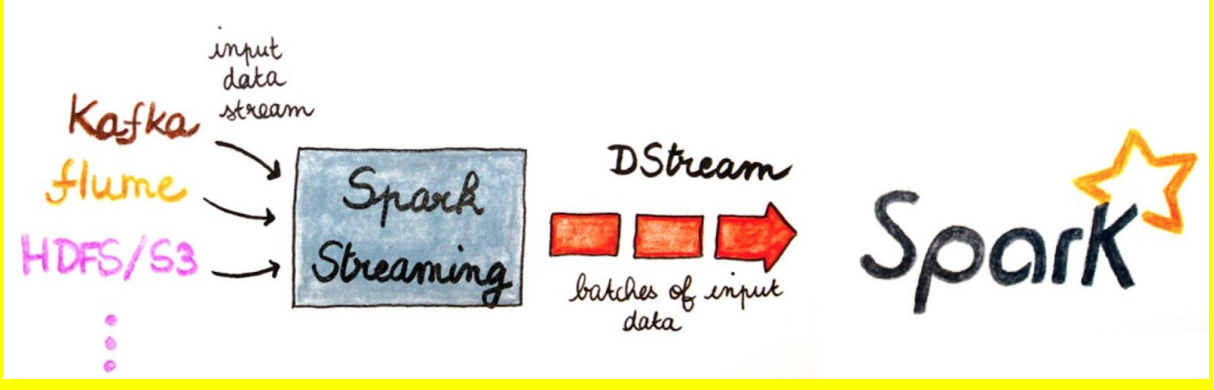
Spark Structured Streaming-Java Application: Read CSV file into Data Frame and Execute multiple queries in stream analytics With Spark Structured Streaming And Java

I. Introduction:

In this documentation, we are focused to parse data from a CSV file, perform some queries and output the result in the output using the **Spark Core** and **Spark Structured Streaming** based on **Spark SQL APIs**, and also **Java**.



Note: This Image is about Spark Streaming but in this project we will work with Spark Structured Streaming.

II. Technologies:

- Java 8
- Spark Core 3.0.1

- Spark Structured Streaming 3.0.1
- Spark SQL 3.0.1
- Maven
- Intelllj IDEA

III. Implement some queries using Java and Spark Structured Streaming:

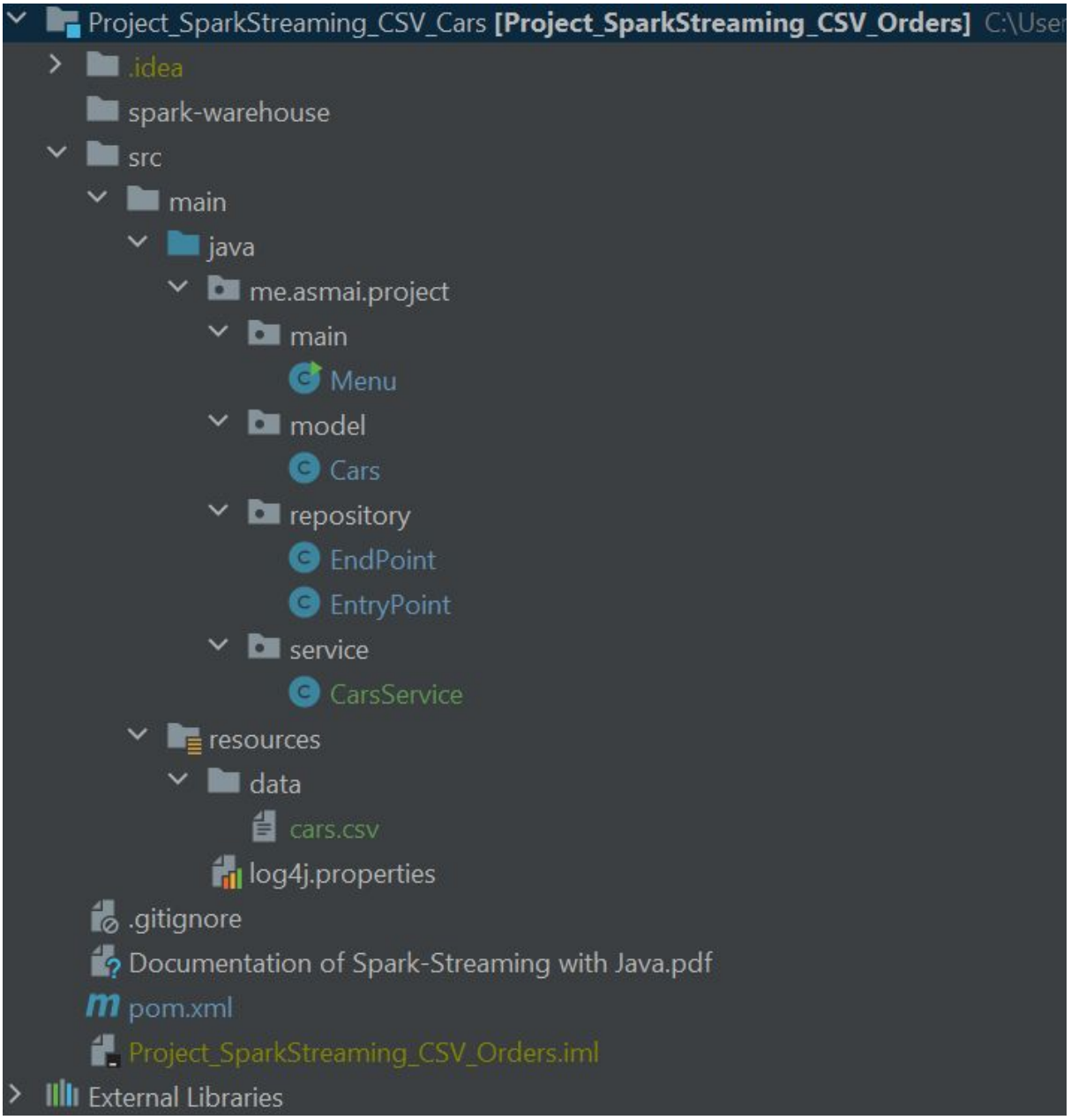
-Let's have a look at the **cars** dataset which we will use for this queries:

