# BIG DATA HADOOP & SPARK TRAINING

**Assignment on Spark MLIB I**

Rashmi Krishna

# Aviation data analysis

The U.S. Department of Transportation's (DOT) Bureau of Transportation Statistics (BTS) tracks the

on-time performance of domestic flights operated by large air carriers. Summary information on the

number of on-time, delayed, canceled, and diverted flights appears in DOT's monthly Air Travel

Consumer Report, published about 30 days after the month's end, as well as in summary tables posted

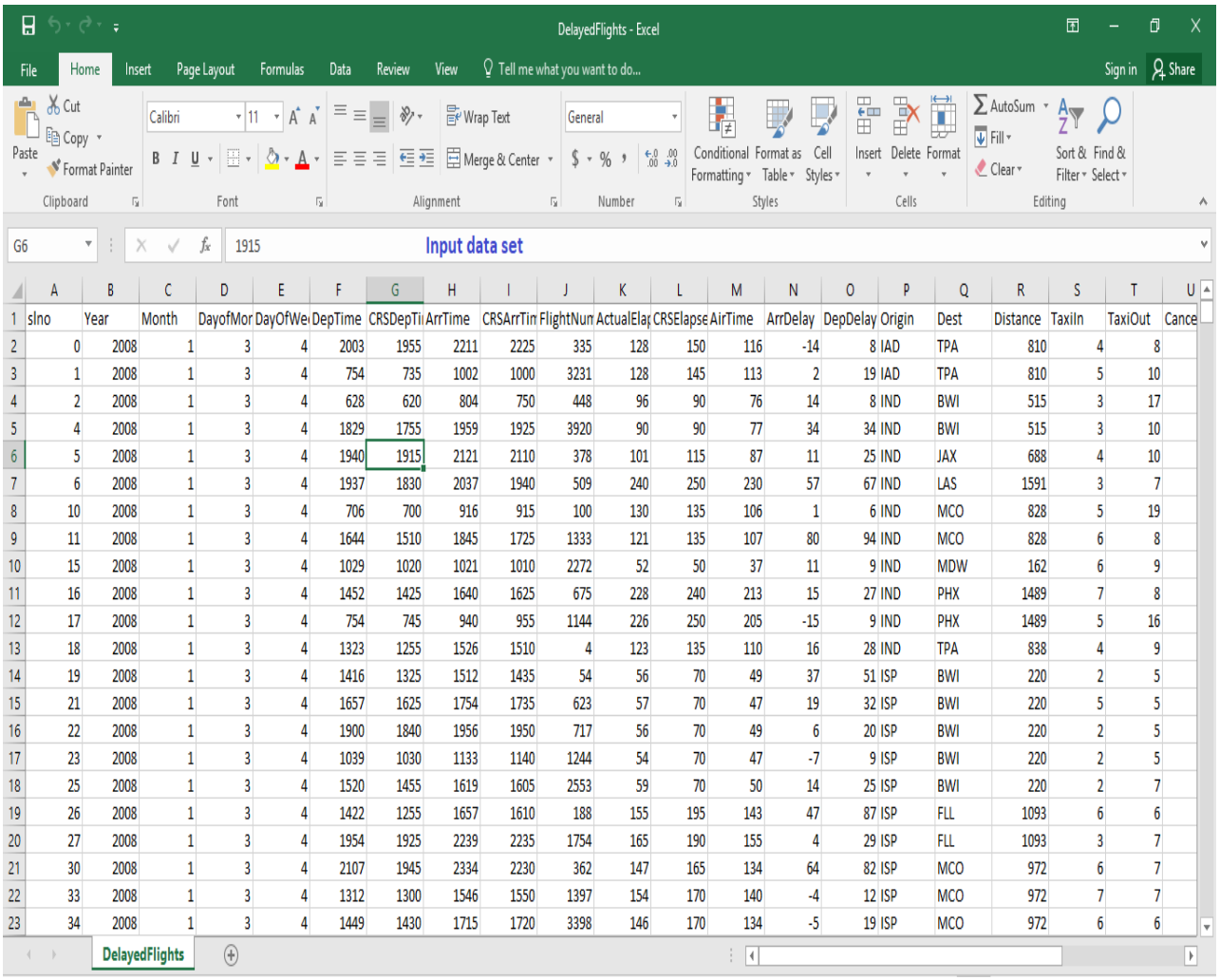
on this website. Summary statistics and raw data are made available to the public at the time the Air

Travel Consumer Report is released.

