LAB2: DATA AGGREGATION, BIG DATA ANALYSIS AND VISUALIZATION

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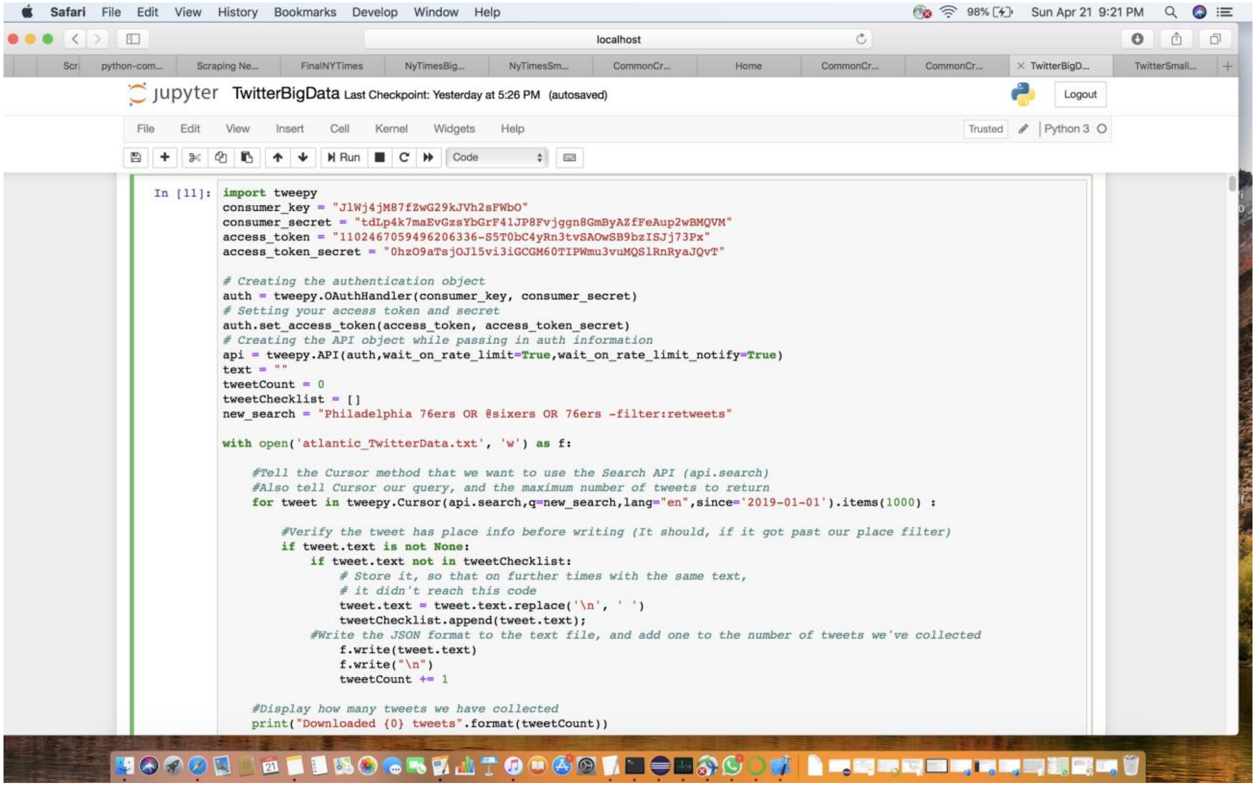
Part 1 :

Collect Twitter,NyTimes and Common Crawl .
We have selected NBA as the main topic . The subtopics being :

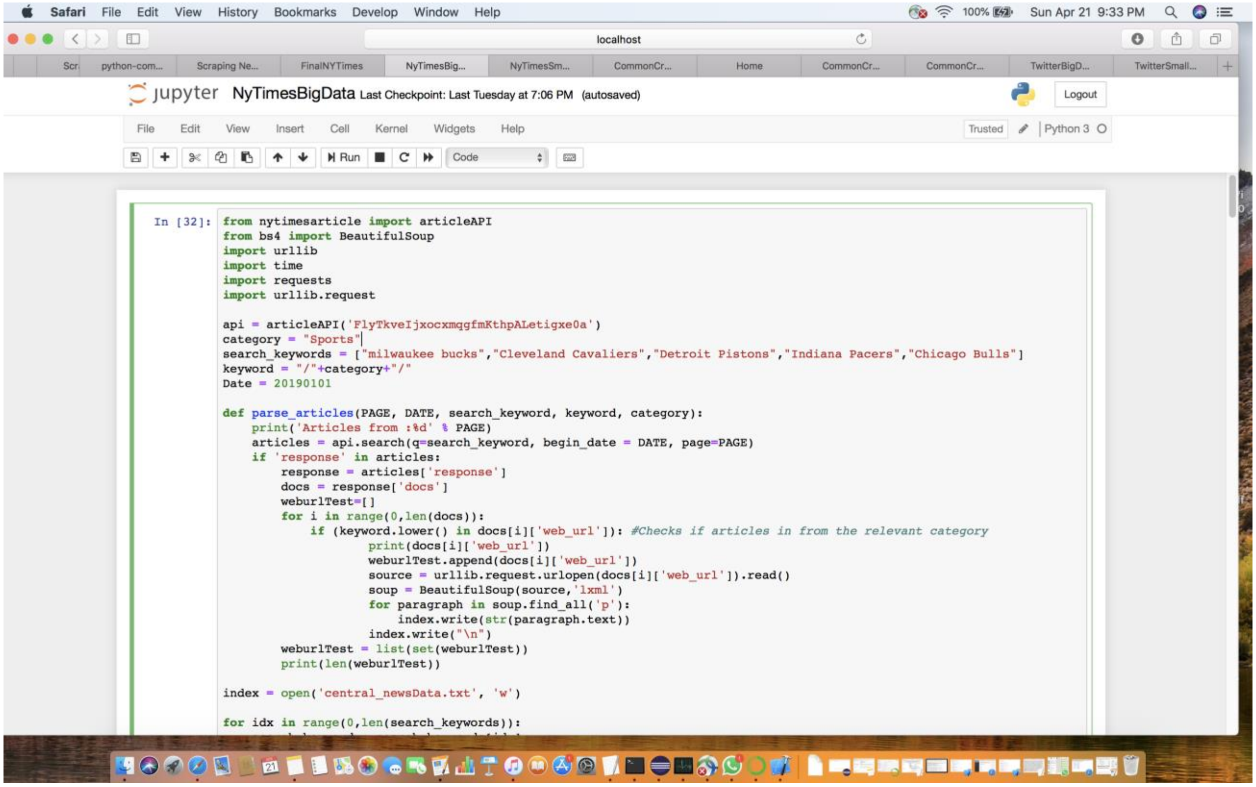
i. Atlantic(Boston Celtics, Brooklyn Nets, New York Knicks,Philadelphia 76ers,Toronto Raptors),
ii. Central(Cleveland Cavaliers,Detroit Pistons,Indiana Pacers,Milwaukee Bucks,Chicago Bulls)
iii. Southeast(Atlanta Hawks,Charlotte Hornets,Miami Heat,Orlando Magic, Washington Wizards),
iv. Southwest(Houston Rockets,Dallas Mavericks,Memphis Grizzlies,New Orleans Pelicans)
v. Northwest(Denver Nuggets,Minnnesota Timberwolves,Oklahoma City Thunder,Portland Trail Blazers,Utah Jazz),
vi. Pacific(Golden State Warriors,Los Angeles Lakers,Phoenix Suns,Sacramento Kings).

