Data Engineering in the Cloud

Manipulating Dataframes in Azure Databricks

Xuemao Zhang
East Stroudsburg University

January 18, 2025

Outline

- Caching a DataFrame
- Removing Duplicate Data
- Manipulating Date and Time
- Removing DataFrame Columns

Caching a DataFrame

- Now, lunch the Azure Databricks workspace and create another notebook `Notebook2`
  - It will take some time to start the cluster
  - Repeat what we did in the last three labs if you do not have a cluster

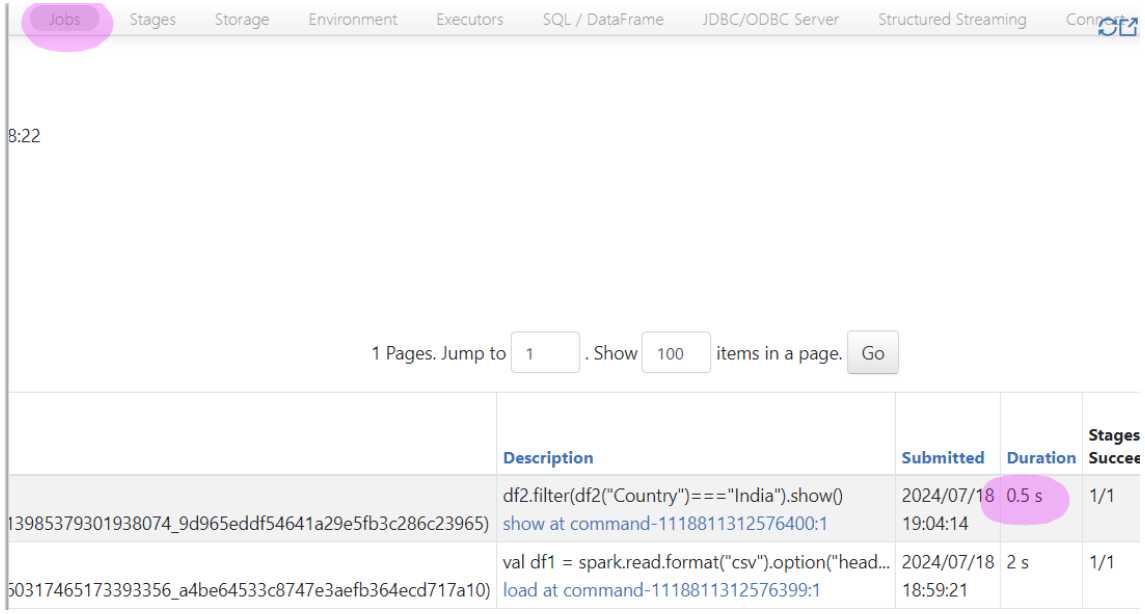
```
val df1 = spark.read.format("csv").
option("header", "true").
load("dbfs:/FileStore/shared_uploads/xzhang2@esu.edu/population-4.csv")
val df2 = df1
  .withColumnRenamed("Country (or dependency)", "Country")
  .withColumnRenamed("Population (2020)", "Population_2020")
  .withColumnRenamed("Yearly Change", "Yearly_Change")
  .withColumnRenamed("Net Change", "Net_Change")
  .withColumnRenamed("Density (P/Km²)", "Density_PKm2")
  .withColumnRenamed("Land Area (Km²)", "Land_Area_Km2")
  .withColumnRenamed("Migrants (net)", "Migrants_net")
  .withColumnRenamed("Fert. Rate", "Fertility_Rate")
  .withColumnRenamed("Med. Age", "Median_Age")
  .withColumnRenamed("Urban Pop %", "Urban_Pop_Percent")
  .withColumnRenamed("World Share", "World_Share")

df2.printSchema()
```

Caching a DataFrame

- Filter one of the rows and run the cell by executing the command given below.

```
df2.filter(df2("Country")=="India").show()
```

- Click on `Spark Jobs` option and then click on `View`. This process has taken 0.5 seconds.



