

# Lab 8

In this lab, we analyze historical data about the stations of the bike sharing system of Barcelona. The data are the same you already analyzed during the previous practice, as well as the main goal of your task: computing the “criticality” for the pairs (station, timeslot) and select the most critical ones. However, in this practice you are requested to use the Spark SQL APIs and the final selection process is slightly different with respect to the one you implemented during the previous practice.

The analysis is based on the same two files (available in the HDFS shared folder of the BigData@Polito cluster) we used during the previous lab:

1. /data/students/bigdata-01QYD/Lab7\_DBD/register.csv
2. /data/students/bigdata-01QYD/Lab7\_DBD/stations.csv

- 1) register.csv contains the historical information about the number of used and free slots for ~3000 stations from May 2008 to September 2008. Each line of register.csv corresponds to one reading about the situation of one station at a specific timestamp. Each line has the following format:

*stationId\timestamp\tusedslots\tfreelots*

where *timestamp* has the format *date time*

For example, the line

23 2008-05-15 19:01:00 5 13

means that there were **5** used slots and **13** free slots at station **23** on **May 15, 2008** at **19:01:00**.

Pay attention that the first line of register.csv contains the header of the file. Moreover, some of the lines of register.csv contain wrong data due to temporary problems of the monitoring system. Specifically, some lines are characterized by used slots = 0 and free slots = 0. Those lines must be filtered before performing the analysis.

- 2) stations.csv contains the description of the stations. Each line of registers.csv has the following format:

*stationId\tlongitude\tlatitude\tname*

For example, the line

1 2.180019 41.397978 Gran Via Corts Catalanes

contains the information about station 1. The coordinates of station 1 are 2.180019,41.397978 and its name is **Gran Via Corts Catalanes**.

## Task 1

Write a single Spark application that selects the combinations (station, timeslot) that are characterized by a high “criticality” value. The first part of this practice is similar to the one

that you already solved during the previous practice. However, in this case you are requested to **solve the problem by using two different sets of Spark SQL APIs.**

- (i) Implement a **first version** of the application based on **Dataframes** and the associated APIs
- (ii) Implement a **second version** of the application based on the use of **SQL queries** in the Spark application, i.e., use **SparkSession.sql("SELECT ...")**.

In this practice, each pair “day of the week – hour” is a timeslot and is associated with all the readings associated with that pair, independently of the date. For instance, the timeslot “Wednesday - 15” corresponds to all the readings made on Wednesday from 15:00:00 to 15:59:59.

A station  $S_i$  is in the critical state if the number of free slots is equal to 0 (i.e., the station is full).

The “criticality” of a station  $S_i$  in the timeslot  $T_j$  is defined as

$$\frac{\text{number of readings with num. of free slot equal to 0 for the combination } (S_i, T_j)}{\text{total number of readings for the combination } (S_i, T_j)}$$

Write two versions (based on Dataframes and SQL queries, respectively) of an application that:

- Computes the **criticality value** for each combination  $(S_i, T_j)$ .
- Selects only the combinations having a criticality value greater than a minimum criticality threshold. The **minimum criticality threshold** is an argument of the application.
- **Join** the content of the previous selected combinations with the content of stations.csv to retrieve **the coordinates of the stations**.
- Store in the output folder the selected records, by using **csv files (with header)**. Store only the following attributes:
  - station
  - day of week
  - hour
  - criticality
  - station longitude
  - station latitude
- Store the results **by decreasing criticality**. If there are two or more records characterized by the same criticality value, consider the station (in ascending order). If also the station is the same, consider the weekday (ascending) and finally the hour (ascending).

### Hints

- The SQL-like language available in Spark SQL is characterized by a predefined function called **hour(timestamp)** that can be used in the SQL queries, or in the

**selectExpr** transformation, to select the “hour part” of a given timestamp. The **date\_format(timestamp,'EE')** is another predefined SQL function available in Spark SQL that can be used to extract the weekday from a timestamp column.

- Example

```
...
resDF= myDataframe.selectExpr("date_format(timestamp,'EE') as weekday",\
                                "hour(timestamp) as hour")
...
```

- In order to specify that the separator of the input CSV files is “tab”, set the delimiter option to `\t`, i.e., invoke `.option("delimiter", "\t")` during the reading of the input data.