Car	MPG	Cylinders	Displacemen	Horsepower	Weight	Acceleration	Model	Origin
Chevrolet Ch	18.0	8	307.0	130.0	3504	12.0	70	US
Buick Skylark	15.0	8	350.0	165.0	3693	11.5	70	US
Plymouth Sat	18.0	8	318.0	150.0	3436	11.0	70	US
AMC Rebel S	16.0	8	304.0	150.0	3433	12.0	70	US
Ford Torino	17.0	8	302.0	140.0	3449	10.5	70	US
Ford Galaxie	15.0	8	429.0	198.0	4341	10.0	70	US
Chevrolet Im	14.0	8	454.0	220.0	4354	9.0	70	US
Plymouth Fu	14.0	8	440.0	215.0	4312	8.5	70	US
Pontiac Catal	14.0	8	455.0	225.0	4425	10.0	70	US
AMC Ambass	15.0	8	390.0	190.0	3850	8.5	70	US
Citroen DS-2	0	4	133.0	115.0	3090	17.5	70	Europe
Chevrolet Ch	0	8	350.0	165.0	4142	11.5	70	US
Ford Torino (	0	8	351.0	153.0	4034	11.0	70	US
Plymouth Sat	0	8	383.0	175.0	4166	10.5	70	US
AMC Rebel S	0	8	360.0	175.0	3850	11.0	70	US
Dodge Challe	15.0	8	383.0	170.0	3563	10.0	70	US
Plymouth 'Cu	14.0	8	340.0	160.0	3609	8.0	70	US
Ford Mustan	0	8	302.0	140.0	3353	8.0	70	US

-These are **queries** to be exported:

- Get all Cars from csv file
- Get Cars By Model
- Get Model of Cars By less HorsePower
- Get Cars sorted by Model and HorsePower.
- Get Cars between two models and Origin and sorted by HorsePower
- Get Cars by Origin and sorted by Model

IV. Project Structure :



V. Setup Dependencies on pom.xml:

After Adding below dependencies on **pom.xml**,It will download all the required packages.

```xml
<groupId>org.example</groupId>
<artifactId>Spark_Streaming_With_Java</artifactId>
<version>1.0-SNAPSHOT</version>
<build>
    <plugins>
        <plugin>
            <groupId>org.apache.maven.plugins</groupId>
            <artifactId>maven-compiler-plugin</artifactId>
            <configuration>
                <source>11</source>
                <target>11</target>
            </configuration>
        </plugin>
    </plugins>
</build>

<dependencies>
    <!-- Dependency of Apache Spark Core-->
    <dependency>
        <groupId>org.apache.spark</groupId>
        <artifactId>spark-core_2.12</artifactId>
        <version>3.0.1</version>
    </dependency>

    <!-- https://mvnrepository.com/artifact/org.apache.spark/spark-sql -
    <dependency>
        <groupId>org.apache.spark</groupId>
        <artifactId>spark-sql_2.12</artifactId>
        <version>3.0.1</version>
    </dependency>
</dependencies>
```

VI. Configure Log4j file on spark console :

We would like to stop various **INFO messages** that are coming on the spark console to get just the result on the console without logging messages.

