

Spark SQL

INTRODUCTION TO SPARK SQL IN PYTHON



Mark Plutowski Phd
Data Scientist

Create SQL table and query it

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Load a dataframe from file

```
df = spark.read.csv(filename)
```

```
df = spark.read.csv(filename, header=True)
```

Create SQL table and query it

```
df.createOrReplaceTempView("schedule")
spark.sql("SELECT * FROM schedule WHERE station = 'San Jose'")
.show()
```

```
+-----+-----+-----+
|train_id| station| time|
+-----+-----+-----+
|      324|San Jose|9:05a|
|      217|San Jose|6:59a|
+-----+-----+-----+
```

Inspecting table schema

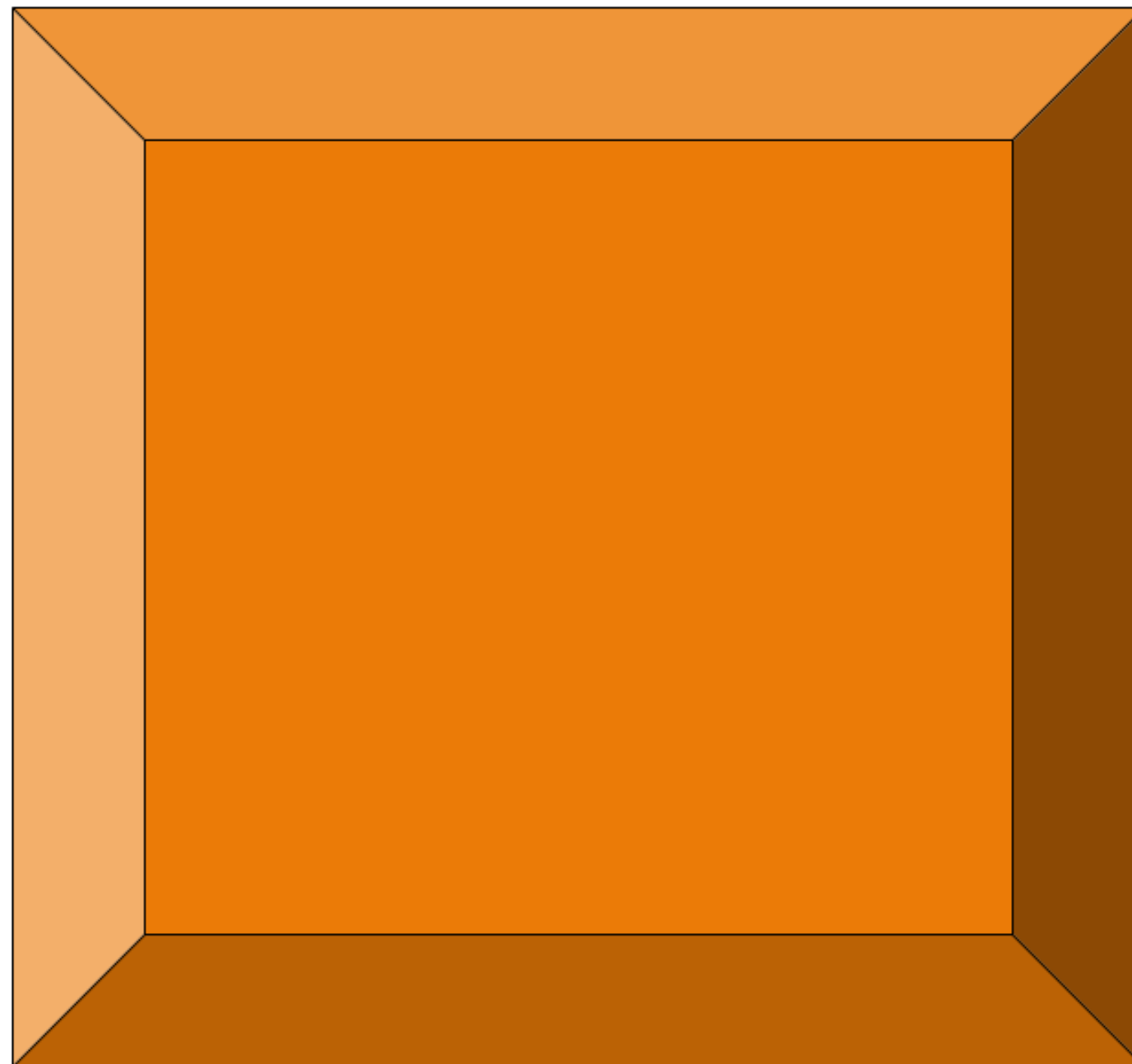
```
result = spark.sql("SHOW COLUMNS FROM tablename")
```

