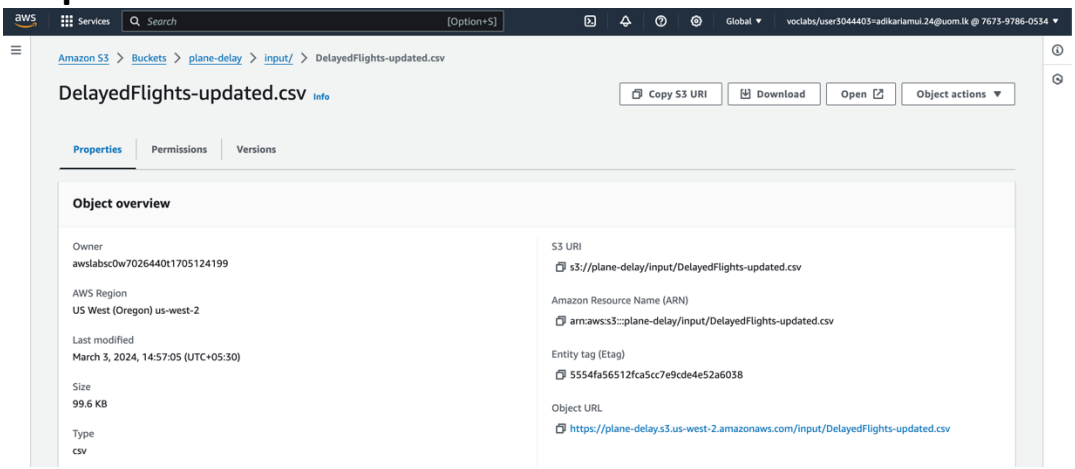
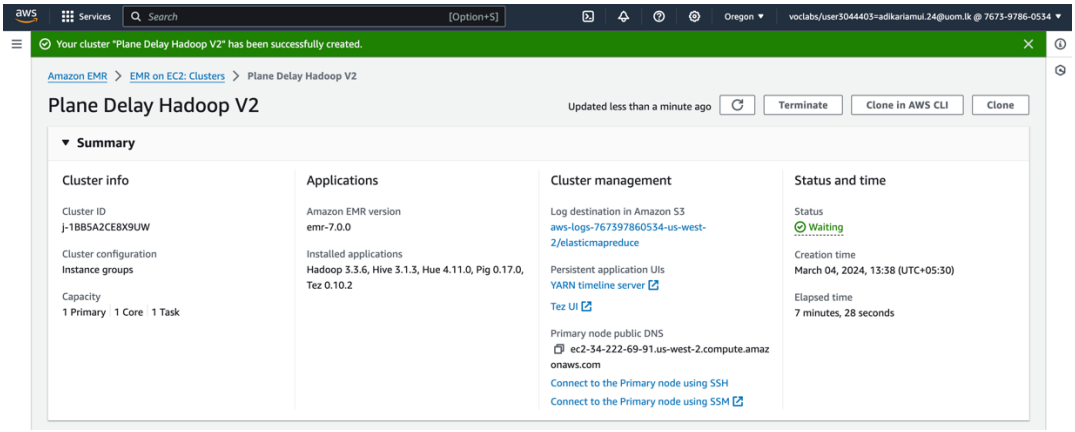
Summary

Map Reduce






```
Last login: Mon Mar  4 13:54:39 on ttys001
upuladikari@Upul-M3 ~ % ssh -i ~/Documents/MSc/upul-test-key.pem hadoop@ec2-34-222-69-91.us-west-
2.compute.amazonaws.com

   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
Last login: Mon Mar  4 08:30:49 2024

EEEEEEEEEEEEEEEEEEE MMMMMMMM           MMMMMMMM RRRRRRRRRRRRRRR
E:::::::::::::::::::E M:::::::M         M:::::::M R:::::::::::::::R
EE:::::EEEEEEEEE:::E M::::::::M       M::::::::M R:::::RRRRRR:::::R
  E::::E       EEEEE M:::::::::M     M:::::::::M RR::::R      R::::R
  E::::E             M::::::M:::M   M:::M::::::M   R:::R      R::::R
  E:::::EEEEEEEEEE   M:::::M M:::M M:::M M:::::M   R:::RRRRRR:::::R
  E::::::::::::::E   M:::::M  M:::M:::M  M:::::M   R:::::::::::RR
  E:::::EEEEEEEEEE   M:::::M   M:::::M   M:::::M   R:::RRRRRR::::R
  E::::E             M:::::M    M:::M    M:::::M   R:::R      R::::R
  E::::E       EEEEE M:::::M     MMM     M:::::M   R:::R      R::::R
EE:::::EEEEEEEE::::E M:::::M             M:::::M   R:::R      R::::R
E::::::::::::::::::E M:::::M             M:::::M RR::::R      R::::R
EEEEEEEEEEEEEEEEEEE MMMMMMM             MMMMMMM RRRRRRR      RRRRRR
```

```
Logging initialized using configuration in file:/etc/hive/conf.dist/hive-log4j2.properties Async: false
hive> CREATE EXTERNAL TABLE FlightDelays (rowNo INT,year STRING,month STRING,dayOfMonth STRING,dayOfWeek STRING,depTime STRING,crsDepTi
me STRING,arrTime STRING,crsArrTime STRING,unCarrier STRING,flightNo STRING,tailNo STRING,actualElapsedTime INT,crsElapsedTime INT,airT
ime INT,arrDelay INT,depDelay INT,origin STRING,dest STRING,distance INT,taxlin INT,taxout INT,cancelled STRING,cancellationCode STRING
,diverted STRING,carrierDelay INT,weatherDelay INT,nasDelay INT,securityDelay INT,lateAirCraftDelay INT)ROW FORMAT DELIMITED FIELDS TER
MINATED BY ',' LOCATION 's3://plane-delay/input' TBLPROPERTIES ("skip.header.line.count"="1");
OK
Time taken: 4.849 seconds
```

```
hive> SELECT year,avg((carrierDelay/arrDelay)*100)from FlightDelays GROUP BY year ORDER BY year;
Query ID = hadoop_20240304083238_7a735697-0aa5-4449-8b8b-5803751a1f68
Total jobs = 1
Launching Job 1 out of 1
Status: Running (Executing on YARN cluster with App id application_1709540004539_0001)

--------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0
--------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0  ----------------------------------------
--------------------------------------------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0  ----------------------------------------
--------------------------------------------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0  ----------------------------------------
```

```
--------------------------------------------------------------------------------
Map 1 ..........  container     SUCCEEDED      1          1        0        0       0       0  ----------------------------------------
------------------------Reducer 2 ......  container     SUCCEEDED      2          2        0        0       0       0