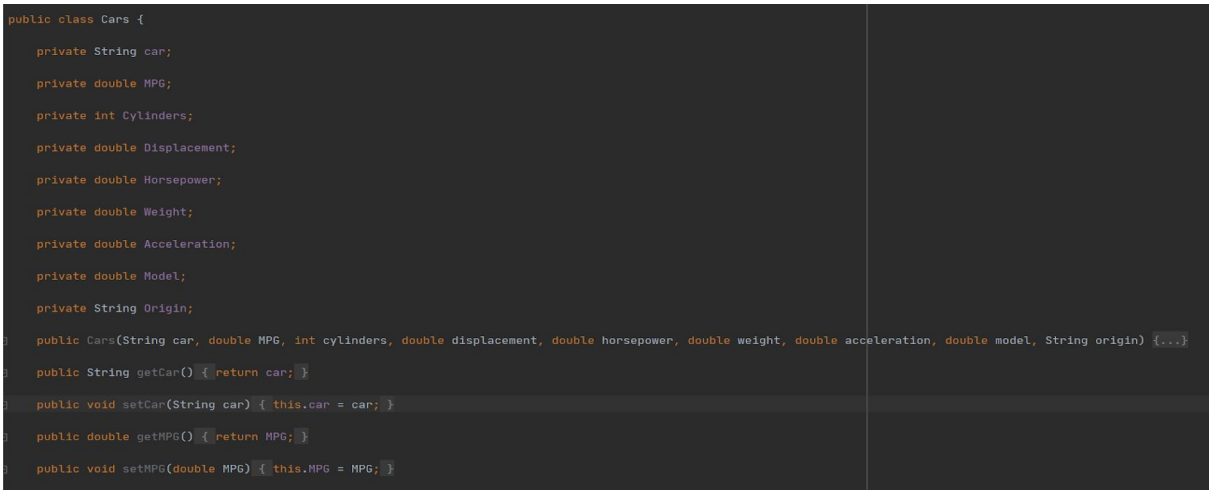
```
21/01/24 00:05:57 INFO TaskSetManager: Finished task 0.0 in stage 0.0 (TID 0) in 430 ms on localhost (executor driver) (1/1)
21/01/24 00:05:57 INFO TaskSchedulerImpl: Removed TaskSet 0.0, whose tasks have all completed, from pool
21/01/24 00:05:57 INFO DAGScheduler: ResultStage 0 (show at Service.java:14) finished in 0.669 s
21/01/24 00:05:57 INFO DAGScheduler: Job 0 finished: show at Service.java:14, took 0.729501 s
+-------+----------+--------+---------+--------------+------------------+---------+------------------+---------------+---------------+
|orderId|      date|quantity|    sales|          mode|            profit|unitPrice|      customerName|customerSegment|productCategory|
+-------+----------+--------+---------+--------------+------------------+---------+------------------+---------------+---------------+
```

We create a new file **log4j.properties** in order to stop these messages.Here are the contents of **log4j.properties:**

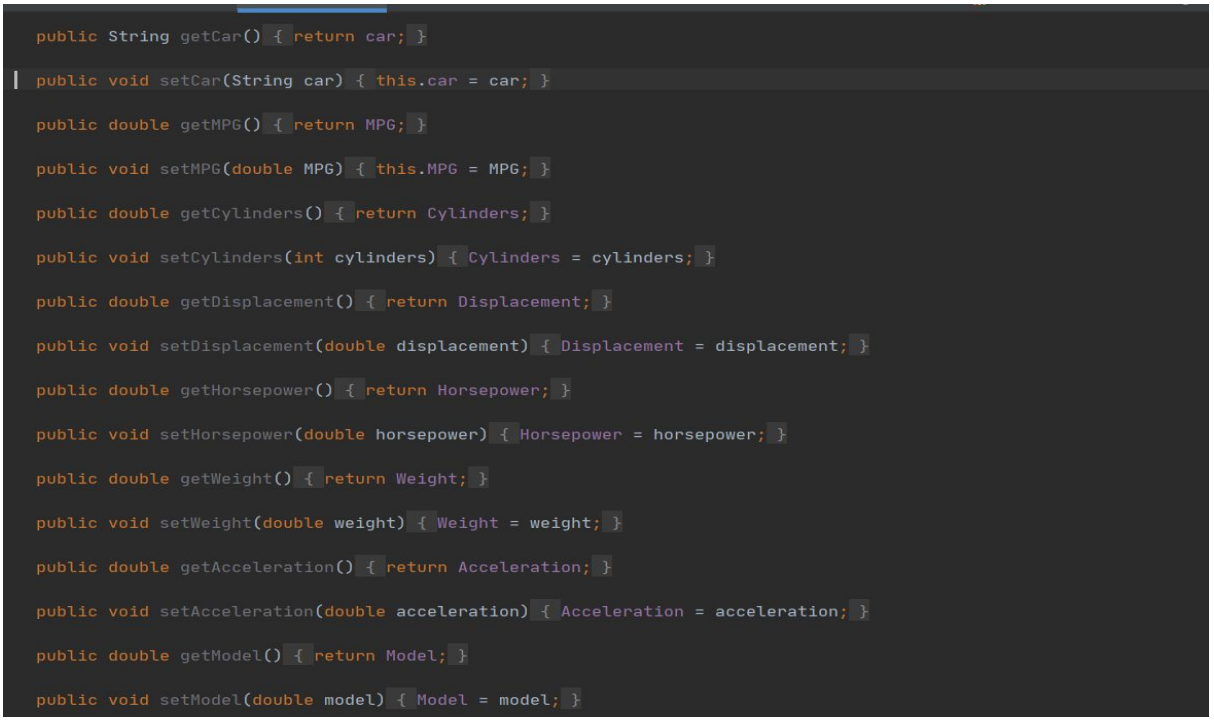
```
#Stop INFO messages displaying on Spark console to get just the result expected
log4j.rootCategory=ERROR, console
log4j.appender.console=org.apache.log4j.ConsoleAppender
log4j.appender.console.target=System.err
log4j.appender.console.layout=org.apache.log4j.PatternLayout
log4j.appender.console.layout.ConversionPattern=%d{yy/MM/dd HH:mm:ss} %p %c{1}: %m%n
```

