Assignment – Day 14

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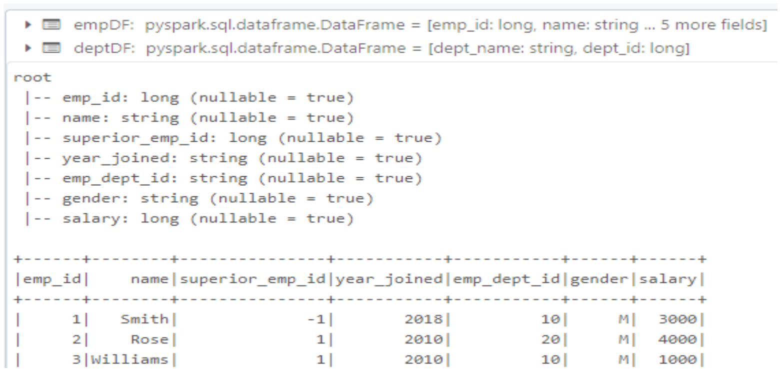
21/11/2024 (Thursday)

Joins in Spark Practice:-

1. **Creating and displaying PySpark DataFrames with employee and department data:-**

```
from pyspark.sql import SparkSession
# Initialize SparkSession
spark = SparkSession.builder \
.appName("example") \
.getOrCreate()
# Data
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,
"Sarthak", 2, "2010","23","",-1)]
empColumns = ["emp_id","name","superior_emp_id","year_joined",
"emp_dept_id","gender","salary"]
empDF = spark.createDataFrame(data=emp, schema = empColumns)
empDF.printSchema()
empDF.show()
dept = [("Finance",10),("Marketing",20),("Sales",30),("IT",40)]
deptColumns = ["dept_name","dept_id"]
deptDF = spark.createDataFrame(data=dept, schema = deptColumns)
deptDF.printSchema()
deptDF.show()
```



```
▸ empDF:  pyspark.sql.dataframe.DataFrame = [emp_id: long, name: string ... 5 more fields]
▸ deptDF:  pyspark.sql.dataframe.DataFrame = [dept_name: string, dept_id: long]
```

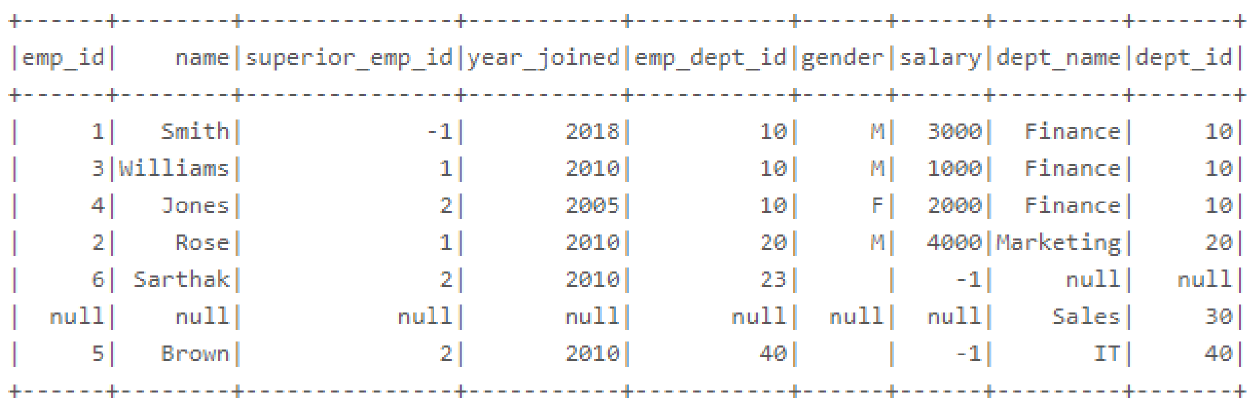
```
root
 |-- emp_id: long (nullable = true)
 |-- name: string (nullable = true)
 |-- superior_emp_id: long (nullable = true)
 |-- year_joined: string (nullable = true)
 |-- emp_dept_id: string (nullable = true)
 |-- gender: string (nullable = true)
 |-- salary: long (nullable = true)

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

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

---

2. **Performing inner, outer, and full joins between employee and department DataFrames in PySpark.**