Reducer 3 ......  container     SUCCEEDED      1          1        0        0       0       0
--------------------------------------------------------------------------------
VERTICES: 03/03  [==========================>>] 100%  ELAPSED TIME: 11.72 s
--------------------------------------------------------------------------------
OK
2003    24.557549755575373
2004    43.64459443230066
2005    28.01977637202288
2006    30.453296261292596
2007    19.850007017971283
2008    28.88346981456985
2009    28.33058554239575
2010    21.89310246015957
```

```
hive> SELECT year,avg((nasDelay/arrDelay)*100)from FlightDelays GROUP BY year ORDER BY year;
Query ID = hadoop_20240304083350_6a09f1e3-30db-4406-b73c-8b3ba75dca67
Total jobs = 1
Launching Job 1 out of 1
Status: Running (Executing on YARN cluster with App id application_1709540004539_0001)

--------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0
--------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0  ----------------------------------------
--------------------------------------------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
--------------------------------------------------------------------------------
Map 1 ..........  container     SUCCEEDED      1          1        0        0       0       0  ----------------------------------------
------------------------Reducer 2 ......  container     SUCCEEDED      2          2        0        0       0       0
Reducer 3 ......  container     SUCCEEDED      1          1        0        0       0       0
--------------------------------------------------------------------------------
VERTICES: 03/03  [==========================>>] 100%  ELAPSED TIME: 6.23 s
--------------------------------------------------------------------------------
OK
2003    29.686276314267346
2004    18.24570061769958
2005    16.63868805373129
2006    18.119312329937703
2007    30.625925917941924
2008    30.16552562594132
2009    37.63093330628511
2010    33.87351363404217
Time taken: 6.49 seconds, Fetched: 8 row(s)
```

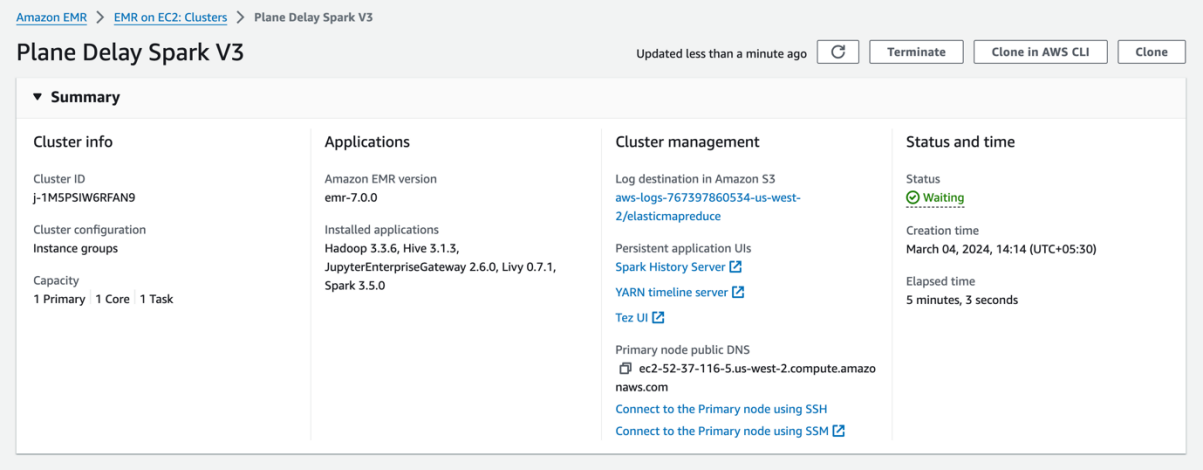
```
hive> SELECT year,avg((weatherDelay/arrDelay)*100)from FlightDelays GROUP BY year ORDER BY year;
Query ID = hadoop_20240304083449_461d2645-4df1-4db2-9e54-070817e6f66a
Total jobs = 1
Launching Job 1 out of 1
Status: Running (Executing on YARN cluster with App id application_1709540004539_0001)

----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
----------------------------------------------------------------------------------------------
```

```
Map 1 .......... container     SUCCEEDED      1          1        0        0       0       0 ----------------------------------------
-------------------------Reducer 2 ...... container     SUCCEEDED      2          2        0        0       0       0
Reducer 3 ...... container     SUCCEEDED      1          1        0        0       0       0
----------------------------------------------------------------------------------------------
VERTICES: 03/03  [==========================>>] 100%  ELAPSED TIME: 6.46 s
