BDA – Hands-on with Spark

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Methodology and Approach

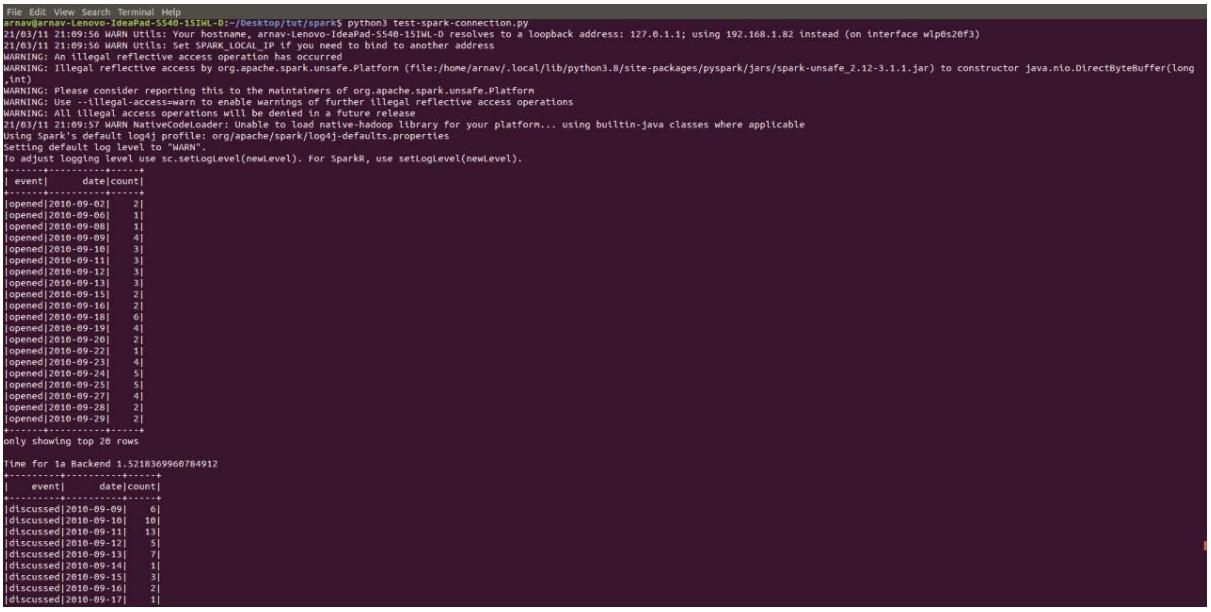
- Apache Spark and all the relational database systems – Postgres, MongoDB, and Hadoop were installed and successfully set-up.
- The next step involved downloading all connectors that are required to connect all these database systems to Spark.
- All queries are formatted in a python file and run. Execution times are observed for all queries to analyze the efficiency and speed of both the methods.
- The queries used were same as those used in Assignment-1 and therefore follow the assumptions mentioned during its submission.

Task 1 – Postgres with Apache Spark

Observation of Execution Time:

Tasks	Frontend	Backend
1a | 1b	2.3964 | 1.4340	1.5218 | 0.2962
2	4.3875	0.4778
3	5.6038	0.5290
4	0.7604	0.2440
5	0.6633	0.1643
6	0.9006	0.3892
7	0.6708	0.1372
Total	12.4856	3.7599

