Final_Project_4

March 10, 2023

Geographical and Time

[1]:
```
import sys
print(sys.version)
```

```
3.8.15 | packaged by conda-forge | (default, Nov 22 2022, 08:46:39)
[GCC 10.4.0]
```

[2]:
```
spark.version
```

[2]:
```
'3.1.3'
```

[3]:
```
import pandas as pd
import numpy as np
pd.set_option('display.max_colwidth', None)
pd.reset_option('display.max_rows')
from itertools import compress
from pyspark.sql.functions import *
from pyspark.sql.types import *
import seaborn as sns
import matplotlib.pyplot as plt
warnings.filterwarnings(action='ignore')
```

[4]:
```
from pyspark.sql import SparkSession
from pyspark import SparkContext
from pyspark.sql import SQLContext
from pyspark.sql import Row
from pyspark.sql.functions import col
```

[5]:
```
spark.conf.set("spark.sql.repl.eagerEval.enabled",True)
```

[6]:
```
%%time
twitter = spark.read.parquet('gs://chen26-bdp/original_data')
```

```
CPU times: user 6.35 ms, sys: 3.72 ms, total: 10.1 ms
Wall time: 8.38 s
```

```
23/03/05 02:19:11 WARN org.apache.spark.sql.catalyst.util.package: Truncated the
string representation of a plan since it was too large. This behavior can be
adjusted by setting 'spark.sql.debug.maxToStringFields'.
```

[7]:
```
keywords = ['college', 'high', 'university', 'students'
            , 'public', 'private', 'secondary', 'primary', 'education',␣
 ↪'undergraduate','graduate']
#filter out rows that do not contain words in keywords
twitter = twitter.withColumn('lower', lower(col('text')))
filter_twitter = twitter.filter(col('lower').rlike('|'.join(keywords)))

twitter_eng = filter_twitter.filter(col('lang') == 'en')
from pyspark.sql import functions as F
from pyspark.sql import types as t
from pyspark.sql.types import ArrayType, IntegerType, BooleanType

eng_ord=F.udf(lambda x: [ord(a) for a in x],t.ArrayType(IntegerType()))

def english_filter(x):
    for index in range(len(x)):
        if x[index] > 128:
            return False
        else:
            return True

filter_udf = F.udf(english_filter, BooleanType())
tweets = twitter_eng.filter(filter_udf(eng_ord('text')) == True)
```

[8]:
```
time = tweets.select('created_at')
```

[9]:
```
time.show(10, truncate = False)
```

```
[Stage 1:>                                                          (0 + 1) / 1]

+------------------------------+
|created_at                    |
+------------------------------+
|Sun Dec 18 00:53:14 +0000 2022|
|Sun Dec 18 00:53:15 +0000 2022|
|Sun Dec 18 00:53:16 +0000 2022|
|Sun Dec 18 00:53:17 +0000 2022|
|Sun Dec 18 00:53:18 +0000 2022|
|Sun Dec 18 00:53:18 +0000 2022|
|Sun Dec 18 00:53:19 +0000 2022|
|Sun Dec 18 00:53:19 +0000 2022|
|Sun Dec 18 00:53:22 +0000 2022|
|Sun Dec 18 00:53:22 +0000 2022|
+------------------------------+
only showing top 10 rows
```

```
[10]: from pyspark.sql.functions import from_unixtime, date_format
      spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")

      time_new = time.withColumn("timestamp_unix",␣
       ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
      time_new = time_new.withColumn("date", date_format("timestamp_unix",␣
       ↪"yyyy-MM-dd"))
```

```
[11]: # Show the updated DataFrame
      time_new.show()
```

```
[Stage 2:>                                                          (0 + 1) / 1]

+--------------------+-------------------+----------+
|          created_at|     timestamp_unix|      date|
+--------------------+-------------------+----------+
|Sun Dec 18 00:53:...|2022-12-18 00:53:14|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:15|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:16|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:17|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:18|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:18|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:19|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:19|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:22|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:22|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:23|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:27|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:28|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:28|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:29|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:29|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:31|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:32|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:33|2022-12-18|
|Sun Dec 18 00:53:...|2022-12-18 00:53:33|2022-12-18|
+--------------------+-------------------+----------+
only showing top 20 rows
```

```
[12]: tweets_day = tweets.select('id', 'created_at')
```

```
tweets_day = tweets_day.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
tweets_day = tweets_day.withColumn("date", date_format("timestamp_unix",␣
 ↪"yyyy-MM-dd"))
tweets_by_day = tweets_day.drop('created_at', 'timestamp_unix')
```

[13]:
```
# Show the updated DataFrame
tweets_by_day.show()
```

```
[Stage 3:>                                                          (0 + 1) / 1]

+-------------------+----------+
|                 id|      date|
+-------------------+----------+
|1604278583291256832|2022-12-18|
|1604278587183415297|2022-12-18|
|1604278590614315008|2022-12-18|
|1604278595215671296|2022-12-18|
|1604278597019115520|2022-12-18|
|1604278598155702273|2022-12-18|
|1604278600655507456|2022-12-18|
|1604278604354834433|2022-12-18|
|1604278614618279936|2022-12-18|
|1604278614748528642|2022-12-18|
|1604278620993757186|2022-12-18|
|1604278633853583362|2022-12-18|
|1604278640241278977|2022-12-18|
|1604278641076092931|2022-12-18|
|1604278643693424643|2022-12-18|
|1604278645501181952|2022-12-18|
|1604278651373199361|2022-12-18|
|1604278654892183553|2022-12-18|
|1604278659983937536|2022-12-18|
|1604278661267574785|2022-12-18|
+-------------------+----------+
only showing top 20 rows
```

[14]:
```
total_by_day = tweets_by_day.groupby('date').agg(count('*').
 ↪alias('daily_tweets'))
day_total = total_by_day.orderBy('date', ascending = True)
day_total.show()
```

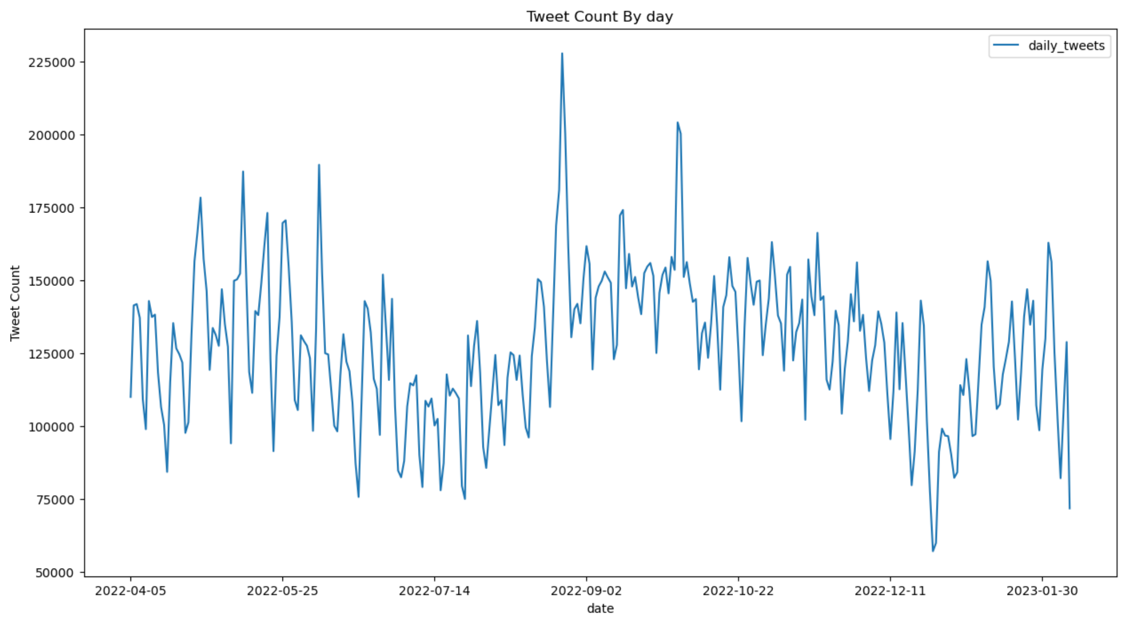
```
[Stage 6:===========================>                                (7 + 8) / 15]

+----------+------------+
|      date|daily_tweets|
+----------+------------+
|2022-04-05|      109939|
|2022-04-06|      141312|
|2022-04-07|      141789|
|2022-04-08|      137075|
|2022-04-09|      109139|
|2022-04-10|       98880|
|2022-04-11|      142839|
|2022-04-12|      137345|
|2022-04-13|      138168|
|2022-04-14|      118257|
|2022-04-15|      106518|
|2022-04-16|      100385|
|2022-04-17|       84230|
|2022-04-18|      115006|
|2022-04-19|      135267|
|2022-04-20|      126609|
|2022-04-21|      124602|
|2022-04-22|      121740|
|2022-04-23|       97615|
|2022-04-24|      101238|
+----------+------------+
only showing top 20 rows
```

[16]:
```
%%time
day_total.write.format("parquet").\
mode('overwrite').\
save('gs://chen26-bdp/day_tweets')
```

```
CPU times: user 892 ms, sys: 213 ms, total: 1.1 s
Wall time: 6min 23s
```

[15]:
```
day = day_total.toPandas()
```

[17]:
```
day.plot(kind="line",x= 'date', y="daily_tweets", figsize=(15, 8))
plt.ylabel("Tweet Count")
plt.title('Tweet Count By day')
plt.show()
```



```
[18]: day
```

```
[18]:           date  daily_tweets
      0    2022-04-05        109939
      1    2022-04-06        141312
      2    2022-04-07        141789
      3    2022-04-08        137075
      4    2022-04-09        109139
      ..          …             …
      305  2023-02-04        102690
      306  2023-02-05         82069
      307  2023-02-06        105679
      308  2023-02-07        128770
      309  2023-02-08         71723

      [310 rows x 2 columns]
```

```
[19]: month_total = day_total.withColumn('month', month(col('date')))
```

```
[ ]: month_total.show()
```

```
[Stage 25:=====================>                                  (5 + 8) / 13]

+----------+------------+-----+
|      date|daily_tweets|month|
+----------+------------+-----+
|2022-04-05|      109939|    4|
|2022-04-06|      141312|    4|
|2022-04-07|      141789|    4|
|2022-04-08|      137075|    4|
|2022-04-09|      109139|    4|
|2022-04-10|       98880|    4|
|2022-04-11|      142839|    4|
|2022-04-12|      137345|    4|
|2022-04-13|      138168|    4|
|2022-04-14|      118257|    4|
|2022-04-15|      106518|    4|
|2022-04-16|      100385|    4|
|2022-04-17|       84230|    4|
|2022-04-18|      115006|    4|
|2022-04-19|      135267|    4|
|2022-04-20|      126609|    4|
|2022-04-21|      124602|    4|
|2022-04-22|      121740|    4|
|2022-04-23|       97615|    4|
|2022-04-24|      101238|    4|
+----------+------------+-----+
only showing top 20 rows
```

