BigData Concepts

11 January 2024 09:03

Apache Kafka Installation

Version of Apache Hadoop 3.2.4
Version of Apache Kafka 2.8.0
Version of Scala 2.13

Download the Apache kafka and scala using the below mentioned link

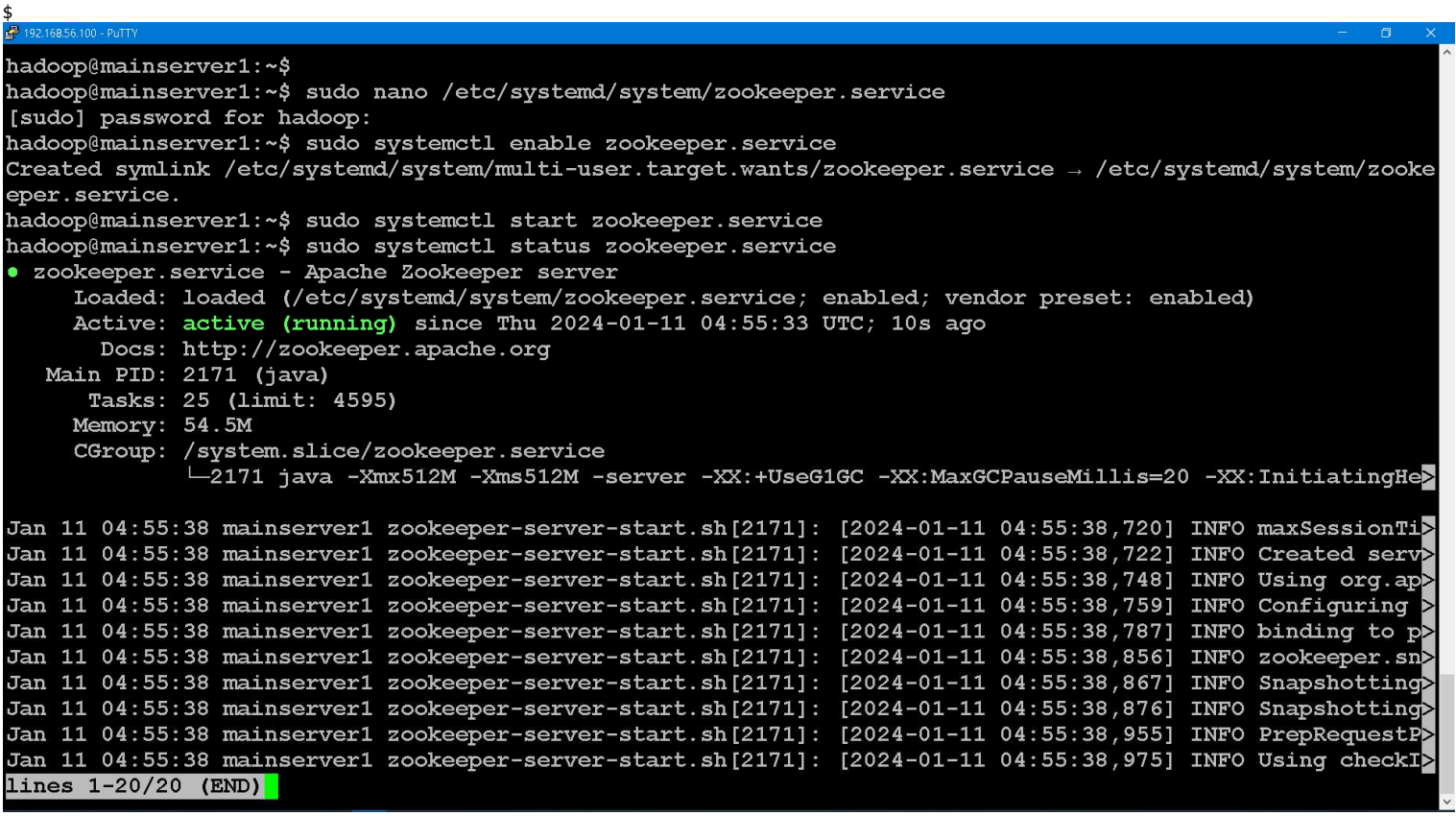
https://archive.apache.org/dist/kafka/2.8.0/kafka_2.13-2.8.0.tgz

