RAMNIRANJAN JHUNJHUNWALA COLLEGE OF ARTS, SCIENCE & COMMERCE

Big Data Analytics with Hadoop and Spark

Name- **Ekta Yadav**

Roll No- **627**

Hindi Vidya Prachar Samiti's

RAMNIRANJAN JHUNJHUNWALA COLLEGE

OF ARTS, SCIENCE & COMMERCE

(Empowered Autonomous College)

DEPARTMENT OF INFORMATION TECHNOLOGY
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M.Sc. (I.T.) Part-1 SEM 2

RJSPGITE202P

Big Data Analytics with Hadoop and Spark

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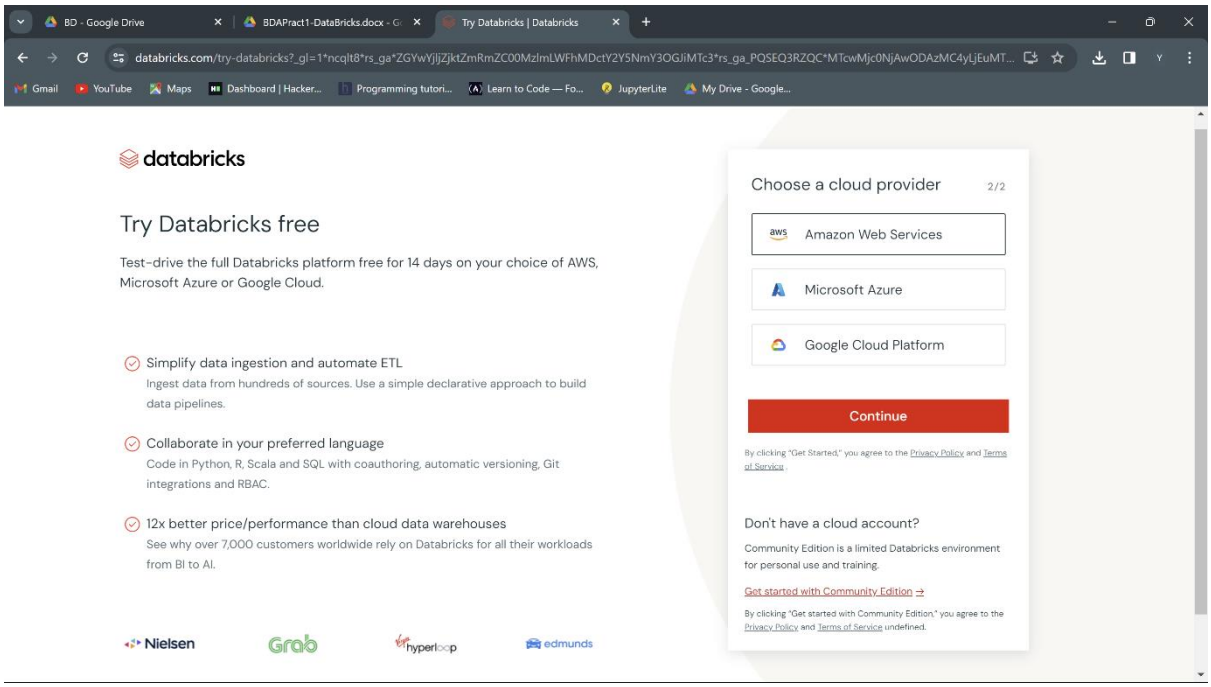
Practical No. 1: Using basic Commands of Linux and Hadoop

Community Edition DataBricks- https://community.cloud.databricks.com/login.html

Click this Link for getting Community edition of Databricks

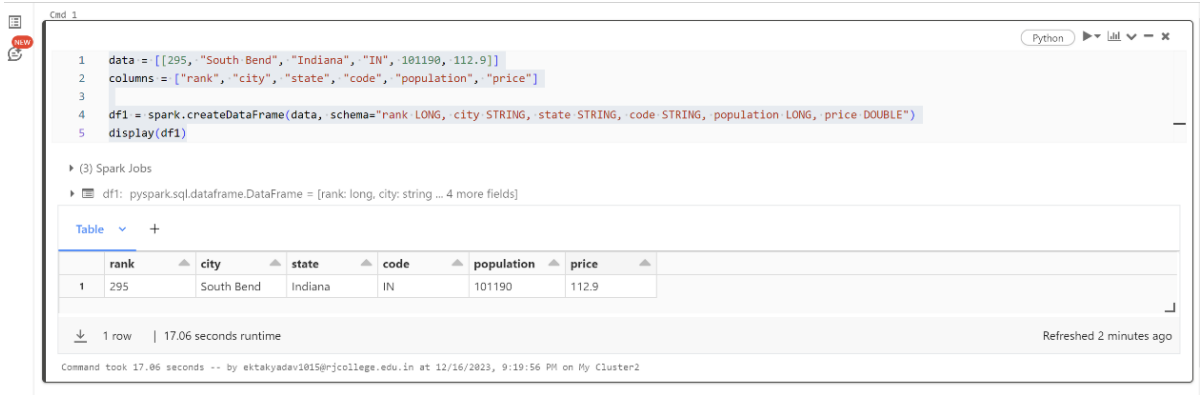


- Create a dataframe for the specified data.

Code-

```
data = [[295, "South Bend", "Indiana", "IN", 101190, 112.9]]
columns = ["rank", "city", "state", "code", "population", "price"]
df1 = spark.createDataFrame(data, schema="rank LONG, city STRING, state STRING, code STRING, population LONG, price DOUBLE")
display(df1)
```

Output-



- Create and load a dataframe for the databricks sample dataset

/databricks-datasets/samples/population-vs-price/data_geo.csv

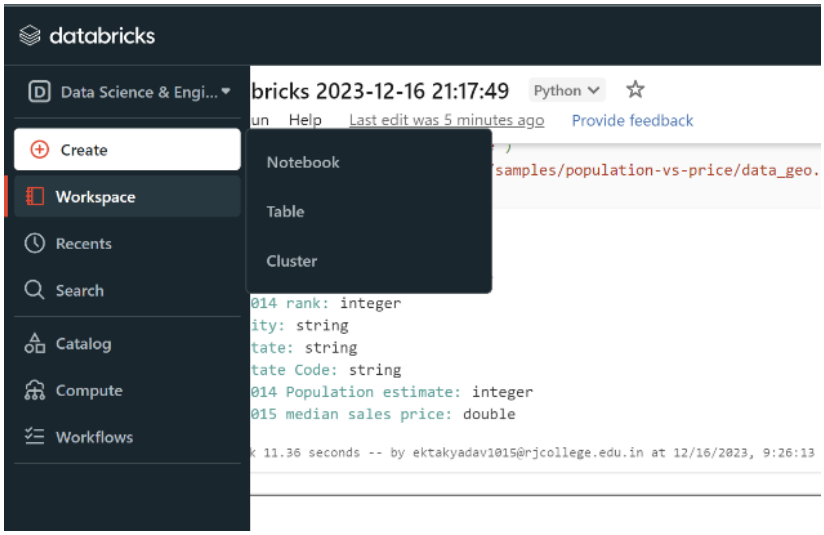
Code-

```
df2 = (spark.read
  .format("csv")
  .option("header", "true")
  .option("inferSchema", "true")
  .load("/databricks-datasets/samples/population-vs-price/data_geo.csv")
)
```

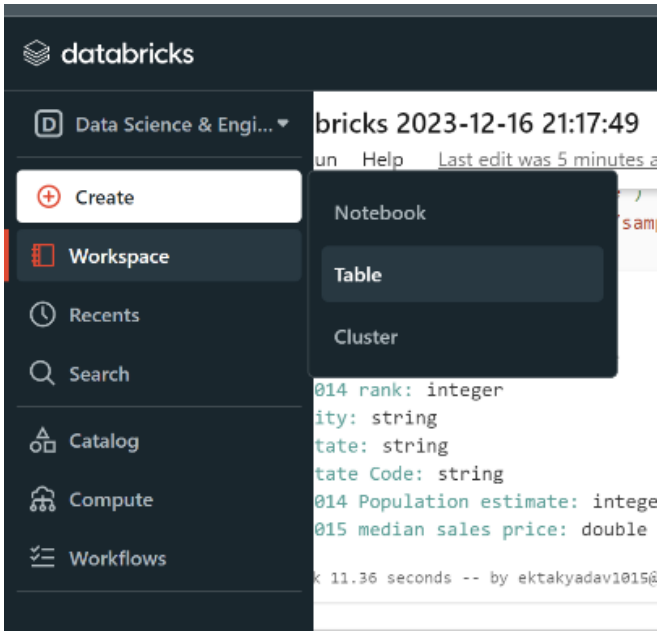
Output-

- Upload any sample dataset.csv file into Databricks and load the Data into dataframe. Download data from github- https://github.com/mwaskom/seaborn-data/blob/master/iris.csv

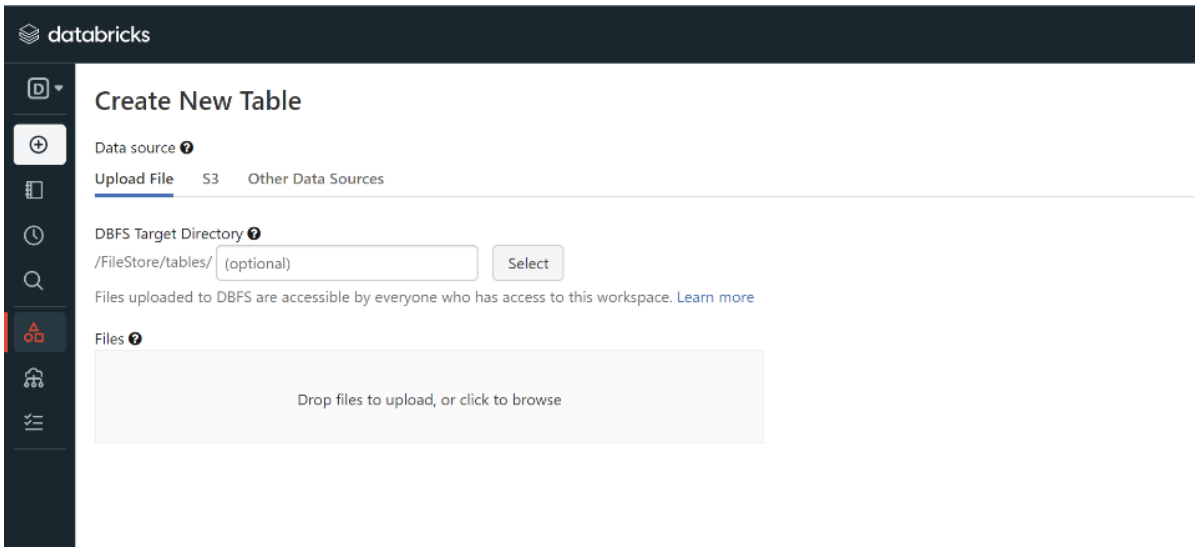
Step 1- Upload Data -Click Create

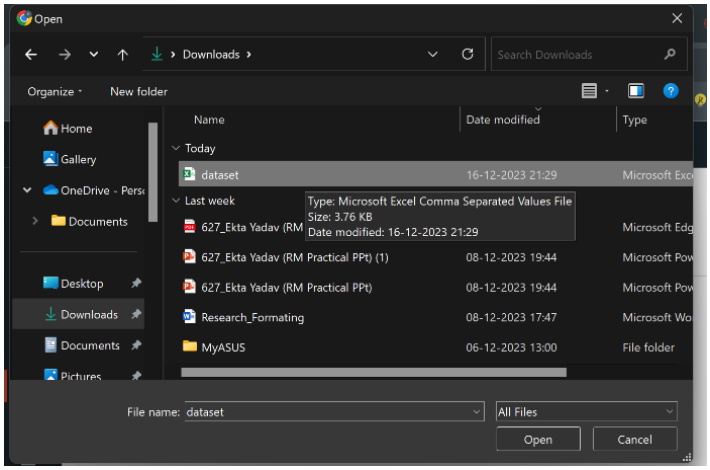


Step 2-Select Table Option

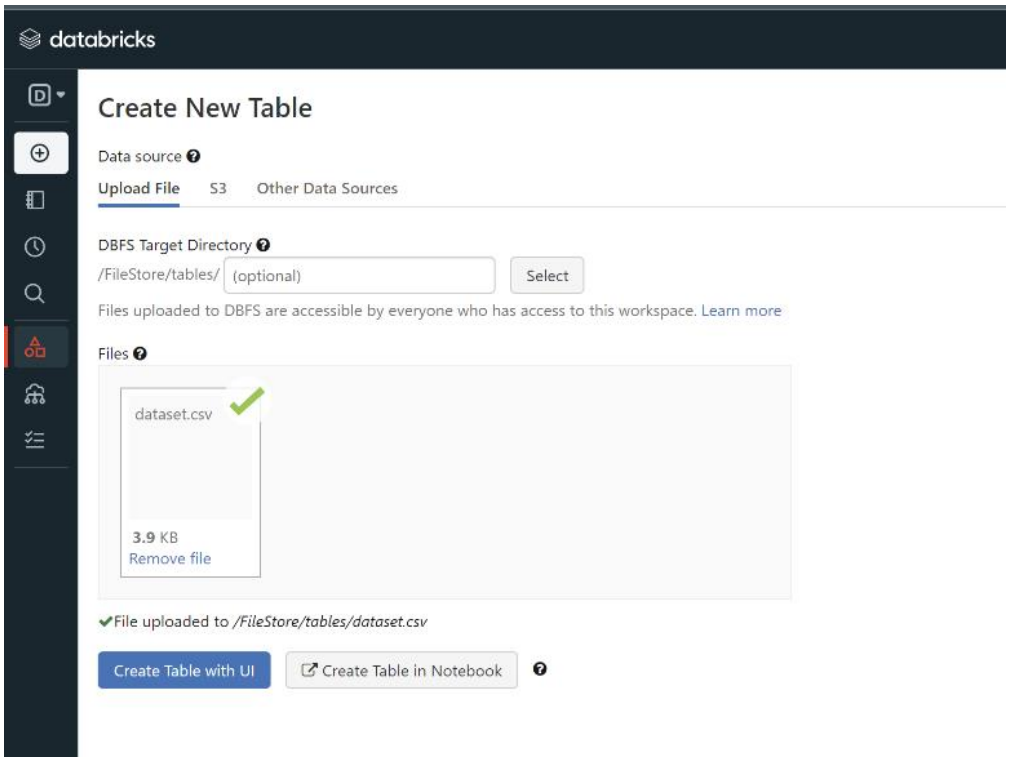


Step 3- Drag file to upload or click to browser

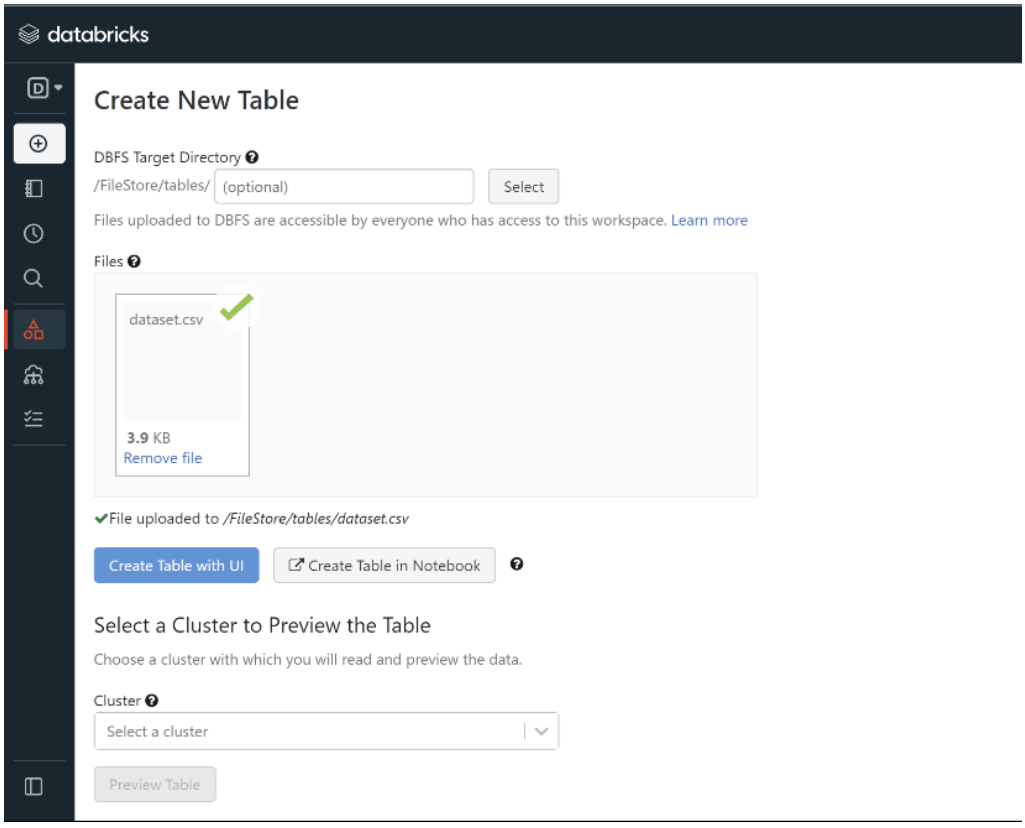


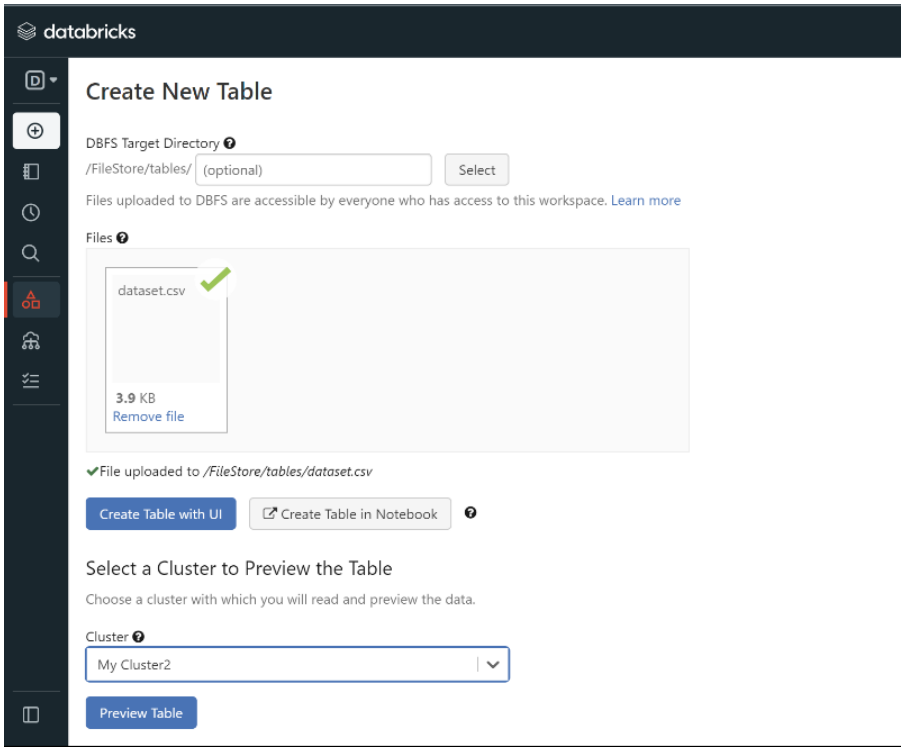


Step 4-File is Uploaded and click Create Table with UI Button

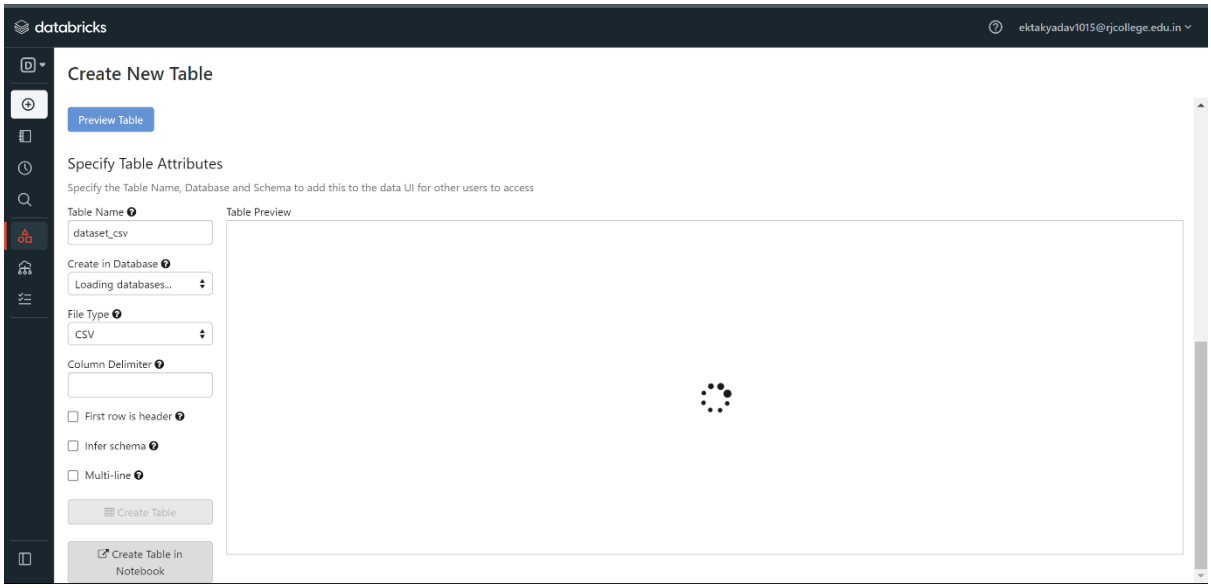


Step 5- Create Cluster and select cluster – Attach and Run

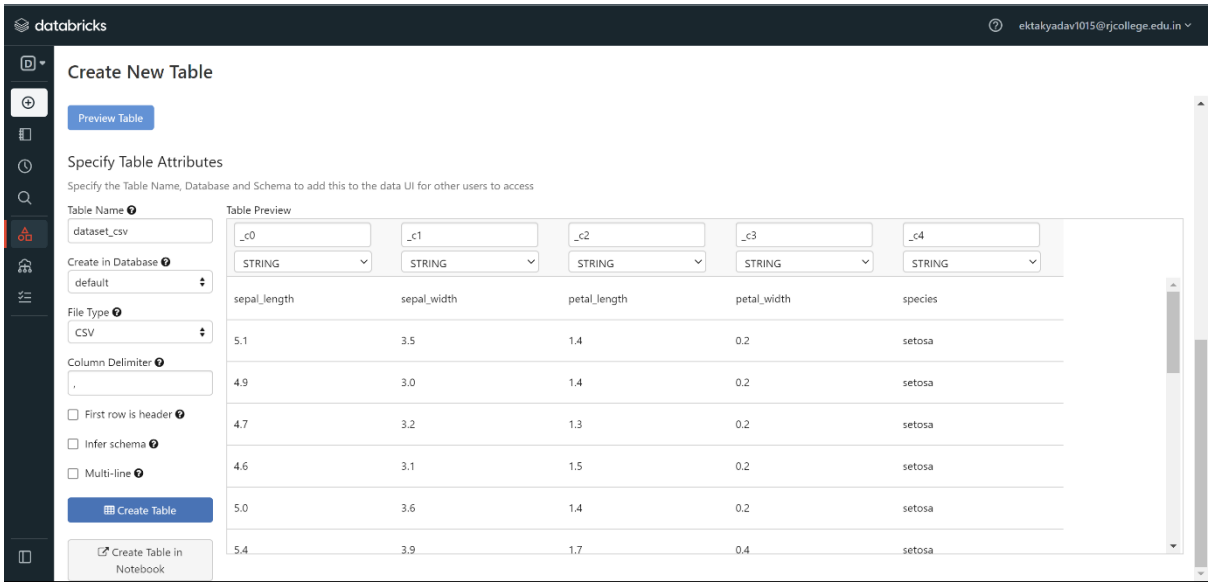




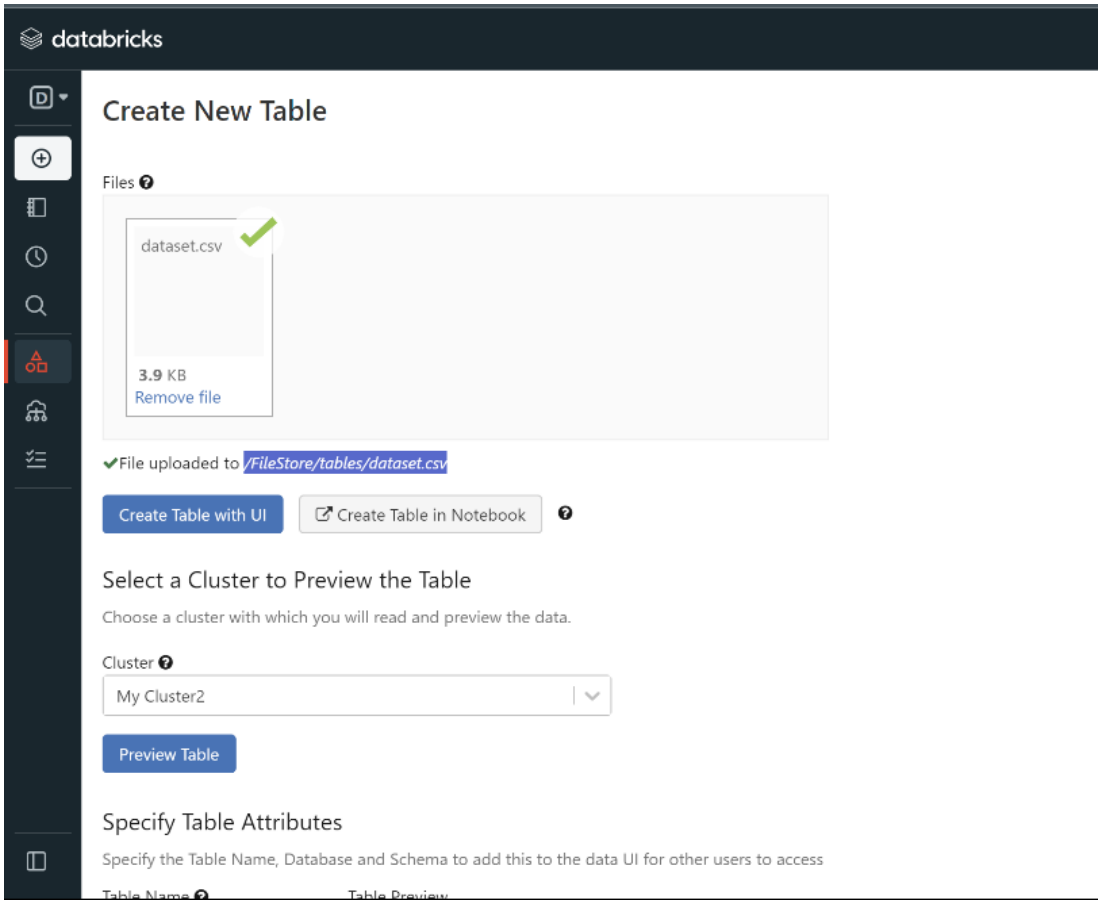
Step 6- After Attach Cluster click on Preview Table Button



Step 7- View the Your loaded Dataset



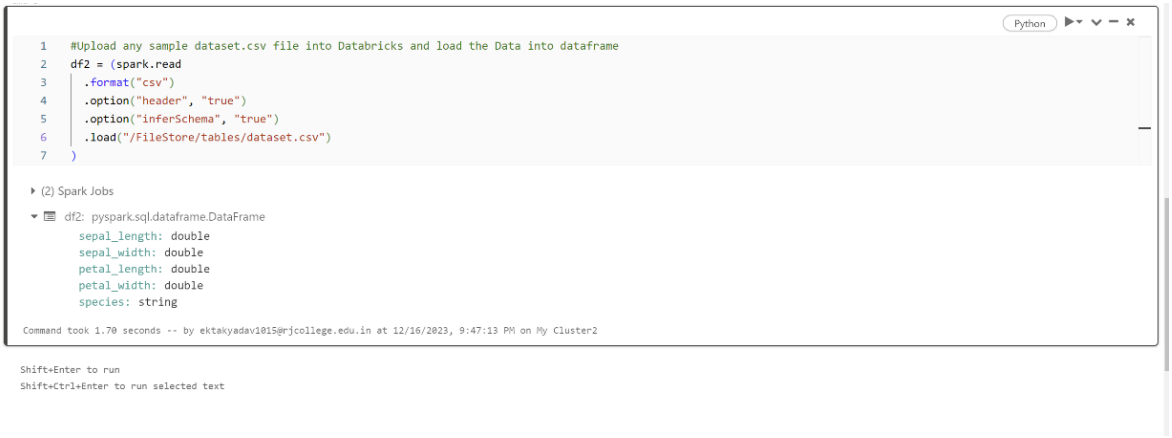
Step 8- Copy the path of loaded data



After copy the path Write the code in Notebook-

```
#Upload any sample dataset.csv file into Databricks and load the Data into dataframe
df2 = (spark.read
  .format("csv")
  .option("header", "true")
  .option("inferSchema", "true")
  .load("/FileStore/tables/dataset.csv")
)
```

Output-



- Upload any sample dataset.json file into Databricks and load the data into the dataframe.

Code-

```
#Upload any sample dataset.json file into Databricks and load the data into the dataframe
data = [[295, "South Bend", "Indiana", "IN", 101190, 112.9]]
columns = ["rank", "city", "state", "code", "population", "price"]

df1 = spark.createDataFrame(data, schema="rank LONG, city STRING, state STRING, code STRING, population LONG, price DOUBLE")
#display(df1)

df1.write.format("json").save("/tmp/json_data3")
```

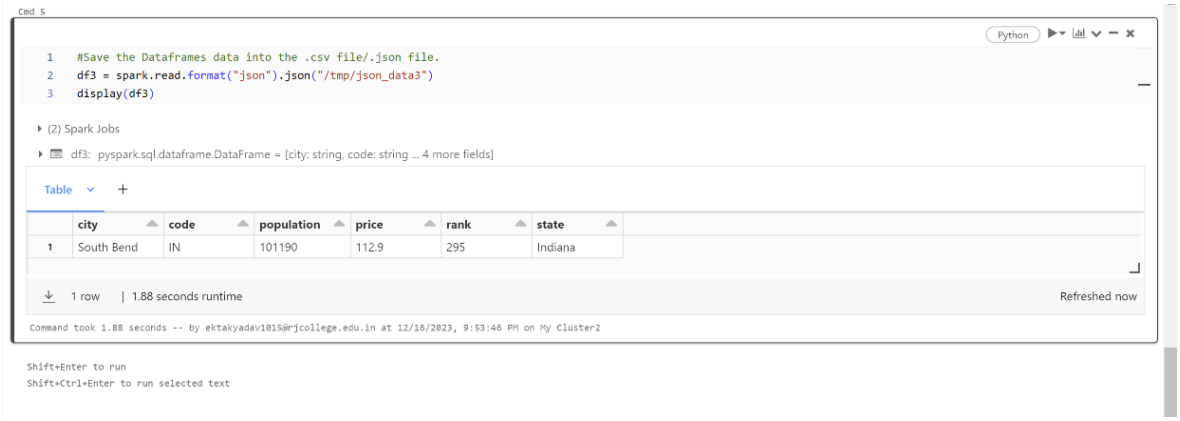
Output-

- Save the Dataframes data into the .csv file/.json file.

Code-

```
#Save the Dataframes data into the .csv file/.json file.
df3 = spark.read.format("json").json("/tmp/json_data3")
display(df3)
```

Output-



Printing the Schema of dataframe-

```
df.printSchema()
```

Output-

- Create dataframe to store the following data

OrderID	Product	SalesAmount	Country
1	Apple	12345	India
2	Grapes	43857	UK
3	PineApple	2345	US

Code-

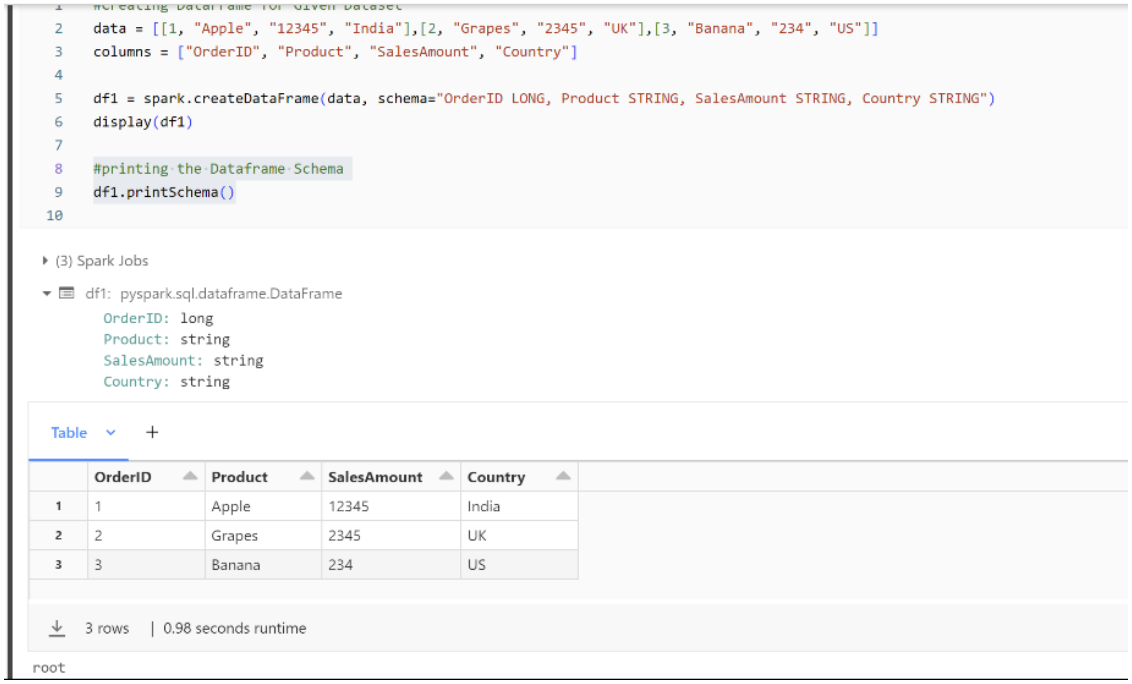
```
#Creating DataFrame for Given Dataset
data = [[1, "Apple", "12345", "India"],[2, "Grapes", "43857", "UK"],[3, "Banana", "2345", "US"]]
columns = ["OrderID", "Product", "SalesAmount", "Country"]

df1 = spark.createDataFrame(data, schema="OrderID LONG, Product STRING, SalesAmount STRING, Country STRING")
display(df1)
```

Output-

Printing the Dataframe schema-

```
#printing the Dataframe Schema
df1.printSchema()
```

Output-



Finding the Union of Dataframe-

Syntax-

```
# Returns a DataFrame that combines the rows of df1 and df2
df = df1.union(df2)
```

Code-

```
# Returns a DataFrame that combines the rows of df1 and df2
data = [[1, "Apple", "12345", "India"],[2, "Grapes", "43857", "UK"],[3, "Banana", "2345", "US"]]
columns = ["OrderID", "Product", "SalesAmount", "Country"]

df1 = spark.createDataFrame(data, schema="OrderID LONG, Product STRING, SalesAmount STRING, Country STRING")
display(df1)

data = [[4, "Chiku", "12345", "India"],[5, "Grava", "43857", "UK"],[6, "Lichhi", "2345", "US"]]
columns = ["OrderID", "Product", "SalesAmount", "Country"]

df2 = spark.createDataFrame(data, schema="OrderID LONG, Product STRING, SalesAmount STRING, Country STRING")
display(df2)

dfu = df1.union(df2)
display(dfu)
```

Cmd 7

```
# Returns a DataFrame that combines the rows of df1 and df2
data = [[1, "Apple", "12345", "India"],[2, "Grapes", "43857", "UK"],[3, "Banana", "2345", "US"]]
columns = ["OrderID", "Product", "SalesAmount", "Country"]

df1 = spark.createDataFrame(data, schema="OrderID LONG, Product STRING, SalesAmount STRING, Country STRING")
display(df1)

data = [[4, "Chiku", "12345", "India"],[5, "Grava", "43857", "UK"],[6, "Lichhi", "2345", "US"]]
columns = ["OrderID", "Product", "SalesAmount", "Country"]

df2 = spark.createDataFrame(data, schema="OrderID LONG, Product STRING, SalesAmount STRING, Country STRING")
display(df2)

dfu = df1.union(df2)
display(dfu)
```

▸ (9) Spark Jobs

▸ df1: pyspark.sql.dataframe.DataFrame = [OrderID: long, Product: string ... 2 more fields]

▸ df2: pyspark.sql.dataframe.DataFrame = [OrderID: long, Product: string ... 2 more fields]

Output-

Table +

	OrderID	Product	SalesAmount	Country
1	1	Apple	12345	India
2	2	Grapes	43857	UK
3	3	Banana	2345	US

3 rows | 2.36 seconds runtime

Table +

	OrderID	Product	SalesAmount	Country
1	4	Chiku	12345	India
2	5	Grava	43857	UK
3	6	Lichhi	2345	US

3 rows | 2.36 seconds runtime

Table +

Table +

	OrderID	Product	SalesAmount	Country
1	1	Apple	12345	India
2	2	Grapes	43857	UK
3	3	Banana	2345	US
4	4	Chiku	12345	India
5	5	Grava	43857	UK
6	6	Lichhi	2345	US

6 rows | 2.36 seconds runtime

Command took 2.36 seconds -- by ektakyadav1015@rjcollege.edu.in at 12/16/2023, 10:18:40 PM on My Cluster2

Shift+Enter to run
Shift+Ctrl+Enter to run selected text

Save the Data to Table format-

Syntax-

```
df.write.saveAsTable("<table name>")
```

Code-

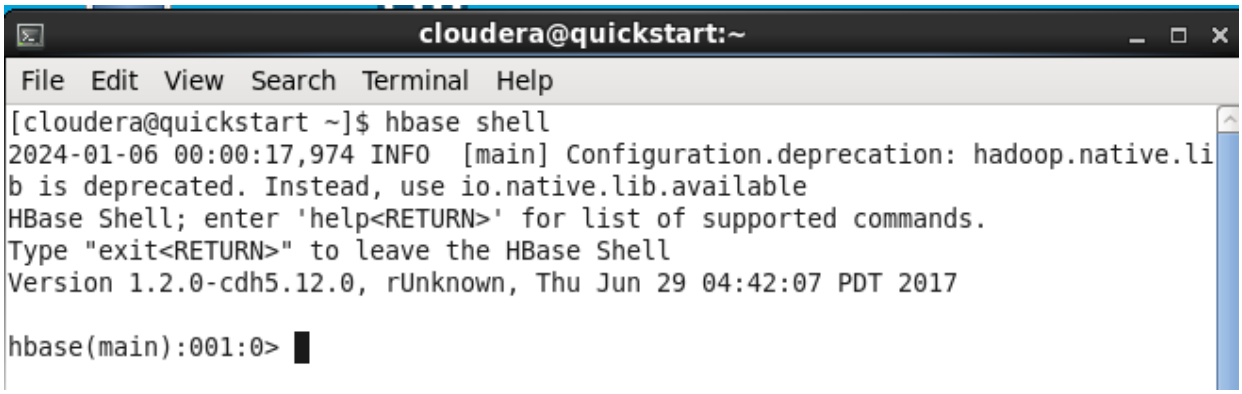
```
dfu.write.saveAsTable("tableORDER")
```

Output-

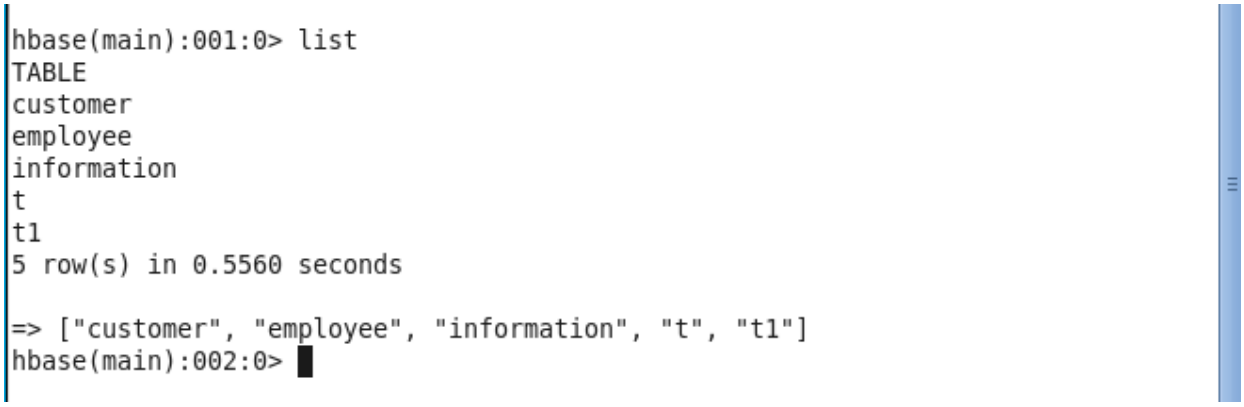
Practical 2: Using HBase Tool

Aim: Using the HBase commands to store and query the columnar data.