Screenshots of OUTPUT



```
File  Edit  View  Search  Terminal  Help
|discussed|2010-10-01|    2|
|discussed|2010-10-04|    8|
|discussed|2010-10-06|   15|
+---------+----------+-----+
only showing top 20 rows

Time for 1b Backend 0.2962524890899658
+------------+-----------+----------+
|        name|monthnumber|countscore|
+------------+-----------+----------+
|rafaelfranca|        1.0|       828|
|rafaelfranca|        2.0|       555|
|rafaelfranca|        3.0|       580|
|rafaelfranca|        4.0|       758|
|rafaelfranca|        5.0|       915|
|rafaelfranca|        6.0|       582|
|rafaelfranca|        7.0|       579|
|rafaelfranca|        8.0|       651|
|rafaelfranca|        9.0|       585|
|rafaelfranca|       10.0|       667|
|rafaelfranca|       11.0|       590|
|   rails-bot|       12.0|       546|
+------------+-----------+----------+

Time for 2 Backend 0.4778673648834228 5
+------------+-------------------+----------+
|        name|               week|countscore|
+------------+-------------------+----------+
|       mikel|2010-09-06 00:00:00|        16|
|       mikel|2010-09-13 00:00:00|         6|
|   josevalim|2010-09-20 00:00:00|         9|
|   josevalim|2010-09-27 00:00:00|         6|
|   josevalim|2010-10-04 00:00:00|        12|
|   josevalim|2010-10-11 00:00:00|         6|
|    krekoten|2010-10-18 00:00:00|         4|
|         fxn|2010-10-25 00:00:00|         1|
|        rsim|2010-11-01 00:00:00|         2|
|  spastorino|2010-11-01 00:00:00|         2|
|   josevalim|2010-11-08 00:00:00|         6|
|franckverrot|2010-11-15 00:00:00|         3|
|   josevalim|2010-11-15 00:00:00|         3|
|  tenderlove|2010-11-22 00:00:00|         6|
|   josevalim|2010-11-29 00:00:00|         4|
|      drogus|2010-12-06 00:00:00|         2|
|   josevalim|2010-12-13 00:00:00|         7|
|         dhh|2010-12-20 00:00:00|         5|
|      jeremy|2011-01-03 00:00:00|        21|
|  tenderlove|2011-01-10 00:00:00|         2|
+------------+-------------------+----------+
only showing top 20 rows

Time for 3 Backend 0.5290446281433105
```

```
File  Edit  View  Search  Terminal  Help
+-------------------+-----+
|2010-08-30 00:00:00|    2|
|2010-09-06 00:00:00|   15|
|2010-09-13 00:00:00|   17|
|2010-09-20 00:00:00|   17|
|2010-09-27 00:00:00|   13|
|2010-10-04 00:00:00|   10|
|2010-10-11 00:00:00|    5|
|2010-10-18 00:00:00|    5|
|2010-10-25 00:00:00|    3|
|2010-11-01 00:00:00|    4|
|2010-11-08 00:00:00|    9|
|2010-11-15 00:00:00|    8|
|2010-11-22 00:00:00|    9|
|2010-11-29 00:00:00|    6|
|2010-12-06 00:00:00|    5|
|2010-12-13 00:00:00|    6|
|2010-12-20 00:00:00|    7|
|2010-12-27 00:00:00|    4|
|2011-01-03 00:00:00|    9|
|2011-01-10 00:00:00|    7|
+-------------------+-----+
only showing top 20 rows

Time for 4 Backend 0.2440032958984375
+---+-----+
|mon|count|
+---+-----+
+---+-----+

Time for 5 Backend 0.16439294815063477
+----------+-----+
|      date|count|
+----------+-----+
|2010-09-02|    2|
|2010-09-06|    1|
|2010-09-08|    1|
|2010-09-09|   10|
|2010-09-10|   13|
|2010-09-11|   16|
|2010-09-12|    8|
|2010-09-13|   10|
|2010-09-14|    1|
|2010-09-15|    5|
|2010-09-16|    4|
|2010-09-17|    1|
|2010-09-18|    6|
|2010-09-19|    4|
|2010-09-20|    2|
|2010-09-21|    6|
|2010-09-22|    4|
|2010-09-23|    9|
```

```
File  Edit  View  Search  Terminal  Help
|2010-09-20|    2|
|2010-09-21|    6|
|2010-09-22|    4|
|2010-09-23|    9|
|2010-09-24|    8|
|2010-09-25|   10|
+----------+-----+
only showing top 20 rows

Time for 6 Backend 0.3892159461975097
+-------+------+
| author|events|
+-------+------+
|arunagw|   228|
+-------+------+

Time for 7 Backend 0.13725733757019043
Total Backend time 3.759995222091675
Ans Frontend 1a
+------+----------+--------+
| event| timestamp|count(1)|
+------+----------+--------+
|opened|2010-09-02|       2|
|opened|2010-09-06|       1|
|opened|2010-09-08|       1|
|opened|2010-09-09|       4|
|opened|2010-09-10|       3|
|opened|2010-09-11|       3|
|opened|2010-09-12|       3|
|opened|2010-09-13|       3|
|opened|2010-09-15|       2|
|opened|2010-09-16|       2|
|opened|2010-09-18|       6|
|opened|2010-09-19|       4|
|opened|2010-09-20|       2|
|opened|2010-09-22|       1|
|opened|2010-09-23|       4|
|opened|2010-09-24|       5|
|opened|2010-09-25|       5|
|opened|2010-09-27|       4|
|opened|2010-09-28|       2|
|opened|2010-09-29|       2|
+------+----------+--------+
only showing top 20 rows

Frontend 1a time 2.39644479751869
Ans Frontend 1b
+---------+----------+--------+
|    event| timestamp|count(1)|
+---------+----------+--------+
|discussed|2010-09-09|       6|
|discussed|2010-09-10|      10|
```

```
File  Edit  View  Search  Terminal  Help
|discussed|2010-09-12|       5|
|discussed|2010-09-13|       7|
|discussed|2010-09-14|       1|
|discussed|2010-09-15|       3|
|discussed|2010-09-16|       2|
|discussed|2010-09-17|       1|
|discussed|2010-09-21|       6|
|discussed|2010-09-22|       3|
|discussed|2010-09-23|       5|
|discussed|2010-09-24|       3|
|discussed|2010-09-25|       5|
|discussed|2010-09-27|       3|
|discussed|2010-09-29|       2|
|discussed|2010-09-30|       3|
|discussed|2010-10-01|       2|
|discussed|2010-10-04|       8|
|discussed|2010-10-06|      15|
+---------+----------+--------+
only showing top 20 rows

Frotend 1b time 1.3715429306030273
Ans Frontend 2
+------------+-----------+----------+
|        name|monthnumber|countscore|
+------------+-----------+----------+
|rafaelfranca|          1|       828|
|rafaelfranca|         10|       667|
|rafaelfranca|          7|       579|
|rafaelfranca|          5|       915|
|rafaelfranca|          4|       758|
|rafaelfranca|          8|       651|
|rafaelfranca|          3|       580|
|rafaelfranca|          6|       582|
|   rails-bot|         12|       546|
|rafaelfranca|          2|       555|
|rafaelfranca|          9|       585|
|rafaelfranca|         11|       590|
+------------+-----------+----------+

Frotend 2 time 4.387509822845459
Ans Frontend 3
+--------------------+--------------------+----------+
|                name|                week|countscore|
+--------------------+--------------------+----------+
|        rafaelfranca|2013-04-01 00:00:00|        33|
|                pftg|2013-08-12 00:00:00|        33|
|           rails-bot|2018-06-18 00:00:00|        33|
|          tenderlove|2011-04-18 00:00:00|        12|
|              jeremy|2011-01-03 00:00:00|        21|
|        rafaelfranca|2015-04-06 00:00:00|        52|
|           rails-bot|2017-04-03 00:00:00|        27|
|carlosantoniodasilva|2012-03-26 00:00:00|        39|
```