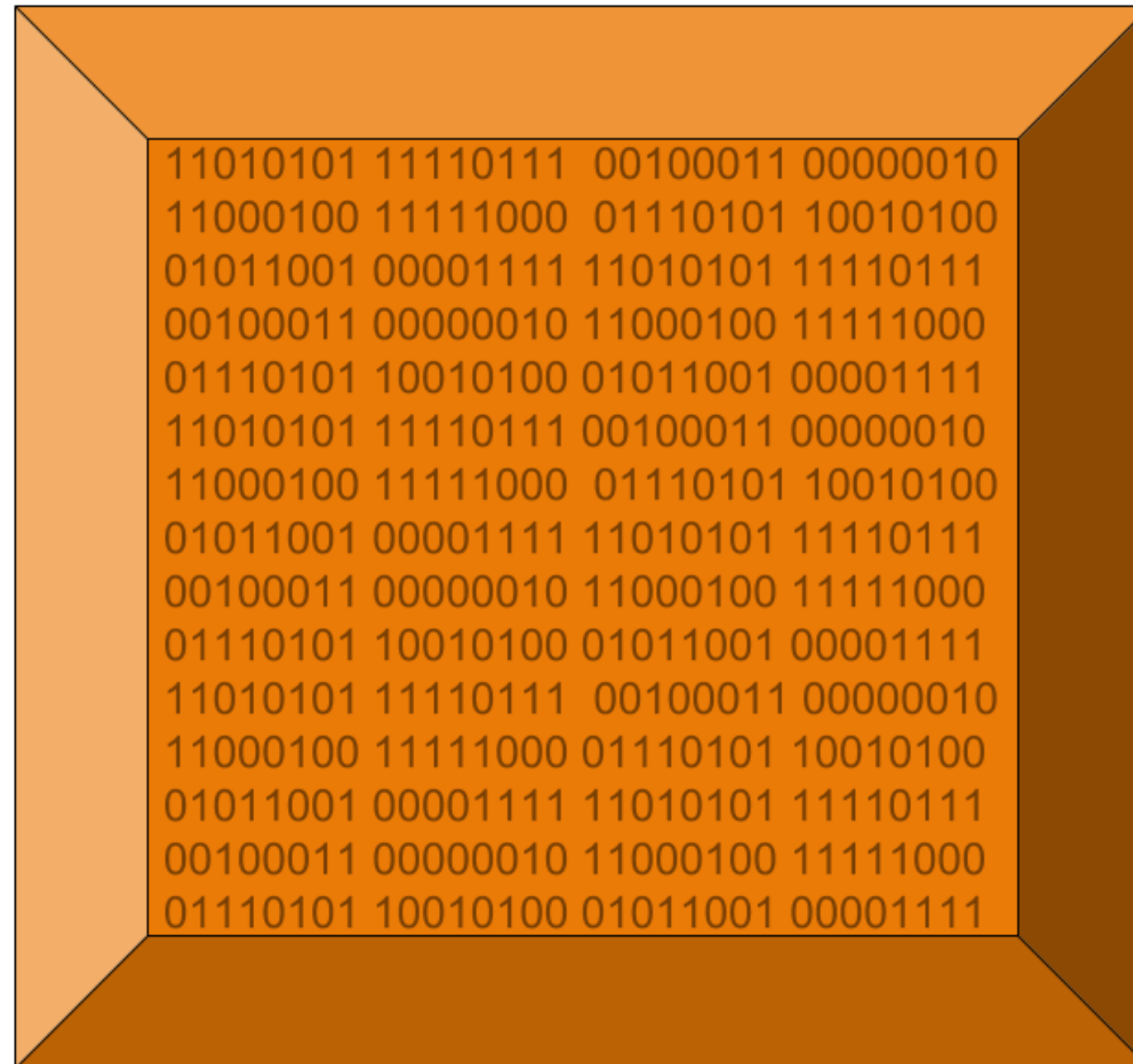
```
result = spark.sql("SELECT * FROM tablename LIMIT 0")
```

```
result = spark.sql("DESCRIBE tablename")
```

```
result.show()
```

```
print(result.columns)
```





