Solution – Exercise 04

Spark, PySpark, Jupyter

Solution

Prerequisites:

- Start Gcloud instance
- Pull and start Docker image (`marcelmittelstaedt/spark_base:latest`)

- Start HDFS and YARN
- Start Jupyter Notebook
- Execute all preparation and example tasks of previous HandsOn slides of last lecture

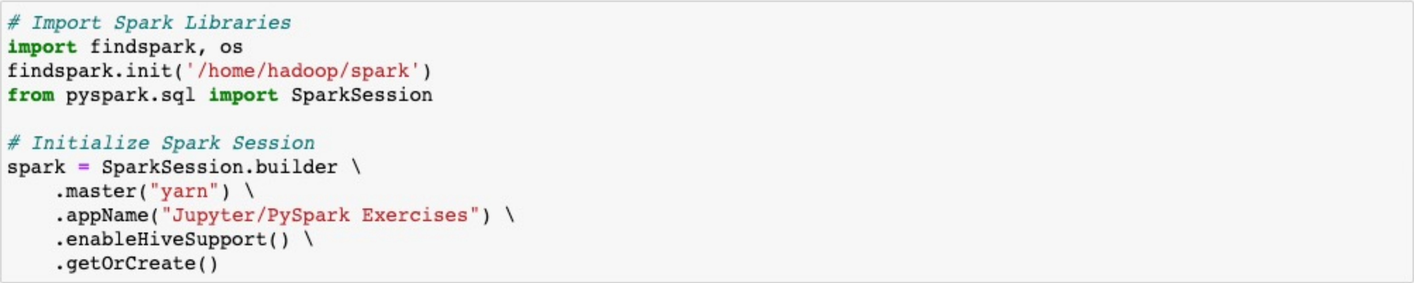
See:

https://github.com/marcelmittelstaedt/BigData/tree/master/solutions/winter_semester_2021-2022/04_spark_pyspark_jupyter/Solutions.html

…for complete solution (Jupyter Notebook).

Solution

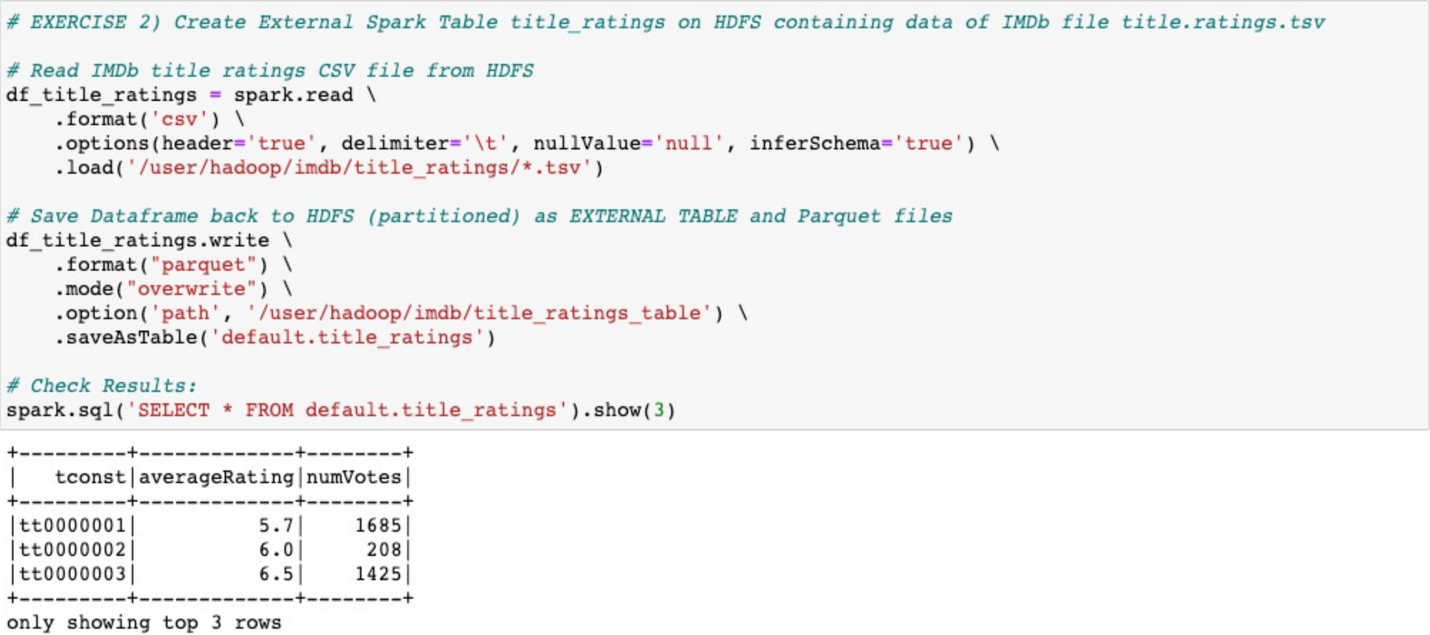
1.) Start Spark Session:



```python
# Import Spark Libraries
import findspark, os
findspark.init('/home/hadoop/spark')
from pyspark.sql import SparkSession

# Initialize Spark Session
spark = SparkSession.builder \
    .master("yarn") \
    .appName("Jupyter/PySpark Exercises") \
    .enableHiveSupport() \
    .getOrCreate()
```