Caching a DataFrame

- **Caching data** is a good method for faster subsequent queries. This will help fetch subsequent data quickly and efficiently. To do so, perform caching of a DataFrame.
- Cache the DataFrame by executing the command given below.

```
df2.cache()
```

- And then run the above code again

```
df2.filter(df2("Country")=="India").show()
```

Description	Submitted	Duration	Stages: Succeeded/Total	Tasks (for all stages): Succeeded/Tota
df2.filter(df2("Country")=="India").show() show at command-1118811312576402:1	2024/07/18 19:11:39	73 ms	1/1	1/1
df2.filter(df2("Country")=="India").show() show at command-1118811312576402:1	2024/07/18 19:11:02	0.1 s	1/1	1/1
df2.filter(df2("Country")=="India").show() show at command-1118811312576402:1	2024/07/18 19:10:00	0.9 s	1/1	1/1
df2.filter(df2("Country")=="India").show() show at command-1118811312576400:1	2024/07/18 19:04:14	0.5 s	1/1	1/1

Removing Duplicate Data

- Now we work on a new data set `population_duplicate_data.csv`
- Follow what we did before, create another notebook `Notebook3` and upload the data

```
val df3 = spark.read.format("csv").
option("header", "true").
load("dbfs:/FileStore/shared_uploads/xzhang2@esu.edu/population_duplicate_data.csv")
df3.printSchema()
df3.cache()
```

Removing Duplicate Data

Just now (1s) 2 Scala

```
df3.show()
```

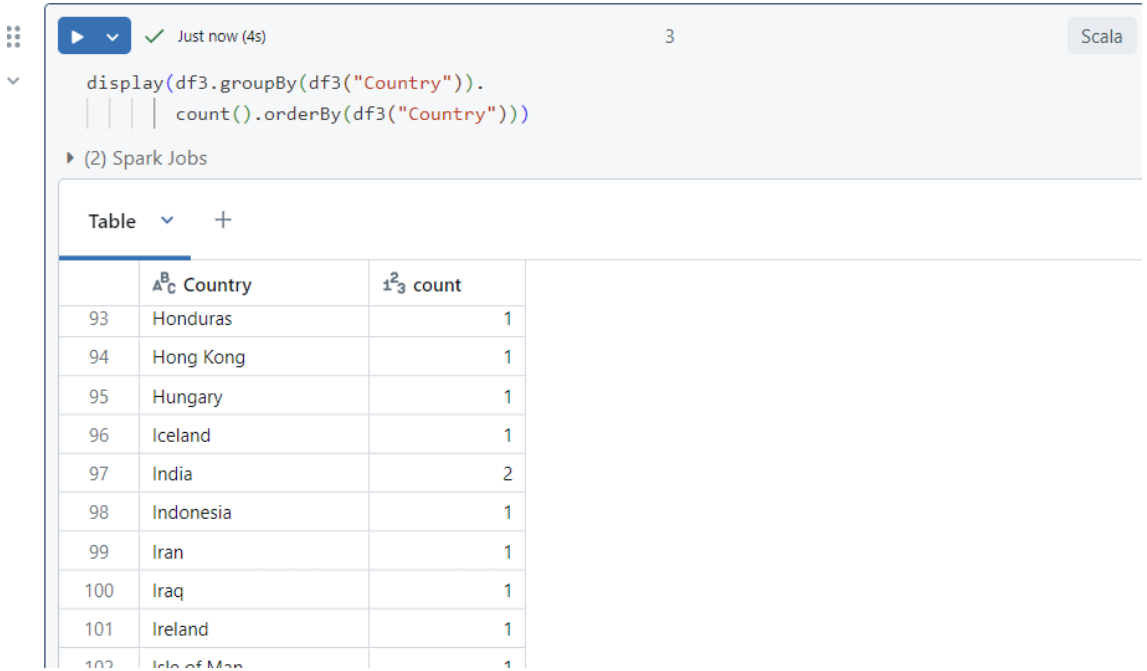
(1) Spark Jobs

```
+-------------+----------+------------+---------+-------+--------+--------+---------+-------+--------+---------
+
|      Country|Population|YearlyChange|NetChange|Density|LandArea|Migrants|Fert_Rate|Med_Age|UrbanPop|WorldShare
|
+-------------+----------+------------+---------+-------+--------+--------+---------+-------+--------+----------
+
|        China|1440297825|       0.39%|  5540090|    153| 9388211| -348399|      1.7|     38|     61%|    18.47%
|
|        India|1382345085|       0.99%| 13586631|    464| 2973190| -532687|      2.2|     28|     35%|    17.70%
|
|        India|1382345085|       0.99%| 13586631|    464| 2973190| -532687|      2.2|     28|     35%|    17.70%
|
|United States| 331341050|       0.59%|  1937734|     36| 9147420|  954806|      1.8|     38|     83%|     4.25%
|
|United States| 331341050|       0.59%|  1937734|     36| 9147420|  954806|      1.8|     38|     83%|     4.25%
|
|    Indonesia| 274021604|       1.07%|  2898047|    151| 1811570|  -98955|      2.3|     30|     56%|     3.51%
|
|     Pakistan| 221612785|       2.00%|  4327022|    287|  770880| -233379|      3.6|     23|     35%|     2.83%
|
|       Brazil| 212821986|       0.72%|  1509890|     25| 8358140|   21200|      1.7|     33|     88%|     2.73%
```