https://downloads.lightbend.com/scala/2.13.0/scala-2.13.0.tgz

$ tar -zxf kafka_2.13-2.8.0.tgz
$ tar -zxf scala-2.13.0.tgz

$ su
# mv kafka_2.13-2.8.0 /usr/local/kafka
# mv scala-2.13.0 /usr/local/scala

# vim /etc/bash.bashrc
# append the following lines to the end to the file
# SCALA CONFIG
SCALA_HOME=/usr/local/scala
export PATH=$PATH:$SCALA_HOME/bin
<save and exit>
$



$ sudo nano /etc/systemd/system/zookeeper.service

[Unit]
Description=Apache Zookeeper server
Documentation=http://zookeeper.apache.org
Requires=network.target remote-fs.target
After=network.target remote-fs.target
[Service]
Type=simple
ExecStart=/usr/local/kafka/bin/zookeeper-server-start.sh /usr/local/kafka/config/zookeeper.properties
ExecStop=/usr/local/kafka/bin/zookeeper-server-stop.sh
Restart=on-abnormal
[Install]
WantedBy=multi-user.target

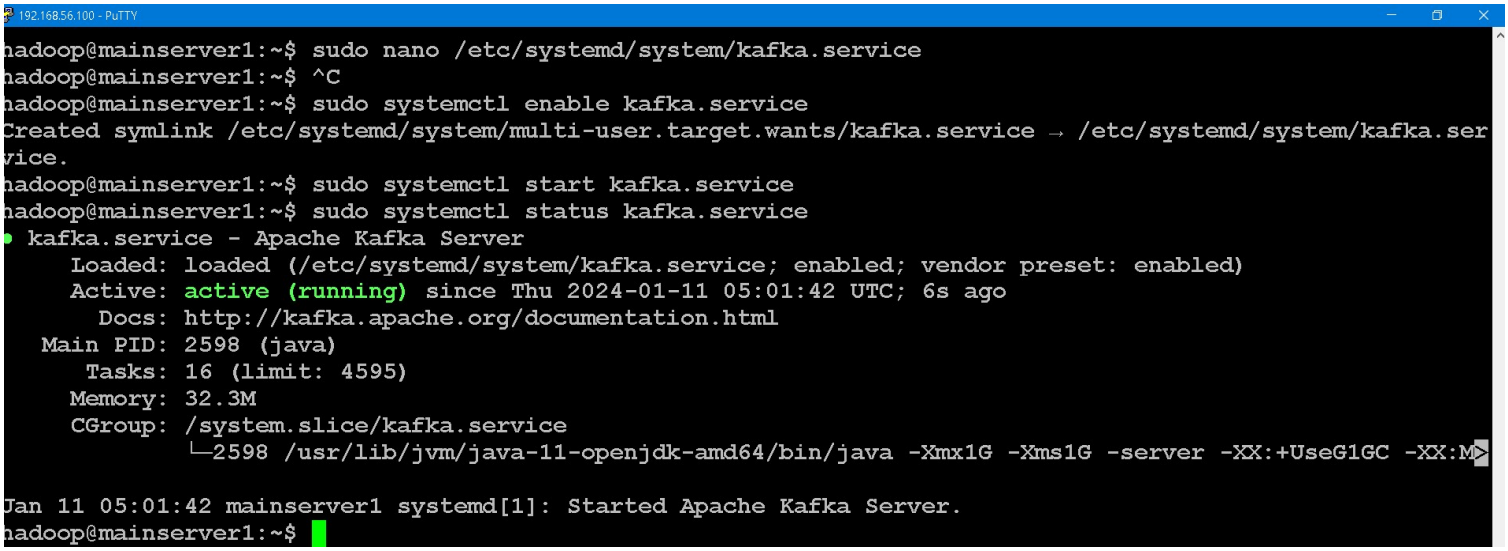
<save and exit>

$ sudo systemctl enable zookeeper.service
$ sudo systemctl start zookeeper.service
$ sudo systemctl status zookeeper.service