Solution

2. Create External Spark Table `title_ratings` on HDFS containing data of IMDb file *title.ratings.tsv*

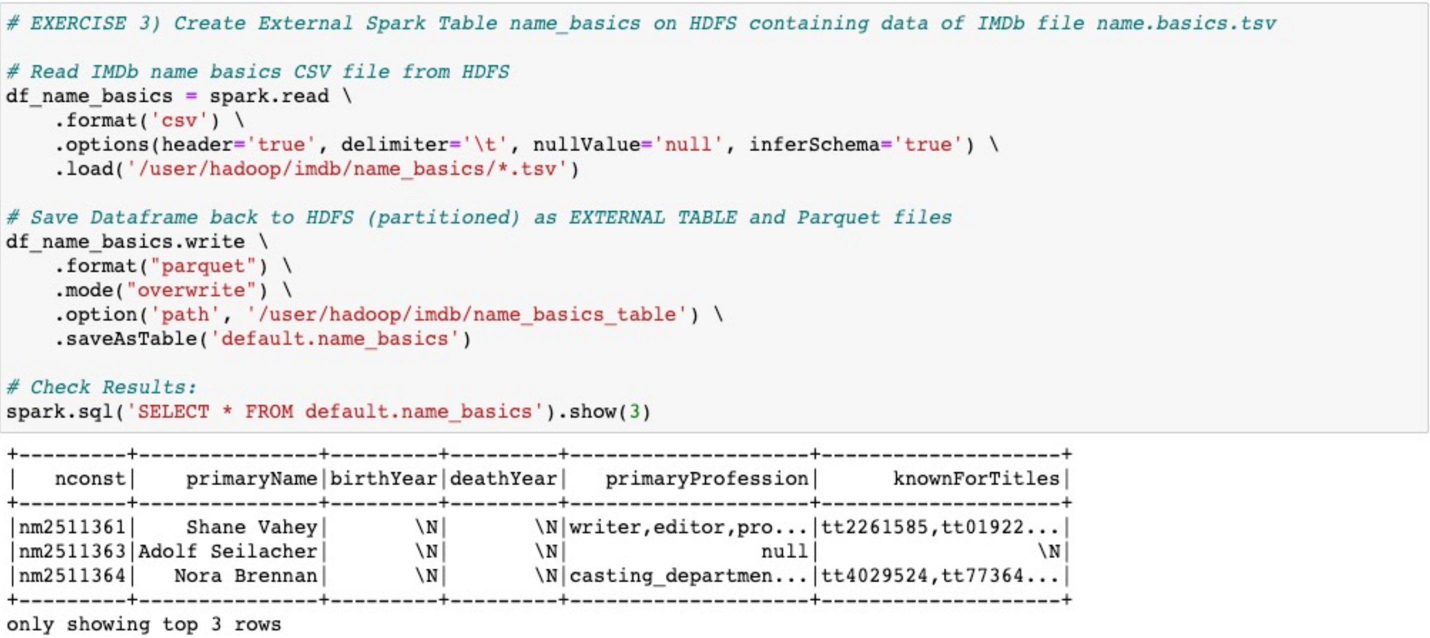


```
# EXERCISE 2) Create External Spark Table title_ratings on HDFS containing data of IMDb file title.ratings.tsv

# Read IMDb title ratings CSV file from HDFS
df_title_ratings = spark.read \
    .format('csv') \
    .options(header='true', delimiter='\t', nullValue='null', inferSchema='true') \
    .load('/user/hadoop/imdb/title_ratings/*.tsv')

# Save Dataframe back to HDFS (partitioned) as EXTERNAL TABLE and Parquet files
df_title_ratings.write \
    .format("parquet") \
    .mode("overwrite") \
    .option('path', '/user/hadoop/imdb/title_ratings_table') \
    .saveAsTable('default.title_ratings')

# Check Results:
spark.sql('SELECT * FROM default.title_ratings').show(3)
```

```
+---------+-------------+--------+
|   tconst|averageRating|numVotes|
+---------+-------------+--------+
|tt0000001|          5.7|    1685|
|tt0000002|          6.0|     208|
|tt0000003|          6.5|    1425|
+---------+-------------+--------+
only showing top 3 rows
```