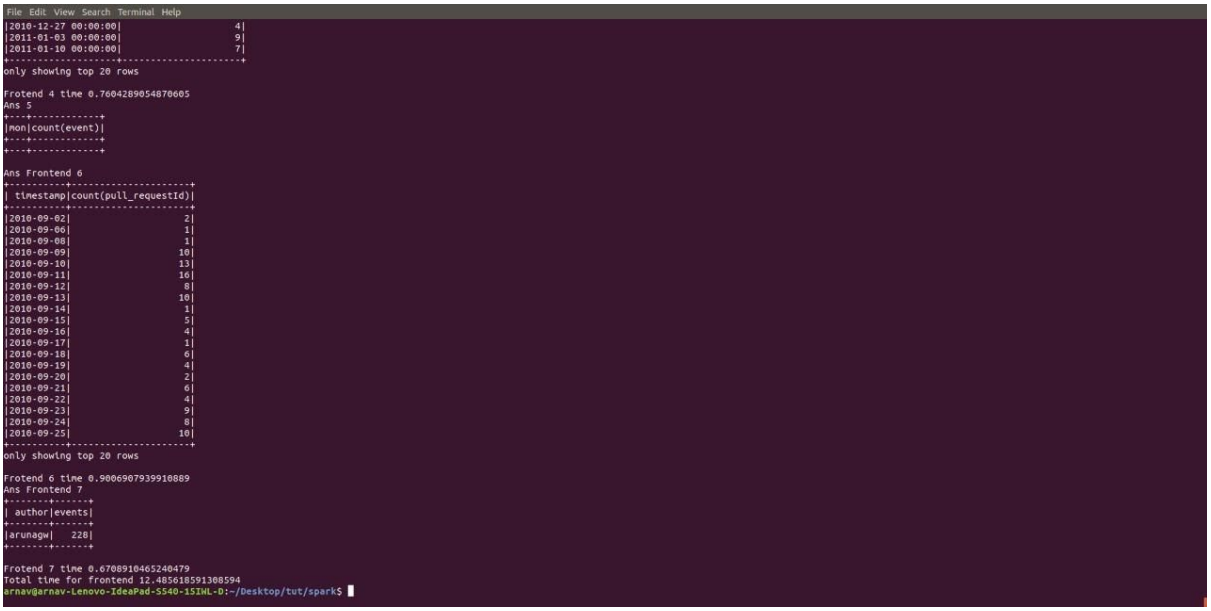
```
Ans Frontend 3
+-------------------+-------------------+----------+
|               name|               week|countscore|
+-------------------+-------------------+----------+
|       rafaelfranca|2013-04-01 00:00:00|        33|
|               pftg|2013-08-12 00:00:00|        33|
|          rails-bot|2018-06-18 00:00:00|        33|
|         tenderlove|2011-04-18 00:00:00|        12|
|             jeremy|2011-01-03 00:00:00|        21|
|       rafaelfranca|2015-04-06 00:00:00|        52|
|          rails-bot|2017-04-03 00:00:00|        27|
|carlosantoniodasilva|2012-03-26 00:00:00|        39|
|                dhh|2011-04-25 00:00:00|        26|
|       steveklabnik|2013-03-11 00:00:00|        50|
|       rafaelfranca|2015-01-26 00:00:00|        30|
|               mikel|2010-09-13 00:00:00|         6|
|          josevalim|2011-11-07 00:00:00|        15|
|       rafaelfranca|2015-05-18 00:00:00|        22|
|         pixeltrix|2017-03-06 00:00:00|        27|
|       rafaelfranca|2013-07-29 00:00:00|        39|
|              sgrif|2014-12-22 00:00:00|        60|
|       rafaelfranca|2015-05-25 00:00:00|        40|
|          rails-bot|2018-05-28 00:00:00|        25|
|         spastorino|2011-07-11 00:00:00|        32|
+-------------------+-------------------+----------+
only showing top 20 rows

Frotend 3 time 5.603874921798706
Ans Frontend 4
+-------------------+----------------------+
|         weekstamp|count(pull_requestid)|
+-------------------+----------------------+
|2010-08-30 00:00:00|                     2|
|2010-09-06 00:00:00|                    15|
|2010-09-13 00:00:00|                    17|
|2010-09-20 00:00:00|                    17|
|2010-09-27 00:00:00|                    13|
|2010-10-04 00:00:00|                    10|
|2010-10-11 00:00:00|                     5|
|2010-10-18 00:00:00|                     5|
|2010-10-25 00:00:00|                     3|
|2010-11-01 00:00:00|                     4|
|2010-11-08 00:00:00|                     9|
|2010-11-15 00:00:00|                     8|
|2010-11-22 00:00:00|                     9|
|2010-11-29 00:00:00|                     6|
|2010-12-06 00:00:00|                     5|
|2010-12-13 00:00:00|                     6|
```

```
File  Edit  View  Search  Terminal  Help
|2010-10-11 00:00:00|                     5|
|2010-10-18 00:00:00|                     5|
|2010-10-25 00:00:00|                     3|
|2010-11-01 00:00:00|                     4|
|2010-11-08 00:00:00|                     9|
|2010-11-15 00:00:00|                     8|
|2010-11-22 00:00:00|                     9|
|2010-11-29 00:00:00|                     6|
|2010-12-06 00:00:00|                     5|
|2010-12-13 00:00:00|                     6|
|2010-12-20 00:00:00|                     7|
|2010-12-27 00:00:00|                     4|
|2011-01-03 00:00:00|                     9|
|2011-01-10 00:00:00|                     7|
+-------------------+----------------------+
only showing top 20 rows

Frotend 4 time 0.8553266525268555
Ans 5
+---+------------+
|mon|count(event)|
+---+------------+
+---+------------+

Frotend 5 time 0.6633701324462891
Ans Frontend 6
+----------+----------------------+
| timestamp|count(pull_requestId)|
+----------+----------------------+
|2010-09-02|                     2|
|2010-09-06|                     1|
|2010-09-08|                     1|
|2010-09-09|                    10|
|2010-09-10|                    13|
|2010-09-11|                    16|
|2010-09-12|                     8|
|2010-09-13|                    10|
|2010-09-14|                     1|
|2010-09-15|                     5|
|2010-09-16|                     4|
|2010-09-17|                     1|
|2010-09-18|                     6|
|2010-09-19|                     4|
|2010-09-20|                     2|
|2010-09-21|                     6|
|2010-09-22|                     4|
|2010-09-23|                     9|
|2010-09-24|                     8|
|2010-09-25|                    10|
+----------+----------------------+
only showing top 20 rows
```