----------------------------------------------------------------------------------------------
OK
2003    7.8319479664511205
2004    6.4475279976916555
2005    5.85069715149616
2006    4.588604183967953
2007    4.042975783210287
2008    3.7254490054008955
2009    0.45316615137982363
2010    2.9023312955584664
Time taken: 6.698 seconds, Fetched: 8 row(s)
```

```
hive> SELECT year,avg((lateAirCraftDelay/arrDelay)*100)from FlightDelays GROUP BY year ORDER BY year;
Query ID = hadoop_20240304083540_0261c367-8161-4d0b-a126-5009933a993e
Total jobs = 1
Launching Job 1 out of 1
Status: Running (Executing on YARN cluster with App id application_1709540004539_0001)

----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container  INITIALIZING     -1          0        0       -1       0       0
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
----------------------------------------------------------------------------------------------
        VERTICES      MODE        STATUS  TOTAL  COMPLETED  RUNNING  PENDING  FAILED  KILLED
----------------------------------------------------------------------------------------------
Map 1            container        INITED      1          0        0        1       0       0 ----------------------------------------
```

```
----------------------------------------------------------------------------------------------
Map 1 .......... container     SUCCEEDED      1          1        0        0       0       0 ----------------------------------------
-------------------------Reducer 2 ...... container     SUCCEEDED      2          2        0        0       0       0
Reducer 3 ...... container     SUCCEEDED      1          1        0        0       0       0
----------------------------------------------------------------------------------------------
VERTICES: 03/03  [==========================>>] 100%  ELAPSED TIME: 6.97 s
----------------------------------------------------------------------------------------------
OK
2003    37.924225963706164
2004    31.662176952308105
2005    49.490838422749654
2006    46.838787224801735
2007    45.252432744291134
2008    37.22555555408794
2009    33.585314999939314
2010    41.331052610239794
Time taken: 7.194 seconds, Fetched: 8 row(s)
```

Spark




```
[hadoop@ip-172-31-5-140 ~]$ spark-shell
Mar 04, 2024 8:51:13 AM org.apache.spark.launcher.Log4jHotPatchOption staticJavaAgentOption
WARNING: spark.log4jHotPatch.enabled is set to true, but /usr/share/log4j-cve-2021-44228-hotpatch/jdk17/Log4jHotPatchFat.jar does not exist at
 the configured location

Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLogLevel(newLevel).
24/03/04 08:51:23 WARN Client: Neither spark.yarn.jars nor spark.yarn.archive is set, falling back to uploading libraries under SPARK_HOME.
24/03/04 08:51:38 WARN YarnSchedulerBackend$YarnSchedulerEndpoint: Attempted to request executors before the AM has registered!
Spark context Web UI available at http://ip-172-31-5-140.us-west-2.compute.internal:4040
Spark context available as 'sc' (master = yarn, app id = application_1709542095932_0001).