Solution

3. Create External Spark Table `name_basics` on HDFS containing data of IMDb file *name.basics.tsv*

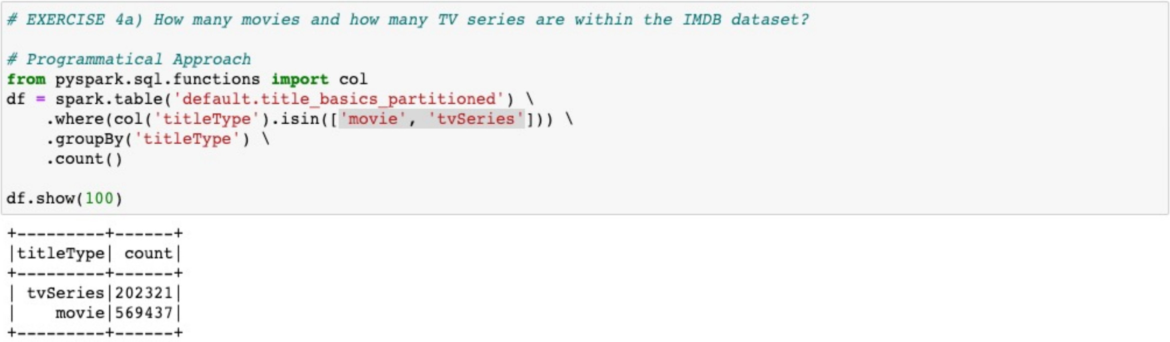


```
# EXERCISE 3) Create External Spark Table name_basics on HDFS containing data of IMDb file name.basics.tsv

# Read IMDb name basics CSV file from HDFS
df_name_basics = spark.read \
    .format('csv') \
    .options(header='true', delimiter='\t', nullValue='null', inferSchema='true') \
    .load('/user/hadoop/imdb/name_basics/*.tsv')

# Save Dataframe back to HDFS (partitioned) as EXTERNAL TABLE and Parquet files
df_name_basics.write \
    .format("parquet") \
    .mode("overwrite") \
    .option('path', '/user/hadoop/imdb/name_basics_table') \
    .saveAsTable('default.name_basics')

# Check Results:
spark.sql('SELECT * FROM default.name_basics').show(3)
```

```
+---------+---------------+---------+---------+--------------------+--------------------+
|   nconst|    primaryName|birthYear|deathYear|   primaryProfession|      knownForTitles|
+---------+---------------+---------+---------+--------------------+--------------------+
|nm2511361|    Shane Vahey|       \N|       \N|writer,editor,pro...|tt2261585,tt01922...|
|nm2511363|Adolf Seilacher|       \N|       \N|                null|                  \N|
|nm2511364|   Nora Brennan|       \N|       \N|casting_departmen...|tt4029524,tt77364...|
+---------+---------------+---------+---------+--------------------+--------------------+
only showing top 3 rows
```

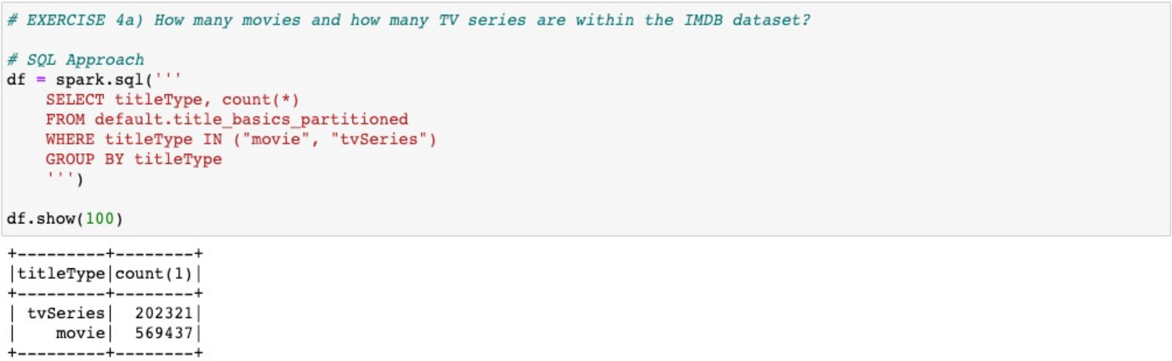
Solution

4.a) How many **movies** and how many **TV series** are within the IMDB dataset?



```
# EXERCISE 4a) How many movies and how many TV series are within the IMDB dataset?

# Programmatical Approach
from pyspark.sql.functions import col
df = spark.table('default.title_basics_partitioned') \
    .where(col('titleType').isin(['movie', 'tvSeries'])) \
    .groupBy('titleType') \
    .count()

df.show(100)
```

```
+---------+------+
|titleType| count|
+---------+------+
| tvSeries|202321|
|    movie|569437|
+---------+------+
```