We have chose Python as the language for data collection. Approximately we have collected 23000 tweets. We have used Tweepy for tweet collection. I have placed all the tweets in the textfile. Below is the code snippet used for tweet collection:


Safari File Edit View History Bookmarks Develop Window Help
98% Sun Apr 21 9:21 PM
localhost
Scr python-com... Scraping Ne... FinalNYTimes NyTimesBig... NyTimesSm... CommonCr... Home CommonCr... CommonCr... TwitterBigD... TwitterSmall...
jupyter TwitterBigData Last Checkpoint: Yesterday at 5:26 PM (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code

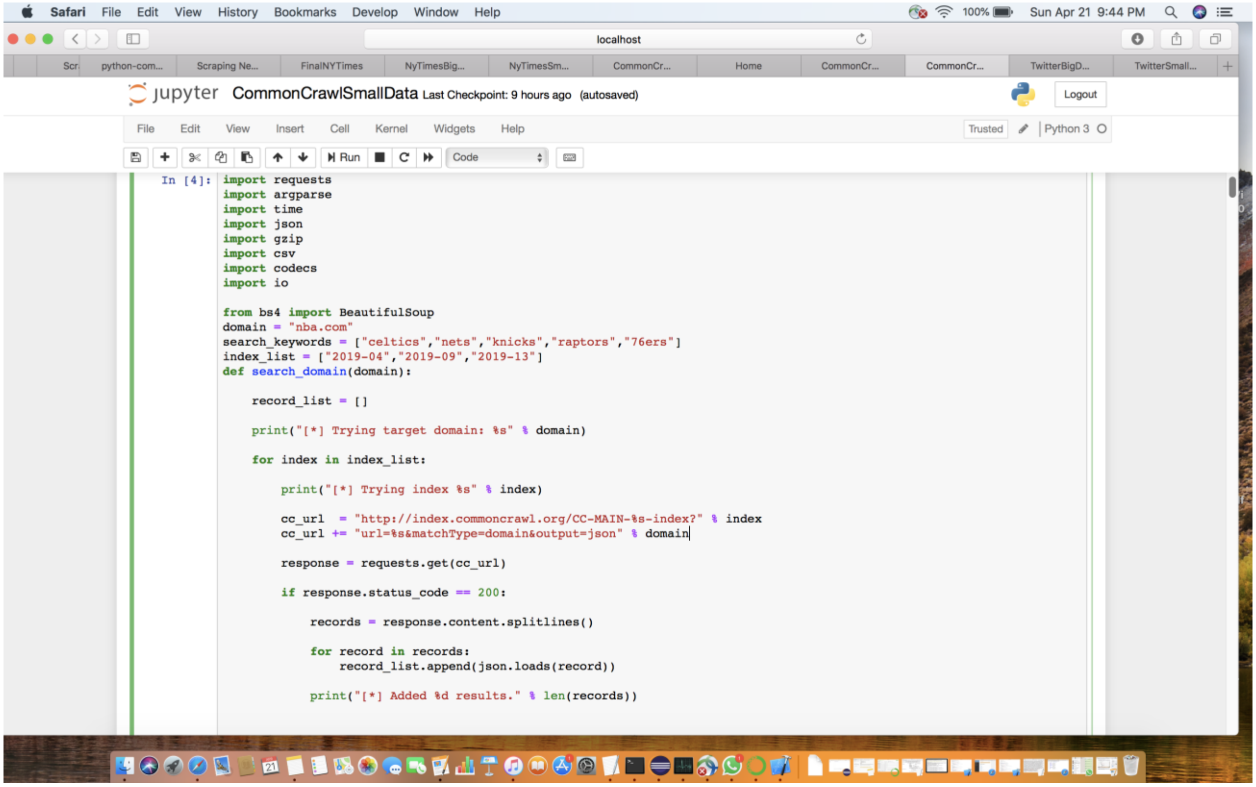
```
In [11]: import tweepy
         consumer_key = "JlWj4jM87fZwG29kJVh2sFWbO"
         consumer_secret = "tdLp4k7maEvGzsYbGrF41JP8Fvjggn8GmByAZfFeAup2wBMQVM"
         access_token = "1102467059496206336-S5T0bC4yRn3tvSAOwSB9bzISJj73Px"
         access_token_secret = "0hzO9aTsjOJ15vi3iGCGM60TIPWmu3vuMQSlRnRyaJQvT"

         # Creating the authentication object
         auth = tweepy.OAuthHandler(consumer_key, consumer_secret)
         # Setting your access token and secret
         auth.set_access_token(access_token, access_token_secret)
         # Creating the API object while passing in auth information
         api = tweepy.API(auth,wait_on_rate_limit=True,wait_on_rate_limit_notify=True)
         text = ""
         tweetCount = 0
         tweetChecklist = []
         new_search = "Philadelphia 76ers OR @sixers OR 76ers -filter:retweets"

         with open('atlantic_TwitterData.txt', 'w') as f:

             #Tell the Cursor method that we want to use the Search API (api.search)
             #Also tell Cursor our query, and the maximum number of tweets to return
             for tweet in tweepy.Cursor(api.search,q=new_search,lang="en",since='2019-01-01').items(1000) :

                 #Verify the tweet has place info before writing (It should, if it got past our place filter)
                 if tweet.text is not None:
                     if tweet.text not in tweetChecklist:
                         # Store it, so that on further times with the same text,
                         # it didn't reach this code
                         tweet.text = tweet.text.replace('\n', ' ')
                         tweetChecklist.append(tweet.text);
                     #Write the JSON format to the text file, and add one to the number of tweets we've collected
                         f.write(tweet.text)
                         f.write("\n")
                         tweetCount += 1

             #Display how many tweets we have collected
             print("Downloaded {0} tweets".format(tweetCount))
```

For Nytimes, I created an account in NYtimes as developer and created an API key(FlyTkveIjxocxmqgfmKthpALetigxe0a). Using the above team names as keywords, we have searched for articles which has those keywords in them. From the response received from the articles, we have fetched the URL’s. I have collected approximately 600 articles(100 + in each subtopic). Using Beautiful Soup,I have scraped the URL’s and fetched the contents and stored them in textile. Below is the code snippet, I have used for achieving this:


Safari File Edit View History Bookmarks Develop Window Help
100% Sun Apr 21 9:33 PM
localhost
Scr python-com... Scraping Ne... FinalNYTimes NyTimesBig... NyTimesSm... CommonCr... Home CommonCr... CommonCr... TwitterBigD... TwitterSmall...
jupyter NyTimesBigData Last Checkpoint: Last Tuesday at 7:06 PM (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code

```
In [32]: from nytimesarticle import articleAPI
         from bs4 import BeautifulSoup
         import urllib
         import time
         import requests
         import urllib.request

         api = articleAPI('FlyTkveIjxocxmqgfmKthpALetigxe0a')
         category = "Sports"
         search_keywords = ["milwaukee bucks","Cleveland Cavaliers","Detroit Pistons","Indiana Pacers","Chicago Bulls"]
         keyword = "/"+category+"/"
         Date = 20190101

         def parse_articles(PAGE, DATE, search_keyword, keyword, category):
             print('Articles from :%d' % PAGE)
             articles = api.search(q=search_keyword, begin_date = DATE, page=PAGE)
             if 'response' in articles:
                 response = articles['response']
                 docs = response['docs']
                 weburlTest=[]
                 for i in range(0,len(docs)):
                     if (keyword.lower() in docs[i]['web_url']): #Checks if articles in from the relevant category
                             print(docs[i]['web_url'])
                             weburlTest.append(docs[i]['web_url'])
                             source = urllib.request.urlopen(docs[i]['web_url']).read()
                             soup = BeautifulSoup(source,'lxml')
                             for paragraph in soup.find_all('p'):
                                 index.write(str(paragraph.text))
                             index.write("\n")
                 weburlTest = list(set(weburlTest))
                 print(len(weburlTest))

         index = open('central_newsData.txt', 'w')

         for idx in range(0,len(search_keywords)):
```

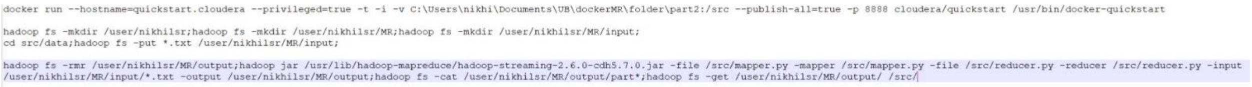
For common Crawl, I have fetched data from index.commoncrawl.org based on the indexes 2019-04,2019-09,2019-13. Of the results obtained, we are downloading the gzipped file. From the Gzipped file, we are fetching the html contents of the pages. I have approximately collected 600 articles.The results I have saved in the textfile. Below is the code snippet for achieving this.



```
In [4]: import requests
        import argparse
        import time
        import json
        import gzip
        import csv
        import codecs
        import io

        from bs4 import BeautifulSoup
        domain = "nba.com"
        search_keywords = ["celtics","nets","knicks","raptors","76ers"]
        index_list = ["2019-04","2019-09","2019-13"]
        def search_domain(domain):

            record_list = []

            print("[*] Trying target domain: %s" % domain)

            for index in index_list:

                print("[*] Trying index %s" % index)

                cc_url  = "http://index.commoncrawl.org/CC-MAIN-%s-index?" % index
                cc_url += "url=%s&matchType=domain&output=json" % domain

                response = requests.get(cc_url)

                if response.status_code == 200:

                    records = response.content.splitlines()

                    for record in records:
                        record_list.append(json.loads(record))

                    print("[*] Added %d results." % len(records))
```