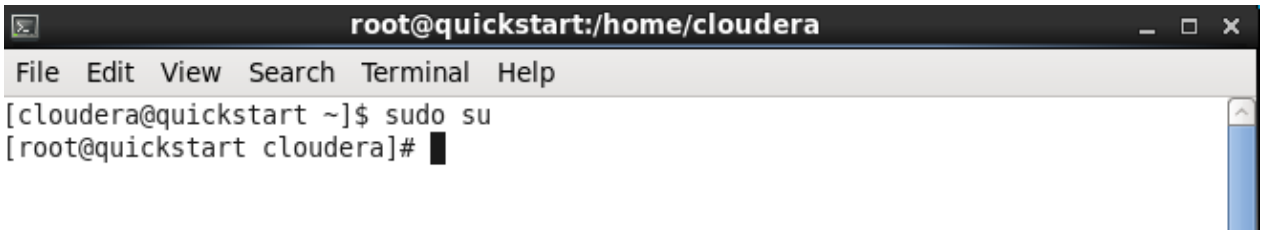
1. Start with HBase
$hbase shell



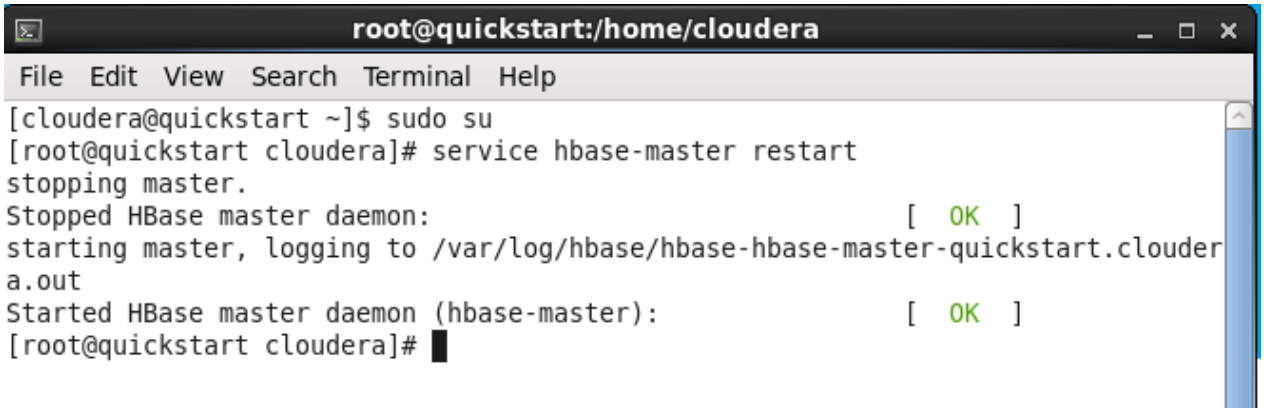
2. List the existing tables.
hbase>list



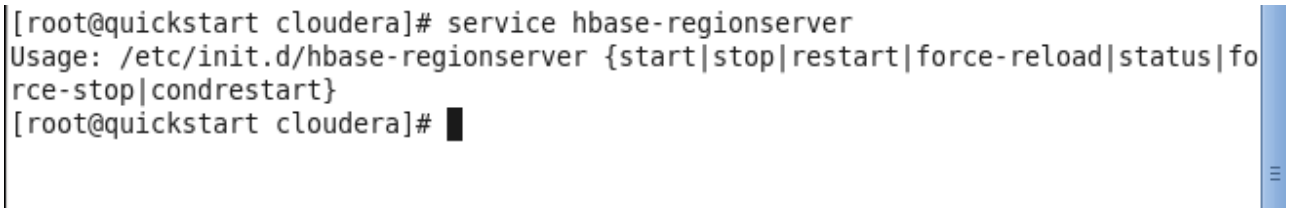
3. To restart the HBase services use the following commands
Get Logged in as a super user
$sudo su



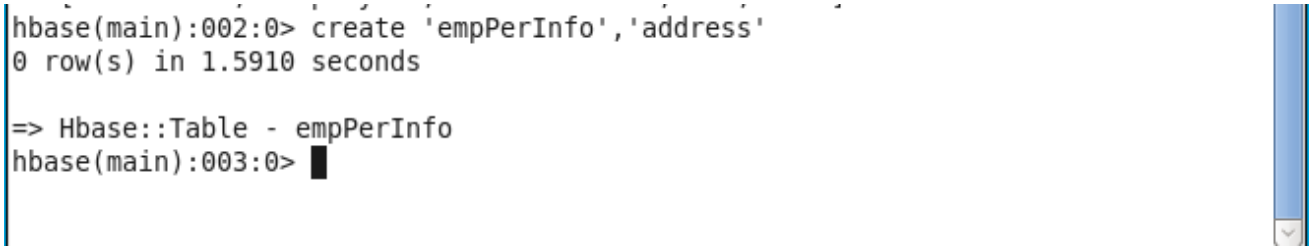
Restart the hbase-master service
$service hbase-master restart



Restart the hbase-regionserver service
$service hbase-regionserver

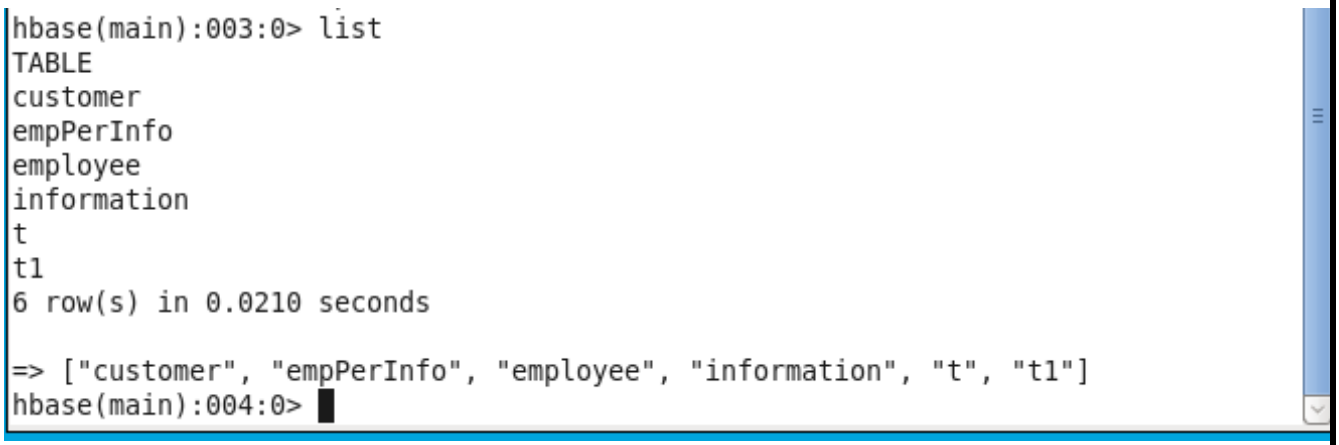


4. Design the schema for storing the employees personal information.
hbase>create 'empPerInfo','address'



5. Check for the creation of the table

hbase>list



6. Check the schema of the 'empPerInfo' table.

hbase>describe 'empPerInfo'

```
hbase(main):004:0> describe 'empPerInfo'
Table empPerInfo is ENABLED
empPerInfo
COLUMN FAMILIES DESCRIPTION
{NAME => 'address', DATA_BLOCK_ENCODING => 'NONE', BLOOMFILTER => 'ROW', REPLICA
TION_SCOPE => '0', VERSIONS => '1', COMPRESSION => 'NONE', MIN_VERSIONS => '0',
TTL => 'FOREVER', KEEP_DELETED_CELLS => 'FALSE', BLOCKSIZE => '65536', IN_MEMORY
 => 'false', BLOCKCACHE => 'true'}
1 row(s) in 0.1820 seconds

hbase(main):005:0>
```

7. Insert records into the 'empPerInfo' table

hbase>put 'empPerInfo', 'Amit','address:Building', 'D1045'

```
hbase(main):005:0> put 'empPerInfo','Amit','address:Building','D1045'
0 row(s) in 0.1090 seconds

hbase(main):006:0>
```

hbase>put 'empPerInfo', 'Amit','address:street','Karve Road'

```
hbase(main):006:0> put 'empPerInfo','Amit','address:street','Karve Road'
0 row(s) in 0.0150 seconds

hbase(main):007:0>
```

hbase>put 'empPerInfo', 'Amit','address:city','Pune'

```
hbase(main):007:0> put 'empPerInfo','Amit','address:city','Pune'
0 row(s) in 0.0140 seconds

hbase(main):008:0>
```

8. Design the schema for storing the employees professional information like education, designation and package amount. (TableName: 'empProfInfo')

```
hbase(main):008:0> create 'empProfInfo','education','designation','package'
0 row(s) in 1.2750 seconds

=> Hbase::Table - empProfInfo
hbase(main):009:0>
```

9. Insert the records in the 'empProfInfo' table.

```
=> Hbase::Table - empProfInfo
hbase(main):009:0> put 'empProfInfo','Amit','education','BSC'
0 row(s) in 0.0200 seconds

hbase(main):010:0> put 'empProfInfo','Amit','designation','Jr.developer'
0 row(s) in 0.0110 seconds

hbase(main):011:0> put 'empProfInfo','Amit','package','4L'
0 row(s) in 0.0090 seconds

hbase(main):012:0> put 'empProfInfo','Ridhi','education','BTech'
0 row(s) in 0.0080 seconds

hbase(main):013:0> put 'empProfInfo','Ridhi','designation','Sr.developer'
0 row(s) in 0.0100 seconds

hbase(main):014:0> put 'empProfInfo','Ridhi','package','8L'
0 row(s) in 0.0100 seconds

hbase(main):015:0>
```

10. Display all records of 'empPerInfo' and 'empProfInfo' tables.

hbase>scan 'empPerInfo'

```
hbase(main):015:0> scan 'empPerInfo'
ROW                   COLUMN+CELL
 Amit                 column=address:Building, timestamp=1704528611292, value=D1
                      045
 Amit                 column=address:city, timestamp=1704528794293, value=Pune
 Amit                 column=address:street, timestamp=1704528747656, value=Karv
                      e Road
1 row(s) in 0.0800 seconds

hbase(main):016:0>
```

hbase>scan 'empProfInfo'

```
hbase(main):016:0> scan 'empProfInfo'
ROW                   COLUMN+CELL
 Amit                 column=designation:, timestamp=1704529149605, value=Jr.dev
                      eloper
 Amit                 column=education:, timestamp=1704529090890, value=BSC
 Amit                 column=package:, timestamp=1704529208629, value=4L
 Ridhi                column=designation:, timestamp=1704529291120, value=Sr.dev
                      eloper
 Ridhi                column=education:, timestamp=1704529251820, value=BTech
 Ridhi                column=package:, timestamp=1704529314111, value=8L
2 row(s) in 0.0420 seconds

hbase(main):017:0>
```

11. Display all the records of the employee 'Amit'

hbase>get 'empPerInfo', 'Amit'

```
hbase(main):017:0> get 'empPerInfo','Amit'
COLUMN                CELL
 address:Building     timestamp=1704528611292, value=D1045
 address:city         timestamp=1704528794293, value=Pune
 address:street       timestamp=1704528747656, value=Karve Road
3 row(s) in 0.0200 seconds

hbase(main):018:0>
```

12. Display address details of the employee 'Amit'

hbase>get 'empPerInfo', 'Amit','address'

```
hbase(main):019:0> get 'empPerInfo','Amit','address'
COLUMN                CELL
 address:Building     timestamp=1704528611292, value=D1045
 address:city         timestamp=1704528794293, value=Pune
 address:street       timestamp=1704528747656, value=Karve Road
3 row(s) in 0.0340 seconds

hbase(main):020:0>
```

13. Display building details of the employee 'Amit'

hbase>get 'empPerInfo', 'Amit','address:Building'

```
hbase(main):020:0> get 'empPerInfo','Amit','address:Building'
COLUMN                CELL
 address:Building     timestamp=1704528611292, value=D1045
1 row(s) in 0.0110 seconds

hbase(main):021:0>
```

14. Delete building details of the employee 'Amit'

hbase>delete 'empPerInfo', 'Amit','address:Building'

```
hbase(main):021:0> delete 'empPerInfo','Amit','address:building'
0 row(s) in 0.0350 seconds

hbase(main):022:0>
```

hbase>get ‘empPerInfo’, ‘Amit’,’address’

```
hbase(main):023:0> get 'empPerInfo','Amit','address'
COLUMN                CELL
 address:Building     timestamp=1704528611292, value=D1045
 address:city         timestamp=1704528794293, value=Pune
 address:street       timestamp=1704528747656, value=Karve Road
3 row(s) in 0.0150 seconds

hbase(main):024:0>
```

15. Delete address details of the employee ‘Amit’

hbase>deleteall ‘empPerInfo’, ‘Amit’

```
hbase(main):024:0> deleteall 'empPerInfo','Amit'
0 row(s) in 0.0080 seconds

hbase(main):025:0>
```

hbase>get ‘empPerInfo’, ‘Amit’

```
hbase(main):025:0> get 'empPerInfo','Amit'
COLUMN                CELL
0 row(s) in 0.0090 seconds

hbase(main):026:0>
```

16. Display the total number of records of “empProfInfo’ table

hbase>count ‘empProfInfo’

```
hbase(main):026:0> count 'empProfInfo'
2 row(s) in 0.0270 seconds

=> 2
hbase(main):027:0>
```

17. Delete the education column family of the ‘empProfInfo’ table using the alter command.

hbase>alter ‘empProfInfo’, ‘delete’ =>’education’

```
hbase(main):027:0> alter 'empProfInfo','delete'=>'education'
Updating all regions with the new schema...
1/1 regions updated.
Done.
0 row(s) in 2.2550 seconds

hbase(main):028:0>
```

18. Disable 'empProfInfo' table.

hbase>disable 'empProfInfo'

```
hbase(main):028:0> disable 'empProfInfo'
0 row(s) in 2.3150 seconds

hbase(main):029:0>
```

19. Enable 'empProfInfo'

hbase>enable 'empProfInfo'

```
hbase(main):029:0> enable 'empProfInfo'
0 row(s) in 1.3280 seconds

hbase(main):030:0>
```

20. Make the 'empProfInfo' table read only.

hbase>alter 'empProfInfo' 'READONLY'

```
hbase(main):030:0> alter 'empProfInfo' 'READONLY'

ERROR: Can't find a table: empProfInfoREADONLY

Alter a table. If the "hbase.online.schema.update.enable" property is set to
false, then the table must be disabled (see help 'disable'). If the
"hbase.online.schema.update.enable" property is set to true, tables can be
altered without disabling them first. Altering enabled tables has caused problem
s
in the past, so use caution and test it before using in production.

You can use the alter command to add,
modify or delete column families or change table configuration options.
Column families work in a similar way as the 'create' command. The column family
specification can either be a name string, or a dictionary with the NAME attribu
te.
Dictionaries are described in the output of the 'help' command, with no argument
s.

For example, to change or add the 'f1' column family in table 't1' from
current value to keep a maximum of 5 cell VERSIONS, do:

  hbase> alter 't1', NAME => 'f1', VERSIONS => 5

You can operate on several column families:

  hbase> alter 't1', 'f1', {NAME => 'f2', IN_MEMORY => true}, {NAME => 'f3', VER
SIONS => 5}

To delete the 'f1' column family in table 'ns1:t1', use one of:
```

21. Drop table ‘empProfInfo’

hbase>drop ‘empProfInfo’

```
hbase(main):031:0> drop 'empProfInfo'

ERROR: Table empProfInfo is enabled. Disable it first.

Drop the named table. Table must first be disabled:
  hbase> drop 't1'
  hbase> drop 'ns1:t1'


hbase(main):032:0>
```

22. Create the second version of ‘empPerfInfo’ table as ‘empPerInfoVer2’

hbase>alter ‘empPerInfo’ , NAME=‘empPerInfoVer2’, VERSION=>2

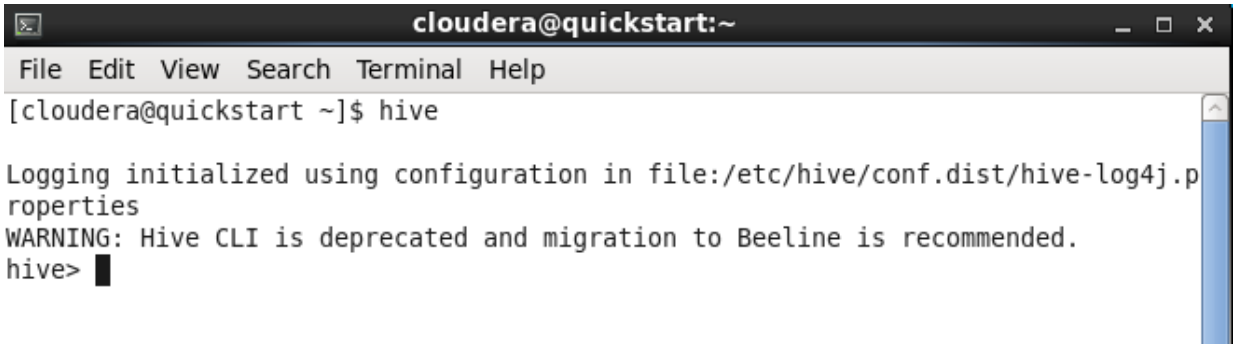
```
hbase(main):032:0> alter 'empPerInfo',NAME='empPerInfoVer2',VERSION=>2
Updating all regions with the new schema...
1/1 regions updated.
Done.
Unknown argument ignored: 1.8.7
Updating all regions with the new schema...
1/1 regions updated.
Done.
0 row(s) in 4.1980 seconds

hbase(main):033:0>
```

hbase>scan ‘empPerInfoVer2’

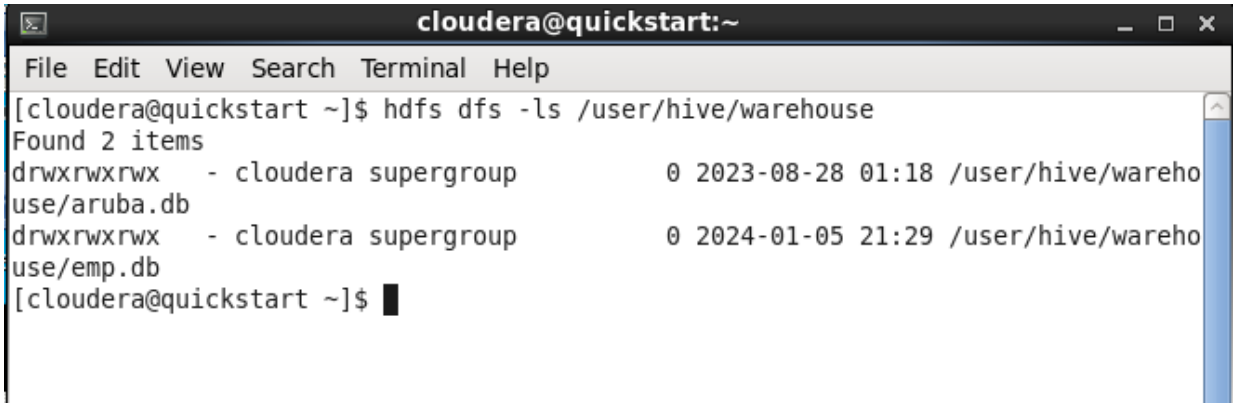
```
hbase(main):033:0> scan 'empPerInfoVer2'
ROW                   COLUMN+CELL

ERROR: Unknown table empPerInfoVer2!

Scan a table; pass table name and optionally a dictionary of scanner
specifications.  Scanner specifications may include one or more of:
TIMERANGE, FILTER, LIMIT, STARTROW, STOPROW, ROWPREFIXFILTER, TIMESTAMP,
MAXLENGTH or COLUMNS, CACHE or RAW, VERSIONS, ALL_METRICS or METRICS

If no columns are specified, all columns will be scanned.
To scan all members of a column family, leave the qualifier empty as in
'col_family'.

The filter can be specified in two ways:
1. Using a filterString - more information on this is available in the
Filter Language document attached to the HBASE-4176 JIRA
2. Using the entire package name of the filter.

If you wish to see metrics regarding the execution of the scan, the
ALL_METRICS boolean should be set to true. Alternatively, if you would
prefer to see only a subset of the metrics, the METRICS array can be
defined to include the names of only the metrics you care about.

Some examples:

  hbase> scan 'hbase:meta'
  hbase> scan 'hbase:meta', {COLUMNS => 'info:regioninfo'}
  hbase> scan 'ns1:t1', {COLUMNS => ['c1', 'c2'], LIMIT => 10, STARTROW => 'xyz'
}
  hbase> scan 't1', {COLUMNS => ['c1', 'c2'], LIMIT => 10, STARTRO
```

Practical 3: Using Hive

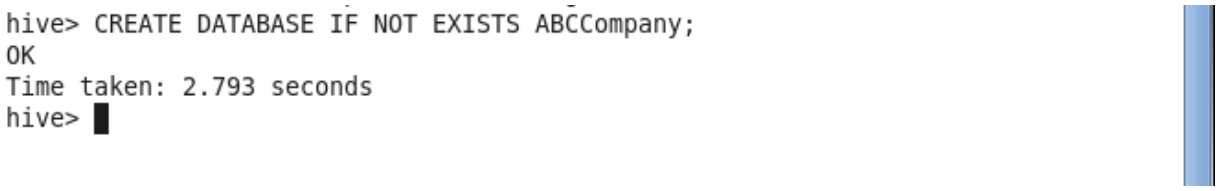
Q.1. Start with Hive



Q.2. List the existing Hive database

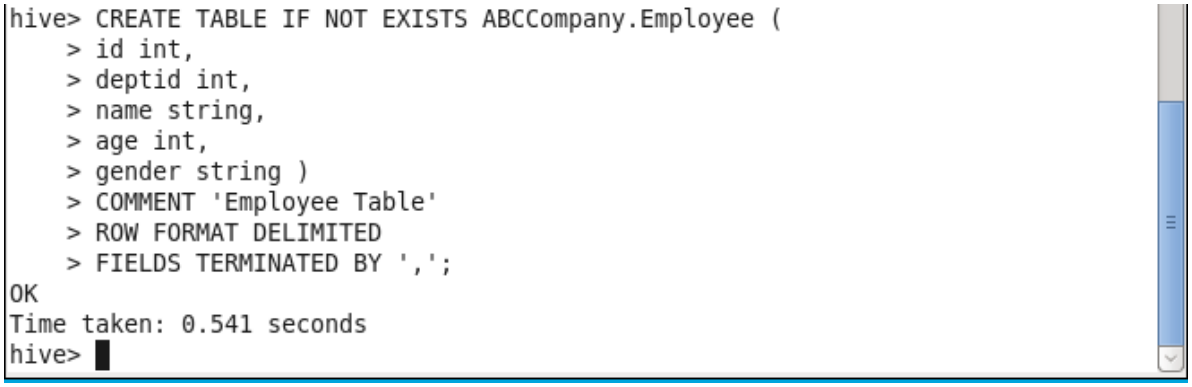


Q.3. Create a database named “ABCCompany”. Before creating the database check the existence of the database.



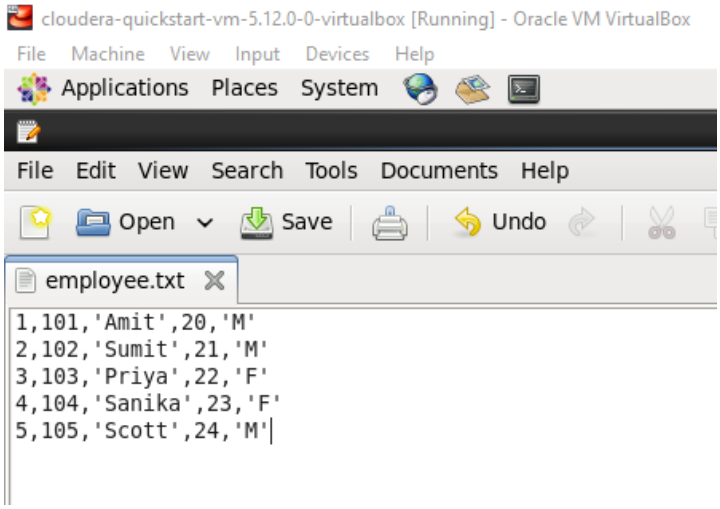
Q.4. Create a table name ‘Employee’ in the above database with the following attributes.

id int, deptid int, name string, age int,and gender string



Q.5. Create data.csv or data.txt file for 'Employee' data and store data for at least 5 employees from each department.

```
[cloudera@quickstart ~]$ gedit employee.txt
[cloudera@quickstart ~]$
```



Q.6. Load the data of the data file into the 'Employee' table.

```
[cloudera@quickstart ~]$ hdfs dfs -copyFromLocal /home/cloudera/employee.txt
[cloudera@quickstart ~]$ hdfs dfs -ls
Found 4 items
-rw-r--r--   1 cloudera cloudera        105 2024-01-08 21:16 employee.txt
drwxr-xr-x   - cloudera cloudera          0 2023-09-25 01:42 pig
drwxr-xr-x   - cloudera cloudera          0 2023-09-25 22:13 train
drwxr-xr-x   - cloudera cloudera          0 2023-08-28 00:32 zipcodes
[cloudera@quickstart ~]$
```

```
hive> LOAD DATA INPATH 'employee.txt' INTO TABLE ABCCompany.Employee;
Loading data to table abccompany.employee
Table abccompany.employee stats: [numFiles=1, totalSize=105]
OK
Time taken: 0.745 seconds
hive>
```

Q.7. Create the 'Department' table with the following fields.

deptid int, deptname string

```
hive> CREATE TABLE IF NOT EXISTS ABCCompany.Department (
    > deptid int,
    > deptname string )
    > COMMENT 'Department Table'
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ',';
OK
Time taken: 0.084 seconds
hive>
```

Q.8. Insert the data of the deptdata file into the ‘department’ table using INSERT command.

INSERT INTO emp.employee values(101,’Account’);

INSERT INTO emp.employee values(102,IT);

```
hive> INSERT INTO ABCCompany.Department values(101,'Account');
Query ID = cloudera_20240108212525_aad6257e-0149-4e42-b9b7-5e341288b697
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1704774615894_0001, Tracking URL = http://quickstart.cloudera
:8088/proxy/application_1704774615894_0001/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1704774615894_0001
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-01-08 21:25:28,015 Stage-1 map = 0%,  reduce = 0%
2024-01-08 21:25:40,893 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.35 se
c
MapReduce Total cumulative CPU time: 2 seconds 350 msec
Ended Job = job_1704774615894_0001
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/abccompany.d
b/department/.hive-staging_hive_2024-01-08_21-25-04_825_535281849686411828-1/-ex
t-10000
Loading data to table abccompany.department
Table abccompany.department stats: [numFiles=1, numRows=1, totalSize=12, rawData
Size=11]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.35 sec   HDFS Read: 3584 HDFS Write: 8
9 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 350 msec
OK
Time taken: 37.583 seconds
hive>
```

```
hive> INSERT INTO ABCCompany.Department values(102,'IT');
Query ID = cloudera_20240108212828_ce8976a6-60ce-44a7-9fb8-aede74df75f3
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1704774615894_0002, Tracking URL = http://quickstart.cloudera
:8088/proxy/application_1704774615894_0002/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1704774615894_0002
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-01-08 21:29:09,143 Stage-1 map = 0%,  reduce = 0%
2024-01-08 21:29:22,151 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.4 sec
MapReduce Total cumulative CPU time: 2 seconds 400 msec
Ended Job = job_1704774615894_0002
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/abccompany.d
b/department/.hive-staging_hive_2024-01-08_21-28-49_206_410121194036946658-1/-ex
t-10000
Loading data to table abccompany.department
Table abccompany.department stats: [numFiles=2, numRows=2, totalSize=19, rawData
Size=17]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.4 sec   HDFS Read: 3663 HDFS Write: 84
 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 400 msec
OK
Time taken: 34.89 seconds
hive>
```

Q.9. List the records of both ‘Employee’ and ‘Department’ table.

```
hive> SELECT * FROM ABCCompany.Employee;
OK
1       101     'Amit'  20      'M'
2       102     'Sumit' 21      'M'
3       103     'Priya' 22      'F'
4       104     'Sanika'        23      'F'
5       105     'Scott' 24      'M'
Time taken: 1.715 seconds, Fetched: 5 row(s)
hive> SELECT * FROM ABCCompany.Department;
OK
101     Account
102     IT
Time taken: 0.105 seconds, Fetched: 2 row(s)
hive>
```

Q.10. Display the schema of each table.

```
hive> DESCRIBE ABCCompany.Employee;
OK
id                      int
deptid                  int
name                    string
age                     int
gender                  string
Time taken: 0.183 seconds, Fetched: 5 row(s)
hive> DESCRIBE ABCCompany.Department;
OK
deptid                  int
deptname                string
Time taken: 0.085 seconds, Fetched: 2 row(s)
hive>
```

Q. 11. Create the external table named ‘orders’ with the following fields in the prodorders folder in hdfs.

orderid, customerid, orderdate, productid, quantity

```
hive> CREATE EXTERNAL TABLE ABCCompany.Orders (
    > orderid int,
    > customerid int,
    > orderdate string,
    > productid int,
    > quantity string )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > LOCATION '/user/hive/prodorders/Orders';
OK
Time taken: 0.121 seconds
hive>
```

Q.12. Create the external table named ‘customers’ with the following fields in the prodorders folder in hdfs.Custid, custname

```
hive> CREATE EXTERNAL TABLE ABCCompany.Customers (
    > custid int,
    > custname string )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > LOCATION '/user/hive/prodorders/Customers';
OK
Time taken: 0.125 seconds
hive>
```

Q. 13. Create the temporary table named ‘product’ with the following fields in the prodorders folder in hdfs.Productid, productname, price

```
hive> CREATE TEMPORARY TABLE ABCCompany.Product (
    > Productid int,
    > Productname string,
    > Price int )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > LOCATION '/user/hive/prodorders/Product';
OK
Time taken: 0.051 seconds
hive>
```

Q. 14. Create the transaction table named ‘Transact’ with the following fields in the Prodorders folder in hdfs.
transid, transdate,custid, orderid,prodid, quantity,totalamount

```
hive> CREATE EXTERNAL TABLE IF NOT EXISTS Transact (
    > transid INT,transdate STRING,custid INT,orderid INT,prodid INT,quantity INT,totalamount DOUBLE)
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > LOCATION '/home/cloudera/Desktop/prodorders';
OK
Time taken: 0.06 seconds
hive>
```

Q. 15. Load or insert at least two related records in above tables and display the list of all records.
Inserting 2 records into Orders:

```
hive> INSERT INTO Orders VALUES(1,101,'1-1-2024',201,3);
```

```
hive> INSERT INTO Orders VALUES(1,101,'1-1-2024',201,3);
Query ID = cloudera_20240226012222_e1197fdc-6788-40c7-acae-e96cb01f8b66
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0004, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0004/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0004
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:23:04,706 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:23:17,092 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.42 sec
MapReduce Total cumulative CPU time: 2 seconds 420 msec
Ended Job = job_1708926577653_0004
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-22-51_484_1791816063088516483-1/-ext-10000
Loading data to table default.orders
Table default.orders stats: [numFiles=1, numRows=1, totalSize=21, rawDataSize=20]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.42 sec   HDFS Read: 4534 HDFS Write: 91 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 420 msec
OK
Time taken: 26.966 seconds
hive>
```

```
hive> INSERT INTO Orders VALUES(2,102,'2-1-2024',202,5);
```

```
hive> INSERT INTO Orders VALUES(2,102,'2-1-2024',202,5);
Query ID = cloudera_20240226012525_f0d1729f-bf46-4016-bc58-22bfbb65b787
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0005, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0005/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0005
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:25:30,686 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:25:42,829 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.36 sec
MapReduce Total cumulative CPU time: 2 seconds 360 msec
Ended Job = job_1708926577653_0005
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-25-17_277_1825841825231098788-1/-ext-10000
Loading data to table default.orders
Table default.orders stats: [numFiles=2, numRows=2, totalSize=42, rawDataSize=40]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.36 sec   HDFS Read: 4618 HDFS Write: 91 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 360 msec
OK
Time taken: 26.973 seconds
hive>
```

Displaying Data

```
hive> SELECT * FROM Orders;
OK
1       101     1-1-2024        201     3
2       102     2-1-2024        202     5
Time taken: 0.104 seconds, Fetched: 2 row(s)
hive>
```

Inserting 2 records into Customers:

```
hive> INSERT INTO Customers VALUES(101,'Jack');
```

```
hive> INSERT INTO Customers VALUES(101,'Jack');
Query ID = cloudera_20240226012929_fb56267f-46a4-4611-bfcd-d30592306e36
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0006, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0006/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0006
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:29:52,876 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:30:05,177 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.33 sec
MapReduce Total cumulative CPU time: 2 seconds 330 msec
Ended Job = job_1708926577653_0006
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-29-39_711_3791738435119846815-1/-ext-10000
Loading data to table default.customers
Table default.customers stats: [numFiles=3, numRows=1, totalSize=51, rawDataSize=8]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.33 sec   HDFS Read: 4002 HDFS Write: 82 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 330 msec
OK
Time taken: 26.935 seconds
hive>
```

```
hive> INSERT INTO Customers VALUES(102,'Jill');
```

```
hive> INSERT INTO Customers VALUES(102,'Jill');
Query ID = cloudera_20240226013131_0139ed47-eb64-40c4-98b3-3d2f8812a469
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0007, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0007/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0007
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:31:24,352 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:31:36,884 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.39 sec
MapReduce Total cumulative CPU time: 2 seconds 390 msec
Ended Job = job_1708926577653_0007
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-31-11_126_5116937329139596967-1/-ext-10000
Loading data to table default.customers
Table default.customers stats: [numFiles=4, numRows=2, totalSize=60, rawDataSize=16]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.39 sec   HDFS Read: 4005 HDFS Write: 82 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 390 msec
OK
Time taken: 28.393 seconds
hive>
```

Displaying Data

```
hive> SELECT * FROM Customers;
OK
1       101
2       102
101     Jack
102     Jill
Time taken: 0.061 seconds, Fetched: 4 row(s)
hive>
```

Inserting 2 records into Product:

```
hive> INSERT INTO Product VALUES(201,"PEN",5.00);
```

```
hive> INSERT INTO product VALUES(201,"PEN",5.00);
Query ID = cloudera_20240226013434_a9f53a67-795b-43f9-a7da-307366db2bba
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0008, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0008/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0008
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:35:14,014 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:35:25,285 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.45 sec
MapReduce Total cumulative CPU time: 2 seconds 450 msec
Ended Job = job_1708926577653_0008
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-34-59_823_6928804279956113658-1/-ext-10000
Loading data to table default.product
Table default.product stats: [numFiles=5, numRows=1, totalSize=72, rawDataSize=11]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.45 sec   HDFS Read: 4364 HDFS Write: 83 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 450 msec
OK
Time taken: 28.013 seconds
hive>
```

```
hive> INSERT INTO Product VALUES(202,"PENCIL",3.00);
hive> INSERT INTO product VALUES(202,"PENCIL",3.00);
Query ID = cloudera_20240226013838_c1fbd19e-cd5d-4a56-b494-4ff7a9e4817a
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0009, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0009/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0009
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:38:17,697 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:38:30,034 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.46 sec
MapReduce Total cumulative CPU time: 2 seconds 460 msec
Ended Job = job_1708926577653_0009
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-38-04_497_766063974842650476-1/-ext-10000
Loading data to table default.product
Table default.product stats: [numFiles=6, numRows=2, totalSize=87, rawDataSize=25]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.46 sec   HDFS Read: 4367 HDFS Write: 86 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 460 msec
OK
Time taken: 26.917 seconds
hive>
```

Displaying Data:

```
hive> SELECT * FROM Product;
OK
1       101     NULL
2       102     NULL
101     Jack    NULL
102     Jill    NULL
201     PEN     5.0
202     PENCIL  3.0
```

Inserting 2 records into Transact:

```
hive> INSERT INTO TABLE Transact VALUES
    > (1, '1-1-2024', 101, 1, 201, 3, 15),
    > (2, '2-1-2024', 102, 2, 202, 5, 15);
```

```
hive> INSERT INTO TABLE Transact VALUES
    > (1, '1-1-2024', 101, 1, 201, 3, 15),
    > (2, '2-1-2024', 102, 2, 202, 5, 15);
Query ID = cloudera_20240226014545_3382c479-a2e4-445d-a62f-de83a9240c67
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0012, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0012/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0012
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:45:59,511 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:46:11,966 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.49 sec
MapReduce Total cumulative CPU time: 2 seconds 490 msec
Ended Job = job_1708926577653_0012
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders/.hive-staging_hive_20
24-02-26_01-45-46_516_5258006532080569069-1/-ext-10000
Loading data to table default.transact
Table default.transact stats: [numFiles=9, numRows=2, totalSize=170, rawDataSize=54]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 2.49 sec   HDFS Read: 5202 HDFS Write: 128 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 490 msec
OK
Time taken: 26.886 seconds
hive>
```

Displaying Data:

```
hive> SELECT * FROM Transact;
OK
1       1-1-2024        101     1       201     3       15.0
2       2-1-2024        102     2       202     5       15.0
```

Q. 16. Create the ‘productDummy’ table using the ‘product’ table and the SELECT command.

```
hive> CREATE TABLE IF NOT EXISTS productDummy As
    > SELECT * FROM Product;
```

```
hive> CREATE TABLE IF NOT EXISTS productDummy As
    > SELECT * FROM Product;
Query ID = cloudera_20240226015050_59579e9c-9769-470d-9b6d-e077aac0bf3f
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1708926577653_0013, Tracking URL = http://quickstart.cloudera:8088/proxy/applicatio
n_1708926577653_0013/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1708926577653_0013
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-02-26 01:50:32,877 Stage-1 map = 0%,  reduce = 0%
2024-02-26 01:50:45,106 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.92 sec
MapReduce Total cumulative CPU time: 1 seconds 920 msec
Ended Job = job_1708926577653_0013
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/.hive-staging_hive_2024-02-26_01-5
0-20_054_5496292111288149089-1/-ext-10001
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/productdummy
Table default.productdummy stats: [numFiles=1, numRows=10, totalSize=130, rawDataSize=120]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 1.92 sec   HDFS Read: 4604 HDFS Write: 207 SUCCESS
Total MapReduce CPU Time Spent: 1 seconds 920 msec
OK
Time taken: 26.361 seconds
hive>
```

Q. 17. Create the table named ‘empDup’ using the ‘LIKE’ clause.

```
hive> CREATE TABLE IF NOT EXISTS empDup LIKE Employee;
OK
Time taken: 0.162 seconds
hive>
```

Q. 18. Describe the table structure of internal/managed table, external table, temporary table, and transactional table and observe the output details.