Spark session available as 'spark'.
Welcome to
      ____              __
     / __/__  ___ _____/ /__
    _\ \/ _ \/ _ `/ __/  '_/
   /___/ .__/\_,_/_/ /_/\_\   version 3.5.0-amzn-0
      /_/
```

```
scala> import org.apache.spark.sql.SparkSession
import org.apache.spark.sql.SparkSession

scala> val spark = SparkSession.builder.appName("PlaneDelayApp").getOrCreate()
24/03/04 08:51:47 WARN SparkSession: Using an existing Spark session; only runtime SQL configurations will take effect.
spark: org.apache.spark.sql.SparkSession = org.apache.spark.sql.SparkSession@516cb8e1

scala> val df = spark.read.option("header", "true").option("inferSchema", "true").csv("s3://plane-delay/input/DelayedFlights-updated.csv")
df: org.apache.spark.sql.DataFrame = [_c0: int, Year: int ... 28 more fields]

scala> df.createOrReplaceTempView("plane_delay")
24/03/04 08:52:25 WARN SparkStringUtils: Truncated the string representation of a plan since it was too large. This behavior can be adjusted b
y setting 'spark.sql.debug.maxToStringFields'.
```

```
scala> val resultCarrierDelay = spark.sql("SELECT Year, avg((CarrierDelay /ArrDelay)*100) from plane_delay GROUP BY Year")