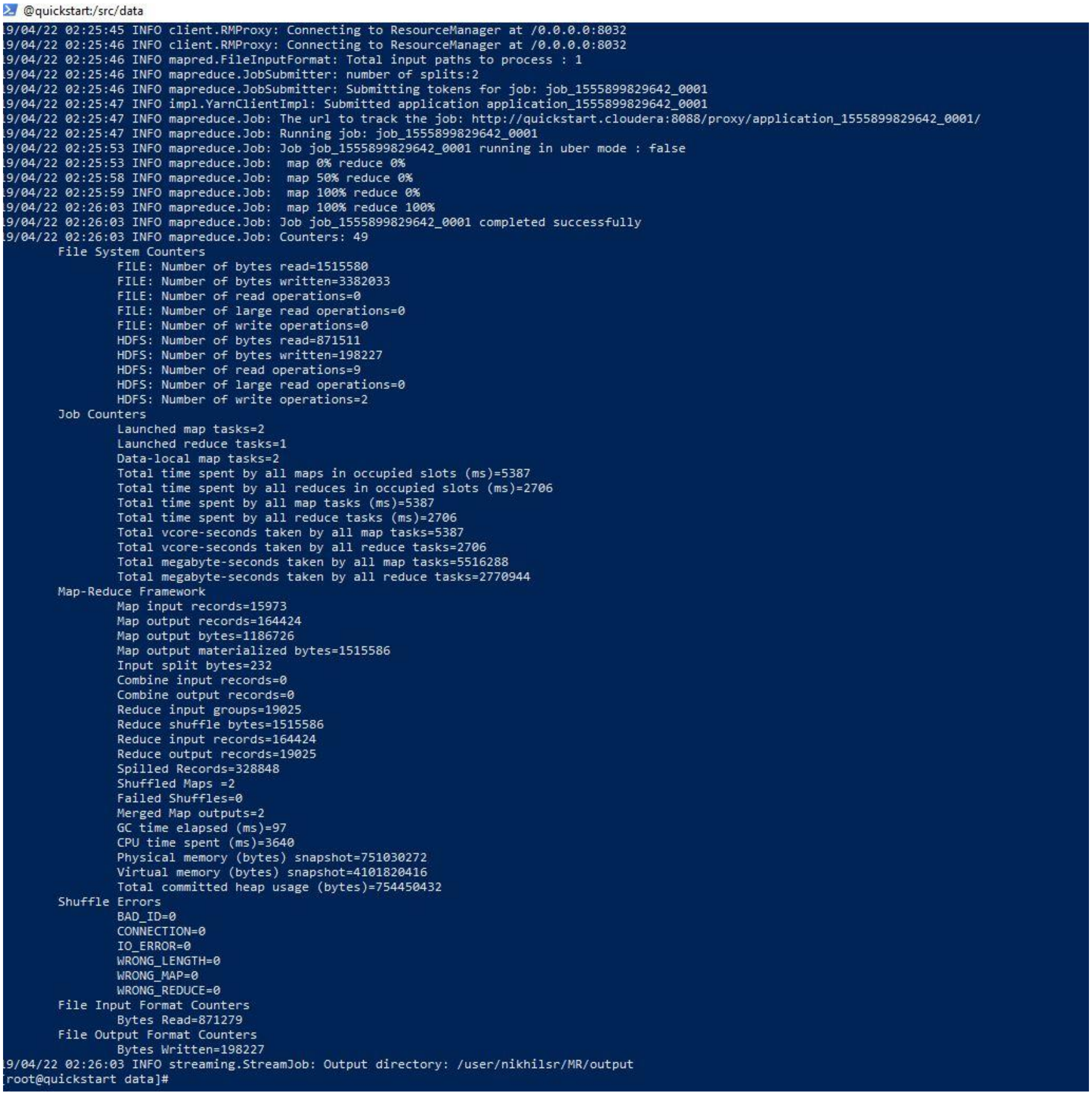
Part 2:

As part of this task, I setup the Hadoop Environemnt on my system. I, first installed docker and then downloaded the hadoop image, as per the instructions given.
Once Hadoop Virtual Environemnt was setup, I ran the same program given : Finding the word occurence for pg345.txt file using the given mapper.py and reduce.py files, arranged in a certain folder structure.
Below are the Hadoop commands that I ran to accomplish this task:



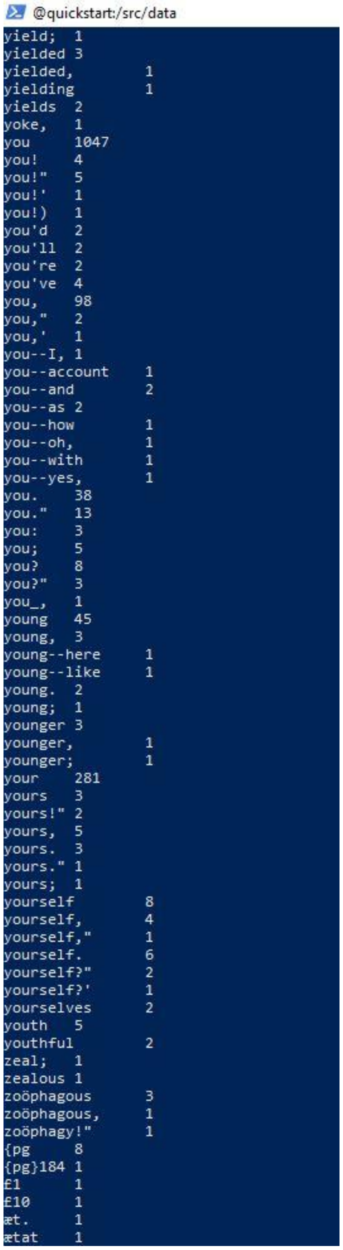
```
docker run --hostname=quickstart.cloudera --privileged=true -t -i -v C:\Users\nikhi\Documents\UB\dockerMR\folder\part2:/src --publish-all=true -p 8888 cloudera/quickstart /usr/bin/docker-quickstart

hadoop fs -mkdir /user/nikhilsr;hadoop fs -mkdir /user/nikhilsr/MR;hadoop fs -mkdir /user/nikhilsr/MR/input;
cd src/data;hadoop fs -put *.txt /user/nikhilsr/MR/input;

hadoop fs -rmr /user/nikhilsr/MR/output;hadoop jar /usr/lib/hadoop-mapreduce/hadoop-streaming-2.6.0-cdh5.7.0.jar -file /src/mapper.py -mapper /src/mapper.py -file /src/reducer.py -reducer /src/reducer.py -input
/user/nikhilsr/MR/input/*.txt -output /user/nikhilsr/MR/output;hadoop fs -cat /user/nikhilsr/MR/output/part*;hadoop fs -get /user/nikhilsr/MR/output/ /src/
```

Here is the snapshot of the hadoop console while it was executing these commands:



```
19/04/22 02:25:45 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
19/04/22 02:25:46 INFO client.RMProxy: Connecting to ResourceManager at /0.0.0.0:8032
19/04/22 02:25:46 INFO mapred.FileInputFormat: Total input paths to process : 1
19/04/22 02:25:46 INFO mapreduce.JobSubmitter: number of splits:2
19/04/22 02:25:46 INFO mapreduce.JobSubmitter: Submitting tokens for job: job_1555899829642_0001
19/04/22 02:25:47 INFO impl.YarnClientImpl: Submitted application application_1555899829642_0001
19/04/22 02:25:47 INFO mapreduce.Job: The url to track the job: http://quickstart.cloudera:8088/proxy/application_1555899829642_0001/
19/04/22 02:25:47 INFO mapreduce.Job: Running job: job_1555899829642_0001
19/04/22 02:25:53 INFO mapreduce.Job: Job job_1555899829642_0001 running in uber mode : false
19/04/22 02:25:53 INFO mapreduce.Job:  map 0% reduce 0%
19/04/22 02:25:58 INFO mapreduce.Job:  map 50% reduce 0%
19/04/22 02:25:59 INFO mapreduce.Job:  map 100% reduce 0%
19/04/22 02:26:03 INFO mapreduce.Job:  map 100% reduce 100%
19/04/22 02:26:03 INFO mapreduce.Job: Job job_1555899829642_0001 completed successfully
19/04/22 02:26:03 INFO mapreduce.Job: Counters: 49
        File System Counters
                FILE: Number of bytes read=1515580
                FILE: Number of bytes written=3382033
                FILE: Number of read operations=0
                FILE: Number of large read operations=0
                FILE: Number of write operations=0
                HDFS: Number of bytes read=871511
                HDFS: Number of bytes written=198227
                HDFS: Number of read operations=9
                HDFS: Number of large read operations=0
                HDFS: Number of write operations=2
        Job Counters
                Launched map tasks=2
                Launched reduce tasks=1
                Data-local map tasks=2
                Total time spent by all maps in occupied slots (ms)=5387
                Total time spent by all reduces in occupied slots (ms)=2706
                Total time spent by all map tasks (ms)=5387
                Total time spent by all reduce tasks (ms)=2706
                Total vcore-seconds taken by all map tasks=5387
                Total vcore-seconds taken by all reduce tasks=2706
                Total megabyte-seconds taken by all map tasks=5516288
                Total megabyte-seconds taken by all reduce tasks=2770944
        Map-Reduce Framework
                Map input records=15973
                Map output records=164424
                Map output bytes=1186726
                Map output materialized bytes=1515586
                Input split bytes=232
                Combine input records=0
                Combine output records=0
                Reduce input groups=19025
                Reduce shuffle bytes=1515586
                Reduce input records=164424
                Reduce output records=19025
                Spilled Records=328848
                Shuffled Maps =2
                Failed Shuffles=0
                Merged Map outputs=2
                GC time elapsed (ms)=97
                CPU time spent (ms)=3640
                Physical memory (bytes) snapshot=751030272
                Virtual memory (bytes) snapshot=4101820416
                Total committed heap usage (bytes)=754450432
        Shuffle Errors
                BAD_ID=0
                CONNECTION=0
                IO_ERROR=0
                WRONG_LENGTH=0
                WRONG_MAP=0
                WRONG_REDUCE=0
        File Input Format Counters
                Bytes Read=871279
        File Output Format Counters
                Bytes Written=198227
19/04/22 02:26:03 INFO streaming.StreamJob: Output directory: /user/nikhilsr/MR/output
[root@quickstart data]#
```