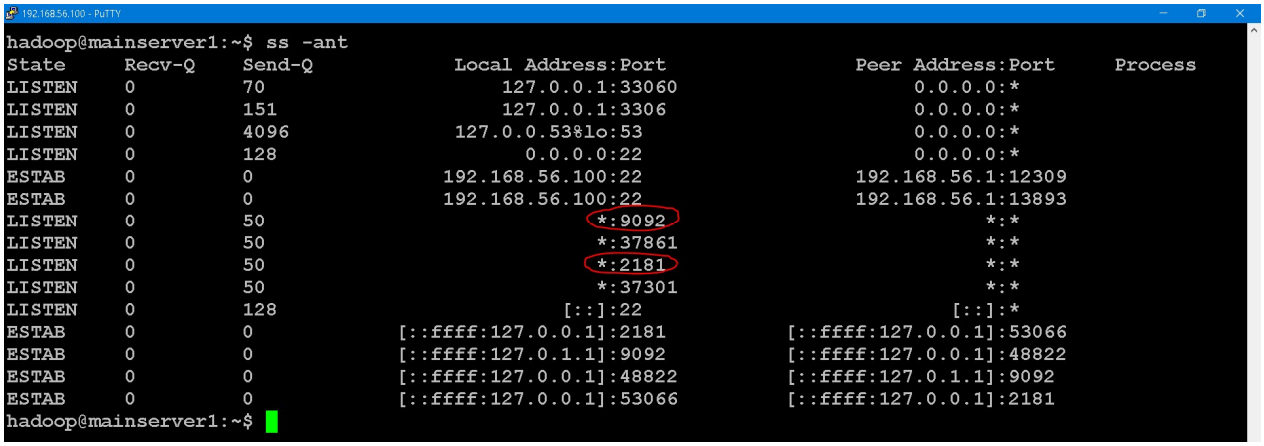
$ sudo nano /etc/systemd/system/kafka.service
[Unit]
Description=Apache Kafka Server
Documentation=http://kafka.apache.org/documentation.html
Requires=zookeeper.service

[Service]
Type=simple
Environment="JAVA_HOME=/usr/lib/jvm/java-11-openjdk-amd64"
ExecStart=/usr/local/kafka/bin/kafka-server-start.sh /usr/local/kafka/config/server.properties
ExecStop=/usr/local/kafka/bin/kafka-server-stop.sh

[Install]
WantedBy=multi-user.target



$ sudo systemctl enable kafka.service Kafka port
$ sudo systemctl start kafka.service
$ sudo systemctl status kafka.service Zookeeper port
$ ss -ant



- When all the components are installed, we need to create a topic and try to send a message.
- In kafka a topic is a fundamental unit used to organize messages
- Each topic should have a unique name across a cluster.
- Topics allows users to send and read data between kafka servers.
- We can create as many clusters as possible in kafka.
- Default port of zookeeper is 2181 and default port for kafka is 9092

Testing scala - This is used to check scala REPL (Read-Eval-Print-Loop)

curl -fL https://github.com/coursier/coursier/releases/latest/download/cs-x86_64-pc-linux.gz | gzip -d > cs && chmod +x cs
&& ./cs setup

