MinhVo-BDP-Final-Analysis

March 11, 2023

0.1 Big Data Platforms - Winter 2023

0.2 Final Project Education

0.2.1 Twitterer Profile Analysis

Minh Vo

[1]:
```
import os
import time
import re
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from itertools import islice
# import sh
from pyspark.sql.functions import *
from pyspark.sql.types import *
from itertools import compress

from pyspark.sql.functions import date_format, to_timestamp, unix_timestamp,␣
↪from_unixtime
from pyspark.sql.functions import split

pd.set_option('display.max_colwidth', None)
pd.reset_option('display.max_rows')
warnings.filterwarnings(action='ignore')
```

[2]:
```
from google.cloud import storage
```

[3]:
```
!hadoop fs -ls "gs://msca-bdp-students-bucket/shared_data/mdvo/
↪BDP-Final-Project" | head -10
```

```
Found 5742 items
-rwx------   3 root root          0 2023-03-09 07:30 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-Project/_SUCCESS
-rwx------   3 root root    2605946 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00000-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
```

```
-rwx------   3 root root    2855860 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00001-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    2960462 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00002-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    2707638 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00003-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    3077704 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00004-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    2726253 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00005-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    2708650 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00006-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
-rwx------   3 root root    2734642 2023-03-09 07:14 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final-
Project/part-00007-59df6c97-c835-4c6d-8159-1dfe42cf74f5-c000.snappy.parquet
```

0.2.2 Data Loading

[4]:
```
spark.conf.set("spark.sql.repl.eagerEval.enabled",True)
```

[6]:
```
%%time
mypath = "gs://msca-bdp-students-bucket/shared_data/mdvo/BDP-Final-Project"
twt_newdf = spark.read.parquet(mypath)
twt_newdf.limit(5)
```

```
CPU times: user 0 ns, sys: 5.01 ms, total: 5.01 ms
Wall time: 1.14 s
```

[6]:
```
+-----------+-------------+-----------+----------------------+---------+-----
--------+---------------+-------------------+--------------------+-------+-----
-------+---------+----------+-----------+-------------+--------------------+----
---------------+---------------+-------------------+--------------------+-----
----------+-------------+--------------------+--------+----+
|coordinates|favorite_count|filter_level|in_reply_to_screen_name|retweeted|retwe
et_count| retweeted_from|    retweeted_status|
text|country|country_code|full_name|place_type|bounding_box| timestamp_ms|
id_str|                name|    screen_name|            location|
description|followers_count|statuses_count|          created_at|verified|lang|
+-----------+-------------+-----------+----------------------+---------+-----
--------+---------------+-------------------+--------------------+-------+-----
```

```
-------+---------+----------+------------+-------------+--------------------+----
---------------+---------------+--------------------+--------------------+-----
----------+--------------+--------------------+--------+----+
|       null|             0|         low|                    null|       RT|
0|     imillhiser|{null, Mon Apr 25…|RT @imillhiser: L…|   null|
null|     null|      null|        null|1650908748129|         1638422174|Amos
Burton   |    Bellarusque|rent free in your…|"First of all, I …|
64|        195316|Thu Aug 01 17:06:…|   false|  en|
|       null|             0|         low|                    null|       RT|
0|BenIrvineAuthor|{null, Mon Apr 25…|RT @BenIrvineAuth…|   null|
null|     null|      null|        null|1650908749742| 883407625714634752|
KJV   |  KJVBaptist193|    London, England.|Imperfect #Christ…|
11877|        126224|Fri Jul 07 19:29:…|   false|  en|
|       null|             0|         low|                    null|       RT|
0|     MelanieMse|{null, Mon Apr 25…|RT @MelanieMse: H…|   null|
null|     null|      null|        null|1650908750704|1383730953361625089|
Cats, Kids, Chaos|  catskidschaos|    Richmond, London|Sharing London tw…|
1018|          7544|Sun Apr 18 10:35:…|   false|  en|
|       null|             0|         low|                    null|       RT|
0|     jk_rowling|{null, Mon Apr 25…|RT @jk_rowling: I…|   null|
null|     null|      null|        null|1650908750966|1070744322058936321|
Urbas Michèle|   MicheleUrbas|                null|                null|
15|          1431|Thu Dec 06 18:18:…|   false|  en|
|       null|             0|         low|                    null|       RT|
0|     joeyhiles1|{null, Sun Apr 24…|RT @joeyhiles1: W…|   null|
null|     null|      null|        null|1650908753102| 868642741332455424|
quentin quarantino|sweetlizardtail|                null|V | they/them | 2…|
66|         48501|Sun May 28 01:39:…|   false|  en|
+-----------+-------------+-----------+----------------------+---------+-----
--------+---------------+--------------------+--------------------+-------+-----
-------+---------+----------+------------+-------------+--------------------+----
---------------+---------------+--------------------+--------------------+-----
----------+--------------+--------------------+--------+----+
```