[ ]:
```
%%time
month_total.write.format("parquet").\
mode('overwrite').\
save('gs://chen26-bdp/month_tweets')
```

[7]:
```
month_total = spark.read.parquet('gs://chen26-bdp/month_tweets')
```

[9]:
```
month_total_t = month_total.groupby('month').agg(sum('daily_tweets').
 ↪alias('monthly_tweets'))
```

[10]:
```
month = month_total_t.toPandas()
```

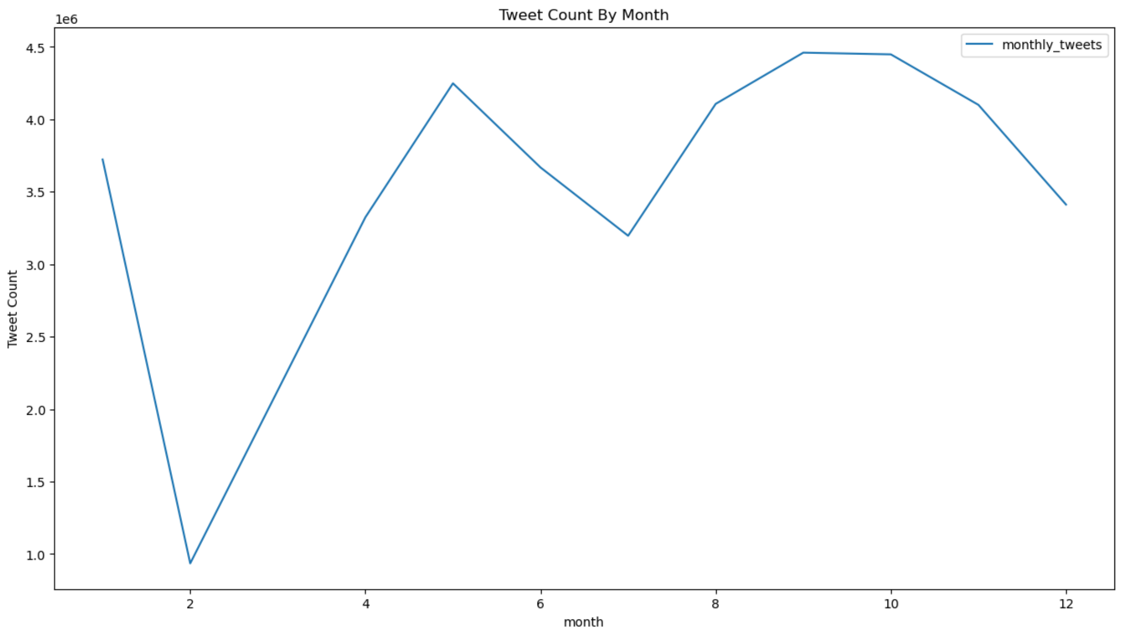
[15]:
```
month = month.sort_values(by = 'month')
```

[16]:
```
month
```

[16]:
```
   month  monthly_tweets
1      1         3722912
9      2          935033
5      4         3323905
```

```
3        5        4248605
2        6        3667682
6        7        3196325
10       8        4106759
4        9        4460274
7       10        4448331
8       11        4099704
0       12        3411590
```

[17]:
```python
month.plot(kind="line",x= 'month', y="monthly_tweets", figsize=(15, 8))
plt.ylabel("Tweet Count")
plt.title('Tweet Count By Month')
plt.show()
```



[29]:
```python
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
tweets_week = tweets.select('id', 'created_at')
tweets_week = tweets_week.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
tweets_week = tweets_week.withColumn('day_of_week',␣
 ↪date_format(to_date('created_at', 'EEE MMM dd HH:mm:ss Z yyyy'), 'EEEE'))
#tweets_by_day = tweets_day.drop('created_at', 'timestamp_unix')
```

[31]:
```python
tweets_week = tweets_week.drop('timestamp_unix')
```

[32]:
```python
day_of_week = tweets_week.groupby('day_of_week').agg(count('id'))
```

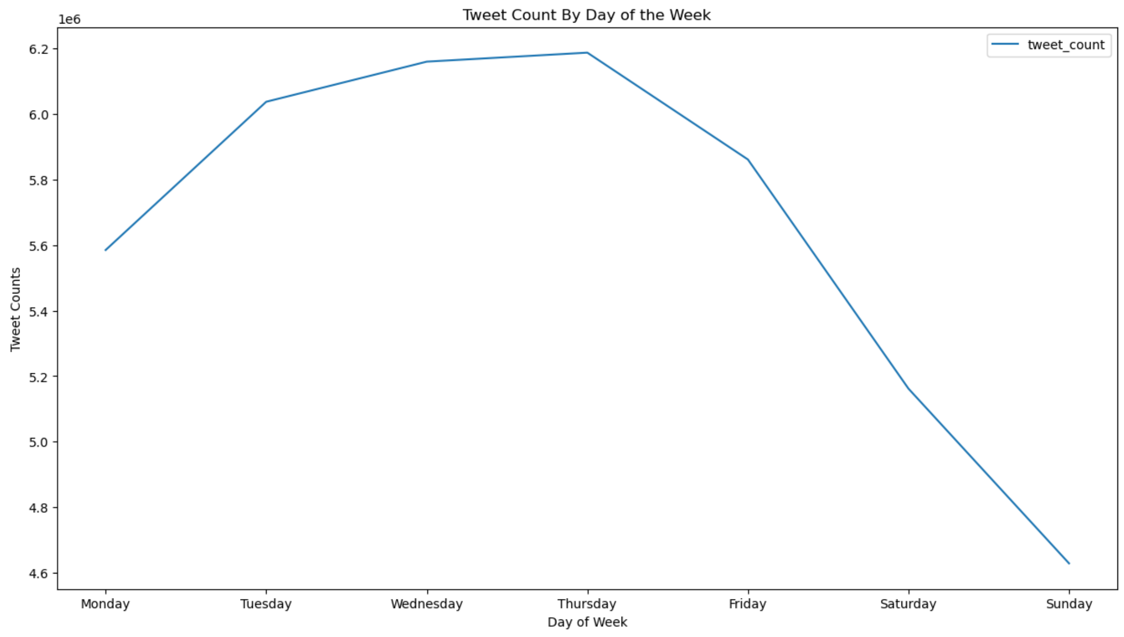
```
[ ]: dw = day_of_week.toPandas()
```

```
[35]: dw.sort_values(by = 'day_of_week')
```

```
[35]:   day_of_week  count(id)
      2      Friday    5861154
      5      Monday    5584926
      4    Saturday    5162074
      6      Sunday    4629016
      3    Thursday    6187074
      1     Tuesday    6037232
      0   Wednesday    6159644
```

```
[37]: days = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday', 'Saturday',␣
       ↪'Sunday']
      count = [5584926, 6037232, 6159644, 6187074, 5861154, 5162074, 4629016]

      tweet_week = pd.DataFrame({'Days': days, 'tweet_count': count})
```

```
[39]: tweet_week.plot(kind="line",x= 'Days', y="tweet_count", figsize=(15, 8))
      plt.ylabel("Tweet Counts")
      plt.xlabel('Day of Week')
      plt.title('Tweet Count By Day of the Week')
      plt.show()
```



Geographic

```
[ ]: # tweets location
```

```
[40]: tweets_loc = tweets.select('id', tweets.place.country.alias('tweet_country'),␣
       ↪tweets.place.full_name.alias('tweet_location'))
```

```
[42]: tweet_country = tweets_loc.select('id', 'tweet_country')
```

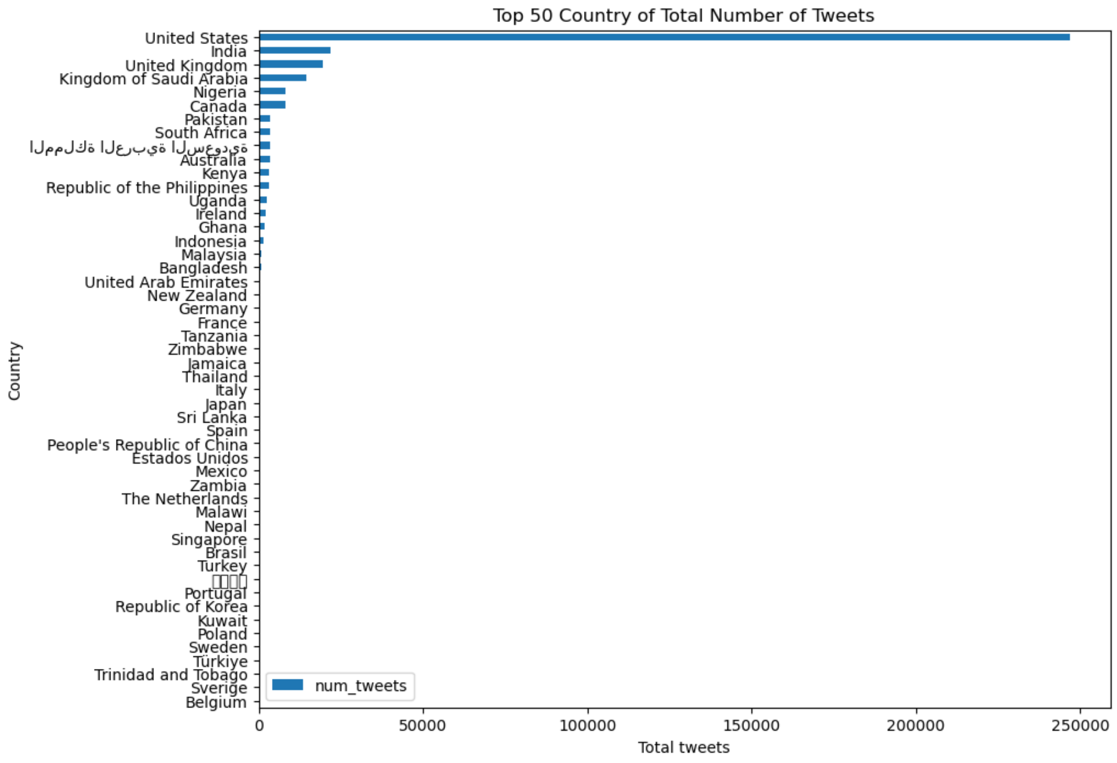
```
[51]: country = tweet_country.filter(col('tweet_country').isNotNull())
```

```
[59]: t_by_country = country.groupby(col('tweet_country')).agg(count('*').
       ↪alias('num_tweets'))
```

```
[61]: top50_country = t_by_country.orderBy(col('num_tweets').desc()).limit(50)
```

```
[63]: top50_country_df = top50_country.toPandas()
```

```
[72]: ax = top50_country_df.plot(x ='tweet_country',y='num_tweets', kind='barh',␣
       ↪figsize = (10, 8))

      ax.set_ylabel('Country')
      ax.set_xlabel('Total tweets')
      ax.set_title('Top 50 Country of Total Number of Tweets')
      ax.invert_yaxis()

      # show the plot
      plt.show()
```



```
[10]: tweet_location = tweets_loc.select('id', 'tweet_location')
```

```
[11]: location = tweet_location.filter(col('tweet_location').isNotNull())
```

```
[16]: location_c = location.withColumn("loc", split(location.tweet_location, ", ").
       ↪getItem(0))
```

```
[17]: location_c
```

