**F1 Project**

Data can be accessed from:

<http://ergast.com/mrd/>

Data Overview

|  |  |
| --- | --- |
| **File** | **Type** |
| Circuits | CSV |
| Races | CSV |
| Constructors | Single Line JSON |
| Drivers | Single Line Nested JSON |
| Results | Single Line JSON |
| PitStops | Multi Line JSON |
| LapTimes | Split CSV Files |
| Qualifying | Split Multi Line JSON Files |

**Requirements for Ingestion**

* Ingest All 8 files into data lake
* Ingested data must have the schema applied
* Ingested data must have audit columns
* Ingested data must be stored in columnar format (i.e. Parquet)
* Must be able to analyse the ingested data via SQL
* Ingestion logic must be able to handle incremental load

A screenshot of a computer

Description automatically generatedThis is the ingestion path:

**Circuits.csv Ingestion**

Spark documentation:

<https://spark.apache.org/docs/latest/api/python/reference/pyspark.sql/io.html>

We want to load a CSV file and return the result as a DataFrame.

A screen shot of a computer code

Description automatically generatedHere is an example:

Spark.read.csv() is what we need.

**Create Mount Points**

A screen shot of a computer

Description automatically generatedA screen shot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generated

A screenshot of a computer

Description automatically generatedNotice that the header is ‘c0, c1, c2’. This means that the header has been interpreted incorrectly. To fix this we can refer to documentation:

The documentation specifies that there is an option that we can specify with regards to the header.

To fix our code:

A screenshot of a computer

Description automatically generatedWe specify that header=’true’, which means the first line in our table will become the column names.

**PrintSchema()**

A close-up of a computer code

Description automatically generated<https://spark.apache.org/docs/latest/api/python/reference/pyspark.sql/api/pyspark.sql.DataFrame.printSchema.html?highlight=printschema>

This can show us information about our schema.

A screenshot of a computer program

Description automatically generatedTo implement the method:

Notice that all of the column types have been identified as strings. We need to rectify this, because we know that we have some integers.

**Circuits\_df.describe().show()**

.describe().show() performs a summary of descriptive statistics on a DataFrame and displays the results.

* Count: the number of non-null entries
* Mean: the average value of the column (for numeric columns)
* Stddev: the standard deviation of the column (for numeric columns)
* Min: the minimum value in the column.
* Max: the maximum value in the column.

A screenshot of a computer

Description automatically generated**inferSchema()**

InferSchema is an option you can set when reading data to automatically detect the data types of each column in your dataset. This is particularly useful when reading data from formats that do not explicitly define the schema, such as CSV or JSON files.

Some of the benefits of ‘inferSchema’ include;

* **Automatic Type Detection**: You don’t need to manually specify the schema, which can save time and reduce errors, especially for large datasets with many columns.
* **Improved Data Handling**: by correctly identifying data types, Spark can apply the appropriate operations and optimisations on the data.
* A screenshot of a computer

  Description automatically generated**Ease of Use**: Makes it easier to work with semi-structured data or when the schema is not known beforehand.

Now we can see that the column types have been correctly updated.

A white text with black text

Description automatically generated

Explicitly defining the schema:

**StructType**

StructType is used to define the overall structure (schema) of the Data Frame.

StructField is used to define each column in the schema, it takes three arguments:

* Name: the name of the column
* datatype: The data type of the column
* nullable: a Boolean flag indicating whether the column can contain null values

A screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generatedThis allows us to define the schema explicitly. This can improve performance. Schema inference with ‘inferSchema’ can incur a performance penalties.

A screenshot of a computer program

Description automatically generatedA screenshot of a computer

Description automatically generated

Now it looks like our dataframe has been edited correctly.

**Select/Drop columns**

There are some columns we do not need in our table; for example ‘url’.

**DataFrame.select**

<https://spark.apache.org/docs/latest/api/python/reference/pyspark.sql/api/pyspark.sql.DataFrame.select.html>

Here is an example:



Notice we are able to select the schema that we want to use.

There are multiple ways we can achieve this:

1: circuits\_selected\_df = circuits\_df.select("circuitId", "circuitRef", "name", "location", "country", "lat", "lng", "alt")

A screenshot of a computer

Description automatically generated

2: circuits\_selected\_df = circuits\_df.select(circuits\_df.circuitId, circuits\_df.circuitRef, circuits\_df.name, circuits\_df.location, circuits\_df.country, circuits\_df.lat, circuits\_df.lng, circuits\_df.alt)

A screenshot of a computer

Description automatically generated

3: circuits\_selected\_df = circuits\_df.select(circuits\_df["circuitId"], circuits\_df["circuitRef"], circuits\_df["name"], circuits\_df["location"], circuits\_df["country"], circuits\_df["lat"], circuits\_df["lng"], circuits\_df["alt"])

A screenshot of a computer

Description automatically generated

4: circuits\_selected\_df = circuits\_df.select(col("circuitId"), col("circuitRef"), col("name"), col("location"), col("country"), col("lat"), col("lng"), col("alt"))

A screenshot of a computer

Description automatically generated

The final method requires ‘col’ to be imported.

It is important to be aware that there are a variety of ways to select/rename columns.

Note that col can give more flexibility:A screenshot of a computer

Description automatically generated

We can use ‘alias’ to rename columns.

**Rename Columns**

DataFrame.withColumnRenamed

[https://spark.apache.org/docs/latest/api/python/reference/pyspark.sql/api/pyspark.sql.DataFrame.withColumnRenamed.html?highlight=withcolumnrenamedA computer screen shot of a computer code

Description automatically generated](https://spark.apache.org/docs/latest/api/python/reference/pyspark.sql/api/pyspark.sql.DataFrame.withColumnRenamed.html?highlight=withcolumnrenamed)

This allows us to rename columns.

A screenshot of a computer

Description automatically generatedNote that we only need to call on columns we want to rename:

**Adding Columns**

<https://spark.apache.org/docs/3.1.3/api/python/reference/api/pyspark.sql.DataFrame.withColumn.html>

A screenshot of a computer

Description automatically generateddataframe.withColumn() can be used to add columns.

Now we have added a timestamp!

**Dataframe Writer**

**A screenshot of a computer

Description automatically generated**

We have all of the data as we need it. Our next step is to write it to our DataLake. We need to write it as a parquet file.

<https://spark.apache.org/docs/3.1.3/api/python/reference/api/pyspark.sql.DataFrameWriter.parquet.html>

Here is an example:



A screenshot of a computer code

Description automatically generated

Note that we can’t keep running this bit of code. If the filepath already exists, it won’t work! To get round this we can use ‘mode’ and overwrite;

file\_path = "/mnt/formula1dl/processed/circuits"

circuits\_final\_df.write.mode("overwrite").parquet(file\_path)

Now we can keep running the code and it will work.

**Data Ingestion - Races**