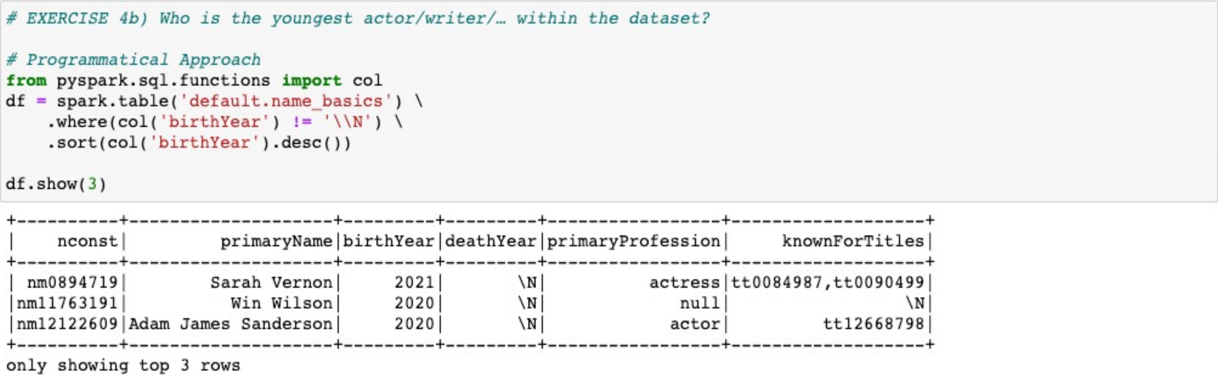


```
# EXERCISE 4a) How many movies and how many TV series are within the IMDB dataset?

# SQL Approach
df = spark.sql('''
    SELECT titleType, count(*)
    FROM default.title_basics_partitioned
    WHERE titleType IN ("movie", "tvSeries")
    GROUP BY titleType
    ''')

df.show(100)
```

```
+---------+--------+
|titleType|count(1)|
+---------+--------+
| tvSeries|  202321|
|    movie|  569437|
+---------+--------+
```

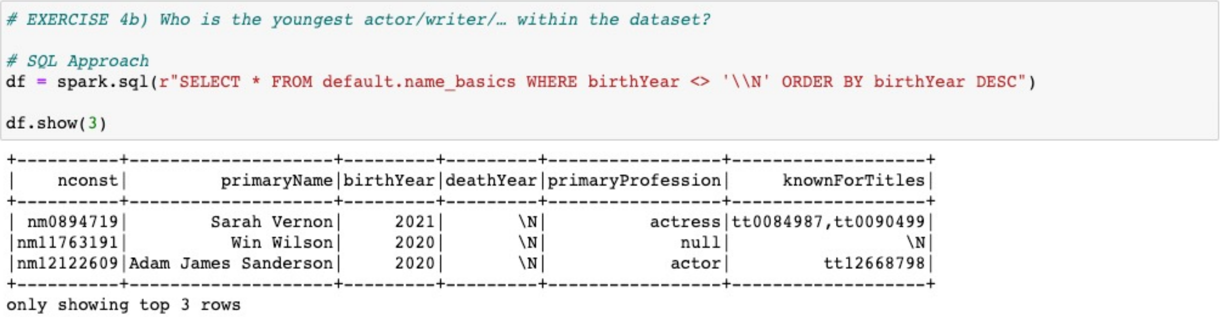
Solution

4.b) Who is the **youngest** actor/writer/… within the dataset?



```
# EXERCISE 4b) Who is the youngest actor/writer/… within the dataset?

# Programmatical Approach
from pyspark.sql.functions import col
df = spark.table('default.name_basics') \
    .where(col('birthYear') != '\\N') \
    .sort(col('birthYear').desc())

df.show(3)
```

```
+----------+--------------------+---------+---------+-----------------+-------------------+
|    nconst|         primaryName|birthYear|deathYear|primaryProfession|     knownForTitles|
+----------+--------------------+---------+---------+-----------------+-------------------+
| nm0894719|        Sarah Vernon|     2021|       \N|          actress|tt0084987,tt0090499|
|nm11763191|          Win Wilson|     2020|       \N|             null|                 \N|
|nm12122609|Adam James Sanderson|     2020|       \N|            actor|         tt12668798|
+----------+--------------------+---------+---------+-----------------+-------------------+
only showing top 3 rows
```