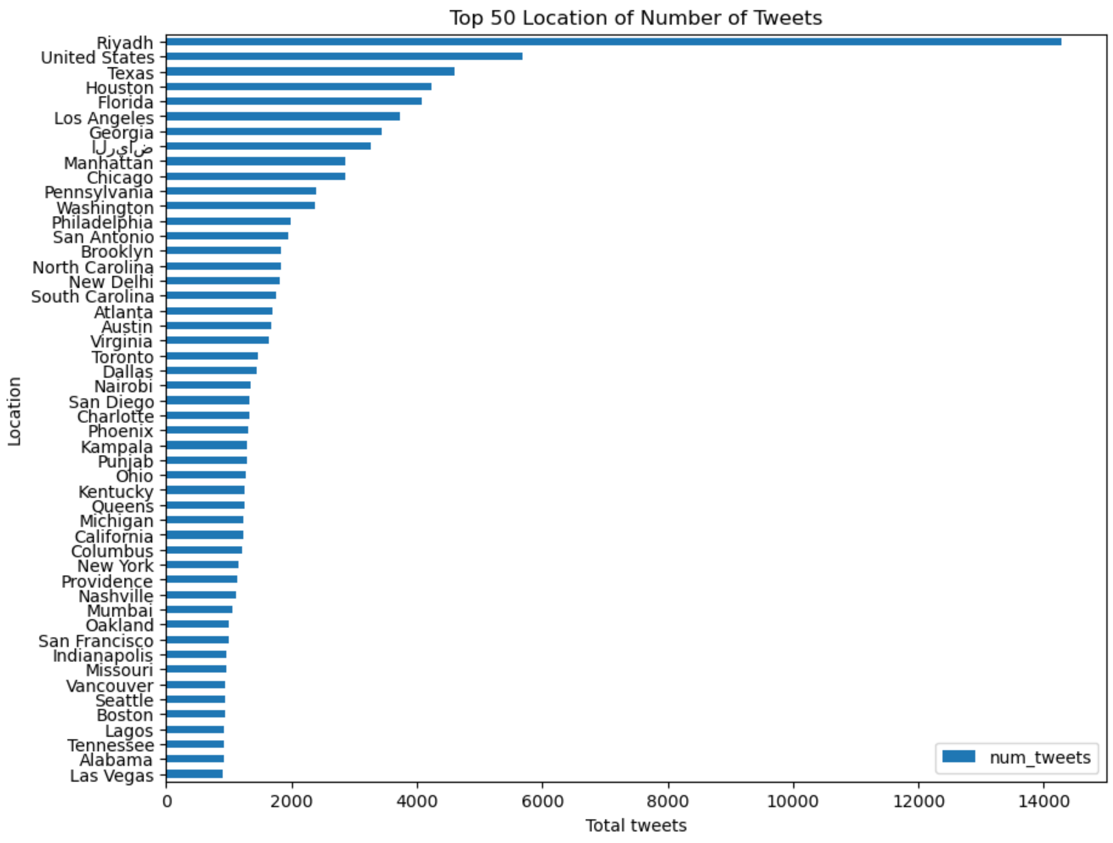
```
[17]: +-------------------+--------------------+--------------------+
      |                 id|      tweet_location|                 loc|
      +-------------------+--------------------+--------------------+
      |1555124473338253315|    Punjab, Pakistan|              Punjab|
      |1555124856861360128| Bhubaneshwar, India|        Bhubaneshwar|
      |1555125171669061632|               India|               India|
      |1555125396970115072|Greengairs, Scotland|          Greengairs|
      |1530714698655596545|Mount Vernon Pres…|Mount Vernon Pres…|
      |1530714877664403457|      Marshfield, MA|          Marshfield|
      |1530715122515296256|    Little Falls, NJ|        Little Falls|
      |1530715510123466752|        Sarasota, FL|            Sarasota|
      |1530715614649647104|        Georgia, USA|             Georgia|
      |1530716000383025159|  Virginia Beach, VA|      Virginia Beach|
      |1530716062416875521|Lake Central High…|Lake Central High…|
      |1533456562458464261|    Philadelphia, PA|        Philadelphia|
      |1533456594264104961| North Carolina, USA|      North Carolina|
      |1533456664585719809|   North Olmsted, OH|       North Olmsted|
      |1533456934665211904|    Collinsville, IL|        Collinsville|
      |1533457154220470274|    Philadelphia, PA|        Philadelphia|
      |1530540890221158402|          Maine, USA|               Maine|
      |1530541106454200320|     Nsukka, Nigeria|              Nsukka|
      |1530541114918313984|         Legacy Park|         Legacy Park|
      |1530541231679356928|       Kentucky, USA|            Kentucky|
      +-------------------+--------------------+--------------------+
      only showing top 20 rows
```

[19]:
```
t_by_location = location_c.groupby(col('loc')).agg(count('*').
 ↪alias('num_tweets'))
```

[20]:
```
top50_loc = t_by_location.orderBy(col('num_tweets').desc()).limit(50)
```

[22]:
```
top50_loc_df = top50_loc.toPandas()
```

[24]:
```
ax = top50_loc_df.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10, 8))

ax.set_ylabel('Location')
ax.set_xlabel('Total tweets')
ax.set_title('Top 50 Location of Number of Tweets')
ax.invert_yaxis()

# show the plot
plt.show()
```



[25]:
```
# remove locations with only country
filt_location = location.filter(col("tweet_location").like("%,%"))
```

[27]:
```
location_f = filt_location.withColumn("loc", split(location.tweet_location, ",␣
↪").getItem(0))
```

[29]:
```
location_f
```

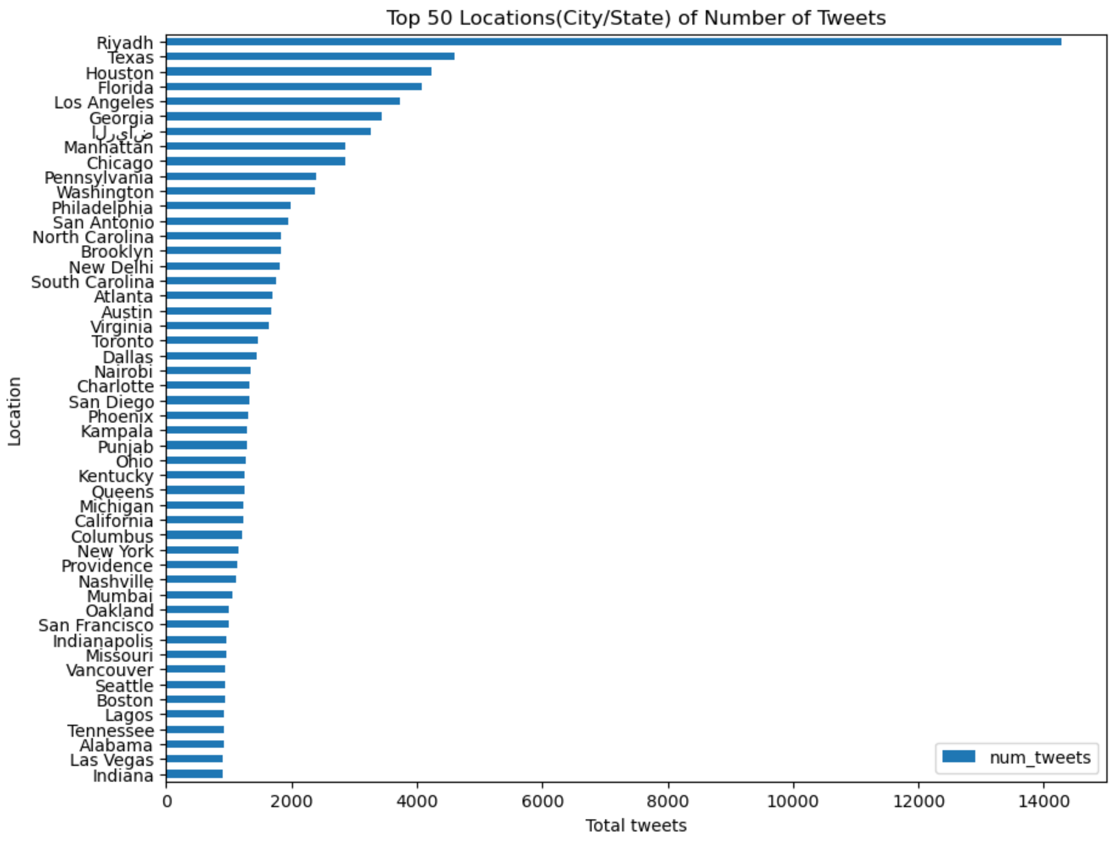
[29]:
```
+-------------------+--------------------+--------------+
|                 id|      tweet_location|           loc|
+-------------------+--------------------+--------------+
|1555124473338253315|     Punjab, Pakistan|        Punjab|
|1555124856861360128|  Bhubaneshwar, India|  Bhubaneshwar|
|1555125396970115072|Greengairs, Scotland|    Greengairs|
|1530714877664403457|        Marshfield, MA|    Marshfield|
|1530715122515296256|     Little Falls, NJ|  Little Falls|
|1530715510123466752|          Sarasota, FL|      Sarasota|
|1530715614649647104|          Georgia, USA|       Georgia|
|1530716000383025159|   Virginia Beach, VA|Virginia Beach|
|1533456562458464261|      Philadelphia, PA|  Philadelphia|
|1533456594264104961| North Carolina, USA|North Carolina|
|1533456664585719809|   North Olmsted, OH| North Olmsted|
|1533456934665211904|    Collinsville, IL|  Collinsville|
|1533457154220470274|    Philadelphia, PA|  Philadelphia|
|1530540890221158402|          Maine, USA|         Maine|
|1530541106454200320|     Nsukka, Nigeria|        Nsukka|
|1530541231679356928|       Kentucky, USA|      Kentucky|
|1530541346032861184| Nawabshah, Pakistan|     Nawabshah|
|1530541387443122176|   Chandigarh, India|    Chandigarh|
|1566012216994070528|         Kota, India|          Kota|
|1566012298983923713|  Maharashtra, India|   Maharashtra|
+-------------------+--------------------+--------------+
only showing top 20 rows
```