resultCarrierDelay: org.apache.spark.sql.DataFrame = [Year: int, avg(((CarrierDelay / ArrDelay) * 100)): double]

scala> spark.time(resultCarrierDelay .show())
+----+----------------------------------------+
|Year|avg(((CarrierDelay / ArrDelay) * 100))|
+----+----------------------------------------+
|2003|                      24.557549755575373|
|2004|                       43.64459443230066|
|2005|                       28.01977637202288|
|2006|                      30.453296261292596|
|2007|                      19.850007017971283|
|2008|                       28.88346981456985|
|2009|                       28.33058554239575|
|2010|                       21.89310246015957|
+----+----------------------------------------+
```

```
scala> val resultNASDelay = spark.sql("SELECT Year, avg((NASDelay /ArrDelay)*100) from plane_delay GROUP BY Year")
resultNASDelay: org.apache.spark.sql.DataFrame = [Year: int, avg(((NASDelay / ArrDelay) * 100)): double]

scala> spark.time(resultNASDelay .show())
+----+----------------------------------+
|Year|avg(((NASDelay / ArrDelay) * 100))|
+----+----------------------------------+
|2003|                29.686276314267346|
|2004|                 18.24570061769958|
|2005|                 16.63868805373129|
|2006|                18.119312329937703|