VII. Define Data Model:

In the **model** package, we define **Cars** class.
model/Cars.class:



```
public class Cars {
    private String car;
    private double MPG;
    private int Cylinders;
    private double Displacement;
    private double Horsepower;
    private double Weight;
    private double Acceleration;
    private double Model;
    private String Origin;
    public Cars(String car, double MPG, int cylinders, double displacement, double horsepower, double weight, double acceleration, double model, String origin) {...}
    public String getCar() { return car; }
    public void setCar(String car) { this.car = car; }
    public double getMPG() { return MPG; }
    public void setMPG(double MPG) { this.MPG = MPG; }
```



```
    public String getCar() { return car; }
    public void setCar(String car) { this.car = car; }
    public double getMPG() { return MPG; }
    public void setMPG(double MPG) { this.MPG = MPG; }
    public double getCylinders() { return Cylinders; }
    public void setCylinders(int cylinders) { Cylinders = cylinders; }
    public double getDisplacement() { return Displacement; }
    public void setDisplacement(double displacement) { Displacement = displacement; }
    public double getHorsepower() { return Horsepower; }
    public void setHorsepower(double horsepower) { Horsepower = horsepower; }
    public double getWeight() { return Weight; }
    public void setWeight(double weight) { Weight = weight; }
    public double getAcceleration() { return Acceleration; }
    public void setAcceleration(double acceleration) { Acceleration = acceleration; }
    public double getModel() { return Model; }
    public void setModel(double model) { Model = model; }
```

VIII. Create a Repository to working with Dataframe(Cars.csv):

Let's create a repository to interact with **Cars** from the csv file.
In the **repository** package, create a class **EntryPoint** which is responsible for reading **CSV file** and loading the data into a **spark dataframe** with a custom schema.

```
import org.apache.spark.sql.types.StructType;

public class EntryPoint {

    public EntryPoint() { }

    public static SparkSession sparkSession(){
        return SparkSession
                .builder()
                .appName(" Application with Spark SQL and Java")
                .master("local[*]")
                .getOrCreate();
    }

    public static Dataset<Cars> getDataset(){
        Encoder<Cars> carsEncoder = Encoders.bean(Cars.class);

        Dataset<Cars> carsDataset = sparkSession().read()
                .option("header","true")
                .option("treatEmptyValuesAsNulls", "true")
                .option("inferSchema", "true")
                .option("mode","DROPMALFORMED")
                .option("delimiter",";")
                .csv( path: "src/main/resources/cars.csv")
                .as(carsEncoder);

        carsDataset.registerTempTable( tableName: "cars");
        return carsDataset;
    }
}
```

However, the second one is **EndPoint** class which is responsible for saving the content of the streaming Dataset out into the console using two output modes ("**Append**", "**Complete**"). We are using **Complete** mode in the **last two queries** because the **Append** mode doesn't support **sorting** operations and **aggregation**.

```
public class EndPoint {
```

```
    public EndPoint(){}

    public static void displayDatasetWithCars(Dataset<Cars> dataset, int
numberRows) throws StreamingQueryException {
        dataset.writeStream()
                .format("console")
                .outputMode("append")
                .option("numRows",numberRows)
                .start()
                .awaitTermination();
    }

    public static void displayDatasetWithRows(Dataset<Row> dataset, int
numberRows , String outputMode) throws StreamingQueryException {
        dataset.writeStream()
                .format("console")
                .outputMode(outputMode)
                .option("numRows",numberRows)
                .start()
                .awaitTermination();
    }
}
```