[30]:
```
t_by_location_f = location_f.groupby(col('loc')).agg(count('*').
 ↪alias('num_tweets'))
```

[31]:
```
top50_loc_f = t_by_location_f.orderBy(col('num_tweets').desc()).limit(50)
```

[32]:
```
top50_loc_f_df = top50_loc_f.toPandas()
```

[81]:
```
ax = top50_loc_f_df.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10,␣
 ↪8))

ax.set_ylabel('Location')
ax.set_xlabel('Total tweets')
ax.set_title('Top 50 Locations(City/State) of Number of Tweets')
ax.invert_yaxis()

# show the plot
plt.show()
```



```
[ ]: # check why many tweets come from riyadh
```

```
[43]: riyadh = tweets.filter(tweets.place.full_name == 'Riyadh, Kingdom of Saudi␣
       ↪Arabia')
```

```
[51]: spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
      riyadh_timeline = riyadh.select('id', 'created_at')
      riyadh_month = riyadh_timeline.withColumn("timestamp_unix",␣
       ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
      riyadh_month = riyadh_month.withColumn("date", date_format("timestamp_unix",␣
       ↪"yyyy-MM-dd"))
      riyadh_month = riyadh_month.withColumn('month', month('date'))
```

```
[56]: r_d = riyadh_month.select('id', 'date')
      r_tweets = r_d.groupby('date').agg(count('*'))
```

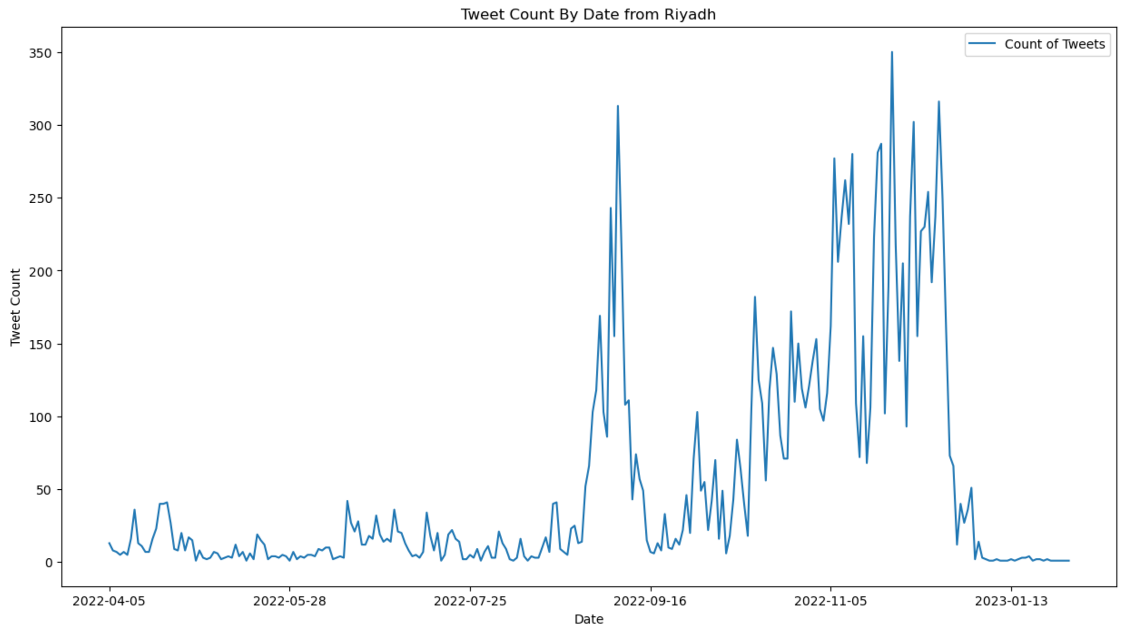
```
[ ]: r_tweets_day = r_tweets.orderBy('date', ascending = True)
     r_tweets_day.show()
```

```
[Stage 79:========================================>                (9 + 4) / 13]
```

```
+----------+--------+
|      date|count(1)|
+----------+--------+
|2022-04-05|      13|
|2022-04-06|       8|
|2022-04-07|       7|
|2022-04-08|       5|
|2022-04-09|       7|
|2022-04-10|       5|
|2022-04-11|      16|
|2022-04-12|      36|
|2022-04-13|      13|
|2022-04-14|      11|
|2022-04-15|       7|
|2022-04-16|       7|
|2022-04-17|      16|
|2022-04-18|      23|
|2022-04-19|      40|
|2022-04-20|      40|
|2022-04-21|      41|
|2022-04-22|      27|
|2022-04-23|       9|
|2022-04-24|       8|
+----------+--------+
only showing top 20 rows
```

[59]:
```
rt_df = r_tweets_day.toPandas()
```

[63]:
```
ax = rt_df.plot(kind="line", x='date', y="count(1)", figsize=(15, 8))
ax.set_ylabel("Tweet Count")
ax.set_xlabel('Date')
ax.set_title('Tweet Count By Date from Riyadh')

# Adding Legend and Renaming
ax.legend(['Count of Tweets'])

plt.show()
```



```
[ ]: # peak 1: Jul, Aug: Biden saudi visit
     # peak 2: Dec: world cup
```

```
[ ]:
```

```
[ ]:
```

```
[ ]: # twitter user location
```

```
[64]: user_loc = tweets.select('id', tweets.user.location.alias('user_location'),␣
       ↪tweets.user.id.alias('user_id'))
```

```
[66]: u_loc = user_loc.filter(col('user_location').isNotNull())
```

```
[68]: u_loc_count = u_loc.groupby('user_location').agg(count('user_id'))
```

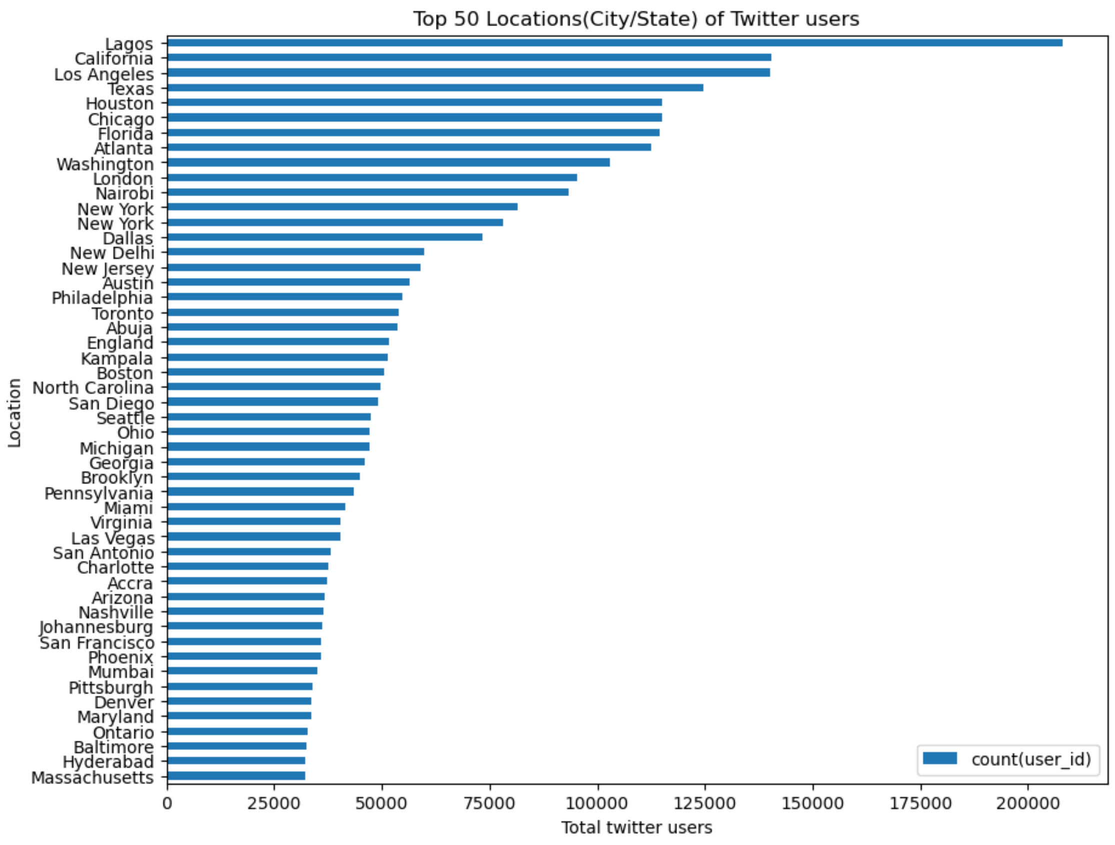
```
[71]: lc_desc = u_loc_count.orderBy(col('count(user_id)').desc())
```

```
[72]: lc = lc_desc.withColumn("loction", split(lc_desc.user_location, ", ").
       ↪getItem(0))
```

```
[74]: lc_f = lc.filter(col("user_location").like("%,%"))
```

```
[77]: l_df = lc_f.limit(50).toPandas()
      ax = l_df.plot(x ='loction',y='count(user_id)', kind='barh', figsize = (10, 8))
```

```
ax.set_ylabel('Location')
ax.set_xlabel('Total twitter users')
ax.set_title('Top 50 Locations(City/State) of Twitter users')
ax.invert_yaxis()

# show the plot
plt.show()
```