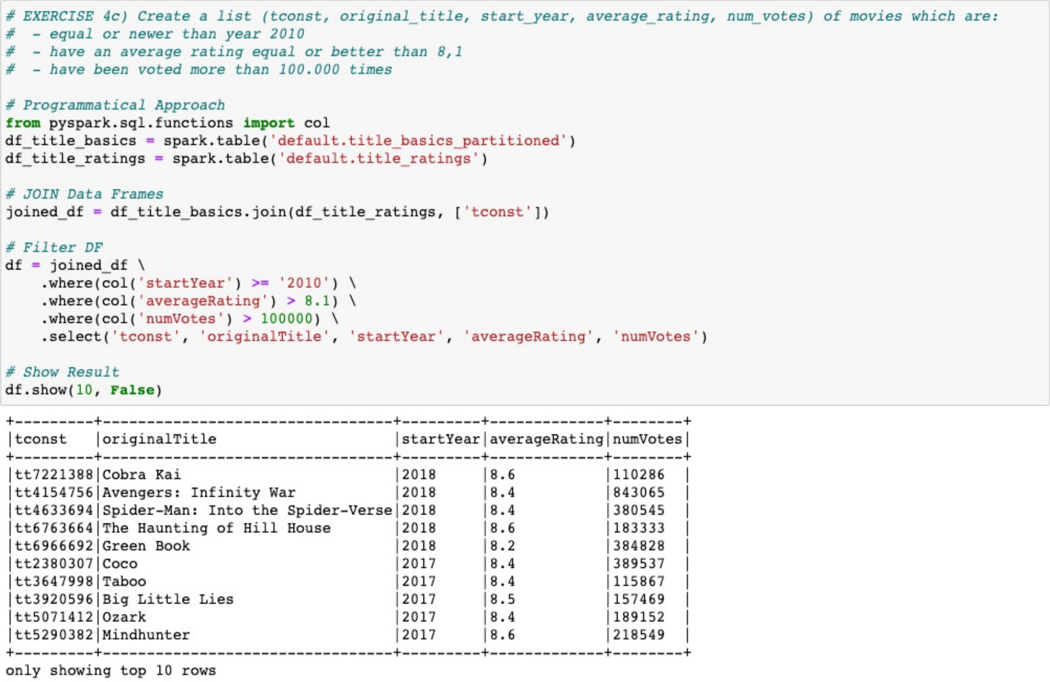
```
# EXERCISE 4b) Who is the youngest actor/writer/… within the dataset?

# SQL Approach
df = spark.sql(r"SELECT * FROM default.name_basics WHERE birthYear <> '\\N' ORDER BY birthYear DESC")

df.show(3)
```

```
+----------+--------------------+---------+---------+-----------------+-------------------+
|    nconst|         primaryName|birthYear|deathYear|primaryProfession|     knownForTitles|
+----------+--------------------+---------+---------+-----------------+-------------------+
| nm0894719|        Sarah Vernon|     2021|       \N|          actress|tt0084987,tt0090499|
|nm11763191|          Win Wilson|     2020|       \N|             null|                 \N|
|nm12122609|Adam James Sanderson|     2020|       \N|            actor|         tt12668798|
+----------+--------------------+---------+---------+-----------------+-------------------+
only showing top 3 rows
```

Solution

4.c) Create a list (`tconst, original_title, start_year, average_rating, num_votes`) of movies which are:

- equal or newer than year 2010
- have an average rating equal or better than 8,1
- have been voted more than 100.000 times

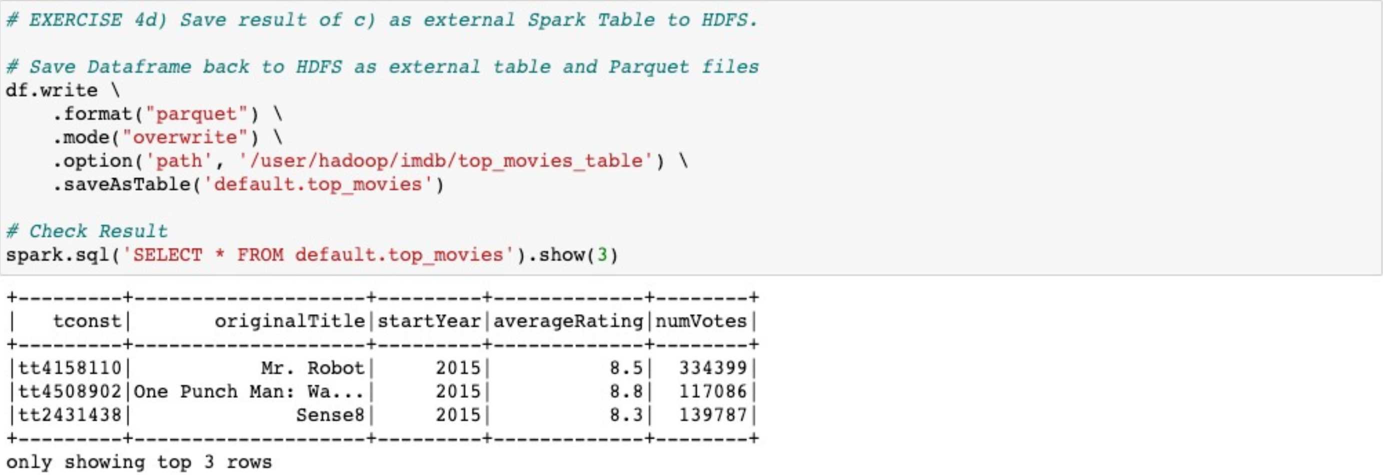


```
# EXERCISE 4c) Create a list (tconst, original_title, start_year, average_rating, num_votes) of movies which are:
#  - equal or newer than year 2010
#  - have an average rating equal or better than 8,1
#  - have been voted more than 100.000 times

# Programmatical Approach
from pyspark.sql.functions import col
df_title_basics = spark.table('default.title_basics_partitioned')
df_title_ratings = spark.table('default.title_ratings')

# JOIN Data Frames
joined_df = df_title_basics.join(df_title_ratings, ['tconst'])

# Filter DF
df = joined_df \
    .where(col('startYear') >= '2010') \
    .where(col('averageRating') > 8.1) \
    .where(col('numVotes') > 100000) \
    .select('tconst', 'originalTitle', 'startYear', 'averageRating', 'numVotes')

# Show Result
df.show(10, False)
```

```
+---------+---------------------------------+---------+-------------+--------+
|tconst   |originalTitle                    |startYear|averageRating|numVotes|
+---------+---------------------------------+---------+-------------+--------+
|tt7221388|Cobra Kai                        |2018     |8.6          |110286  |
|tt4154756|Avengers: Infinity War           |2018     |8.4          |843065  |
|tt4633694|Spider-Man: Into the Spider-Verse|2018     |8.4          |380545  |
|tt6763664|The Haunting of Hill House       |2018     |8.6          |183333  |
|tt6966692|Green Book                       |2018     |8.2          |384828  |
|tt2380307|Coco                             |2017     |8.4          |389537  |
|tt3647998|Taboo                            |2017     |8.4          |115867  |
|tt3920596|Big Little Lies                  |2017     |8.5          |157469  |
|tt5071412|Ozark                            |2017     |8.4          |189152  |
|tt5290382|Mindhunter                       |2017     |8.6          |218549  |
+---------+---------------------------------+---------+-------------+--------+
only showing top 10 rows
```