```
#Inner join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"inner").show()
#outer join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"outer").show()
#full join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"full").show()
```

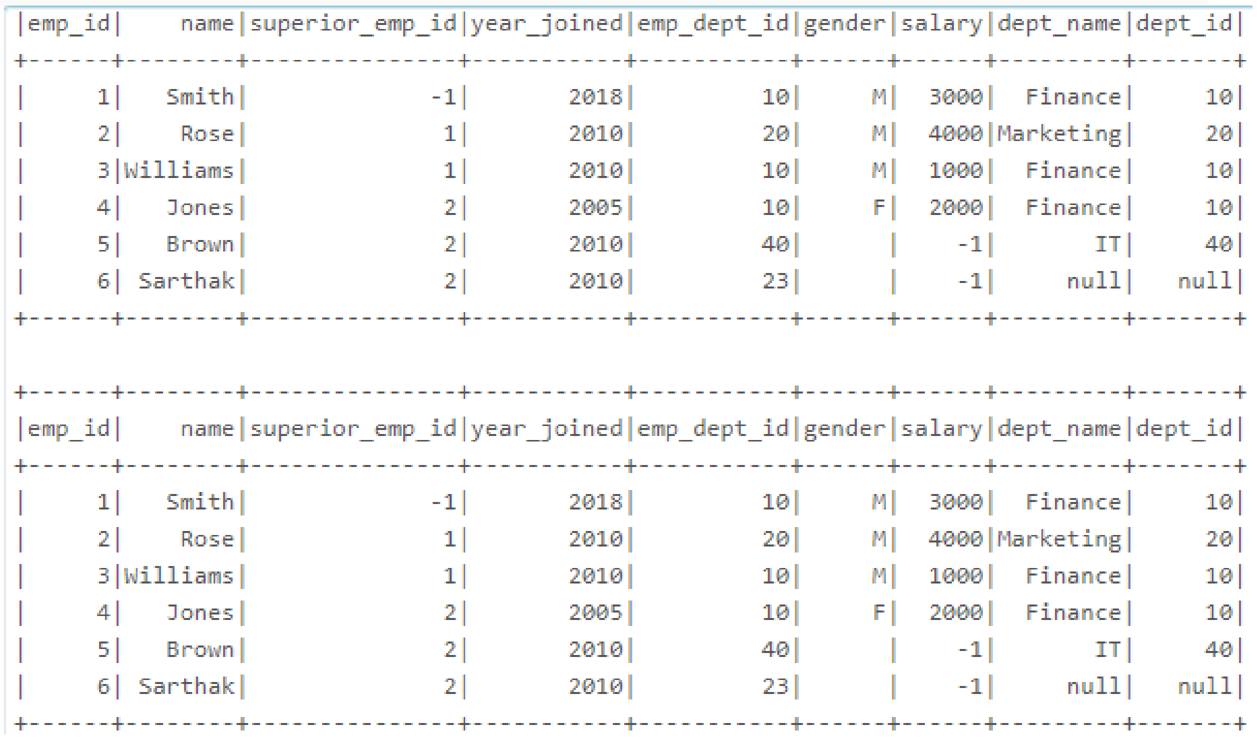
```
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|emp_id|    name|superior_emp_id|year_joined|emp_dept_id|gender|salary|dept_name|dept_id|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|     1|   Smith|             -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|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+

+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|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|
|     6| Sarthak|              2|       2010|         23|      |    -1|     null|   null|
|  null|    null|           null|       null|       null|  null|  null|    Sales|     30|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
```



```
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|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|
|     6| Sarthak|              2|       2010|         23|      |    -1|     null|   null|
|  null|    null|           null|       null|       null|  null|  null|    Sales|     30|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
```

3. **Performing left and left outer joins between employee and department DataFrames in PySpark.**

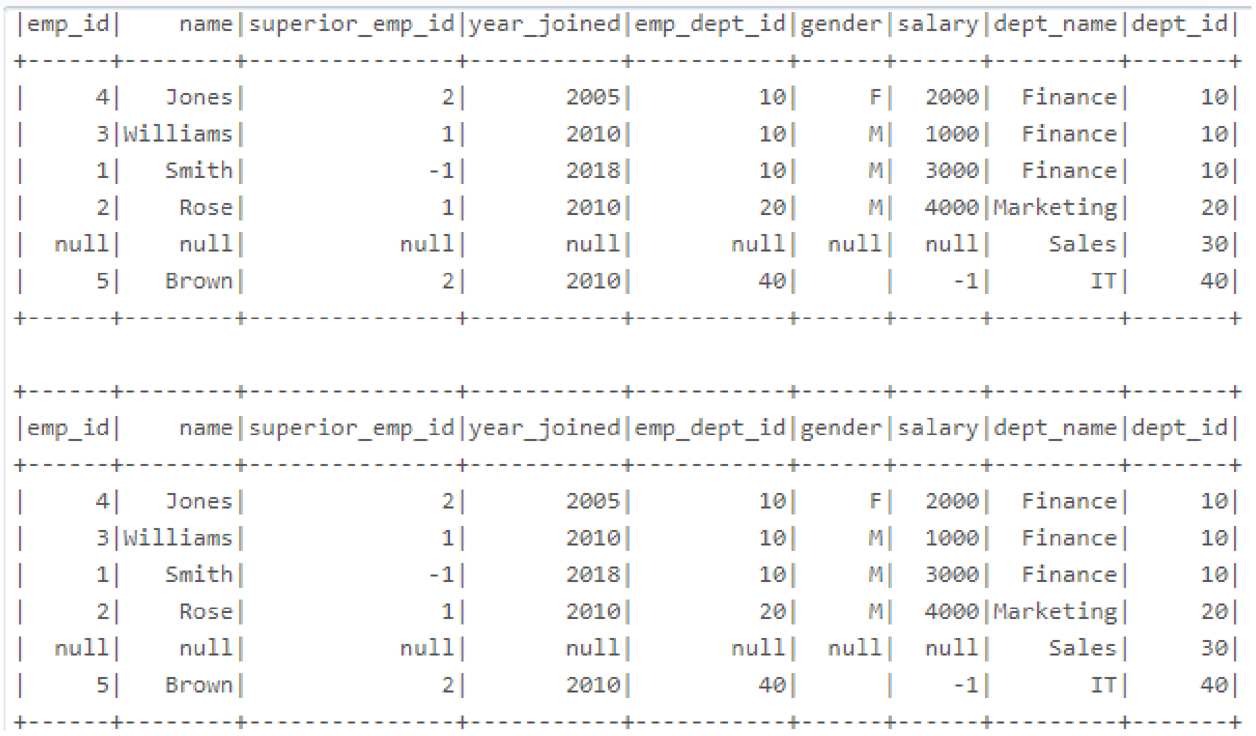
```
#Left join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"left").show()
#Left Outer join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"leftouter").show()
```