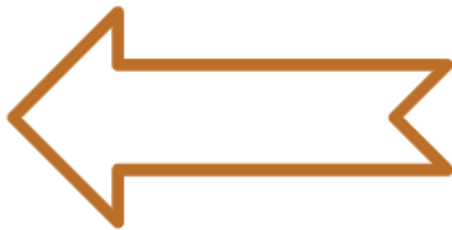
Tabular data

```
+-----+-----+-----+
|train_id|  station|  time|
+-----+-----+-----+
|    324|San Francisco|7:59a|
|    324|  22nd Street|8:03a|
|    324|    Millbrae|8:16a|
|    324|    Hillsdale|8:24a|
|    324|Redwood City|8:31a|
|    324|    Palo Alto|8:37a|
|    324|    San Jose|9:05a|
|    217|    Gilroy|6:06a|
|    217|  San Martin|6:15a|
|    217|Morgan Hill|6:21a|
|    217|Blossom Hill|6:36a|
|    217|    Capitol|6:42a|
|    217|    Tamien|6:50a|
|    217|    San Jose|6:59a|
+-----+-----+-----+
```


<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a

<u>train_id</u>	<u>station</u>	<u>time</u>
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a



<u>train_id</u>	<u>station</u>	<u>time</u>
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a

217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a

217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	<u>train_id</u> 9:05a
		<u>station</u>
		<u>time</u>
	217	Gilroy
	217	San Martin
	217	Morgan Hill
	217	Blossom Hill
	217	Capitol
	217	Tamien
	217	San Jose

<u>train_id</u>	<u>station</u>	<u>time</u>			
324	San Francisco	7:59a			
324	22nd Street	8:03a			
324	Millbrae	8:16a			
324	Hillsdale	8:24a			
324	Redwood City	8:31a			
324	Palo Alto	8:37a			
324	San Jose	9:05a	<u>train_id</u>	<u>station</u>	<u>time</u>
			217	Gilroy	6:06a
			217	San Martin	6:15a
			217	Morgan Hill	6:21a
			217	Blossom Hill	6:36a
			217	Capitol	6:42a
			217	Tamien	6:50a
			217	San Jose	6:59a

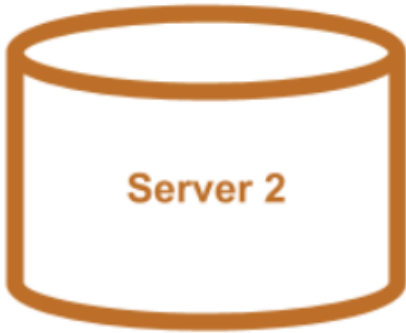
<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a

<u>train_id</u>	<u>station</u>	<u>time</u>
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a

<u>train_id</u>	<u>station</u>	<u>time</u>
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a



