Environment Setup

Download the Dataset

In this assignmentl you need to download two files, people.txt and people.json into your Sandbox's **tmp** folder. The commands below should be typed into Shell-in-a-Box

1. Assuming you start as **root** user:

```
cd /tmp
```

2. Copy and paste the command to download the people.txt:

```
#Download people.txt
wget https://raw.githubusercontent.com/hortonworks/data-
tutorials/master/tutorials/hdp/dataFrame-and-dataset-examples-in-spark-
repl/assets/people.txt
```

3. Copy and paste the command to download the people.json:

```
#Download people.json
wget https://raw.githubusercontent.com/hortonworks/data-
tutorials/master/tutorials/hdp/dataFrame-and-dataset-examples-in-spark-
repl/assets/people.json
```

Upload the dataset to HDFS

1. Before moving the files into HDFS you need to login under **hdfs** user in order to give root user permission to perform file operations:

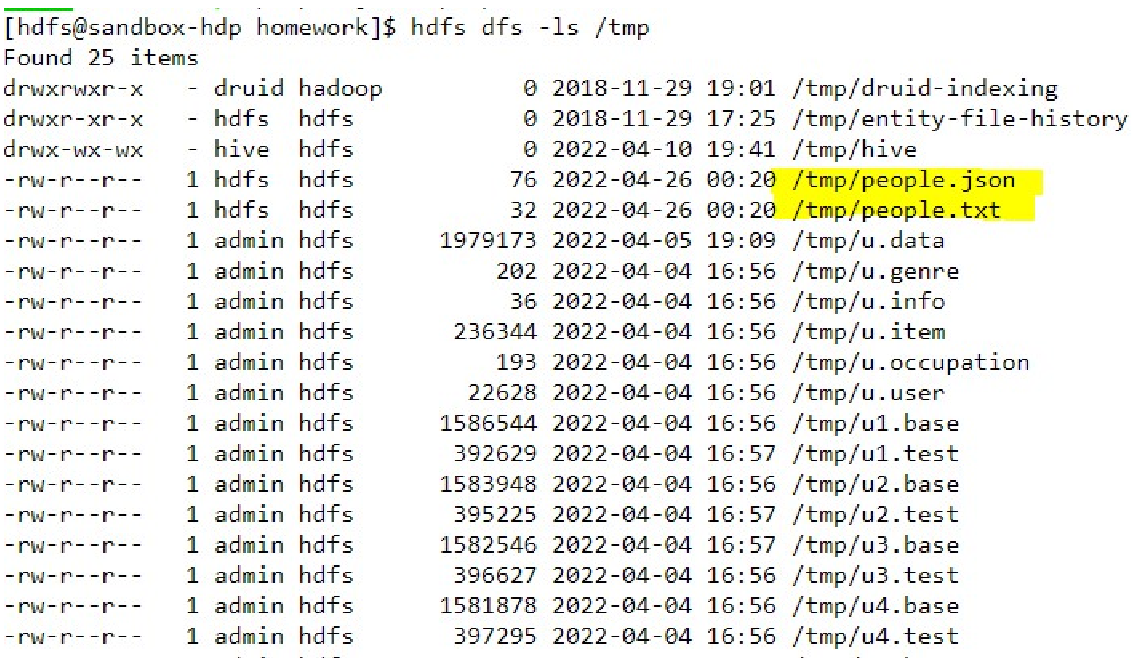
```
#Login as hdfs user to give root permissions for file operations
su hdfs
cd
```

2. Next, upload people.txt and people.json files to HDFS:

```
#Copy files from local system to HDF
hdfs dfs -put /tmp/people.txt /tmp/people.txt
hdfs dfs -put /tmp/people.json /tmp/people.json
```