You can download the datasets from the following links:

https://drive.google.com/file/d/0B_Qjau8wv1KoWTVDUVFOdzlJNWM/view

Screen shot of the input data set:




| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | slno | Year | Month | DayofMor | DayOfWe | DepTime | CRSDepTi | ArrTime | CRSArrTin | FlightNun | ActualElap | CRSElapse | AirTime | ArrDelay | DepDelay | Origin | Dest | Distance | TaxiIn | TaxiOut | Cance |
| 2 | 0 | 2008 | 1 | 3 | 4 | 2003 | 1955 | 2211 | 2225 | 335 | 128 | 150 | 116 | -14 | 8 | IAD | TPA | 810 | 4 | 8 | |
| 3 | 1 | 2008 | 1 | 3 | 4 | 754 | 735 | 1002 | 1000 | 3231 | 128 | 145 | 113 | 2 | 19 | IAD | TPA | 810 | 5 | 10 | |
| 4 | 2 | 2008 | 1 | 3 | 4 | 628 | 620 | 804 | 750 | 448 | 96 | 90 | 76 | 14 | 8 | IND | BWI | 515 | 3 | 17 | |
| 5 | 4 | 2008 | 1 | 3 | 4 | 1829 | 1755 | 1959 | 1925 | 3920 | 90 | 90 | 77 | 34 | 34 | IND | BWI | 515 | 3 | 10 | |
| 6 | 5 | 2008 | 1 | 3 | 4 | 1940 | 1915 | 2121 | 2110 | 378 | 101 | 115 | 87 | 11 | 25 | IND | JAX | 688 | 4 | 10 | |
| 7 | 6 | 2008 | 1 | 3 | 4 | 1937 | 1830 | 2037 | 1940 | 509 | 240 | 250 | 230 | 57 | 67 | IND | LAS | 1591 | 3 | 7 | |
| 8 | 10 | 2008 | 1 | 3 | 4 | 706 | 700 | 916 | 915 | 100 | 130 | 135 | 106 | 1 | 6 | IND | MCO | 828 | 5 | 19 | |
| 9 | 11 | 2008 | 1 | 3 | 4 | 1644 | 1510 | 1845 | 1725 | 1333 | 121 | 135 | 107 | 80 | 94 | IND | MCO | 828 | 6 | 8 | |
| 10 | 15 | 2008 | 1 | 3 | 4 | 1029 | 1020 | 1021 | 1010 | 2272 | 52 | 50 | 37 | 11 | 9 | IND | MDW | 162 | 6 | 9 | |
| 11 | 16 | 2008 | 1 | 3 | 4 | 1452 | 1425 | 1640 | 1625 | 675 | 228 | 240 | 213 | 15 | 27 | IND | PHX | 1489 | 7 | 8 | |
| 12 | 17 | 2008 | 1 | 3 | 4 | 754 | 745 | 940 | 955 | 1144 | 226 | 250 | 205 | -15 | 9 | IND | PHX | 1489 | 5 | 16 | |
| 13 | 18 | 2008 | 1 | 3 | 4 | 1323 | 1255 | 1526 | 1510 | 4 | 123 | 135 | 110 | 16 | 28 | IND | TPA | 838 | 4 | 9 | |
| 14 | 19 | 2008 | 1 | 3 | 4 | 1416 | 1325 | 1512 | 1435 | 54 | 56 | 70 | 49 | 37 | 51 | ISP | BWI | 220 | 2 | 5 | |
| 15 | 21 | 2008 | 1 | 3 | 4 | 1657 | 1625 | 1754 | 1735 | 623 | 57 | 70 | 47 | 19 | 32 | ISP | BWI | 220 | 5 | 5 | |
| 16 | 22 | 2008 | 1 | 3 | 4 | 1900 | 1840 | 1956 | 1950 | 717 | 56 | 70 | 49 | 6 | 20 | ISP | BWI | 220 | 2 | 5 | |
| 17 | 23 | 2008 | 1 | 3 | 4 | 1039 | 1030 | 1133 | 1140 | 1244 | 54 | 70 | 47 | -7 | 9 | ISP | BWI | 220 | 2 | 5 | |
| 18 | 25 | 2008 | 1 | 3 | 4 | 1520 | 1455 | 1619 | 1605 | 2553 | 59 | 70 | 50 | 14 | 25 | ISP | BWI | 220 | 2 | 7 | |
| 19 | 26 | 2008 | 1 | 3 | 4 | 1422 | 1255 | 1657 | 1610 | 188 | 155 | 195 | 143 | 47 | 87 | ISP | FLL | 1093 | 6 | 6 | |
| 20 | 27 | 2008 | 1 | 3 | 4 | 1954 | 1925 | 2239 | 2235 | 1754 | 165 | 190 | 155 | 4 | 29 | ISP | FLL | 1093 | 3 | 7 | |
| 21 | 30 | 2008 | 1 | 3 | 4 | 2107 | 1945 | 2334 | 2230 | 362 | 147 | 165 | 134 | 64 | 82 | ISP | MCO | 972 | 6 | 7 | |
| 22 | 33 | 2008 | 1 | 3 | 4 | 1312 | 1300 | 1546 | 1550 | 1397 | 154 | 170 | 140 | -4 | 12 | ISP | MCO | 972 | 7 | 7 | |
| 23 | 34 | 2008 | 1 | 3 | 4 | 1449 | 1430 | 1715 | 1720 | 3398 | 146 | 170 | 134 | -5 | 19 | ISP | MCO | 972 | 6 | 6 | |