Orders:

```
hive> DESCRIBE FORMATTED Orders;
OK
# col_name              data_type               comment

orderid                 int
customerid              int
orderdate               string
productid               int
quantity                int

# Detailed Table Information
Database:               default
Owner:                  cloudera
CreateTime:             Mon Feb 26 01:07:46 PST 2024
LastAccessTime:         UNKNOWN
Protect Mode:           None
Retention:              0
Location:               hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders
Table Type:             EXTERNAL_TABLE
Table Parameters:
        COLUMN_STATS_ACCURATE   true
        EXTERNAL                TRUE
        numFiles                2
        numRows                 2
        rawDataSize             40
        totalSize               42
        transient_lastDdlTime   1708939544
```

Customers:

```
hive> DESCRIBE FORMATTED Customers;
OK
# col_name              data_type               comment

custid                  int
custname                string

# Detailed Table Information
Database:               default
Owner:                  cloudera
CreateTime:             Mon Feb 26 01:09:52 PST 2024
LastAccessTime:         UNKNOWN
Protect Mode:           None
Retention:              0
Location:               hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders
Table Type:             EXTERNAL_TABLE
Table Parameters:
        COLUMN_STATS_ACCURATE   true
        EXTERNAL                TRUE
        numFiles                4
        numRows                 2
        rawDataSize             16
        totalSize               60
        transient_lastDdlTime   1708939899
```

Product:

```
hive> DESCRIBE FORMATTED Product;
OK
# col_name              data_type               comment

productid               int
productname             string
price                   double

# Detailed Table Information
Database:               default
Owner:                  cloudera
CreateTime:             Mon Feb 26 01:13:30 PST 2024
LastAccessTime:         UNKNOWN
Protect Mode:           None
Retention:              0
Location:               hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders
Table Type:             EXTERNAL_TABLE
Table Parameters:
        COLUMN_STATS_ACCURATE   true
        EXTERNAL                TRUE
        numFiles                8
        numRows                 4
        rawDataSize             50
        totalSize               114
        transient_lastDdlTime   1708940550
```

Transact:

```
hive> DESCRIBE FORMATTED Transact;
OK
# col_name              data_type               comment

transid                 int
transdate               string
custid                  int
orderid                 int
prodid                  int
quantity                int
totalamount             double

# Detailed Table Information
Database:               default
Owner:                  cloudera
CreateTime:             Mon Feb 26 01:16:51 PST 2024
LastAccessTime:         UNKNOWN
Protect Mode:           None
Retention:              0
Location:               hdfs://quickstart.cloudera:8020/home/cloudera/Desktop/prodorders
Table Type:             EXTERNAL_TABLE
Table Parameters:
        COLUMN_STATS_ACCURATE   true
        EXTERNAL                TRUE
        numFiles                9
        numRows                 2
        rawDataSize             54
        totalSize               170
        transient_lastDdlTime   1708940773
```

Q. 19. Drop table ‘empDup’ using drop command.

```
hive> drop table empDup;
OK
Time taken: 0.312 seconds
hive>
```

Q. 20. Drop table 'productDummy' using drop command and PURGE clause.

```
hive> DROP TABLE IF EXISTS productDummy PURGE;
OK
Time taken: 0.091 seconds
hive>
```

Q. 21. Alter table 'orders' to change its name to 'ordersTable'
hive>alter table orders RENAME to ordersTable

```
hive> alter table orders RENAME to ordersTable;
OK
Time taken: 0.12 seconds
hive>
```

```
hive> describe ordersTable;
OK
orderid                 int
customerid              int
orderdate               string
productid               int
quantity                int
Time taken: 0.114 seconds, Fetched: 5 row(s)
hive>
```

Q. 22. Add the address column to the 'Employee' table using the alter command.
hive>alter table Employee add columns(empAddress string);

```
hive> alter table Employee add columns(empAddress string);
OK
Time taken: 0.138 seconds
hive>
```

```
hive> describe Employee;
OK
id                      int
deptid                  int
name                    string
age                     int
gender                  string
empaddress              string
Time taken: 0.068 seconds, Fetched: 6 row(s)
hive>
```

Q. 23. Create and Drop database named "RJC'.

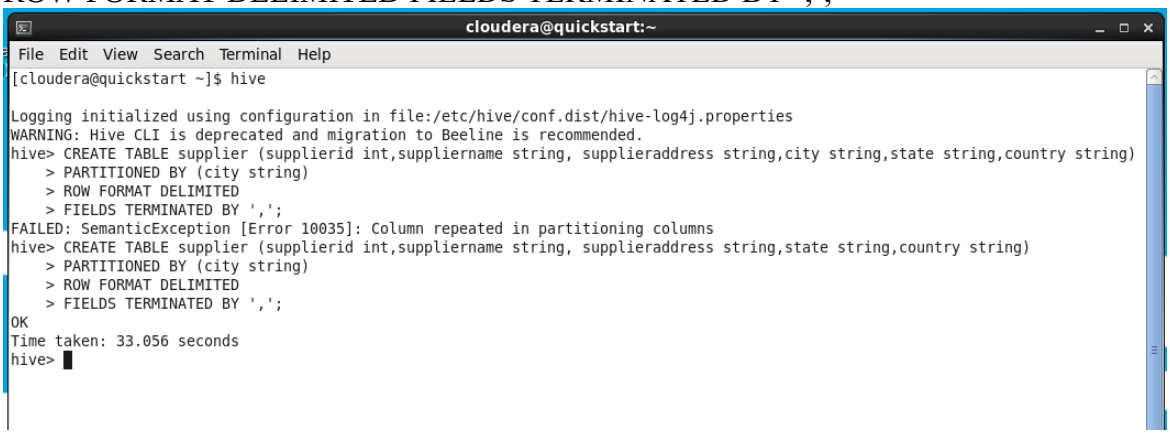
```
hive> create database rjc;
OK
Time taken: 0.072 seconds
hive> drop database rjc;
OK
Time taken: 0.155 seconds
hive> show databases;
OK
abccompany
default
emp
xyzcompany
Time taken: 0.026 seconds, Fetched: 4 row(s)
hive>
```

Practical 4: Hive Partitioning, Bucketing, Joining and Sorting

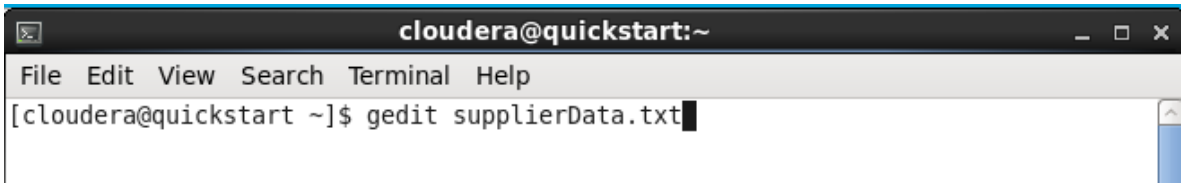
I. PARTITIONED Tables

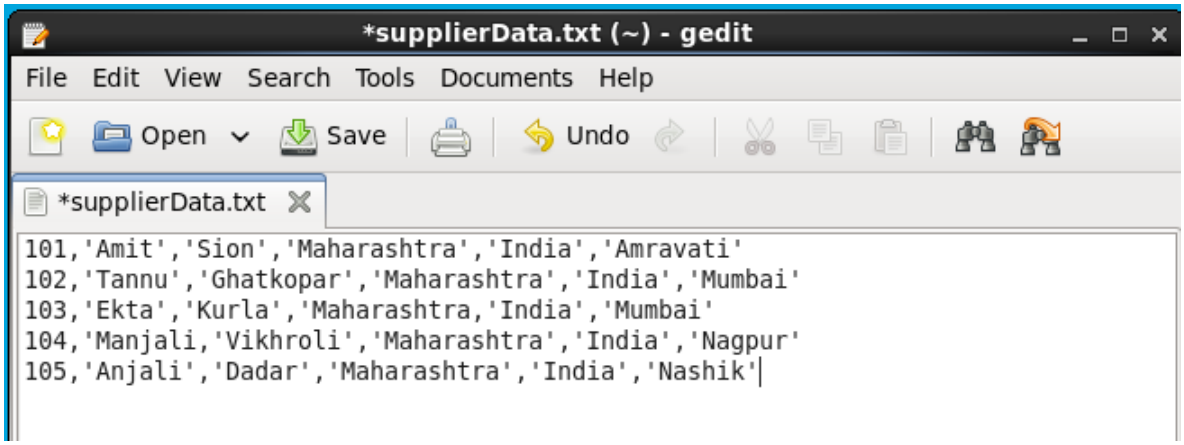
Q1. Create a partitioned table named 'supplier' with the following attributes and also partition the suppliers data based on the city.
Supplierid, suppliername, supplieraddress,city,state,country

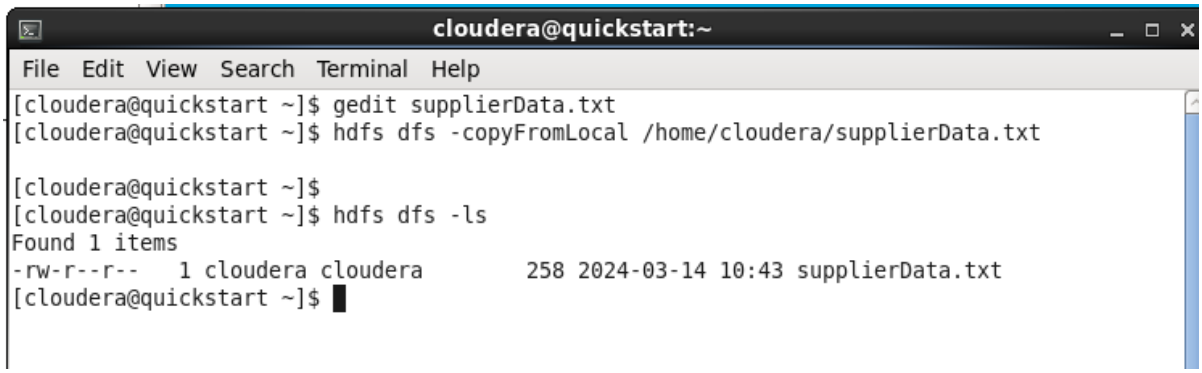
CREATE TABLE supplier (supplierid int, suppliername string, supplieraddress string, city string, state string, country string)
PARTITIONED BY (city string)
ROW FORMAT DELIMITED FIELDS TERMINATED BY ',';



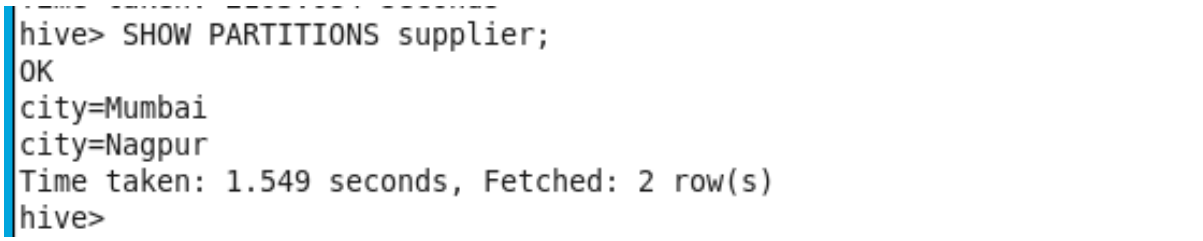
Q2. Load the data from supplierData.txt file into the supplies table. Also try insert command to insert data into the partitioned table.







Q3. Display all partitions of the table.



Q4. Display the data of the 'supplier' table.

```
hive> SELECT * FROM supplier;
OK
101     'Amit'  'Sionaharashtra'        'India' 'Amravati'      Mumbai
102     'Tannu' 'Ghatkopar'     'Maharashtra'   'India' Mumbai
103     'Ekta'  'Kurla' 'Maharashtra    'India' Mumbai
104     'Manjali        'Vikhroli'      'Maharashtra'   'India' Mumbai
105     'Anjali'        'Dadar' 'Maharashtra'   'India' Mumbai
106     Sudha   Ghatkopar       Maharashtra     India   Nagpur
Time taken: 4.613 seconds, Fetched: 6 row(s)
hive> Display all 478 possibilities? (y or n)
hive>
```

Q5. Display the schema of the Hive partitioned table and check for partitions information.

```
hive> DESCRIBE FORMATTED supplier;
OK
# col_name              data_type               comment

supplierid              int
suppliername            string
supplieraddress         string
state                   string
country                 string

# Partition Information
# col_name              data_type               comment

city                    string

# Detailed Table Information
Database:               default
Owner:                  cloudera
CreateTime:             Wed Mar 13 14:16:35 PDT 2024
LastAccessTime:         UNKNOWN
Protect Mode:           None
Retention:              0
Location:               hdfs://quickstart.cloudera:8020/user/hive/warehouse/supplier
Table Type:             MANAGED_TABLE
Table Parameters:
        numPartitions           2
        transient_lastDdlTime   1710364595

# Storage Information
SerDe Library:          org.apache.hadoop.hive.serde2.lazy.LazySimpleSerDe
InputFormat:            org.apache.hadoop.mapred.TextInputFormat
OutputFormat:           org.apache.hadoop.hive.ql.io.HiveIgnoreKeyTextOutputFormat
Compressed:             No
Num Buckets:            -1
Bucket Columns:         []
Sort Columns:           []
Storage Desc Params:
        field.delim             ,
        serialization.format    ,
Time taken: 2.044 seconds, Fetched: 37 row(s)
hive>
```

Q6. Update the partition location of any one partition using the ALTER command.

```
hive> ALTER TABLE supplier PARTITION (city='Mumbai') SET LOCATION '/home/cloudera/supplierData2.txt';
OK
Time taken: 3.694 seconds
hive>
```

Q7. Rename any one partition using the ALTER command.

```
hive> ALTER TABLE supplier PARTITION (city='Nagpur') RENAME TO PARTITION (city='Nashik');
OK
Time taken: 3.047 seconds
```

Q8. Display the 'supplier' data for the specific partition.

```
hive> SELECT * FROM supplier WHERE city='Mumbai';
OK
Time taken: 10.164 seconds
hive>
```

Q9. Demonstrate the DROP command on the hive partition.

```
hive> ALTER TABLE supplier DROP PARTITION (city='Mumbai');
Dropped the partition city=Mumbai
OK
Time taken: 7.588 seconds
hive>
```

Q10. Get the suppliers list in upper case format.

```
hive> SELECT UPPER(suppliername) AS suppliername_upper FROM supplier;
OK
SUDHA
Time taken: 0.522 seconds, Fetched: 1 row(s)
hive>
```

II. Hive Bucketing

Q1. Create a partitioned table named 'supplierBucket' with the following attributes and also partition and bucket the suppliers data based on the city.

```
hive> CREATE TABLE supplierBucket (
    > supplier_id INT,
    > supplier_name STRING
    > )
    > PARTITIONED BY (city STRING)
    > CLUSTERED BY (supplier_id) INTO 4 BUCKETS;
OK
Time taken: 0.401 seconds
hive>
```

```
hive> INSERT INTO supplierBucket PARTITION (city='MUmbai') VALUES
    > (1, 'Tannu'),
    > (2, 'Ekta');
Query ID = cloudera_20240314130707_3df85bff-1df0-4397-8154-fc02accfdc10
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0002, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0002/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0002
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-03-14 13:10:32,659 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:11:33,499 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:12:36,088 Stage-1 map = 0%,  reduce = 0%, Cumulative CPU 1.8 sec
2024-03-14 13:12:43,221 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 4.36 sec
MapReduce Total cumulative CPU time: 4 seconds 600 msec
Ended Job = job_1710187546367_0002
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/supplierbucket/city=MUmbai/.hive-staging_hive_2024-03-14_13-0
7-22_964_8696354398050949245-1/-ext-10000
Loading data to table default.supplierbucket partition (city=MUmbai)
Partition default.supplierbucket{city=MUmbai} stats: [numFiles=1, numRows=2, totalSize=15, rawDataSize=13]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 4.6 sec   HDFS Read: 4060 HDFS Write: 105 SUCCESS
Total MapReduce CPU Time Spent: 4 seconds 600 msec
OK
Time taken: 337.108 seconds
hive>
```

```
hive> INSERT INTO supplierBucket PARTITION (city='Delhi') VALUES
    > (3, 'Sudha'),
    > (4, 'Radhika');
Query ID = cloudera_20240314132121_2c280208-f61f-4b0e-8388-91b76878ee6e
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0003, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0003/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0003
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-03-14 13:21:58,534 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:22:58,949 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:23:06,387 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 3.98 sec
MapReduce Total cumulative CPU time: 3 seconds 980 msec
Ended Job = job_1710187546367_0003
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/supplierbucket/city=Delhi/.hive-staging_hive_2024-03-14_13-21
-17_615_484502699107440214-1/-ext-10000
Loading data to table default.supplierbucket partition (city=Delhi)
Partition default.supplierbucket{city=Delhi} stats: [numFiles=1, numRows=2, totalSize=18, rawDataSize=16]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 3.98 sec   HDFS Read: 4055 HDFS Write: 107 SUCCESS
Total MapReduce CPU Time Spent: 3 seconds 980 msec
OK
Time taken: 120.261 seconds
hive>
```

```
hive> INSERT INTO supplierBucket PARTITION (city='Kolkata') VALUES
    > (5, 'Manjali'),
    > (6, 'Anjali');
Query ID = cloudera_20240314132525_26a5447d-9351-4618-8f12-52ea6bfa3b3e
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0004, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0004/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0004
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-03-14 13:26:28,957 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:27:30,840 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:27:44,623 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 3.21 sec
MapReduce Total cumulative CPU time: 3 seconds 210 msec
Ended Job = job_1710187546367_0004
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/supplierbucket/city=Kolkata/.hive-staging_hive_2024-03-14_13-
25-28_371_658892595117024656 2-1/-ext-10000
Loading data to table default.supplierbucket partition (city=Kolkata)
Partition default.supplierbucket{city=Kolkata} stats: [numFiles=1, numRows=2, totalSize=19, rawDataSize=17]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 3.21 sec   HDFS Read: 4069 HDFS Write: 110 SUCCESS
Total MapReduce CPU Time Spent: 3 seconds 210 msec
OK
Time taken: 144.588 seconds
hive>
```

```
hive> INSERT INTO supplierBucket PARTITION (city='Chennai') VALUES
    > (7, 'Ankit'),
    > (8, 'Amit');
Query ID = cloudera_20240314133030_b0f6b58f-e1f3-4adf-8403-b3f56f9ed96a
Total jobs = 3
Launching Job 1 out of 3
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0005, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0005/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0005
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 0
2024-03-14 13:31:08,277 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:31:55,424 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.79 sec
MapReduce Total cumulative CPU time: 3 seconds 610 msec
Ended Job = job_1710187546367_0005
Stage-4 is selected by condition resolver.
Stage-3 is filtered out by condition resolver.
Stage-5 is filtered out by condition resolver.
Moving data to: hdfs://quickstart.cloudera:8020/user/hive/warehouse/supplierbucket/city=Chennai/.hive-staging_hive_2024-03-14_13-
30-20_271_2908018460549787699-1/-ext-10000
Loading data to table default.supplierbucket partition (city=Chennai)
Partition default.supplierbucket{city=Chennai} stats: [numFiles=1, numRows=2, totalSize=15, rawDataSize=13]
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1   Cumulative CPU: 3.61 sec   HDFS Read: 4065 HDFS Write: 106 SUCCESS
Total MapReduce CPU Time Spent: 3 seconds 610 msec
OK
Time taken: 114.917 seconds
hive>
```

Q2. Display the data of ‘supplierBucket’ tables.

```
hive> SELECT * FROM supplierBucket;
OK
7       Ankit   Chennai
8       Amit    Chennai
3       Sudha   Delhi
4       Radhika Delhi
5       Manjali Kolkata
6       Anjali  Kolkata
1       Tannu   MUmbai
2       Ekta    MUmbai
Time taken: 0.373 seconds, Fetched: 8 row(s)
hive>
```

Q3. Display the ‘supplier’ data for the specific bucket.

```
hive> SELECT * FROM supplierBucket TABLESAMPLE(BUCKET 2 OUT OF 4);
OK
5       Manjali Kolkata
1       Tannu   MUmbai
Time taken: 0.607 seconds, Fetched: 2 row(s)
hive>
```

Q4. Display total number of records of a specific bucket.

```
hive> SELECT COUNT(*) FROM supplierBucket WHERE city='MUmbai';
Query ID = cloudera_20240314133737_875c4d3c-f865-4cfd-8d04-26310f556c6c
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1710187546367_0007, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0007/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0007
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2024-03-14 13:38:11,943 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:39:28,670 Stage-1 map = 0%,  reduce = 0%
2024-03-14 13:39:36,681 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 4.46 sec
2024-03-14 13:40:12,289 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 6.38 sec
MapReduce Total cumulative CPU time: 6 seconds 380 msec
Ended Job = job_1710187546367_0007
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 6.38 sec   HDFS Read: 8020 HDFS Write: 2 SUCCESS
Total MapReduce CPU Time Spent: 6 seconds 380 msec
OK
2
Time taken: 137.47 seconds, Fetched: 1 row(s)
hive>
```

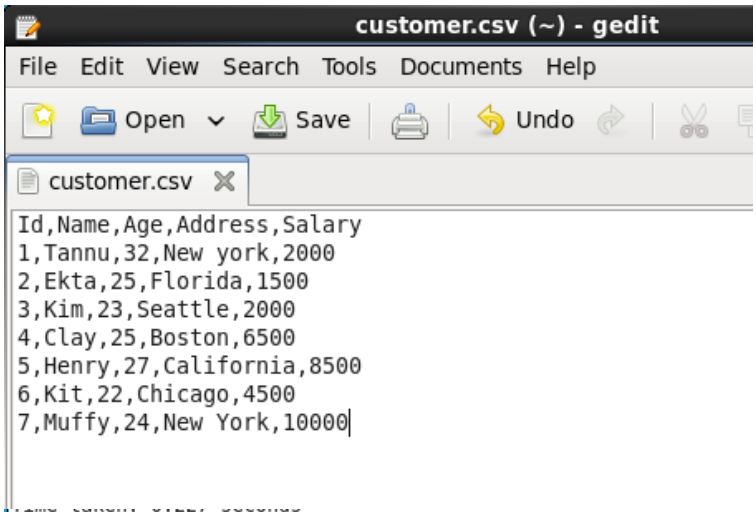
III. Hive Joining

Q1. create a database named “HiveJoins” and Create following external tables, data files and load data of data files into the tables.

Example:
create table customers(ID int, Name string, Age int, Address string, Salary float)
row format delimited
fields terminated by ‘,’
tblproperties(“skip.header.line.count” =”1”);

```
hive> CREATE TABLE customers(
    > ID int,
    > Name string,
    > Age int,
    > Address string,
    > Salary float
    > )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > tblproperties("skip.header.line.count"="1");
OK
Time taken: 10.415 seconds
hive>
```

Customer.csv

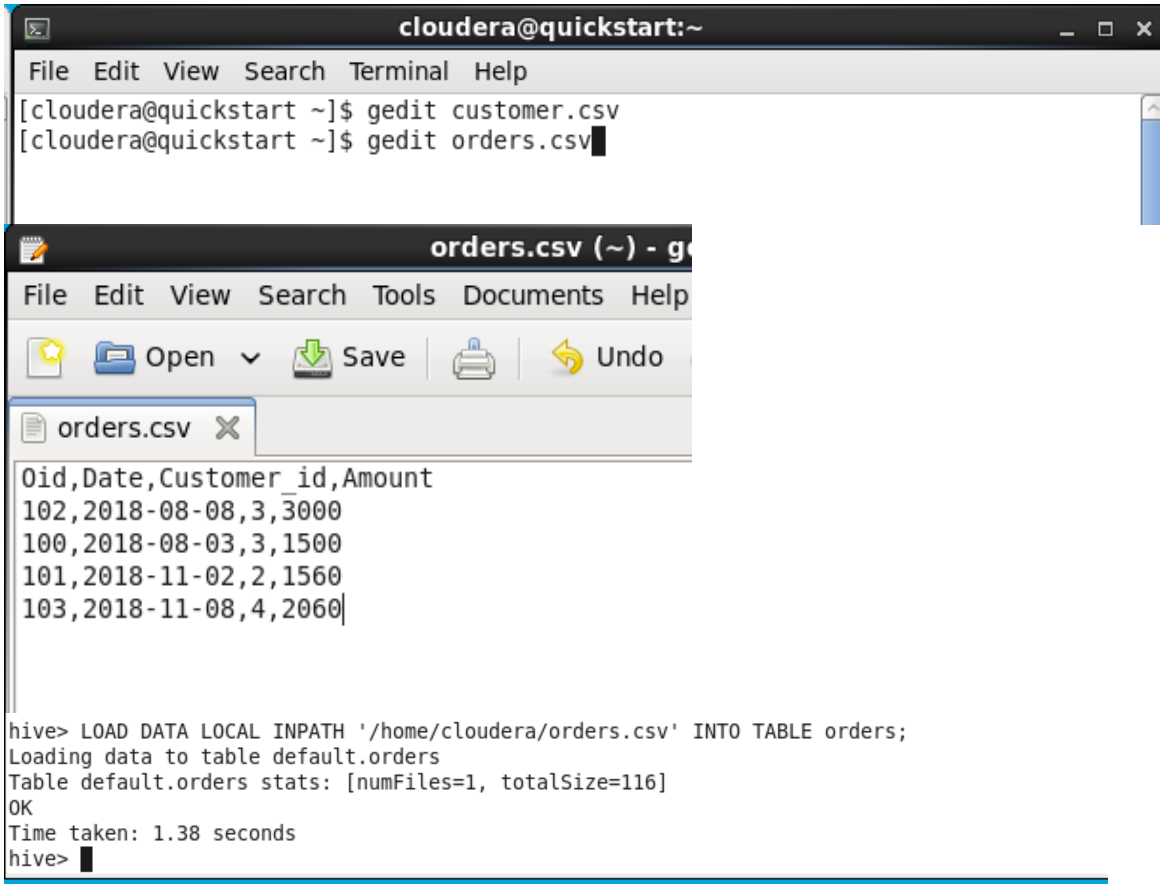



```
hive> LOAD DATA LOCAL INPATH '/home/cloudera/customer.csv' INTO TABLE customers;
Loading data to table default.customers
Table default.customers stats: [numFiles=1, totalSize=194]
OK
Time taken: 1.432 seconds
hive>
```

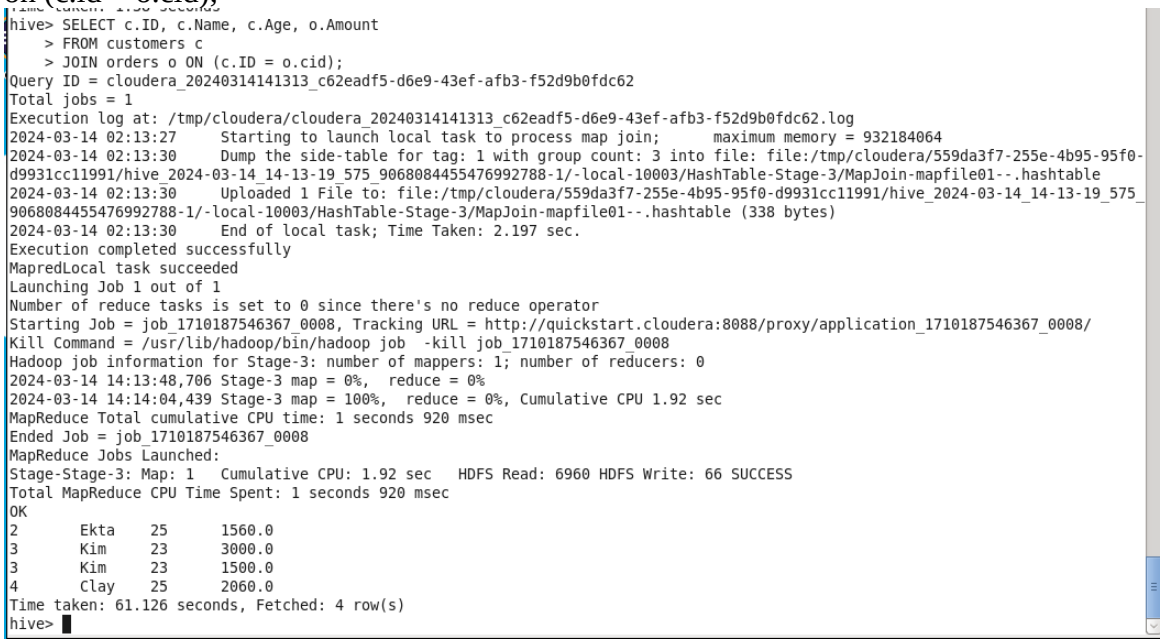
create table orders(oid int, odate date, cid int, amount float)
row format delimited
fields terminated by ‘,’
tblproperties(“skip.header.line.count” =”1”);

```
hive> CREATE TABLE orders(
    > oid int,
    > odate date,
    > cid int,
    > amount float
    > )
    > ROW FORMAT DELIMITED
    > FIELDS TERMINATED BY ','
    > tblproperties("skip.header.line.count"="1");
OK
Time taken: 0.227 seconds
hive>
```

Orders.csv



Q2. Write a query to retrieve customer id, name, age from customers table and amount from the orders table by using various join on id of the customers and orders table.
Example:
Normal Join
select c.id, c.name, c.age, o.amount
from customers c JOIN orders o
on (c.id = o.cid);



Left Outer Join

select c.id, c.name, o.amount, o.odate
from customers c LEFT OUTER JOIN orders o
on (c.id = o.cid);

```
hive> SELECT c.ID, c.Name, o.Amount, o.odate
    > FROM customers c LEFT OUTER JOIN orders o
    > on (c.ID = o.cid);
Query ID = cloudera_20240314141616_23589d5b-ecb9-4944-b274-23a78ea79f71
Total jobs = 1
Execution log at: /tmp/cloudera/cloudera_20240314141616_23589d5b-ecb9-4944-b274-23a78ea79f71.log
2024-03-14 02:16:36     Starting to launch local task to process map join;      maximum memory = 932184064
2024-03-14 02:16:40     Dump the side-table for tag: 1 with group count: 3 into file: file:/tmp/cloudera/559da3f7-255e-4b95-95f0-
d9931cc11991/hive_2024-03-14_14-16-30_008_7223135153109691991-1/-local-10003/HashTable-Stage-3/MapJoin-mapfile11--.hashtable
2024-03-14 02:16:40     Uploaded 1 File to: file:/tmp/cloudera/559da3f7-255e-4b95-95f0-d9931cc11991/hive_2024-03-14_14-16-30_008_
7223135153109691991-1/-local-10003/HashTable-Stage-3/MapJoin-mapfile11--.hashtable (350 bytes)
2024-03-14 02:16:40     End of local task; Time Taken: 3.658 sec.
Execution completed successfully
MapredLocal task succeeded
Launching Job 1 out of 1
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0009, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0009/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0009
Hadoop job information for Stage-3: number of mappers: 1; number of reducers: 0
2024-03-14 14:16:52,776 Stage-3 map = 0%,  reduce = 0%
2024-03-14 14:17:00,096 Stage-3 map = 100%,  reduce = 0%, Cumulative CPU 1.11 sec
MapReduce Total cumulative CPU time: 1 seconds 110 msec
Ended Job = job_1710187546367_0009
MapReduce Jobs Launched:
Stage-Stage-3: Map: 1   Cumulative CPU: 1.11 sec   HDFS Read: 7038 HDFS Write: 152 SUCCESS
Total MapReduce CPU Time Spent: 1 seconds 110 msec
OK
1       Tannu   NULL    NULL
2       Ekta    1560.0  2018-11-02
3       Kim     3000.0  2018-08-08
3       Kim     1500.0  2018-08-03
4       Clay    2060.0  2018-11-08
5       Henry   NULL    NULL
6       Kit     NULL    NULL
7       Muffy   NULL    NULL
Time taken: 32.293 seconds, Fetched: 8 row(s)
hive>
```

Right Outer Join

select c.id, c.name, o.amount, o.odate
from customers c RIGHT OUTER JOIN orders o
on (c.id = o.cid);

```
hive> SELECT c.ID, c.Name, o.Amount, o.odate
    > FROM customers c
    > RIGHT OUTER JOIN orders o ON (c.id = o .cid);
Query ID = cloudera_20240314141818_08154012-51f8-41dd-8931-e886eb3f1420
Total jobs = 1
Execution log at: /tmp/cloudera/cloudera_20240314141818_08154012-51f8-41dd-8931-e886eb3f1420.log
2024-03-14 02:18:37     Starting to launch local task to process map join;      maximum memory = 932184064
2024-03-14 02:18:38     Dump the side-table for tag: 0 with group count: 7 into file: file:/tmp/cloudera/559da3f7-255e-4b95-95f0-
d9931cc11991/hive_2024-03-14_14-18-34_034_9134433556291938991-1/-local-10003/HashTable-Stage-3/MapJoin-mapfile20--.hashtable
2024-03-14 02:18:38     Uploaded 1 File to: file:/tmp/cloudera/559da3f7-255e-4b95-95f0-d9931cc11991/hive_2024-03-14_14-18-34_034_
9134433556291938991-1/-local-10003/HashTable-Stage-3/MapJoin-mapfile20--.hashtable (429 bytes)
2024-03-14 02:18:38     End of local task; Time Taken: 1.015 sec.
Execution completed successfully
MapredLocal task succeeded
Launching Job 1 out of 1
Number of reduce tasks is set to 0 since there's no reduce operator
Starting Job = job_1710187546367_0010, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0010/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0010
Hadoop job information for Stage-3: number of mappers: 1; number of reducers: 0
2024-03-14 14:18:47,887 Stage-3 map = 0%,  reduce = 0%
2024-03-14 14:18:55,268 Stage-3 map = 100%,  reduce = 0%, Cumulative CPU 1.4 sec
MapReduce Total cumulative CPU time: 1 seconds 400 msec
Ended Job = job_1710187546367_0010
MapReduce Jobs Launched:
Stage-Stage-3: Map: 1   Cumulative CPU: 1.4 sec   HDFS Read: 6950 HDFS Write: 98 SUCCESS
Total MapReduce CPU Time Spent: 1 seconds 400 msec
OK
3       Kim     3000.0  2018-08-08
3       Kim     1500.0  2018-08-03
2       Ekta    1560.0  2018-11-02
4       Clay    2060.0  2018-11-08
Time taken: 23.38 seconds, Fetched: 4 row(s)
hive>
```

IV. Hive Sorting

Q1. Display the first four customers' salaries from the customers table in descending order.
select salary from customers sort by salary desc limit 4;

```
hive> SELECT salary FROM customers ORDER BY salary DESC LIMIT 4;
Query ID = cloudera_20240314142020_dd30a8db-7ffb-4955-87d8-d3099e9d6be2
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1710187546367_0011, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0011/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0011
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2024-03-14 14:20:56,834 Stage-1 map = 0%,  reduce = 0%
2024-03-14 14:21:11,742 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 2.62 sec
2024-03-14 14:21:41,052 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 4.18 sec
MapReduce Total cumulative CPU time: 4 seconds 180 msec
Ended Job = job_1710187546367_0011
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 4.18 sec   HDFS Read: 7149 HDFS Write: 29 SUCCESS
Total MapReduce CPU Time Spent: 4 seconds 180 msec
OK
10000.0
8500.0
6500.0
4500.0
Time taken: 82.783 seconds, Fetched: 4 row(s)
hive>
```

Q2. Get the orders list in the ascending order of date.
Select * from orders Order By odate ASC;

```
hive> SELECT * FROM orders ORDER BY odate ASC;
Query ID = cloudera_20240314142222_3d2b37be-93bc-4eb9-8b75-d05eb274d72f
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1710187546367_0012, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0012/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0012
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2024-03-14 14:23:09,683 Stage-1 map = 0%,  reduce = 0%
2024-03-14 14:23:17,367 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 1.08 sec
2024-03-14 14:23:34,422 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 2.57 sec
MapReduce Total cumulative CPU time: 2 seconds 570 msec
Ended Job = job_1710187546367_0012
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 2.57 sec   HDFS Read: 7917 HDFS Write: 96 SUCCESS
Total MapReduce CPU Time Spent: 2 seconds 570 msec
OK
100     2018-08-03      3       1500.0
102     2018-08-08      3       3000.0
101     2018-11-02      2       1560.0
103     2018-11-08      4       2060.0
Time taken: 43.226 seconds, Fetched: 4 row(s)
hive>
```

Q3. Get the list of customers in the ascending order of the customer's name.

```
hive> SELECT * FROM orders ORDER BY Name ASC;
FAILED: SemanticException [Error 10004]: Line 1:30 Invalid table alias or column reference 'Name': (possible column names are: oi
d, odate, cid, amount)
hive> SELECT * FROM customers ORDER BY Name ASC;
Query ID = cloudera_20240314142525_9795a545-5ad6-48c5-97b6-99af42118533
Total jobs = 1
Launching Job 1 out of 1
Number of reduce tasks determined at compile time: 1
In order to change the average load for a reducer (in bytes):
  set hive.exec.reducers.bytes.per.reducer=<number>
In order to limit the maximum number of reducers:
  set hive.exec.reducers.max=<number>
In order to set a constant number of reducers:
  set mapreduce.job.reduces=<number>
Starting Job = job_1710187546367_0013, Tracking URL = http://quickstart.cloudera:8088/proxy/application_1710187546367_0013/
Kill Command = /usr/lib/hadoop/bin/hadoop job  -kill job_1710187546367_0013
Hadoop job information for Stage-1: number of mappers: 1; number of reducers: 1
2024-03-14 14:26:01,044 Stage-1 map = 0%,  reduce = 0%
2024-03-14 14:26:15,378 Stage-1 map = 100%,  reduce = 0%, Cumulative CPU 3.41 sec
2024-03-14 14:26:48,443 Stage-1 map = 100%,  reduce = 100%, Cumulative CPU 5.08 sec
MapReduce Total cumulative CPU time: 5 seconds 80 msec
Ended Job = job_1710187546367_0013
MapReduce Jobs Launched:
Stage-Stage-1: Map: 1  Reduce: 1   Cumulative CPU: 5.08 sec   HDFS Read: 8232 HDFS Write: 181 SUCCESS
Total MapReduce CPU Time Spent: 5 seconds 80 msec
OK
4       Clay    25      Boston  6500.0
2       Ekta    25      Florida 1500.0
5       Henry   27      California      8500.0
3       Kim     23      Seattle 2000.0
6       Kit     22      Chicago 4500.0
7       Muffy   24      New York        10000.0
1       Tannu   32      New york        2000.0
Time taken: 73.364 seconds, Fetched: 7 row(s)
hive>
    >
```

Practical 5: Using Pig and PigLatin

What is Apache Pig

Apache Pig is a high-level data flow platform for executing MapReduce programs of Hadoop. The language used for Pig is Pig Latin.