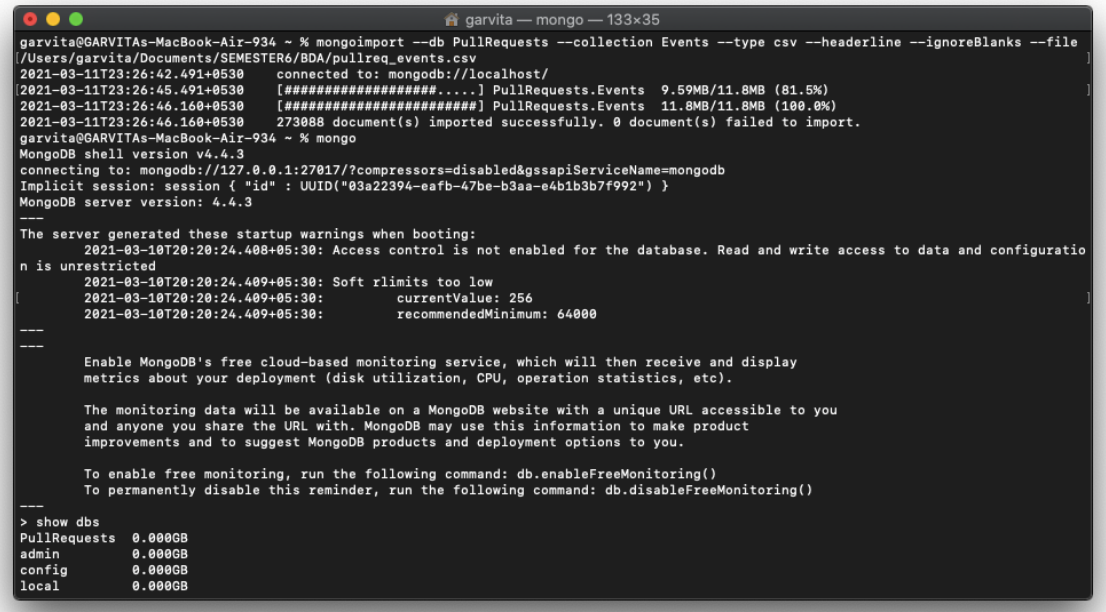


Inferences:

- The queries were answered relatively faster when directly sent to the backend instead of working through the pgadmin service.
- Due to the smaller size of the database, the difference in execution times is not significant. But still comparable to find out the better approach.

Task 2 – MongoDB

Importing database on mongodb using Terminal



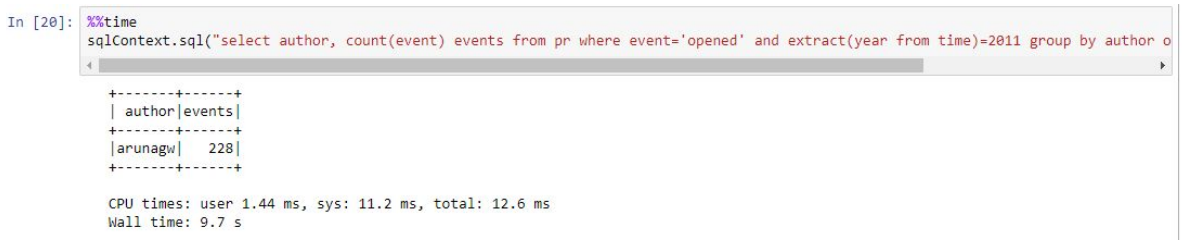
The database is imported in MongoDB and all queries are requested using the shell.