[ ]:
```
twt_newdf.count()
```

[ ]:
```
24721729
```

[ ]:
```
#twt_newdf.describe().show()
```

[7]:
```
twt_newdf.columns
```

[7]:
```
['coordinates',
 'favorite_count',
 'filter_level',
```

```
 'in_reply_to_screen_name',
 'retweeted',
 'retweet_count',
 'retweeted_from',
 'retweeted_status',
 'text',
 'country',
 'country_code',
 'full_name',
 'place_type',
 'bounding_box',
 'timestamp_ms',
 'id_str',
 'name',
 'screen_name',
 'location',
 'description',
 'followers_count',
 'statuses_count',
 'created_at',
 'verified',
 'lang']
```

[ ]:
```
twt_newdf2 = twt_newdf.
 ↪select('retweet_count','bounding_box','followers_count','verified','description','text','la
twt_newdf2.describe()
```

[ ]:
```
+-------+-------------+-----------------+------------+--------------------+-----
---+--------------------+
|summary|retweet_count|  followers_count| description|                text|
lang|          created_at|
+-------+-------------+-----------------+------------+--------------------+-----
---+--------------------+
|  count|     24721729|         24721729|    20167284|
24721729|24721729|            24721729|
|   mean|          0.0|8055.355479788651|         NaN|                null|
null|               null|
| stddev|          0.0| 271266.154528689|         NaN|                null|
null|               null|
|    min|            0|               -1|           !!!

Check out this…|      en|Fri Apr 01 00:00:…|
|    max|            0|        122849058|  //   // | all my senior…|
en|Wed Sep 30 23:59:…|
+-------+-------------+-----------------+------------+--------------------+-----
```

```
---+--------------------+
```

0.2.3 Analysis

Identify the most prolific / influential Twitterers:

[9]:
```
%%time

# List of Twitterers and their screen names
user_df = twt_newdf.groupBy('id_str').agg(max('screen_name').alias('user_name'))
user_df.show(10)
```

```
[Stage 12:>                                                         (0 + 1) / 1]

+------------------+-------------+
|            id_str|    user_name|
+------------------+-------------+
|1000006405380812800|annoyingsoul29|
|1000006420299898880|      ainiwhy|
|1000011951274123269|    stelexies|
|1000015310651645953|   PhilStudge|
|         100001851|alqamaronline|
|1000026245508329472|   MNBlankson|
|1000026471044407296|    HeadUnity|
|1000027408508977152|    SaigonSte|
|1000040355209793536| gimbapgoogie|
|1000040400810323969|     xShadiku|
+------------------+-------------+
only showing top 10 rows

CPU times: user 195 ms, sys: 47.2 ms, total: 242 ms
Wall time: 1min 16s
```

[ ]:
```
%%time

# twitterers by number of followers
followers_df = twt_newdf.groupBy('id_str','screen_name')\
                        .agg(max('followers_count').alias('Total_Followers'))\
                        .orderBy('Total_Followers',ascending = False)
followers_df.show(10)
```

```
+--------+-----------+---------------+
|  id_str|screen_name|Total_Followers|
+--------+-----------+---------------+
|44196397|    elonmusk|      122849058|
|21447363|   katyperry|      108899882|
```

```
|18839785|narendramodi|       83552404|
|10228272|     YouTube|       77788673|
|23375688| selenagomez|       65889944|
|11348282|        NASA|       64878725|
|  428333|      cnnbrk|       64160677|
|  759251|         CNN|       61104555|
|  807095|     nytimes|       54936969|
| 5402612| BBCBreaking|       51529913|
+--------+------------+---------------+
only showing top 10 rows

CPU times: user 150 ms, sys: 30.4 ms, total: 181 ms
Wall time: 57.4 s
```

[7]:
```
# twitterers by number of followers
followers_df = twt_newdf.groupBy('id_str','screen_name')\
                        .agg(max('followers_count').alias('Total_Followers'))\
                        .orderBy('Total_Followers',ascending = False)
followers_df.show(10)
```

```
[Stage 10:=============================================>             (13 + 4) / 17]

+--------+------------+---------------+
|  id_str| screen_name|Total_Followers|
+--------+------------+---------------+
|44196397|    elonmusk|      122849058|
|21447363|   katyperry|      108899882|
|18839785|narendramodi|       83552404|
|10228272|     YouTube|       77788673|
|23375688| selenagomez|       65889944|
|11348282|        NASA|       64878725|
|  428333|      cnnbrk|       64160677|
|  759251|         CNN|       61104555|
|  807095|     nytimes|       54936969|
| 5402612| BBCBreaking|       51529913|
+--------+------------+---------------+
only showing top 10 rows
```