Solution

4.d) Save result of c) as external Spark Table to HDFS.

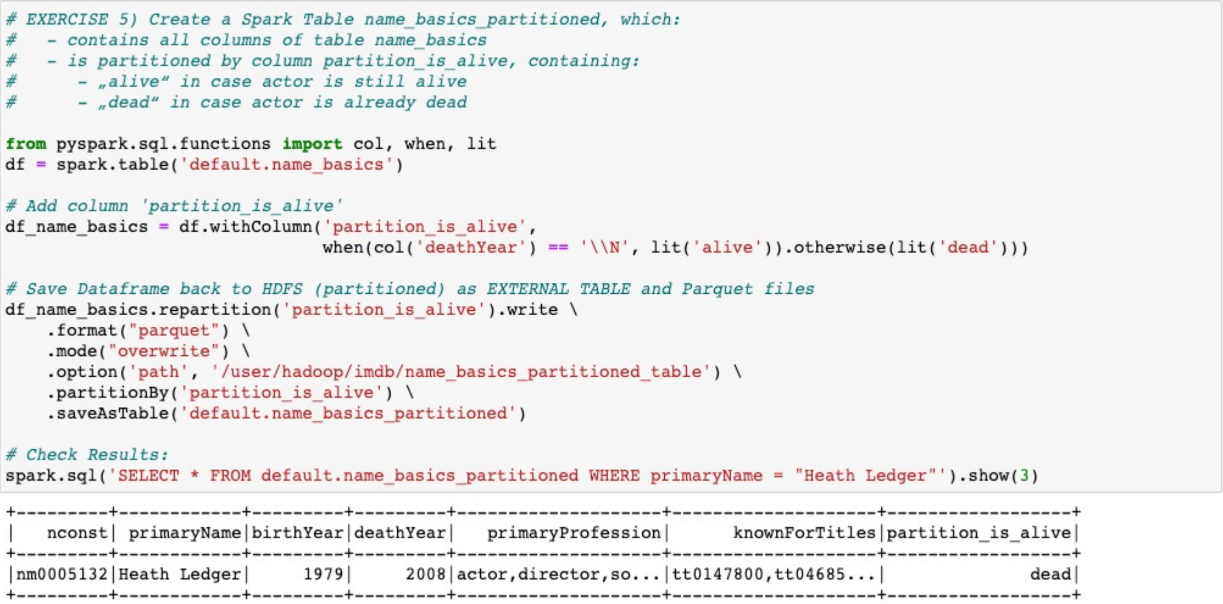


```
# EXERCISE 4d) Save result of c) as external Spark Table to HDFS.

# Save Dataframe back to HDFS as external table and Parquet files
df.write \
    .format("parquet") \
    .mode("overwrite") \
    .option('path', '/user/hadoop/imdb/top_movies_table') \
    .saveAsTable('default.top_movies')

# Check Result
spark.sql('SELECT * FROM default.top_movies').show(3)
```

```
+---------+--------------------+---------+-------------+--------+
|   tconst|       originalTitle|startYear|averageRating|numVotes|
+---------+--------------------+---------+-------------+--------+
|tt4158110|           Mr. Robot|     2015|          8.5|  334399|
|tt4508902|One Punch Man: Wa...|     2015|          8.8|  117086|
|tt2431438|              Sense8|     2015|          8.3|  139787|
+---------+--------------------+---------+-------------+--------+
only showing top 3 rows
```