3.Verify that both files were copied into HDFS **/tmp** folder by copying the following commands:

```
#Verify that files were move to HDF
hdfs dfs -ls /tmp
```



```
[hdfs@sandbox-hdp homework]$ hdfs dfs -ls /tmp
Found 25 items
drwxrwxr-x   - druid hadoop          0 2018-11-29 19:01 /tmp/druid-indexing
drwxr-xr-x   - hdfs  hdfs            0 2018-11-29 17:25 /tmp/entity-file-history
drwx-wx-wx   - hive  hdfs            0 2022-04-10 19:41 /tmp/hive
-rw-r--r--   1 hdfs  hdfs           76 2022-04-26 00:20 /tmp/people.json
-rw-r--r--   1 hdfs  hdfs           32 2022-04-26 00:20 /tmp/people.txt
-rw-r--r--   1 admin hdfs      1979173 2022-04-05 19:09 /tmp/u.data
-rw-r--r--   1 admin hdfs          202 2022-04-04 16:56 /tmp/u.genre
-rw-r--r--   1 admin hdfs           36 2022-04-04 16:56 /tmp/u.info
-rw-r--r--   1 admin hdfs       236344 2022-04-04 16:56 /tmp/u.item
-rw-r--r--   1 admin hdfs          193 2022-04-04 16:56 /tmp/u.occupation
-rw-r--r--   1 admin hdfs        22628 2022-04-04 16:56 /tmp/u.user
-rw-r--r--   1 admin hdfs      1586544 2022-04-04 16:56 /tmp/u1.base
-rw-r--r--   1 admin hdfs       392629 2022-04-04 16:57 /tmp/u1.test
-rw-r--r--   1 admin hdfs      1583948 2022-04-04 16:56 /tmp/u2.base
-rw-r--r--   1 admin hdfs       395225 2022-04-04 16:57 /tmp/u2.test
-rw-r--r--   1 admin hdfs      1582546 2022-04-04 16:57 /tmp/u3.base
-rw-r--r--   1 admin hdfs       396627 2022-04-04 16:56 /tmp/u3.test
-rw-r--r--   1 admin hdfs      1581878 2022-04-04 16:56 /tmp/u4.base
-rw-r--r--   1 admin hdfs       397295 2022-04-04 16:56 /tmp/u4.test
```

Now, we are ready to start the examples.

4.Launch the Spark Shell:

```
spark-shell
```

DataFrame API Example

DataFrame API provides easier access to data since it looks conceptually like a Table and a lot of developers from Python/R/Pandas are familiar with it.

At a `scala>` REPL prompt, type the following:

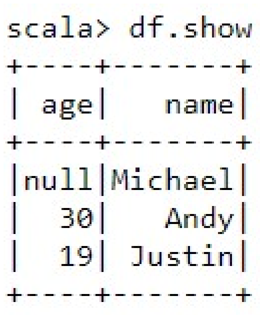
```
val df = spark.read.json("/tmp/people.json")
```

Using `df.show`, display the contents of the DataFrame:

```
df.show
```

You should see an output similar to:

```
...
+----+-------+
| age|   name|
+----+-------+
|null|Michael|
|  30|   Andy|
|  19| Justin|
+----+-------+

scala>
```



```
scala> df.show
+----+-------+
| age|   name|
+----+-------+
|null|Michael|
|  30|   Andy|
|  19| Justin|
+----+-------+
```

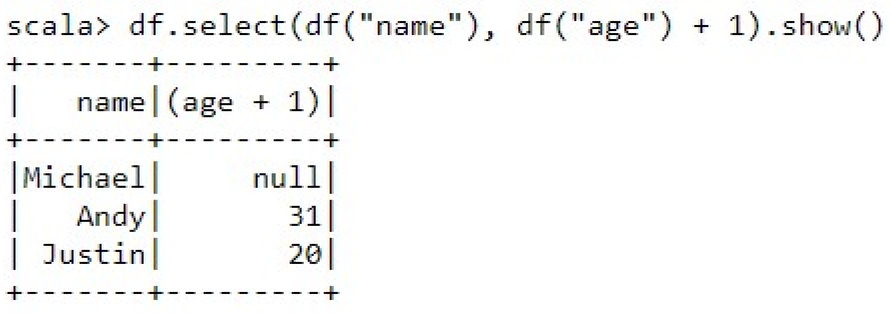
Additional DataFrame API examples

Now, lets select "name" and "age" columns and increment the "age" column by 1:

```
df.select(df("name"), df("age") + 1).show()
```

This will produce an output similar to the following:

```
...
+-------+---------+
|   name|(age + 1)|
+-------+---------+
|Michael|     null|
|   Andy|       31|
| Justin|       20|
+-------+---------+
```