By message volume (original content)

[6]:
```
## Original contents imply tweets which are not retweets (retweeted_status =␣
↪null)
twt_newdf = twt_newdf.withColumn('is_original_twt',when(col('retweeted_status.
↪retweeted').isNull(), 1).otherwise(0))
```

[7]:
```
%%time
twitterer_groups = twt_newdf.withColumn('Twitterer_Group', \
            when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('college')),'Universities').\
            when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('university')), 'Universities').\
            when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('school')), 'Schools').\
            when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('government')),'Government Entities').\
            when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('news') | lower(col('description')).contains('magazine')),'News␣
 ↪Outlets').\
            when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('organization') | lower(col('description')).
 ↪contains('organization')),'Non-Profit Organizations').\
            when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('non-profit')),'Non-Profit Organizations').\
            when((twt_newdf.verified==True) & ((twt_newdf.followers_count >␣
 ↪5000) | (lower(col('description')).contains('influencer'))),'Social Media␣
 ↪Influencers').\
            otherwise('Others'))
```

```
CPU times: user 18.6 ms, sys: 7.62 ms, total: 26.2 ms
Wall time: 347 ms
```

[ ]:
```
twitterer_groups.groupby('Twitterer_Group').count().
 ↪orderBy("count",ascending=False).toPandas()
```

[ ]:

	Twitterer_Group	count
0	Others	24343776
1	Social Media Influencers	226766
2	News Outlets	127342
3	Universities	9641
4	Schools	6209
5	Government Entities	5067
6	Non-Profit Organizations	2928

[9]:
```
# Save the output
save_path = 'gs://msca-bdp-students-bucket/shared_data/mdvo/BDP-Final/
 ↪User-Groups'
twitterer_groups.write.format('parquet').\
            mode('overwrite').\
            save(save_path)
```

[52]:
```
%%time
## Find the number of original tweets by users (apply not null filter on␣
 ↪description)
original_tweets = twitterer_groups.filter(col('description').isNotNull())\
                                  .
 ↪groupBy('screen_name','Twitterer_Group','description')\
                                       .agg(sum("is_original_twt").
 ↪alias("Total_Original_Tweets"),\
                                            max('followers_count').
 ↪alias('Total_Followers'))\
                                       .
 ↪orderBy("Total_Original_Tweets",ascending=False)
original_tweets.limit(10)
```

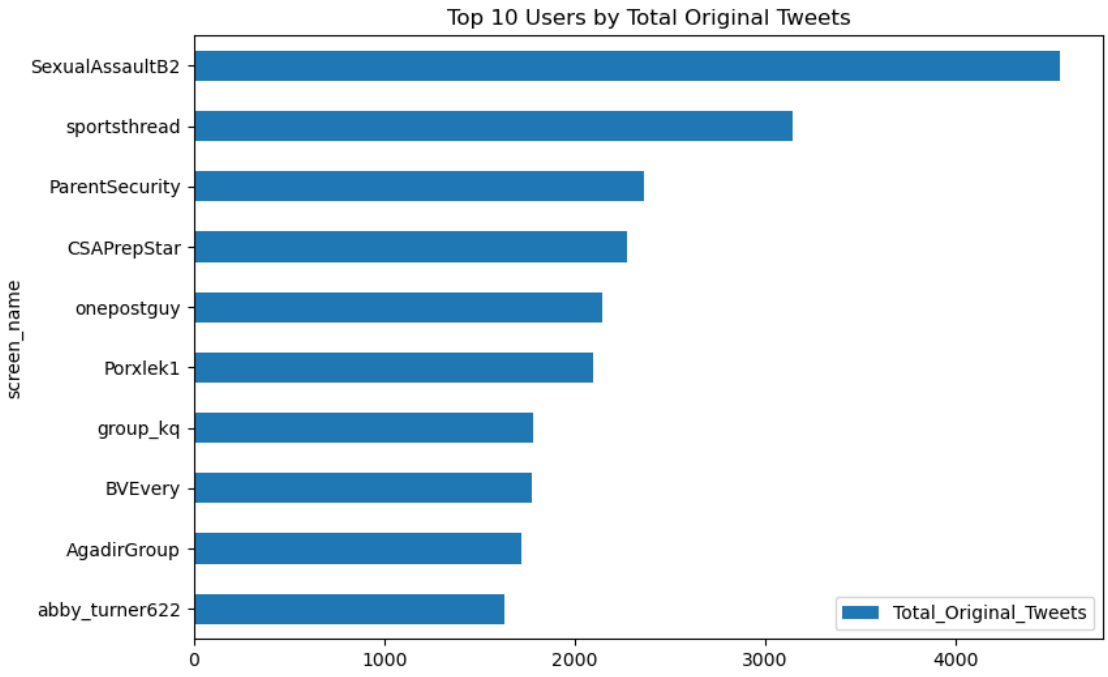
```
CPU times: user 0 ns, sys: 11.6 ms, total: 11.6 ms
Wall time: 141 ms
```