```
|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|
|     2|    Rose|              1|       2010|         20|     M|  4000|Marketing|     20|
|     3|Williams|              1|       2010|         10|     M|  1000|  Finance|     10|
|     4|   Jones|              2|       2005|         10|     F|  2000|  Finance|     10|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
|     6| Sarthak|              2|       2010|         23|      |    -1|     null|   null|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+

+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|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|
|     2|    Rose|              1|       2010|         20|     M|  4000|Marketing|     20|
|     3|Williams|              1|       2010|         10|     M|  1000|  Finance|     10|
|     4|   Jones|              2|       2005|         10|     F|  2000|  Finance|     10|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
|     6| Sarthak|              2|       2010|         23|      |    -1|     null|   null|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
```

4. **Performing right and right outer joins between employee and department DataFrames in PySpark.**

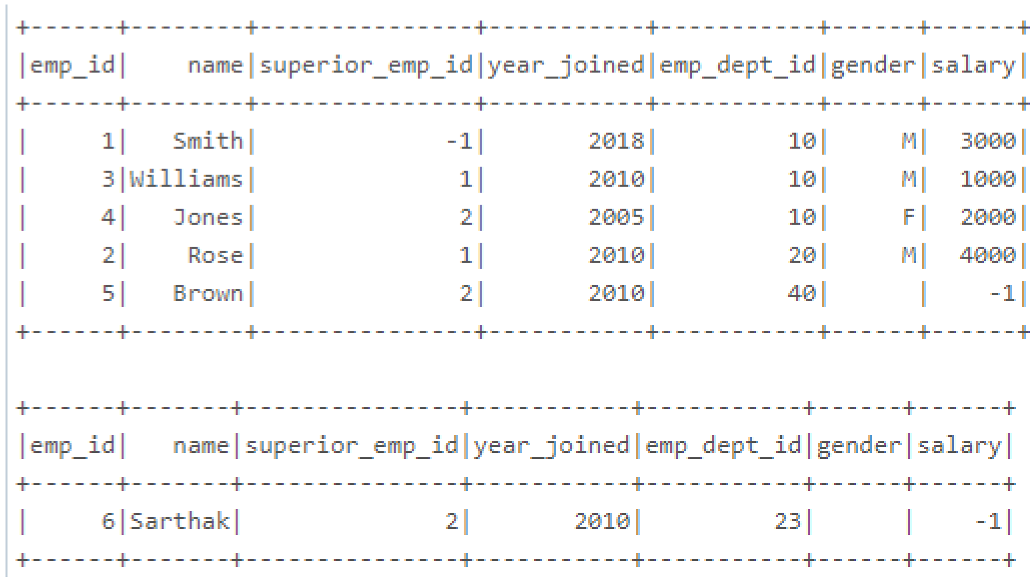
```
#right join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"right").show()
#right outer join
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"rightouter").show()
```



```
|emp_id|    name|superior_emp_id|year_joined|emp_dept_id|gender|salary|dept_name|dept_id|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|     4|   Jones|              2|       2005|         10|     F|  2000|  Finance|     10|
|     3|Williams|              1|       2010|         10|     M|  1000|  Finance|     10|
|     1|   Smith|             -1|       2018|         10|     M|  3000|  Finance|     10|
|     2|    Rose|              1|       2010|         20|     M|  4000|Marketing|     20|
|  null|    null|           null|       null|       null|  null|  null|    Sales|     30|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+


+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|emp_id|    name|superior_emp_id|year_joined|emp_dept_id|gender|salary|dept_name|dept_id|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
|     4|   Jones|              2|       2005|         10|     F|  2000|  Finance|     10|
|     3|Williams|              1|       2010|         10|     M|  1000|  Finance|     10|
|     1|   Smith|             -1|       2018|         10|     M|  3000|  Finance|     10|
|     2|    Rose|              1|       2010|         20|     M|  4000|Marketing|     20|
|  null|    null|           null|       null|       null|  null|  null|    Sales|     30|
|     5|   Brown|              2|       2010|         40|      |    -1|       IT|     40|
+------+--------+---------------+-----------+-----------+------+------+---------+-------+
```

5. **Performing left semi and left anti joins between employee and department DataFrames in PySpark.**