At the end of this process, the output file Part0001.txt was created with the word counts. Here is a snippet from that file:



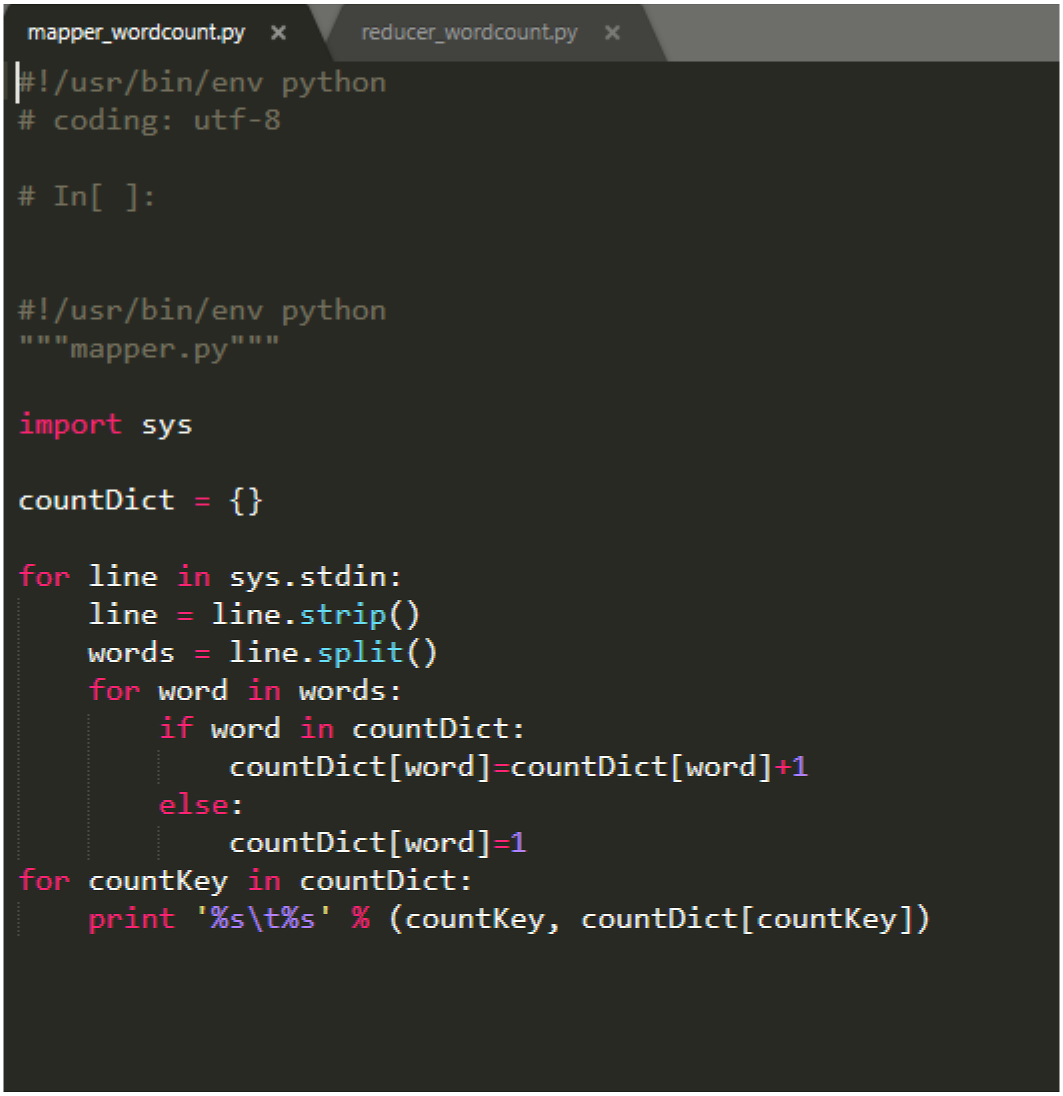
```
yield;  1
yielded 3
yielded,        1
yielding        1
yields  2
yoke,   1
you     1047
you!    4
you!"   5
you!'   1
you!)   1
you'd   2
you'll  2
you're  2
you've  4
you,    98
you,"   2
you,'   1
you--I, 1
you--account    1
you--and        2
you--as 2
you--how        1
you--oh,        1
you--with       1
you--yes,       1
you.    38
you."   13
you:    3
you;    5
you?    8
you?"   3
you_,   1
young   45
young,  3
young--here     1
young--like     1
young.  2
young;  1
younger 3
younger,        1
younger;        1
your    281
yours   3
yours!" 2
yours,  5
yours.  3
yours." 1
yours;  1
yourself        8
yourself,       4
yourself,"      1
yourself.       6
yourself?"      2
yourself?'      1
yourselves      2
youth   5
youthful        2
zeal;   1
zealous 1
zoöphagous      3
zoöphagous,     1
zoöphagy!"      1
{pg     8
{pg}184 1
£1      1
£10     1
æt.     1
ætat    1
```

Part 3:

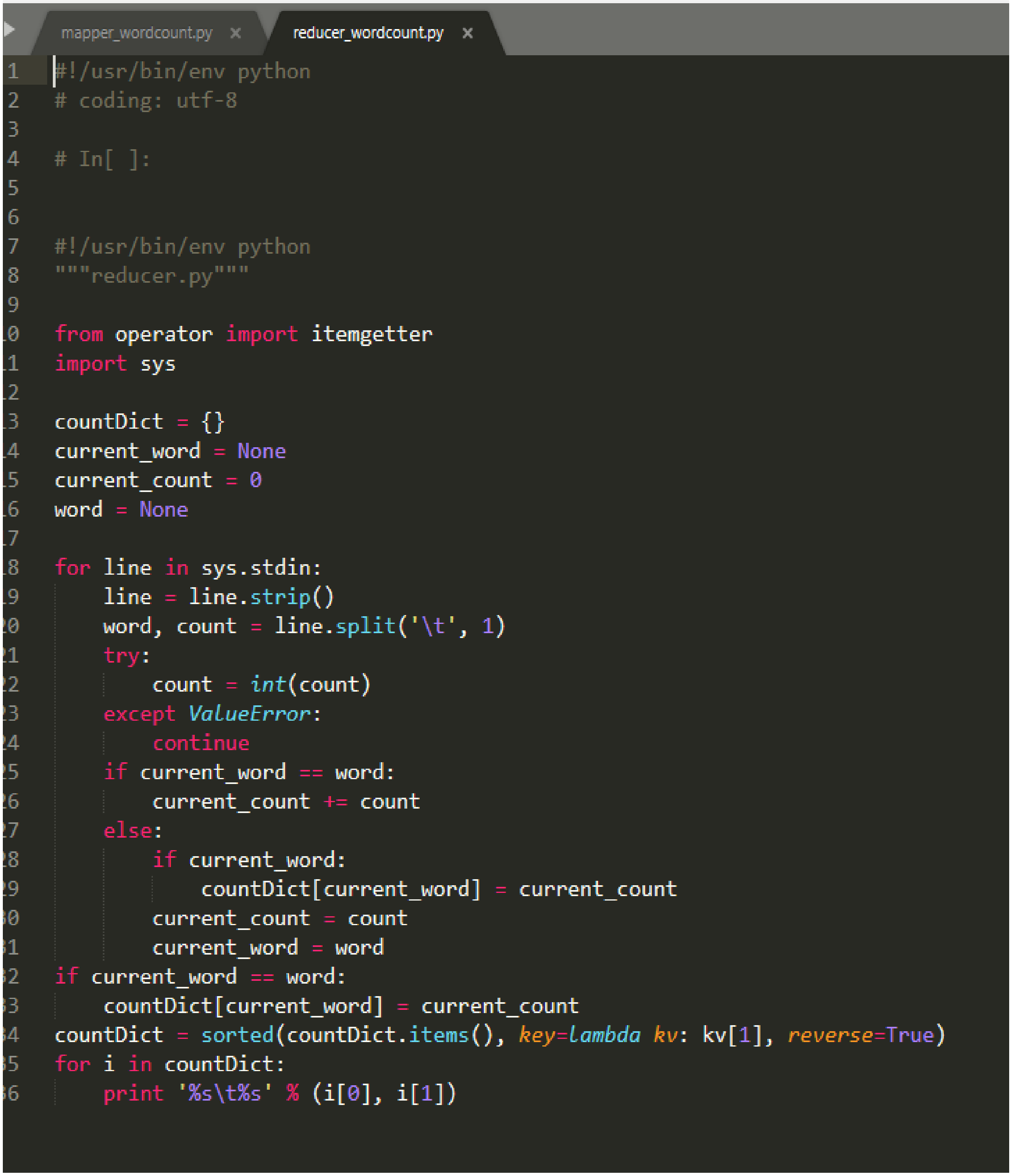
Task 1:

We started off with small dataset and did the word count. We optimized the word count code using associative arrays and it is giving a better word count.

Code Snippets are below:



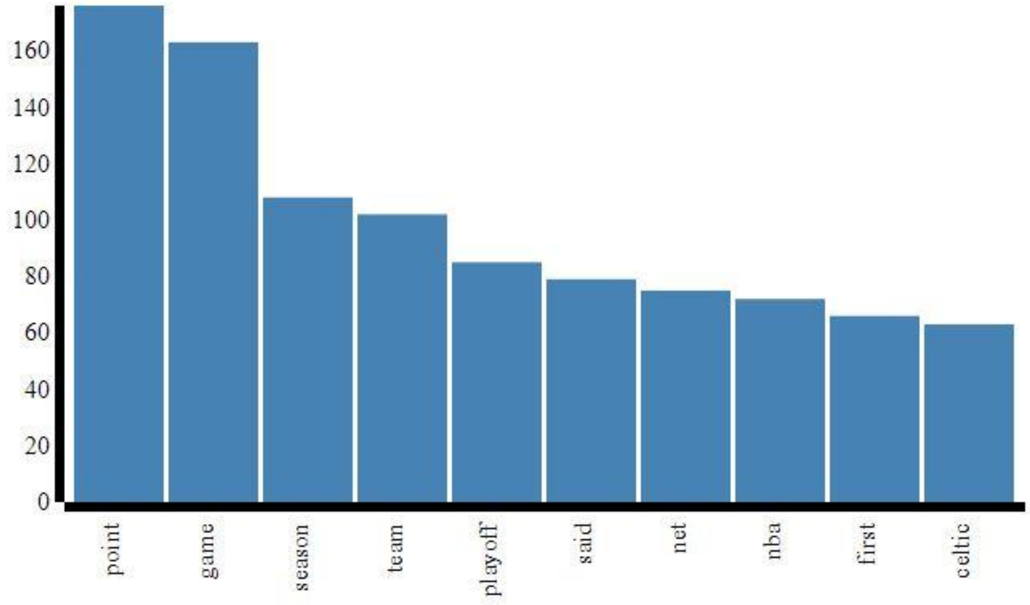
```
#!/usr/bin/env python
# coding: utf-8

# In[ ]:


#!/usr/bin/env python
"""mapper.py"""

import sys

countDict = {}

for line in sys.stdin:
    line = line.strip()
    words = line.split()
    for word in words:
        if word in countDict:
            countDict[word]=countDict[word]+1
        else:
            countDict[word]=1
for countKey in countDict:
    print '%s\t%s' % (countKey, countDict[countKey])
```



```python
#!/usr/bin/env python
# coding: utf-8

# In[ ]:


#!/usr/bin/env python
"""reducer.py"""

from operator import itemgetter
import sys

countDict = {}
current_word = None
current_count = 0
word = None

for line in sys.stdin:
    line = line.strip()
    word, count = line.split('\t', 1)
    try:
        count = int(count)
    except ValueError:
        continue
    if current_word == word:
        current_count += count
    else:
        if current_word:
            countDict[current_word] = current_count
        current_count = count
        current_word = word
if current_word == word:
    countDict[current_word] = current_count
countDict = sorted(countDict.items(), key=lambda kv: kv[1], reverse=True)
for i in countDict:
    print '%s\t%s' % (i[0], i[1])
```

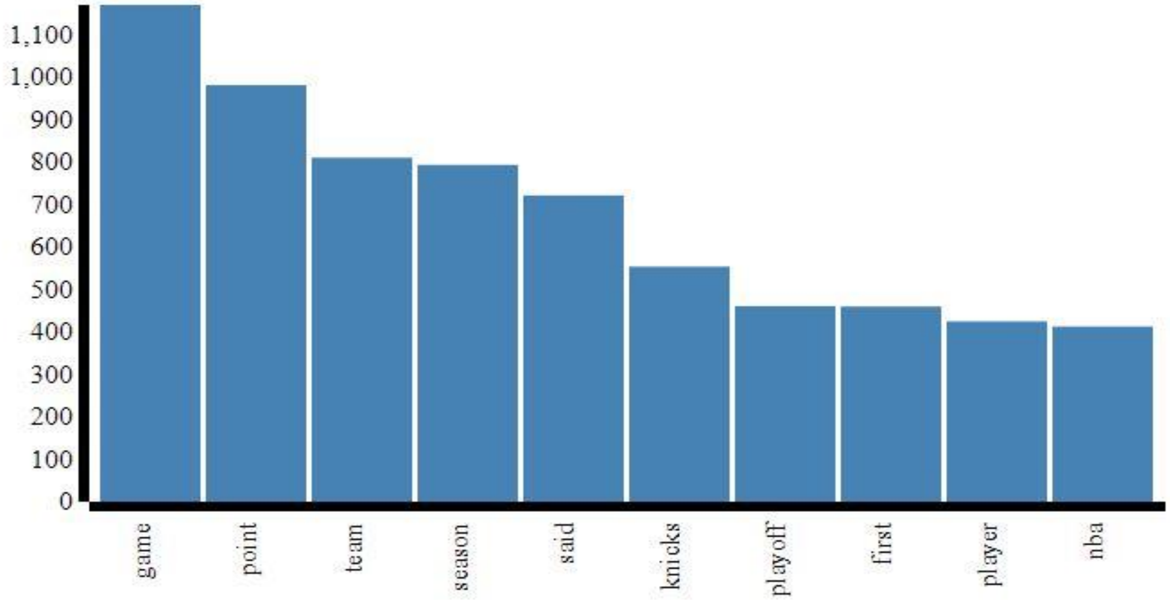
Task 2:

For the visualization part, we have drawn a bar graph for the top 10 words, obtained from Task 1.