[52]:
```
+---------------+--------------------+--------------------+--------------------
+---------------+
|    screen_name|     Twitterer_Group|
description|Total_Original_Tweets|Total_Followers|
+---------------+--------------------+--------------------+--------------------
+---------------+
|SexualAssaultB2|              Others|Raising awareness…|
4551|              22|
|   sportsthread|Social Media Infl…| Sports Thread i…|
3148|          206502|
| ParentSecurity|              Others|#Parents who want…|
2362|             301|
|    CSAPrepStar|              Others|Got Game? Get Rec…|
2273|           68155|
|     onepostguy|              Others|I am not a bot be…|
2143|             123|
|       Porxlek1|              Others|                   .|
2095|               0|
|       group_kq|              Others|THIS WEBSITE PROV…|
1780|             199|
|        BVEvery|              Others|GA, TN, VA, WV  S…|
1777|            8323|
|    AgadirGroup|              Others|Welcome to AGADIR…|
1722|             103|
| abby_turner622|              Others|A bot who needs l…|
1629|              35|
+---------------+--------------------+--------------------+--------------------
+---------------+
```

```
+---------------+
```

[22]:
```
# # plot original twts
# original_df_plot = original_tweets.limit(10).toPandas()
# original_df_plot.sort_values('Total_Original_Tweets',inplace=True)
# original_df_plot.plot(kind='barh', x='screen_name',␣
 ↪y='Total_Original_Tweets', figsize=(8,6), title="Top 10 Users by Total␣
 ↪Original Tweets")
```

[22]:
```
<AxesSubplot:title={'center':'Top 10 Users by Total Original Tweets'},
ylabel='screen_name'>
```



By message retweet (how often their messages are being retweeted)

[ ]:
```
%%time

#by twitterers (who have high number of tweets being retweeted)
retweeted_user = twitterer_groups.filter(twt_newdf.retweeted_status.
 ↪isNotNull())\
                        .groupBy('retweeted_from','Twitterer_Group')\
                        .agg(sum('retweeted_status.retweet_count').
 ↪alias('Total_Retweets'),\
                             max('followers_count').alias('Total_Followers'))\
```

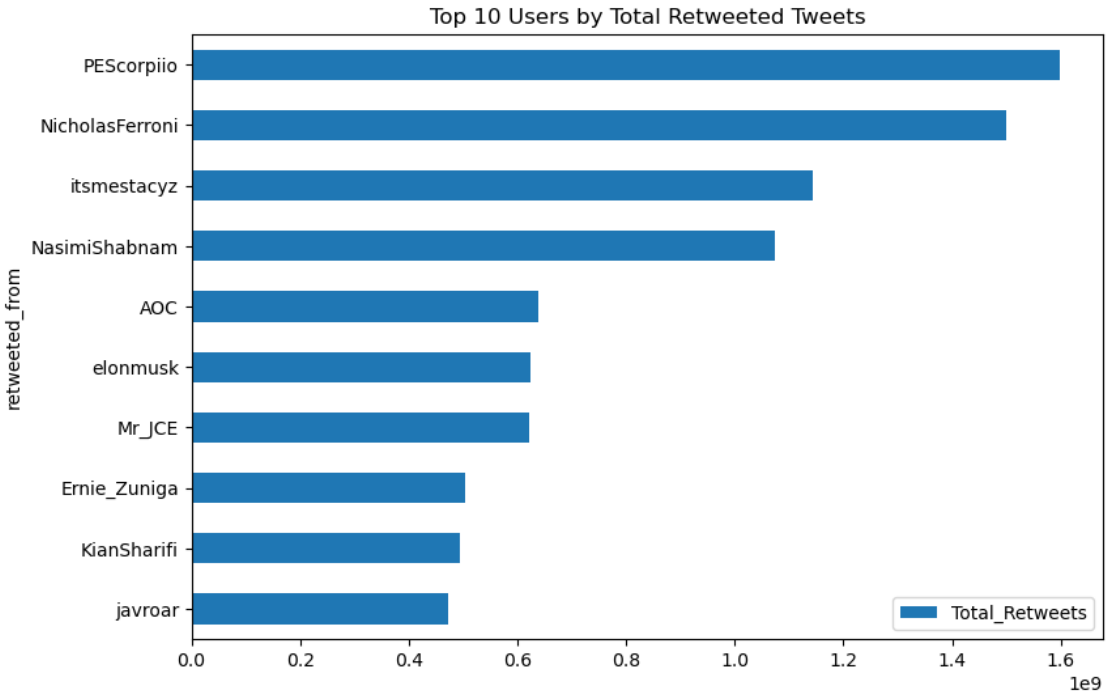
```
                        .orderBy('Total_Retweets',ascending = False)
retweeted_user.limit(10)
```

```
CPU times: user 4.98 ms, sys: 7.87 ms, total: 12.8 ms
Wall time: 119 ms
```