Task 3 – HDFS (Hadoop File System) with Apache Spark

Observations of Execution Time:

Tasks	Frontend
1a | 1b	2.85 | 3.31
2	18.8
3	27.5
4	2.98
5	3.01
6	5.87
7	9.7
Total	74.02

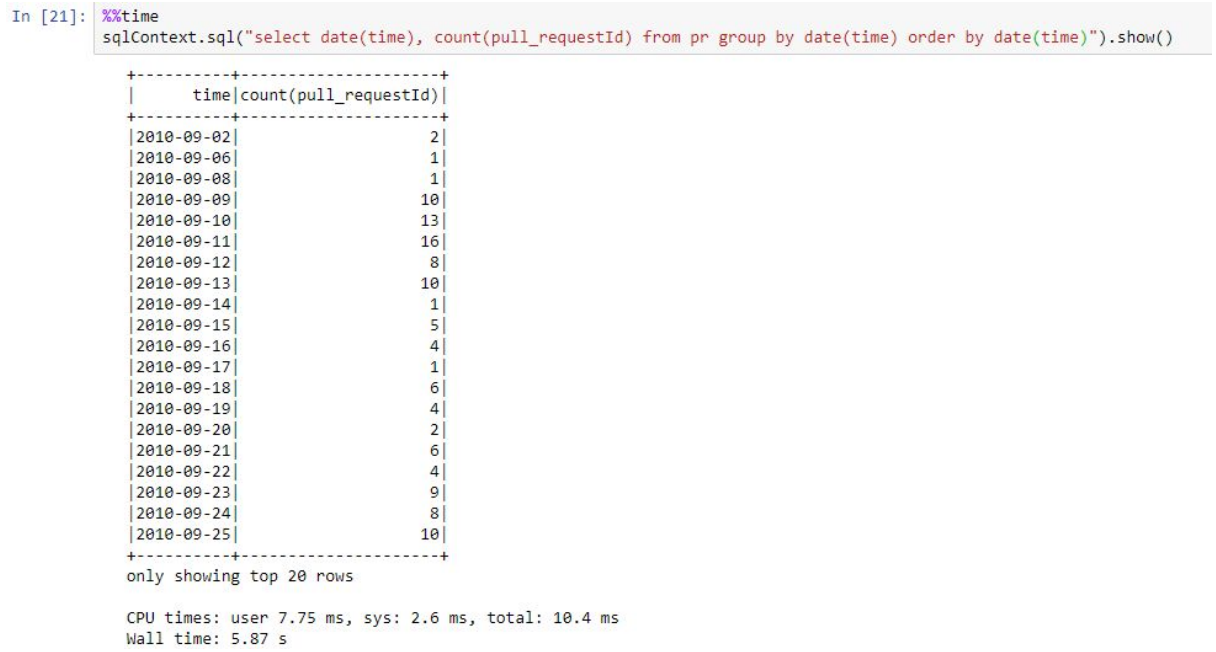
Screenshots of OUTPUT



```
In [20]: %%time
sqlContext.sql("select author, count(event) events from pr where event='opened' and extract(year from time)=2011 group by author o

+-------+------+
| author|events|
+-------+------+
|arunagw|   228|
+-------+------+

CPU times: user 1.44 ms, sys: 11.2 ms, total: 12.6 ms
Wall time: 9.7 s
```



```
In [21]: %%time
sqlContext.sql("select date(time), count(pull_requestId) from pr group by date(time) order by date(time)").show()

+----------+---------------------+
|      time|count(pull_requestId)|
+----------+---------------------+
|2010-09-02|                    2|
|2010-09-06|                    1|
|2010-09-08|                    1|
|2010-09-09|                   10|
|2010-09-10|                   13|
|2010-09-11|                   16|
|2010-09-12|                    8|
|2010-09-13|                   10|
|2010-09-14|                    1|
|2010-09-15|                    5|
|2010-09-16|                    4|
|2010-09-17|                    1|
|2010-09-18|                    6|
|2010-09-19|                    4|
|2010-09-20|                    2|
|2010-09-21|                    6|
|2010-09-22|                    4|
|2010-09-23|                    9|
|2010-09-24|                    8|
|2010-09-25|                   10|
+----------+---------------------+
only showing top 20 rows

CPU times: user 7.75 ms, sys: 2.6 ms, total: 10.4 ms
Wall time: 5.87 s
```

```
%%time
sqlContext.sql("select a.name,b.monthnumber,b.countscore from(select hello.name, max(events) even, hello.monthnumber   from (selec
```

```
+------------+-----------+----------+
|        name|monthnumber|countscore|
+------------+-----------+----------+
|rafaelfranca|          1|       828|
|rafaelfranca|          2|       555|
|rafaelfranca|          3|       580|
|rafaelfranca|          4|       758|
|rafaelfranca|          5|       915|
|rafaelfranca|          6|       582|
|rafaelfranca|          7|       579|
|rafaelfranca|          8|       651|
|rafaelfranca|          9|       585|
|rafaelfranca|         10|       667|
|rafaelfranca|         11|       590|
|   rails-bot|         12|       546|
+------------+-----------+----------+

CPU times: user 2.42 ms, sys: 23.4 ms, total: 25.8 ms
Wall time: 18.8 s
```

```
:  %%time
   sqlContext.sql("select event,date(time),count(*) from pr group by event,date(time) having ev
```

```
+------+----------+--------+
| event|      time|count(1)|
+------+----------+--------+
|opened|2010-09-02|       2|
|opened|2010-09-06|       1|
|opened|2010-09-08|       1|
|opened|2010-09-09|       4|
|opened|2010-09-10|       3|
|opened|2010-09-11|       3|
|opened|2010-09-12|       3|
|opened|2010-09-13|       3|
|opened|2010-09-15|       2|
|opened|2010-09-16|       2|
|opened|2010-09-18|       6|
|opened|2010-09-19|       4|
|opened|2010-09-20|       2|
|opened|2010-09-22|       1|
|opened|2010-09-23|       4|
|opened|2010-09-24|       5|
|opened|2010-09-25|       5|
|opened|2010-09-27|       4|
|opened|2010-09-28|       2|
|opened|2010-09-29|       2|
+------+----------+--------+
only showing top 20 rows

CPU times: user 0 ns, sys: 23.6 ms, total: 23.6 ms
Wall time: 4.27 s
```

```
%%time
sqlContext.sql("select event,date(time),count(*) from pr group by event,date(time) having event='opened' order by date(tim
```

```
+------+----------+--------+
| event|      time|count(1)|
+------+----------+--------+
|opened|2010-09-02|       2|
|opened|2010-09-06|       1|
|opened|2010-09-08|       1|
|opened|2010-09-09|       4|
|opened|2010-09-10|       3|
|opened|2010-09-11|       3|
|opened|2010-09-12|       3|
|opened|2010-09-13|       3|
|opened|2010-09-15|       2|
|opened|2010-09-16|       2|
|opened|2010-09-18|       6|
|opened|2010-09-19|       4|
|opened|2010-09-20|       2|
|opened|2010-09-22|       1|
|opened|2010-09-23|       4|
|opened|2010-09-24|       5|
|opened|2010-09-25|       5|
|opened|2010-09-27|       4|
|opened|2010-09-28|       2|
|opened|2010-09-29|       2|
+------+----------+--------+
only showing top 20 rows

CPU times: user 0 ns, sys: 23.6 ms, total: 23.6 ms
Wall time: 4.27 s
```

```
+------------+--------------------+----------+
|        name|                week|countscore|
+------------+--------------------+----------+
|       mikel|2010-09-06 00:00:00|        16|
|       mikel|2010-09-13 00:00:00|         6|
|   josevalim|2010-09-20 00:00:00|         9|
|   josevalim|2010-09-27 00:00:00|         6|
|   josevalim|2010-10-04 00:00:00|        12|
|   josevalim|2010-10-11 00:00:00|         6|
|    krekoten|2010-10-18 00:00:00|         4|
|         fxn|2010-10-25 00:00:00|         1|
|  spastorino|2010-11-01 00:00:00|         2|
|        rsim|2010-11-01 00:00:00|         2|
|   josevalim|2010-11-08 00:00:00|         6|
|franckverrot|2010-11-15 00:00:00|         3|
|   josevalim|2010-11-15 00:00:00|         3|
|  tenderlove|2010-11-22 00:00:00|         6|
|   josevalim|2010-11-29 00:00:00|         4|
|      drogus|2010-12-06 00:00:00|         2|
|   josevalim|2010-12-13 00:00:00|         7|
|         dhh|2010-12-20 00:00:00|         5|
|      jeremy|2011-01-03 00:00:00|        21|
|   josevalim|2011-01-10 00:00:00|         2|
+------------+--------------------+----------+
only showing top 20 rows

CPU times: user 19.7 ms, sys: 14.1 ms, total: 33.8 ms
Wall time: 27.5 s
```

```
%%time
sqlContext.sql("select EXTRACT(MONTH FROM time) mon, count(event) from pr where event='merged' and extract(year from time)=2010 gr
```

```
+---+------------+
|mon|count(event)|
+---+------------+
+---+------------+

CPU times: user 7.32 ms, sys: 2.62 ms, total: 9.95 ms
Wall time: 3.01 s
```