[ ]:
```
# focus peaks in trend: may
```

[9]:
```
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
timeline = tweets.select('id', 'created_at', tweets.place.full_name.
 ↪alias('tweet_location'))
timeline = timeline.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
timeline = timeline.withColumn("date", date_format("timestamp_unix",␣
 ↪"yyyy-MM-dd"))
timeline = timeline.withColumn('month', month('date'))
```

[11]:
```
timeline_loc = timeline.filter(col('tweet_location').isNotNull())
```

[13]:
```
timeline_loc_may = timeline_loc.filter(col('month') == 5).select('id',␣
↪'tweet_location', 'date')
```

[15]:
```
timeline_l_may = timeline_loc_may.withColumn('loc', split(timeline_loc_may.
↪tweet_location, ", ").getItem(0))
```

[20]:
```
may = timeline_l_may.groupby('loc').agg(count('id').alias('num_tweets')).
↪orderBy(col('num_tweets').desc()).limit(50)
```

[ ]:
```
may.show()
```

```
[Stage 19:=======================>                              (7 + 10) / 17]

+--------------+----------+
|           loc|num_tweets|
+--------------+----------+
| United States|      4041|
|       Houston|       443|
|       Georgia|       410|
|   Los Angeles|       370|
|       Florida|       354|
|         Texas|       339|
|     Manhattan|       303|
|       Chicago|       278|
|    Washington|       241|
|  Philadelphia|       209|
|  Pennsylvania|       199|
|      Brooklyn|       192|
|North Carolina|       187|
|   San Antonio|       173|
|      Virginia|       171|
|       Atlanta|       170|
|        Austin|       168|
|South Carolina|       154|
|     New Delhi|       153|
|        Riyadh|       147|
+--------------+----------+
only showing top 20 rows
```

Topics

[ ]:
```
# "Florida math book ban"
```

[8]:
```
dt = tweets.select([tweets.created_at,
                    tweets.id_str.alias('tweet_id'),
                    tweets.user['id'].alias('user_id'),
                    tweets.user['screen_name'].alias('user_name'),
                    tweets.user['verified'].alias('verified'),
                    tweets.user['followers_count'].alias('followers_count'),
                    tweets.user['description'].alias('user_description'),
                    tweets.user['location'].alias('user_location'),
                    tweets.text,
                    tweets.retweeted_status.retweet_count.alias('rt_count'),
                    tweets.retweeted_status.favorite_count.alias('rt_fav'),
                    tweets.retweeted_status.quote_count.alias('rt_quo'),
                    tweets.retweeted_status.retweeted.alias('retweet'),
                    tweets.retweeted_status.user['name'].alias('rt_user_name')])
```

[ ]:
```
# filter texts to find those that contain "Florida math book ban"
```

[15]:
```
fl_key = ['Florida', 'math', 'book', 'ban']
#filter out rows that do not contain words in keywords
dt = dt.withColumn('lower', lower(col('text')))
fl_dt = dt.filter(col('lower').rlike('|'.join(fl_key)))
```

[16]:
```
fl_dt.count()
```

[16]:
```
1620798
```

[27]:
```
fl_dt_loc = fl_dt.filter(col('user_location').isNotNull())
```

[28]:
```
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
fl_may = fl_dt_loc.select('tweet_id', 'created_at', 'user_location')
fl_may = fl_may.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
fl_may = fl_may.withColumn("date", date_format("timestamp_unix", "yyyy-MM-dd"))
fl_may = fl_may.withColumn('month', month('date'))
```

[29]:
```
fl_may
```

[29]:
```
+-------------------+--------------------+--------------------+-----------------
--+----------+-----+
|           tweet_id|          created_at|       user_location|
timestamp_unix|      date|month|
+-------------------+--------------------+--------------------+-----------------
--+----------+-----+
|1604278645501181952|Sun Dec 18 00:53:…|    Capital city, LA|2022-12-18
00:53:29|2022-12-18|   12|
|1604278670776041472|Sun Dec 18 00:53:…|       United States|2022-12-18
```

```
00:53:35|2022-12-18|   12|
|1604278780037660674|Sun Dec 18 00:54:…|       Missouri, USA|2022-12-18
00:54:01|2022-12-18|   12|
|1604279313477632003|Sun Dec 18 00:56:…|     San Antonio, TX|2022-12-18
00:56:09|2022-12-18|   12|
|1604279364690104322|Sun Dec 18 00:56:…|Duluth,Minnesota USA|2022-12-18
00:56:21|2022-12-18|   12|
|1604279474551259136|Sun Dec 18 00:56:…|Stellenbosch, Sou…|2022-12-18
00:56:47|2022-12-18|   12|
|1604279577362178048|Sun Dec 18 00:57:…|    thy phrontistery|2022-12-18
00:57:11|2022-12-18|   12|
|1604279665757409280|Sun Dec 18 00:57:…| western Washington |2022-12-18
00:57:33|2022-12-18|   12|
|1604280491238096897|Sun Dec 18 01:00:…|             Nigeria|2022-12-18
01:00:49|2022-12-18|   12|
|1604280526268923906|Sun Dec 18 01:00:…|    Floyds Knobs, IN|2022-12-18
01:00:58|2022-12-18|   12|
|1604280555100684291|Sun Dec 18 01:01:…|         Atlanta, GA|2022-12-18
01:01:05|2022-12-18|   12|
|1604280601548394496|Sun Dec 18 01:01:…|    Myrtle Beach, SC|2022-12-18
01:01:16|2022-12-18|   12|
|1604280711128797184|Sun Dec 18 01:01:…|    Myrtle Beach, SC|2022-12-18
01:01:42|2022-12-18|   12|
|1604280809908846592|Sun Dec 18 01:02:…|England-Turkey- C…|2022-12-18
01:02:05|2022-12-18|   12|
|1610637225871511552|Wed Jan 04 14:00:…|An 804 girl livin…|2023-01-04
14:00:13|2023-01-04|    1|
|1610637264421355526|Wed Jan 04 14:00:…|    Myrtle Beach, SC|2023-01-04
14:00:22|2023-01-04|    1|
|1610637278346354689|Wed Jan 04 14:00:…|      United Kingdom|2023-01-04
14:00:26|2023-01-04|    1|
|1610637463474651137|Wed Jan 04 14:01:…|    Myrtle Beach, SC|2023-01-04
14:01:10|2023-01-04|    1|
|1610637510492803077|Wed Jan 04 14:01:…|             Firenze|2023-01-04
14:01:21|2023-01-04|    1|
|1610637652121845761|Wed Jan 04 14:01:…|   Midlands, England|2023-01-04
14:01:55|2023-01-04|    1|
+-------------------+--------------------+--------------------+-----------------
--+----------+-----+
only showing top 20 rows
```

[30]:
```
fl_m_count = fl_may.groupby('date').agg(count('*').alias('daily_tweets'))
```

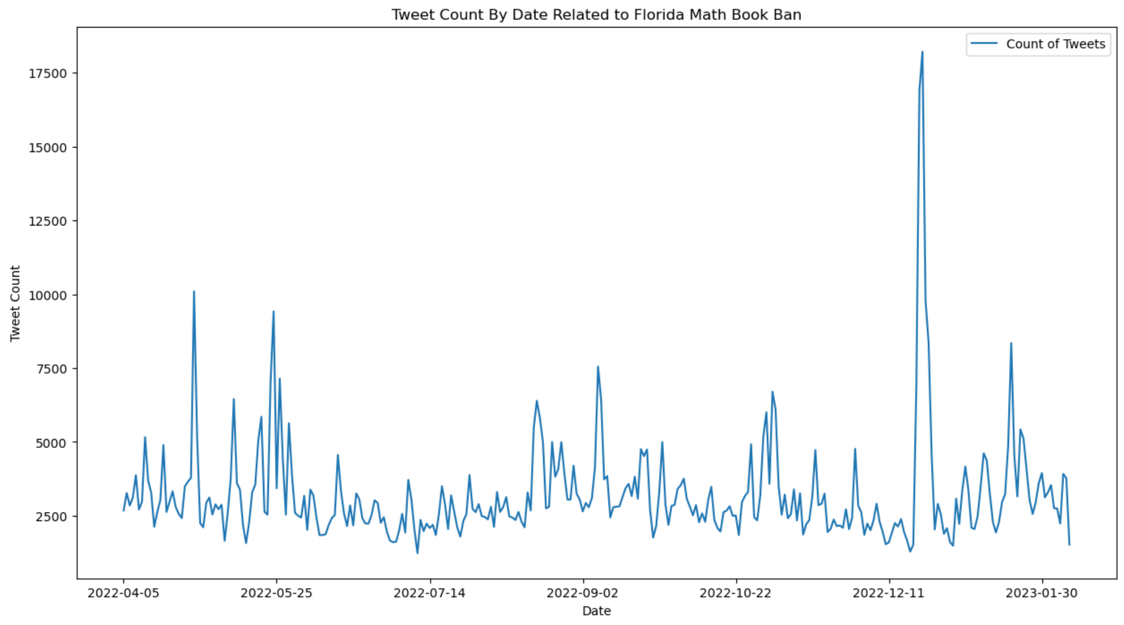
[ ]:
```
fl_m_count
```

```
[ ]: +----------+------------+
     |      date|daily_tweets|
     +----------+------------+
     |2022-07-30|        2892|
     |2022-09-03|        2933|
     |2022-12-14|        2134|
     |2022-05-04|        2538|
     |2022-11-04|        6096|
     |2022-11-27|        2718|
     |2022-09-07|        7552|
     |2022-05-16|        2270|
     |2022-07-23|        2107|
     |2022-12-07|        2906|
     |2022-05-17|        3294|
     |2022-10-13|        3035|
     |2022-11-09|        2549|
     |2022-10-24|        2952|
     |2022-11-23|        2370|
     |2022-08-17|        5485|
     |2023-01-05|        4164|
     |2022-07-04|        1992|
     |2022-07-25|        2327|
     |2022-06-03|        3175|
     +----------+------------+
     only showing top 20 rows
```

```
[32]: fl_count = fl_m_count.orderBy('date', ascending = True)
```

```
[33]: fl_df = fl_count.toPandas()
```

