)
        at org.apache.hadoop.util.RunJar.run(RunJar.java:328)
        at org.apache.hadoop.util.RunJar.main(RunJar.java:241)
Caused by: java.io.IOException: Input path does not exist: hdfs://localhost:9000/rgs/avtemp.txt
        at org.apache.hadoop.mapreduce.lib.input.FileInputFormat.singleThreadedListStatus(FileInputFormat.java:313)
        ... 19 more
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /out8/*
cat: `/out8/*': No such file or directory
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ ^C
```

```
Caused by: java.io.IOException: Input path does not exist: hdfs://localhost:9000/rgs/avtemp.txt
        at org.apache.hadoop.mapreduce.lib.input.FileInputFormat.singleThreadedListStatus(FileInputFormat.java:313)
        ... 19 more
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop jar /home/hadoop/Desktop/Min_Max_Temp.jar MMDriver /rgs/1903 /out8
2025-05-06 15:26:34,876 INFO impl.MetricsConfig: Loaded properties from hadoop-metrics2.properties
2025-05-06 15:26:34,916 INFO impl.MetricsSystemImpl: Scheduled Metric snapshot period at 10 second(s).
2025-05-06 15:26:34,916 INFO impl.MetricsSystemImpl: JobTracker metrics system started
2025-05-06 15:26:34,976 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not performed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2025-05-06 15:26:35,029 INFO input.FileInputFormat: Total input files to process : 1
2025-05-06 15:26:35,081 INFO mapreduce.JobSubmitter: number of splits:1
2025-05-06 15:26:35,148 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_local1063792118_0001
2025-05-06 15:26:35,148 INFO mapreduce.JobSubmitter: Executing with tokens: []
2025-05-06 15:26:35,215 INFO mapreduce.Job: The url to track the job: http://localhost:8080/
2025-05-06 15:26:35,216 INFO mapreduce.Job: Running job: job_local1063792118_0001
2025-05-06 15:26:35,216 INFO mapred.LocalJobRunner: OutputCommitter set in config null
2025-05-06 15:26:35,220 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to FileOutputCommitterFactory
2025-05-06 15:26:35,221 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-05-06 15:26:35,221 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: false
2025-05-06 15:26:35,221 INFO mapred.LocalJobRunner: OutputCommitter is org.apache.hadoop.mapreduce.lib.output.FileOutputCommitter
2025-05-06 15:26:35,267 INFO mapred.LocalJobRunner: Waiting for map tasks
2025-05-06 15:26:35,268 INFO mapred.LocalJobRunner: Starting task: attempt_local1063792118_0001_m_000000_0
2025-05-06 15:26:35,278 INFO output.PathOutputCommitterFactory: No output committer factory defined, defaulting to FileOutputCommitterFactory
2025-05-06 15:26:35,278 INFO output.FileOutputCommitter: File Output Committer Algorithm version is 2
2025-05-06 15:26:35,279 INFO output.FileOutputCommitter: FileOutputCommitter skip cleanup _temporary folders under output directory:false, ignore cleanup failures: false
2025-05-06 15:26:35,286 INFO mapred.Task:  Using ResourceCalculatorProcessTree : [ ]
2025-05-06 15:26:35,287 INFO mapred.MapTask: Processing split: hdfs://localhost:9000/rgs/1903:0+888190
2025-05-06 15:26:35,322 INFO mapred.MapTask: (EQUATOR) 0 kvi 26214396(104857584)
2025-05-06 15:26:35,322 INFO mapred.MapTask: mapreduce.task.io.sort.mb: 100
2025-05-06 15:26:35,322 INFO mapred.MapTask: soft limit at 83886080
2025-05-06 15:26:35,322 INFO mapred.MapTask: bufstart = 0; bufvoid = 104857600
2025-05-06 15:26:35,322 INFO mapred.MapTask: kvstart = 26214396; length = 6553600
2025-05-06 15:26:35,325 INFO mapred.MapTask: Map output collector class = org.apache.hadoop.mapred.MapTask$MapOutputBuffer
2025-05-06 15:26:35,440 INFO mapred.LocalJobRunner:
2025-05-06 15:26:35,441 INFO mapred.MapTask: Starting flush of map output
2025-05-06 15:26:35,441 INFO mapred.MapTask: Spilling map output
2025-05-06 15:26:35,441 INFO mapred.MapTask: bufstart = 0; bufend = 45948; bufvoid = 104857600
2025-05-06 15:26:35,441 INFO mapred.MapTask: kvstart = 26214396(104857584); kvend = 26188144(104752576); length = 26253/6553600
2025-05-06 15:26:35,451 INFO mapred.MapTask: Finished spill 0
2025-05-06 15:26:35,456 INFO mapred.Task: Task:attempt_local1063792118_0001_m_000000_0 is done. And is in the process of committing
2025-05-06 15:26:35,458 INFO mapred.LocalJobRunner: map
2025-05-06 15:26:35,458 INFO mapred.Task: Task 'attempt_local1063792118_0001_m_000000_0' done.
2025-05-06 15:26:35,461 INFO mapred.Task: Final Counters for attempt_local1063792118_0001_m_000000_0: Counters: 23
        File System Counters
                FILE: Number of bytes read=4359
                FILE: Number of bytes written=703803
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=888190
                HDFS: Number of bytes written=0
                HDFS: Number of read operations=5
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=1
                HDFS: Number of bytes read erasure-coded=0
        Map-Reduce Framework
                Map input records=6565
```