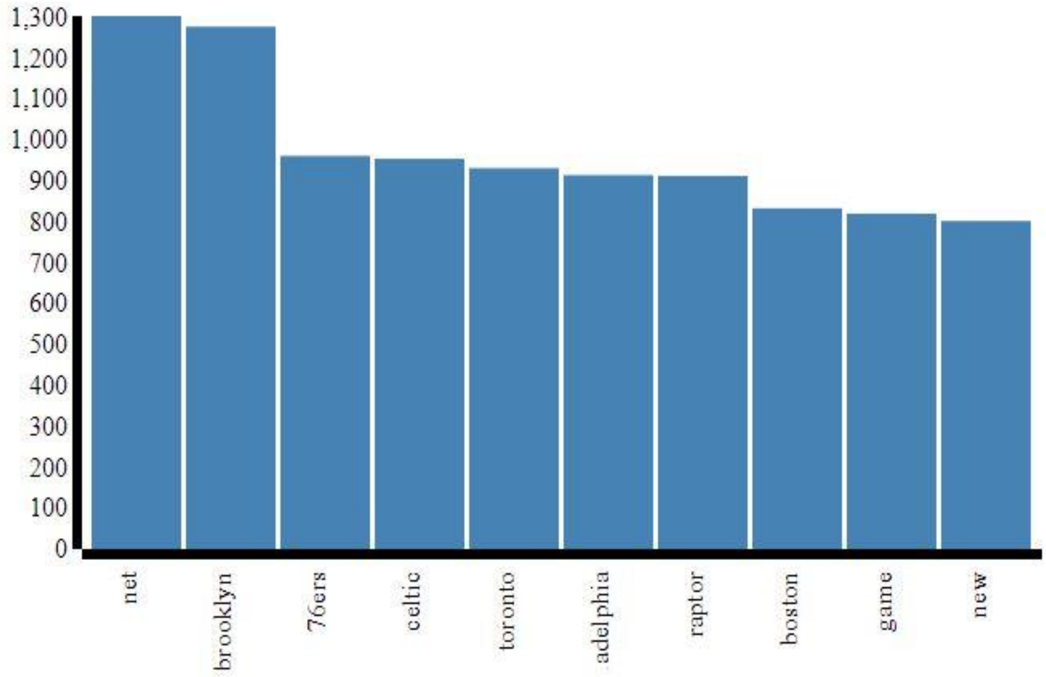
Task 3:

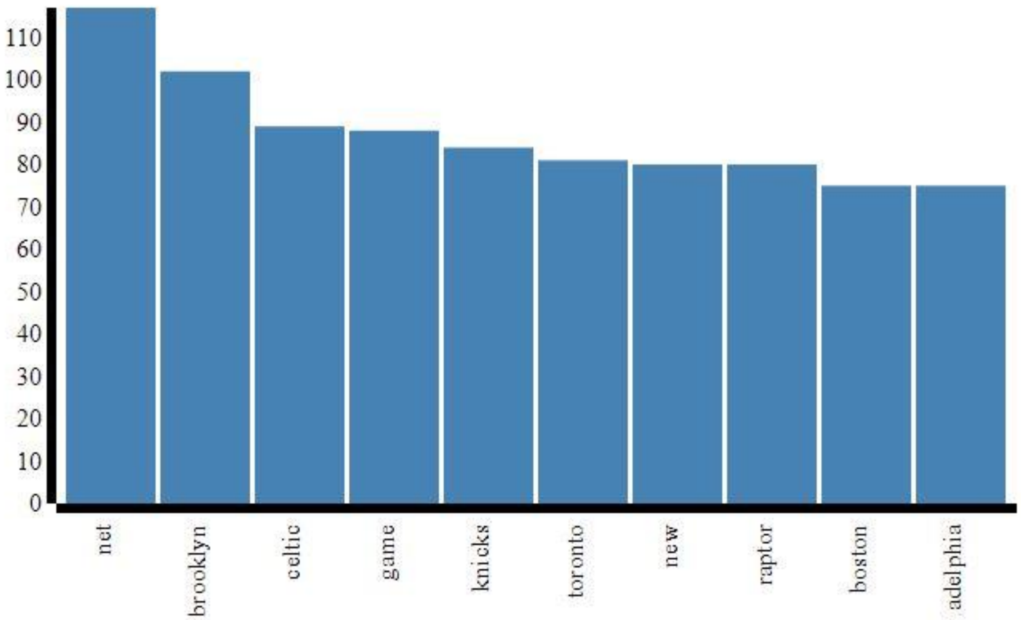
We created bar graphs for the corresponding large data.