```
#left semijoin
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"leftsemi").show()

#left anti
empDF.join(deptDF,empDF.emp_dept_id == deptDF.dept_id,
"leftanti").show()
```



```
+------+--------+---------------+-----------+-----------+------+------+
|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|
|     4|   Jones|              2|       2005|         10|     F|  2000|
|     2|    Rose|              1|       2010|         20|     M|  4000|
|     5|   Brown|              2|       2010|         40|      |    -1|
+------+--------+---------------+-----------+-----------+------+------+

+------+-------+---------------+-----------+-----------+------+------+
|emp_id|   name|superior_emp_id|year_joined|emp_dept_id|gender|salary|
+------+-------+---------------+-----------+-----------+------+------+
|     6|Sarthak|              2|       2010|         23|      |    -1|
+------+-------+---------------+-----------+-----------+------+------+
```

Joins in Spark Summary:-

The above codes demonstrates the creation of two PySpark DataFrames: empDF containing employee data and deptDF containing department data. It showcases various types of joins to combine the two DataFrames based on the common key emp_dept_id in empDF and dept_id in deptDF.

1. **Inner Join** returns rows where there is a match in both DataFrames.
2. **Outer Join** (or Full Join) includes all rows from both DataFrames, with null values for non-matching rows.
3. **Left and Right Joins** (and their outer variants) return all rows from one DataFrame and matching rows (if any) from the other.

Additionally, **Left Semi Join** filters rows in empDF that have a match in deptDF, while **Left Anti Join** returns rows in empDF that do not match with deptDF.

Assignment – Day 14

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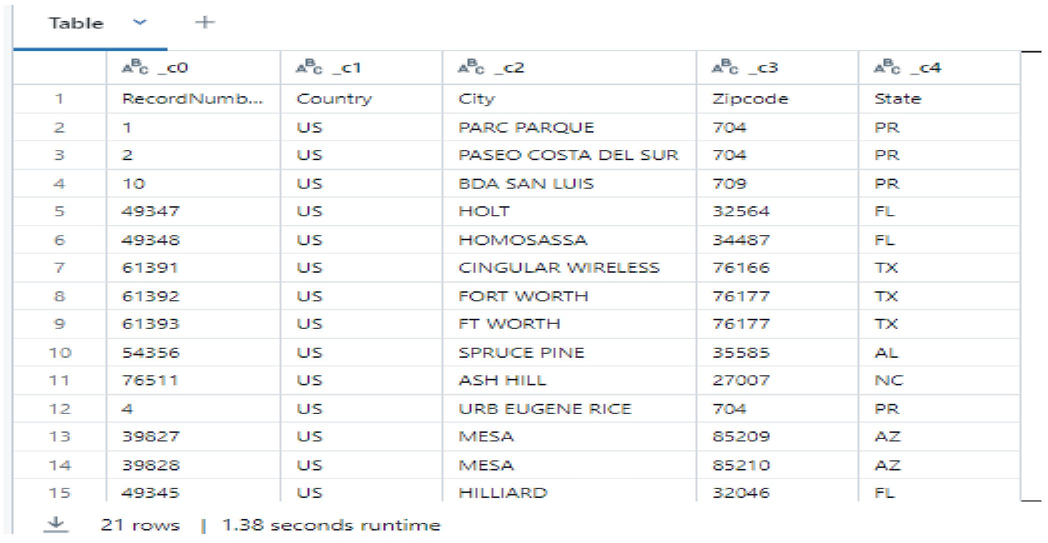
21/11/2024 (Thursday)

Spark-SQL Practice: -

1. **Loading a CSV file into a Spark DataFrame with specified options and creating a temporary SQL view.**