IX. Create a Spark Service:

CarsService class uses **Repository/EntryPoint** class for 5 functions:

→ `getAllCars(int numberRows)`: Get all Cars from csv file
→ `getCarsByModel(double model)`: Get Cars By Model
→ `getModelOfCarsByLessHorsePower()`: Get only the Model of Cars which have less HorsePower.
→ `getCarsSortedByModelAndHorsePower()`: Get Cars sorted by Model and HorsePower.
→`getCarsBetweenTwoModelsOfAnOriginAndSortedByHorsePower(double model1, double model2, String origin`: Get Cars between two models and Origin and sorted by HorsePower.
→ `getCarsByOriginAndSortedByModel(String origin)` : Get Cars by Origin and sorted by Model.

Here is the code of **service/CarsService.java:**

```java
package me.asmai.project.service;
import static me.asmai.project.repository.EntryPoint.getDataset;
import static me.asmai.project.repository.EntryPoint.sparkSession;
import me.asmai.project.repository.EndPoint;
import me.asmai.project.repository.EntryPoint;
import me.asmai.project.model.Cars;
import org.apache.spark.api.java.function.FilterFunction;
import org.apache.spark.sql.Dataset;
import org.apache.spark.sql.Row;
import org.apache.spark.sql.streaming.StreamingQueryException;
import java.util.concurrent.TimeoutException;

public class CarsService {

    public void getAllCars(int numberRows) throws StreamingQueryException, TimeoutException {
        EndPoint.displayDatasetWithCars(EntryPoint.getDataset(),numberRows, outputMode: "append");
    }

    public void getCarsByModel(double model) throws StreamingQueryException, TimeoutException {

        Dataset<Cars> cars = EntryPoint.getDataset().filter("Model == \"" + model + "\"");
        EndPoint.displayDatasetWithCars(cars, numberRows: 407, outputMode: "append");

    }

    public void getModelOfCarsByLessHorsePower() throws StreamingQueryException, TimeoutException {

        EntryPoint.getDataset().createOrReplaceTempView( viewName: "cars");
        Dataset<Row> cars = sparkSession().sql( sqlText: "SELECT Model,MIN(Horsepower) FROM cars GROUP BY Model");
        EndPoint.displayDatasetWithRows(cars, numberRows: 407, outputMode: "complete");
    }
```

```java
public void getModelOfCarsByLessHorsePower() throws StreamingQueryException, TimeoutException {

    EntryPoint.getDataset().createOrReplaceTempView( viewName: "cars");
    Dataset<Row> cars = sparkSession().sql( sqlText: "SELECT Model,MIN(Horsepower) FROM cars GROUP BY Model");
    EndPoint.displayDatasetWithRows(cars, numberRows: 407, outputMode: "complete");
}

public void getCarsSortedByModelAndHorsePower() throws StreamingQueryException, TimeoutException {

    EntryPoint.getDataset().createOrReplaceTempView( viewName: "cars");
    Dataset<Row> cars = getDataset() Dataset<Cars>
            .groupBy( col1: "Model", ...cols: "Horsepower","car","MPG","Cylinders","Weight","Acceleration","Displacement") RelationalGroupedDataset
            .count() Dataset<Row>
            .sort( sortCol: "Model", ...sortCols: "Horsepower");
    EndPoint.displayDatasetWithRows(cars, numberRows: 407, outputMode: "complete");
}

public void getCarsByBetweenTwoModelsOfAnOriginAndSortedByHorsePower(double model1, double model2, String origin) throws StreamingQueryException, TimeoutException {
    Dataset<Row> cars = getDataset().filter((FilterFunction<Cars>) car -> car.getOrigin().equals(origin))
            .filter("Model >= \"" + model1 + "\"")
            .filter("Model <= \"" + model2 + "\"")
            .groupBy( col1: "Horsepower")
            .count()
            .sort( sortCol: "Horsepower");

    EndPoint.displayDatasetWithRows(cars, numberRows: 407, outputMode: "complete");
}

public void getCarsByOriginAndSortedByModel(String origin) throws StreamingQueryException, TimeoutException {
    Dataset<Row> cars = getDataset().filter((FilterFunction<Cars>) car -> car.getOrigin().equals(origin))
            .groupBy( col1: "Model")
            .count()
            .sort( sortCol: "Model");
    EndPoint.displayDatasetWithRows(cars, numberRows: 407, outputMode: "append");
}
```

X. Creating a Menu Driven Program :

Let's create a **Menu** class under package **Main** to obtain input from a user by displaying a list of options.