```
2025-05-06 15:26:36,222 INFO mapreduce.Job: Job job_local1063792118_0001 completed successfully
2025-05-06 15:26:36,233 INFO mapreduce.Job: Counters: 36
        File System Counters
                FILE: Number of bytes read=126914
                FILE: Number of bytes written=1466688
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=1776380
                HDFS: Number of bytes written=74
                HDFS: Number of read operations=15
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=4
                HDFS: Number of bytes read erasure-coded=0
        Map-Reduce Framework
                Map input records=6565
                Map output records=6564
                Map output bytes=45948
                Map output materialized bytes=59082
                Input split bytes=95
                Combine input records=0
                Combine output records=0
                Reduce input groups=12
                Reduce shuffle bytes=59082
                Reduce input records=6564
                Reduce output records=12
                Spilled Records=13128
                Shuffled Maps =1
                Failed Shuffles=0
                Merged Map outputs=1
                GC time elapsed (ms)=0
                Total committed heap usage (bytes)=1052770304
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=888190
        File Output Format Counters
                Bytes Written=74
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hdfs dfs -cat /out8/*
01      4
02      0
03      7
04      44
05      100
06      168
07      219
08      198
09      141
10      100
11      19
12      3
```

LABORATORY PROGRAM – 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.

Code, command with output:

Driver Code:

```
package samples.topn;

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

public class TopNDriver {

   public static void main(String[] args) throws Exception {
      if (args.length != 3) {
         System.err.println("Usage: TopNDriver <in> <temp-out> <final-out>");
         System.exit(2);
      }

      Configuration conf = new Configuration();

      // === Job 1: Word Count ===
      Job wcJob = Job.getInstance(conf, "word count");
      wcJob.setJarByClass(TopNDriver.class);
      wcJob.setMapperClass(WordCountMapper.class);
      wcJob.setCombinerClass(WordCountReducer.class);
      wcJob.setReducerClass(WordCountReducer.class);
      wcJob.setOutputKeyClass(Text.class);
      wcJob.setOutputValueClass(IntWritable.class);