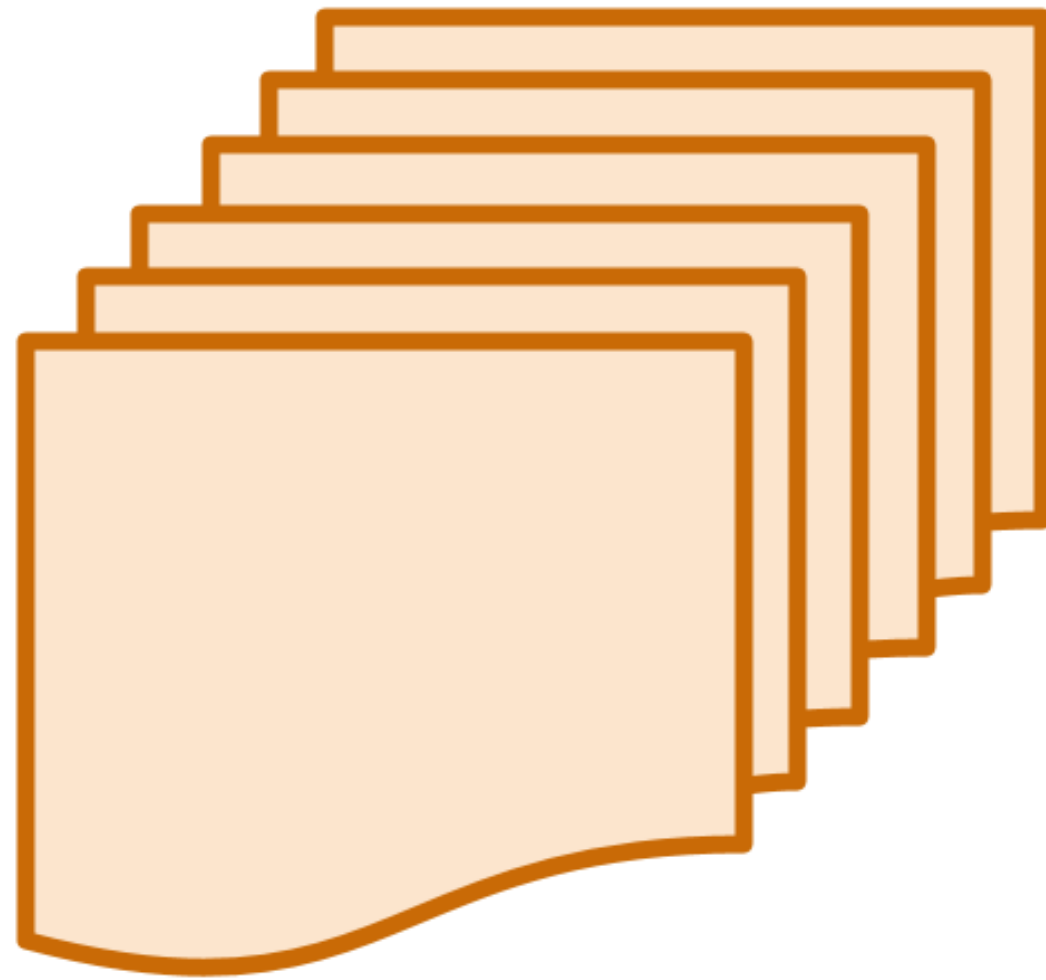
<u>train_id</u>	<u>station</u>	<u>time</u>
217	Gilroy	6:06a
217	San Martin	6:15a
217	Morgan Hill	6:21a
217	Blossom Hill	6:36a
217	Capitol	6:42a
217	Tamien	6:50a
217	San Jose	6:59a

SQL

Structured Query Language

```
SELECT train_id, time  
FROM table1  
WHERE station = 'San Jose'
```

<u>train_id</u>	<u>station</u>	<u>time</u>
324	San Francisco	7:59a
324	22nd Street	8:03a
324	Millbrae	8:16a
324	Hillsdale	8:24a
324	Redwood City	8:31a
324	Palo Alto	8:37a
324	San Jose	9:05a



```
SELECT train_id, time  
FROM table1  
WHERE station = 'San Jose'
```

train_id, station, time

Loading delimited text

Loads a comma-delimited file `trainsched.txt` into a dataframe called `df` :

```
df = spark.read.csv("trainsched.txt", header=True)
```