The Pig scripts get internally converted to Map Reduce jobs and get executed on data stored in HDFS. Apart from that, Pig can also execute its job in Apache Tez or Apache Spark.

Pig can handle any type of data, i.e., structured, semi-structured or unstructured and stores the corresponding results into Hadoop Data File System. Every task which can be achieved using PIG can also be achieved using java used in MapReduce.

Features of Apache Pig

The various uses of Pig technology.

1) Ease of programming

Writing complex java programs for map reduce is quite tough for non-programmers. Pig makes this process easy. In the Pig, the queries are converted to MapReduce internally.

2) Optimization opportunities

It is how tasks are encoded permits the system to optimize their execution automatically, allowing the user to focus on semantics rather than efficiency.

3) Extensibility

A user-defined function is written in which the user can write their logic to execute over the data set.

4) Flexible

It can easily handle structured as well as unstructured data.

5) In-built operators

It contains various type of operators such as sort, filter and joins.

Advantages of Apache Pig

• Less code - The Pig consumes less line of code to perform any operation.

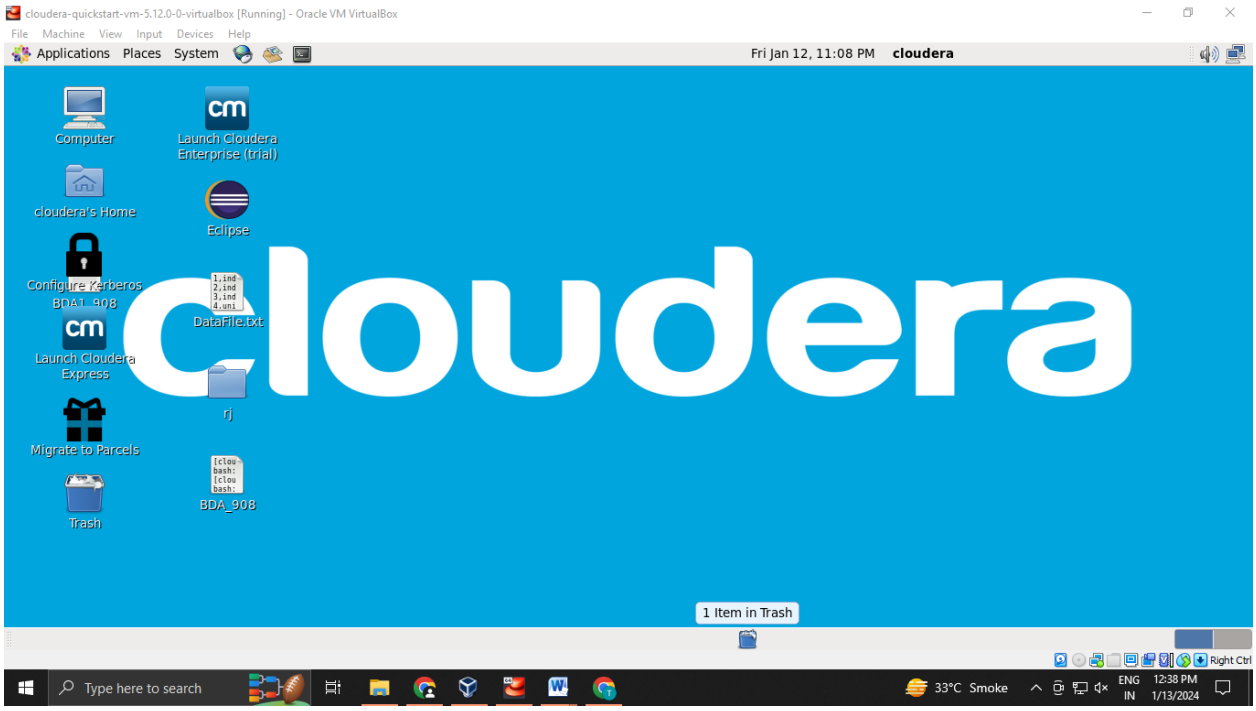
• Reusability - The Pig code is flexible enough to reuse again.

• Nested data types - The Pig provides a useful concept of nested data types like tuple, bag, and map.

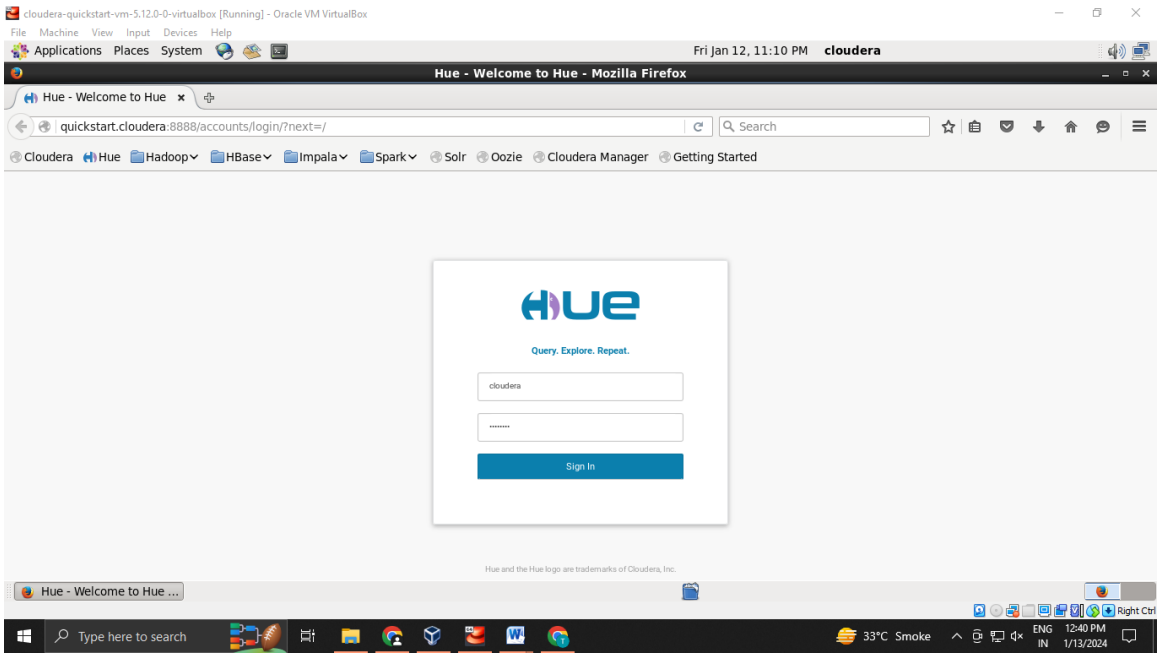
To implement Word Count problem using Pig

Steps:

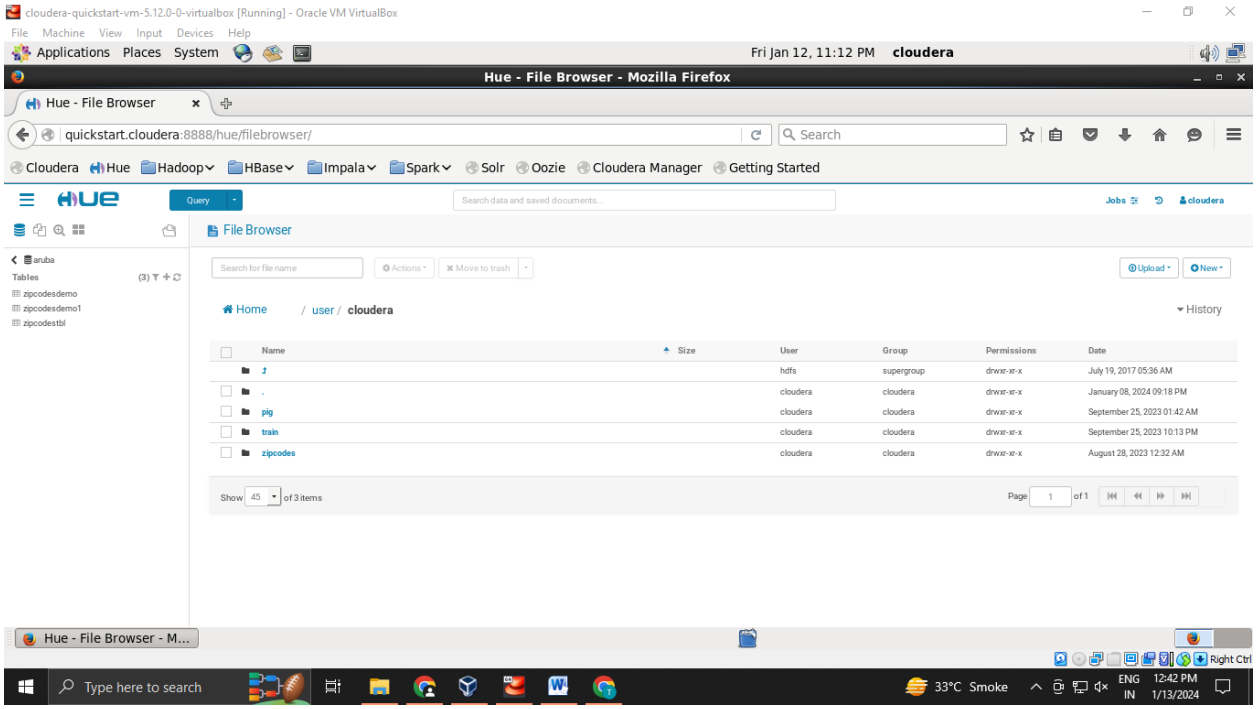
1) Start the cloudera.



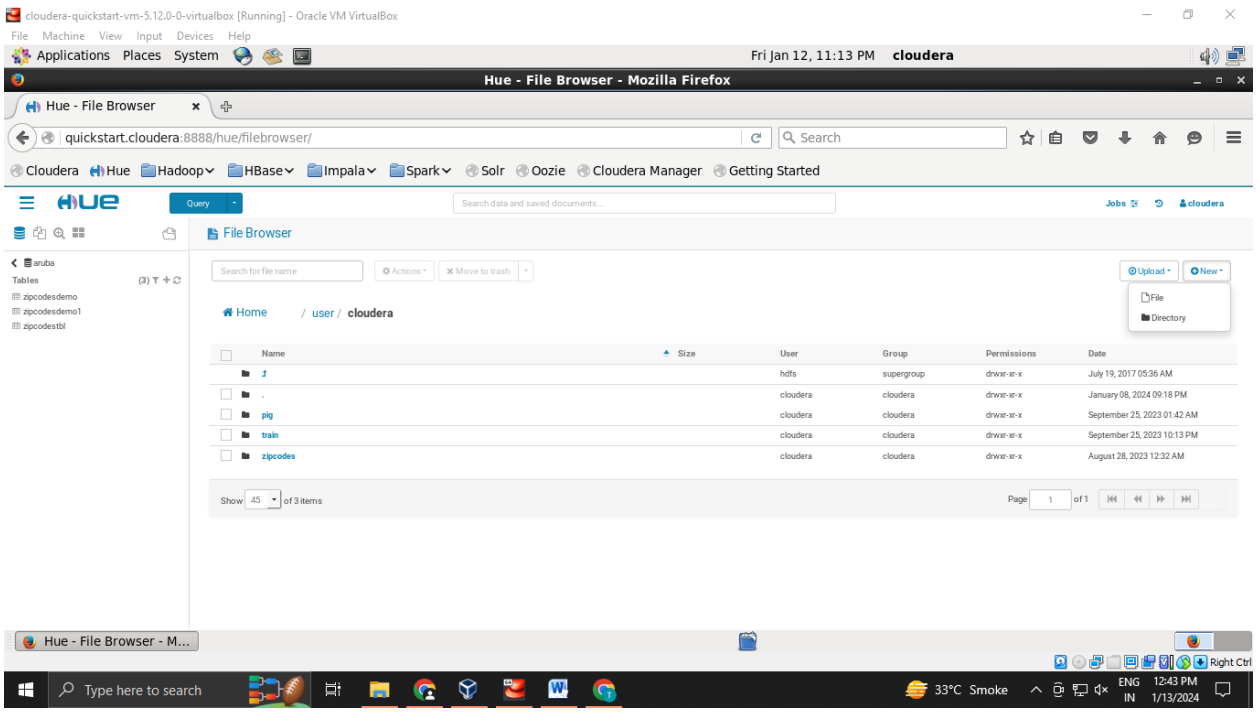
2) Open the browser. And then open Hue and login using default credentials.

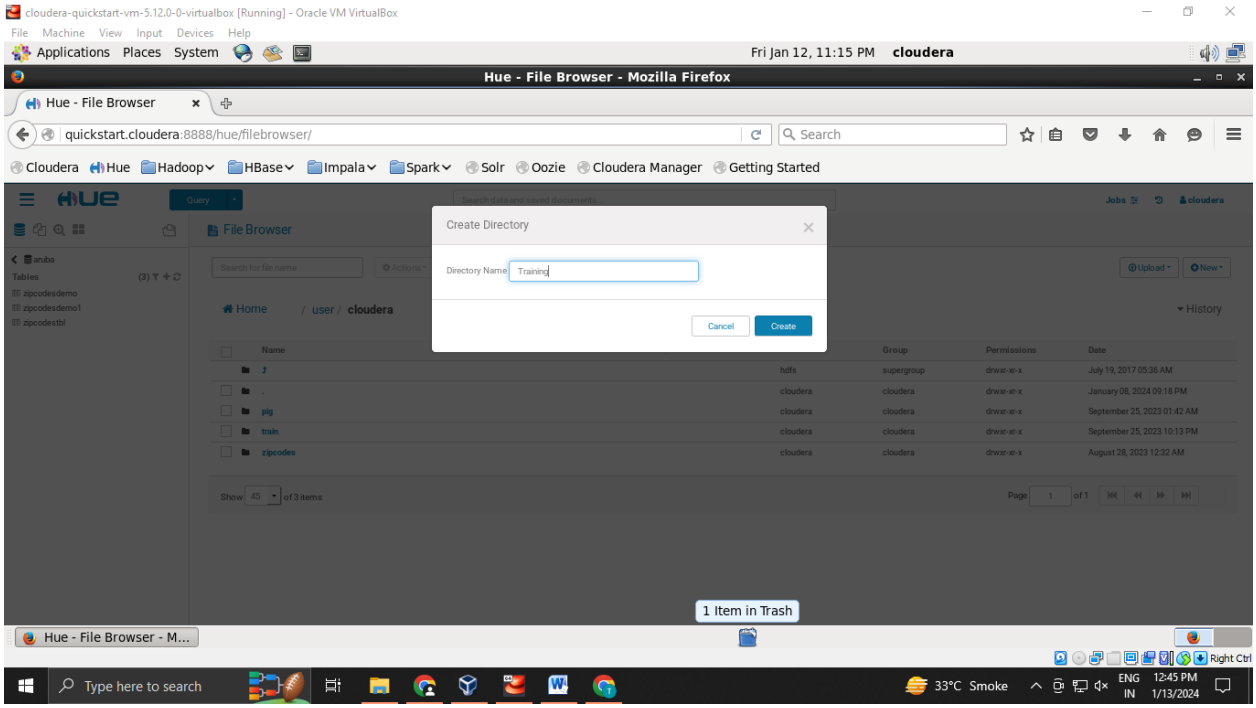


3) Now open the directory /user/cloudera → Click on menu option go to files.

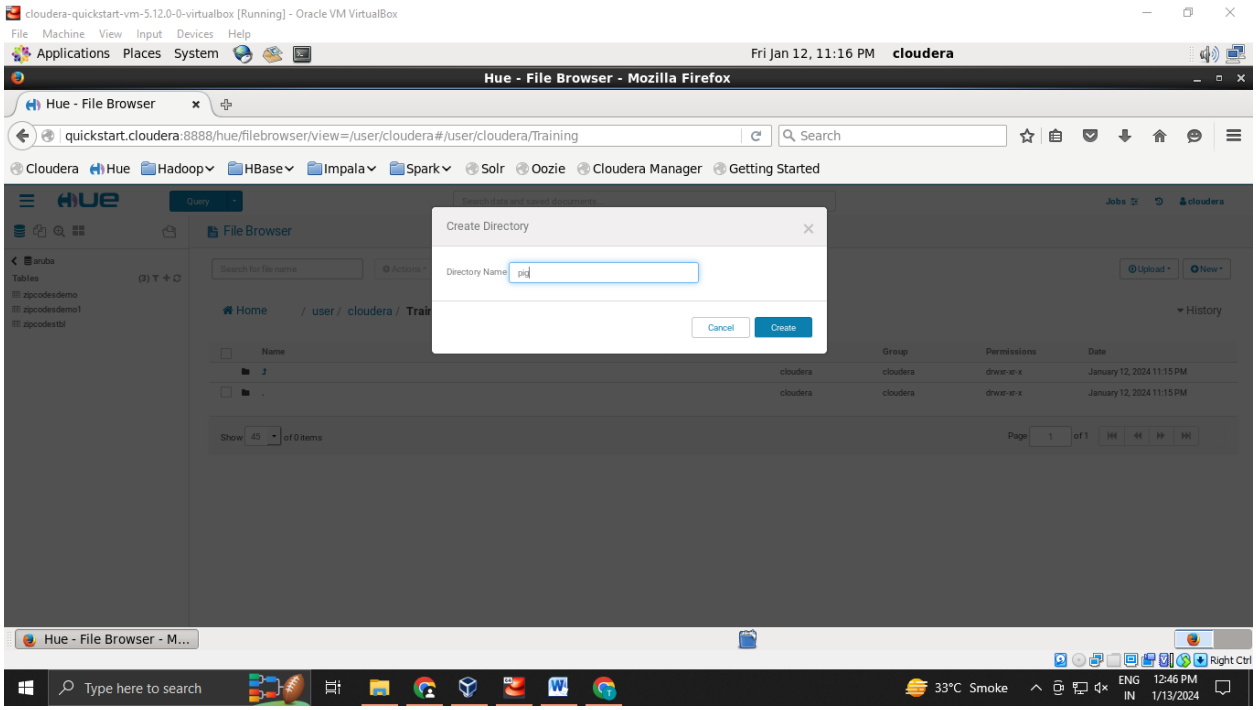


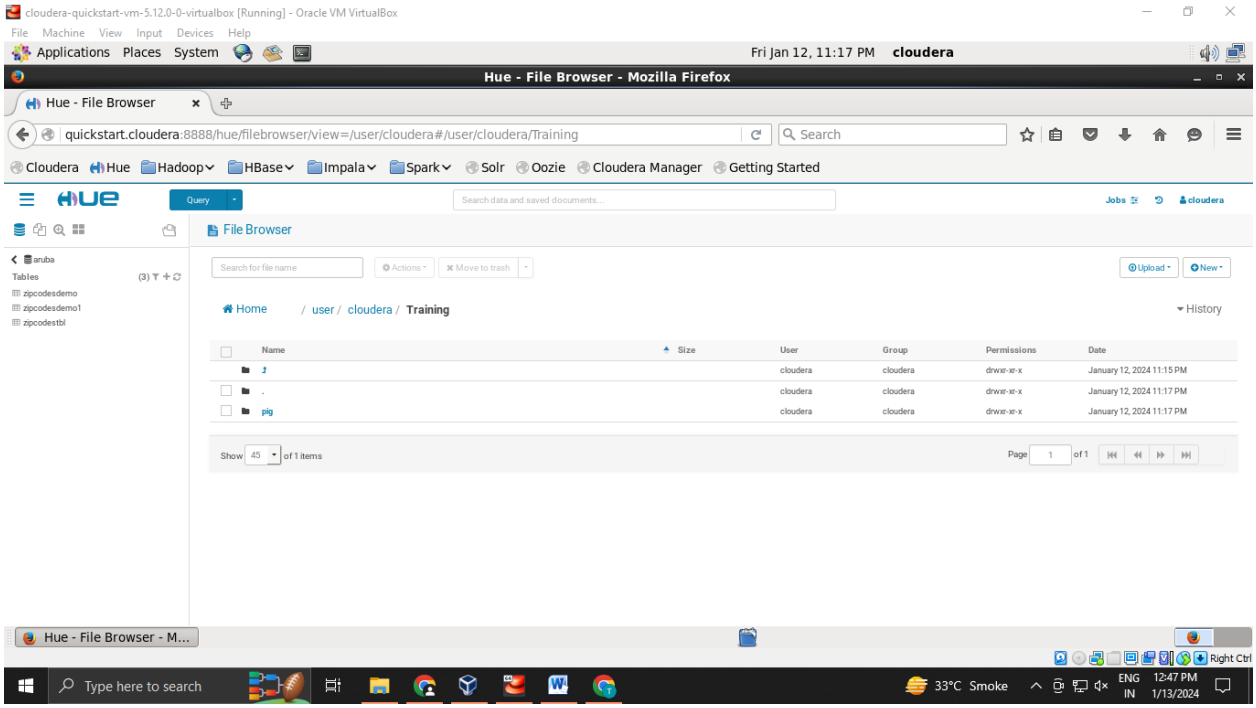
4) Now we are creating the directory as Training inside /user/cloudera → Click on New button in Right side → Click on directory.



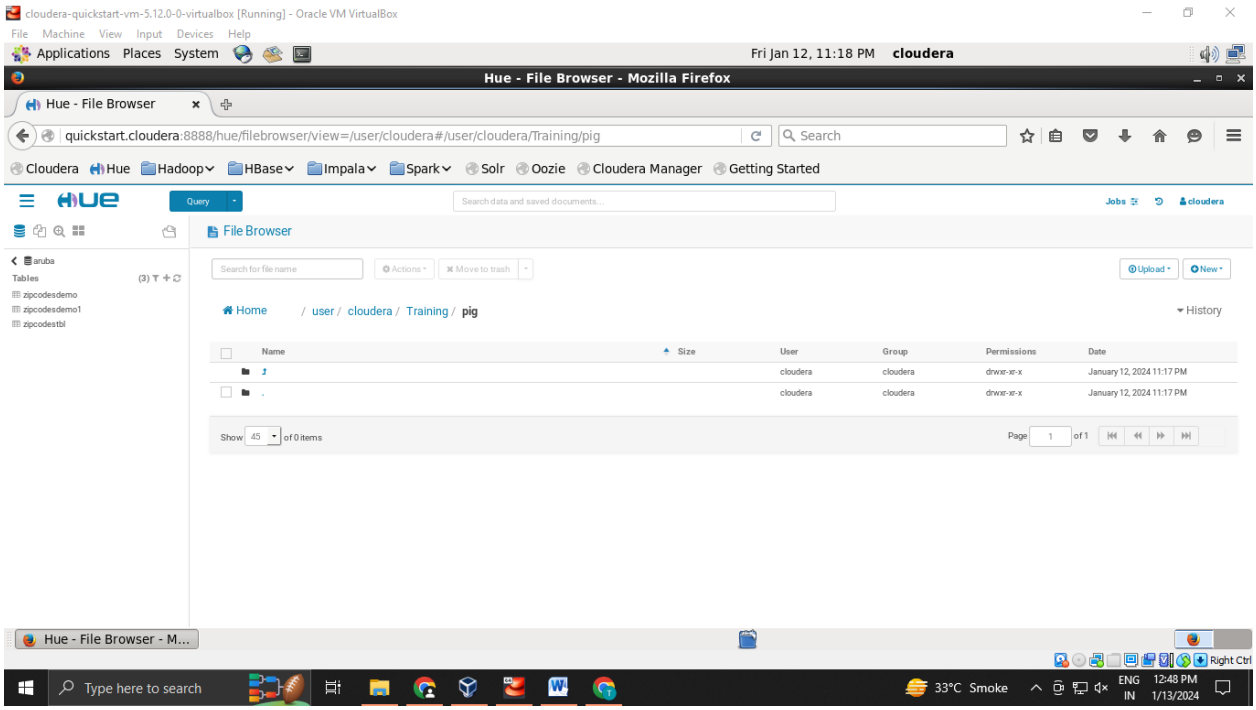


5) After creating Training directory now creating the pig directory inside Training.

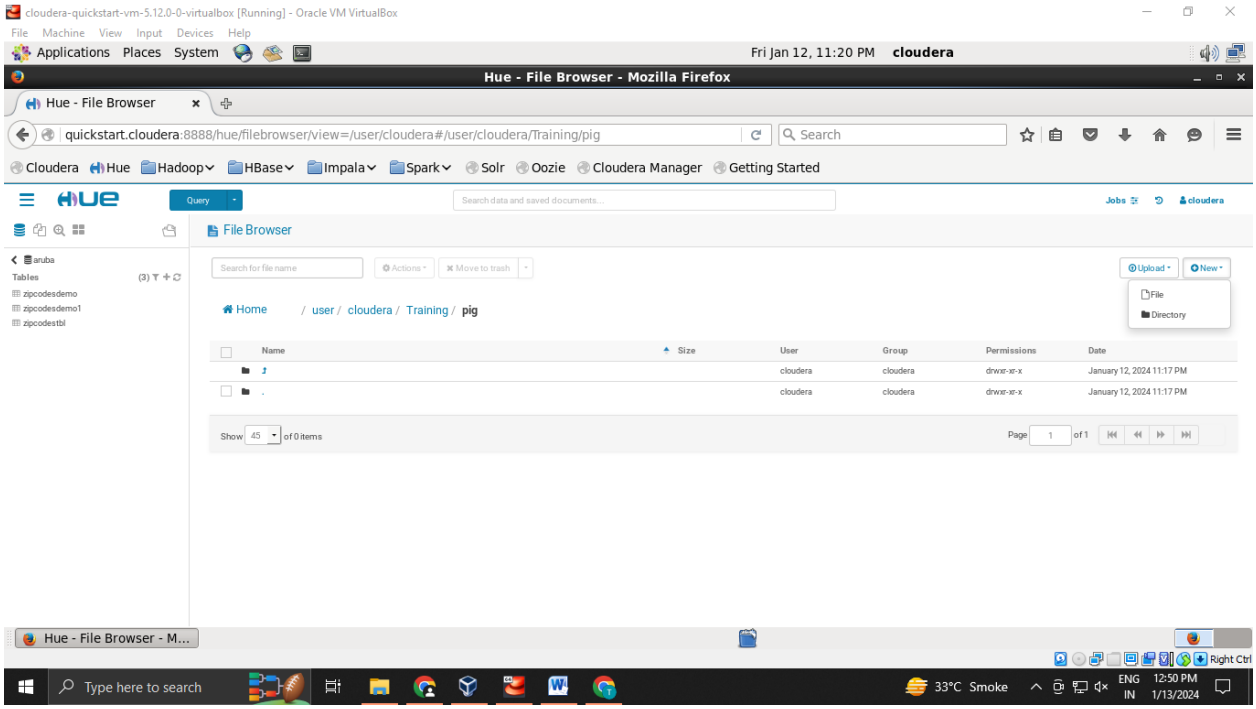


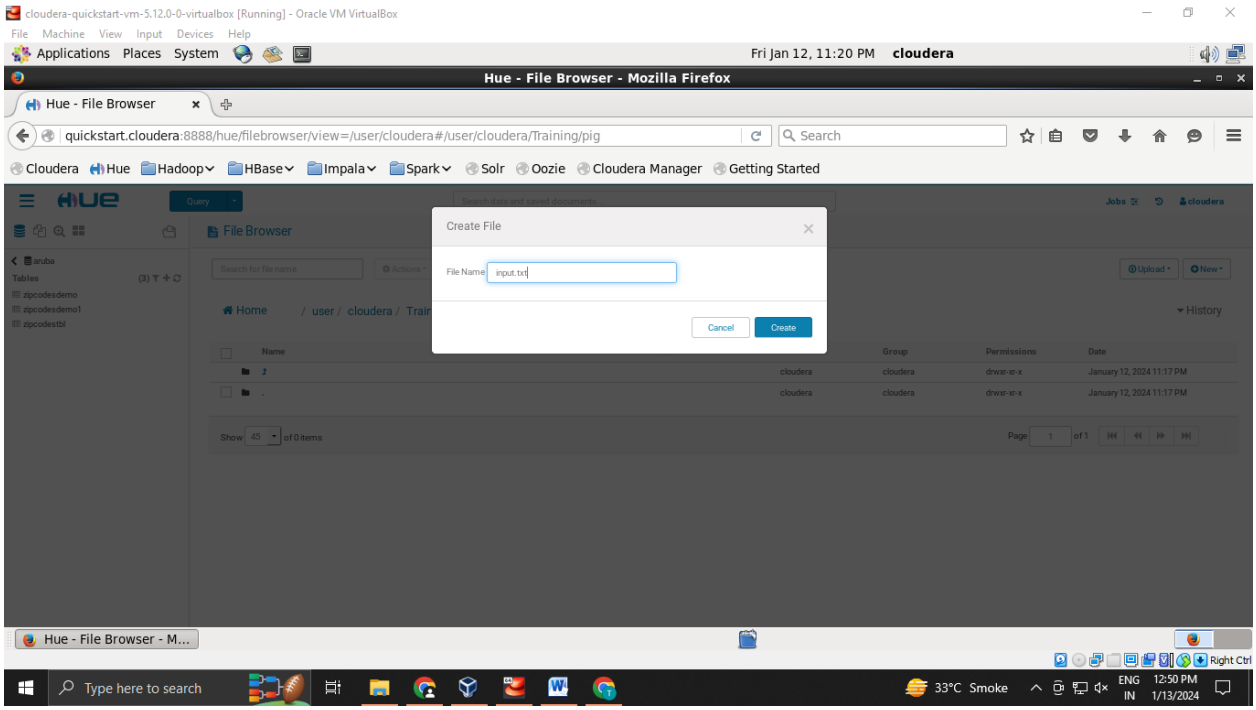


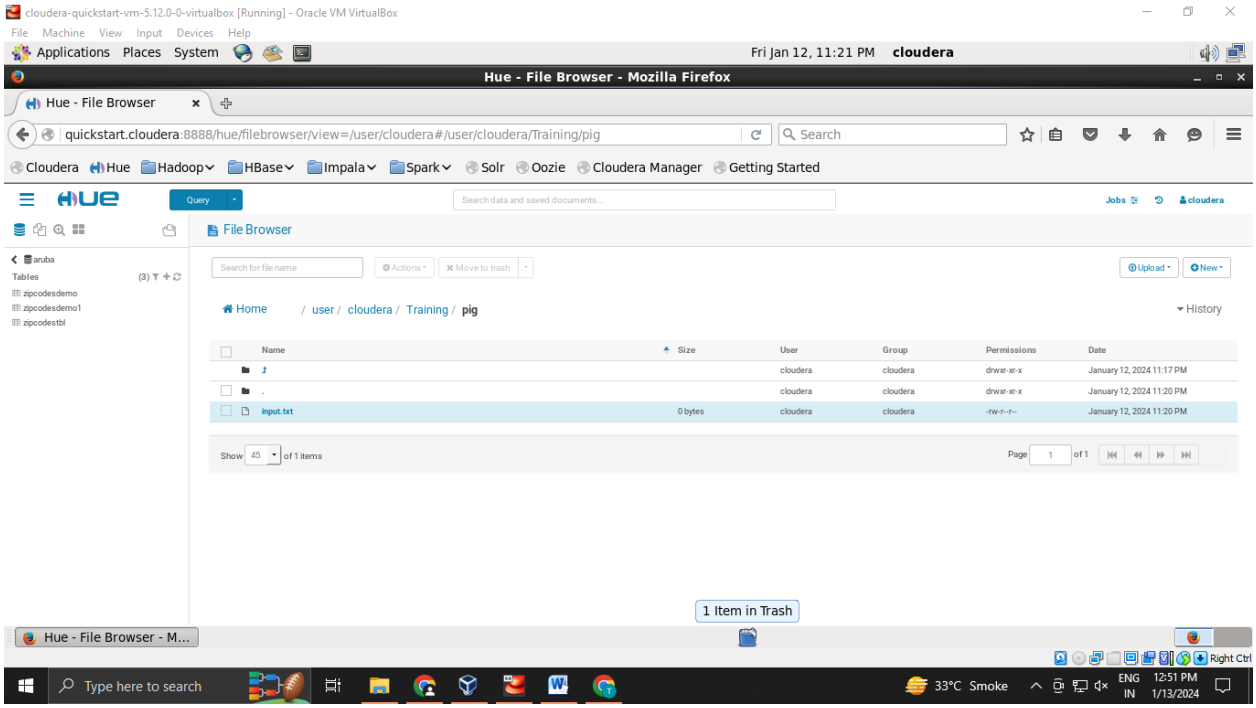
6) pig directory has been created inside /user/cloudera/Training