**Delayed_Flights.csv Datasets**

There are 29 columns in this dataset. Some of them have been mentioned below:

- Year: 1987 – 2008
- Month: 1 – 12
- FlightNum: Flight number
- Canceled: Was the flight canceled?
- CancelleationCode: The reason for cancellation.

For complete details, refer to this link.

**Program to accomplish the below tasks:**

This part of the program reads the CSV file as per the schema defined, convert to dataframe and register as temporary table called "**Flights_Table"**

```
package MLIB

import org.apache.spark.sql.SparkSession
import org.apache.spark.sql.functions._
import org.apache.spark.sql.types.{LongType, StringType, StructField, StructType}


object asnt27 {

  def main(args: Array[String]): Unit = {

// create a spark session object

    val spark = SparkSession
      .builder()
      .master("local")
      .appName("MLIB example")
      .config("spark.some.config.option", "some-value")
      .getOrCreate()
    println("Spark Session Object created")

// create a variable "Flight" to save the contents of the csv file and convert to dataframe
and register a temporary table on the data frame
    val Flight = spark.read.format("CSV").option("header", true).load("E:\\assignments
ss\\DelayedFlights.csv")
    val Fl = Flight.toDF()
    Flight.show()
    Fl.registerTempTable("Flights_Table")
    println("Flights_Table is registered!")
```

NewProj1 [C:\Users\Laptop\IdeaProjects\NewProj1] - ...\src\main\scala\MLIB\asnt27.scala [newproj1] - IntelliJ IDEA