```
# File location and type
file_location = "/FileStore/tables/simple_zipcodes-1.csv"
file_type = "csv"
# CSV options
infer_schema = "false"
first_row_is_header = "false"
delimiter = ","
# The applied options are for CSV files. For other file types, these will
be ignored.
df = spark.read.format(file_type) \
  .option("inferSchema", infer_schema) \
  .option("header", first_row_is_header) \
  .option("sep", delimiter) \
  .load(file_location)
display(df)
df.createOrReplaceTempView("tempdata")
```



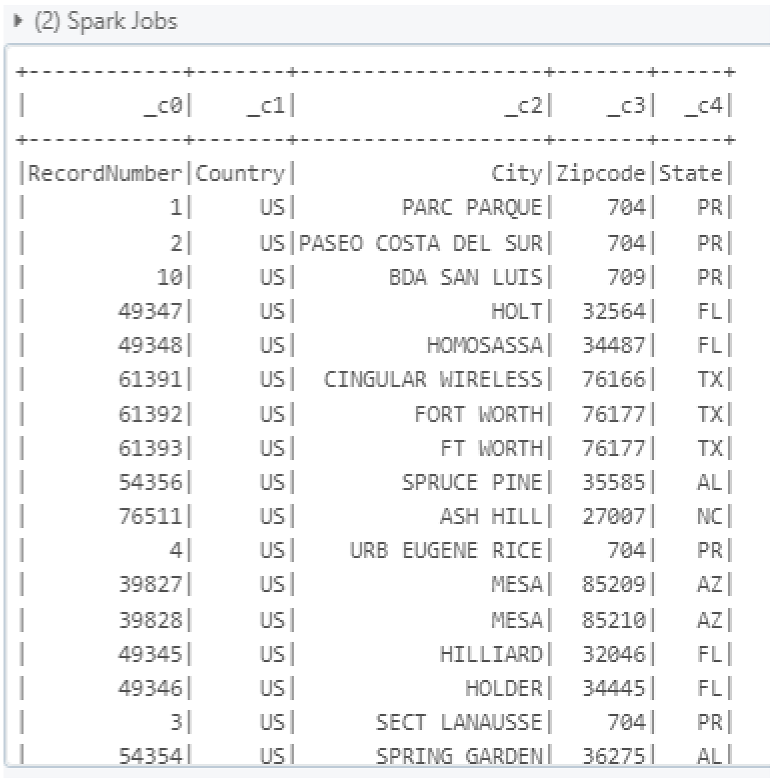
Table

	_c0	_c1	_c2	_c3	_c4
1	RecordNumb...	Country	City	Zipcode	State
2	1	US	PARC PARQUE	704	PR
3	2	US	PASEO COSTA DEL SUR	704	PR
4	10	US	BDA SAN LUIS	709	PR
5	49347	US	HOLT	32564	FL
6	49348	US	HOMOSASSA	34487	FL
7	61391	US	CINGULAR WIRELESS	76166	TX
8	61392	US	FORT WORTH	76177	TX
9	61393	US	FT WORTH	76177	TX
10	54356	US	SPRUCE PINE	35585	AL
11	76511	US	ASH HILL	27007	NC
12	4	US	URB EUGENE RICE	704	PR
13	39827	US	MESA	85209	AZ
14	39828	US	MESA	85210	AZ
15	49345	US	HILLIARD	32046	FL

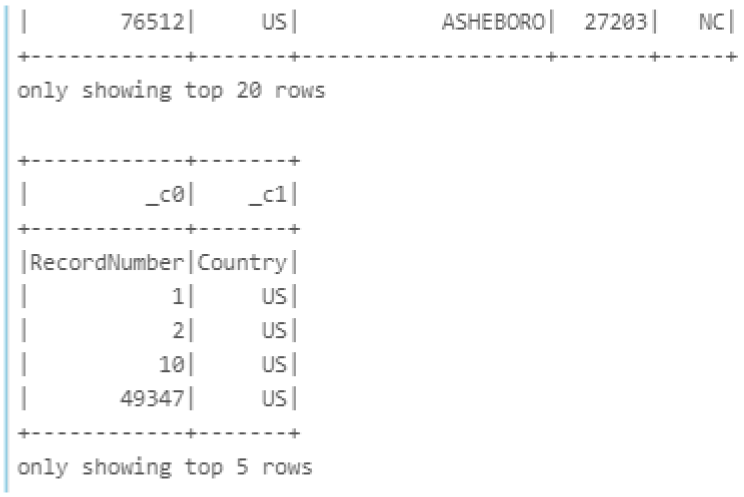
21 rows | 1.38 seconds runtime

2. **Querying a temporary SQL view and selecting specific columns from a DataFrame in Spark.**

```
spark.sql("select * from tempdata").show()
df.select("_c0","_c1").show(5)
```



```
▸ (2) Spark Jobs
+------------+-------+------------------+-------+-----+
|         _c0|    _c1|               _c2|    _c3|  _c4|
+------------+-------+------------------+-------+-----+
|RecordNumber|Country|              City|Zipcode|State|
|           1|     US|       PARC PARQUE|    704|   PR|
|           2|     US|PASEO COSTA DEL SUR|    704|   PR|
|          10|     US|      BDA SAN LUIS|    709|   PR|
|       49347|     US|              HOLT|  32564|   FL|
|       49348|     US|         HOMOSASSA|  34487|   FL|
|       61391|     US| CINGULAR WIRELESS|  76166|   TX|
|       61392|     US|        FORT WORTH|  76177|   TX|
|       61393|     US|          FT WORTH|  76177|   TX|
|       54356|     US|       SPRUCE PINE|  35585|   AL|
|       76511|     US|          ASH HILL|  27007|   NC|
|           4|     US|   URB EUGENE RICE|    704|   PR|
|       39827|     US|              MESA|  85209|   AZ|
|       39828|     US|              MESA|  85210|   AZ|
|       49345|     US|          HILLIARD|  32046|   FL|
|       49346|     US|            HOLDER|  34445|   FL|
|           3|     US|     SECT LANAUSSE|    704|   PR|
|       54354|     US|     SPRING GARDEN|  36275|   AL|
```

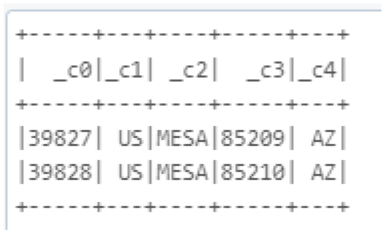