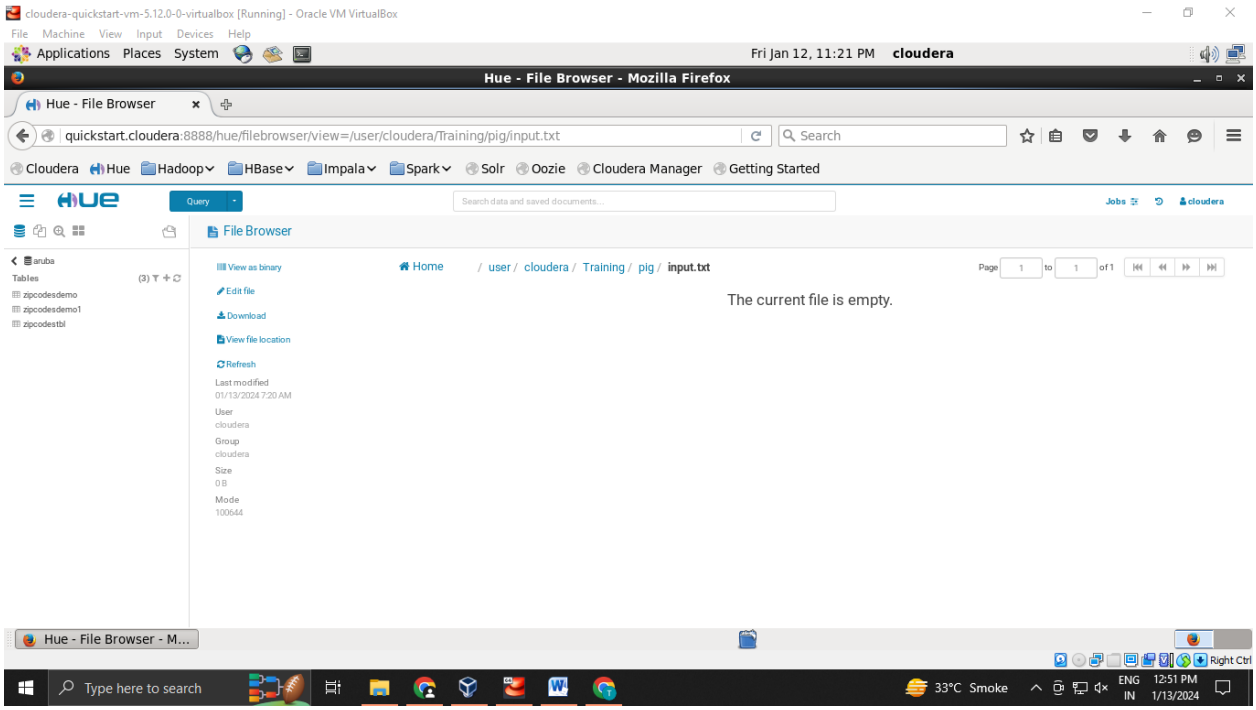
7) Creating input.txt file inside /usr/cloudera/training/pig directory



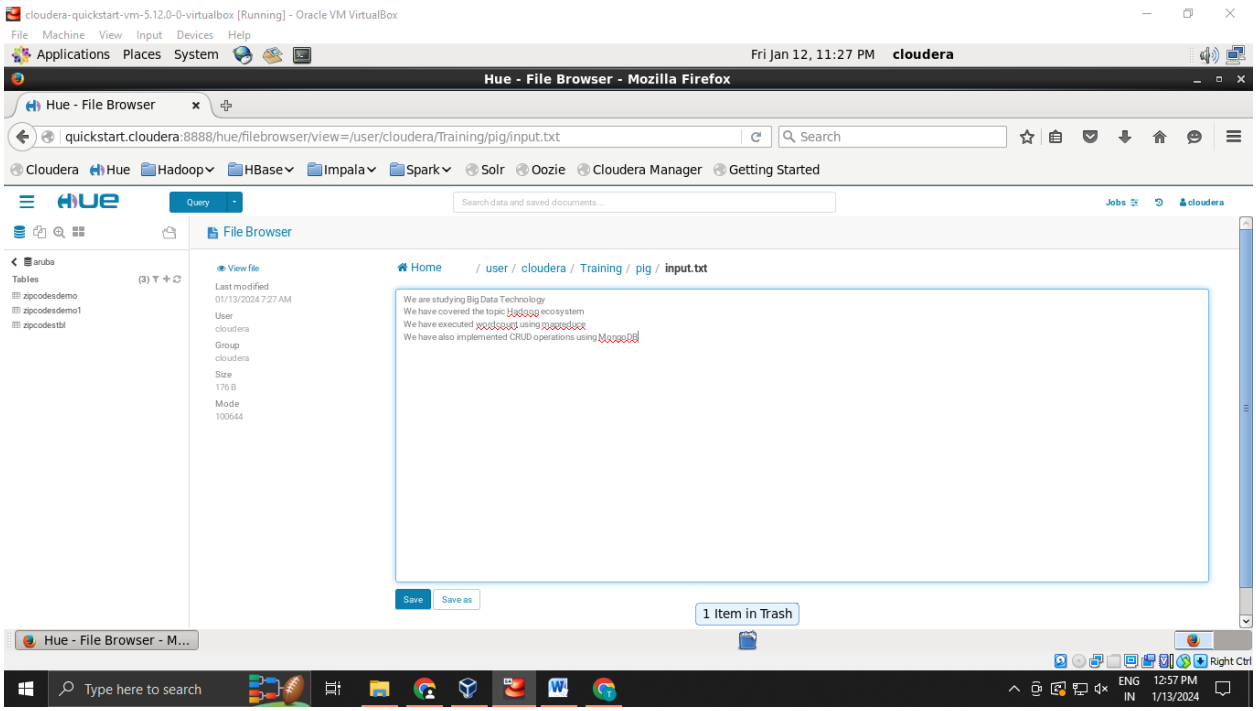




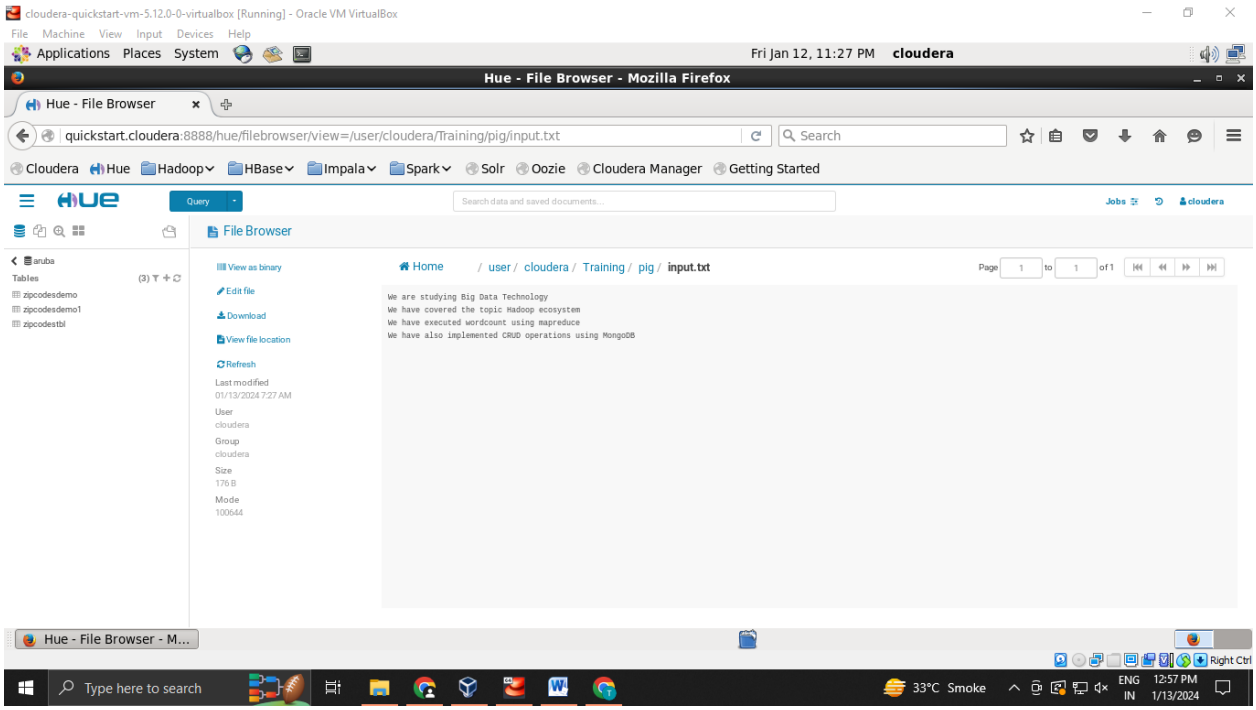
8) Adding some contents to this input.txt file.



Click on Edit file option → Write the below lines and click on save button.

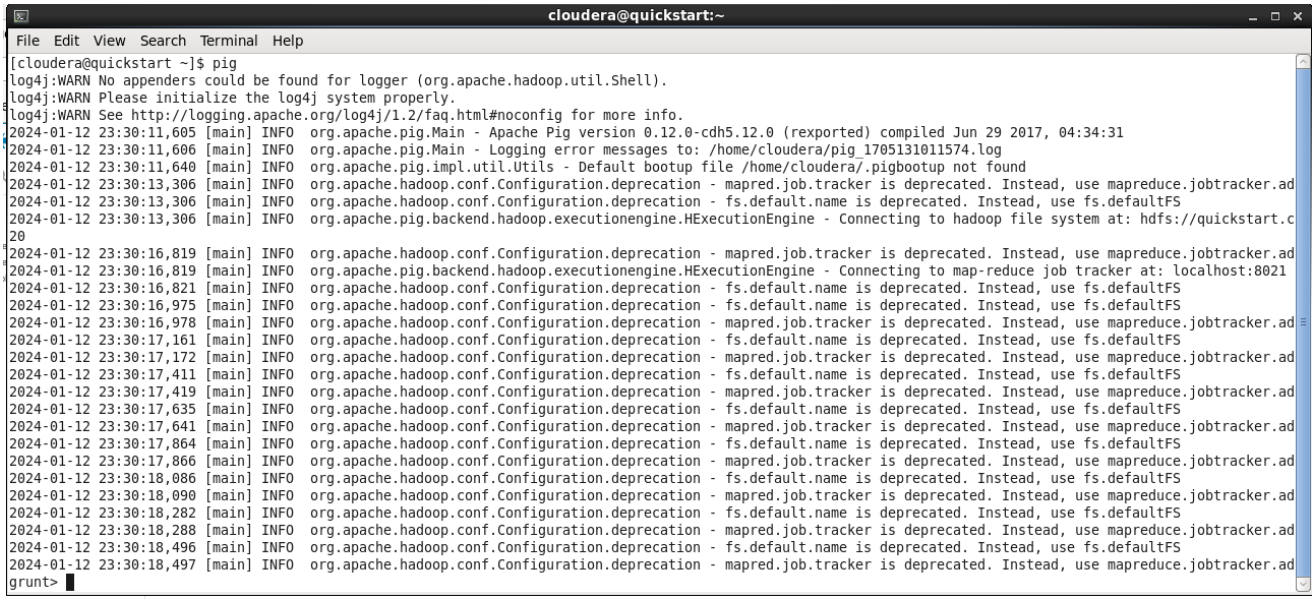


Save the input.txt file



9) Now Open the terminal. And start Pig by typing pig on terminal.

Now the pig started



10) Now we have to load that input file where ever it is stored. By typing the command

Input1 = LOAD '/usr/cloudera/Training/pig/input.txt' AS (f1:chararray);

```
grunt> Input1 = LOAD '/user/cloudera/Training/pig/input.txt' AS (f1:chararray);
grunt>
```

11) Now we are dumping the data. It will done the mapreduce task.

DUMP input1;

```
grunt> DUMP Input1;
2024-01-12 23:36:08,842 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig
features used in the script: UNKNOWN
2024-01-12 23:36:08,917 [main] INFO  org.apache.pig.newplan.logical.optimizer.Logical
PlanOptimizer - {RULES_ENABLED=[AddForEach, ColumnMapKeyPrune, DuplicateForEachColumn
Rewrite, GroupByConstParallelSetter, ImplicitSplitInserter, LimitOptimizer, LoadTypeC
astInserter, MergeFilter, MergeForEach, NewPartitionFilterOptimizer, PushDownForEachF
latten, PushUpFilter, SplitFilter, StreamTypeCastInserter], RULES_DISABLED=[FilterLog
icExpressionSimplifier, PartitionFilterOptimizer]}
2024-01-12 23:36:09,203 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MRCompiler - File concatenation threshold: 100 optimistic? false
2024-01-12 23:36:09,246 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MultiQueryOptimizer - MR plan size before optimization: 1
2024-01-12 23:36:09,246 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MultiQueryOptimizer - MR plan size after optimization: 1
2024-01-12 23:36:09,636 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecti
ng to ResourceManager at /0.0.0.0:8032
2024-01-12 23:36:10,099 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig
script settings are added to the job
2024-01-12 23:36:10,243 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation
 - mapred.job.reduce.markreset.buffer.percent is deprecated. Instead, use mapreduce.r

Job DAG:
job_1705129341413_0001


2024-01-12 23:37:08,216 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MapReduceLauncher - Success!
2024-01-12 23:37:08,221 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation
 - fs.default.name is deprecated. Instead, use fs.defaultFS
2024-01-12 23:37:08,221 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation
 - mapred.job.tracker is deprecated. Instead, use mapreduce.jobtracker.address
2024-01-12 23:37:08,222 [main] INFO  org.apache.pig.data.SchemaTupleBackend - Key [pi
g.schematuple] was not set... will not generate code.
2024-01-12 23:37:08,254 [main] INFO  org.apache.hadoop.mapreduce.lib.input.FileInputF
ormat - Total input paths to process : 1
2024-01-12 23:37:08,254 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ut
il.MapRedUtil - Total input paths to process : 1
(We are studying Big Data Technology)
(We have covered the topic Hadoop ecosystem)
(We have executed wordcount using mapreduce)
(We have also implemented CRUD operations using MongoDB)
grunt>
```

12) wordsInEachLine = FOREACH input1 GENERATE flatten(TOKENIZE(f1)) as word;

```
grunt> wordsInEachLine = FOREACH Input1 GENERATE flatten(TOKENIZE(f1)) as word;
2024-01-12 23:42:44,316 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation
 - fs.default.name is deprecated. Instead, use fs.defaultFS
2024-01-12 23:42:44,316 [main] INFO  org.apache.hadoop.conf.Configuration.deprecation
 - mapred.job.tracker is deprecated. Instead, use mapreduce.jobtracker.address
grunt>
```

13) dump wordsInEachLine;

```
grunt> dump wordsInEachLine;
2024-01-12 23:44:21,589 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig
features used in the script: UNKNOWN
2024-01-12 23:44:21,598 [main] INFO  org.apache.pig.newplan.logical.optimizer.Logical
PlanOptimizer - {RULES_ENABLED=[AddForEach, ColumnMapKeyPrune, DuplicateForEachColumn
Rewrite, GroupByConstParallelSetter, ImplicitSplitInserter, LimitOptimizer, LoadTypeC
astInserter, MergeFilter, MergeForEach, NewPartitionFilterOptimizer, PushDownForEachF
latten, PushUpFilter, SplitFilter, StreamTypeCastInserter], RULES_DISABLED=[FilterLog
icExpressionSimplifier, PartitionFilterOptimizer]}
2024-01-12 23:44:21,629 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MRCompiler - File concatenation threshold: 100 optimistic? false
2024-01-12 23:44:21,632 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MultiQueryOptimizer - MR plan size before optimization: 1
2024-01-12 23:44:21,632 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.MultiQueryOptimizer - MR plan size after optimization: 1
2024-01-12 23:44:21,689 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecti
ng to ResourceManager at /0.0.0.0:8032
2024-01-12 23:44:21,694 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig
script settings are added to the job
2024-01-12 23:44:21,711 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ma
pReduceLayer.JobControlCompiler - mapred.job.reduce.markreset.buffer.percent is not s
2024-01-12 23:45:17,267 [main] INFO  org.apache.hadoop.mapreduce.lib.input.FileInputF
ormat - Total input paths to process : 1
2024-01-12 23:45:17,267 [main] INFO  org.apache.pig.backend.hadoop.executionengine.ut
il.MapRedUtil - Total input paths to process : 1
(We)
(are)
(studying)
(Big)
(Data)
(Technology)
(We)
(have)
(covered)
(the)
(topic)
(Hadoop)
(ecosystem)
(We)
(have)
(executed)
(wordcount)
(using)
(mapreduce)
(We)
(have)
(also)
(implemented)
(CRUD)
(operations)
(using)
(MongoDB)
grunt>
```

14) Now grouping the words present in each line.

groupedWords = group wordsInEachLine by word;

```
grunt> groupedWords = group wordsInEachLine by word;
grunt>
```

dump groupedWords;

```
grunt> dump groupedWords;
2024-01-12 23:49:55,524 [main] INFO  org.apache.pig.tools.pigstats.ScriptState
 - Pig features used in the script: GROUP_BY
2024-01-12 23:49:55,526 [main] INFO  org.apache.pig.newplan.logical.optimizer.
LogicalPlanOptimizer - {RULES_ENABLED=[AddForEach, ColumnMapKeyPrune, Duplicat
eForEachColumnRewrite, GroupByConstParallelSetter, ImplicitSplitInserter, Limi
tOptimizer, LoadTypeCastInserter, MergeFilter, MergeForEach, NewPartitionFilte
rOptimizer, PushDownForEachFlatten, PushUpFilter, SplitFilter, StreamTypeCastI
nserter], RULES_DISABLED=[FilterLogicExpressionSimplifier, PartitionFilterOpti
mizer]}
2024-01-12 23:49:55,538 [main] INFO  org.apache.pig.backend.hadoop.executionen
gine.mapReduceLayer.MRCompiler - File concatenation threshold: 100 optimistic?
 false
2024-01-12 23:49:55,551 [main] INFO  org.apache.pig.backend.hadoop.executionen
gine.mapReduceLayer.MultiQueryOptimizer - MR plan size before optimization: 1
2024-01-12 23:49:55,551 [main] INFO  org.apache.pig.backend.hadoop.executionen
gine.mapReduceLayer.MultiQueryOptimizer - MR plan size after optimization: 1
2024-01-12 23:49:55,613 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - C
onnecting to ResourceManager at /0.0.0.0:8032
2024-01-12 23:49:55,620 [main] INFO  org.apache.pig.tools.pigstats.ScriptState
 - Pig script settings are added to the job
2024-01-12 23:49:55,644 [main] INFO  org.apache.pig.backend.hadoop.executionen
gine.mapReduceLayer.JobControlCompiler - mapred.job.reduce.markreset.buffer.pe
rcent is not set, set to default 0.3
2024-01-12 23:50:58,710 [main] INFO  org.apache.pig.backend.hadoop.executionen
gine.util.MapRedUtil - Total input paths to process : 1
(We,{(We),(We),(We),(We)})
(Big,{(Big)})
(are,{(are)})
(the,{(the)})
(CRUD,{(CRUD)})
(Data,{(Data)})
(also,{(also)})
(have,{(have),(have),(have)})
(topic,{(topic)})
(using,{(using),(using)})
(Hadoop,{(Hadoop)})
(MongoDB,{(MongoDB)})
(covered,{(covered)})
(executed,{(executed)})
(studying,{(studying)})
(ecosystem,{(ecosystem)})
(mapreduce,{(mapreduce)})
(wordcount,{(wordcount)})
(Technology,{(Technology)})
(operations,{(operations)})
(implemented,{(implemented)})
grunt>
```

15) Now we count those words. For each group we count words in each line.

countedWords = foreach groupedWords generate group, COUNT(wordsInEachLine);

```
ne)nt> countedWords = foreach groupedWords generate group, COUNT(wordsInEachLine);
grunt>
```

16) dump countedWords;

Now the Final Output we are getting as word count for every word.

```
grunt> dump countedWords;
2024-01-12 23:55:08,377 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig features
 used in the script: GROUP_BY
2024-01-12 23:55:08,382 [main] INFO  org.apache.pig.newplan.logical.optimizer.LogicalPlanOpti
mizer - {RULES_ENABLED=[AddForEach, ColumnMapKeyPrune, DuplicateForEachColumnRewrite, GroupBy
ConstParallelSetter, ImplicitSplitInserter, LimitOptimizer, LoadTypeCastInserter, MergeFilter
, MergeForEach, NewPartitionFilterOptimizer, PushDownForEachFlatten, PushUpFilter, SplitFilte
r, StreamTypeCastInserter], RULES_DISABLED=[FilterLogicExpressionSimplifier, PartitionFilterO
ptimizer]}
2024-01-12 23:55:08,409 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceL
ayer.MRCompiler - File concatenation threshold: 100 optimistic? false
2024-01-12 23:55:08,417 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceL
ayer.CombinerOptimizer - Choosing to move algebraic foreach to combiner
2024-01-12 23:55:08,433 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceL
ayer.MultiQueryOptimizer - MR plan size before optimization: 1
2024-01-12 23:55:08,433 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceL
ayer.MultiQueryOptimizer - MR plan size after optimization: 1
2024-01-12 23:55:08,476 [main] INFO  org.apache.hadoop.yarn.client.RMProxy - Connecting to Re
sourceManager at /0.0.0.0:8032
2024-01-12 23:55:08,480 [main] INFO  org.apache.pig.tools.pigstats.ScriptState - Pig script s
ettings are added to the job
2024-01-12 23:55:08,507 [main] INFO  org.apache.pig.backend.hadoop.executionengine.mapReduceL
```

```
2024-01-12 23:56:07,447 [main] INFO  org.apache.pig.backend.hadoop.executionengine.util.MapRe
dUtil - Total input paths to process : 1
(We,4)
(Big,1)
(are,1)
(the,1)
(CRUD,1)
(Data,1)
(also,1)
(have,3)
(topic,1)
(using,2)
(Hadoop,1)
(MongoDB,1)
(covered,1)
(executed,1)
(studying,1)
(ecosystem,1)
(mapreduce,1)
(wordcount,1)
(Technology,1)
(operations,1)
(implemented,1)
grunt>
```

As we can see from above image the Word “We” start with capital W occurred twice, word “we” start with small w occurred twice, word “Big” occurred once, and so on.

17) Now Exit from the grunt shell using quit command.

```
grunt> quit
[cloudera@quickstart ~]$
```

Practical 6: RDD Actions and Transformations

1. Install Java, PySpark and FindSpark
!apt-get install openjdk-8-jdk-headless -qq > /dev/null

!wget -q http://archive.apache.org/dist/spark/spark-3.1.1/spark-3.1.1-binhadoop3.2.tgz !tar xf spark-3.1.1-bin-hadoop3.2.tgz

!pip install -q findspark

```
!apt-get install openjdk-8-jdk-headless -qq > /dev/null
!wget -q http://archive.apache.org/dist/spark/spark-3.1.1/spark-3.1.1-bin-hadoop3.2.tgz
!tar xf spark-3.1.1-bin-hadoop3.2.tgz
!pip install -q findspark
```

2. Set environment variables
import os
os.environ["JAVA_HOME"] = "/usr/lib/jvm/java-8-openjdk-amd64"
os.environ["SPARK_HOME"] = "/content/spark-3.1.1-bin-hadoop3.2"

```
import os
os.environ["JAVA_HOME"] = "/usr/lib/jvm/java-8-openjdk-amd64"
os.environ["SPARK_HOME"] = "/content/spark-3.1.1-bin-hadoop3.2"
```

```
!ls
```

```
[5] !apt-get install openjdk-8-jdk-headless -qq > /dev/null
    !wget -q http://archive.apache.org/dist/spark/spark-3.1.1/spark-3.1.1-bin-hadoop3.2.tgz
    !tar xf spark-3.1.1-bin-hadoop3.2.tgz
    !pip install -q findspark

[6] import os
    os.environ["JAVA_HOME"] = "/usr/lib/jvm/java-8-openjdk-amd64"
    os.environ["SPARK_HOME"] = "/content/spark-3.1.1-bin-hadoop3.2"

[7] !ls

    sample_data                spark-3.1.1-bin-hadoop3.2.tgz    spark-3.1.1-bin-hadoop3.2.tgz.2
    spark-3.1.1-bin-hadoop3.2  spark-3.1.1-bin-hadoop3.2.tgz.1
```

```
!pip install pyspark
!pip install spark
```

3. Initialize findSpark
import findspark
findspark.init()

```
import findspark
```

```
findspark.init()
```

4. Create Spark Session

```
from pyspark.sql import SparkSession
spark = SparkSession.builder.getOrCreate()
```

```
from pyspark.context import SparkContext
from pyspark.sql import SparkSession
```

```
spark = SparkSession.builder.master("local[*]").getOrCreate()
spark.conf.set("spark.sql.repleagerEval.enabled",True)
sc = SparkContext.getOrCreate()
```

```
sc
```

5. Create a dataframe by specifying row

```
from datetime import datetime, date
import pandas as pd
from pyspark.sql import Row

df1 = spark.createDataFrame([
    Row(a=1, b=2., c='string1', d=date(2000, 1, 1), e=datetime(2000, 1, 1, 12, 0)),
    Row(a=2, b=3., c='string2', d=date(2000, 2, 1), e=datetime(2000, 1, 2, 12, 0)),
    Row(a=4, b=5., c='string3', d=date(2000, 3, 1), e=datetime(2000, 1, 3, 12, 0))
])
df
```

```
from datetime import datetime, date
import pandas as pd
from pyspark.sql import Row
```

```
from datetime import datetime, date
import pandas as pd
from pyspark.sql import Row
```

```
df1 = spark.createDataFrame([Row(a=1, b=2.0, c='string1',d=date(2000,1,1),
e=datetime(2000,1,1,12,0)),
                    Row(a=2,b=3.0,c='string2',d=date(2000,2,1),e=datetime(2000,1,2,12,0)),
                    Row(a=2,b=3.0,c='string3',d=date(2000,3,1),e=datetime(2000,1,3,12,0))])
df1
```

```
df1 = spark.createDataFrame([Row(a=1, b=2.0, c='string1',d=date(2000,1,1), e=datetime(2000,1,1,12,0)),
                             Row(a=2,b=3.0,c='string2',d=date(2000,2,1),e=datetime(2000,1,2,12,0)),
                             Row(a=2,b=3.0,c='string3',d=date(2000,3,1),e=datetime(2000,1,3,12,0))])
df1
```

```
DataFrame[a: bigint, b: double, c: string, d: date, e: timestamp]
```

6. Create a PySpark DataFrame with an explicit schema.

```
df2 = spark.createDataFrame([
    (1, 2., 'string1', date(2000, 1, 1), datetime(2000, 1, 1, 12, 0)),
    (2, 3., 'string2', date(2000, 2, 1), datetime(2000, 1, 2, 12, 0)),
    (3, 4., 'string3', date(2000, 3, 1), datetime(2000, 1, 3, 12, 0))
], schema='a long, b double, c string, d date, e timestamp')
df
```

```
df2 = spark.createDataFrame([(1,2.0,'string1',date(2000,1,1),datetime(2000,1,1,12,0)),
                    (2,3.0,'string2',date(2000,2,1),datetime(2000,1,2,12,0)),
                    (3,4.0,'string3',date(2000,3,1),datetime(2000,1,3,12,0))
                    ],schema='a long,b double, c string, d date, e timestamp')
df2
```

```
Generate   Using ...   10 random numbers using numpy

df2 = spark.createDataFrame([(1,2.0,'string1',date(2000,1,1),datetime(2000,1,1,12,0)),
                             (2,3.0,'string2',date(2000,2,1),datetime(2000,1,2,12,0)),
                             (3,4.0,'string3',date(2000,3,1),datetime(2000,1,3,12,0))
                             ],schema='a long,b double, c string, d date, e timestamp')
df2

DataFrame[a: bigint, b: double, c: string, d: date, e: timestamp]
```

7. Create a PySpark DataFrame from a pandas DataFrame

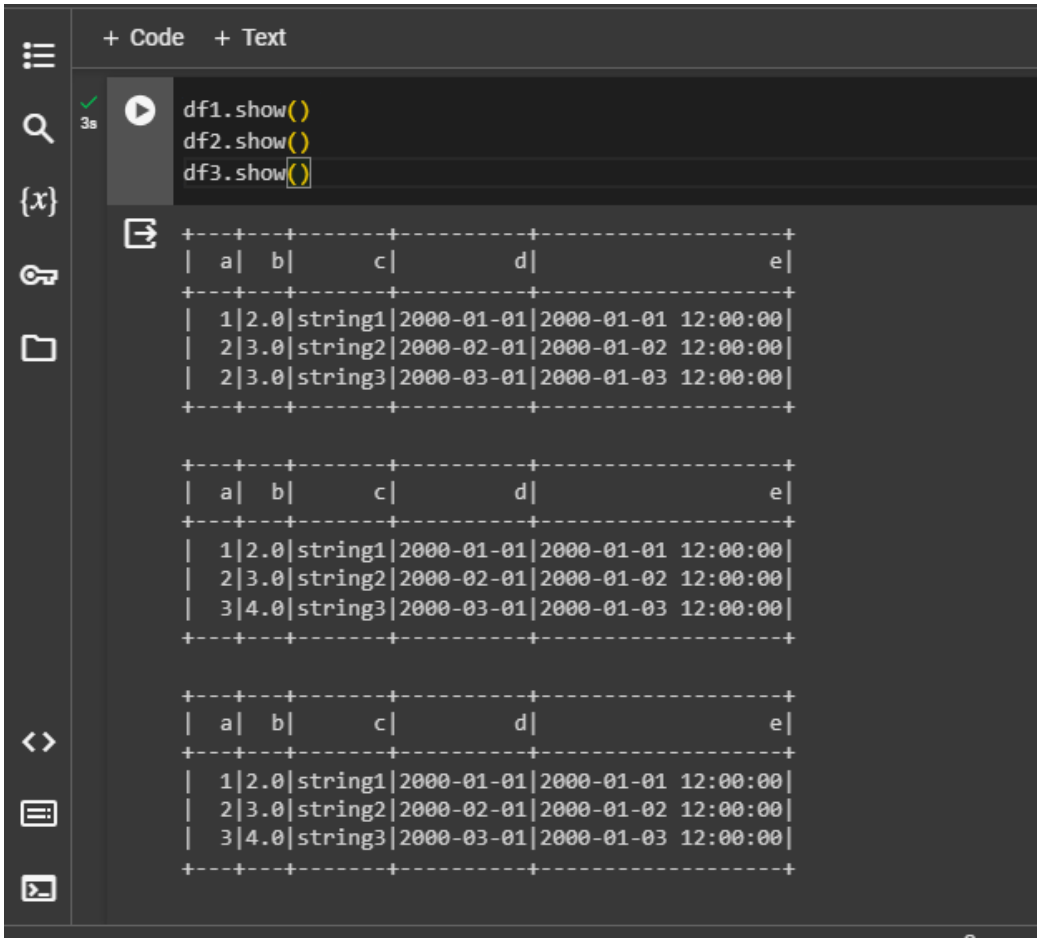
```
df_pandas = pd.DataFrame({
    'a': [1, 2, 3],
    'b': [2., 3., 4.],
    'c': ['string1', 'string2', 'string3'],
    'd': [date(2000, 1, 1), date(2000, 2, 1), date(2000, 3, 1)],
    'e': [datetime(2000, 1, 1, 12, 0), datetime(2000, 1, 2, 12, 0), datetime(2000, 1, 3, 12, 0)]
})
df3 = spark.createDataFrame(df_pandas)
df3
```

```
df_pandas = pd.DataFrame({
    'a':[1,2,3],
    'b':[2.,3.,4.],
    'c':['string1','string2','string3'],
    'd':[date(2000,1,1),date(2000,2,1),date(2000,3,1)],
    'e':[datetime(2000,1,1,12,0),datetime(2000,1,2,12,0),datetime(2000,1,3,12,0)]
})
df3 = spark.createDataFrame(df_pandas)
df3
```

8. Display the dataframe contents.

df1.show()
df2.show()
df3.show()

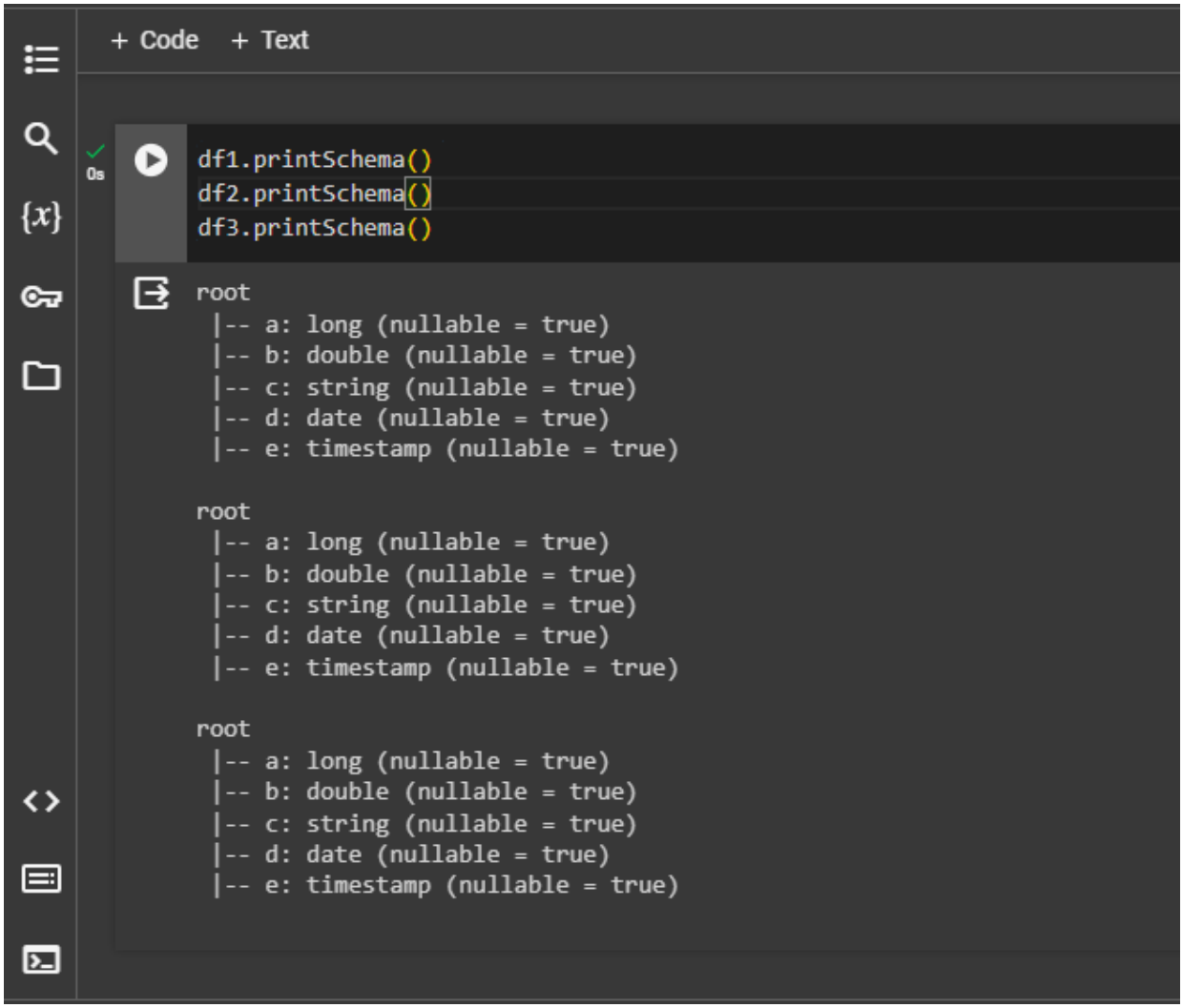
```
df1.show()
df2.show()
df3.show()
```



9. Print the schema of dataframe

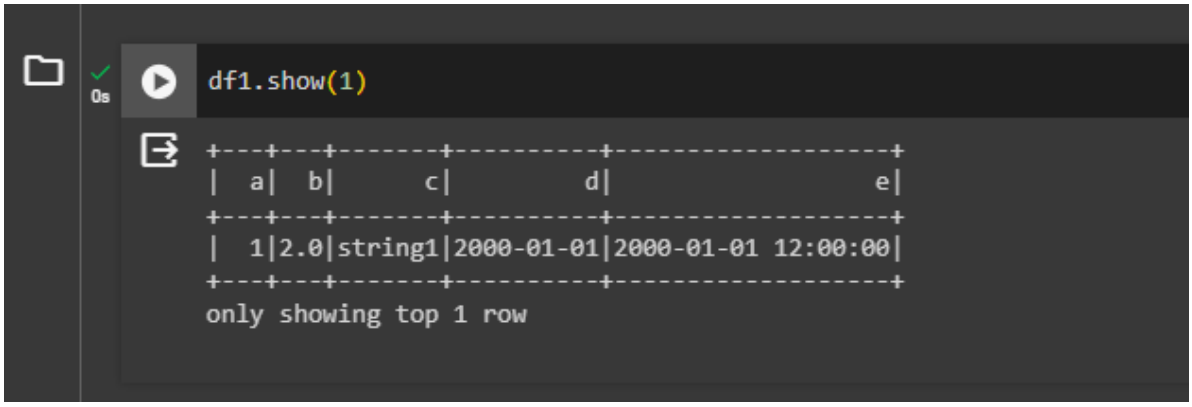
df1.printSchema()
df2.printSchema()
df3.printSchema()

```
df1.printSchema()
df2.printSchema()
df3.printSchema()
```