File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help

NewProj1 > src > main > scala > MLIB > asnt27.scala

Run: asnt27

```
"C:\Program Files\Java\jdk1.8.0_161\bin\java.exe" ...
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.properties
18/06/24 11:35:54 INFO SparkContext: Running Spark version 2.1.0
18/06/24 11:35:55 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
18/06/24 11:35:55 INFO SecurityManager: Changing view acls to: Laptop
18/06/24 11:35:55 INFO SecurityManager: Changing modify acls to: Laptop
18/06/24 11:35:55 INFO SecurityManager: Changing view acls groups to:
18/06/24 11:35:55 INFO SecurityManager: Changing modify acls groups to:
18/06/24 11:35:55 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users  with view permissions: Set(Laptop); groups with view permissions: Set(); user
18/06/24 11:35:56 INFO Utils: Successfully started service 'sparkDriver' on port 62204.
18/06/24 11:35:56 INFO SparkEnv: Registering MapOutputTracker
18/06/24 11:35:56 INFO SparkEnv: Registering BlockManagerMaster
18/06/24 11:35:56 INFO BlockManagerMasterEndpoint: Using org.apache.spark.storage.DefaultTopologyMapper for getting topology information
18/06/24 11:35:56 INFO BlockManagerMasterEndpoint: BlockManagerMasterEndpoint up
18/06/24 11:35:56 INFO DiskBlockManager: Created local directory at C:\Users\Laptop\AppData\Local\Temp\blockmgr-72911522-6c4b-4547-baec-913b665dd609
18/06/24 11:35:56 INFO MemoryStore: MemoryStore started with capacity 902.7 MB
18/06/24 11:35:56 INFO SparkEnv: Registering OutputCommitCoordinator
18/06/24 11:35:57 INFO Utils: Successfully started service 'SparkUI' on port 4040.
18/06/24 11:35:57 INFO SparkUI: Bound SparkUI to 0.0.0.0, and started at http://192.168.56.1:4040
18/06/24 11:35:57 INFO Executor: Starting executor ID driver on host localhost
18/06/24 11:35:57 INFO Utils: Successfully started service 'org.apache.spark.network.netty.NettyBlockTransferService' on port 62213.
18/06/24 11:35:57 INFO NettyBlockTransferService: Server created on 192.168.56.1:62213
18/06/24 11:35:57 INFO BlockManager: Using org.apache.spark.storage.RandomBlockReplicationPolicy for block replication policy
18/06/24 11:35:57 INFO BlockManagerMaster: Registering BlockManager BlockManagerId(driver, 192.168.56.1, 62213, None)
18/06/24 11:35:57 INFO BlockManagerMasterEndpoint: Registering block manager 192.168.56.1:62213 with 902.7 MB RAM, BlockManagerId(driver, 192.168.56.1, 62213, None)
18/06/24 11:35:57 INFO BlockManagerMaster: Registered BlockManager BlockManagerId(driver, 192.168.56.1, 62213, None)
18/06/24 11:35:57 INFO BlockManager: Initialized BlockManager: BlockManagerId(driver, 192.168.56.1, 62213, None)
18/06/24 11:35:57 INFO SharedState: Warehouse path is 'file:/C:/Users/Laptop/IdeaProjects/NewProj1/spark-warehouse/'.
Spark Session Object created
18/06/24 11:35:59 INFO MemoryStore: Block broadcast_0 stored as values in memory (estimated size 127.1 KB, free 902.6 MB)
18/06/24 11:35:59 INFO MemoryStore: Block broadcast_0_piece0 stored as bytes in memory (estimated size 14.3 KB, free 902.6 MB)
18/06/24 11:35:59 INFO BlockManagerInfo: Added broadcast_0_piece0 in memory on 192.168.56.1:62213 (size: 14.3 KB, free: 902.7 MB)
18/06/24 11:35:59 INFO SparkContext: Created broadcast 0 from load at asnt27.scala:49
18/06/24 11:35:59 ERROR Shell: Failed to locate the winutils binary in the hadoop binary path
```

NewProj1 [C:\Users\Laptop\IdeaProjects\NewProj1] - ...\src\main\scala\MLIB\asnt27.scala [newproj1] - IntelliJ IDEA