```
|       76512|     US|          ASHEBORO|  27203|   NC|
+------------+-------+------------------+-------+-----+
only showing top 20 rows

+------------+-------+
|         _c0|    _c1|
+------------+-------+
|RecordNumber|Country|
|           1|     US|
|           2|     US|
|          10|     US|
|       49347|     US|
+------------+-------+
only showing top 5 rows
```

3. **Filtering rows from a temporary SQL view in Spark based on a column value condition.**

```
spark.sql("""SELECT * From tempdata WHERE _c4='AZ'""").show(5)
```



```
+-----+---+----+-----+---+
|  _c0|_c1| _c2|  _c3|_c4|
+-----+---+----+-----+---+
|39827| US|MESA|85209| AZ|
|39828| US|MESA|85210| AZ|
+-----+---+----+-----+---+
```

---

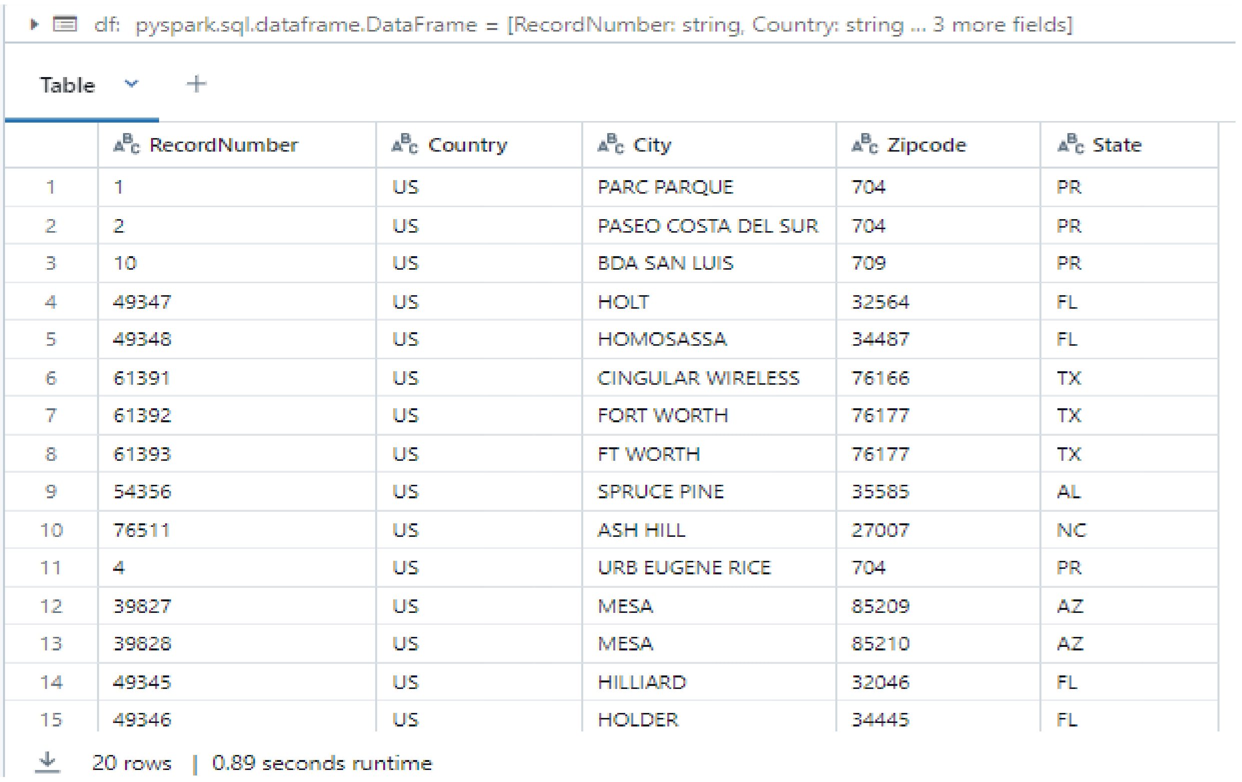
4. **Loading a CSV file with headers into a Spark DataFrame and creating a temporary SQL view named "customer".**

```
# File location and type
file_location = "/FileStore/tables/simple_zipcodes-1.csv"
file_type = "csv"