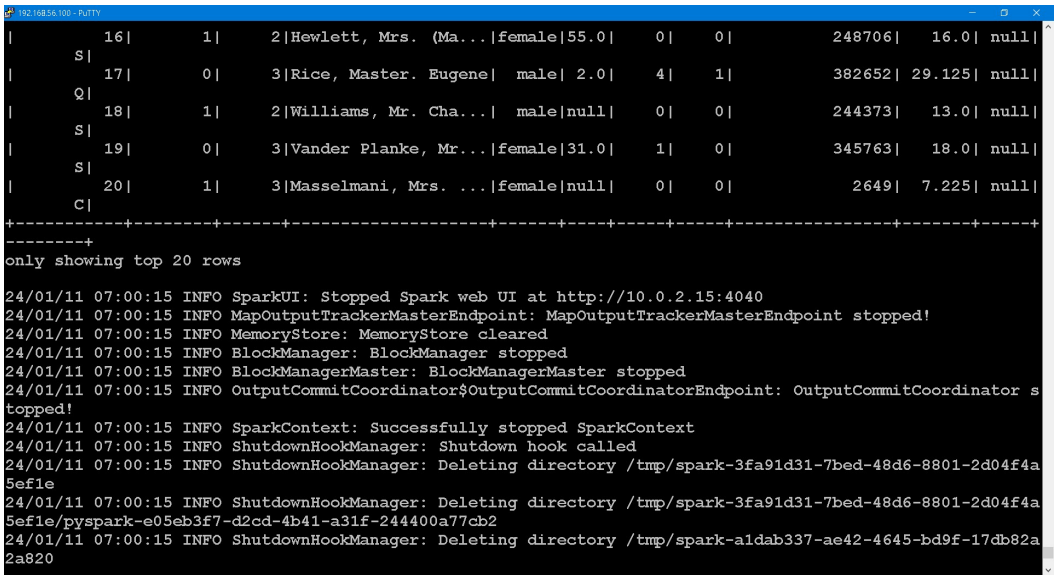
Analysing CSV data using pyspark

We are using the titanic.csv file present in our home directory

```
$  Vim  titanic_proj.py
from pyspark.sql import SparkSession
from pyspark.sql.functions import col

# Step 1: Create a Spark session
spark = SparkSession.builder.appName("TitanicAnalysis").getOrCreate()

# Step 2: Load the Titanic dataset into a PySpark DataFrame
titanic_df = spark.read.csv("/home/hadoop/titanic.csv", header=True, inferSchema=True)

# Step 3: Explore the data
print("Number of rows: ", titanic_df.count())
print("Schema: ")
titanic_df.printSchema()

# Display the data present in the file
titanic_df.show()

# Stop the spark session
spark.stop()

$ spark-submit ./titanic_proj.py
```

Sample output :

```
24/01/11 07:00:13 INFO TaskSchedulerImpl: Removed TaskSet 4.0, whose tasks have all completed, from pool
24/01/11 07:00:13 INFO DAGScheduler: ResultStage 4 (count at NativeMethodAccessorImpl.java:0) finished in
 0.399 s
24/01/11 07:00:13 INFO DAGScheduler: Job 3 is finished. Cancelling potential speculative or zombie tasks
for this job
24/01/11 07:00:13 INFO TaskSchedulerImpl: Killing all running tasks in stage 4: Stage finished
24/01/11 07:00:13 INFO DAGScheduler: Job 3 finished: count at NativeMethodAccessorImpl.java:0, took 0.443
568 s
Number of rows:  891
Schema:
root
 |-- PassengerId: integer (nullable = true)
 |-- Survived: integer (nullable = true)
 |-- Pclass: integer (nullable = true)
 |-- Name: string (nullable = true)
 |-- Sex: string (nullable = true)
 |-- Age: double (nullable = true)
 |-- SibSp: integer (nullable = true)
 |-- Parch: integer (nullable = true)
 |-- Ticket: string (nullable = true)
 |-- Fare: double (nullable = true)
 |-- Cabin: string (nullable = true)
 |-- Embarked: string (nullable = true)

24/01/11 07:00:14 INFO FileSourceStrategy: Pushed Filters:
24/01/11 07:00:14 INFO FileSourceStrategy: Post-Scan Filters:
24/01/11 07:00:14 INFO FileSourceStrategy: Output Data Schema: struct<PassengerId: int, Survived: int, Pc
lass: int, Name: string, Sex: string ... 10 more fields>
```



Alter the file titanic_proj.py, run the script and view the output

```
# Step 4:  if you need to display only few rows or eg : 5 rows only we can alter it as
titanic_df.show(5)

# Step 5: Let us perfrom the data cleaning and preproceesing
```

# drop irrelevanet colums and handle missing values
titanic_df = titanic_df.drop("Cabin") # Drop the cabin column
titanic_df = titanic_df.dropna() # Drop the irows with missing null values