|2007|                30.625925917941924|
|2008|                 30.16552562594132|
|2009|                 37.63093330628511|
|2010|                 33.87351363404217|
+----+----------------------------------+

Time taken: 419 ms
```

```
scala> val resultWeatherDelay = spark.sql("SELECT Year, avg((WeatherDelay /ArrDelay)*100) from plane_delay GROUP BY Year")
resultWeatherDelay: org.apache.spark.sql.DataFrame = [Year: int, avg(((WeatherDelay / ArrDelay) * 100)): double]

scala> spark.time(resultWeatherDelay .show())
+----+-----------------------------------+
|Year|avg(((WeatherDelay / ArrDelay) * 100))|
+----+-----------------------------------+
|2003|                   7.8319479664511205|
|2004|                   6.4475279976916555|
|2005|                    5.85069715149616|
|2006|                    4.588604183967953|
|2007|                    4.042975783210287|
|2008|                   3.7254490054008955|
|2009|                  0.45316615137982363|
|2010|                   2.9023312955584664|
+----+-----------------------------------+

Time taken: 1759 ms
```

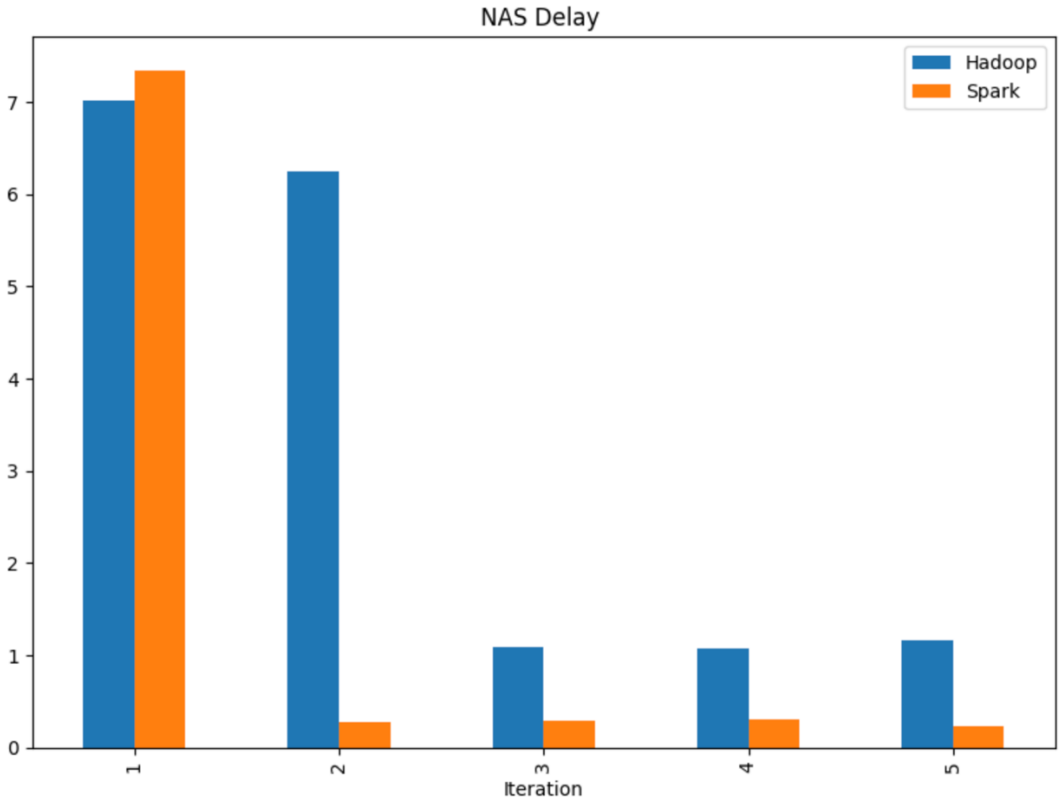
```
scala> val resultLateAircraftDelay = spark.sql("SELECT Year, avg((LateAircraftDelay /ArrDelay)*100) from plane_delay GROUP BY Year")