10. Show only the first row of the dataframe.
df1.show(1)

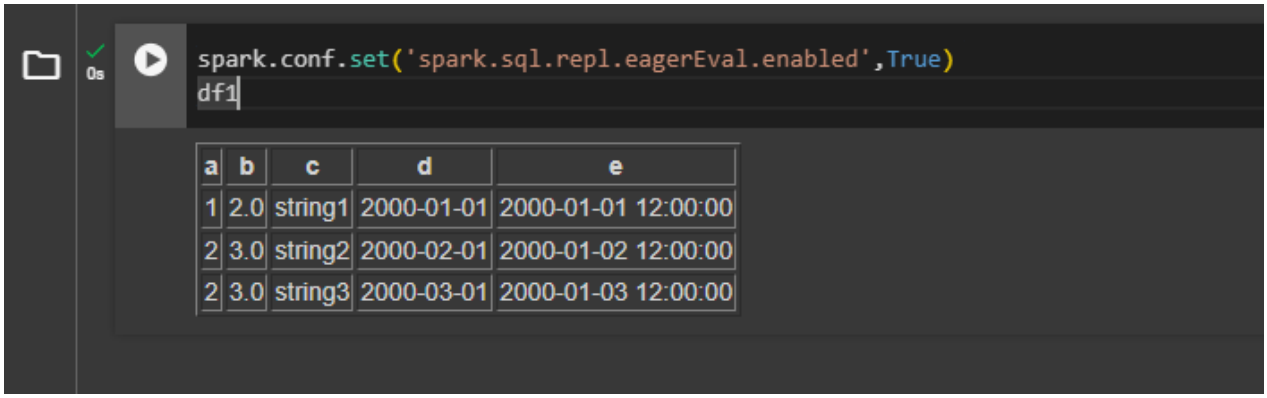
```
df1.show(1)
```



11.Enable spark.sql.repl.eagerEval.enabled configuration for the eager evaluation of PySpark DataFrame in notebooks such as Jupyter. The number of rows to show can be controlled via spark.sql.repl.eagerEval.maxNumRows configuration.

spark.conf.set('spark.sql.repl.eagerEval.enabled', True)
df1

```
spark.conf.set('spark.sql.repl.eagerEval.enabled',True)
df1
```



12. Display the row in vertical fashion.

df1.show(1, vertical=True)

```
df1.show(1, vertical=True)
```

```
df1.show(1, vertical=True)
```

```
-RECORD 0------------------
 a   | 1
 b   | 2.0
 c   | string1
 d   | 2000-01-01
 e   | 2000-01-01 12:00:00
only showing top 1 row
```

13. Display list of columns
df1.columns

```
df1.columns
```

```
df1.columns
```

```
['a', 'b', 'c', 'd', 'e']
```

14. Show the summary of the DataFrame
df1.select("a", "b", "c")

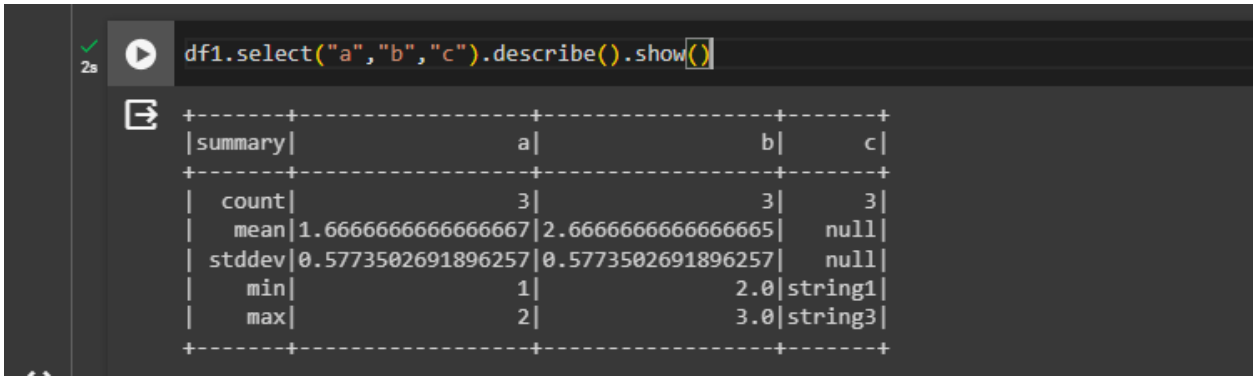
df1.select("a", "b", "c").describe().show()

```
df1.select("a","b","c")
```

```
df1.select("a","b","c")
```

a	b	c
1	2.0	string1
2	3.0	string2
2	3.0	string3

```
df1.select("a","b","c").describe().show()
```

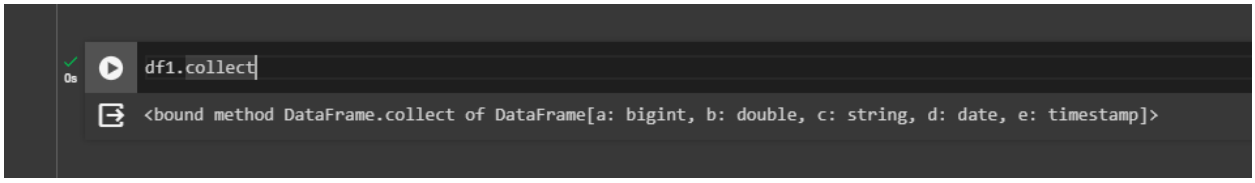


```
df1.select("a","b","c").describe().show()
```

```
+-------+------------------+------------------+-------+
|summary|                 a|                 b|      c|
+-------+------------------+------------------+-------+
|  count|                 3|                 3|      3|
|   mean|1.6666666666666667|2.6666666666666665|   null|
| stddev|0.5773502691896257|0.5773502691896257|   null|
|    min|                 1|               2.0|string1|
|    max|                 2|               3.0|string3|
+-------+------------------+------------------+-------+
```

15. collects the distributed data to the driver side as the local data in Python.
df1.collect

```
df1.collect
```

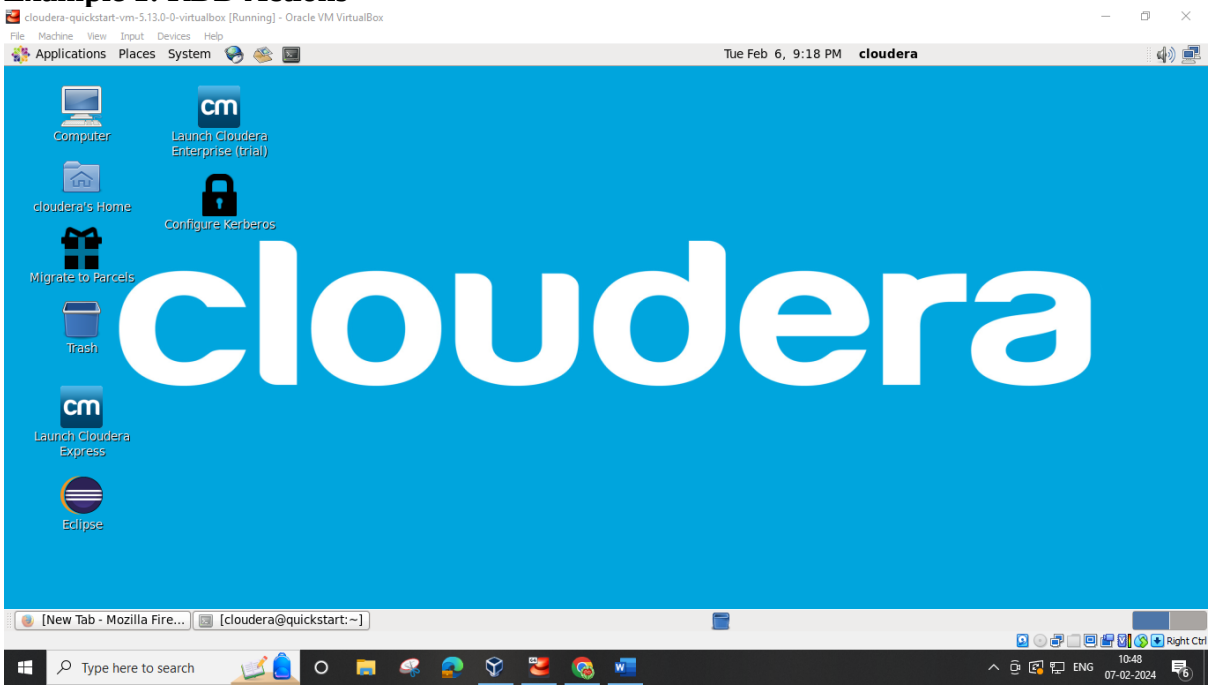


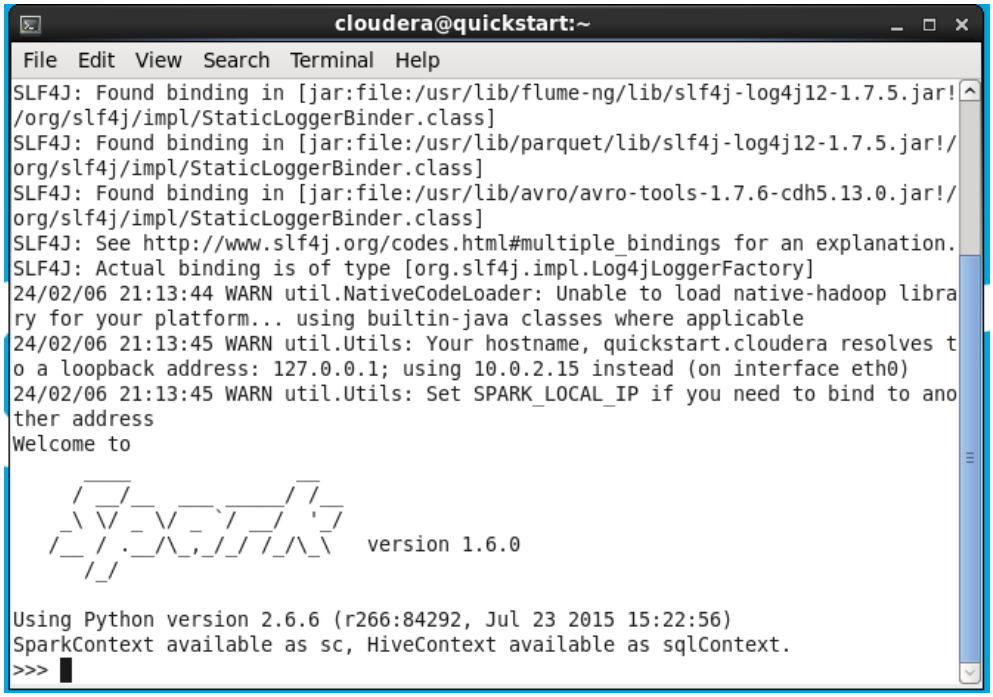
```
df1.collect
```

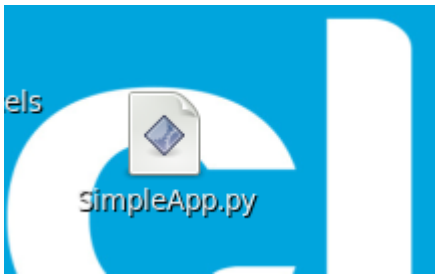
```
<bound method DataFrame.collect of DataFrame[a: bigint, b: double, c: string, d: date, e: timestamp]>
```

Practical No. 7: Creating PySpark Application

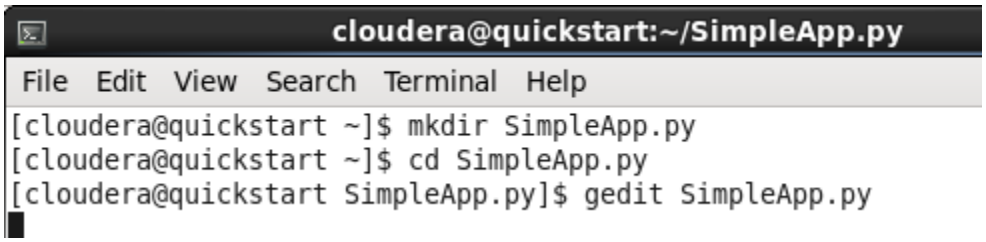
Example 1: RDD Actions

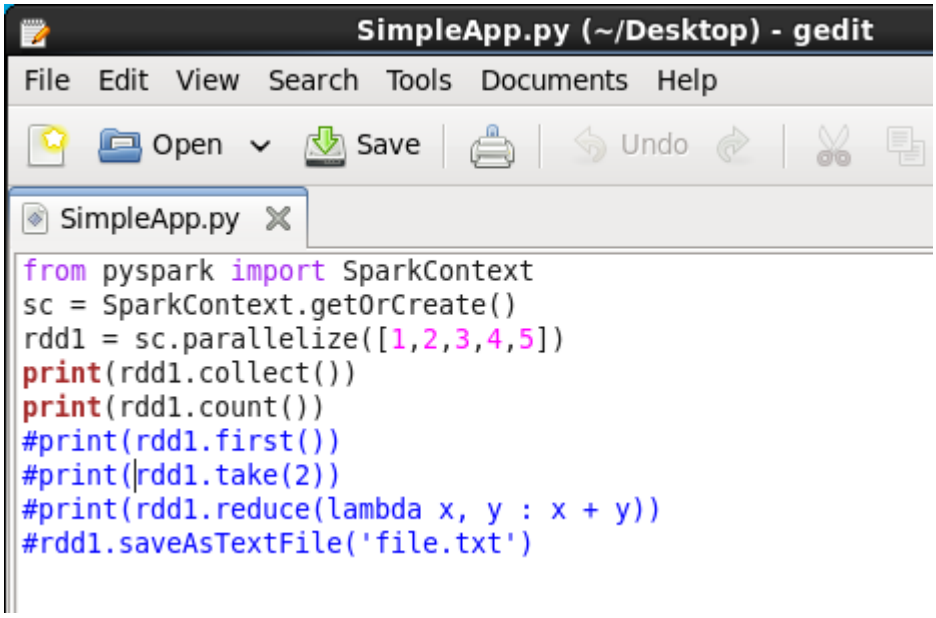






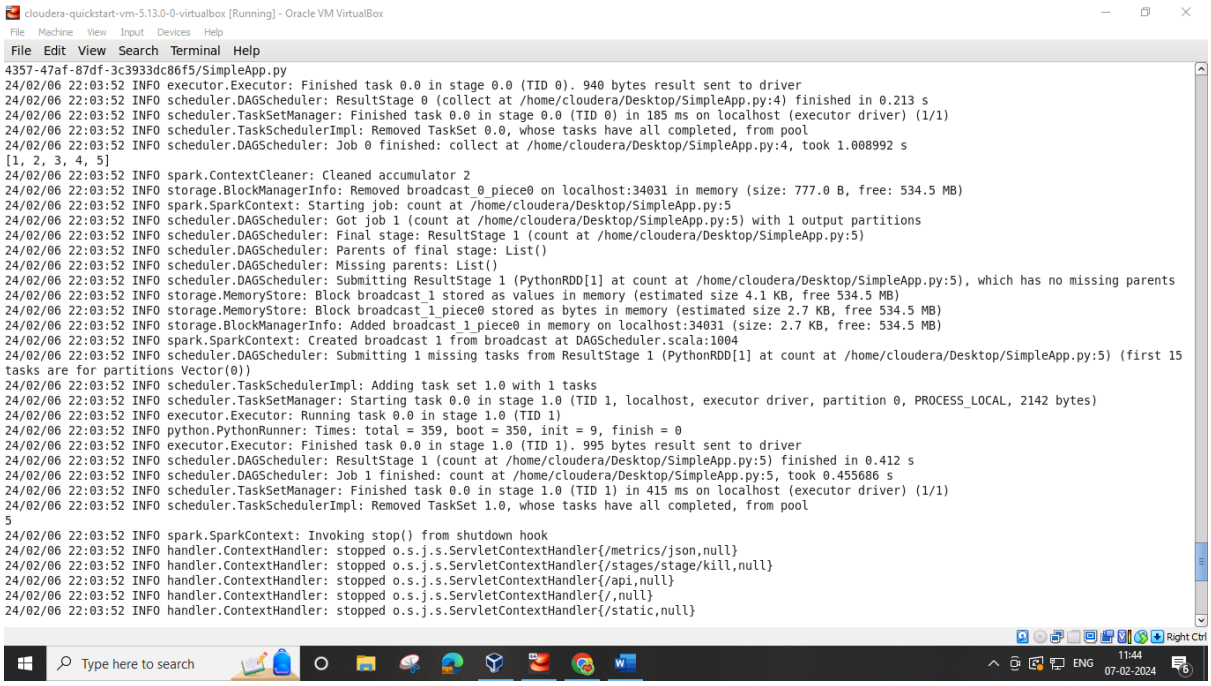
Open another Terminal






```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/SimpleApp.py
```

OUTPUT



SimpleApp.py (~/Desktop) - gedit

File Edit View Search Tools Documents Help

Open Save Undo

SimpleApp.py

```
from pyspark import SparkContext
sc = SparkContext.getOrCreate()
rdd1 = sc.parallelize([1,2,3,4,5])
print(rdd1.collect())
print(rdd1.count())
print(rdd1.first())
print(rdd1.take(2))
print(rdd1.reduce(lambda x, y : x + y))
rdd1.saveAsTextFile('file.txt')
```

OUTPUT

cloudera-quickstart-vm-5.13.0-0-virtualbox [Running] - Oracle VM VirtualBox

Applications Places System Tue Feb 6, 10:17 PM cloudera

cloudera@quickstart:~/SimpleApp.py

File Edit View Search Terminal Help

```
24/02/06 22:17:11 INFO scheduler.DAGScheduler: Job 0 finished: collect at /home/cloudera/Desktop/SimpleApp.py:4, took 1.049866 s
[1, 2, 3, 4, 5]
24/02/06 22:17:12 INFO spark.ContextCleaner: Cleaned accumulator 2
24/02/06 22:17:12 INFO storage.BlockManagerInfo: Removed broadcast_0_piece0 on localhost:36502 in memory (size: 777.0 B, free: 534.5 MB)
24/02/06 22:17:12 INFO spark.SparkContext: Starting job: count at /home/cloudera/Desktop/SimpleApp.py:5
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Got job 1 (count at /home/cloudera/Desktop/SimpleApp.py:5) with 1 output partitions
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Final stage: ResultStage 1 (count at /home/cloudera/Desktop/SimpleApp.py:5)
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Parents of final stage: List()
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Missing parents: List()
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Submitting ResultStage 1 (PythonRDD[1] at count at /home/cloudera/Desktop/SimpleApp.py:5), which has no missing parents
24/02/06 22:17:12 INFO storage.MemoryStore: Block broadcast_1 stored as values in memory (estimated size 4.1 KB, free 534.5 MB)
24/02/06 22:17:12 INFO storage.MemoryStore: Block broadcast_1_piece0 stored as bytes in memory (estimated size 2.7 KB, free 534.5 MB)
24/02/06 22:17:12 INFO storage.BlockManagerInfo: Added broadcast_1_piece0 in memory on localhost:36502 (size: 2.7 KB, free: 534.5 MB)
24/02/06 22:17:12 INFO spark.SparkContext: Created broadcast 1 from broadcast at DAGScheduler.scala:1004
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Submitting 1 missing tasks from ResultStage 1 (PythonRDD[1] at count at /home/cloudera/Desktop/SimpleApp.py:5) (first 15
tasks are for partitions Vector(0))
24/02/06 22:17:12 INFO scheduler.TaskSchedulerImpl: Adding task set 1.0 with 1 tasks
24/02/06 22:17:12 INFO scheduler.TaskSetManager: Starting task 0.0 in stage 1.0 (TID 1, localhost, executor driver, partition 0, PROCESS_LOCAL, 2142 bytes)
24/02/06 22:17:12 INFO executor.Executor: Running task 0.0 in stage 1.0 (TID 1)
24/02/06 22:17:12 INFO python.PythonRunner: Times: total = 349, boot = 337, init = 12, finish = 0
24/02/06 22:17:12 INFO executor.Executor: Finished task 0.0 in stage 1.0 (TID 1). 995 bytes result sent to driver
24/02/06 22:17:12 INFO scheduler.DAGScheduler: ResultStage 1 (count at /home/cloudera/Desktop/SimpleApp.py:5) finished in 0.433 s
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Job 1 finished: count at /home/cloudera/Desktop/SimpleApp.py:5, took 0.480339 s
24/02/06 22:17:12 INFO scheduler.TaskSetManager: Finished task 0.0 in stage 1.0 (TID 1) in 436 ms on localhost (executor driver) (1/1)
24/02/06 22:17:12 INFO scheduler.TaskSchedulerImpl: Removed TaskSet 1.0, whose tasks have all completed, from pool
5
24/02/06 22:17:12 INFO spark.SparkContext: Starting job: runJob at PythonRDD.scala:393
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Got job 2 (runJob at PythonRDD.scala:393) with 1 output partitions
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Final stage: ResultStage 2 (runJob at PythonRDD.scala:393)
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Parents of final stage: List()
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Missing parents: List()
24/02/06 22:17:12 INFO scheduler.DAGScheduler: Submitting ResultStage 2 (PythonRDD[2] at RDD at PythonRDD.scala:43), which has no missing parents
24/02/06 22:17:12 INFO storage.MemoryStore: Block broadcast_2 stored as values in memory (estimated size 3.2 KB, free 534.5 MB)
```

[cloudera@quickstart:~] cloudera@quickstart:...

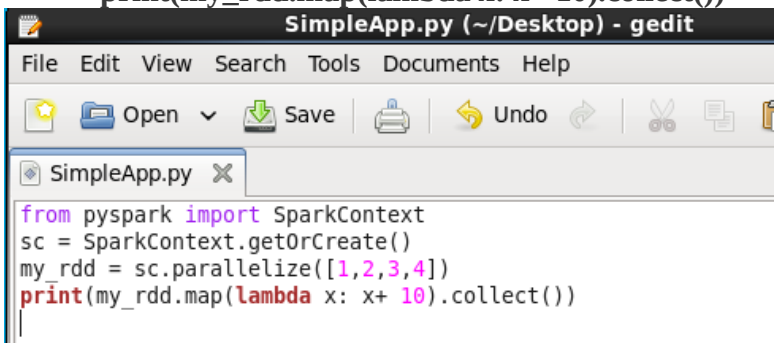
Type here to search ENG 11:47 07-02-2024

Example 2: RDD Transformations

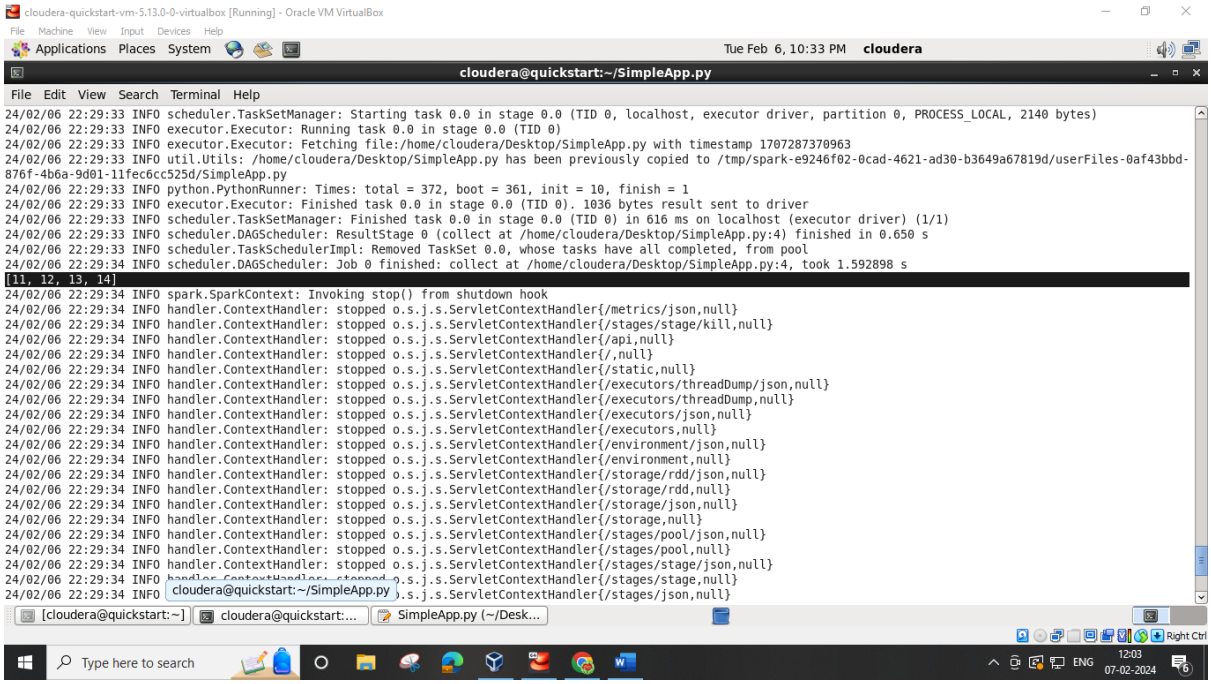
1. **map()**

   my_rdd = sc.parallelize([1,2,3,4])

   print(my_rdd.map(lambda x: x+ 10).collect())



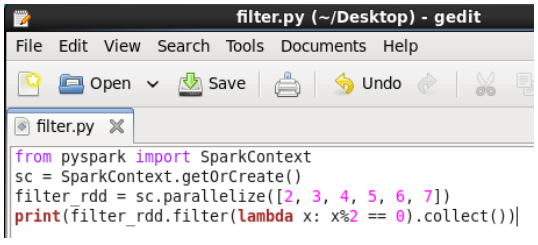
Output:



2. filter()

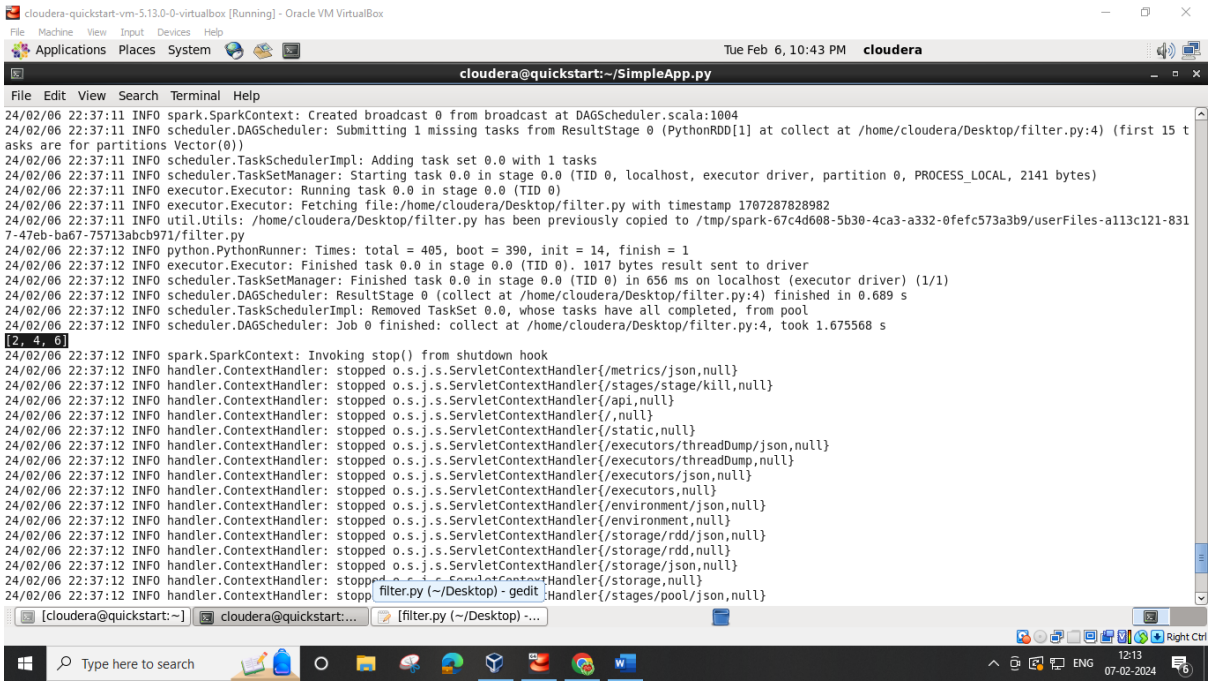
filter_rdd = sc.parallelize([2, 3, 4, 5, 6, 7])

print(filter_rdd.filter(lambda x: x%2 == 0).collect())



```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/filter.py
```

OUTPUT:



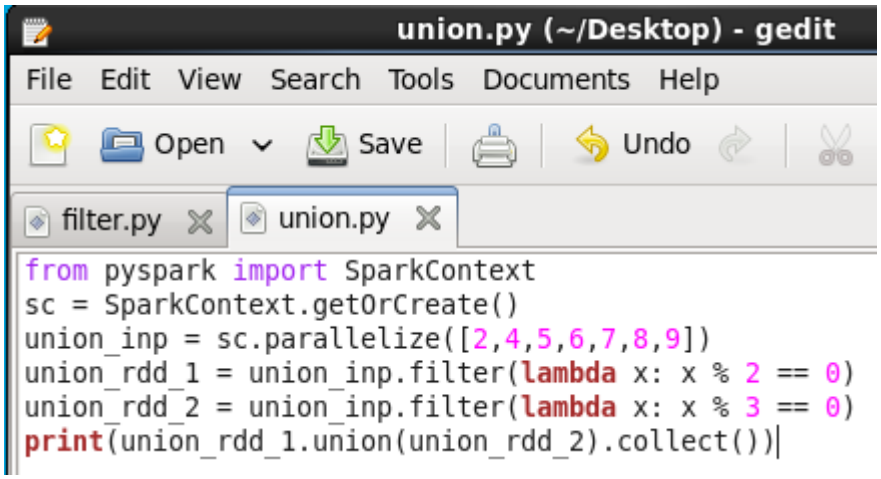
3. union()

union_inp = sc.parallelize([2,4,5,6,7,8,9])

union_rdd_1 = union_inp.filter(lambda x: x % 2 == 0)

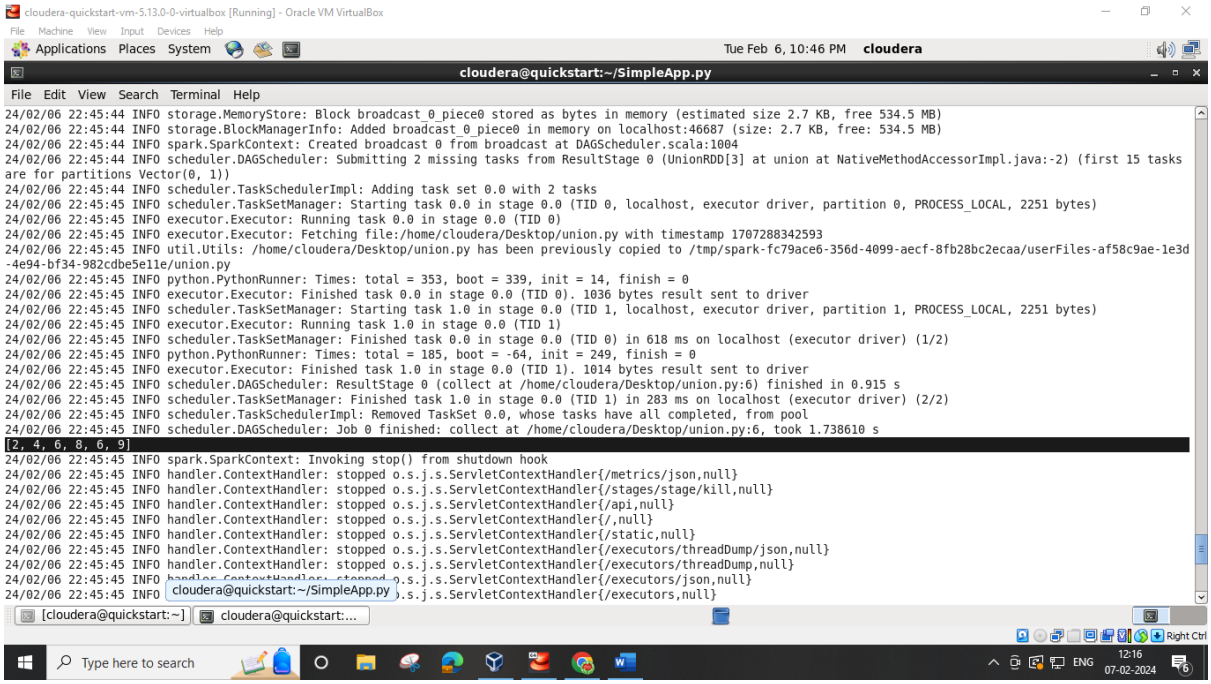
union_rdd_2 = union_inp.filter(lambda x: x % 3 == 0)

print(union_rdd_1.union(union_rdd_2).collect())




```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/union.py
```

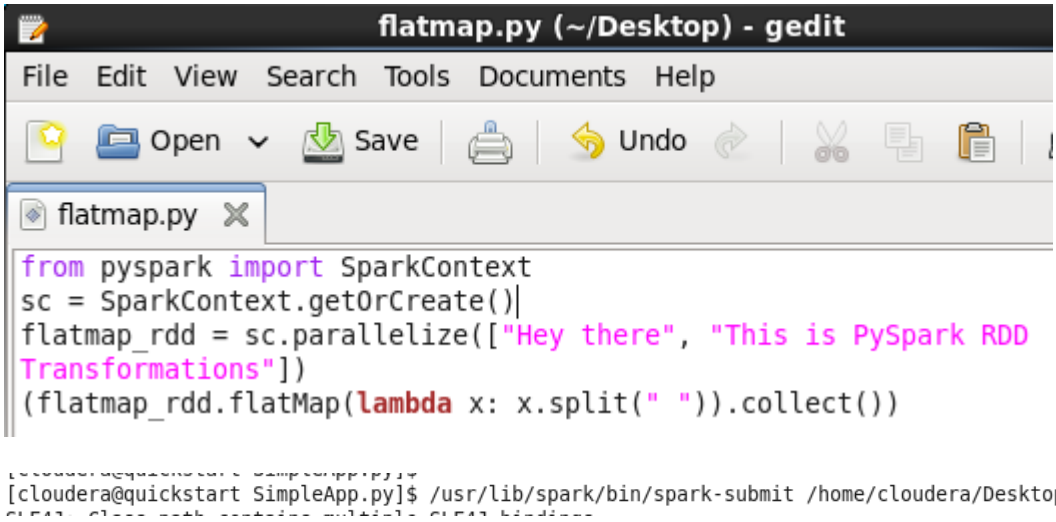
OUTPUT:



4. flatMap()

flatmap_rdd = sc.parallelize(["Hey there", "This is PySpark RDD Transformations"])

(flatmap_rdd.flatMap(lambda x: x.split(" ")).collect())



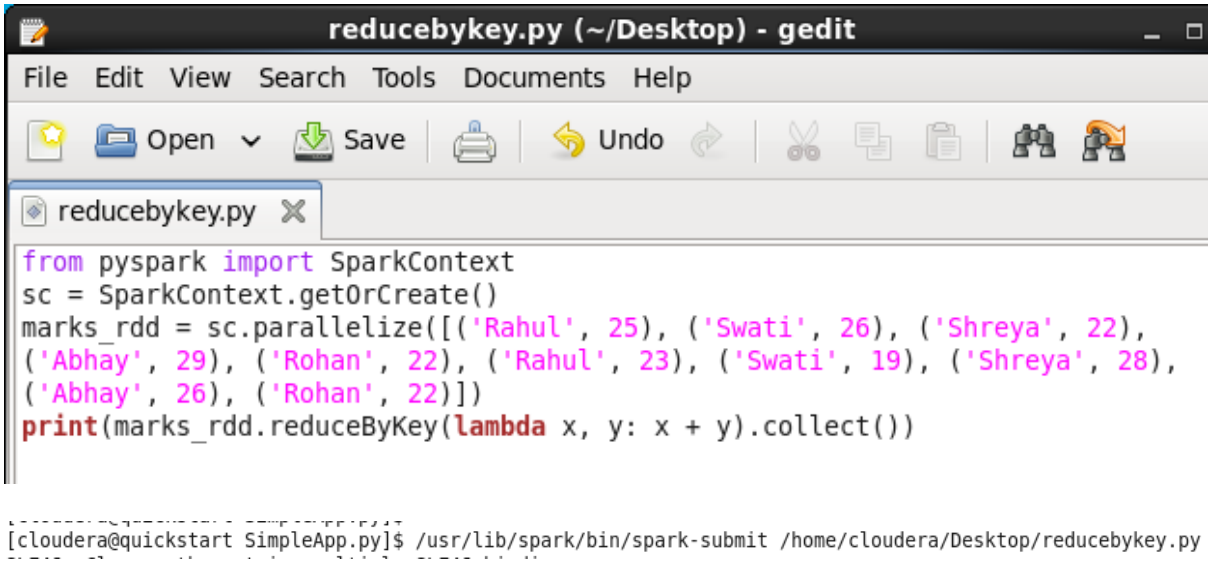

```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/flatmap.py
```

OUTPUT:

5. **reduceByKey()**

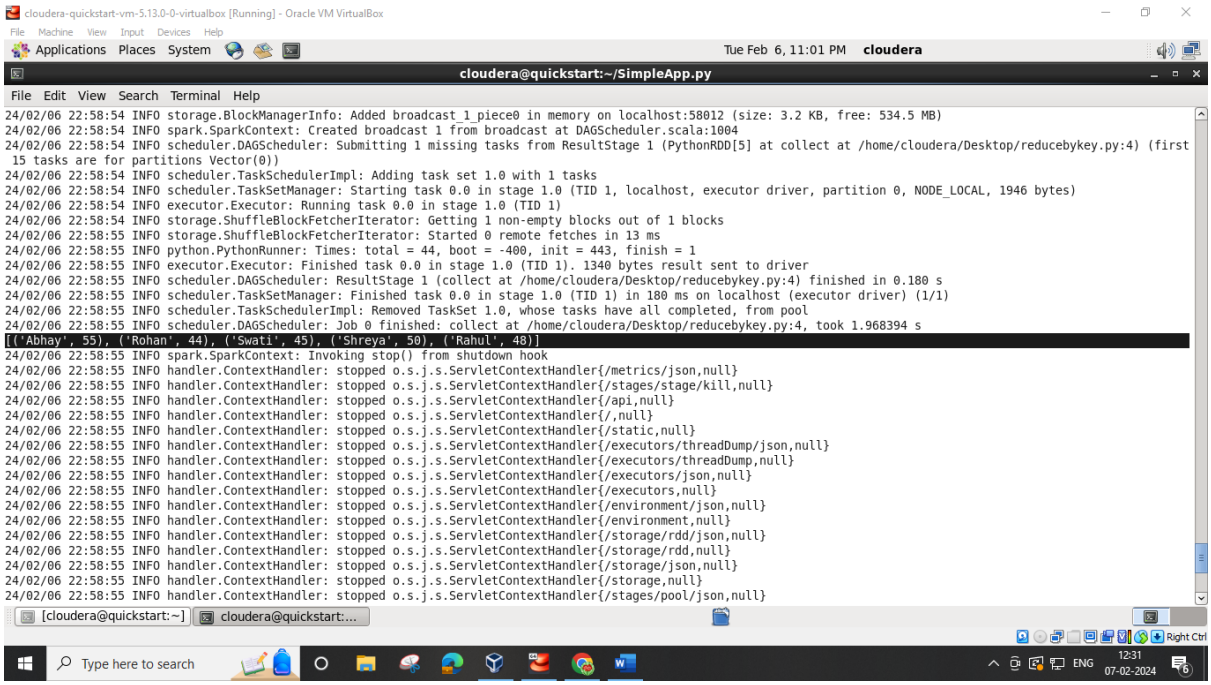
marks_rdd = sc.parallelize([('Rahul', 25), ('Swati', 26), ('Shreya', 22), ('Abhay', 29), ('Rohan', 22), ('Rahul', 23), ('Swati', 19), ('Shreya', 28), ('Abhay', 26), ('Rohan', 22)])

print(marks_rdd.reduceByKey(lambda x, y: x + y).collect())




```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/reducebykey.py
```

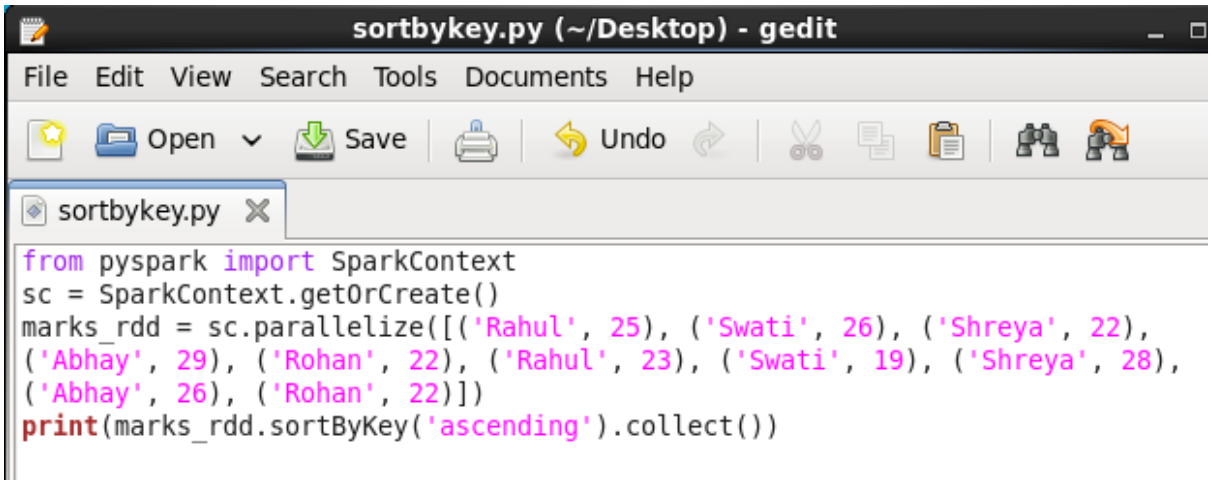
OUTPUT:



6. sortByKey()

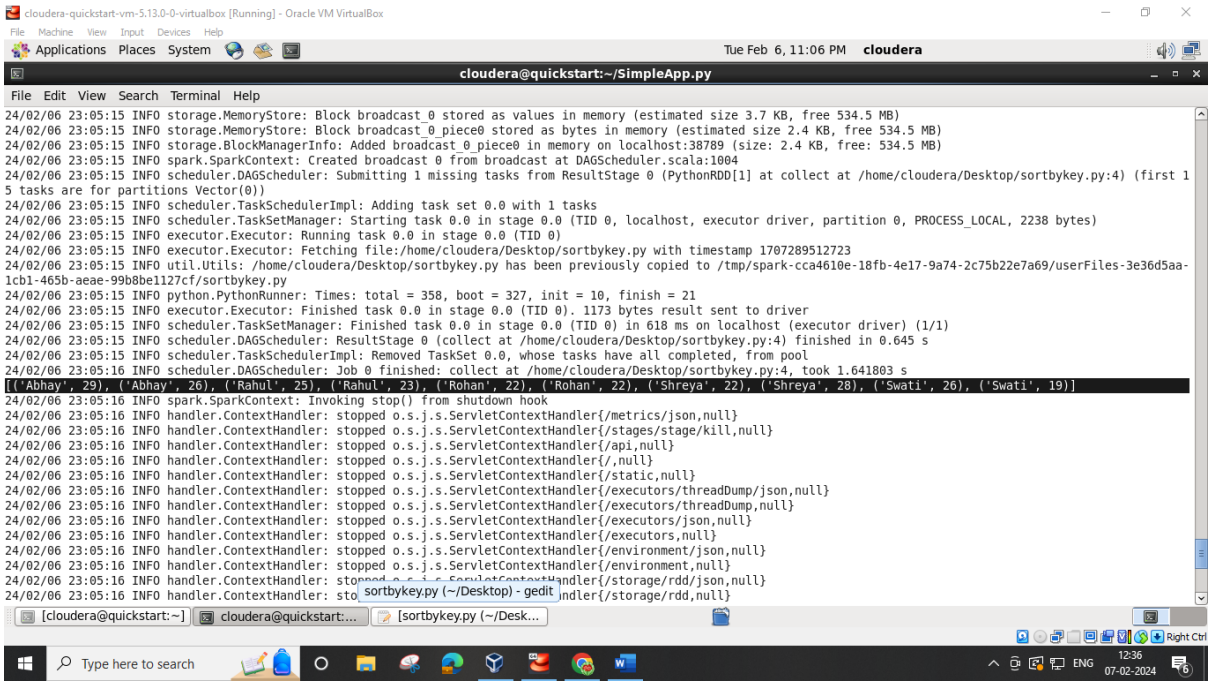
marks_rdd = sc.parallelize([('Rahul', 25), ('Swati', 26), ('Shreya', 22), ('Abhay', 29), ('Rohan', 22), ('Rahul', 23), ('Swati', 19), ('Shreya', 28), ('Abhay', 26), ('Rohan', 22)])

print(marks_rdd.sortByKey('ascending').collect())




```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/sortbykey.py
```

OUTPUT:



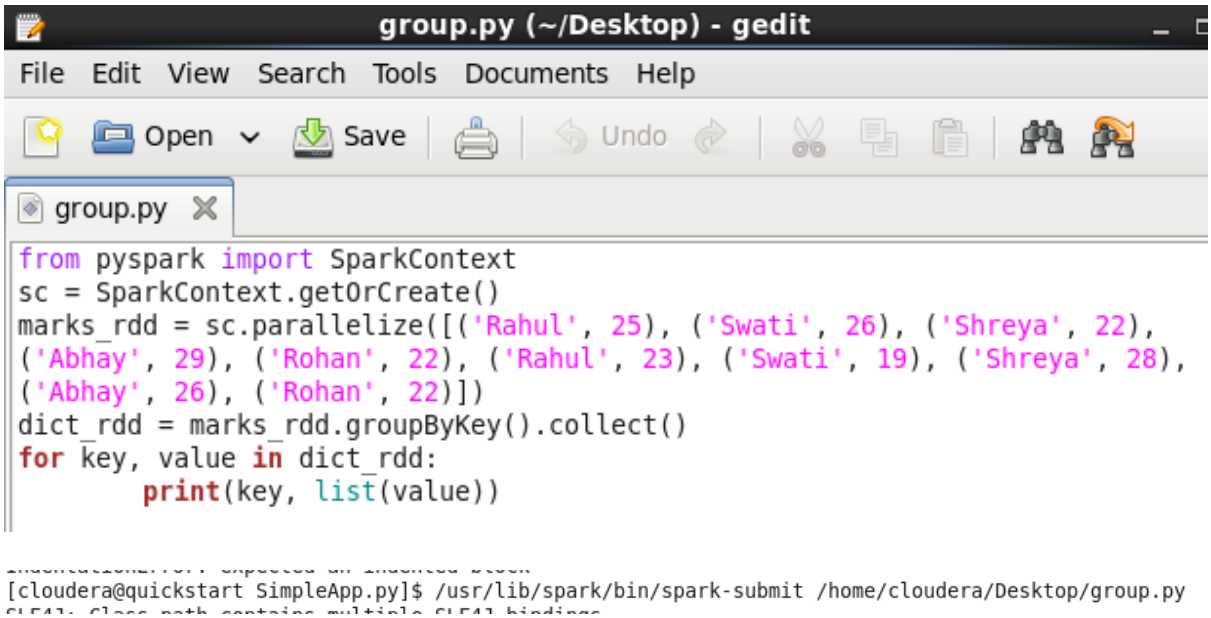
7. groupByKey ()

marks_rdd = sc.parallelize([('Rahul', 25), ('Swati', 26), ('Shreya', 22), ('Abhay', 29), ('Rohan', 22), ('Rahul', 23), ('Swati', 19), ('Shreya', 28), ('Abhay', 26), ('Rohan', 22)])

dict_rdd = marks_rdd.groupByKey().collect()

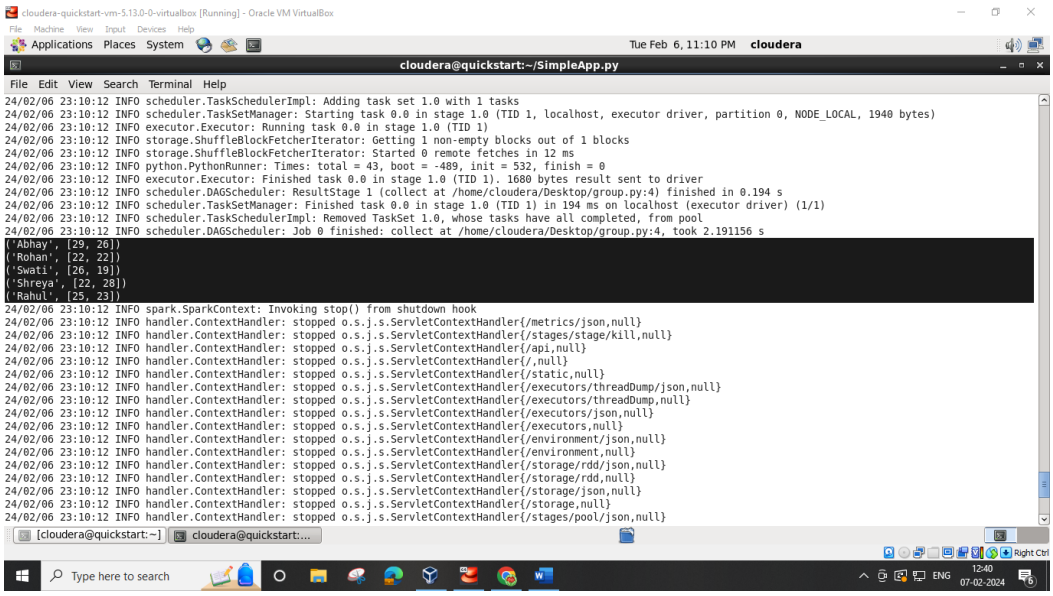
for key, value in dict_rdd:

print(key, list(value))




```
[cloudera@quickstart SimpleApp.py]$ /usr/lib/spark/bin/spark-submit /home/cloudera/Desktop/group.py
```

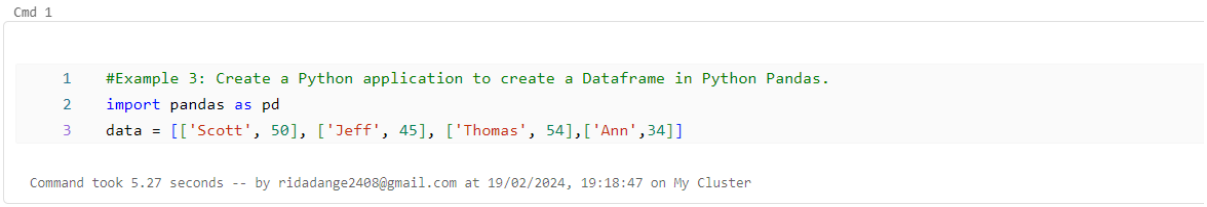
Output:



Example 3: Create a Python application to create a Dataframe in Python Pandas.

import pandas as pd

data = [['Scott', 50], ['Jeff', 45], ['Thomas', 54],['Ann',34]]

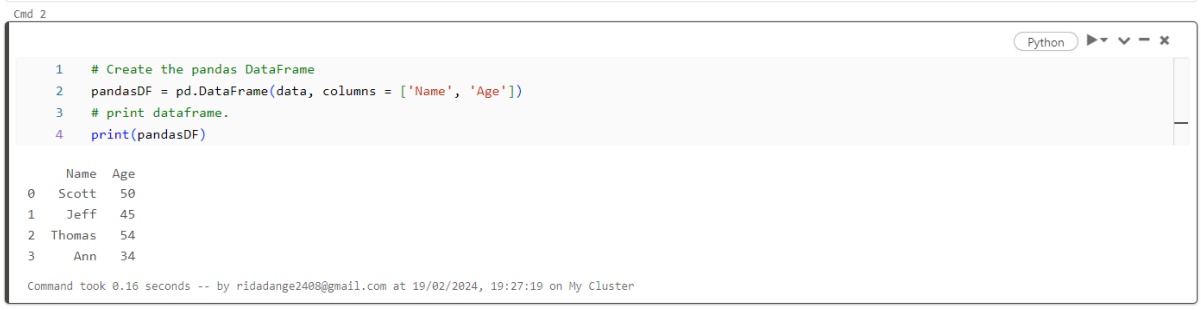


 # Create the pandas DataFrame

pandasDF = pd.DataFrame(data, columns = ['Name', 'Age'])

 # print dataframe.

print(pandasDF)



Example 4: Creating a dataframe from Spark RDD

1. Create a directory list

data = [{"Category": 'A', "ID": 1, "Value": 121.44, "Truth": True},

{"Category": 'B', "ID": 2, "Value": 300.01, "Truth": False},

{"Category": 'C', "ID": 3, "Value": 10.99, "Truth": None},

{"Category": 'E', "ID": 4, "Value": 33.87, "Truth": True}

]

2. Import and create a SparkContext:

from pyspark import SparkContext, SparkConf

conf = SparkConf().setAppName("projectName").setMaster("local[*]")

sc = SparkContext.getOrCreate(conf)

3. Generate an RDD from the created data. Check the type to confirm the object is an RDD:

rdd = sc.parallelize(data)

type(rdd)

4. Call the toDF() method on the RDD to create the DataFrame. Test the object type to confirm:

df = rdd.toDF()

type(df)

Practical 8: Spark Dataframes and SQL

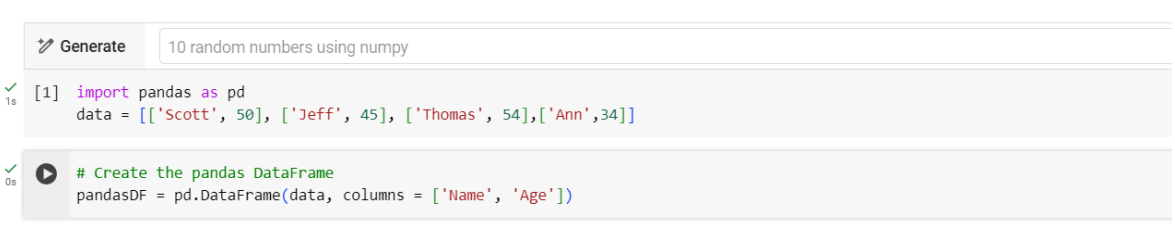
Example 1: Create a Dataframe in Python Pandas.

import pandas as pd

data = [['Scott', 50], ['Jeff', 45], ['Thomas', 54],['Ann',34]]

Create the pandas DataFrame

pandasDF = pd.DataFrame(data, columns = ['Name', 'Age'])



print dataframe.

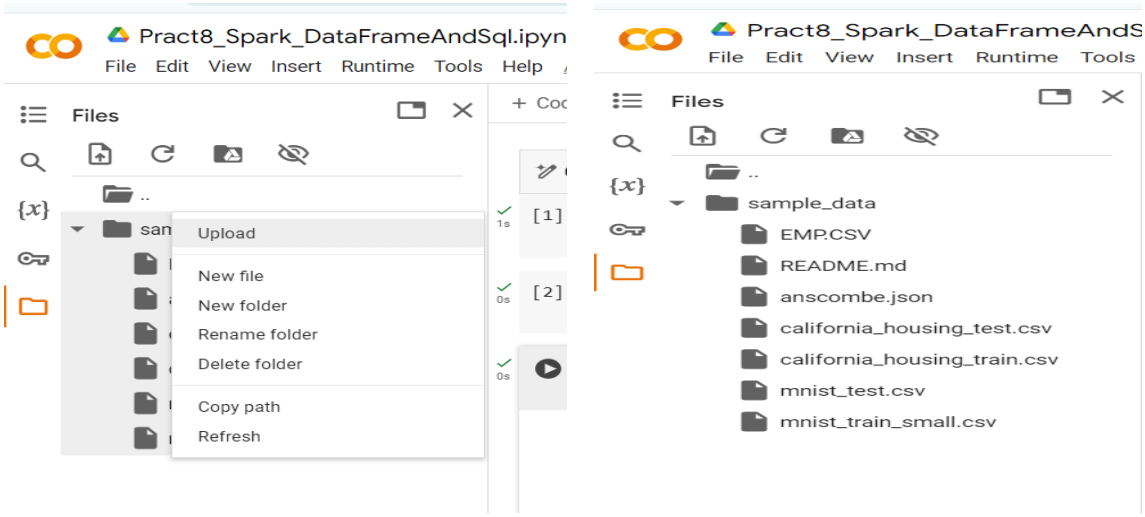
print(pandasDF)

```
[1] import pandas as pd
    data = [['Scott', 50], ['Jeff', 45], ['Thomas', 54],['Ann',34]]

[2] # Create the pandas DataFrame
    pandasDF = pd.DataFrame(data, columns = ['Name', 'Age'])

    # print dataframe.
    print(pandasDF)

       Name  Age
0   Scott   50
1    Jeff   45
2  Thomas   54
3     Ann   34
```

Example 2:

1. Load emp.csv in the dataframe.

Ref: https://drive.google.com/file/d/1Tc2SFSMq-Na7rnLgH2kBU81XReDqsHv6/view?usp=sharing




```
# spark is an existing SparkSession
df =
spark.read.option("header",True).csv("/content/sample_data/EMP.CSV")
```

```
[8] ! pip install pyspark

Collecting pyspark
  Downloading pyspark-3.5.1.tar.gz (317.0 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 317.0/317.0 MB 5.1 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Requirement already satisfied: py4j==0.10.9.7 in /usr/local/lib/python3.10/dist-packages (from pyspark) (0.10.9.7)
Building wheels for collected packages: pyspark
  Building wheel for pyspark (setup.py) ... done
  Created wheel for pyspark: filename=pyspark-3.5.1-py2.py3-none-any.whl size=317488491 sha256=957a6a4c40c82a781e8f6befd018a56bbf05ef9d4ab479a9ac1f6c5d8c324ad0
  Stored in directory: /root/.cache/pip/wheels/80/1d/60/2c256ed38dddce2fdd93be545214a63e02fbd8d74fb0b7f3a6
Successfully built pyspark
Installing collected packages: pyspark
Successfully installed pyspark-3.5.1

[9] import pyspark
    from pyspark.sql import SparkSession

    spark = SparkSession.builder.getOrCreate()

    # spark is an existing SparkSession
    df = spark.read.option("header",True).csv("/content/sample_data/EMP.CSV")
```

1. Displays the content of the DataFrame to stdout

df.show()

```
[10] # spark is an existing SparkSession
     df = spark.read.option("header",True).csv("/content/sample_data/EMP.CSV")

     df.show()
```

```
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|    JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|        198|    Donald| OConnell|DOCONNEL|650.507.9833|21-JUN-07|  SH_CLERK|  2600|           - |       124|           50|
|        199|   Douglas|    Grant|  DGRANT|650.507.9844|13-JAN-08|  SH_CLERK|  2600|           - |       124|           50|
|        200|  Jennifer|   Whalen| JWHALEN|515.123.4444|17-SEP-03|   AD_ASST|  4400|           - |       101|           10|
|        201|   Michael|Hartstein|MHARTSTE|515.123.5555|17-FEB-04|    MK_MAN| 13000|           - |       100|           20|
|        202|       Pat|      Fay|    PFAY|603.123.6666|17-AUG-05|    MK_REP|  6000|           - |       201|           20|
|        203|     Susan|   Mavris| SMAVRIS|515.123.7777|07-JUN-02|    HR_REP|  6500|           - |       101|           40|
|        204|   Hermann|     Baer|   HBAER|515.123.8888|07-JUN-02|    PR_REP| 10000|           - |       101|           70|
|        205|   Shelley|  Higgins|SHIGGINS|515.123.8080|07-JUN-02|    AC_MGR| 12008|           - |       101|          110|
|        206|   William|    Gietz|  WGIETZ|515.123.8181|07-JUN-02|AC_ACCOUNT|  8300|           - |       205|          110|
|        100|    Steven|     King|   SKING|515.123.4567|17-JUN-03|   AD_PRES| 24000|           - |         - |           90|
|        101|     Neena|  Kochhar|NKOCHHAR|515.123.4568|21-SEP-05|     AD_VP| 17000|           - |       100|           90|
|        102|       Lex|  De Haan| LDEHAAN|515.123.4569|13-JAN-01|     AD_VP| 17000|           - |       100|           90|
|        103| Alexander|   Hunold| AHUNOLD|590.423.4567|03-JAN-06|   IT_PROG|  9000|           - |       102|           60|
|        104|     Bruce|    Ernst|  BERNST|590.423.4568|21-MAY-07|   IT_PROG|  6000|           - |       103|           60|
|        105|     David|   Austin| DAUSTIN|590.423.4569|25-JUN-05|   IT_PROG|  4800|           - |       103|           60|
|        106|     Valli|Pataballa|VPATABAL|590.423.4560|05-FEB-06|   IT_PROG|  4800|           - |       103|           60|
|        107|     Diana|  Lorentz|DLORENTZ|590.423.5567|07-FEB-07|   IT_PROG|  4200|           - |       103|           60|
|        108|     Nancy|Greenberg|NGREENBE|515.124.4569|17-AUG-02|    FI_MGR| 12008|           - |       101|          100|
|        109|    Daniel|   Faviet| DFAVIET|515.124.4169|16-AUG-02|FI_ACCOUNT|  9000|           - |       108|          100|
|        110|      John|     Chen|   JCHEN|515.124.4269|28-SEP-05|FI_ACCOUNT|  8200|           - |       108|          100|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
only showing top 20 rows
```

2. Display the dataframe schema.

df.printSchema()

```
df.printSchema()
```

```
root
 |-- EMPLOYEE_ID: string (nullable = true)
 |-- FIRST_NAME: string (nullable = true)
 |-- LAST_NAME: string (nullable = true)
 |-- EMAIL: string (nullable = true)
 |-- PHONE_NUMBER: string (nullable = true)
 |-- HIRE_DATE: string (nullable = true)
 |-- JOB_ID: string (nullable = true)
 |-- SALARY: string (nullable = true)
 |-- COMMISSION_PCT: string (nullable = true)
 |-- MANAGER_ID: string (nullable = true)
 |-- DEPARTMENT_ID: string (nullable = true)
```

3. Check the first five or last few records of the dataframe.

df.head()

```
[14] df.head()
```

```
Row(EMPLOYEE_ID='198', FIRST_NAME='Donald', LAST_NAME='OConnell', EMAIL='DOCONNEL', PHONE_NUMBER='650.507.9833', HIRE_DATE='21-JUN-07', JOB_ID='SH_CLERK', SALARY='2600',
COMMISSION_PCT=' - ', MANAGER_ID='124', DEPARTMENT_ID='50')
```

df.tail(5)

```
[15] df.tail(5)

[Row(EMPLOYEE_ID='136', FIRST_NAME='Hazel', LAST_NAME='Philtanker', EMAIL='HPHILTAN', PHONE_NUMBER='650.127.1634', HIRE_DATE='06-FEB-08', JOB_ID='ST_CLERK', SALARY='2200',
COMMISSION_PCT=' - ', MANAGER_ID='122', DEPARTMENT_ID='50'),
 Row(EMPLOYEE_ID='137', FIRST_NAME='Renske', LAST_NAME='Ladwig', EMAIL='RLADWIG', PHONE_NUMBER='650.121.1234', HIRE_DATE='14-JUL-03', JOB_ID='ST_CLERK', SALARY='3600',
COMMISSION_PCT=' - ', MANAGER_ID='123', DEPARTMENT_ID='50'),
 Row(EMPLOYEE_ID='138', FIRST_NAME='Stephen', LAST_NAME='Stiles', EMAIL='SSTILES', PHONE_NUMBER='650.121.2034', HIRE_DATE='26-OCT-05', JOB_ID='ST_CLERK', SALARY='3200',
COMMISSION_PCT=' - ', MANAGER_ID='123', DEPARTMENT_ID='50'),
 Row(EMPLOYEE_ID='139', FIRST_NAME='John', LAST_NAME='Seo', EMAIL='JSEO', PHONE_NUMBER='650.121.2019', HIRE_DATE='12-FEB-06', JOB_ID='ST_CLERK', SALARY='2700', COMMISSION_PCT=' - ',
MANAGER_ID='123', DEPARTMENT_ID='50'),
 Row(EMPLOYEE_ID='140', FIRST_NAME='Joshua', LAST_NAME='Patel', EMAIL='JPATEL', PHONE_NUMBER='650.121.1834', HIRE_DATE='06-APR-06', JOB_ID='ST_CLERK', SALARY='2500', COMMISSION_PCT='
 - ', MANAGER_ID='123', DEPARTMENT_ID='50')]
```

df.head(2)

```
df.head(2)

[Row(EMPLOYEE_ID='198', FIRST_NAME='Donald', LAST_NAME='OConnell', EMAIL='DOCONNEL', PHONE_NUMBER='650.507.9833', HIRE_DATE='21-JUN-07', JOB_ID='SH_CLERK', SALARY='2600',
COMMISSION_PCT=' - ', MANAGER_ID='124', DEPARTMENT_ID='50'),
 Row(EMPLOYEE_ID='199', FIRST_NAME='Douglas', LAST_NAME='Grant', EMAIL='DGRANT', PHONE_NUMBER='650.507.9844', HIRE_DATE='13-JAN-08', JOB_ID='SH_CLERK', SALARY='2600', COMMISSION_PCT='
 - ', MANAGER_ID='124', DEPARTMENT_ID='50')]
```

4. Display employees list

```
df. select("FIRST_NAME","LAST_NAME")
```

```
[18] df. select("FIRST_NAME","LAST_NAME")

     DataFrame[FIRST_NAME: string, LAST_NAME: string]
```

df. select(“FIRST_NAME”,”LAST_NAME”) .show(2)

```
df.select("FIRST_NAME","LAST_NAME").show(2)

+----------+---------+
|FIRST_NAME|LAST_NAME|
+----------+---------+
|    Donald| OConnell|
|   Douglas|    Grant|
+----------+---------+
only showing top 2 rows
```

5. Increment the salary of each employee by 100 rs.
df.select(df['FIRST_NAME'], df['SALARY'] + 100).show()

```
df.select(df['FIRST_NAME'], df['SALARY'] + 100).show()
```

```
+----------+--------------+
|FIRST_NAME|(SALARY + 100)|
+----------+--------------+
|    Donald|        2700.0|
|   Douglas|        2700.0|
|  Jennifer|        4500.0|
|   Michael|       13100.0|
|       Pat|        6100.0|
|     Susan|        6600.0|
|   Hermann|       10100.0|
|   Shelley|       12108.0|
|   William|        8400.0|
|    Steven|       24100.0|
|     Neena|       17100.0|
|       Lex|       17100.0|
| Alexander|        9100.0|
|     Bruce|        6100.0|
|     David|        4900.0|
|     Valli|        4900.0|
|     Diana|        4300.0|
|     Nancy|       12108.0|
|    Daniel|        9100.0|
|      John|        8300.0|
+----------+--------------+
only showing top 20 rows
```

6. Display the employees list having a salary more than 10000.
df.filter(df['SALARY'] > 21).show()

```
df.filter(df['SALARY'] > 21).show()
```

```
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|    JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|        198|    Donald| OConnell|DOCONNEL|650.507.9833|21-JUN-07|  SH_CLERK|  2600|             - |       124|           50|
|        199|   Douglas|    Grant|  DGRANT|650.507.9844|13-JAN-08|  SH_CLERK|  2600|             - |       124|           50|
|        200|  Jennifer|   Whalen| JWHALEN|515.123.4444|17-SEP-03|   AD_ASST|  4400|             - |       101|           10|
|        201|   Michael|Hartstein|MHARTSTE|515.123.5555|17-FEB-04|    MK_MAN| 13000|             - |       100|           20|
|        202|       Pat|      Fay|    PFAY|603.123.6666|17-AUG-05|    MK_REP|  6000|             - |       201|           20|
|        203|     Susan|   Mavris| SMAVRIS|515.123.7777|07-JUN-02|    HR_REP|  6500|             - |       101|           40|
|        204|   Hermann|     Baer|   HBAER|515.123.8888|07-JUN-02|    PR_REP| 10000|             - |       101|           70|
|        205|   Shelley|  Higgins|SHIGGINS|515.123.8080|07-JUN-02|    AC_MGR| 12008|             - |       101|          110|
|        206|   William|    Gietz|  WGIETZ|515.123.8181|07-JUN-02|AC_ACCOUNT|  8300|             - |       205|          110|
|        100|    Steven|     King|   SKING|515.123.4567|17-JUN-03|   AD_PRES| 24000|             - |         - |          90|
|        101|     Neena|  Kochhar|NKOCHHAR|515.123.4568|21-SEP-05|     AD_VP| 17000|             - |       100|          90|
|        102|       Lex|  De Haan| LDEHAAN|515.123.4569|13-JAN-01|     AD_VP| 17000|             - |       100|          90|
|        103| Alexander|   Hunold| AHUNOLD|590.423.4567|03-JAN-06|   IT_PROG|  9000|             - |       102|          60|
|        104|     Bruce|    Ernst|  BERNST|590.423.4568|21-MAY-07|   IT_PROG|  6000|             - |       103|          60|
|        105|     David|   Austin| DAUSTIN|590.423.4569|25-JUN-05|   IT_PROG|  4800|             - |       103|          60|
|        106|     Valli|Pataballa|VPATABAL|590.423.4560|05-FEB-06|   IT_PROG|  4800|             - |       103|          60|
|        107|     Diana|  Lorentz|DLORENTZ|590.423.5567|07-FEB-07|   IT_PROG|  4200|             - |       103|          60|
|        108|     Nancy|Greenberg|NGREENBE|515.124.4569|17-AUG-02|    FI_MGR| 12008|             - |       101|         100|
|        109|    Daniel|   Faviet| DFAVIET|515.124.4169|16-AUG-02|FI_ACCOUNT|  9000|             - |       108|         100|
|        110|      John|     Chen|   JCHEN|515.124.4269|28-SEP-05|FI_ACCOUNT|  8200|             - |       108|         100|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
only showing top 20 rows
```

7. Count the employees having the same designation.

df.groupBy("JOB_ID").count().show()

```
df.groupBy("JOB_ID").count().show()
```

```
+----------+-----+
|    JOB_ID|count|
+----------+-----+
|FI_ACCOUNT|    5|
|    MK_MAN|    1|
|   IT_PROG|    5|
|    FI_MGR|    1|
|AC_ACCOUNT|    1|
|    HR_REP|    1|
|  PU_CLERK|    5|
|    AC_MGR|    1|
|    PR_REP|    1|
|    ST_MAN|    5|
|    MK_REP|    1|
|    PU_MAN|    1|
|  SH_CLERK|    2|
|   AD_PRES|    1|
|   AD_ASST|    1|
|  ST_CLERK|   16|
|     AD_VP|    2|
+----------+-----+
```

8. Display the list of employees who have joined on the date 12-Dec-07 or 07-Jun-02

```
df.select("FIRST_NAME","LAST_NAME").where(df["HIRE_DATE"] == "16-AUG-02").show()
```

```
df.select("FIRST_NAME","LAST_NAME").where(df["HIRE_DATE"] == "16-AUG-02").show()
```

```
+----------+---------+
|FIRST_NAME|LAST_NAME|
+----------+---------+
|    Daniel|   Faviet|
+----------+---------+
```

9. Display the ascending order list of employees who are working under the manager with manager id 124.

```
df.select("FIRST_NAME","LAST_NAME").where(df["MANAGER_ID"]=="124").orderBy("FIRST_NAME","LAST_NAME").show()
```

```
df.select("FIRST_NAME","LAST_NAME").where(df["MANAGER_ID"]=="124").orderBy("FIRST_NAME","LAST_NAME").show()
```

```
+----------+---------+
|FIRST_NAME|LAST_NAME|
+----------+---------+
|    Donald| OConnell|
|   Douglas|    Grant|
+----------+---------+
```

10. Display list of employees and their email ids in lowercase for the department 50.

```
df.select(F.lower("FIRST_NAME"),F.lower("LAST_NAME"),F.lower("EMAIL")).where(df["DEPARTMENT_ID"]=="50").show()
```

```
from pyspark.sql import functions as F

df.select(F.lower("FIRST_NAME"),F.lower("LAST_NAME"),F.lower("EMAIL")).where(df["DEPARTMENT_ID"]=="50").show()
```

```
+-----------------+----------------+------------+
|lower(FIRST_NAME)|lower(LAST_NAME)|lower(EMAIL)|
+-----------------+----------------+------------+
|           donald|        oconnell|    doconnel|
|          douglas|           grant|      dgrant|
|          matthew|           weiss|      mweiss|
|             adam|           fripp|      afripp|
|            payam|        kaufling|    pkauflin|
|           shanta|         vollman|    svollman|
|            kevin|         mourgos|    kmourgos|
|            julia|           nayer|      jnayer|
|            irene|     mikkilineni|    imikkili|
|            james|          landry|     jlandry|
|           steven|          markle|     smarkle|
|            laura|          bissot|     lbissot|
|            mozhe|        atkinson|    matkinso|
|            james|          marlow|     jamrlow|
|               tj|           olson|     tjolson|
|            jason|          mallin|     jmallin|
|          michael|          rogers|     mrogers|
|               ki|             gee|        kgee|
|            hazel|      philtanker|    hphiltan|
|           renske|          ladwig|     rladwig|
+-----------------+----------------+------------+
only showing top 20 rows
```

11. Display the last 4 characters of PHONE_NUMBER of employees of manager with manager id108.

substring(str, pos, len)

```
df.filter(df["MANAGER_ID"] == 108).select(df["FIRST_NAME"], df["PHONE_NUMBER"]).withColumn("substring",F.substring("PHONE_NUMBER", 9, 4)).show()
```

```
[102] df.filter(df["MANAGER_ID"] == 108).select(df["FIRST_NAME"], df["PHONE_NUMBER"]).withColumn("substring",F.substring("PHONE_NUMBER", 9, 4)).show()
```

```
+-----------+------------+---------+
| FIRST_NAME|PHONE_NUMBER|substring|
+-----------+------------+---------+
|     Daniel|515.124.4169|     4169|
|       John|515.124.4269|     4269|
|     Ismael|515.124.4369|     4369|
|Jose Manuel|515.124.4469|     4469|
|       Luis|515.124.4567|     4567|
+-----------+------------+---------+
```

12. Get the joining day, month and year of all employees having a job as a FI_ACCOUNT.

dayofmonth()

month(col)

year(col)

```
df.select(F.dayofmonth(F.to_date("HIRE_DATE","dd-MMM-
yy")).alias("JOINING_DAY"),
          F.month(F.to_date("HIRE_DATE","dd-MMM-
yy")).alias("JOINING_MONTH"),
          F.year(F.to_date("HIRE_DATE","dd-MMM-
yy")).alias("JOINING_YEAR")).where(df["JOB_ID"]=="FI_ACCOUNT").show()
```

```
df.select(F.dayofmonth(F.to_date("HIRE_DATE","dd-MMM-yy")).alias("JOINING_DAY"),
          F.month(F.to_date("HIRE_DATE","dd-MMM-yy")).alias("JOINING_MONTH"),
          F.year(F.to_date("HIRE_DATE","dd-MMM-yy")).alias("JOINING_YEAR")).where(df["JOB_ID"]=="FI_ACCOUNT").show()
```

```
+-----------+-------------+------------+
|JOINING_DAY|JOINING_MONTH|JOINING_YEAR|
+-----------+-------------+------------+
|         16|            8|        2002|
|         28|            9|        2005|
|         30|            9|        2005|
|          7|            3|        2006|
|          7|           12|        2007|
+-----------+-------------+------------+
```

13. Get the list of names of managers.

df.filter(df["MANAGER_ID"].isNotNull()).select("FIRST_NAME", "LAST_NAME").show()

```
#Get the list of names of managers.

df.filter(df["MANAGER_ID"].isNotNull()).select("FIRST_NAME", "LAST_NAME").show()
```