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

      if (!wcJob.waitForCompletion(true)) {
         System.exit(1);
      }

      // === Job 2: Top N ===
      Job topJob = Job.getInstance(conf, "top 10 words");
      topJob.setJarByClass(TopNDriver.class);
      topJob.setMapperClass(TopNMapper.class);
      topJob.setReducerClass(TopNReducer.class);
      topJob.setMapOutputKeyClass(IntWritable.class);
      topJob.setMapOutputValueClass(Text.class);
      topJob.setOutputKeyClass(Text.class);
      topJob.setOutputValueClass(IntWritable.class);

      FileInputFormat.addInputPath(topJob, tempDir);
      FileOutputFormat.setOutputPath(topJob, new Path(args[2]));

      System.exit(topJob.waitForCompletion(true) ? 0 : 1);
   }
}
```

Mapper Code:

```
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 WordCountMapper
   extends Mapper<Object, Text, Text, IntWritable> {

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

   @Override
   protected void map(Object key, Text value, Context context)
      throws IOException, InterruptedException {

      // clean & tokenize
      String clean = value.toString()
                     .toLowerCase()
                     .replaceAll(tokens, " ");
      StringTokenizer itr = new StringTokenizer(clean);
      while (itr.hasMoreTokens()) {
         word.set(itr.nextToken().trim());
         context.write(word, ONE);
      }
   }
}
```

Mapper Code:

```
package samples.topn;

import java.io.IOException;

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, IntWritable, Text> {

   private IntWritable count = new IntWritable();
   private Text word = new Text();

   @Override
   protected void map(Object key, Text value, Context context)
      throws IOException, InterruptedException {

      // input line: word \t count
      String[] parts = value.toString().split("\\t");
      if (parts.length == 2) {
         word.set(parts[0]);
         count.set(Integer.parseInt(parts[1]));
         // emit count → word, so Hadoop sorts by count
         context.write(count, word);
      }
   }
}
```

Reducer Code:

```
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 WordCountReducer
   extends Reducer<Text, IntWritable, Text, IntWritable> {

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

      int sum = 0;
      for (IntWritable val : values) {
         sum += val.get();
      }
      context.write(key, new IntWritable(sum));
   }
}
```

Reducer Code :

```
package samples.topn;

import java.io.IOException;
import java.util.ArrayList;
import java.util.Collections;
import java.util.List;
import java.util.Map;
import java.util.TreeMap;

import org.apache.hadoop.io.IntWritable;
import org.apache.hadoop.io.Text;
import org.apache.hadoop.mapreduce.Reducer;

public class TopNReducer
   extends Reducer<IntWritable, Text, Text, IntWritable> {

   // TreeMap with descending order of keys (counts)
   private TreeMap<Integer, List<String>> countMap =
      new TreeMap<>(Collections.reverseOrder());

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

      int cnt = key.get();
      List<String> words = countMap.getOrDefault(cnt, new ArrayList<>());
      for (Text w : values) {
         words.add(w.toString());
      }
      countMap.put(cnt, words);
   }

   @Override
   protected void cleanup(Context context)
      throws IOException, InterruptedException {

      // collect top 10 word→count pairs
      List<WordCount> topList = new ArrayList<>();
      int seen = 0;
      for (Map.Entry<Integer, List<String>> entry : countMap.entrySet()) {
```

```
            int cnt = entry.getKey();
            for (String w : entry.getValue()) {
                topList.add(new WordCount(w, cnt));
                seen++;
                if (seen == 10) break;
            }
            if (seen == 10) break;
        }

        // sort these 10 entries alphabetically by word
        Collections.sort(topList, (a, b) -> a.word.compareTo(b.word));

        // emit final top 10 in alphabetical order
        for (WordCount wc : topList) {
            context.write(new Text(wc.word), new IntWritable(wc.count));
        }
    }

    // helper class
    private static class WordCount {
        String word;
        int count;
        WordCount(String w, int c) { word = w; count = c; }
    }
}
```