[ ]:
```
+---------------+---------------+--------------+---------------+
| retweeted_from|Twitterer_Group|Total_Retweets|Total_Followers|
+---------------+---------------+--------------+---------------+
|     PEScorpiio|         Others|    1595534088|         345186|
|NicholasFerroni|         Others|    1495469654|         202283|
|    itsmestacyz|         Others|    1144297406|          67211|
|  NasimiShabnam|         Others|    1065018547|         533689|
|            AOC|         Others|     636188634|         168573|
|       elonmusk|         Others|     623136488|         554636|
|         Mr_JCE|         Others|     615883493|         760187|
|   Ernie_Zuniga|         Others|     500188211|         824459|
|    KianSharifi|         Others|     488854229|         987453|
|        javroar|         Others|     472114449|         283557|
+---------------+---------------+--------------+---------------+
```

[29]:
```
# plot retweets
retweets_df_plot = retweeted_user.limit(10).toPandas()
retweets_df_plot.sort_values('Total_Retweets',inplace=True)
retweets_df_plot.plot(kind='barh', x='retweeted_from', y='Total_Retweets',␣
 ↪figsize=(9,6), title="Top 10 Users by Total Retweeted Tweets")
```

[29]:
```
<AxesSubplot:title={'center':'Top 10 Users by Total Retweeted Tweets'},
ylabel='retweeted_from'>
```



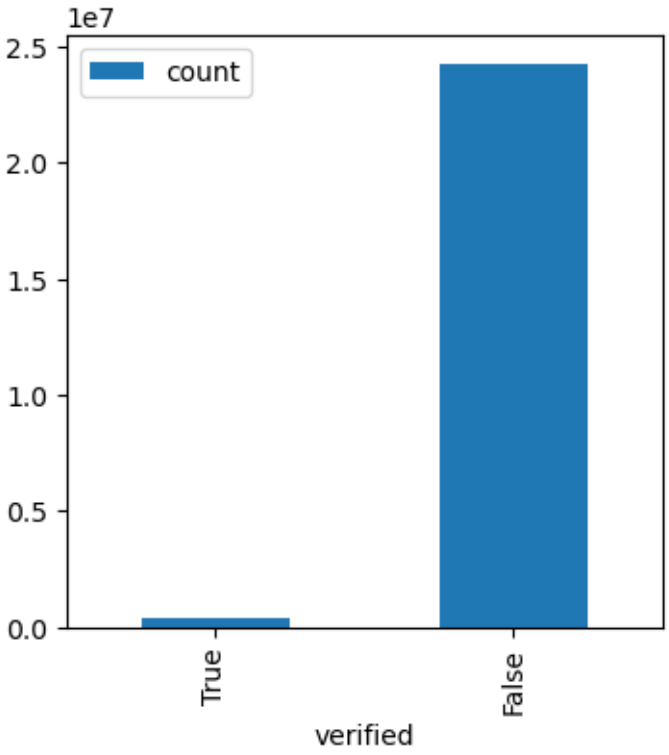
[30]:
```
verified = twt_newdf.groupBy('verified').count().toPandas()
verified
```

[30]:

	verified	count
0	True	431896
1	False	24289833

[39]:
```
verified.plot.bar(x='verified',y='count',legend='verified',figsize=(4, 4))
```