resultLateAircraftDelay: org.apache.spark.sql.DataFrame = [Year: int, avg(((LateAircraftDelay / ArrDelay) * 100)): double]

scala> spark.time(resultLateAircraftDelay .show())
+----+-------------------------------------------+
|Year|avg(((LateAircraftDelay / ArrDelay) * 100))|
+----+-------------------------------------------+
|2003|                         37.924225963706164|
|2004|                         31.662176952308105|
|2005|                         49.490838422749654|
|2006|                         46.838787224801735|
|2007|                         45.252432744291134|
|2008|                          37.22555555408794|
|2009|                         33.585314999939314|
|2010|                         41.331052610239794|
+----+-------------------------------------------+

Time taken: 514 ms
```

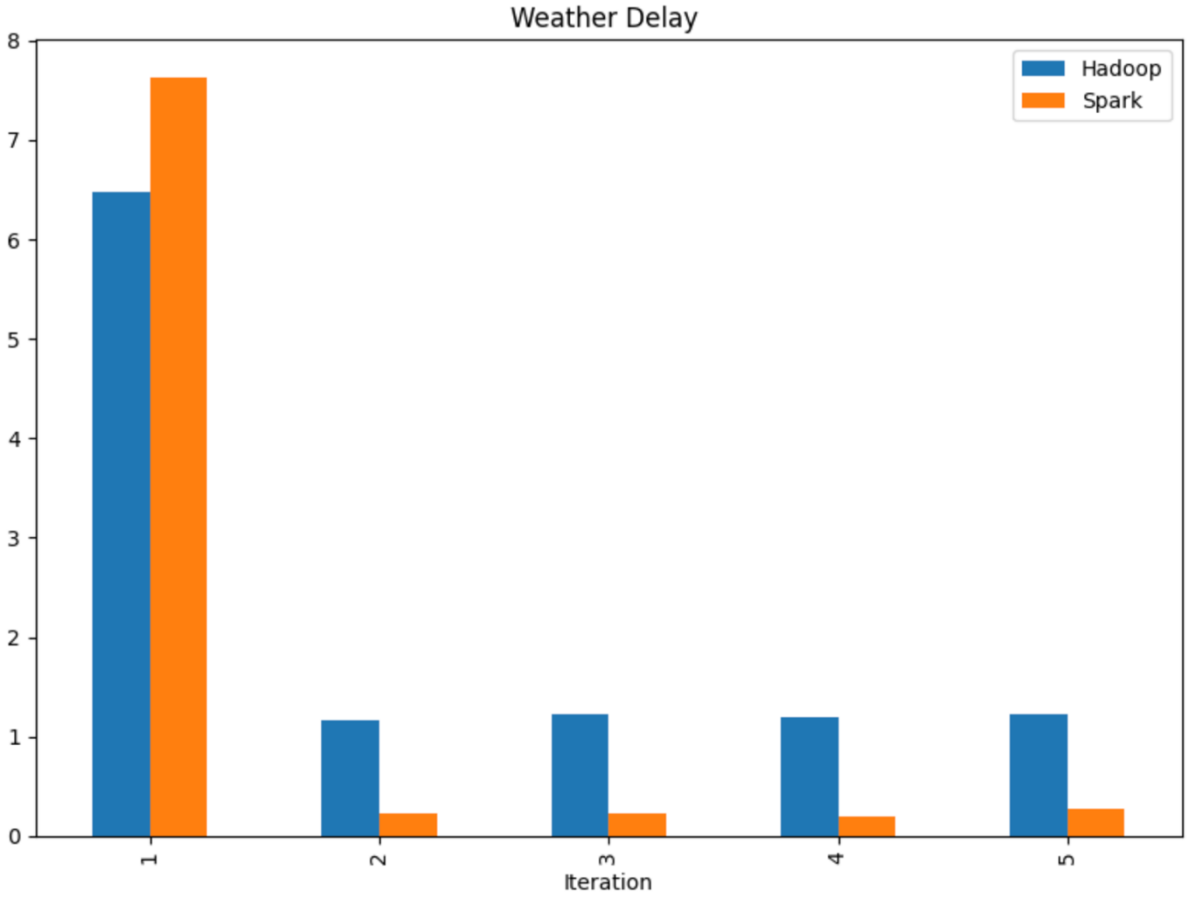
```
scala> val resultSecurityDelay = spark.sql("SELECT Year, avg((SecurityDelay /ArrDelay)*100) from plane_delay GROUP BY Year")
resultSecurityDelay: org.apache.spark.sql.DataFrame = [Year: int, avg(((SecurityDelay / ArrDelay) * 100)): double]

scala> spark.time(resultSecurityDelay .show())