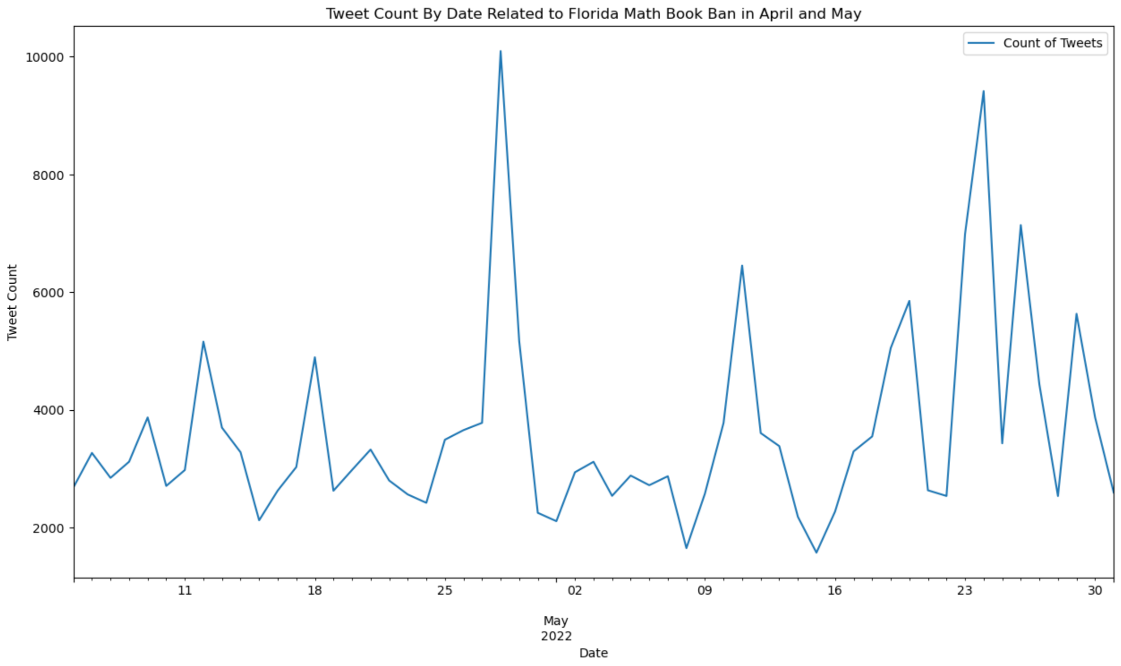
```
[36]: ax = fl_df.plot(kind="line", x='date', y="daily_tweets", figsize=(15, 8))
      ax.set_ylabel("Tweet Count")
      ax.set_xlabel('Date')
      ax.set_title('Tweet Count By Date Related to Florida Math Book Ban')

      # Adding Legend and Renaming
      ax.legend(['Count of Tweets'])

      plt.show()
```



```
[48]: fl_df['date'] = pd.to_datetime(fl_df['date'])
      fl_df['M'] = fl_df['date'].dt.month
```

```
[55]: fl_df_4_5 = fl_df[(fl_df['M'] == 4) | (fl_df['M'] == 5)]
```

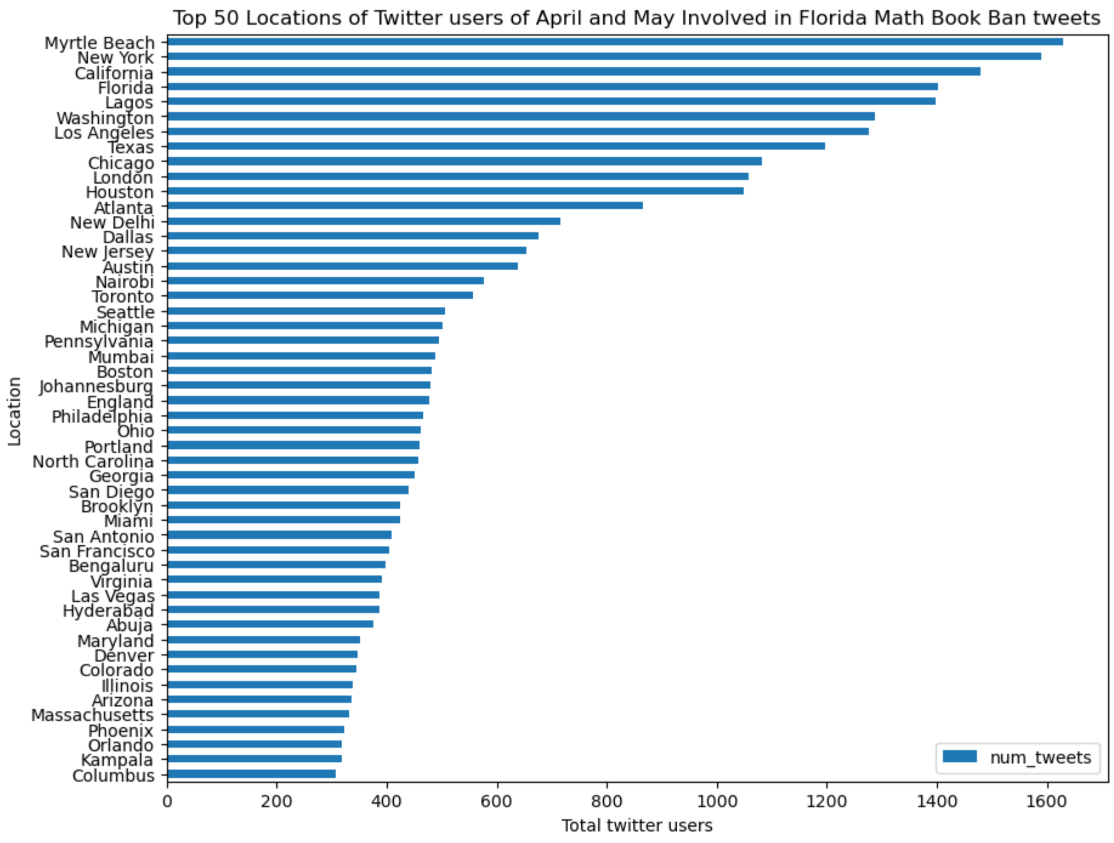
```
[57]: ax = fl_df_4_5.plot(kind="line", x='date', y="daily_tweets", figsize=(15, 8))
      ax.set_ylabel("Tweet Count")
      ax.set_xlabel('Date')
      ax.set_title('Tweet Count By Date Related to Florida Math Book Ban in April and␣
       ↪May')

      # Adding Legend and Renaming
      ax.legend(['Count of Tweets'])

      plt.show()
```



[58]:
```
fl_4_5 = fl_may.filter(col('month').isin([4, 5]))
fl_4_5 = fl_4_5.withColumn('loc', split(fl_4_5.user_location, ", ").getItem(0))
fl_4_5 = fl_4_5.filter(col("user_location").like("%,%"))
fl_count = fl_4_5.groupby('loc').agg(count('*').alias('num_tweets'))
fl_desc = fl_count.orderBy(col('num_tweets').desc()).limit(50)
```

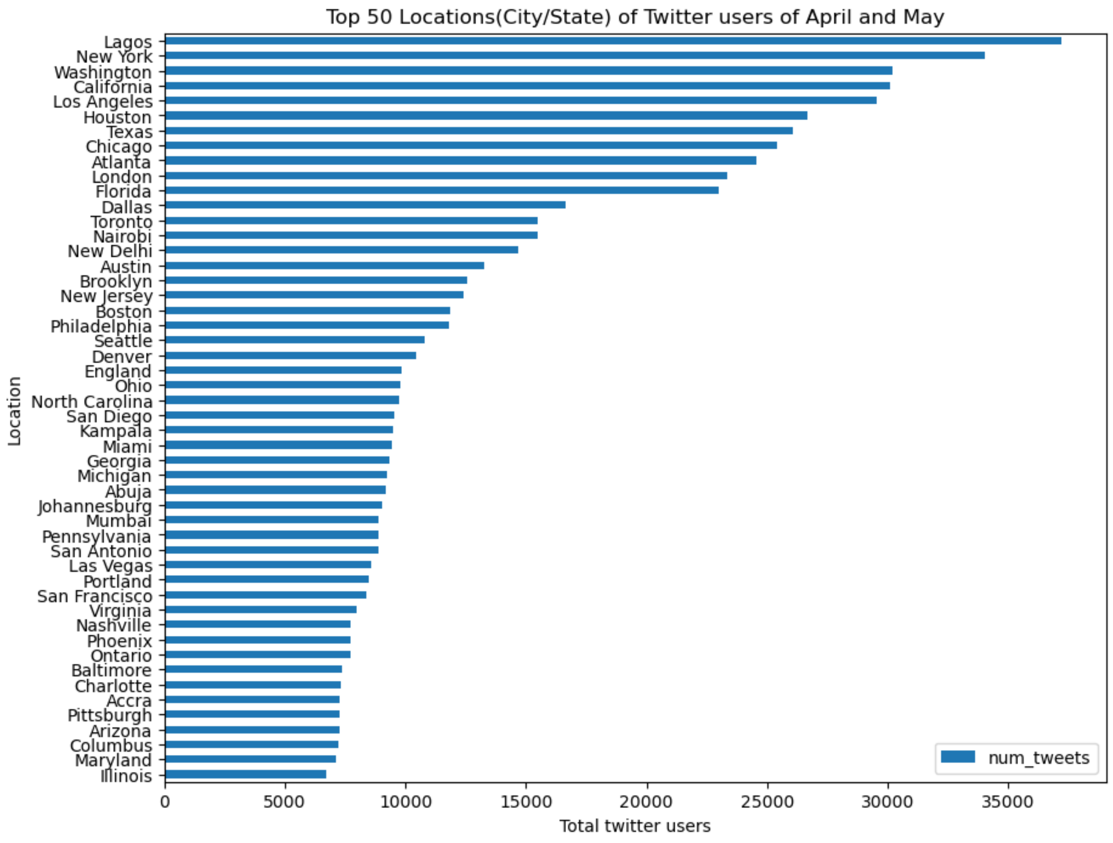
[59]:
```
fl_desc_df = fl_desc.toPandas()
```

