CORK INSTITUTE OF TECHNOLOGY
INSTITIÚID TEICNEOLAÍOCHTA CHORCAÍ

Computing@CIT

BIG DATA & ANALYTICS

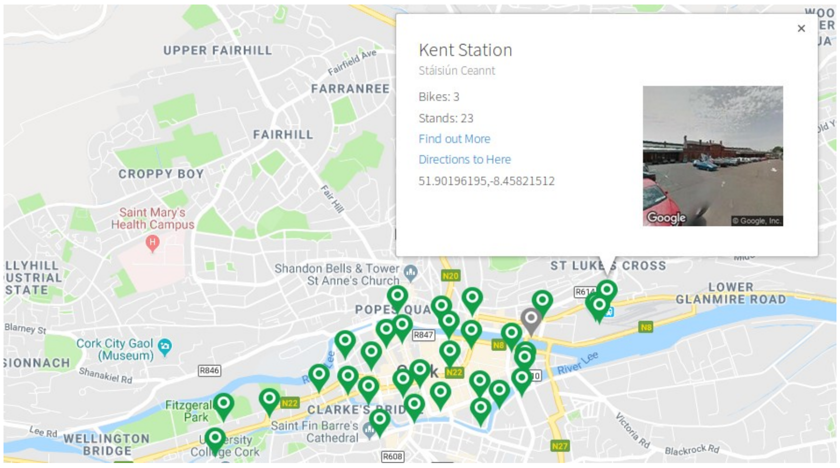
ASSIGNMENT 2: SPARK AND SPARK STREAMING

BACKGROUND.

Cork Smart Gateway is the home of open data for Cork: http://data.corkcity.ie/
At the moment it contains 8 datasets in open format. One of them is the "Coca-Cola Zero Bikes" (http://data.corkcity.ie/dataset/coca-cola-zero-bikes) which provides data related to the bike-sharing rental service supported by the city council.

While historic information on the state of the 31 bike stations in Cork city is not available, real-time information can be obtained via:

- The Coca-Cola Zero Bikes website: Visual Format
  https://www.bikeshare.ie/cork.html



Kent Station
Stáisiún Ceannt
Bikes: 3
Stands: 23
Find out More
Directions to Here
51.90196195,-8.45821512

- The Open Data API Endpoint: JSON Format.
  https://data.bikeshare.ie/dataapi/resources/station/data/list

```
{"schemeId":2,           "schemeShortName":"Cork",       "stationId":2032,
 "name":"Kent Station",  "nameIrish":"Stáisiún Ceannt",  "docksCount":30,
 "bikesAvailable":3,     "docksAvailable":23,            "status":0,
 "latitude":51.902,      "longitude": -8.458,      "dateStatus":"15-10-2018 15:32:30" }
```

MY_DATASET FOLDER

My former colleague Michael O'Keefe collected data from mid January 2017 to late September 2017 by creating a service quering the API every 5 minutes from 6am to midnight and gathering all entries of a day into a file.

I have selected the files for the period 01/02/2017 – 31/08/2017 and provided the entries in the following csv format:
status ; name ; longitude ; latitude ; dateStatus ; bikesAvailable ; docksAvailable
For example, the aforementioned entry for Kent Station would be represented as follows:
0;Kent Station;-8.45821512;51.90196195;15-10-2018 15:32:30;3;23

In total, the dataset for the selected period contains 1,339,200 entries for 43,200 API requests over 200 days.

MY_CODE FOLDER

The assignment is divided into 4 parts:

- Part1: Introductory Data Analysis with Spark.
- Part2: Introductory Data Analysis with Spark.
- Part3: Advance Data Analysis with Spark.
- Part4: Introductory Data Analysis with Spark Streaming.

The four parts are provided in the folder "my_code".
Each part provides a Python file (A02_Part_Number.py) with the exercises to be completed.

MY_RESULT FOLDER

The correct results to be obtained from each exercise are provided in the folder "my_result".

MARK BREAKDOWN.

The assignment is worth 25 marks. It consists on 4 parts, each of them worth 6.25 marks.

SUBMISSION DETAILS.

Submission deadline: Sunday 10th of May, 11:59pm
Please submit to Canvas (folder 5. Submissions) a zip file **A02.zip** containing the following Python files:

- Part 1 -> A02_Part1.py
- Part 2 -> A02_Part2.py
- Part 3 -> A02_Part3.py
- Part 4 -> A02_Part4.py

ASSIGNMENT 2 – PART 1 **(Week 9)**

GOAL.