# CSV options
infer_schema = "false"
first_row_is_header = "true"
delimiter = ","

# The applied options are for CSV files. For other file types, these
will be ignored.
df = spark.read.format(file_type) \
  .option("inferSchema", infer_schema) \
  .option("header", first_row_is_header) \
  .option("sep", delimiter) \
  .load(file_location)

display(df)
df.createOrReplaceTempView("customer")
```


df: pyspark.sql.dataframe.DataFrame = [RecordNumber: string, Country: string ... 3 more fields]

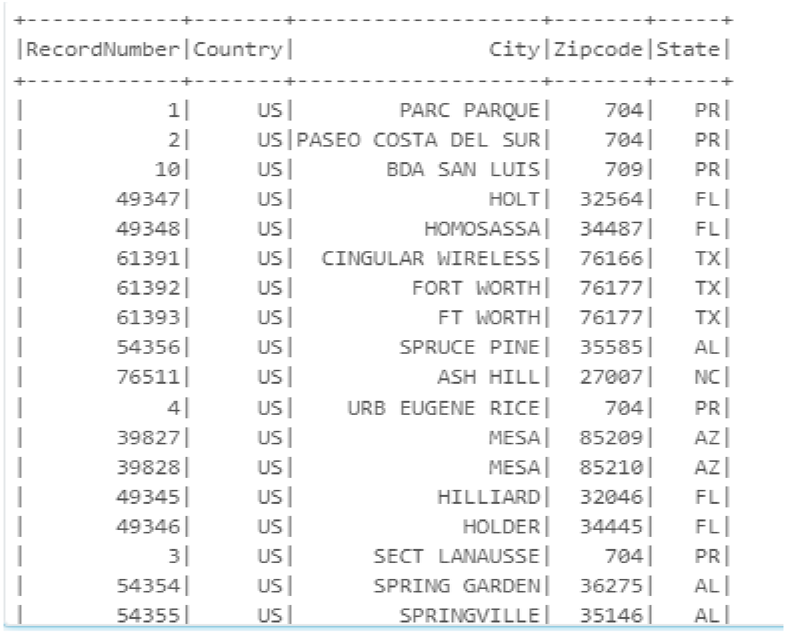
Table

	RecordNumber	Country	City	Zipcode	State
1	1	US	PARC PARQUE	704	PR
2	2	US	PASEO COSTA DEL SUR	704	PR
3	10	US	BDA SAN LUIS	709	PR
4	49347	US	HOLT	32564	FL
5	49348	US	HOMOSASSA	34487	FL
6	61391	US	CINGULAR WIRELESS	76166	TX
7	61392	US	FORT WORTH	76177	TX
8	61393	US	FT WORTH	76177	TX
9	54356	US	SPRUCE PINE	35585	AL
10	76511	US	ASH HILL	27007	NC
11	4	US	URB EUGENE RICE	704	PR
12	39827	US	MESA	85209	AZ
13	39828	US	MESA	85210	AZ
14	49345	US	HILLIARD	32046	FL
15	49346	US	HOLDER	34445	FL

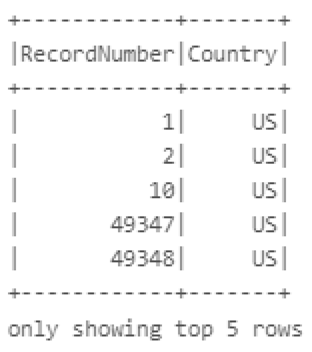
20 rows | 0.89 seconds runtime

5. **Displaying all records from a SQL view and selecting specific columns from a DataFrame in Spark.**

```
spark.sql("select * from customer").show()
df.select("RecordNumber","Country").show(5)
```



```
+------------+-------+-------------------+-------+-----+
|RecordNumber|Country|               City|Zipcode|State|
+------------+-------+-------------------+-------+-----+
|           1|     US|        PARC PARQUE|    704|   PR|
|           2|     US|PASEO COSTA DEL SUR|    704|   PR|
|          10|     US|       BDA SAN LUIS|    709|   PR|
|       49347|     US|               HOLT|  32564|   FL|
|       49348|     US|          HOMOSASSA|  34487|   FL|
|       61391|     US|  CINGULAR WIRELESS|  76166|   TX|
|       61392|     US|         FORT WORTH|  76177|   TX|
|       61393|     US|           FT WORTH|  76177|   TX|
|       54356|     US|        SPRUCE PINE|  35585|   AL|
|       76511|     US|           ASH HILL|  27007|   NC|
|           4|     US|    URB EUGENE RICE|    704|   PR|
|       39827|     US|               MESA|  85209|   AZ|
|       39828|     US|               MESA|  85210|   AZ|
|       49345|     US|           HILLIARD|  32046|   FL|
|       49346|     US|             HOLDER|  34445|   FL|
|           3|     US|      SECT LANAUSSE|    704|   PR|
|       54354|     US|      SPRING GARDEN|  36275|   AL|
|       54355|     US|        SPRINGVILLE|  35146|   AL|
```

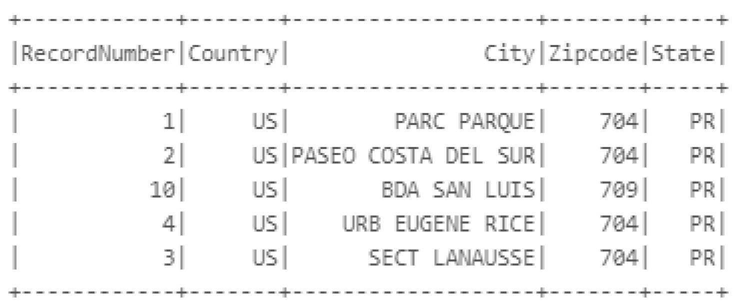


```
+------------+-------+
|RecordNumber|Country|
+------------+-------+
|           1|     US|
|           2|     US|
|          10|     US|
|       49347|     US|
|       49348|     US|
+------------+-------+
only showing top 5 rows
```

---

6. Filtering rows from the "customer" SQL view in Spark where the state is 'PR'.