In [43]:
```
%%time
sqlContext.sql(" select date_trunc('week',time) weekstamp, count(pull_requestid)  from pr  where event='opened'  group by event,we
```

```
+-------------------+---------------------+
|          weekstamp|count(pull_requestid)|
+-------------------+---------------------+
|2010-08-30 00:00:00|                    2|
|2010-09-06 00:00:00|                   15|
|2010-09-13 00:00:00|                   17|
|2010-09-20 00:00:00|                   17|
|2010-09-27 00:00:00|                   13|
|2010-10-04 00:00:00|                   10|
|2010-10-11 00:00:00|                    5|
|2010-10-18 00:00:00|                    5|
|2010-10-25 00:00:00|                    3|
|2010-11-01 00:00:00|                    4|
|2010-11-08 00:00:00|                    9|
|2010-11-15 00:00:00|                    8|
|2010-11-22 00:00:00|                    9|
|2010-11-29 00:00:00|                    6|
|2010-12-06 00:00:00|                    5|
|2010-12-13 00:00:00|                    6|
|2010-12-20 00:00:00|                    7|
|2010-12-27 00:00:00|                    4|
|2011-01-03 00:00:00|                    9|
|2011-01-10 00:00:00|                    7|
+-------------------+---------------------+
only showing top 20 rows

CPU times: user 4.63 ms, sys: 1.77 ms, total: 6.4 ms
Wall time: 2.98 s
```