```
2025-04-29 15:32:09,761 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager
 at /0.0.0.0:8032
2025-04-29 15:32:09,829 INFO client.DefaultNoHARMFailoverProxyProvider: Connecting to ResourceManager
 at /0.0.0.0:8032
2025-04-29 15:32:09,918 WARN mapreduce.JobResourceUploader: Hadoop command-line option parsing not pe
rformed. Implement the Tool interface and execute your application with ToolRunner to remedy this.
2025-04-29 15:32:09,944 INFO mapreduce.JobResourceUploader: Disabling Erasure Coding for path: /tmp/h
adoop-yarn/staging/hadoop/.staging/job_1745919848818_0003
2025-04-29 15:32:10,138 INFO mapred.FileInputFormat: Total input files to process : 1
2025-04-29 15:32:10,227 INFO mapreduce.JobSubmitter: number of splits:2
2025-04-29 15:32:10,318 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1745919848818_000
3
2025-04-29 15:32:10,318 INFO mapreduce.JobSubmitter: Executing with tokens: []
2025-04-29 15:32:10,405 INFO conf.Configuration: resource-types.xml not found
2025-04-29 15:32:10,405 INFO resource.ResourceUtils: Unable to find 'resource-types.xml'.
2025-04-29 15:32:10,556 INFO impl.YarnClientImpl: Submitted application application_1745919848818_000
3
2025-04-29 15:32:10,574 INFO mapreduce.Job: The url to track the job: http://bmscecse-HP-Elite-Tower-
800-G9-Desktop-PC:8088/proxy/application_1745919848818_0003/
2025-04-29 15:32:10,575 INFO mapreduce.Job: Running job: job_1745919848818_0003
2025-04-29 15:32:15,652 INFO mapreduce.Job: Job job_1745919848818_0003 running in uber mode : false
2025-04-29 15:32:15,654 INFO mapreduce.Job:  map 0% reduce 0%
2025-04-29 15:32:18,772 INFO mapreduce.Job:  map 100% reduce 0%
2025-04-29 15:32:22,799 INFO mapreduce.Job:  map 100% reduce 100%
2025-04-29 15:32:23,824 INFO mapreduce.Job: Job job_1745919848818_0003 completed successfully
2025-04-29 15:32:23,882 INFO mapreduce.Job: Counters: 54
        File System Counters
                FILE: Number of bytes read=215
                FILE: Number of bytes written=829242
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=306
                HDFS: Number of bytes written=69
                HDFS: Number of read operations=11
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
                HDFS: Number of bytes read erasure-coded=0
        Job Counters
                Launched map tasks=2
                Launched reduce tasks=1
                Data-local map tasks=2
                Total time spent by all maps in occupied slots (ms)=2555
                Total time spent by all reduces in occupied slots (ms)=1281
                Total time spent by all map tasks (ms)=2555
                Total time spent by all reduce tasks (ms)=1281
                Total vcore-milliseconds taken by all map tasks=2555
                Total vcore-milliseconds taken by all reduce tasks=1281
                Total megabyte-milliseconds taken by all map tasks=2616320
                Total megabyte-milliseconds taken by all reduce tasks=1311744
```

```
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -ls /rgs/output
Found 2 items
-rw-r--r--   1 hadoop supergroup          0 2025-04-29 15:32 /rgs/output/_SUCCESS
-rw-r--r--   1 hadoop supergroup         69 2025-04-29 15:32 /rgs/output/part-00000
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$ hadoop fs -cat /rgs/output/part-00000
are     1
brother 1
family  1
hi      1
how     5
is      4
job     1
sister  1
you     1
your    4
hadoop@bmscecse-HP-Elite-Tower-800-G9-Desktop-PC:~$
```

LABORATORY PROGRAM – 8

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

Code, command with output:

```
bmscecse@bmscecse-HP-Elite-Tower-600-G9-Desktop-PC:~$ spark-shell
25/05/20 11:28:13 WARN Utils: Your hostname, bmscecse-HP-Elite-Tower-600-G9-Desktop-PC resolves to a loopback address: 127.0.1.1; using 10.124.3.80 instead (on interface eno1)
25/05/20 11:28:13 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to another address
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/opt/spark/jars/spark-unsafe_2.12-3.0.3.jar) to constructor java.nio.DirectByteBuffer(long,int)
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
25/05/20 11:28:13 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
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://10.124.3.80:4040
Spark context available as 'sc' (master = local[*], app id = local-1747720695950).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 3.0.3
      /_/

Using Scala version 2.12.10 (OpenJDK 64-Bit Server VM, Java 11.0.26)
Type in expressions to have them evaluated.
Type :help for more information.

scala> for (i <- 1 to 100) print(i + " ")
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 6
5 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
```

LABORATORY PROGRAM – 9

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

Code, command with output:

```
scala> val rdd = spark.sparkContext.textFile("file:/home/bmscecse/Desktop/scala")
rdd: org.apache.spark.rdd.RDD[String] = file:/home/bmscecse/Desktop/scala MapPartitionsRDD[1] at textFile at <console>:23

scala> val counts = rdd.flatMap(_.split("\\s+")).map(word => (word.toLowerCase, 1)).reduceByKey(_ + _).filter(_._2 > 4)
counts: org.apache.spark.rdd.RDD[(String, Int)] = MapPartitionsRDD[5] at filter at <console>:25

scala> counts.collect().foreach{ case (word, count) => println(s"$word $count") }
spark 6

scala>
```

LABORATORY PROGRAM – 10

Write a simple streaming program in Spark to receive text data streams on a particular port, perform basic text cleaning (like white space removal, stop words removal, lemmatization, etc.), and print the cleaned text on the screen. (Open Ended Question).

Code, command with output:

```
!pip install nltk

import nltk
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')

from pyspark.sql import SparkSession
from pyspark.sql.functions import col, lower, regexp_replace, split, explode, udf
from pyspark.sql.types import ArrayType, StringType
from pyspark.ml.feature import StopWordsRemover
from nltk.stem import WordNetLemmatizer
spark = SparkSession.builder.appName("TextProcessing").getOrCreate()

lines = [
   "Hello, I hate you.",
   "I hate that I love you.",
   "Don't want to, but I can't put",
   "nobody else above you."
]

df = spark.createDataFrame(lines, "string").toDF("value")
df_clean = df.select(regexp_replace(lower(col("value")), "[^a-zA-Z\\s]", "").alias("cleaned"))
df_tokens = df_clean.select(split(col("cleaned"), "\\s+").alias("tokens"))

remover = StopWordsRemover(inputCol="tokens", outputCol="filtered")
df_filtered = remover.transform(df_tokens)

lemmatizer = WordNetLemmatizer()

def lemmatize_words(words):
   return [lemmatizer.lemmatize(word) for word in words]

lemmatize_udf = udf(lemmatize_words, ArrayType(StringType()))

df_lemmatized = df_filtered.withColumn("lemmatized", lemmatize_udf(col("filtered")))
df_lemmatized.select(explode(col("lemmatized")).alias("word")).show(truncate=False)
```

```
Requirement already satisfied: nltk in /usr/local/lib/python3.11/dist-packages (3.9.1)
Requirement already satisfied: click in /usr/local/lib/python3.11/dist-packages (from nltk) (8.2.0)
Requirement already satisfied: joblib in /usr/local/lib/python3.11/dist-packages (from nltk) (1.5.0)
Requirement already satisfied: regex>=2021.8.3 in /usr/local/lib/python3.11/dist-packages (from nltk) (2024.11.6)
Requirement already satisfied: tqdm in /usr/local/lib/python3.11/dist-packages (from nltk) (4.67.1)
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...
+------+
|word  |
+------+
|hello |
|hate  |
|hate  |
|love  |
|dont  |
|want  |
|cant  |
|put   |
|nobody|
|else  |
+------+
```