main/Menu.java:

```java
package me.asmai.project.main;

import me.asmai.project.service.CarsService;
import org.apache.spark.sql.streaming.StreamingQueryException;

import java.util.Scanner;
import java.util.concurrent.TimeoutException;


public class Menu {

    public static Scanner scanner = new Scanner(System.in);
    public static CarsService carsService = new CarsService();

    public static void main(String[] args) throws TimeoutException, StreamingQueryException {

        int menuOption = 0;
        double model1;
        double model;
        double model2;
        String origin;

        do {
            menuOption = showMenu();

            switch (menuOption) {

                case 1:
                    System.out.println("Enter the rows number of Cars that you want preview : ");
                    int numberRows = scanner.nextInt();
                    carsService.getAllCars(numberRows);
                    break;
                case 2:
                    System.out.println("Enter the model of car :  Ex= 70");
```

```java
case 1:
    System.out.println("Enter the rows number of Cars that you want preview : ");
    int numberRows = scanner.nextInt();
    carsService.getAllCars(numberRows);
    break;
case 2:
    System.out.println("Enter the model of car :  Ex= 70");
    scanner.nextLine();
    model = scanner.nextInt();
    carsService.getCarsByModel(model);
    break;
case 3:
    carsService.getModelOfCarsByLessHorsePower();
    break;
case 4:
    carsService.getCarsSortedByModelAndHorsePower();
    break;
case 5:
    System.out.println("Enter the model of the car : Ex: 80");
    scanner.nextLine();
    model1 = scanner.nextInt();
    System.out.println("Enter the second model of the car : Ex: 81");
    scanner.nextLine();
    model2 = scanner.nextInt();
    System.out.println("Enter the origin of the car : Ex: US");
    scanner.nextLine();
    origin = scanner.nextLine();
    carsService.getCarsByBetweenTwoModelsOfAnOriginAndSortedByHorsePower(model1,model2,origin);
    break;
case 6:
    System.out.println("Enter the origin of the car : Ex: Japan");
    scanner.nextLine();
    origin = scanner.nextLine();
    carsService.getCarsByOriginAndSortedByModel(origin);
```

```
                origin = scanner.nextLine();
                carsService.getCarsByOriginAndSortedByModel(origin);
            case 7:
                System.out.println("Quitting Program...");
                break;
            default:
                System.out.println("Sorry, please enter a valid Option");
        }

    } while (menuOption != 7);

    // Exiting message when user decides to quit Program
    System.out.println("Thanks for using this Program...");


}
public static int showMenu() {
    int option = 0;

    System.out.println("Menu:");
    System.out.println("1. Get All Cars form CSV file ");
    System.out.println("2. Get Cars By Model");
    System.out.println("3. Get Model of Cars By Less HorsePower");
    System.out.println("4. Get Cars Sorted by Model and HorsePower");
    System.out.println("5. Get Cars By Origin and Between Two Models and Sorted by HorsePower");
    System.out.println("6. Get Cars by Origin and Sorted by Model");
    System.out.println("7. Quit Program");

    // Getting query number from above menu
    System.out.println("Enter the number of Query from above...");
    option = scanner.nextInt();

    return option;
}
```

XI. Output:

While executing each query , you will be able to see below its content in the console.

1. ***Menu:***

```
Menu:
1. Get All Cars form CSV file
2. Get Cars By Model
3. Get Model of Cars By Less HorsePower
4. Get Cars Sorted by Model and HorsePower
5. Get Cars By Origin and Between Two Models and Sorted by HorsePower
6. Get Cars by Origin and Sorted by Model
7. Quit Program
Enter the number of Query from above...
```

2. *First Query:*

```
Enter the number of Query from above...
1
Enter the rows number of Cars that you want preview :
10
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/C:/Users/alMostapha/
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operati
WARNING: All illegal access operations will be denied in a future release
-------------------------------------------
Batch: 0
-------------------------------------------
+--------------------+----+---------+------------+----------+------+------------+-----+------+
|                 Car| MPG|Cylinders|Displacement|Horsepower|Weight|Acceleration|Model|Origin|
+--------------------+----+---------+------------+----------+------+------------+-----+------+
|Chevrolet Chevell...|18.0|        8|       307.0|     130.0|3504.0|        12.0| 70.0|    US|
|   Buick Skylark 320|15.0|        8|       350.0|     165.0|3693.0|        11.5| 70.0|    US|
|  Plymouth Satellite|18.0|        8|       318.0|     150.0|3436.0|        11.0| 70.0|    US|
|       AMC Rebel SST|16.0|        8|       304.0|     150.0|3433.0|        12.0| 70.0|    US|
|         Ford Torino|17.0|        8|       302.0|     140.0|3449.0|        10.5| 70.0|    US|
|    Ford Galaxie 500|15.0|        8|       429.0|     198.0|4341.0|        10.0| 70.0|    US|
|    Chevrolet Impala|14.0|        8|       454.0|     220.0|4354.0|         9.0| 70.0|    US|
|   Plymouth Fury iii|14.0|        8|       440.0|     215.0|4312.0|         8.5| 70.0|    US|
|    Pontiac Catalina|14.0|        8|       455.0|     225.0|4425.0|        10.0| 70.0|    US|
|  AMC Ambassador DPL|15.0|        8|       390.0|     190.0|3850.0|         8.5| 70.0|    US|
+--------------------+----+---------+------------+----------+------+------------+-----+------+
```