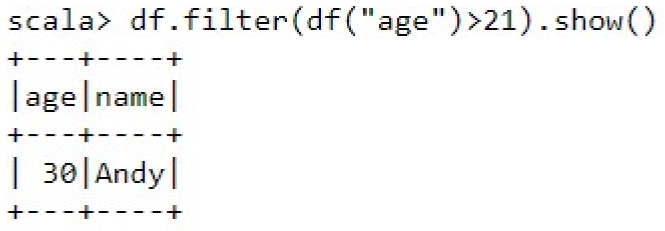
```
scala> df.select(df("name"), df("age") + 1).show()
+-------+---------+
|   name|(age + 1)|
+-------+---------+
|Michael|     null|
|   Andy|       31|
| Justin|       20|
+-------+---------+
```

To return people older than 21, use the filter() function:

```
df.filter(df("age") > 21).show()
```

This will produce an output similar to the following:

```
...
+---+----+
|age|name|
+---+----+
| 30|Andy|
+---+----+
```



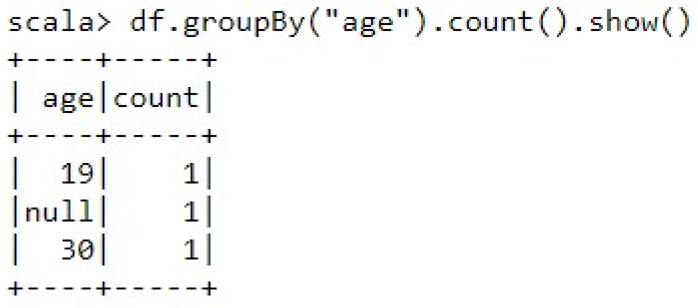
```
scala> df.filter(df("age")>21).show()
+---+----+
|age|name|
+---+----+
| 30|Andy|
+---+----+
```

Next, to count the number of people of specific age, use groupBy() & count() functions:

```
df.groupBy("age").count().show()
```

This will produce an output similar to the following:

```
...
+----+-----+
| age|count|
+----+-----+
|  19|    1|
|null|    1|
|  30|    1|
+----+-----+
```



```
scala> df.groupBy("age").count().show()
+----+-----+
| age|count|
+----+-----+
|  19|    1|
|null|    1|
|  30|    1|
+----+-----+
```

Programmatically Specifying Schema

Type the following commands(one line a time) into your Spark-shell:

1. Import the necessary libraries

```
import org.apache.spark.sql._
import org.apache.spark.sql.Row
import org.apache.spark.sql.types._
import spark.implicits._
```

2. Create and RDD

```
val peopleRDD = spark.sparkContext.textFile("/tmp/people.txt")
```

3. Encode the Schema in a string

```
val schemaString = "name age"
```

4. Generate the schema based on the string of schema

```
val fields = schemaString.split(" ").map(fieldName => StructField(fieldName,
StringType, nullable = true))

val schema = StructType(fields)
```

5. Convert records of the RDD (people) to Rows

```
val rowRDD = peopleRDD.map(_.split(",")).map(attributes => Row(attributes(0),
attributes(1).trim))
```

6. Apply the schema to the RDD

```
val peopleDF = spark.createDataFrame(rowRDD, schema)
```

6. Creates a temporary view using the DataFrame

```
peopleDF.createOrReplaceTempView("people")
```

7. SQL can be run over a temporary view created using DataFrames

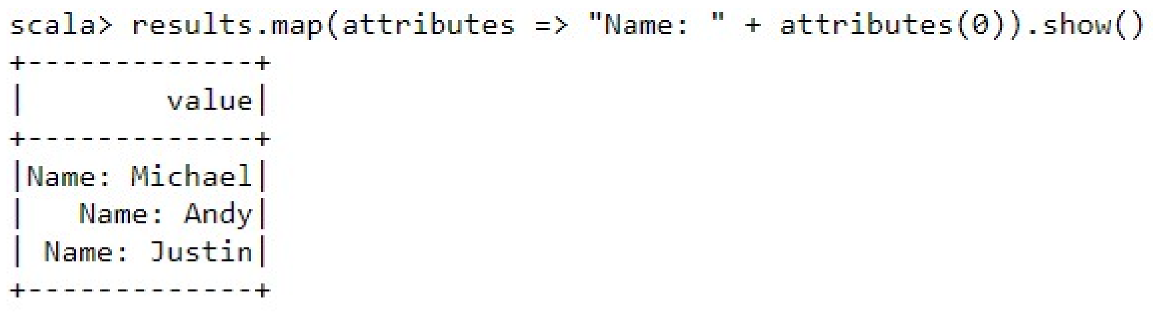
```
val results = spark.sql("SELECT name FROM people")
```