Solution

5. Create a Spark Table **name_basics_partitioned**, which:
- contains all columns of table `name_basics`
- is partitioned by column `partition_is_alive`, containing:
  - „*alive*“ in case actor is still alive
  - „*dead*“ in case actor is already dead

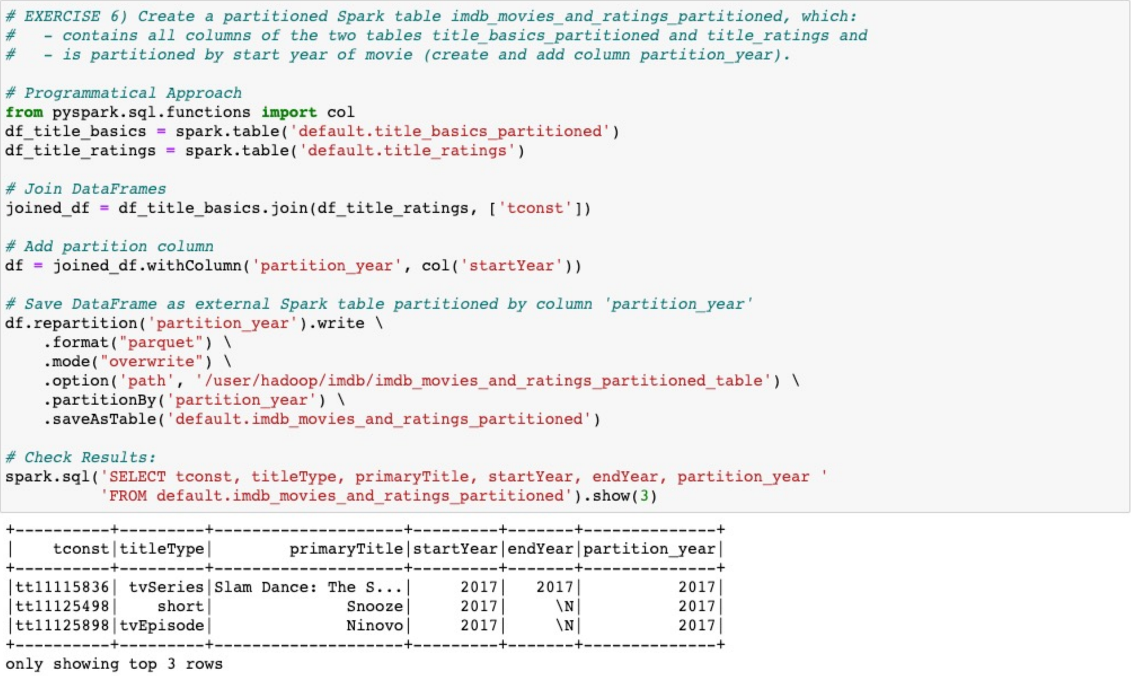


```
# EXERCISE 5) Create a Spark Table name_basics_partitioned, which:
#   - contains all columns of table name_basics
#   - is partitioned by column partition_is_alive, containing:
#      - „alive“ in case actor is still alive
#      - „dead“ in case actor is already dead

from pyspark.sql.functions import col, when, lit
df = spark.table('default.name_basics')

# Add column 'partition_is_alive'
df_name_basics = df.withColumn('partition_is_alive',
                               when(col('deathYear') == '\\N', lit('alive')).otherwise(lit('dead')))

# Save Dataframe back to HDFS (partitioned) as EXTERNAL TABLE and Parquet files
df_name_basics.repartition('partition_is_alive').write \
    .format("parquet") \
    .mode("overwrite") \
    .option('path', '/user/hadoop/imdb/name_basics_partitioned_table') \
    .partitionBy('partition_is_alive') \
    .saveAsTable('default.name_basics_partitioned')

# Check Results:
spark.sql('SELECT * FROM default.name_basics_partitioned WHERE primaryName = "Heath Ledger"').show(3)
```

```
+---------+------------+---------+---------+--------------------+--------------------+------------------+
|   nconst| primaryName|birthYear|deathYear|   primaryProfession|      knownForTitles|partition_is_alive|
+---------+------------+---------+---------+--------------------+--------------------+------------------+
|nm0005132|Heath Ledger|     1979|     2008|actor,director,so...|tt0147800,tt04685...|              dead|
+---------+------------+---------+---------+--------------------+--------------------+------------------+
```

Solution

6. Create a partitioned Spark table **`imdb_movies_and_ratings_partitioned`**, which:
   - contains all columns of the two tables `title_basics_partitioned` and `title_ratings` and
   - is partitioned by start year of movie (create and add column `partition_year`).