3. Second Query:

```
Enter the number of Query from above...
2
Enter the model of car :  Ex= 70
72
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/C:/Users/alMostapha/.m
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operation
WARNING: All illegal access operations will be denied in a future release
-------------------------------------------
Batch: 0
-------------------------------------------
+--------------------+----+---------+------------+----------+------+------------+-----+------+
|                 Car| MPG|Cylinders|Displacement|Horsepower|Weight|Acceleration|Model|Origin|
+--------------------+----+---------+------------+----------+------+------------+-----+------+
|Toyota Corolla Ha...|24.0|        4|       113.0|      95.0|2278.0|        15.5| 72.0| Japan|
|  Dodge Colt Hardtop|25.0|        4|        97.5|      80.0|2126.0|        17.0| 72.0|    US|
|   Volkswagen Type 3|23.0|        4|        97.0|      54.0|2254.0|        23.5| 72.0|Europe|
|      Chevrolet Vega|20.0|        4|       140.0|      90.0|2408.0|        19.5| 72.0|    US|
| Ford Pinto Runabout|21.0|        4|       122.0|      86.0|2226.0|        16.5| 72.0|    US|
|    Chevrolet Impala|13.0|        8|       350.0|     165.0|4274.0|        12.0| 72.0|    US|
|    Pontiac Catalina|14.0|        8|       400.0|     175.0|4385.0|        12.0| 72.0|    US|
|   Plymouth Fury III|15.0|        8|       318.0|     150.0|4135.0|        13.5| 72.0|    US|
|    Ford Galaxie 500|14.0|        8|       351.0|     153.0|4129.0|        13.0| 72.0|    US|
|  AMC Ambassador SST|17.0|        8|       304.0|     150.0|3672.0|        11.5| 72.0|    US|
|     Mercury Marquis|11.0|        8|       429.0|     208.0|4633.0|        11.0| 72.0|    US|
|Buick LeSabre Custom|13.0|        8|       350.0|     155.0|4502.0|        13.5| 72.0|    US|
|Oldsmobile Delta ...|12.0|        8|       350.0|     160.0|4456.0|        13.5| 72.0|    US|
|Chrysler Newport ...|13.0|        8|       400.0|     190.0|4422.0|        12.5| 72.0|    US|
|     Mazda RX2 Coupe|19.0|        3|        70.0|      97.0|2330.0|        13.5| 72.0| Japan|
|    AMC Matador (sw)|15.0|        8|       304.0|     150.0|3892.0|        12.5| 72.0|    US|
|Chevrolet Chevell...|13.0|        8|       307.0|     130.0|4098.0|        14.0| 72.0|    US|
```

4. *Third Query:*

```
Enter the number of Query from above...
3
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/C:/Users/a
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Pl
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective acce
WARNING: All illegal access operations will be denied in a future release
-------------------------------------------
Batch: 0
-------------------------------------------
+-----+---------------+
|Model|min(Horsepower)|
+-----+---------------+
| 70.0|           46.0|
| 75.0|           53.0|
| 80.0|            0.0|
| 77.0|           58.0|
| 78.0|           48.0|
| 79.0|           65.0|
| 71.0|            0.0|
| 72.0|           54.0|
| 82.0|            0.0|
| 74.0|            0.0|
| 81.0|            0.0|
| 73.0|           46.0|
| 76.0|           52.0|
+-----+---------------+
```