```
spark.sql("""SELECT * From customer WHERE state='PR'""").show(5)
```

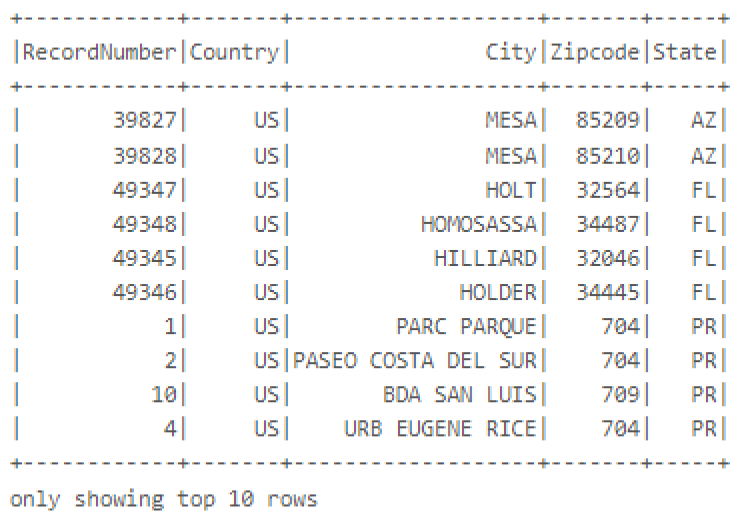


```
+------------+-------+-------------------+-------+-----+
|RecordNumber|Country|               City|Zipcode|State|
+------------+-------+-------------------+-------+-----+
|           1|     US|        PARC PARQUE|    704|   PR|
|           2|     US|PASEO COSTA DEL SUR|    704|   PR|
|          10|     US|       BDA SAN LUIS|    709|   PR|
|           4|     US|    URB EUGENE RICE|    704|   PR|
|           3|     US|      SECT LANAUSSE|    704|   PR|
+------------+-------+-------------------+-------+-----+
```

---

7. Filtering and ordering rows from the "customer" SQL view in Spark by specific states.

```
spark.sql("""select * FROM customer WHERE state in
('PR','AZ','FL')order by state """).show(10)
```

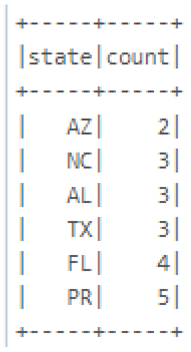


```
+------------+-------+-------------------+-------+-----+
|RecordNumber|Country|               City|Zipcode|State|
+------------+-------+-------------------+-------+-----+
|       39827|     US|               MESA|  85209|   AZ|
|       39828|     US|               MESA|  85210|   AZ|
|       49347|     US|               HOLT|  32564|   FL|
|       49348|     US|          HOMOSASSA|  34487|   FL|
|       49345|     US|           HILLIARD|  32046|   FL|
|       49346|     US|             HOLDER|  34445|   FL|
|           1|     US|        PARC PARQUE|    704|   PR|
|           2|     US|PASEO COSTA DEL SUR|    704|   PR|
|          10|     US|       BDA SAN LUIS|    709|   PR|
|           4|     US|    URB EUGENE RICE|    704|   PR|
+------------+-------+-------------------+-------+-----+
only showing top 10 rows
```

---

8. Grouping and counting the number of records for each state from the "customer" SQL view in Spark.

```
spark.sql("""SELECT state,count(*) as count FROM customer GROUP BY
state""").show()
```



```
+-----+-----+
|state|count|
+-----+-----+
|   AZ|    2|
|   NC|    3|
|   AL|    3|
|   TX|    3|
|   FL|    4|
|   PR|    5|
+-----+-----+
```

<u>Spark-SQL Summary: -</u>

The provided code demonstrates the process of loading and processing CSV files using Apache Spark. Initially, a CSV file is read into a Spark DataFrame with no schema inference and no header, then displayed and queried through a temporary SQL view named tempdata. Queries include displaying all data, selecting specific columns (_c0, _c1), and filtering rows where column _c4 equals 'AZ'.

Later, the CSV file is reloaded with headers enabled into a DataFrame and assigned to a new SQL view named customer. Queries on this view include retrieving all data, selecting specific columns (RecordNumber, Country), filtering rows where the state column equals 'PR', and filtering states in a specific list (PR, AZ, FL) while ordering the results by state. Additionally, a query is used to group the data by the state column and count the number of records for each state. The code showcases Spark's SQL and DataFrame APIs for data analysis and transformations. The code also demonstrates how to read the same CSV file multiple times with different configurations, such as enabling header parsing in the second instance. Through these queries, Spark's ability to handle large datasets efficiently with SQL-like syntax for filtering, grouping, and ordering operations is highlighted, making it suitable for big data processing tasks.