Loading delimited text

```
df = spark.read.csv("trainsched.txt", header=True)
df.show()
```

```
+-----+-----+-----+
|train_id|station|time|
+-----+-----+-----+
|    324|San Francisco|7:59a|
|    324|  22nd Street|8:03a|
|    324|    Millbrae|8:16a|
|    324|    Hillsdale|8:24a|
|    324|Redwood City|8:31a|
|    ...|          ...|   ...|
|    217| Blossom Hill|6:36a|
|    217|    Capitol|6:42a|
|    217|    Tamien|6:50a|
|    217|    San Jose|6:59a|
+-----+-----+-----+
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```


Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>>
```

Welcome to



```
Using Python version 3.6
SparkSession available as 'spark'.
>>> |
```

Let's practice

INTRODUCTION TO SPARK SQL IN PYTHON

Window Function SQL

INTRODUCTION TO SPARK SQL IN PYTHON



Mark Plutowski
Data Scientist

What is a Window Function SQL?

- Express operations more simply than dot notation or queries
- Each row uses the values of other rows to calculate its value

A train schedule

train_id	station	time
324	San Francisco	7:59
324	22nd Street	8:03
324	Millbrae	8:16
324	Hillsdale	8:24
324	Redwood City	8:31
324	Palo Alto	8:37
324	San Jose	9:05

Column with time until next stop added

train_id	station	time	time_to_next_stop
324	San Francisco	7:59	4 min
324	22nd Street	8:03	13 min
324	Millbrae	8:16	8 min
324	Hillsdale	8:24	7 min
324	Redwood City	8:31	6 min
324	Palo Alto	8:37	28 min
324	San Jose	9:05	null

Column with time of next stop

train_id	station	time	time (following row)
324	San Francisco	7:59	8:03
324	22nd Street	8:03	8:16
324	Millbrae	8:16	8:24
324	Hillsdale	8:24	8:31
324	Redwood City	8:31	8:37
324	Palo Alto	8:37	9:05
324	San Jose	9:05	null

OVER clause and ORDER BY clause

```
query = """
SELECT train_id, station, time,
LEAD(time, 1) OVER (ORDER BY time) AS time_next
FROM sched
WHERE train_id=324 """
spark.sql(query).show()
```

```
+-----+-----+-----+-----+
|train_id|  station|  time|time_next|
+-----+-----+-----+-----+
|    324|San Francisco|7:59 |    8:03 |
|    324|  22nd Street|8:03 |    8:16 |
|    324|    Millbrae|8:16 |    8:24 |
|    324|    Hillsdale|8:24 |    8:31 |
|    324|Redwood City|8:31 |    8:37 |
|    324|    Palo Alto|8:37 |    9:05 |
|    324|    San Jose|9:05 |    null |
+-----+-----+-----+-----+
```

PARTITION BY clause

```
SELECT
train_id,
station,
time,
LEAD(time,1) OVER (PARTITION BY train_id ORDER BY time) AS time_next
FROM sched
```

Result of adding PARTITION BY clause

```
+-----+-----+-----+-----+
|train_id|station|time|time_next|
+-----+-----+-----+-----+
|    217|   Gilroy|6:06 |   6:15 |
|    217| San Martin|6:15 |   6:21 |
|    217| Morgan Hill|6:21 |   6:36 |
|    217| Blossom Hill|6:36 |   6:42 |
|    217|   Capitol|6:42 |   6:50 |
|    217|   Tamien|6:50 |   6:59 |
|    217| San Jose|6:59 |  null |
|    324|San Francisco|7:59 |   8:03 |
|    324| 22nd Street|8:03 |   8:16 |
|    324|   Millbrae|8:16 |   8:24 |
|    324|   Hillsdale|8:24 |   8:31 |
|    324| Redwood City|8:31 |   8:37 |
|    324|   Palo Alto|8:37 |   9:05 |
|    324|   San Jose|9:05 |  null |
+-----+-----+-----+-----+
```

train_id	station	time	time_to_next_stop
324	San Francisco	7:59	4 min
324	22nd Street	8:03	13 min
324	Millbrae	8:16	8 min
324	Hillsdale	8:24	7 min
324	Redwood City	8:31	6 min
324	Palo Alto	8:37	28 min
324	San Jose	9:05	null