File Edit View Navigate Code Analyze Refactor Build Run Tools VCS Window Help

NewProj1 > src > main > scala > MLIB > asnt27.scala

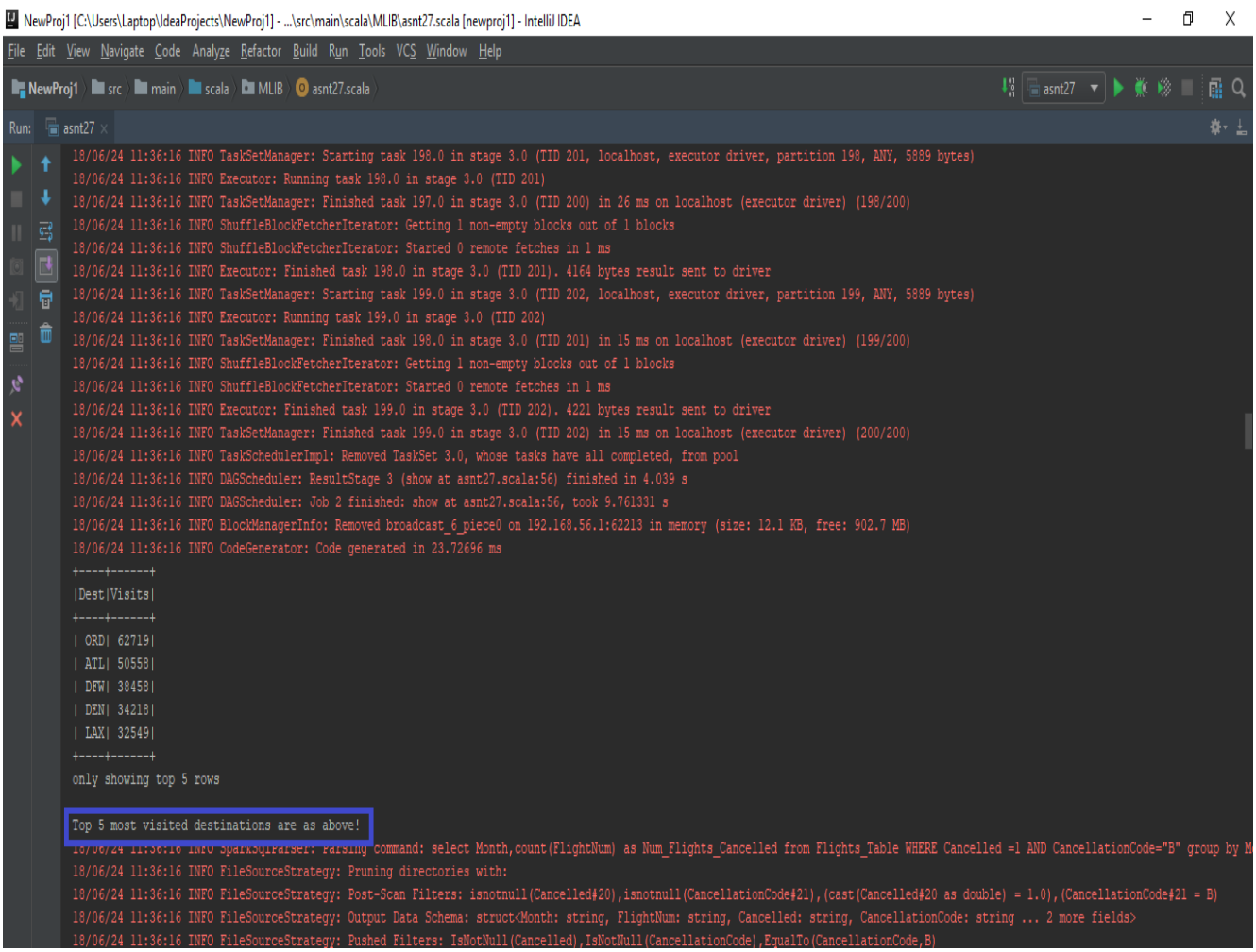
Run: asnt27

```
18/06/24 11:36:00 INFO DAGScheduler: Missing parents: List()
18/06/24 11:36:00 INFO DAGScheduler: Submitting ResultStage 1 (MapPartitionsRDD[5] at load at asnt27.scala:49), which has no missing parents
18/06/24 11:36:00 INFO MemoryStore: Block broadcast_3 stored as values in memory (estimated size 3.5 KB, free 902.4 MB)
18/06/24 11:36:00 INFO MemoryStore: Block broadcast_3_piece0 stored as bytes in memory (estimated size 2.1 KB, free 902.4 MB)
18/06/24 11:36:00 INFO BlockManagerInfo: Added broadcast_3_piece0 in memory on 192.168.56.1:62213 (size: 2.1 KB, free: 902.7 MB)
18/06/24 11:36:00 INFO SparkContext: Created broadcast 3 from broadcast at DAGScheduler.scala:996
18/06/24 11:36:00 INFO DAGScheduler: Submitting 1 missing tasks from ResultStage 1 (MapPartitionsRDD[5] at load at asnt27.scala:49)
18/06/24 11:36:00 INFO TaskSchedulerImpl: Adding task set 1.0 with 1 tasks
18/06/24 11:36:00 INFO TaskSetManager: Starting task 0.0 in stage 1.0 (TID 1, localhost, executor driver, partition 0, PROCESS_LOCAL, 5988 bytes)
18/06/24 11:36:00 INFO Executor: Running task 0.0 in stage 1.0 (TID 1)
18/06/24 11:36:00 INFO HadoopRDD: Input split: file:/E:/assignments ss/DelayedFlights.csv:0+33554432
18/06/24 11:36:00 INFO Executor: Finished task 0.0 in stage 1.0 (TID 1). 1283 bytes result sent to driver