2 Executor

```
+------------+-------------------+----------+
|        name|               week|countscore|
+------------+-------------------+----------+
|       mikel|2010-09-06 00:00:00|        16|
|       mikel|2010-09-13 00:00:00|         6|
|   josevalim|2010-09-20 00:00:00|         9|
|   josevalim|2010-09-27 00:00:00|         6|
|   josevalim|2010-10-04 00:00:00|        12|
|   josevalim|2010-10-11 00:00:00|         6|
|    krekoten|2010-10-18 00:00:00|         4|
|         fxn|2010-10-25 00:00:00|         1|
|  spastorino|2010-11-01 00:00:00|         2|
|        rsim|2010-11-01 00:00:00|         2|
|   josevalim|2010-11-08 00:00:00|         6|
|franckverrot|2010-11-15 00:00:00|         3|
|   josevalim|2010-11-15 00:00:00|         3|
|  tenderlove|2010-11-22 00:00:00|         6|
|   josevalim|2010-11-29 00:00:00|         4|
|      drogus|2010-12-06 00:00:00|         2|
|   josevalim|2010-12-13 00:00:00|         7|
|         dhh|2010-12-20 00:00:00|         5|
|      jeremy|2011-01-03 00:00:00|        21|
|   josevalim|2011-01-10 00:00:00|         2|
+------------+-------------------+----------+
only showing top 20 rows

CPU times: user 8.35 ms, sys: 0 ns, total: 8.35 ms
Wall time: 16.6 s
```

```
: %%time
my_spark.sql("select a.name,b.monthnumber,b.countscore from(select hello.name, max(events) even, hello.monthnumber   from (select
```

```
+-----------+-----------+----------+
|       name|monthnumber|countscore|
+-----------+-----------+----------+
|rafaelfranca|          1|       828|
|rafaelfranca|          2|       555|
|rafaelfranca|          3|       580|
|rafaelfranca|          4|       758|
|rafaelfranca|          5|       915|
|rafaelfranca|          6|       582|
|rafaelfranca|          7|       579|
|rafaelfranca|          8|       651|
|rafaelfranca|          9|       585|
|rafaelfranca|         10|       667|
|rafaelfranca|         11|       590|
|   rails-bot|         12|       546|
+-----------+-----------+----------+

CPU times: user 3.2 ms, sys: 12.8 ms, total: 16 ms
Wall time: 13.1 s
```

```
#1b
my_spark.sql("select event,date(time),count(*) from pr group by event,date(time) having event='discussed' order by date(time)").sh
```

```
+---------+----------+--------+
|    event|      time|count(1)|
+---------+----------+--------+
|discussed|2010-09-09|       6|
|discussed|2010-09-10|      10|
|discussed|2010-09-11|      13|
|discussed|2010-09-12|       5|
|discussed|2010-09-13|       7|
|discussed|2010-09-14|       1|
|discussed|2010-09-15|       3|
|discussed|2010-09-16|       2|
|discussed|2010-09-17|       1|
|discussed|2010-09-21|       6|
|discussed|2010-09-22|       3|
|discussed|2010-09-23|       5|
|discussed|2010-09-24|       3|
|discussed|2010-09-25|       5|
|discussed|2010-09-27|       3|
|discussed|2010-09-29|       2|
|discussed|2010-09-30|       3|
|discussed|2010-10-01|       2|
|discussed|2010-10-04|       8|
|discussed|2010-10-06|      15|
+---------+----------+--------+
only showing top 20 rows

CPU times: user 1.39 ms, sys: 12.1 ms, total: 13.5 ms
Wall time: 2.03 s
```


```
#1b
my_spark.sql("select event,date(time),count(*) from pr group by event,date(time) having event='discussed' order by date(time)").sh
```

```
+---------+----------+--------+
|    event|      time|count(1)|
+---------+----------+--------+
|discussed|2010-09-09|       6|
|discussed|2010-09-10|      10|
|discussed|2010-09-11|      13|
|discussed|2010-09-12|       5|
|discussed|2010-09-13|       7|
|discussed|2010-09-14|       1|
|discussed|2010-09-15|       3|
|discussed|2010-09-16|       2|
|discussed|2010-09-17|       1|
|discussed|2010-09-21|       6|
|discussed|2010-09-22|       3|
|discussed|2010-09-23|       5|
|discussed|2010-09-24|       3|
|discussed|2010-09-25|       5|
|discussed|2010-09-27|       3|
|discussed|2010-09-29|       2|
|discussed|2010-09-30|       3|
|discussed|2010-10-01|       2|
|discussed|2010-10-04|       8|
|discussed|2010-10-06|      15|
+---------+----------+--------+
only showing top 20 rows

CPU times: user 1.39 ms, sys: 12.1 ms, total: 13.5 ms
Wall time: 2.03 s
```


```
%%time
#5
my_spark.sql("select EXTRACT(MONTH FROM time) mon, count(event) from pr where event='merged' and extract(year from time)=2010 grou
```

```
+---+------------+
|mon|count(event)|
+---+------------+
+---+------------+

CPU times: user 0 ns, sys: 9.8 ms, total: 9.8 ms
Wall time: 2.02 s
```

```
my_spark.sql("select event,date(time),count(*) from pr group by event,date(time) having event='opened' order by date(time)").show(
```

```
+------+----------+--------+
| event|      time|count(1)|
+------+----------+--------+
|opened|2010-09-02|       2|
|opened|2010-09-06|       1|
|opened|2010-09-08|       1|
|opened|2010-09-09|       4|
|opened|2010-09-10|       3|
|opened|2010-09-11|       3|
|opened|2010-09-12|       3|
|opened|2010-09-13|       3|
|opened|2010-09-15|       2|
|opened|2010-09-16|       2|
|opened|2010-09-18|       6|
|opened|2010-09-19|       4|
|opened|2010-09-20|       2|
|opened|2010-09-22|       1|
|opened|2010-09-23|       4|
|opened|2010-09-24|       5|
|opened|2010-09-25|       5|
|opened|2010-09-27|       4|
|opened|2010-09-28|       2|
|opened|2010-09-29|       2|
+------+----------+--------+
only showing top 20 rows

CPU times: user 5.03 ms, sys: 2.05 ms, total: 7.07 ms
Wall time: 2.18 s
```

```
%%time
#7
my_spark.sql("select author, count(event) events from pr where event='opened' and extract(year from time)=2011 group by author ord
```

```
+-------+------+
| author|events|
+-------+------+
|arunagw|   228|
+-------+------+

CPU times: user 4.3 ms, sys: 1.76 ms, total: 6.06 ms
Wall time: 2.54 s
```

```
%%time
#6
my_spark.sql("select date(time), count(pull_requestId) from pr group by date(time) order by date(time)").show()
```

```
+----------+---------------------+
|      time|count(pull_requestId)|
+----------+---------------------+
|2010-09-02|                    2|
|2010-09-06|                    1|
|2010-09-08|                    1|
|2010-09-09|                   10|
|2010-09-10|                   13|
|2010-09-11|                   16|
|2010-09-12|                    8|
|2010-09-13|                   10|
|2010-09-14|                    1|
|2010-09-15|                    5|
|2010-09-16|                    4|
|2010-09-17|                    1|
|2010-09-18|                    6|
|2010-09-19|                    4|
|2010-09-20|                    2|
|2010-09-21|                    6|
|2010-09-22|                    4|
|2010-09-23|                    9|
|2010-09-24|                    8|
|2010-09-25|                   10|
+----------+---------------------+
only showing top 20 rows

CPU times: user 5.82 ms, sys: 2.36 ms, total: 8.19 ms
Wall time: 2.13 s
```

```
#3
my_spark.sql("select a.name,b.week,b.countscore   from(select hello.name, max(events) even, hello.week  from (select author as nam
```

```
+------------+-------------------+----------+
|        name|               week|countscore|
+------------+-------------------+----------+
|       mikel|2010-09-06 00:00:00|        16|
|       mikel|2010-09-13 00:00:00|         6|
|   josevalim|2010-09-20 00:00:00|         9|
|   josevalim|2010-09-27 00:00:00|         6|
|   josevalim|2010-10-04 00:00:00|        12|
|   josevalim|2010-10-11 00:00:00|         6|
|    krekoten|2010-10-18 00:00:00|         4|
|         fxn|2010-10-25 00:00:00|         1|
|  spastorino|2010-11-01 00:00:00|         2|
|        rsim|2010-11-01 00:00:00|         2|
|   josevalim|2010-11-08 00:00:00|         6|
|franckverrot|2010-11-15 00:00:00|         3|
|   josevalim|2010-11-15 00:00:00|         3|
|  tenderlove|2010-11-22 00:00:00|         6|
|   josevalim|2010-11-29 00:00:00|         4|
|      drogus|2010-12-06 00:00:00|         2|
|   josevalim|2010-12-13 00:00:00|         7|
|         dhh|2010-12-20 00:00:00|         5|
|      jeremy|2011-01-03 00:00:00|        21|
|   josevalim|2011-01-10 00:00:00|         2|
+------------+-------------------+----------+
only showing top 20 rows

CPU times: user 10.9 ms, sys: 0 ns, total: 10.9 ms
Wall time: 15.6 s
```