Removing Duplicate Data

- Group the values by `country` to understand how many of these have duplicate values by executing the command given below.
  - Aggregate the data using the `groupBy()` function

```
val groupedDF3 = df3.groupBy(df3("Country")).
        count().orderBy(df3("Country"))
display(groupedDF3)
```



	Country	count
93	Honduras	1
94	Hong Kong	1
95	Hungary	1
96	Iceland	1
97	India	2
98	Indonesia	1
99	Iran	1
100	Iraq	1
101	Ireland	1

Removing Duplicate Data

```
val duplicatesDF3 = groupedDF3.filter("count > 1")
display(duplicatesDF3)
```

Just now (1s) 4

```
val duplicatesDF3 = groupedDF3.filter("count > 1")
display(duplicatesDF3)
```

(2) Spark Jobs

duplicatesDF3: org.apache.spark.sql.Dataset[org.apache.spark.sql.Row] = [Country: string, count: long]

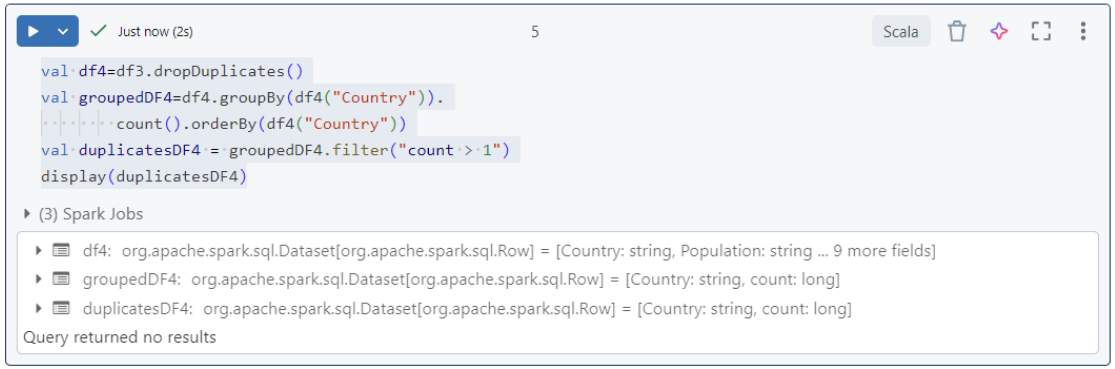
Table

	Country	count
1	Australia	2
2	Bangladesh	2
3	Egypt	2
4	Finland	2
5	India	2
6	Italy	2
7	Japan	2
8	Maldives	2
9	Spain	2
10	Switzerland	2
11	United States	2