[39]: <AxesSubplot:xlabel='verified'>



[8]:
```
# %%time
# twitterers_groups = twt_newdf.filter(col('verified')==True)\
# .withColumn('Twitterer_Group', \
#             when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('college')),'Universities').\
#             when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('university')), 'Universities').\
#             when((twt_newdf.verified==True) & (lower(col('name')).
 ↪contains('school')), 'Schools').\
#             when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('government')),'Government Entities').\
#             when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('news') | lower(col('description')).contains('magazine')),'News␣
 ↪Outlets').\
#             when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('organization') | lower(col('description')).
 ↪contains('organization')),'Non-Profit Organizations').\
#             when((twt_newdf.verified==True) & lower(col('description')).
 ↪contains('non-profit'),'Non-Profit Organizations').\
#             when((twt_newdf.verified==True) & (lower(col('description')).
 ↪contains('influencer')) | (twt_newdf.followers_count > 5000),'Social Media␣
 ↪Influencers').\
```

```
#            otherwise('Others'))
```

```
CPU times: user 19.8 ms, sys: 6.67 ms, total: 26.5 ms
Wall time: 406 ms
```

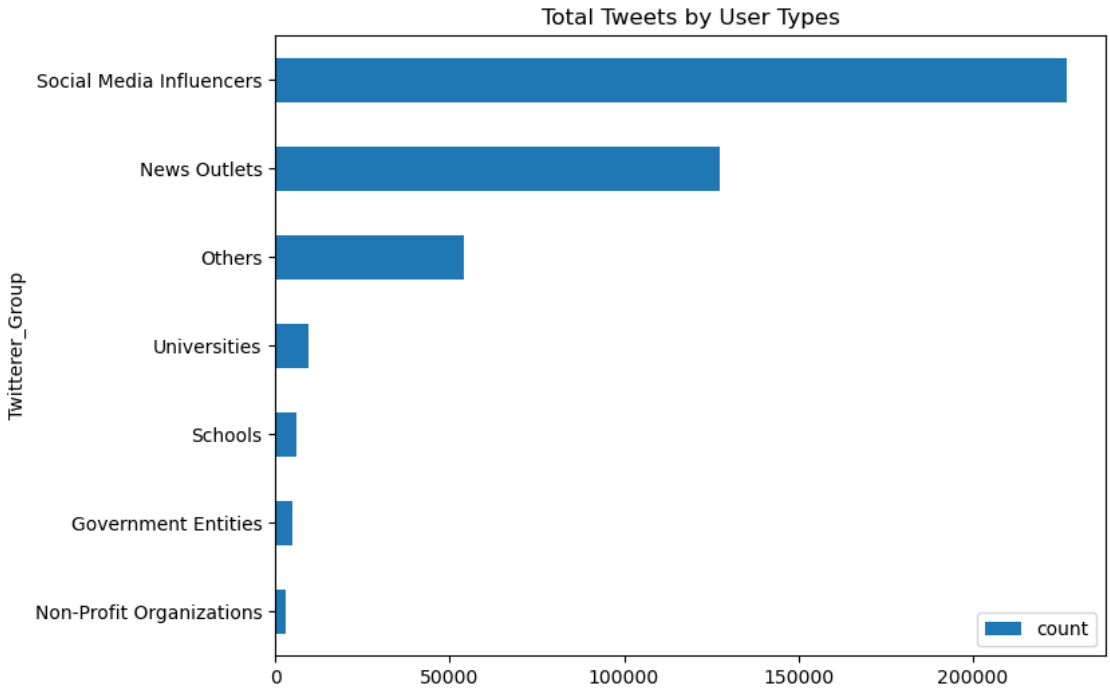
[9]:
```
#table (count by group)
verified_group = twitterer_groups.filter(col('verified')==True)
verified_group.groupby('Twitterer_Group').count().
 ↪orderBy("count",ascending=False).toPandas()
```

[9]:

	Twitterer_Group	count
0	Social Media Influencers	226766
1	News Outlets	127342
2	Others	53943
3	Universities	9641
4	Schools	6209
5	Government Entities	5067
6	Non-Profit Organizations	2928