Inferences:

- Similar trends in the execution time are spotted in both Hadoop and Postgres.
- This verifies the assumption that using the backend service directly using interfaces like Spark greatly improves the query resolution time.

Merits and Demerits of Directly Executing commands on Backend of the database System

- Faster speed – Directly executing commands at the backend helps achieve a faster query resolution time. This property is very important while dealing with large databases.
- Easy to Use once configured – Services like Spark gives us the flexibility of options to work in many languages. For example, Java, Scala, Python, R and SQL shells.
- Difficult to set up and configure settings.
- For smaller datasets, the database main memory interfaces provide great ease of use and are better in terms of the tradeoff between speed and comfort.

Merits and Demerits of Importing the data in main memory (RDD) to evaluate the queries

- Easy to set up and work on.
- SQL queries reduce chances of erroneous behavior by the system.
- Slower while responding to complex database queries for small data and any SQL query for larger data sizes.
- Does not provide the flexibility and mobility as in the case of backend programming.

Learnings

- Working of Apache Spark
- All various functions of Spark and its connectivity and scalability.
- Mechanism, configuration and debugging while installing each software.

- Understood why there is a difference in execution time of queries when requested through different methods.
- Functions and unique points of each Relational Database System included in the scope of this assignment.
- Revised SQL basics and aggregate function queries.
- Understood the meaning of spark connectors and importance of services provided by Apache Spark

Challenges

- Difficulty connecting Apache Spark with MongoDB system.
- Difficulty installing Hadoop on a Windows system. Had to switch to Ubuntu to successfully work with HDFS.
- Postgres was a relatively simpler task as compared to MongoDB and Hadoop.
- Navigating through and finding relevant information from the documentation.
- Working with unusual directory paths.

References

- https://spark.apache.org/docs/latest/sql-data-sources-jdbc.html
- https://www.youtube.com/watch?v=snZvQcI2HfQ
- https://stackoverflow.com/questions/52390553/org-apache-spark-sql-catalyst-parser-parseexception-in-spark-scala-cassandra-ap
- https://docs.databricks.com/_static/notebooks/mongodb.html
- https://docs.mongodb.com/spark-connector/current/python-api/
- https://community.cloudera.com/t5/Support-Questions/Spark-1-6-How-to-read-and-write-a-csv-file-to-hdfs-without/td-p/222865