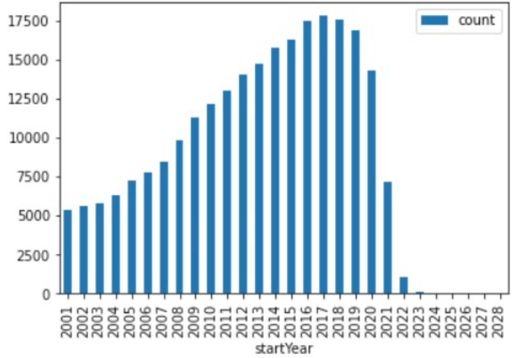


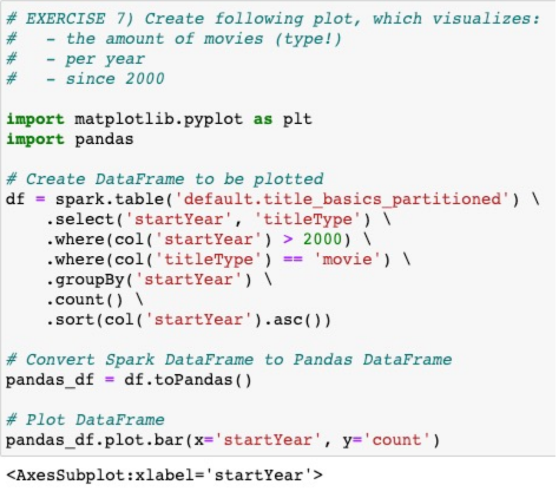
```
# EXERCISE 6) Create a partitioned Spark table imdb_movies_and_ratings_partitioned, which:
#   - contains all columns of the two tables title_basics_partitioned and title_ratings and
#   - is partitioned by start year of movie (create and add column partition_year).

# Programmatical Approach
from pyspark.sql.functions import col
df_title_basics = spark.table('default.title_basics_partitioned')
df_title_ratings = spark.table('default.title_ratings')

# Join DataFrames
joined_df = df_title_basics.join(df_title_ratings, ['tconst'])

# Add partition column
df = joined_df.withColumn('partition_year', col('startYear'))

# Save DataFrame as external Spark table partitioned by column 'partition_year'
df.repartition('partition_year').write \
    .format("parquet") \
    .mode("overwrite") \
    .option('path', '/user/hadoop/imdb/imdb_movies_and_ratings_partitioned_table') \
    .partitionBy('partition_year') \
    .saveAsTable('default.imdb_movies_and_ratings_partitioned')

# Check Results:
spark.sql('SELECT tconst, titleType, primaryTitle, startYear, endYear, partition_year '
          'FROM default.imdb_movies_and_ratings_partitioned').show(3)
```

```
+----------+---------+--------------------+---------+-------+--------------+
|    tconst|titleType|        primaryTitle|startYear|endYear|partition_year|
+----------+---------+--------------------+---------+-------+--------------+
|tt11115836| tvSeries|Slam Dance: The S...|     2017|   2017|          2017|
|tt11125498|    short|              Snooze|     2017|     \N|          2017|
|tt11125898|tvEpisode|              Ninovo|     2017|     \N|          2017|
+----------+---------+--------------------+---------+-------+--------------+
only showing top 3 rows
```

Solution

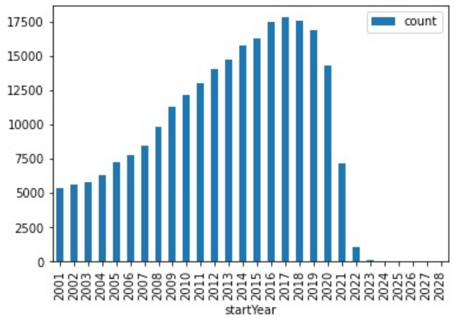
7. Create following plot, which visualizes:
   - the amount of movies (type!)
   - per year
   - since 2000





```
# EXERCISE 7) Create following plot, which visualizes:
#   - the amount of movies (type!)
#   - per year
#   - since 2000

import matplotlib.pyplot as plt
import pandas

# Create DataFrame to be plotted
df = spark.table('default.title_basics_partitioned') \
    .select('startYear', 'titleType') \
    .where(col('startYear') > 2000) \
    .where(col('titleType') == 'movie') \
    .groupBy('startYear') \
    .count() \
    .sort(col('startYear').asc())

# Convert Spark DataFrame to Pandas DataFrame
pandas_df = df.toPandas()

# Plot DataFrame
pandas_df.plot.bar(x='startYear', y='count')
```

```
<AxesSubplot:xlabel='startYear'>
```


count
startYear