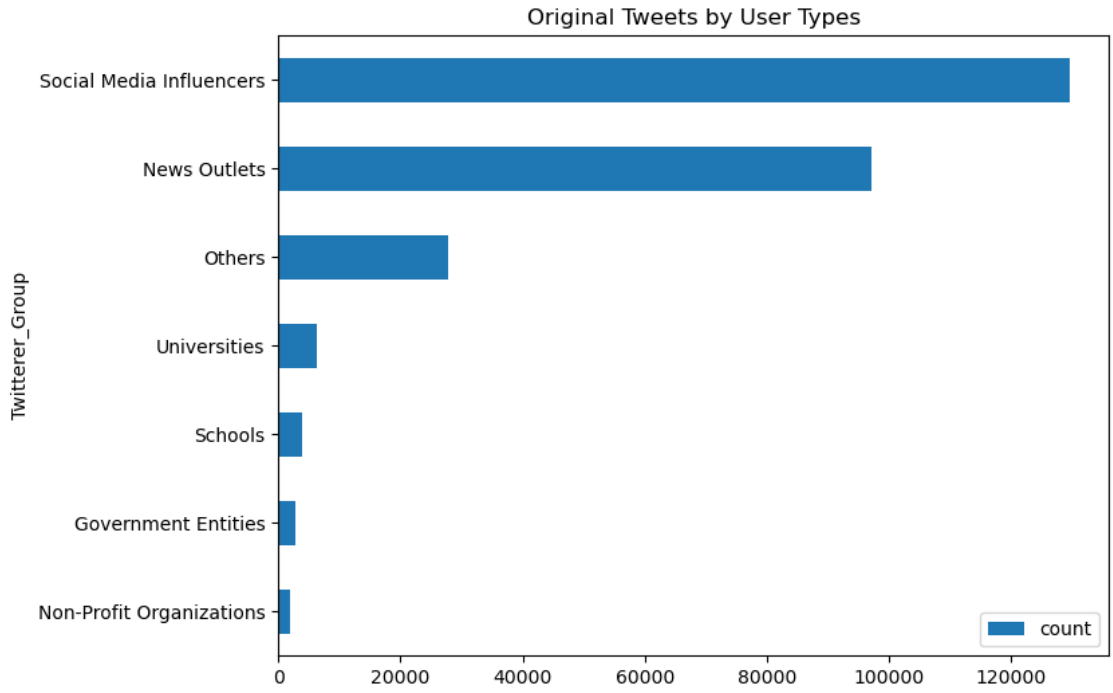
[53]:
```
# tweets by types of orgs
twitterers_groups_plot = verified_group.groupby('Twitterer_Group').count().
 ↪orderBy("count",ascending=True).toPandas()
twitterers_groups_plot.set
twitterers_groups_plot.plot(kind='barh', x='Twitterer_Group', y='count',␣
 ↪figsize=(8,6),title="Total Tweets by User Types")
```

[53]:
```
<AxesSubplot:title={'center':'Total Tweets by User Types'},
ylabel='Twitterer_Group'>
```



[47]:
```
# Original Tweets by User groups plot
org_group_plot = verified_group.filter(col('retweeted')=="").
 ↪groupBy('Twitterer_Group').count().orderBy('count',ascending=True).toPandas()
org_group_plot.plot(kind='barh', x='Twitterer_Group', y='count',␣
 ↪figsize=(8,6),title="Original Tweets by User Types")
```

[47]:
```
<AxesSubplot:title={'center':'Original Tweets by User Types'},
ylabel='Twitterer_Group'>
```



[48]:
```
org_group_plot
```

[48]:

	Twitterer_Group	count
0	Non-Profit Organizations	1943
1	Government Entities	2764
2	Schools	3852
3	Universities	6315
4	Others	27858
5	News Outlets	97064
6	Social Media Influencers	129513

[49]:
```
# Original tweets by Tweeterers and types of Orgs

orgtwt_user_type = verified_group.groupBy('screen_name','Twitterer_Group')\
                        .agg(sum("is_original_twt").
 ↪alias("Total_Original_Tweets"),\
                            max('followers_count').alias('Total_Followers'))\
                        .orderBy('Total_Original_Tweets',ascending = False)
orgtwt_user_type.limit(10).toPandas()
```

[49]:

	screen_name	Twitterer_Group	Total_Original_Tweets	\
0	sportsthread	Social Media Influencers	3148	
1	USNewsEducation	News Outlets	764	