Removing Duplicate Data

- Remove the duplicate values by executing the `dropDuplicates()` function .

```
val df4=df3.dropDuplicates()
val groupedDF4=df4.groupBy(df4("Country")).
        count().orderBy(df4("Country"))

val duplicatesDF4 = groupedDF4.filter("count > 1")
display(duplicatesDF4)
```



Manipulating Date and Time Values

- Now we work on a new data set `population_with_time.csv`
- Follow what we did before, create another notebook `Notebook4` and upload the data

```
val df5 = spark.read.format("csv").option("header", "True").
load("dbfs:/FileStore/shared_uploads/
     xzhang2@esu.edu/population_with_time.csv")
df5.printSchema()

df5.cache()
```

Manipulating Date and Time Values

Just now (<1s)

```
display(df5.select(df5("Time")))
```

(1) Spark Jobs

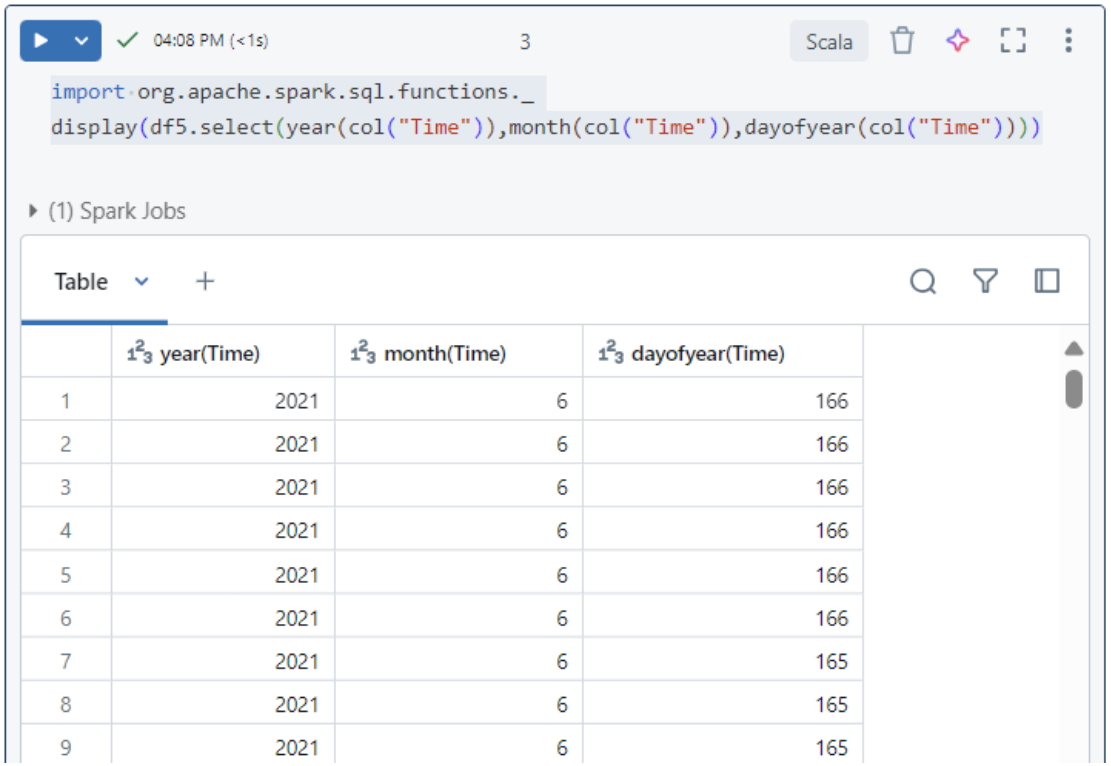
Table

	Time
1	2021-06-15T04:44:38.22...
2	2021-06-15T04:44:21.54...
3	2021-06-15T04:44:21.70...
4	2021-06-15T04:44:31.33...
5	2021-06-15T04:44:12.53...
6	2021-06-15T04:44:16.03...
7	2021-06-14T17:57:02.24...
8	2021-06-14T17:55:17.61...
9	2021-06-14T17:55:18.57...
10	2021-06-14T17:56:51.94...