(1) Spark Jobs

```
+----------+---------+
|FIRST_NAME|LAST_NAME|
+----------+---------+
|    Donald| OConnell|
|   Douglas|    Grant|
|  Jennifer|   Whalen|
|  Michael|Hartstein|
|       Pat|      Fay|
|     Susan|   Mavris|
|   Hermann|     Baer|
|   Shelley|  Higgins|
|   William|    Gietz|
|    Steven|     King|
|     Neena|  Kochhar|
|       Lex|  De Haan|
| Alexander|   Hunold|
|     Bruce|    Ernst|
|     David|   Austin|
|    Valli|Pataballa|
```

14. Who is manager of an employee having employee_id 107.

```
df.select("FIRST_NAME", "LAST_NAME").where(df["EMPLOYEE_ID"] ==
df.select("MANAGER_ID").where(df["EMPLOYEE_ID"] ==
"107").first()[0]).show()
```

```
[95] df.select("FIRST_NAME", "LAST_NAME").where(df["EMPLOYEE_ID"] == df.select("MANAGER_ID").where(df["EMPLOYEE_ID"] == "107").first()[0]).show()
```

```
+----------+---------+
|FIRST_NAME|LAST_NAME|
+----------+---------+
| Alexander|   Hunold|
+----------+---------+
```

15. Get the employee with the maximum salary.

```
df.select("FIRST_NAME","LAST_NAME","SALARY").where(df["SALARY"] ==
df.agg(F.max("SALARY")).first()[0]).show()
```

```
[86] df.select("FIRST_NAME","LAST_NAME","SALARY").where(df["SALARY"] == df.agg(F.max("SALARY")).first()[0]).show()
```

```
+----------+---------+------+
|FIRST_NAME|LAST_NAME|SALARY|
+----------+---------+------+
| Alexander|   Hunold|  9000|
|    Daniel|   Faviet|  9000|
+----------+---------+------+
```

16. Display the descending ordered list of employees who are working under the manager with manager id 101 and having salary more than 10000.

```
df.filter((df["MANAGER_ID"] == 101) & (df["SALARY"] >
10000)).sort(df["SALARY"].desc()).show()
```

```
df.filter((df["MANAGER_ID"] == 101) & (df["SALARY"] > 10000)).sort(df["SALARY"].desc()).show()
```

```
+-----------+----------+---------+--------+------------+---------+------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+------+------+--------------+----------+-------------+
|        205|   Shelley|  Higgins|SHIGGINS|515.123.8080|07-JUN-02|AC_MGR| 12008|             - |       101|          110|
|        108|     Nancy|Greenberg|NGREENBE|515.124.4569|17-AUG-02|FI_MGR| 12008|             - |       101|          100|
+-----------+----------+---------+--------+------------+---------+------+------+--------------+----------+-------------+
```

17. Using spark.sql instead of df.select :
Display the list of employees who have joined on the date 12-Dec-07 or 07-Jun-02

spark.sql(“””select “FIRST_NAME”,”LAST_NAME” where(“df[HIRE_DATE]==’12-Dec-07’”)”””).show()

```
df.createOrReplaceTempView("employees")
#Running the sql queries
result = spark.sql("""
SELECT * FROM employees
WHERE TO_DATE(HIRE_DATE, 'dd-MM-yy') = '2007-12-12' OR
TO_DATE(HIRE_DATE, 'dd-MM-yy') = '2002-06-07'
""")
#Display the result
result.show()
```

```
1  df.createOrReplaceTempView("employees")
2  # Run SQL query to select employees who have joined on the specified dates
3  result = spark.sql("""
4      SELECT * FROM employees
5      WHERE TO_DATE(HIRE_DATE, 'dd-MM-yy') = '2007-12-12' OR TO_DATE(HIRE_DATE, 'dd-MM-yy') = '2002-06-07'
6  """)
7  # Display the result
8  result.show()
```

```
▸ (1) Spark Jobs
▸ result: pyspark.sql.dataframe.DataFrame = [EMPLOYEE_ID: string, FIRST_NAME: string ... 9 more fields]
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|    JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
|        203|     Susan|   Mavris| SMAVRIS|515.123.7777|07-JUN-02|    HR_REP|  6500|           - |       101|           40|
|        204|   Hermann|     Baer|   HBAER|515.123.8888|07-JUN-02|    PR_REP| 10000|           - |       101|           70|
|        205|   Shelley|  Higgins|SHIGGINS|515.123.8080|07-JUN-02|    AC_MGR| 12008|           - |       101|          110|
|        206|   William|    Gietz|  WGIETZ|515.123.8181|07-JUN-02|AC_ACCOUNT|  8300|           - |       205|          110|
|        135|        Ki|      Gee|    KGEE|650.127.1734|12-DEC-07|  ST_CLERK|  2400|           - |       122|           50|
+-----------+----------+---------+--------+------------+---------+----------+------+--------------+----------+-------------+
```

Example 2: Dataframes Joining

1. Create the data list and dataframe for employee and department data.

import pyspark
from pyspark.sql import SparkSession
spark = SparkSession.builder.appName("sparkbyexamples.com").getOrCreate()

```
[116] import pyspark
      from pyspark.sql import SparkSession
      spark = SparkSession.builder.appName("sparkbyexamples.com").getOrCreate()
```

```
emp = [(1,"Smith",-1,"2018","10","M",3000),
   (2,"Rose",1,"2010","20","M",4000),
   (3,"Williams",1,"2010","10","M",1000),
   (4,"Jones",2,"2005","10","F",2000),
   (5,"Brown",2,"2010","40","",-1),
    (6,"Brown",2,"2010","50","",-1)
 ]
empColumns = ["emp_id","name","superior_emp_id","year_joined",
      "emp_dept_id","gender","salary"]

empDF = spark.createDataFrame(data=emp, schema = empColumns)
```

```
emp = [(1,"Smith",-1,"2018","10","M",3000),
    (2,"Rose",1,"2010","20","M",4000),
    (3,"Williams",1,"2010","10","M",1000),
    (4,"Jones",2,"2005","10","F",2000),
    (5,"Brown",2,"2010","40","",-1),
      (6,"Brown",2,"2010","50","",-1)
  ]
empColumns = ["emp_id","name","superior_emp_id","year_joined",
       "emp_dept_id","gender","salary"]

empDF = spark.createDataFrame(data=emp, schema = empColumns)
```

empDF.printSchema()

```
[118] empDF.printSchema()
```

```
root
 |-- emp_id: long (nullable = true)
 |-- name: string (nullable = true)
 |-- superior_emp_id: long (nullable = true)
 |-- year_joined: string (nullable = true)
 |-- emp_dept_id: string (nullable = true)
 |-- gender: string (nullable = true)
 |-- salary: long (nullable = true)
```

empDF.show(truncate=False)

```
empDF.show(truncate=False)
```

```
+------+--------+---------------+-----------+-----------+------+------+
|emp_id|name    |superior_emp_id|year_joined|emp_dept_id|gender|salary|
+------+--------+---------------+-----------+-----------+------+------+
|1     |Smith   |-1             |2018       |10         |M     |3000  |
|2     |Rose    |1              |2010       |20         |M     |4000  |
|3     |Williams|1              |2010       |10         |M     |1000  |
|4     |Jones   |2              |2005       |10         |F     |2000  |
|5     |Brown   |2              |2010       |40         |      |-1    |
|6     |Brown   |2              |2010       |50         |      |-1    |
+------+--------+---------------+-----------+-----------+------+------+
```

dept = [("Finance",10), ("Marketing",20), ("Sales",30), ("IT",40)]
deptColumns = ["dept_name","dept_id"]
deptDF = spark.createDataFrame(data=dept, schema = deptColumns)
deptDF.printSchema()

```
dept = [("Finance",10), ("Marketing",20), ("Sales",30), ("IT",40)  ]
deptColumns = ["dept_name","dept_id"]
deptDF = spark.createDataFrame(data=dept, schema = deptColumns)
deptDF.printSchema()
```

```
root
 |-- dept_name: string (nullable = true)
 |-- dept_id: long (nullable = true)
```

deptDF.show(truncate=False)

```
deptDF.show(truncate=False)
```

```
+---------+-------+
|dept_name|dept_id|
+---------+-------+
|Finance  |10     |
|Marketing|20     |
|Sales    |30     |
|IT       |40     |
+---------+-------+
```

2. Join the employee DataFrames with itself.

from pyspark.sql.functions import col

empDF.alias("emp1").join(empDF.alias("emp2"),
col("emp1.superior_emp_id") ==
col("emp2.emp_id"),"inner").select(col("emp1.emp_id"),col("emp1.name"),
col("emp2.emp_id").alias("superior_emp_id"),
col("emp2.name").alias("superior_emp_name")).show(truncate=False)

```
from pyspark.sql.functions import col

empDF.alias("emp1").join(empDF.alias("emp2"),
col("emp1.superior_emp_id") == col("emp2.emp_id"),"inner").select(col("emp1.emp_id"),col("emp1.name"),
col("emp2.emp_id").alias("superior_emp_id"),
col("emp2.name").alias("superior_emp_name")).show(truncate=False)
```

```
+------+--------+---------------+-----------------+
|emp_id|name    |superior_emp_id|superior_emp_name|
+------+--------+---------------+-----------------+
|2     |Rose    |1              |Smith            |
|3     |Williams|1              |Smith            |
|4     |Jones   |2              |Rose             |
|5     |Brown   |2              |Rose             |
|6     |Brown   |2              |Rose             |
+------+--------+---------------+-----------------+
```

3. Create a view and join the employee and department dataframes.

empDF.createOrReplaceTempView("EMP")

deptDF.createOrReplaceTempView("DEPT")

joinDF2 = spark.sql("SELECT e.* FROM EMP e LEFT OUTER JOIN DEPT d ON e.emp_dept_id == d.dept_id").show(truncate=False)

```
empDF.createOrReplaceTempView("EMP")
deptDF.createOrReplaceTempView("DEPT")

joinDF2 = spark.sql("SELECT e.* FROM EMP e LEFT OUTER JOIN DEPT d ON e.emp_dept_id == d.dept_id").show(truncate=False)
```

```
+------+--------+---------------+-----------+-----------+------+------+
|emp_id|name    |superior_emp_id|year_joined|emp_dept_id|gender|salary|
+------+--------+---------------+-----------+-----------+------+------+
|1     |Smith   |-1             |2018       |10         |M     |3000  |
|3     |Williams|1              |2010       |10         |M     |1000  |
|2     |Rose    |1              |2010       |20         |M     |4000  |
|6     |Brown   |2              |2010       |50         |      |-1    |
|4     |Jones   |2              |2005       |10         |F     |2000  |
|5     |Brown   |2              |2010       |40         |      |-1    |
+------+--------+---------------+-----------+-----------+------+------+
```

4. Try inner, left and right joining for the employee and department table.

```
empDF.join(deptDF,empDF["emp_dept_id"] ==
deptDF["dept_id"],"inner").show(truncate=False)
```

```
empDF.join(deptDF,empDF["emp_dept_id"] == deptDF["dept_id"],"inner").show(truncate=False)
```

```
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|emp_id|name    |superior_emp_id|year_joined|emp_dept_id|gender|salary|dept_name|dept_id|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|1     |Smith   |-1             |2018       |10         |M     |3000  |Finance  |10     |
|3     |Williams|1              |2010       |10         |M     |1000  |Finance  |10     |
|4     |Jones   |2              |2005       |10         |F     |2000  |Finance  |10     |
|2     |Rose    |1              |2010       |20         |M     |4000  |Marketing|20     |
|5     |Brown   |2              |2010       |40         |      |-1    |IT       |40     |
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
```

Example 3: Creating a Data Table in PySpark.

1. Check the list of existing databases

df=spark.sql("show databases")

df.show()

```
df=spark.sql("show databases")
df.show()
```

```
+---------+
|namespace|
+---------+
|  default|
+---------+
```

2. Read the csv file and load it into the data table.

datafile=spark.read.csv("/FileStore/tables/Emp.csv",header=True)

datafile.show(5)

datafile.write.saveAsTable("EmpTable")

```
[128] datafile=spark.read.csv("/content/sample_data/EMP.CSV",header=True)
      datafile.show(5)
      datafile.write.saveAsTable("EmpTable")
```

```
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|  JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
|        198|    Donald| OConnell|DOCONNEL|650.507.9833|21-JUN-07|SH_CLERK|  2600|             - |       124|           50|
|        199|   Douglas|    Grant| DGRANT|650.507.9844|13-JAN-08|SH_CLERK|  2600|             - |       124|           50|
|        200|  Jennifer|   Whalen| JWHALEN|515.123.4444|17-SEP-03| AD_ASST|  4400|             - |       101|           10|
|        201|   Michael|Hartstein|MHARTSTE|515.123.5555|17-FEB-04|  MK_MAN| 13000|             - |       100|           20|
|        202|       Pat|      Fay|    PFAY|603.123.6666|17-AUG-05|  MK_REP|  6000|             - |       201|           20|
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
only showing top 5 rows
```

3. Fetch the data tables rows into the data frame.

df1=spark.sql("select * from EmpTable limit 5")

df1.show()

```
[129] df1=spark.sql("select * from EmpTable limit 5")
      df1.show()
```

```
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
|EMPLOYEE_ID|FIRST_NAME|LAST_NAME|   EMAIL|PHONE_NUMBER|HIRE_DATE|  JOB_ID|SALARY|COMMISSION_PCT|MANAGER_ID|DEPARTMENT_ID|
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
|        198|    Donald| OConnell|DOCONNEL|650.507.9833|21-JUN-07|SH_CLERK|  2600|           - |       124|           50|
|        199|   Douglas|    Grant| DGRANT|650.507.9844|13-JAN-08|SH_CLERK|  2600|           - |       124|           50|
|        200|  Jennifer|   Whalen| JWHALEN|515.123.4444|17-SEP-03| AD_ASST|  4400|           - |       101|           10|
|        201|   Michael|Hartstein|MHARTSTE|515.123.5555|17-FEB-04|  MK_MAN| 13000|           - |       100|           20|
|        202|       Pat|      Fay|    PFAY|603.123.6666|17-AUG-05|  MK_REP|  6000|           - |       201|           20|
+-----------+----------+---------+--------+------------+---------+--------+------+--------------+----------+-------------+
```

4. Display all records of EmpTable.

```
empDF.show(truncate=False)
```

```
[130] empDF.show(truncate=False)
```

```
+------+--------+---------------+-----------+-----------+------+------+
|emp_id|name    |superior_emp_id|year_joined|emp_dept_id|gender|salary|
+------+--------+---------------+-----------+-----------+------+------+
|1     |Smith   |-1             |2018       |10         |M     |3000  |
|2     |Rose    |1              |2010       |20         |M     |4000  |
|3     |Williams|1              |2010       |10         |M     |1000  |
|4     |Jones   |2              |2005       |10         |F     |2000  |
|5     |Brown   |2              |2010       |40         |      |-1    |
|6     |Brown   |2              |2010       |50         |      |-1    |
+------+--------+---------------+-----------+-----------+------+------+
```

PRACTICAL 9: Spark MLib: Regression, CLassification and Clustering

Regression is a type of supervised learning where the goal is to predict a continuous value output based on input features. In this, the algorithm learns a mapping from input variables to a continuous target variable. Common regression algorithms include linear regression, polynomial regression, support vector regression, and neural networks.

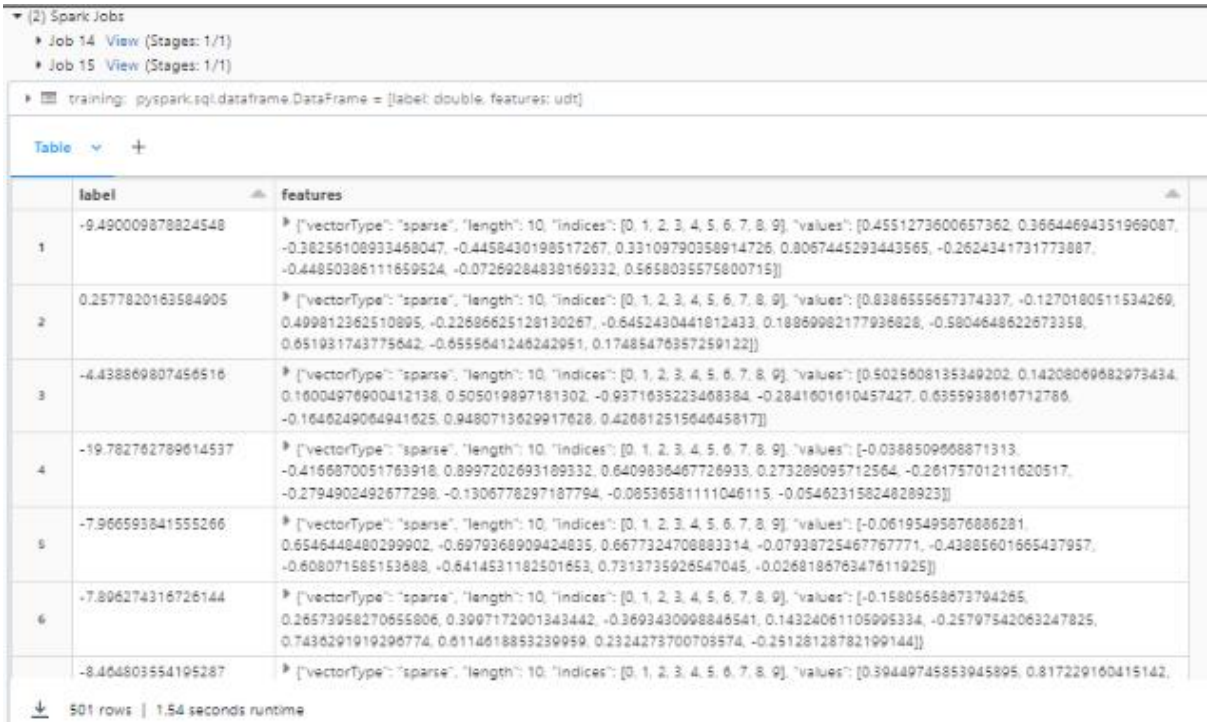
Classification is another type of supervised learning where the goal is to predict the categorical class label of a new instance based on its input features. In this, the algorithm learns to classify data into predefined categories or classes. Common classification algorithms include logistic regression, decision trees, random forests, support vector machines, naive Bayes, and neural networks.

Clustering is an unsupervised learning technique where the goal is to group similar instances together in a dataset. Unlike regression and classification, clustering does not require labeled data; it automatically discovers the natural grouping or structure in the data. Common clustering algorithms include K-means clustering, hierarchical clustering, DBSCAN (Density-Based Spatial Clustering of Applications with Noise), and Gaussian Mixture Models (GMM).

1. Linear Regression
Example: Demonstrates training an elastic net regularized linear regression model and extracting model summary statistics.

```
from pyspark.ml.regression import LinearRegression

# Load training data
training = spark.read.format("libsvm")\
load("data/mllib/sample_linear_regression_data.txt")
training.display()
```

```
from pyspark.ml.regression import LinearRegression

# Load training data
training = spark.read.format("libsvm")\
    .load("/FileStore/tables/sample_linear_regression_data-1.
    txt")

training.display()
```



lr = LinearRegression(maxIter=10, regParam=0.3, elasticNetParam=0.8)

 # Fit the model
lrModel = lr.fit(training)

 # Print the coefficients and intercept for linear regression
print("Coefficients: %s" % str(lrModel.coefficients))
print("Intercept: %s" % str(lrModel.intercept))

```
lr = LinearRegression(maxIter=10, regParam=0.3, elasticNetParam=0.8)

# Fit the model
lrModel = lr.fit(training)

# Print the coefficients and intercept for linear regression
print("Coefficients: %s" % str(lrModel.coefficients))
print("Intercept: %s" % str(lrModel.intercept))
```

OUTPUT:

```
(3) Spark Jobs
 training: pyspark.sql.dataframe.DataFrame
     label: double
     features: udt

Coefficients: [0.0,0.3229251667740594,-0.3438548034562219,1.91560170
2345841,0.05288058680386255,0.765962720459771,0.0,-0.151053926691866
76,-0.21587930360904645,0.2202536918881343]
Intercept: 0.15989368442397356
```

# Summarize the model over the training set and print out some metrics
trainingSummary = lrModel.summary
print("numIterations: %d" % trainingSummary.totalIterations)
print("objectiveHistory: %s" % str(trainingSummary.objectiveHistory))
trainingSummary.residuals.show()
print("RMSE: %f" % trainingSummary.rootMeanSquaredError)
print("r2: %f" % trainingSummary.r2)

```
# Summarize the model over the training set and print out some
metrics
trainingSummary = lrModel.summary
print("numIterations: %d" % trainingSummary.totalIterations)
print("objectiveHistory: %s" % str(trainingSummary.
objectiveHistory))
trainingSummary.residuals.show()
print("RMSE: %f" % trainingSummary.rootMeanSquaredError)
print("r2: %f" % trainingSummary.r2)
```

▸ (1) Spark Jobs

```
numIterations: 6
objectiveHistory: [0.49999999999999994, 0.4967620357443381, 0.493
63616643404634, 0.4936351537897608, 0.4936351214177871, 0.4936351
2062528014, 0.4936351206216114]
+--------------------+
|           residuals|
+--------------------+
|  -9.889232683103197|
|  0.5533794340053553|
|  -5.204019455758822|
| -20.566686715507508|
|    -9.4497405180564|
|  -6.909112502719487|
|  -10.00431602969873|
|  2.0623978070504845|
|  3.1117508432954772|
|  -15.89360822941938|
|  -5.036284254673026|
|  6.4832158769943335|
|  12.429497299109002|
|  -20.32003219007654|
```

```
RMSE: 10.189077
r2: 0.022861
```

```
ypredict=lrModel.transform(training)
ypredict.show(5)
```

```
ypredict=lrModel.transform(training)
ypredict.show(5)
```

▸ (1) Spark Jobs

▸ ypredict: pyspark.sql.dataframe.DataFrame = [label: double, features: udt ... 1 more field]

```
+------------------+--------------------+------------------+
|             label|            features|        prediction|
+------------------+--------------------+------------------+
| -9.490009878824548|(10,[0,1,2,3,4,5,...| 0.3992228042786488|
| 0.2577820163584905|(10,[0,1,2,3,4,5,...|-0.2955974176468648|
| -4.438869807456516|(10,[0,1,2,3,4,5,...| 0.7651496483023065|
|-19.782762789614537|(10,[0,1,2,3,4,5,...|  0.783923925892972|
| -7.966593841555266|(10,[0,1,2,3,4,5,...| 1.4831466765011345|
+------------------+--------------------+------------------+
only showing top 5 rows
```

Example 2:

#Load the data
dataset = spark.read.csv("/databricks-datasets/adult/adult.data", schema=schema)

```
dataset=spark.read.csv("/FileStore/tables/adult1.txt",schema=schema)
dataset.show()
```

▸ (1) Spark Jobs

▸ dataset: pyspark.sql.dataframe.DataFrame = [age: double, workclass: string ... 13 more fields]

```
35.0| United-States| <=50K|
|48.0|          Private|279724.0|     HS-grad|           9.0|Married-civ-spouse
|Machine-op-inspct|       Husband|White|  Male|       3103.0|           0.0|
48.0| United-States|  >50K|
|43.0|          Private|346189.0|     Masters|          14.0|Married-civ-spouse
|  Exec-managerial|       Husband|White|  Male|          0.0|           0.0|
50.0| United-States|  >50K|
|20.0|        State-gov|444554.0|Some-college|          10.0|      Never-married
|     Other-service|     Own-child|White|  Male|          0.0|           0.0|
25.0| United-States| <=50K|
|43.0|          Private|128354.0|     HS-grad|           9.0|Married-civ-spouse
|      Adm-clerical|          Wife|White|Female|          0.0|           0.0|
30.0| United-States| <=50K|
|37.0|          Private| 60548.0|     HS-grad|           9.0|           Widowed
|Machine-op-inspct|    Unmarried|White|Female|          0.0|           0.0|
20.0| United-States| <=50K|
+----+----------------+--------+------------+-------------+------------------
+-----------------+-------------+-----+------+-------------+-------------+-----
---------+--------------+------+
only showing top 20 rows
```

#Define the column names
schema = """`age` DOUBLE,
`workclass` STRING,
`fnlwgt` DOUBLE,
`education` STRING,
`education_num` DOUBLE,
`marital_status` STRING,
`occupation` STRING,
`relationship` STRING,
`race` STRING,
`sex` STRING,
`capital_gain` DOUBLE,
`capital_loss` DOUBLE,
`hours_per_week` DOUBLE,
`native_country` STRING,
`income` STRING"""

```
schema = """`age` DOUBLE,
`workclass` STRING,
`fnlwgt` DOUBLE,
`education` STRING,
`education_num` DOUBLE,
`marital_status` STRING,
`occupation` STRING,
`relationship` STRING,
`race` STRING,
`sex` STRING,
`capital_gain` DOUBLE,
`capital_loss` DOUBLE,
`hours_per_week` DOUBLE,
`native_country` STRING,
`income` STRING"""
```

#Divide data in training and testing dataframe
trainDF, testDF = dataset.randomSplit([0.8, 0.2], seed=42)
print(trainDF.cache().count()) # Cache because accessing training data multiple times
print(testDF.count())

```
trainDF,testDF=dataset.randomSplit([0.8,0.2],seed=42)
print(trainDF.cache().count())
print(testDF.count())
```

```
▸ (4) Spark Jobs
▸ trainDF: pyspark.sql.dataframe.DataFrame = [age: double, workclass: string ... 13 more fields]
▸ testDF: pyspark.sql.dataframe.DataFrame = [age: double, workclass: string ... 13 more fields]
39137
9706
```

#Explore data
display(trainDF)

```
display(trainDF)
```

▸ (1) Spark Jobs

Table +

	age	workclass	fnlwgt	education	education_nu
1	null	workclass	null	education	null
2	17	?	27251	11th	7
3	17	?	34505	11th	7
4	17	?	35603	11th	7
5	17	?	40299	10th	6
6	17	?	45037	10th	6
7	17	?	54978	7th-8th	4

10,000 rows | Truncated data | 0.52 seconds runtime Refreshed 14 minutes ago

#What's the distribution of the number of hours_per_week?

display(trainDF.select("hours_per_week").summary())

```
#What's the distribution of the number of hours_per_week?
display(trainDF.select("hours_per_week").summary())
```

▸ (2) Spark Jobs

Table +

	summary	hours_per_week
1	count	39136
2	mean	40.40561120196239
3	stddev	12.40954323086354
4	min	1.0
5	25%	40.0
6	50%	40.0
7	75%	45.0

8 rows | 0.87 seconds runtime Refreshed 15 minutes ago

#What is education status?
display(trainDF
.groupBy("education")
.count()
.sort("count", ascending=False))

```
#What is education status?
display(trainDF.groupBy("education").count().sort("count", ascending=False))
```

▸ (2) Spark Jobs

Table +

	education	count
1	HS-grad	12647
2	Some-college	8693
3	Bachelors	6429
4	Masters	2117
5	Assoc-voc	1663
6	11th	1478
7	Assoc-acdm	1282

17 rows | 1.99 seconds runtime Refreshed 14 minutes ago

# Feature Engineering
# Convert the categorical data into numeric data
from pyspark.ml.feature import StringIndexer, OneHotEncoder
categoricalCols = ["workclass", "education", "marital_status", "occupation", "relationship", "race", "sex"]
# The following two lines are estimators. They return functions that we will later apply to transform the dataset.
stringIndexer = StringIndexer(inputCols=categoricalCols, outputCols=[x + "Index" for x in categoricalCols])
encoder = OneHotEncoder(inputCols=stringIndexer.getOutputCols(), outputCols=[x + "OHE" for x in categoricalCols])
# The label column ("income") is also a string value - it has two possible values, "<=50K" and ">50K".
# Convert it to a numeric value using StringIndexer.
labelToIndex = StringIndexer(inputCol="income", outputCol="label")

```
from pyspark.ml.feature import StringIndexer, OneHotEncoder
categoricalCols=["workclass","education","marital_status","occupation",
"relationship","race","sex"]
stringIndexer = StringIndexer(inputCols=categoricalCols, outputCols=[x +
"Index" for x in categoricalCols])
encoder = OneHotEncoder(inputCols=stringIndexer.getOutputCols(), outputCols=
[x + "OHE" for x in categoricalCols])
labelToIndex = StringIndexer(inputCol="income", outputCol="label")
```

stringIndexerModel = stringIndexer.fit(trainDF)
display(stringIndexerModel.transform(trainDF))

```
stringIndexerModel=stringIndexer.fit(trainDF)
display(stringIndexerModel.transform(trainDF))
```

▸ (3) Spark Jobs

Table +

	age	workclass	fnlwgt	education	education_nu
1	null	workclass	null	education	null
2	17	?	27251	11th	7
3	17	?	34505	11th	7
4	17	?	35603	11th	7
5	17	?	40299	10th	6
6	17	?	45037	10th	6
7	17	?	54978	7th-8th	4

10,000 rows | Truncated data | 2.55 seconds runtime Refreshed now

# Convert all features into a single feature
from pyspark.ml.feature import VectorAssembler
# This includes both the numeric columns and the one-hot encoded binary vector columns in our dataset.
numericCols = ["age", "fnlwgt", "education_num", "capital_gain", "capital_loss", "hours_per_week"]
assemblerInputs = [c + "OHE" for c in categoricalCols] + numericCols
vecAssembler = VectorAssembler(inputCols=assemblerInputs, outputCol="features")

```
#Convert all features into single feature
from pyspark.ml.feature import VectorAssembler
numericCols = ["age", "fnlwgt", "education_num", "capital_gain",
"capital_loss", "hours_per_week"]
assemblerInputs = [c + "OHE" for c in categoricalCols] + numericCols
vecAssembler = VectorAssembler(inputCols=assemblerInputs,
outputCol="features")
```

Define model

```
from pyspark.ml.classification import LogisticRegression
lr = LogisticRegression(featuresCol="features", labelCol="label", regParam=1.0)
```

```
#Define model
from pyspark.ml.classification import LogisticRegression
lr = LogisticRegression(featuresCol="features", labelCol="label", regParam=1.
0)
```

```
# Build the pipeline
from pyspark.ml import Pipeline
# Define the pipeline based on the stages created in previous steps.
pipeline = Pipeline(stages=[stringIndexer, encoder, labelToIndex, vecAssembler, lr])
# Define the pipeline model.
pipelineModel = pipeline.fit(trainDF)
# Apply the pipeline model to the test dataset.
predDF = pipelineModel.transform(testDF)
```

```
# Build the pipeline
from pyspark.ml import Pipeline
# Define the pipeline based on the stages created in previous steps.
pipeline = Pipeline(stages=[stringIndexer, encoder, labelToIndex,
vecAssembler, lr])
# Define the pipeline model.
pipelineModel = pipeline.fit(trainDF)
# Apply the pipeline model to the test dataset.
predDF = pipelineModel.transform(testDF)
```

▸ (17) Spark Jobs

▸ predDF: pyspark.sql.dataframe.DataFrame = [age: double, workclass: string ... 32

```
# Display the predictions
display(predDF.select("features", "label", "prediction", "probability"))
```

```
# Display the predictions
display(predDF.select("features", "label", "prediction", "probability"))
```

▸ (1) Spark Jobs

Table +

	features
1	▸ {"vectorType": "sparse", "length": 59, "indices": [3, 13, 24, 36, 45, 48, 53, 54, 55, 58], "values
2	▸ {"vectorType": "sparse", "length": 59, "indices": [3, 15, 24, 36, 45, 48, 52, 53, 54, 55, 58], "va 30]}
3	▸ {"vectorType": "sparse", "length": 59, "indices": [3, 13, 24, 36, 45, 48, 53, 54, 55, 58], "values
4	▸ {"vectorType": "sparse", "length": 59, "indices": [3, 13, 24, 36, 45, 48, 52, 53, 54, 55, 58], "va 18]}
5	▸ {"vectorType": "sparse", "length": 59, "indices": [3, 15, 24, 36, 45, 48, 53, 54, 55, 58], "values

6,485 rows | 2.26 seconds runtime Refreshed now

```
# Evaluate model
display(pipelineModel.stages[-1], predDF.drop("prediction", "rawPrediction",
"probability"), "ROC")
```

Practical 10: Data Ingestion: Importing Relational Data with Sqoop, Ingesting Streaming Data with Flume.

1. hostname -f //Checks the hostname

```
[cloudera@quickstart ~]$ hostname -f
quickstart.cloudera
[cloudera@quickstart ~]$
```

2. Lists the databases using Sqoop
sqoop list-databases --connect jdbc:mysql://localhost/ --password cloudera --username root;

```
[cloudera@quickstart ~]$ sqoop list-databases --connect jdbc:mysql://localhost/ --password cloudera --username root;
Warning: /usr/lib/sqoop/../accumulo does not exist! Accumulo imports will fail.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
24/03/11 11:49:15 INFO sqoop.Sqoop: Running Sqoop version: 1.4.6-cdh5.13.0
24/03/11 11:49:15 WARN tool.BaseSqoopTool: Setting your password on the command-line is insecure. Consider using -P instead.
24/03/11 11:49:15 INFO manager.MySQLManager: Preparing to use a MySQL streaming resultset.
information_schema
cm
firehose
hue
metastore
mysql
nav
navms
oozie
retail_db
rman
sentry
[cloudera@quickstart ~]$
```

3. Now to list the tables present in retail_db using Sqoop, type the following command:
sqoop list-tables --connect jdbc:mysql://quickstart:3306/retail_db --password cloudera --username root;

```
[cloudera@quickstart ~]$ sqoop list-tables --connect jdbc:mysql://quickstart:3306/retail_db --password cloudera --username root;
Warning: /usr/lib/sqoop/../accumulo does not exist! Accumulo imports will fail.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
24/03/11 11:52:37 INFO sqoop.Sqoop: Running Sqoop version: 1.4.6-cdh5.13.0
24/03/11 11:52:37 WARN tool.BaseSqoopTool: Setting your password on the command-line is insecure. Consider using -P instead.
24/03/11 11:52:37 INFO manager.MySQLManager: Preparing to use a MySQL streaming resultset.
categories
customers
departments
order_items
orders
products
[cloudera@quickstart ~]$
```

4. Executes Map Tasks at the back end
sqoop import --connect jdbc:mysql://quickstart:3306/retail_db --password cloudera --username root --table departments;

```
[cloudera@quickstart ~]$ sqoop import --connect jdbc:mysql://quickstart:3306/retail_db --password cloudera --username root --table departments;
Warning: /usr/lib/sqoop/../accumulo does not exist! Accumulo imports will fail.
Please set $ACCUMULO_HOME to the root of your Accumulo installation.
24/03/11 11:55:23 INFO sqoop.Sqoop: Running Sqoop version: 1.4.6-cdh5.13.0
24/03/11 11:55:23 WARN tool.BaseSqoopTool: Setting your password on the command-line is insecure. Consider using -P instead.
24/03/11 11:55:24 INFO manager.MySQLManager: Preparing to use a MySQL streaming resultset.
24/03/11 11:55:24 INFO tool.CodeGenTool: Beginning code generation
24/03/11 11:55:24 INFO manager.SqlManager: Executing SQL statement: SELECT t.* FROM `departments` AS t LIMIT 1
24/03/11 11:55:24 INFO manager.SqlManager: Executing SQL statement: SELECT t.* FROM `departments` AS t LIMIT 1
24/03/11 11:55:24 INFO orm.CompilationManager: HADOOP_MAPRED_HOME is /usr/lib/hadoop-mapreduce
Note: /tmp/sqoop-cloudera/compile/7b3758d458a555c0a4b8d634c65d73c5/departments.java uses or overrides a deprecated API.
Note: Recompile with -Xlint:deprecation for details.
24/03/11 11:55:26 INFO orm.CompilationManager: Writing jar file: /tmp/sqoop-cloudera/compile/7b3758d458a555c0a4b8d634c65d73c5/departments.jar
24/03/11 11:55:26 WARN manager.MySQLManager: It looks like you are importing from mysql.
24/03/11 11:55:26 WARN manager.MySQLManager: This transfer can be faster! Use the --direct
24/03/11 11:55:26 WARN manager.MySQLManager: option to exercise a MySQL-specific fast path.
24/03/11 11:55:26 INFO manager.MySQLManager: Setting zero DATETIME behavior to convertToNull (mysql)
24/03/11 11:55:26 INFO mapreduce.ImportJobBase: Beginning import of departments
24/03/11 11:55:26 INFO Configuration.deprecation: mapred.job.tracker is deprecated. Instead, use mapreduce.jobtracker.address
24/03/11 11:55:26 INFO Configuration.deprecation: mapred.jar is deprecated. Instead, use mapreduce.job.jar
24/03/11 11:55:27 INFO Configuration.deprecation: mapred.map.tasks is deprecated. Instead, use mapreduce.job.maps
24/03/11 11:55:27 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
24/03/11 11:55:28 WARN hdfs.DFSClient: Caught exception
java.lang.InterruptedException
        at java.lang.Object.wait(Native Method)
        at java.lang.Thread.join(Thread.java:1281)
        at java.lang.Thread.join(Thread.java:1355)
        at org.apache.hadoop.hdfs.DFSOutputStream$DataStreamer.closeResponder(DFSOutputStream.java:967)
        at org.apache.hadoop.hdfs.DFSOutputStream$DataStreamer.endBlock(DFSOutputStream.java:705)
        at org.apache.hadoop.hdfs.DFSOutputStream$DataStreamer.run(DFSOutputStream.java:894)
24/03/11 11:55:28 WARN hdfs.DFSClient: Caught exception
java.lang.InterruptedException
        at java.lang.Object.wait(Native Method)
        at java.lang.Thread.join(Thread.java:1281)
        at java.lang.Thread.join(Thread.java:1355)
        at org.apache.hadoop.hdfs.DFSOutputStream$DataStreamer.closeResponder(DFSOutputStream.java:967)
        at org.apache.hadoop.hdfs.DFSOutputStream$DataStreamer.endBlock(DFSOutputStream.java:705)
```