[70]:
```
ax = fl_desc_df.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10, 8))

ax.set_ylabel('Location')
ax.set_xlabel('Total twitter users')
ax.set_title('Top 50 Locations of Twitter users of April and May Involved in␣
 ↪Florida Math Book Ban tweets')
ax.invert_yaxis()

# show the plot
plt.show()
```



[ ]:
```
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
tdt = dt.filter(col('user_location').isNotNull())
tdt = tdt.select('tweet_id', 'created_at', 'user_location')
tdt = tdt.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
tdt = tdt.withColumn("date", date_format("timestamp_unix", "yyyy-MM-dd"))
tdt = tdt.withColumn('month', month('date'))
tdt_4_5 = tdt.filter(col('month').isin([4, 5]))
tdt_4_5 = tdt_4_5.withColumn('loc', split(tdt_4_5.user_location, ", ").
 ↪getItem(0))
tdt_4_5 = tdt_4_5.filter(col("user_location").like("%,%"))
tdt_count = tdt_4_5.groupby('loc').agg(count('*').alias('num_tweets'))
tdt_desc = tdt_count.orderBy(col('num_tweets').desc()).limit(50)
tdt_df = tdt_desc.toPandas()
```

[72]:
```
ax = tdt_df.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10, 8))

ax.set_ylabel('Location')
ax.set_xlabel('Total twitter users')
ax.set_title('Top 50 Locations(City/State) of Twitter users of April and May')
ax.invert_yaxis()

# show the plot
plt.show()
```



```
[ ]: # chatgpt and education
```

```
[9]: gpt_key = ['chatgpt', 'gpt', 'ai']
     #filter out rows that do not contain words in keywords
     dt = dt.withColumn('lower', lower(col('text')))
     gpt_dt = dt.filter(col('lower').rlike('|'.join(gpt_key)))
```

```
[81]: gpt_dt.count()
```

```
[81]: 6399921
```

```
[12]: gpt_dt_loc = gpt_dt.filter(col('user_location').isNotNull())
      spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
      gpt_dt_loc = gpt_dt_loc.select('tweet_id', 'created_at', 'user_location')
      gpt_dt_loc = gpt_dt_loc.withColumn("timestamp_unix",␣
       ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
      gpt_dt_loc = gpt_dt_loc.withColumn("date", date_format("timestamp_unix",␣
       ↪"yyyy-MM-dd"))
      gpt_dt_loc = gpt_dt_loc.withColumn('month', month('date'))
```

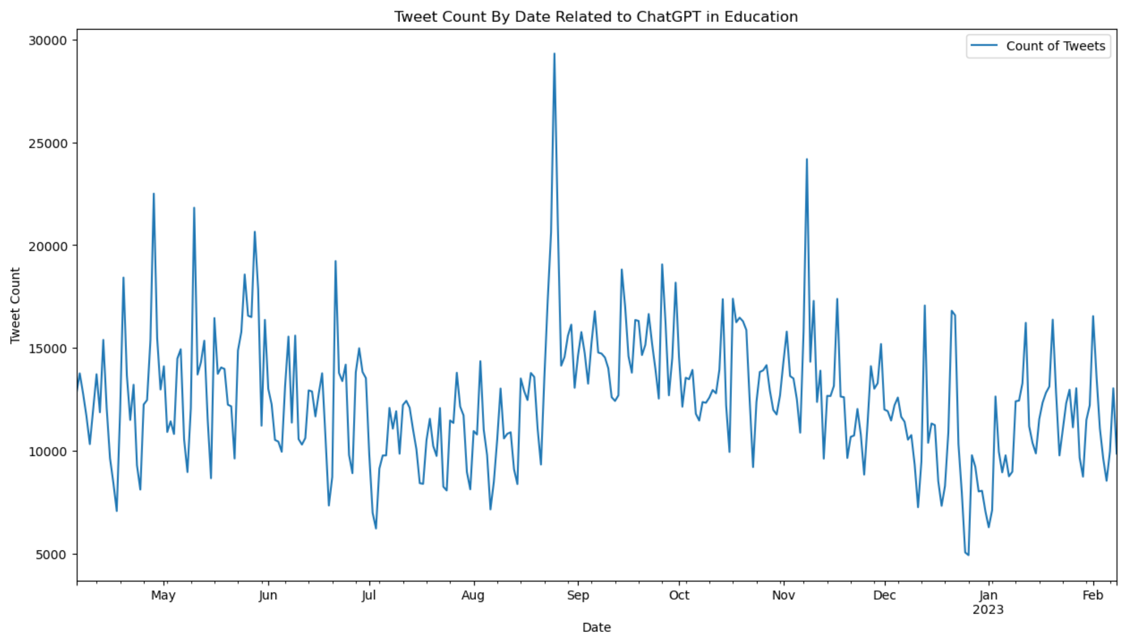
```
[13]: gpt_ct = gpt_dt_loc.groupby('date').agg(count('*').alias('daily_tweets'))
      gpt_ct_desc = gpt_ct.orderBy('date', ascending = True)
```

```
[ ]: gpt_ct_df = gpt_ct_desc.toPandas()
```

```
[102]: gpt_ct_df
```

```
[102]:           date  daily_tweets  M
        0   2022-04-05         12760  4
        1   2022-04-06         13760  4
        2   2022-04-07         12778  4
        3   2022-04-08         11672  4
        4   2022-04-09         10318  4
        ..         …             … ..
        305 2023-02-04          9619  2
        306 2023-02-05          8535  2
        307 2023-02-06          9963  2
        308 2023-02-07         13035  2
        309 2023-02-08          9856  2

        [310 rows x 3 columns]
```

```
[103]: ax = gpt_ct_df.plot(kind="line", x='date', y="daily_tweets", figsize=(15, 8))
       ax.set_ylabel("Tweet Count")
       ax.set_xlabel('Date')
       ax.set_title('Tweet Count By Date Related to ChatGPT in Education')

       # Adding Legend and Renaming
       ax.legend(['Count of Tweets'])

       plt.show()
```



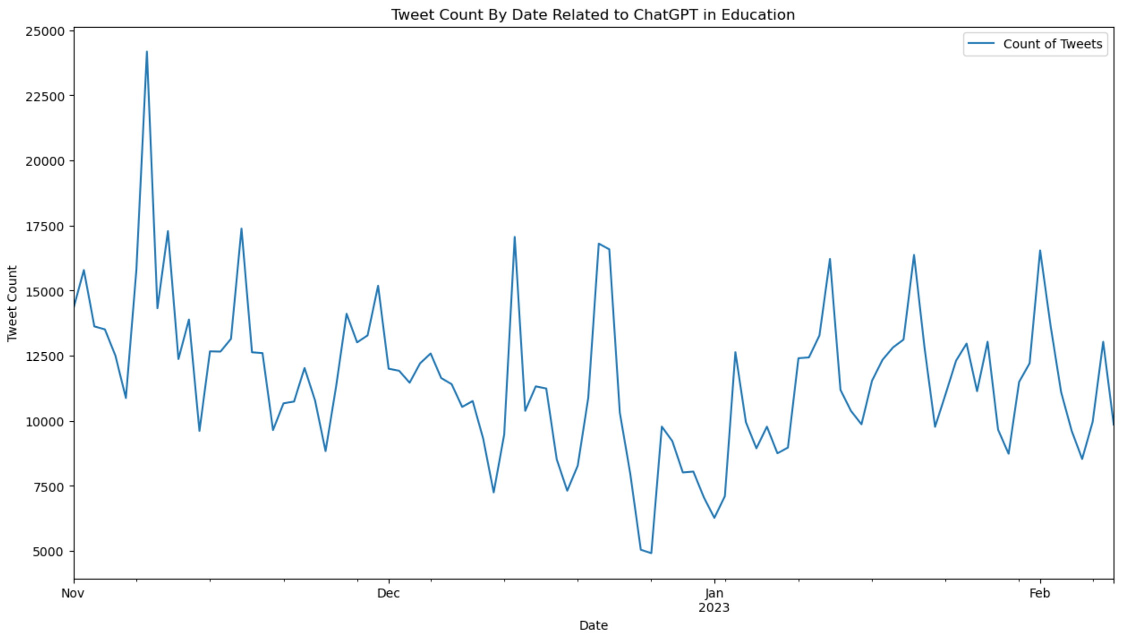
```
[96]: gpt_ct_df['date'] = pd.to_datetime(gpt_ct_df['date'])
      gpt_ct_df['M'] = gpt_ct_df['date'].dt.month
      gpt_df_11 = gpt_ct_df[(gpt_ct_df['M'] >= 11) | (gpt_ct_df['M'].isin([1,2]))]
```

```
[97]: gpt_df_11
```

```
[97]:           date  daily_tweets   M
      210 2022-11-01         14299  11
      211 2022-11-02         15791  11
      212 2022-11-03         13626  11
      213 2022-11-04         13512  11
      214 2022-11-05         12504  11
      ..         …             …  ..
      305 2023-02-04          9619   2
      306 2023-02-05          8535   2
      307 2023-02-06          9963   2
      308 2023-02-07         13035   2
      309 2023-02-08          9856   2

      [100 rows x 3 columns]
```

```
[98]: ax = gpt_df_11.plot(kind="line", x='date', y="daily_tweets", figsize=(15, 8))
      ax.set_ylabel("Tweet Count")
      ax.set_xlabel('Date')
      ax.set_title('Tweet Count By Date Related to ChatGPT in Education')
```

```
# Adding Legend and Renaming
ax.legend(['Count of Tweets'])

plt.show()
```