Manipulating Date and Time Values

- Display the year, month, and day separately in the "Time" column of the population_with_time file by executing the command given below.

```
import org.apache.spark.sql.functions._
display(df5.select(year(col("Time")),
                   month(col("Time")),dayofyear(col("Time"))))
```

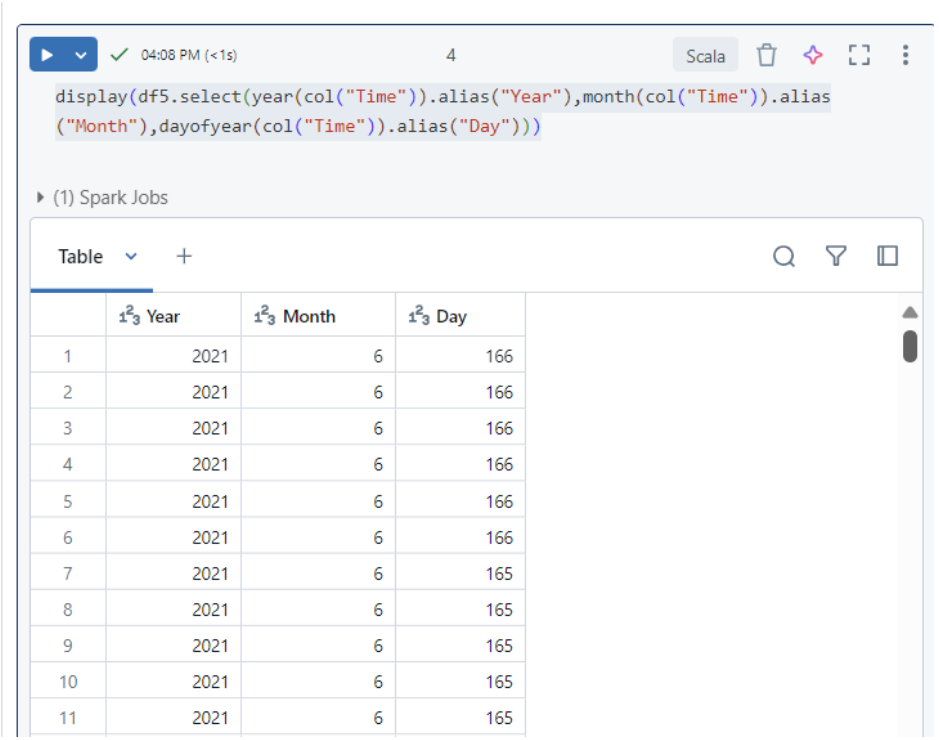


	year(Time)	month(Time)	dayofyear(Time)
1	2021	6	166
2	2021	6	166
3	2021	6	166
4	2021	6	166
5	2021	6	166
6	2021	6	166
7	2021	6	165
8	2021	6	165
9	2021	6	165

Manipulating Date and Time Values

- We can also replace the name of any column with any other string. For example, we can distribute the Time column into year, month, and day columns using the `alias()` function by executing the command given below.

```
display(df5.select(year(col("Time")).alias("Year"),
        month(col("Time")).alias("Month"),
        dayofyear(col("Time")).alias("Day")))
```