<Save and exit>

Alter the file again with the below parameters
Step 5: Basic Analysis
Count the number of survivors by gender
survivors_by_gender =
titanic_df.groupBy("Sex").agg({"Survived":"sum"}).withColumnRenamed("sum(Survived)","SurvivorCount")

survivors_by_gender.show()

Sample output:

```
24/01/11 09:10:49 INFO TaskSchedulerImpl: Removed TaskSet 7.0, whose tasks have all completed, from pool
24/01/11 09:10:49 INFO DAGScheduler: ResultStage 7 (showString at NativeMethodAccessorImpl.java:0) finish
ed in 0.590 s
24/01/11 09:10:49 INFO DAGScheduler: Job 5 is finished. Cancelling potential speculative or zombie tasks
for this job
24/01/11 09:10:49 INFO TaskSchedulerImpl: Killing all running tasks in stage 7: Stage finished
24/01/11 09:10:49 INFO DAGScheduler: Job 5 finished: showString at NativeMethodAccessorImpl.java:0, took
0.688359 s
24/01/11 09:10:49 INFO CodeGenerator: Code generated in 84.442611 ms
+------+-------------+
|   Sex|SurvivorCount|
+------+-------------+
|female|          195|
|  male|           93|
+------+-------------+

24/01/11 09:10:50 INFO FileSourceStrategy: Pushed Filters:
24/01/11 09:10:50 INFO FileSourceStrategy: Post-Scan Filters: atleastnnonnulls(11, PassengerId#16, Surviv
ed#17, Pclass#18, Name#19, Sex#20, Age#21, SibSp#22, Parch#23, Ticket#24, Fare#25, Embarked#27)
24/01/11 09:10:50 INFO FileSourceStrategy: Output Data Schema: struct<PassengerId: int, Survived: int, Pc
lass: int, Name: string, Sex: string ... 9 more fields>
24/01/11 09:10:50 INFO CodeGenerator: Code generated in 266.508376 ms
```

# STEP 6: Caclating the average age of a passenger
average_age = titanic_df.select("Pclass", "Age").groupBy("Pclass").agg({"Age": "avg"}).withColumnRenamed("avg(Age)",
"AverageAge")
average_age.show()

Sample output:

```
24/01/11 09:23:29 INFO DAGScheduler: ResultStage 10 (showString at NativeMethodAccessorImpl.java:0) finis
hed in 0.148 s
24/01/11 09:23:29 INFO DAGScheduler: Job 7 is finished. Cancelling potential speculative or zombie tasks
for this job
24/01/11 09:23:29 INFO TaskSchedulerImpl: Killing all running tasks in stage 10: Stage finished
24/01/11 09:23:29 INFO DAGScheduler: Job 7 finished: showString at NativeMethodAccessorImpl.java:0, took
0.188337 s
+------+-----------------+
|Pclass|       AverageAge|
+------+-----------------+
|     1|38.10554347826087|
|     3|25.14061971830986|
|     2|29.87763005780347|
+------+-----------------+

24/01/11 09:23:30 INFO FileSourceStrategy: Pushed Filters:
24/01/11 09:23:30 INFO FileSourceStrategy: Post-Scan Filters: atleastnnonnulls(11, PassengerId#16, Surviv
ed#17, Pclass#18, Name#19, Sex#20, Age#21, SibSp#22, Parch#23, Ticket#24, Fare#25, Embarked#27)
24/01/11 09:23:30 INFO FileSourceStrategy: Output Data Schema: struct<PassengerId: int, Survived: int, Pc
lass: int, Name: string, Sex: string ... 9 more fields>
24/01/11 09:23:30 INFO CodeGenerator: Code generated in 56.384357 ms
```

Creating an Airflow DAG - to schedule and execute the script as a Directed Acyclic Graph and we shall save the results to another file.