18/06/24 11:36:00 INFO TaskSetManager: Finished task 0.0 in stage 1.0 (TID 1) in 48 ms on localhost (executor driver) (1/1)
18/06/24 11:36:00 INFO TaskSchedulerImpl: Removed TaskSet 1.0, whose tasks have all completed, from pool
18/06/24 11:36:00 INFO DAGScheduler: ResultStage 1 (load at asnt27.scala:49) finished in 0.051 s
18/06/24 11:36:00 INFO DAGScheduler: Job 1 finished: load at asnt27.scala:49, took 0.096066 s
18/06/24 11:36:01 INFO BlockManagerInfo: Removed broadcast_1_piece0 on 192.168.56.1:62213 in memory (size: 2.1 KB, free: 902.7 MB)
18/06/24 11:36:01 INFO BlockManagerInfo: Removed broadcast_2_piece0 on 192.168.56.1:62213 in memory (size: 14.3 KB, free: 902.7 MB)
18/06/24 11:36:01 INFO BlockManagerInfo: Removed broadcast_3_piece0 on 192.168.56.1:62213 in memory (size: 2.1 KB, free: 902.7 MB)
18/06/24 11:36:04 INFO SparkSqlParser: Parsing command: Flights_Table
Flights_Table is registered!
18/06/24 11:36:04 INFO SparkSqlParser: Parsing command: select Dest,count(dest) as Visits from Flights_Table  group by Dest
18/06/24 11:36:05 INFO FileSourceStrategy: Pruning directories with:
18/06/24 11:36:05 INFO FileSourceStrategy: Post-Scan Filters:
18/06/24 11:36:05 INFO FileSourceStrategy: Output Data Schema: struct<Dest: string>
18/06/24 11:36:05 INFO FileSourceStrategy: Pushed Filters:
18/06/24 11:36:05 WARN Utils: Truncated the string representation of a plan since it was too large. This behavior can be adjusted by setting 'spark.debug.maxToStringFields' in SparkEnv
```