+----+---------------------------------------+
|Year|avg(((SecurityDelay / ArrDelay) * 100))|
+----+---------------------------------------+
|2003|                                    0.0|
|2004|                                    0.0|
|2005|                                    0.0|
|2006|                                    0.0|
|2007|                   0.22865853658536586|
|2008|                                    0.0|
|2009|                                    0.0|
|2010|                                    0.0|
+----+---------------------------------------+

Time taken: 332 ms
```

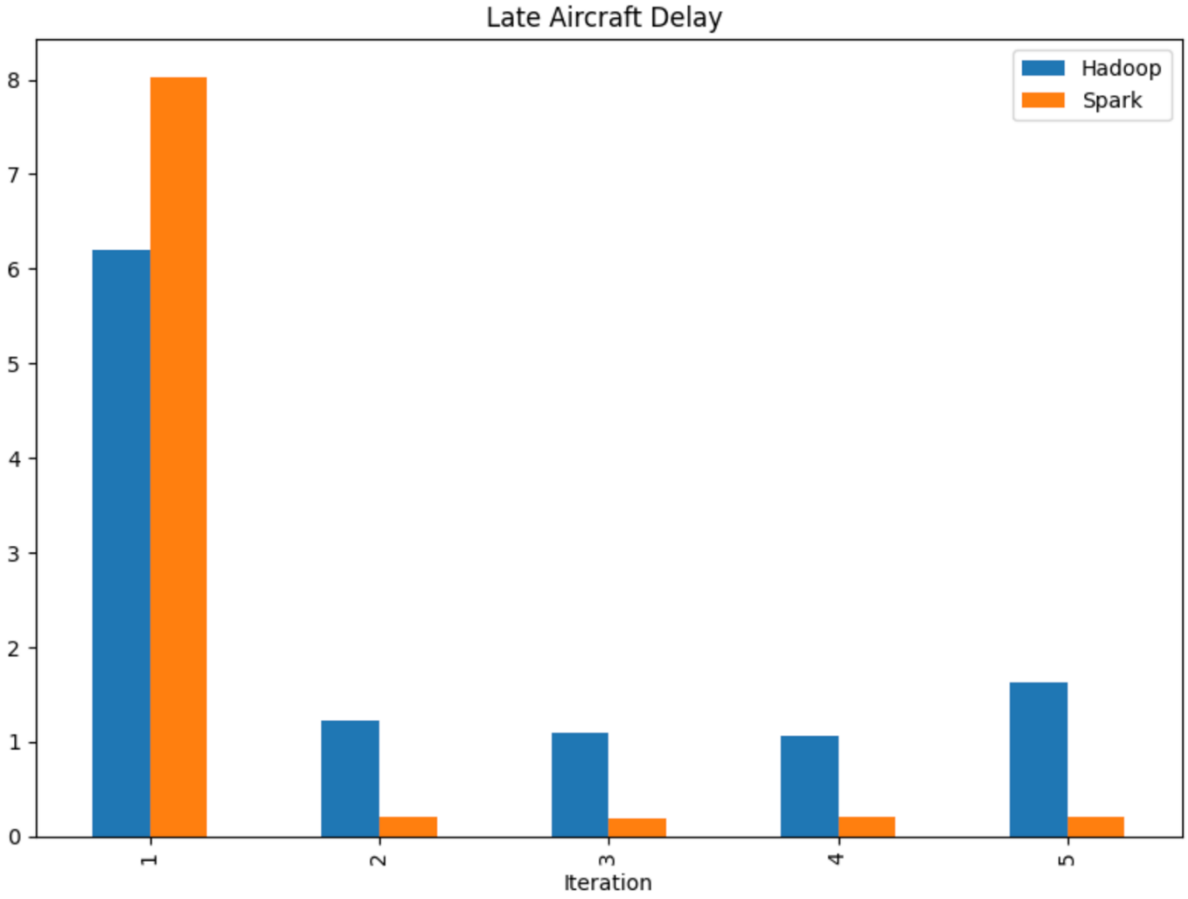
Results

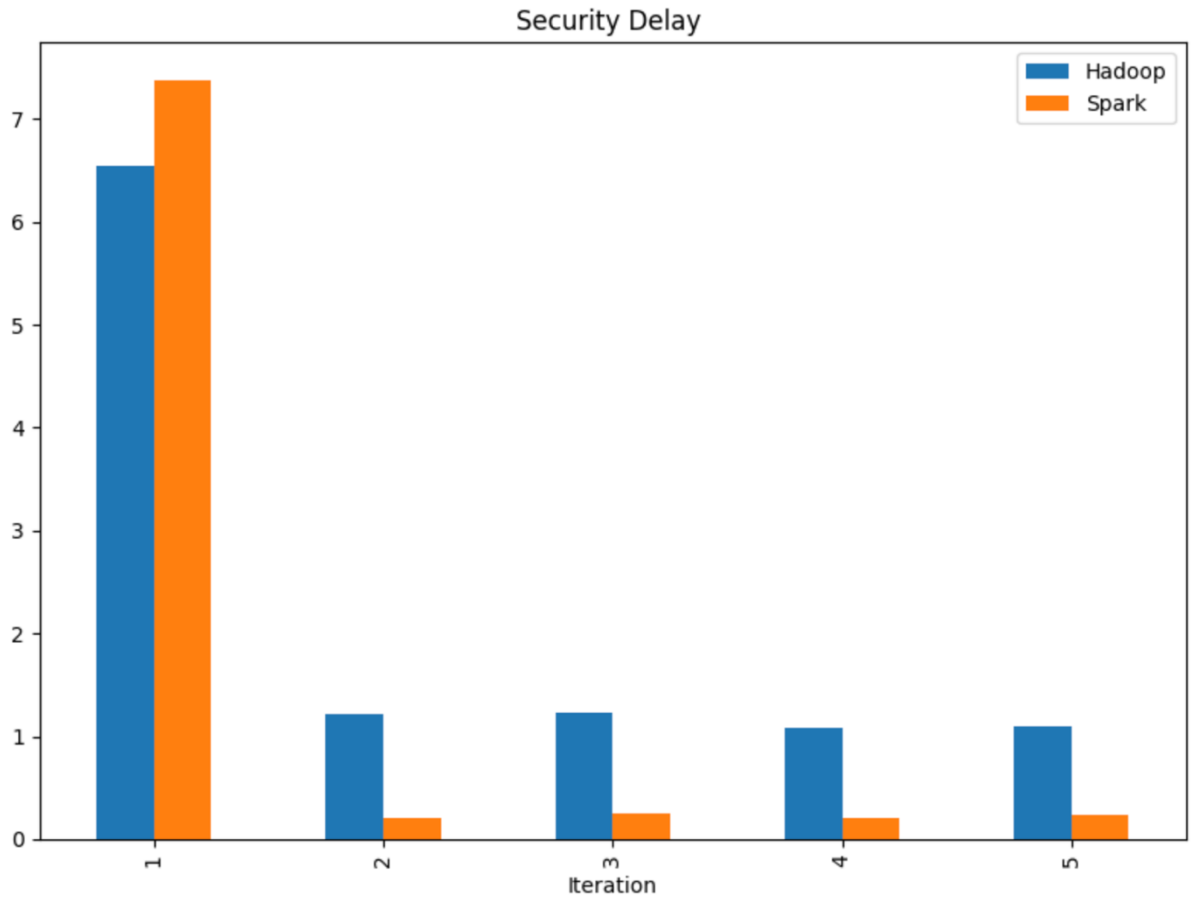
One Iteration Summary (5th Iteration)

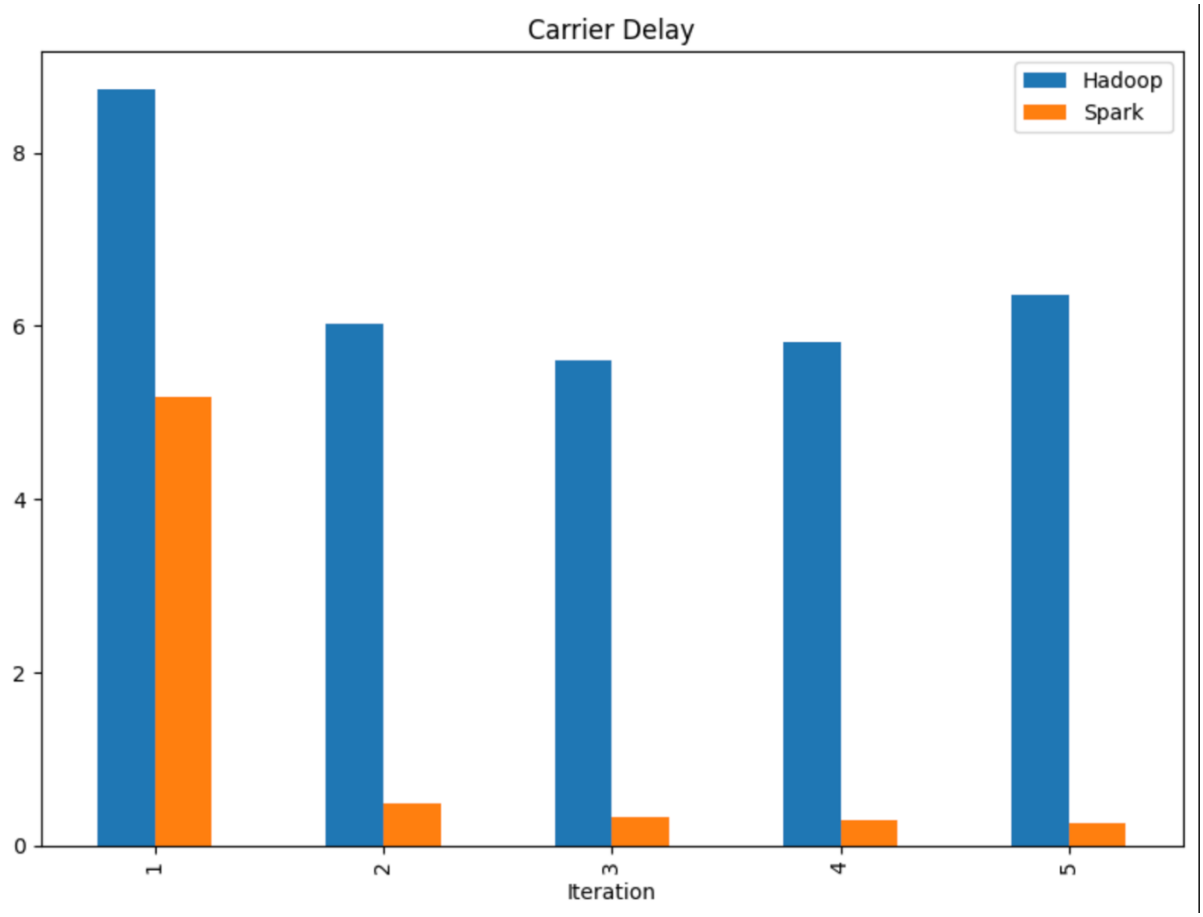
Time Taken By Query (in Sec) In One Iteration	HIVE QL	SPARK SQL
Carrier Delay Query	6.36	0.269
NAS Delay Query	1.16	1.16
Weather Delay Query	1.22	1.22
Late Aircraft Delay Query	1.63	0.213
Security Delay Query	1.09	0.229




Weather Delay
Hadoop
Spark
8
7
6
5
4
3
2
1
0
1
2
3
4
5
Iteration


Late Aircraft Delay
Hadoop
Spark
8
7
6
5
4
3
2
1
0
1
2
3
4
5
Iteration


Security Delay
Hadoop
Spark
0
1
2
3
4
5
6
7
1
2
3
4
5
Iteration


Carrier Delay
Hadoop
Spark
0
2
4
6
8
1
2
3
4
5
Iteration