We will be using the existing titanic.csv dataset and the previously written script in this exercise
path where the titanic dataset is present /home/hadoop/titanic.csv

$ nohup airflow scheduler > scheduler.log 2>&1 &

$ nohup airflow webserver -p 8080 > webserver.log 2>&1 &

$ mkdir AirflowDAG
$ cd AirflowDAG

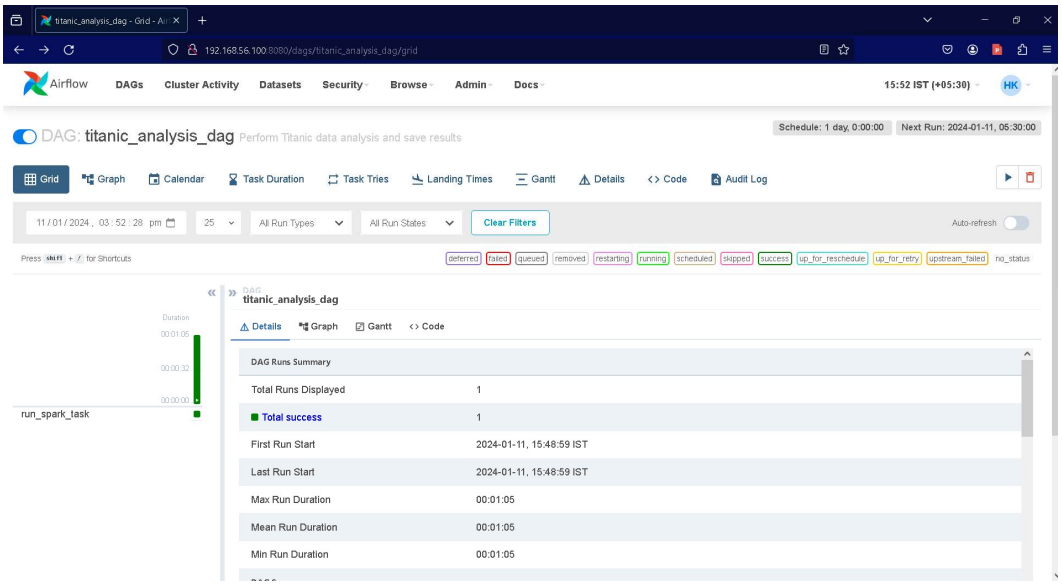
$ vim titanic_analysis.py

```
from pyspark.sql import SparkSession
from pyspark.sql.functions import col

# Step 1: Create a Spark session
spark = SparkSession.builder.appName("TitanicAnalysis").getOrCreate()

# Step 2: Load the Titanic dataset into a PySpark DataFrame
titanic_df = spark.read.csv("/home/hadoop/spark/AirflowDAG/titanic.csv", header=True, inferSchema=True)
```

```
# Step 3: Explore the data
print("Number of rows: ", titanic_df.count())
print("Schema: ")
titanic_df.printSchema()

# Step 4: Let us perfrom the data cleaning and preproceesing
# drop irrelevanet colums and handle missing values
# Drop the cabin column
titanic_df = titanic_df.drop("Cabin")

# Drop the rows with missing null values
titanic_df = titanic_df.dropna()

# Step 5: Basic Analysis
# Count the number of survivors by gender
survivors_by_gender =
titanic_df.groupBy("Sex").agg({"Survived":"sum"}).withColumnRenamed("sum(Survived)","SurvivorCount")
survivors_by_gender.show()


# Save the results to anothere file (in csv format itself)
survivors_by_gender.write.csv("/home/hadoop/spark/AirflowDAG/survivors_by_gender.csv",header=True,mode="overwrite")

# STEP 6: Caclating the average age of a passenger
average_age = titanic_df.select("Pclass", "Age").groupBy("Pclass").agg({"Age": "avg"}).withColumnRenamed("avg(Age)",
"AverageAge")
average_age.show()


# Save the results to anothere file (in csv format itself)
average_age.write.csv("/home/hadoop/spark/AirflowDAG/average_age.csv",header=True,mode="overwrite")

# STEP 6: Display the data present in the file
titanic_df.show()
# -- this will display by default 20 rows

# Step 6-1:  if you need to display only few rows or eg : 5 rows only we can alter it as
# titanic_df.show(5)

# Step 7: Stop the spark session
spark.stop()

<save and exit>

# vim  titanic_analysis_dag.py

from datetime import datetime, timedelta
from airflow import DAG
from airflow.operators.bash_operator import BashOperator

# Default arguments for the DAG
default_args = {
    'owner': 'airflow',
    'depends_on_past': False,
    'start_date': datetime(2024, 1, 11),
    'email_on_failure': False,
    'email_on_retry': False,
    'retries': 1,
    'retry_delay': timedelta(minutes=5),
}

# Create a DAG
dag = DAG(
    'titanic_analysis_dag',
    default_args=default_args,
    description='Perform Titanic data analysis and save results',
    schedule_interval=timedelta(days=1),  # Set your desired schedule
)

# Task to run the PySpark script
run_spark_task = BashOperator(
    task_id='run_spark_task',
    bash_command='spark-submit /home/hadoop/spark/AirflowDAG/titanic_analysis.py',
    dag=dag,
)

# Define task dependencies
run_spark_task

<save and exit>
```