Given the Coca-Cola bikes dataset provided:

- Create a Spark job to compute the number of times each Coca-Cola bike station ran out of bikes. Sort the stations by decreasing number of ran outs.
    - Note: A bike station is ran out of bikes if:

      status == 0 and *bikes_available == 0*

EXERCISE.

To perform the Spark job, complete the following code:

- **A02_Part1.py =>** Program the function **my_main**.

Note: You can use as many auxiliary functions as you need.

ASSIGNMENT 2 – PART 2 **(Week 10)**

GOAL.

Given the Coca-Cola bikes dataset provided:

- Create a Spark job to compute the amount of times per day and hour that the Fitzgerald Park station was run out of bikes. Present this result as the total amount and as the percentage of total ran outs the station had across the dataset.
    - Note: A bike station is ran out of bikes if:

      status == 0 and *bikes_available == 0*

EXERCISE.

To perform the Spark job, complete the following code:

A02_Part2.py => Program the function **my_main**.

Note: You can use as many auxiliary functions as you need.

ASSIGNMENT 2 – PART 3 **(Week 11)**

GOAL.

Given the Coca-Cola bikes dataset provided:

- Create a Spark job to compute the actual ran-out times for the Fitzgerald Park station. Sort the ran-out times by increasing time in the calendar.
    - We define an "actual" ran-out time as the first moment in which our station is measured to be out of bikes. We define further measurements where the station still has no bikes to be "continuations" of the actual ran-out time previously measured.

      For example: given our 5 minutes measurements, if we notify Fitzgerald Park to be ran-out of bikes at the following times:
        - 10:06:00
        - 10:11:00
        - 15:31:00
        - 15:36:00
        - 15:41:00
        - 19:56:00
    - Then the "actual" ran-out-times are highlighed in red, with "continuations" for them highlighted in blue. In this example, 15:31:00 represents a measurement in which we realised that Fitzgerald Park was ran out of bikes. We can ensure this as 15:26:00 is not in the list. Thus, some Coca-Cola user(s) must took the last bike(s) available at the station between 15:26:00 – 15:31:00.
    - At 15:36:00 we notify that Fitzgerald park has actually ran-out of bikes, and we report it.
    - At 15:41:00 and 15:46:00 we just confirm that the bike station is still with no bikes.
    - Finally, provided that 15:46:00 is not in the list, we can ensure a Coca-Cola user(s) have brought bike(s) back to the station between 15:41:00 – 15:46:00.

  All in all, the goal of the assignment is to print by the screen the actual ran-out times, together with the length (amount of measurements) registered for each of them. In the example before we should have printed:
    - Date (10:06:00, 2)
    - Date (15:31:00, 3)
    - Date (19:56:00, 1)

EXERCISE.

To perform the Spark job, complete the following code:

A02_Part3.py => Program the function **my_main**.

Note: You can use as many auxiliary functions as you need.

ASSIGNMENT 2 – PART 4 **(Week 12)**

EXERCISE.

Given the Coca-Cola bikes dataset provided:

- Adjust the Spark job of Part 1 so that it operates in Streaming mode. In particular:
  - We simulate the dataset to arrive in batches, with each batch consisting of the data of one single day.
  - We reduce our dataset to the processing of just 6 batches, corresponding to the days of the first week of May (from May 1st to May 7th , excluding May 6th for which we unfortunately have no data). This reduction of the dataset is provided automatically by the program via the inclusion of the variable valid_files, which is hardcoded to such these days (for the function streaming_simulation to operate just on them).

  We want to produce results using the 2 stateful operations seen in class:

- updateStateByKey: We want to cummulative display the total amount of ran outs measured during the week. That is, after processing the batch for May 1st we will display just the ran outs for such this day. Then, after processing the batch for May 2nd we will display the cummulative ran outs found in May 1st + May 2nd. After processing May 3rd we will display the the cummulative ran outs found in May 1st + May 2nd + May 3rd (and so on).
- window: We want to amalgamate the batches in windows. In particular, we are interested in windows_duration = 2 and sliding_duration = 1. That is, in computing the ran outs for:
  - May 1st - May 2nd.
  - May 2nd – May 3rd.
  - May 3rd – May 4th.
  - May 4th – May 5th.
  - May 5th – May 7th.

  In both cases, we want the results sorted in decreasing order.

EXERCISE.

To perform the Spark job, complete the following code:

A02_Part4.py => Program the function **my_model**.

Note: You can use as many auxiliary functions as you need.