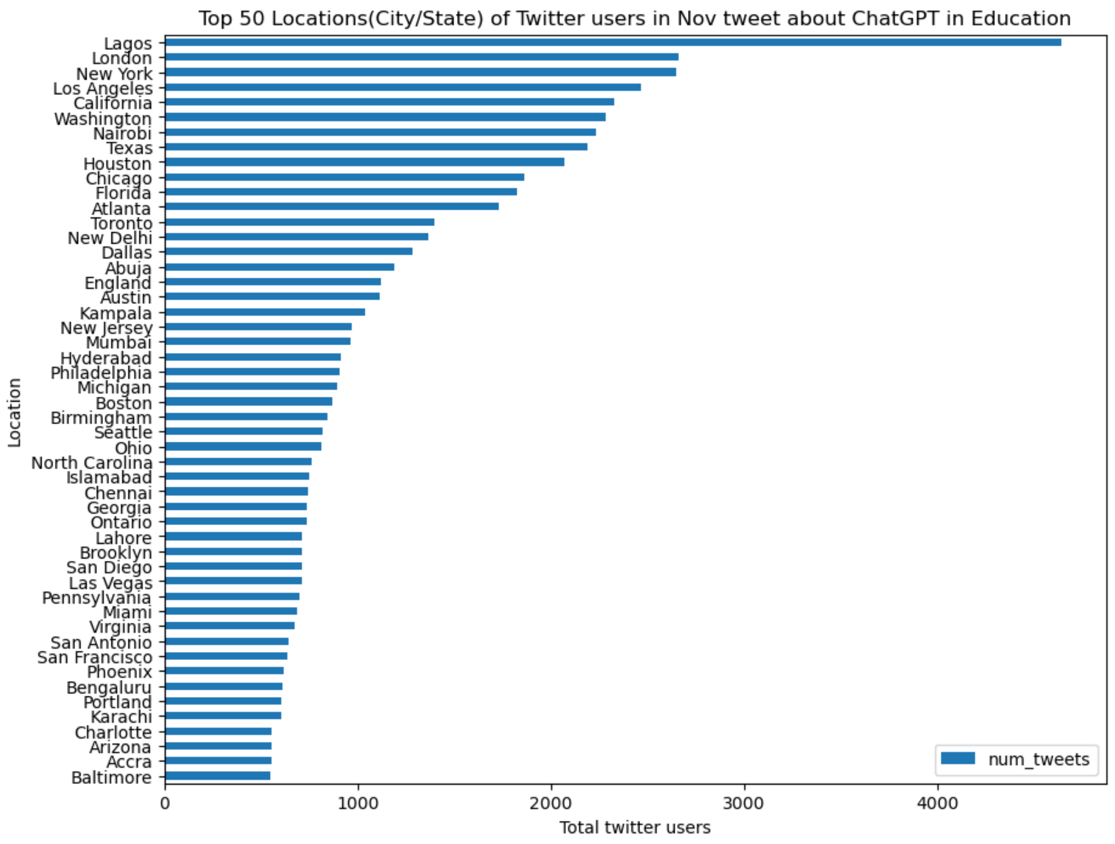


```
[14]: gpt_loc = gpt_dt_loc.filter(col('month')==11)
      gpt_loc = gpt_loc.withColumn('loc', split(gpt_loc.user_location, ", ").
       ↪getItem(0))
      gpt_loc = gpt_loc.filter(col("user_location").like("%,%"))
      gpt_loc_count = gpt_loc.groupby('loc').agg(count('*').alias('num_tweets'))
      gpt_loc_desc = gpt_loc_count.orderBy(col('num_tweets').desc()).limit(50)
```

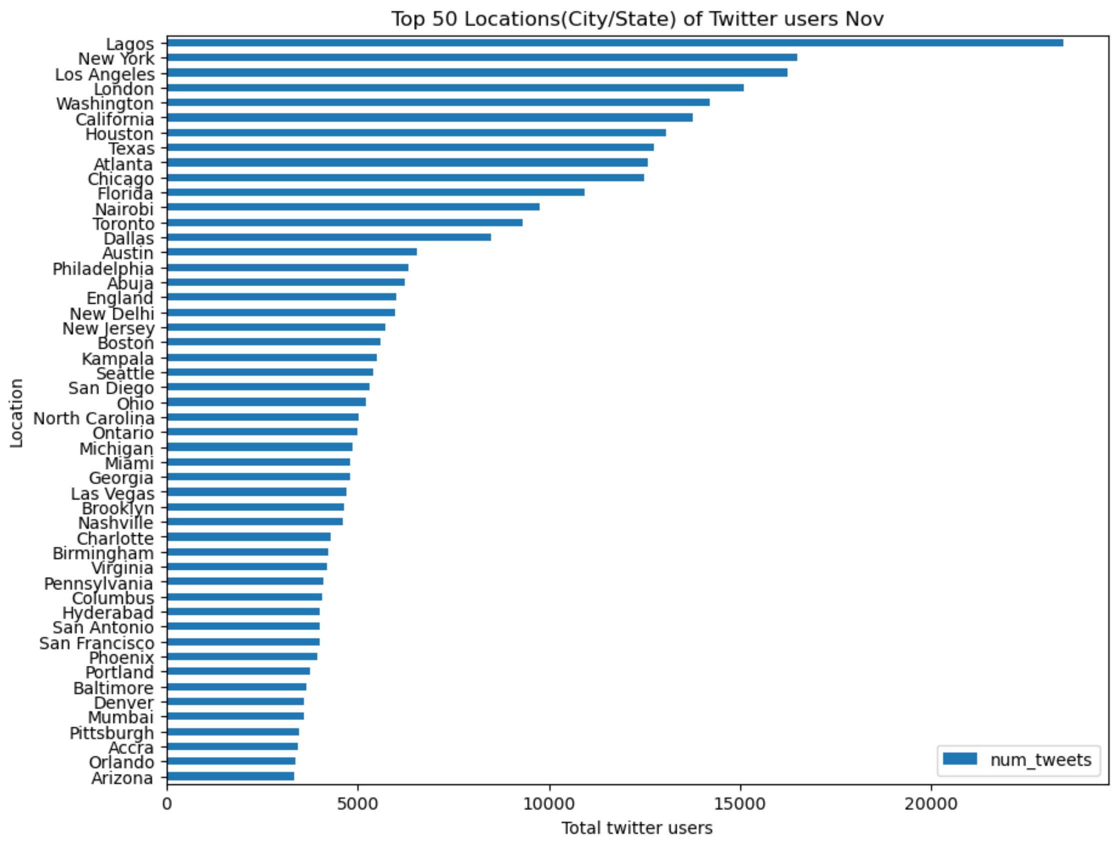
```
[15]: gpt_loc_desc_df = gpt_loc_desc.toPandas()
```

```
[16]: ax = gpt_loc_desc_df.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10,␣
       ↪8))

      ax.set_ylabel('Location')
      ax.set_xlabel('Total twitter users')
      ax.set_title('Top 50 Locations(City/State) of Twitter users in Nov tweet about␣
       ↪ChatGPT in Education')
      ax.invert_yaxis()

      # show the plot
```

```
plt.show()
```



[11]:
```
spark.sql("set spark.sql.legacy.timeParserPolicy=LEGACY")
tdt = dt.filter(col('user_location').isNotNull())
tdt = tdt.select('tweet_id', 'created_at', 'user_location')
tdt = tdt.withColumn("timestamp_unix",␣
 ↪from_unixtime(unix_timestamp("created_at", "EEE MMM dd HH:mm:ss Z yyyy")))
tdt = tdt.withColumn("date", date_format("timestamp_unix", "yyyy-MM-dd"))
tdt = tdt.withColumn('month', month('date'))

tdt_11 = tdt.filter(col('month')==11)
tdt_11 = tdt_11.withColumn('loc', split(tdt_11.user_location, ", ").getItem(0))
tdt_11 = tdt_11.filter(col("user_location").like("%,%"))
tdt_count_11 = tdt_11.groupby('loc').agg(count('*').alias('num_tweets'))
tdt_desc_11 = tdt_count_11.orderBy(col('num_tweets').desc()).limit(50)
tdt_df_11 = tdt_desc_11.toPandas()
ax = tdt_df_11.plot(x ='loc',y='num_tweets', kind='barh', figsize = (10, 8))

ax.set_ylabel('Location')
ax.set_xlabel('Total twitter users')
ax.set_title('Top 50 Locations(City/State) of Twitter users Nov')
ax.invert_yaxis()

# show the plot
plt.show()
```



[ ]:
```

```

[ ]:
```
gpt_loc_desc.write.format("parquet").\
mode('overwrite').\
save('gs://chen26-bdp/gpt_loc_desc')
```

```
[Stage 59:==================================================>(1306 + 10) / 1323]
```

[108]:
```
t = spark.read.parquet('gs://chen26-bdp/gpt_loc_desc')
```

[109]:
```
t
```

[109]:
```
+-----------+---------+
|        loc|num_tweets|
+-----------+---------+
|      Lagos|    10913|
|   New York|     8369|
|     London|     7162|
| Washington|     6949|
|Los Angeles|     6808|
| California|     6516|
|    Nairobi|     6172|
|    Houston|     6007|
|      Texas|     5841|
|    Florida|     5727|
|    Chicago|     5646|
|    Atlanta|     5573|
|  New Delhi|     3959|
|     Dallas|     3752|
|    Toronto|     3624|
|    England|     3124|
|     Austin|     2956|
|      Abuja|     2930|
|     Mumbai|     2879|
| New Jersey|     2804|
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only showing top 20 rows
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```
[81]: %%time
      tweets_loc.write.format("parquet").\
      mode('overwrite').\
      save('gs://chen26-bdp/location_tweets')
```

```
CPU times: user 1.01 s, sys: 335 ms, total: 1.35 s
Wall time: 7min 56s
```

```
[1]: tweets_loc = spark.read.parquet('gs://chen26-bdp/location_tweets')
```

```
[13]: tweet_l = location.groupby(col('tweet_location')).agg(count('id').
       ↪alias('num_tweets'))
```

```
[14]: top50_l = tweet_l.orderBy(col('num_tweets').desc())
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