Let's practice

INTRODUCTION TO SPARK SQL IN PYTHON

Dot notation and SQL

INTRODUCTION TO SPARK SQL IN PYTHON



Mark Plutowski
Data Scientist

Our table has 3 columns

```
df.columns
```

```
['train_id', 'station', 'time']
```

```
df.show(5)
```

```
+-----+-----+-----+
|train_id|station|time|
+-----+-----+-----+
|    324|San Francisco|7:59 |
|    324|  22nd Street|8:03 |
|    324|    Millbrae|8:16 |
|    324|   Hillsdale|8:24 |
|    324|Redwood City|8:31 |
+-----+-----+-----+
```

We only need 2

```
df.select('train_id', 'station')  
      .show(5)
```

```
+-----+-----+  
|train_id|station|  
+-----+-----+  
|      324|San Francisco|  
|      324|  22nd Street|  
|      324|    Millbrae|  
|      324|    Hillsdale|  
|      324|Redwood City|  
+-----+-----+
```

Three ways to select 2 columns

- `df.select('train_id', 'station')`
- `df.select(df.train_id, df.station)`
- `from pyspark.sql.functions import col`
- `df.select(col('train_id'), col('station'))`

Two ways to rename a column

```
df.select('train_id', 'station')  
  .withColumnRenamed('train_id', 'train')  
  .show(5)
```

```
+-----+-----+  
|train|    station|  
+-----+-----+  
|  324|San Francisco|  
|  324|  22nd Street|  
|  324|    Millbrae|  
|  324|    Hillsdale|  
|  324|Redwood City|  
+-----+-----+
```

```
df.select(col('train_id').alias('train'), 'station')
```

Don't do this!

```
df.select('train_id', df.station, col('time'))
```

SQL queries using dot notation

```
spark.sql('SELECT train_id AS train, station FROM schedule LIMIT 5')  
    .show()
```

```
+-----+-----+  
|train|    station|  
+-----+-----+  
|  324|San Francisco|  
|  324|  22nd Street|  
|  324|    Millbrae|  
|  324|    Hillsdale|  
|  324|Redwood City|  
+-----+-----+
```

```
df.select(col('train_id').alias('train'), 'station')  
    .limit(5)  
    .show()
```

Window function SQL

```
query = """
SELECT *,
ROW_NUMBER() OVER(PARTITION BY train_id ORDER BY time) AS id
FROM schedule
"""

spark.sql(query)
    .show(11)
```


Window function SQL

```
+-----+-----+-----+-----+
|train_id|      station|  time|  id|
+-----+-----+-----+-----+
|      217|      Gilroy|6:06 |  1|
|      217|  San Martin|6:15 |  2|
|      217| Morgan Hill|6:21 |  3|
|      217| Blossom Hill|6:36 |  4|
|      217|      Capitol|6:42 |  5|
|      217|      Tamien|6:50 |  6|
|      217|   San Jose|6:59 |  7|
|      324|San Francisco|7:59 |  1|
|      324|  22nd Street|8:03 |  2|
|      324|    Millbrae|8:16 |  3|
|      324|   Hillsdale|8:24 |  4|
+-----+-----+-----+-----+
```

Window function using dot notation

```
from pyspark.sql import Window,  
from pyspark.sql.functions import row_number  
df.withColumn("id", row_number()  
                .over(  
                    Window.partitionBy('train_id')  
                        .orderBy('time')  
                )  
    )
```

- ROW_NUMBER in SQL : `pyspark.sql.functions.row_number`
- The inside of the OVER clause : `pyspark.sql.Window`
- PARTITION BY : `pyspark.sql.Window.partitionBy`
- ORDER BY : `pyspark.sql.Window.orderBy`

Using a WindowSpec

- The `over` function in Spark SQL corresponds to a `OVER` clause in SQL.
- The class `pyspark.sql.window.Window` represents the inside of an `OVER` clause.

```
window = Window.partitionBy('train_id').orderBy('time')
dfx = df.withColumn('next', lead('time', 1).over(window))
```

- Above, `type(window)` is `pyspark.sql.window.WindowSpec`

Let's practice

INTRODUCTION TO SPARK SQL IN PYTHON