8.The results of SQL queries are DataFrames and support all the normal RDD operations. The columns of a row in the result can be accessed by field index or by field name

```
results.map(attributes => "Name: " + attributes(0)).show()
```

This will produce an output similar to the following:

```
...
+-------------+
|        value|
+-------------+
|Name: Michael|
|   Name: Andy|
| Name: Justin|
+-------------+
```



```
scala> results.map(attributes => "Name: " + attributes(0)).show()
+-------------+
|        value|
+-------------+
|Name: Michael|
|   Name: Andy|
| Name: Justin|
+-------------+
```

DataSet API Example

If you haven't done so already in previous sections, make sure to upload people data sets (people.txt and people.json) to HDFS: [Environment Setup]() and imported the libraries in step 1 of **Programmatically Specifying Schema** above:

Finally, if you haven't already:

Launch Spark Shell

```
spark-shell
```

The Spark Dataset API brings the best of RDD and Data Frames together, for type safety and user functions that run directly on existing JVM types.

Let's try the simplest example of creating a dataset by applying a *toDS()* function to a sequence of numbers.

At the `scala>` prompt, copy & paste the following:

```
val ds = Seq(1, 2, 3).toDS()

ds.show
```

You should see the following output:

```
+-----+
|value|
+-----+
|    1|
|    2|
|    3|
+-----+
```

Moving on to a slightly more interesting example, let's prepare a *Person* class to hold our person data. We will use it in two ways by applying it directly on a hardcoded data and then on a data read from a json file.

To apply *Person* class to hardcoded data type:

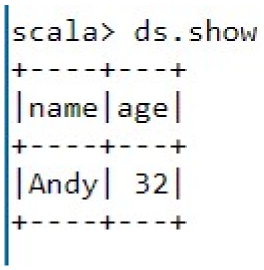
```
case class Person(name: String, age: Long)

val ds = Seq(Person("Andy", 32)).toDS()
```

When you type

```
ds.show
```

you should see the following output of the *ds* Dataset

```
+----+---+
|name|age|
+----+---+
|Andy| 32|
+----+---+
```



```
scala> ds.show
+----+---+
|name|age|
+----+---+
|Andy| 32|
+----+---+
```

Finally, let's map data read from *people.json* to a *Person* class. The mapping will be done by name.

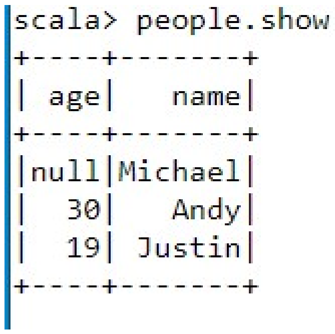
```
val path = "/tmp/people.json"
val people = spark.read.json(path).as[Person] // Creates a DataSet
```

To view contents of people DataFrame type:

```
people.show
```

You should see an output similar to the following:

```
...
+----+-------+
| age|   name|
+----+-------+
|null|Michael|
|  30|   Andy|
|  19| Justin|
+----+-------+
```



```
scala> people.show
+----+-------+
| age|   name|
+----+-------+
|null|Michael|
|  30|   Andy|
|  19| Justin|
+----+-------+
```

Note that the *age* column contains a *null* value. Before we can convert our people DataFrame to a Dataset, let's filter out the *null* value first:

```
val pplFiltered = people.filter("age is not null")
```

Now we can map to the *Person* class and convert our DataFrame to a Dataset.

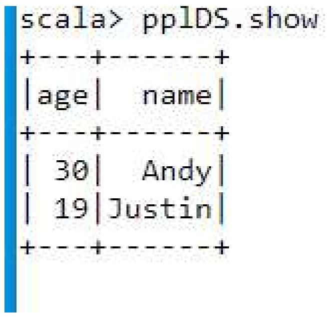
```
val pplDS = pplFiltered.as[Person]
```

View the contents of the Dataset type

```
pplDS.show
```

You should see the following:

```
+-----+---+
|  name|age|
+-----+---+
|  Andy| 30|
|Justin| 19|
+-----+---+
```



```
scala> pplDS.show
+---+------+
|age|  name|
+---+------+
| 30|  Andy|
| 19|Justin|
+---+------+
```

To exit type:

```
:quit
```