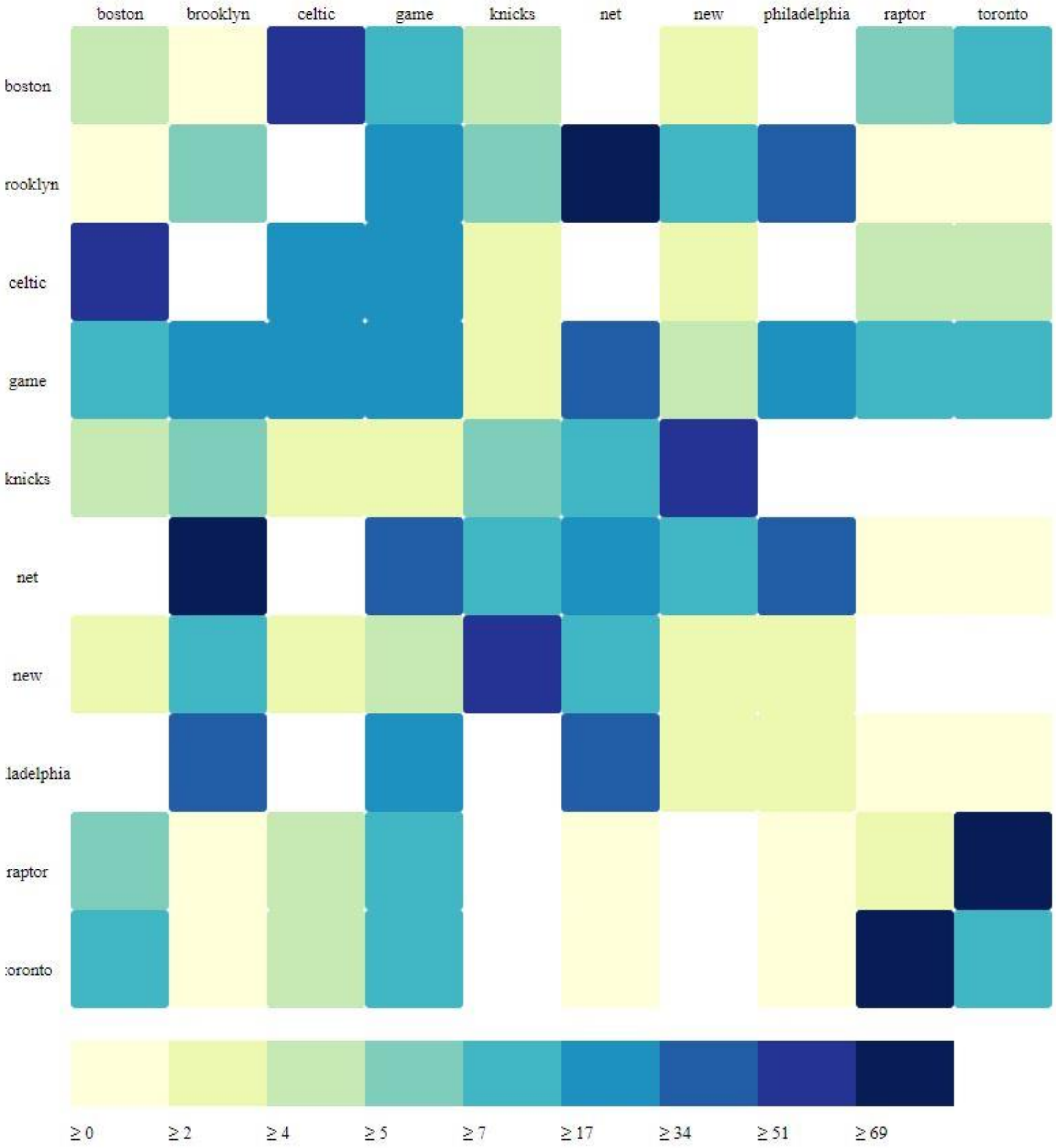


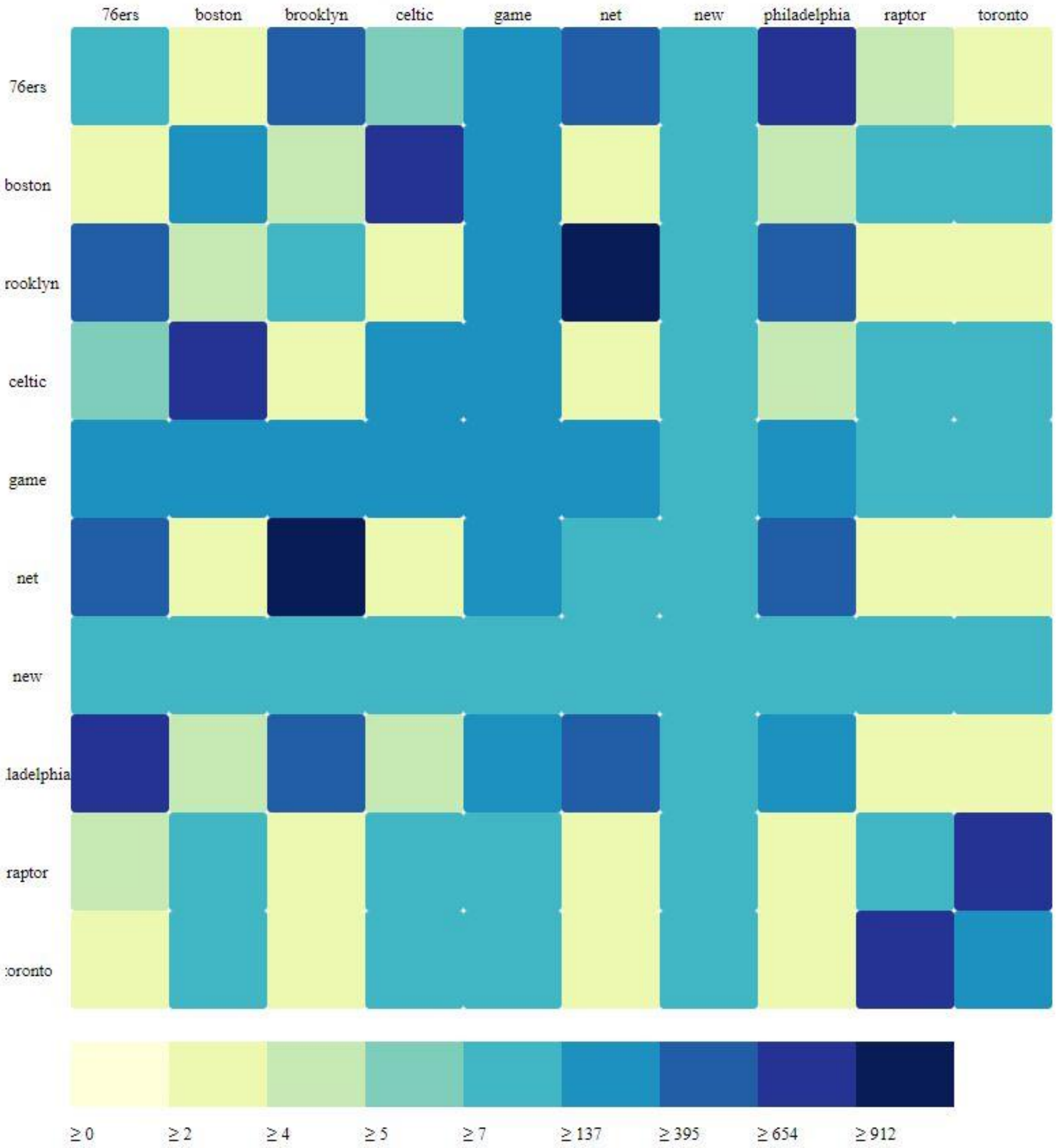
Task 4:

We built an interactive website using d3.js. We have provided 2 dropdown: One is the subtopic and the other being Data Source:Twitter,NyData and common crawl. For word count, we are plotting bar graphs. For word co-occurence we are plotting heat map. Attached are the plots for subtopic – Atlantic division, data source – Twitter, data set size – Large and Small:

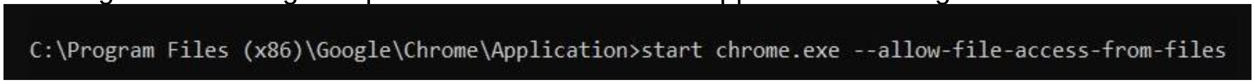



110
100
90
80
70
60
50
40
30
20
10
0
net
brooklyn
celtic
game
knicks
toronto
new
raptor
boston
adelphia


boston
brooklyn
celtic
game
knicks
net
new
philadelphia
raptor
toronto
boston
rooklyn
celtic
game
knicks
net
new
ladelphia
raptor
:oronto
≥ 0
≥ 2
≥ 4
≥ 5
≥ 7
≥ 17
≥ 34
≥ 51
≥ 69



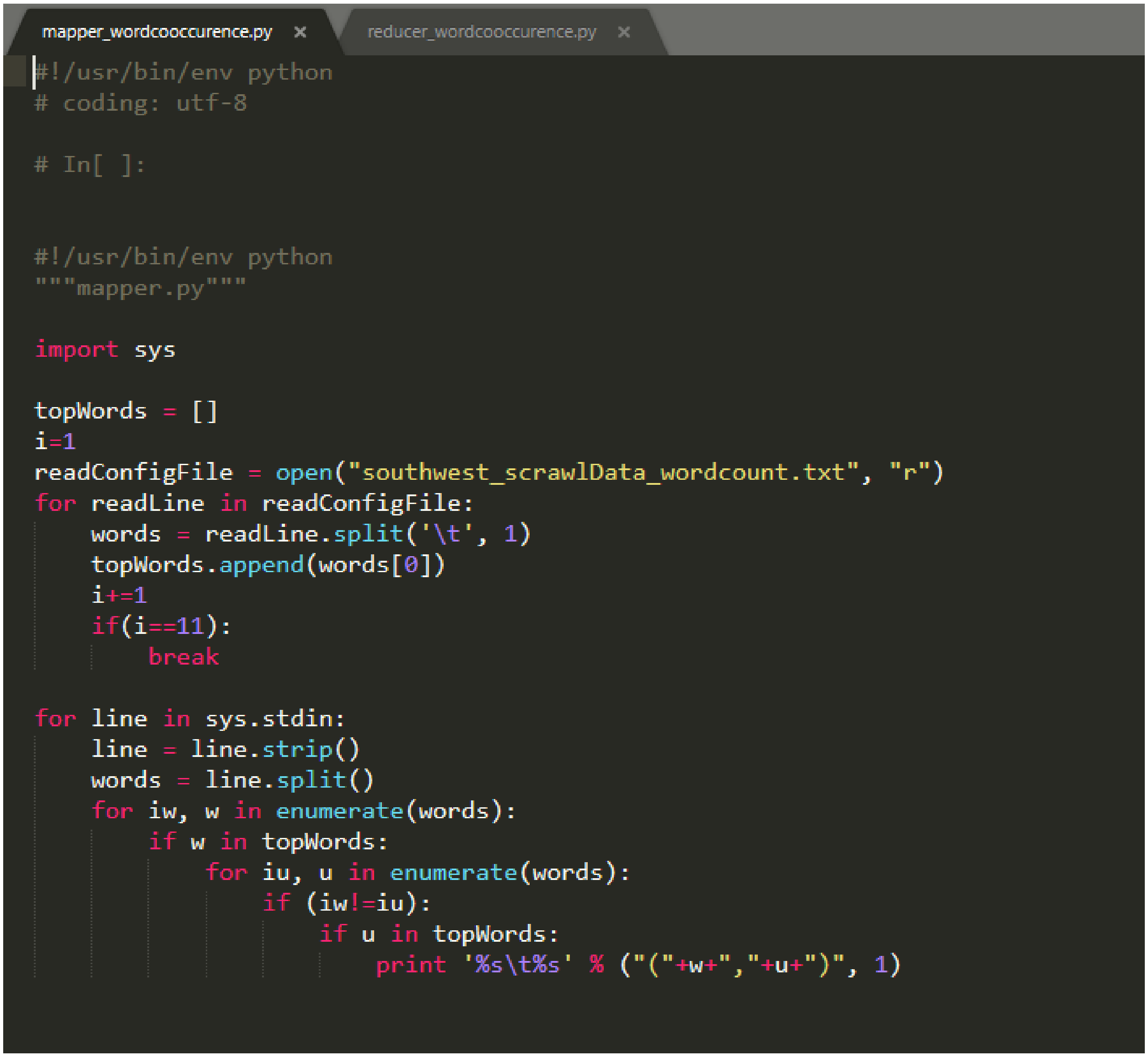
For building the website, we have to read from the text files. To achieve this, start chrome by enabling the cross origin request. Below is the code snippet for achieving this:



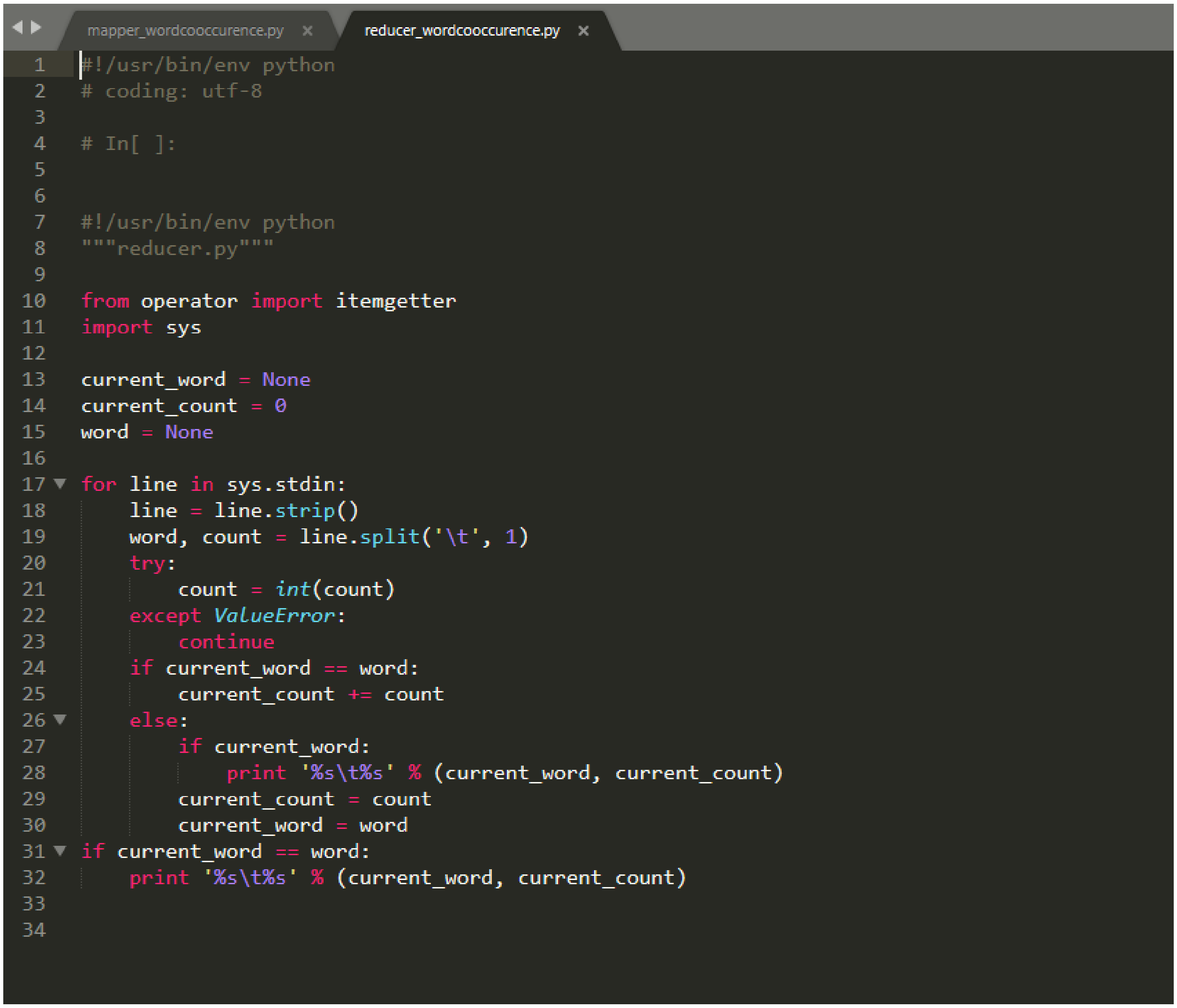
```
C:\Program Files (x86)\Google\Chrome\Application>start chrome.exe --allow-file-access-from-files
```

Task 5:

We took the top 10 words and we found the cooccurring words in the context. We repeated this for all the datasets(small and large) we have. Co-occurence is a 10*10 square symmetric matrix. We passed the word count as the parameter for the mapper reducer and then we picked the top 10 words.

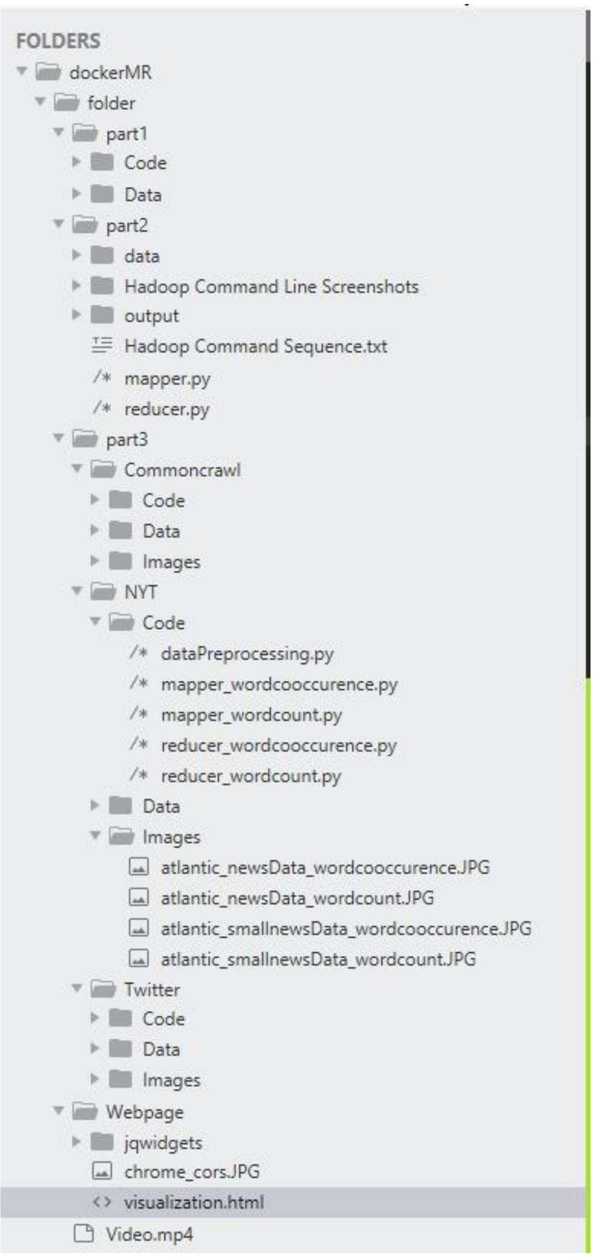


```
#!/usr/bin/env python
# coding: utf-8

# In[ ]:


#!/usr/bin/env python
"""mapper.py"""

import sys

topWords = []
i=1
readConfigFile = open("southwest_scrawlData_wordcount.txt", "r")
for readLine in readConfigFile:
    words = readLine.split('\t', 1)
    topWords.append(words[0])
    i+=1
    if(i==11):
        break

for line in sys.stdin:
    line = line.strip()
    words = line.split()
    for iw, w in enumerate(words):
        if w in topWords:
            for iu, u in enumerate(words):
                if (iw!=iu):
                    if u in topWords:
                        print '%s\t%s' % ("("+w+","+u+")", 1)
```



```python
#!/usr/bin/env python
# coding: utf-8

# In[ ]:


#!/usr/bin/env python
"""reducer.py"""

from operator import itemgetter
import sys

current_word = None
current_count = 0
word = None

for line in sys.stdin:
    line = line.strip()
    word, count = line.split('\t', 1)
    try:
        count = int(count)
    except ValueError:
        continue
    if current_word == word:
        current_count += count
    else:
        if current_word:
            print '%s\t%s' % (current_word, current_count)
        current_count = count
        current_word = word
if current_word == word:
    print '%s\t%s' % (current_word, current_count)
```

<u>Task 6:</u> Below is the directory structure we have used to save the files.



```
FOLDERS
▼ dockerMR
  ▼ folder
    ▼ part1
      ▶ Code
      ▶ Data
    ▼ part2
      ▶ data
      ▶ Hadoop Command Line Screenshots
      ▶ output
        Hadoop Command Sequence.txt
        mapper.py
        reducer.py
    ▼ part3
      ▼ Commoncrawl
        ▶ Code
        ▶ Data
        ▶ Images
      ▼ NYT
        ▼ Code
            dataPreprocessing.py
            mapper_wordcooccurence.py
            mapper_wordcount.py
            reducer_wordcooccurence.py
            reducer_wordcount.py
        ▶ Data
        ▼ Images
            atlantic_newsData_wordcooccurence.JPG
            atlantic_newsData_wordcount.JPG
            atlantic_smallnewsData_wordcooccurence.JPG
            atlantic_smallnewsData_wordcount.JPG
      ▼ Twitter
        ▶ Code
        ▶ Data
        ▶ Images
    ▼ Webpage
      ▶ jqwidgets
        chrome_cors.JPG
        visualization.html
      Video.mp4
```

Task 7: We have attached the video of the demo where both of us have explained the steps we have used to achieve the result.

Conclusion:

In Conclusion, we visualized the word count and word co-occurrences for different topics from different sources. We also found that for a given topic, there were similar patterns occurring in word counts and word co-occurrences across the 3 different data sources. There is not a 100% match, but a lot of similarities can be seen. Especially between the NY Times data and Common Crawler data – understandably as they are similar sources by nature. This can be viewed clearly from the visualization on our website.

Reference:

1. www.d3js.org
2. http://www.dealingdata.net/2016/07/23/PoGo-Series-Tweepy/
3. https://pythonprogramming.net/introduction-scraping-parsing-beautiful-soup-tutorial/
4. https://codeburst.io/web-scraping-101-with-python-beautiful-soup-bb617be1f486
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