Final output

```
root@mainserver1:/home/hadoop/spark/AirflowDAG# tree
.
├── average_age.csv
│   ├── part-00000-b347010b-7c01-4d52-b3b1-ac6d593b647c-c000.csv
│   └── _SUCCESS
├── scheduler.log
├── survivors_by_gender.csv
│   ├── part-00000-972df388-eabf-49b9-abe2-7cf690a362cc-c000.csv
│   └── _SUCCESS
├── titanic_analysis_dag.py
├── titanic_analysis.py
├── titanic.csv
└── webserver.log

2 directories, 9 files
root@mainserver1:/home/hadoop/spark/AirflowDAG# cat average_age.csv/part-00000-b347010b-7c01-4d52-b3b1-ac
6d593b647c-c000.csv
Pclass,AverageAge
1,38.10554347826087
3,25.14061971830986
2,29.87763005780347
root@mainserver1:/home/hadoop/spark/AirflowDAG# cat survivors_by_gender.csv/part-00000-972df388-eabf-49b9
-abe2-7cf690a362cc-c000.csv
Sex,SurvivorCount
female,195
male,93
root@mainserver1:/home/hadoop/spark/AirflowDAG#
```



Creating RDDs:

a. Parallelize: Creating an RDD from a Python list

```
from pyspark import SparkContext

# Create a SparkContext
sc = SparkContext("local", "RDDPersistenceExample")

# Create an RDD from a list of numbers
data = [1, 2, 3, 4, 5]
rdd = sc.parallelize(data)
```

b. Text File: Create an RDD by reading data from a text file

```
from pyspark import SparkContext

sc = SparkContext("local", "RDDExample")
rdd = sc.textFile("path/to/textfile.txt")
```

Transformation Operations : Map, Filter, FlatMap
Action Operations: Collect , Count, Reduce, Take

Transformation and actions -- combined together

Wordcount example which we used earlier

```
words = rdd_flatmap.map(lambda x: (x, 1))   ----> Map, FlatMap
word_counts = words.reduceByKey(add)       ---> Reduce By
result_word_counts = word_counts.collect()   ---> Collect
```

```
hadoop@bigadmin:~$ sudo curl -fL https://github.com/coursier/coursier/releases/latest/download/cs-x86_64-
pc-linux.gz | gzip -d > cs && chmod +x cs && ./cs setup
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0
  0     0    0     0    0     0      0      0 --:--:-- --:--:-- --:--:--     0
100 19.8M  100 19.8M    0     0  2370k      0  0:00:08  0:00:08 --:--:-- 4106k
Checking if a JVM is installed
https://github.com/coursier/jvm-index/raw/master/index.json
  100.0% [##########] 1.4 MiB (417.8 KiB / s)
  No JVM found, should we try to install one? [Y/n] Y
  Should we update ~/.profile? [Y/n] Y
Some shell configuration files were updated. It is recommended to close this terminal once the setup comm
and is done, and open a new one for the changes to be taken into account.

Checking if ~/.local/share/coursier/bin is in PATH
  Should we add ~/.local/share/coursier/bin to your PATH via ~/.profile? [Y/n] Y

Checking if the standard Scala applications are installed
  Installed ammonite
  Installed cs
  Installed coursier
  Installed scala
  Installed scalac
  Installed scala-cli
  Installed sbt
  Installed sbtn
  Installed scalafmt
```