5. *Fourth Query :*

```
Enter the number of Query from above...
4
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/C:/Users/alMostaphs
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operat
WARNING: All illegal access operations will be denied in a future release
-------------------------------------------
Batch: 0
-------------------------------------------
+-----+----------+--------------------+----+---------+------+------------+------------+-----+
|Model|Horsepower|                 car| MPG|Cylinders|Weight|Acceleration|Displacement|count|
+-----+----------+--------------------+----+---------+------+------------+------------+-----+
| 70.0|      46.0|Volkswagen 1131 D...|26.0|        4|1835.0|        20.5|        97.0|    1|
| 70.0|      85.0|       Ford Maverick|21.0|        6|2587.0|        16.0|       200.0|    1|
| 70.0|      87.0|         Peugeot 504|25.0|        4|2672.0|        17.5|       110.0|    1|
| 70.0|      88.0|        Datsun PL510|27.0|        4|2130.0|        14.5|        97.0|    1|
| 70.0|      90.0|         AMC Gremlin|21.0|        6|2648.0|        15.0|       199.0|    1|
| 70.0|      90.0|         Audi 100 LS|24.0|        4|2430.0|        14.5|       107.0|    1|
| 70.0|      95.0|Toyota Corolla Ma...|24.0|        4|2372.0|        15.0|       113.0|    1|
| 70.0|      95.0|     Plymouth Duster|22.0|        6|2833.0|        15.5|       198.0|    1|
| 70.0|      95.0|            Saab 99e|25.0|        4|2375.0|        17.5|       104.0|    1|
| 70.0|      97.0|          AMC Hornet|18.0|        6|2774.0|        15.5|       199.0|    1|
| 70.0|     113.0|            BMW 2002|26.0|        4|2234.0|        12.5|       121.0|    1|
| 70.0|     115.0|Citroen DS-21 Pallas| 0.0|        4|3090.0|        17.5|       133.0|    1|
| 70.0|     130.0|Chevrolet Chevell...|18.0|        8|3504.0|        12.0|       307.0|    1|
| 70.0|     140.0|Ford Mustang Boss...| 0.0|        8|3353.0|         8.0|       302.0|    1|
| 70.0|     140.0|         Ford Torino|17.0|        8|3449.0|        10.5|       302.0|    1|
| 70.0|     150.0|       AMC Rebel SST|16.0|        8|3433.0|        12.0|       304.0|    1|
| 70.0|     150.0|  Plymouth Satellite|18.0|        8|3436.0|        11.0|       318.0|    1|
| 70.0|     150.0|Chevrolet Monte C...|15.0|        8|3761.0|         9.5|       400.0|    1|
| 70.0|     153.0|    Ford Torino (sw)| 0.0|        8|4034.0|        11.0|       351.0|    1|
| 70.0|     160.0|  Plymouth 'Cuda 340|14.0|        8|3609.0|         8.0|       340.0|    1|
| 70.0|     165.0|Chevrolet Chevell...| 0.0|        8|4142.0|        11.5|       350.0|    1|
| 70.0|     165.0|   Buick Skylark 320|15.0|        8|3693.0|        11.5|       350.0|    1|
| 70.0|     170.0| Dodge Challenger SE|15.0|        8|3563.0|        10.0|       383.0|    1|
| 70.0|     175.0|Plymouth Satellit...| 0.0|        8|4166.0|        10.5|       383.0|    1|
```

6. *Fifth Query:*

```
Enter the number of Query from above...
5
Enter the model of the car : Ex: 80
81
Enter the second model of the car : Ex: 81
82
Enter the origin of the car : Ex: US
US
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/C:/
WARNING: Please consider reporting this to the maintainers of org.apache.spark.un
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflecti
WARNING: All illegal access operations will be denied in a future release
-------------------------------------------
Batch: 0
-------------------------------------------
+----------+-----+
|Horsepower|count|
+----------+-----+
|       0.0|    1|
|      63.0|    2|
|      64.0|    1|
|      65.0|    2|
|      70.0|    1|
|      79.0|    1|
|      82.0|    1|
|      84.0|    6|
|      85.0|    3|
|      86.0|    1|
|      88.0|    4|
|      90.0|    2|
|      92.0|    3|
|     105.0|    1|
|     110.0|    3|
|     112.0|    1|
+----------+-----+
```

7. *Sixth Query :*

```
Enter the number of Query from above...
6
Enter the origin of the car : Ex: Japan
Japan
WARNING: An illegal reflective access operation ha
WARNING: Illegal reflective access by org.apache.s
WARNING: Please consider reporting this to the mai
WARNING: Use --illegal-access=warn to enable warni
WARNING: All illegal access operations will be den
-------------------------------------------
Batch: 0
-------------------------------------------
+-----+-----+
|Model|count|
+-----+-----+
| 70.0|    2|
| 71.0|    4|
| 72.0|    5|
| 73.0|    4|
| 74.0|    6|
| 75.0|    4|
| 76.0|    4|
| 77.0|    6|
| 78.0|    8|
| 79.0|    2|
| 80.0|   13|
| 81.0|   12|
| 82.0|    9|
+-----+-----+
```

8. ***Quit Program:***

```
Enter the number of Query from above...
7
Quitting Program...
Thanks for using this Program...

Process finished with exit code 0
```

XII. Wrapping Up:

In this project, we have created a spark application using **Spark Core** and **Spark Structured Streaming** with **Java**. Here, we have loaded the CSV file into **Data Frame**. And perform some queries in stream analytics. Finally, We saving the content of the streaming Dataset out into the console.
If you want to test the examples above, you will find my Github code link:
Read CSV file into Data Frame and Execute multiple queries in stream analytics