## Problem Statement 1: Find out the top 5 most visited destinations.

- Create a variable called dest, which holds the result of the query to find the top most visited destinations.
- Query: we select column “Dest” and count the number of Dest entries from the registered temporary table and group them by Dest column and order them in descending order.
- Filter them with top 5

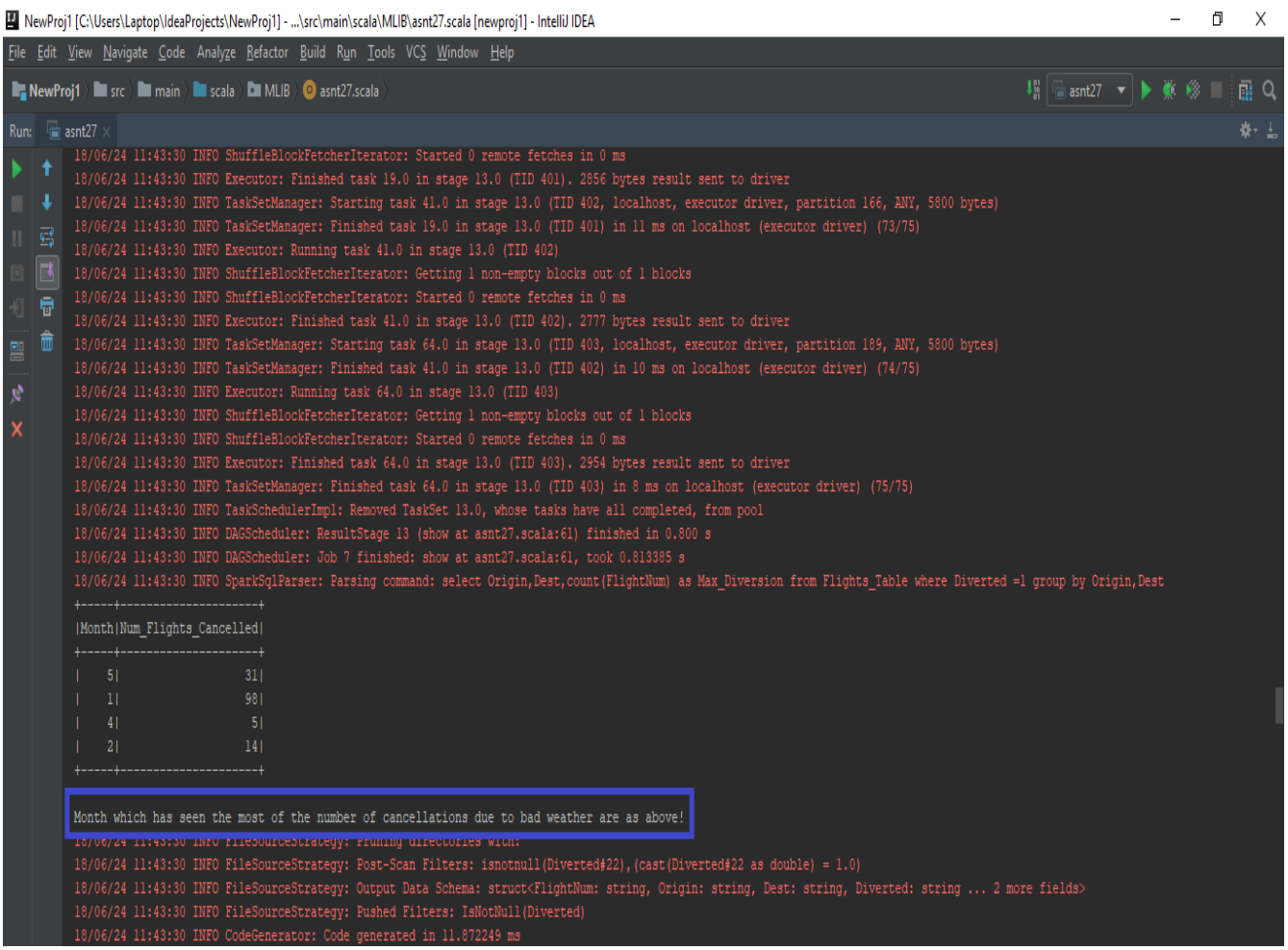
```
//Find out the top 5 most visited destinations.

val dest = spark.sql("""select Dest,count(dest) as Visits from Flights_Table  group by Dest
""").toDF()
 dest.sort(desc("Visits")).show(5)
println("Top 5 most visited destinations are as above!")
```



## Problem Statement 2: Which month has seen the most number of cancellations due to bad weather?

- Create a variable called “cancel”, which holds the result of the query to find which month has seen most number of cancellations due to bad weather.
- Query: we select column Month and count the number of FlightNumber and name it as Num_Flights_Cancelled from the registered table.
- Filter them where column “cancelled” is 1 and concellation code is “B”, which indicates the number of flights cancelled due to bad weather.

```
//Which month has seen the most number of cancellations due to bad weather?
 val cancel = spark.sql("""select Month,count(FlightNum) as Num_Flights_Cancelled from Flights_Table WHERE Cancelled =1 AND CancellationCode="B" group by Month """).toDF()
cancel.show()
 println("Month which has seen the most of the number of cancellations due to bad weather are as above!")
```



## Problem Statement 3: Which route (origin & destination) has seen the maximum diversion?

- Create a variable called “diversion”, which holds the result of the query to find origin and destination which has seen maximum diversion.
- Query: we select columns Origin, Dest and count the number of Flights and name it is as Max_Diversion from the registered table.
- Sort the column “Max_Diversion” in descending order.

```
//Which route (origin & destination) has seen the maximum diversion?
val diversion = spark.sql("""select Origin,Dest,count(FlightNum) as Max_Diversion from Flights_Table where Diverted =1 group by Origin,Dest """)
diversion.toDF().sort(desc("Max_Diversion")).show()
println("List of Origin and destination that has seen the maximum diversion")
```