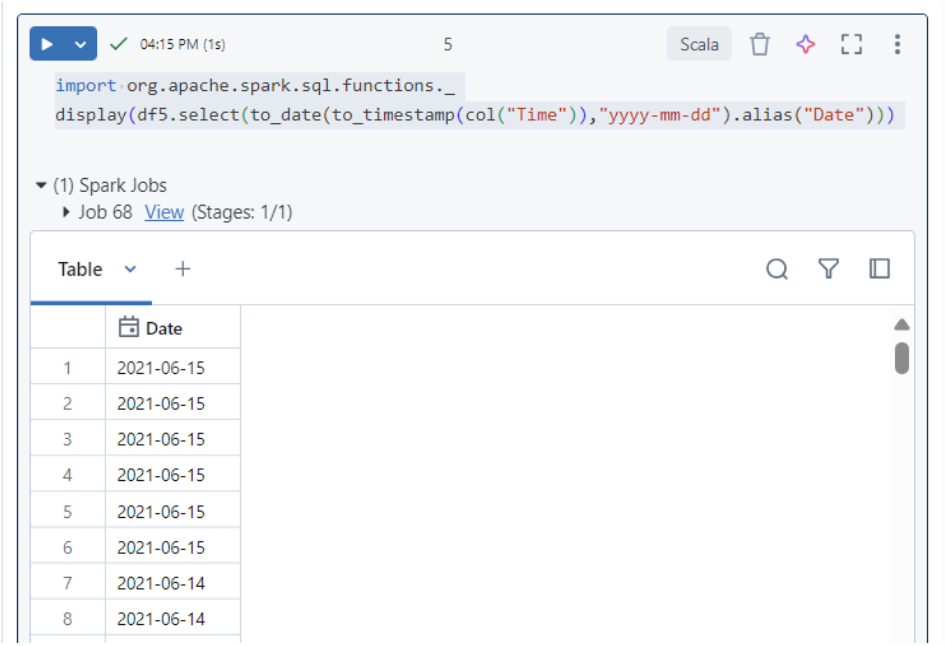


	Year	Month	Day
1	2021	6	166
2	2021	6	166
3	2021	6	166
4	2021	6	166
5	2021	6	166
6	2021	6	166
7	2021	6	165
8	2021	6	165
9	2021	6	165
10	2021	6	165
11	2021	6	165

Manipulating Date and Time Values

- Convert the date into a particular format using the `to_date()` function. Execute the command given below.
  - code first converts the string to a timestamp using the `to_timestamp` function with the appropriate format that includes time and timezone, and then converts the timestamp to a date with `to_date`.

```
display(df5.select(to_date(to_timestamp(col("Time")),
                           "yyyy-mm-dd").alias("Date")))
```



Removing DataFrame Columns

- Suppose we have a new data frame df6

```
val df6 = df5.withColumn("Date",
              to_date(to_timestamp(col("Time")), "yyyy-MM-dd"))
df6.printSchema()
```

Removing DataFrame Columns

- To remove one of the columns (for example, WorldShare) use the `df.drop()` function and add the name of the column that has to be deleted
  - You can see that the WorldShare column is now removed from the Dataframe.

```
val df7 = df6.drop("WorldShare")
df7.printSchema()
```

Just now (1s) 7 Scala

```
val df7 = df6.drop("WorldShare")
df7.printSchema()
```

```
df7: org.apache.spark.sql.DataFrame = [Country: string, Population: string ... 10 more fields]

root
 |-- Country: string (nullable = true)
 |-- Population: string (nullable = true)
 |-- YearlyChange: string (nullable = true)
 |-- NetChange: string (nullable = true)
 |-- Density: string (nullable = true)
 |-- LandArea: string (nullable = true)
 |-- Migrants: string (nullable = true)
 |-- Fert_Rate: string (nullable = true)
 |-- Med_Age: string (nullable = true)
 |-- UrbanPop: string (nullable = true)
 |-- Time: string (nullable = true)
 |-- Date: date (nullable = true)

df7: org.apache.spark.sql.DataFrame = [Country: string, Population: string ... 10 mor
e fields]
```

Summary and Preview

- Azure Databricks: An analytics platform based on Apache Spark that provides collaborative data science and machine learning environments
- Azure Synapse Analytics: An integrated analytics service that combines big data and data warehousing. It allows for data ingestion, preparation, management, and serving for business intelligence and machine learning purposes.
  - Azure Synapse can handle data warehousing, ETL processes, and SQL-based analytics,
- We can use Synapse's integrated data exploration, preparation, and management capabilities to transform and clean our data
  - In Synapse, output our processed data to an Azure Data Lake Storage (ADLS) Gen2 account.
  - Then Mount the ADLS storage in Databricks to access the prepared data.
  - Once mounted, read the data in Databricks for further processing.

License