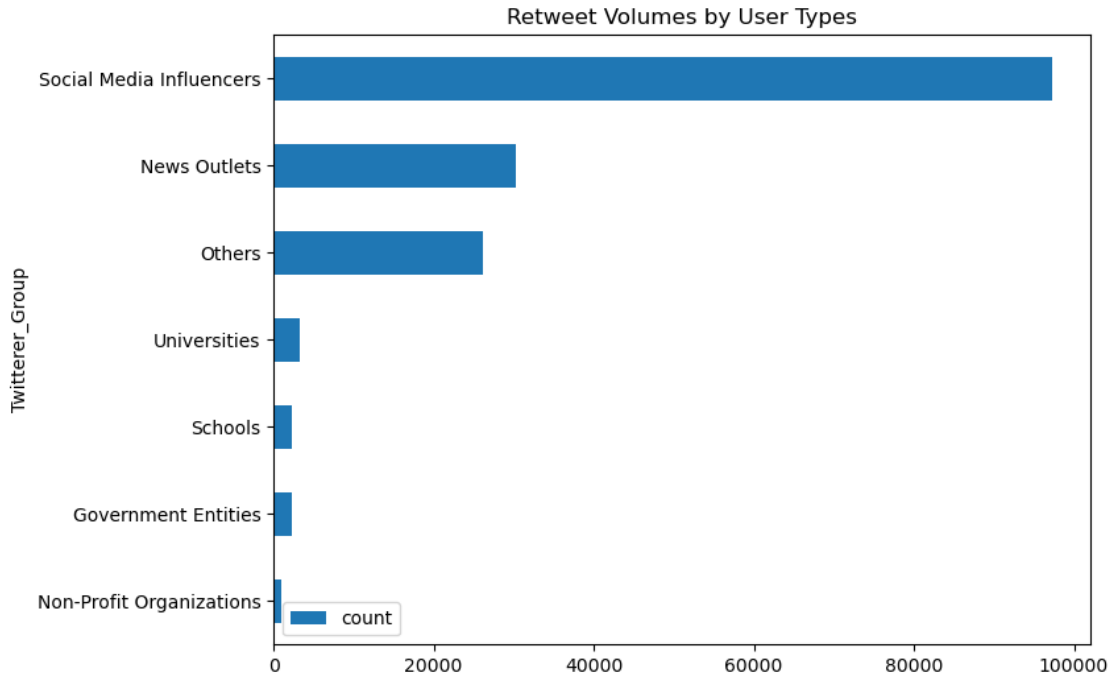
```
2    timeshighered              News Outlets                    726
3       SF_England  Social Media Influencers                    677
4    TOICitiesNews  Social Media Influencers                    636
5  ExploreLearning  Social Media Influencers                    576
6        WashTimes              News Outlets                    514
7   SportsBookWire                    Others                    471
8              tes              News Outlets                    439
9   DeAngelisCorey  Social Media Influencers                    430

   Total_Followers
0           206502
1           332591
2           317637
3           127004
4            27844
5             9477
6           447359
7             3847
8           362347
9           129470
```

[50]:
```
# Retweets by User groups plot
retwt_group_plot = verified_group.filter(twitterers_groups.retweeted_status.
 ↪isNotNull()).groupBy('Twitterer_Group').count().
 ↪orderBy('count',ascending=True).toPandas()
retwt_group_plot
```

[50]:
```
            Twitterer_Group  count
0  Non-Profit Organizations    985
1       Government Entities   2303
2                   Schools   2357
3              Universities   3326
4                    Others  26074
5              News Outlets  30274
6  Social Media Influencers  97219
```

[51]:
```
retwt_group_plot.plot(kind='barh', x='Twitterer_Group', y='count',␣
 ↪figsize=(8,6),title="Retweet Volumes by User Types")
```

[51]:
```
<AxesSubplot:title={'center':'Retweet Volumes by User Types'},
ylabel='Twitterer_Group'>
```



[ ]:
```
# Retweets by Tweeterers and types of Orgs

retwt_user_type = verified_group.filter(col('retweeted')=='RT')\
                        .groupBy('id_str','retweeted_from','Twitterer_Group')\
                        .agg(sum('retweeted_status.retweet_count').
 ↪alias('Total_Retweets'))\
                        .orderBy('Total_Retweets',ascending = False)
retwt_user_type.limit(10).toPandas()
```

[ ]:

	id_str	retweeted_from	Twitterer_Group	Total_Retweets
0	3317348164	NasimiShabnam	Social Media Influencers	440007
1	259725229	ValaAfshar	Social Media Influencers	206303
2	259725229	MichaelWarbur17	Social Media Influencers	159776
3	61109238	ProfFeynman	Social Media Influencers	118004
4	17787164	neiltyson	Social Media Influencers	115117
5	1276140426	DeAngelisCorey	Social Media Influencers	110091
6	322010071	stephyj725	News Outlets	104502
7	76564891	stephyj725	Social Media Influencers	104392
8	7434902	stephyj725	Social Media Influencers	103793
9	20227945	stephyj725	Others	103787

[ ]:
```
retweet_df = retwt_user_type.join(followers_df, 'id_str', how = 'inner')
retweet_df.limit(10)
```

Where are these Twitterers (all of them, not just influencers) located?

- Any relationship between the emergence of new issues in education and progression and locations of these Twitterers?
- Visualize the geographical distribution

[7]:
```
# Table: top 5 countries
location_twt = twt_newdf.filter(col('country').isNotNull())\
         .groupBy('country').count().orderBy(col('count').desc())
location_twt.limit(10).toPandas()
```

[7]:

	country	count
0	United States	114245
1	United Kingdom	13307
2	India	12335
3	Kingdom of Saudi Arabia	8985
4	Canada	4881
5	Nigeria	3638
6	2069	
7	Australia	1951
8	Pakistan	1784
9	Kenya	1644

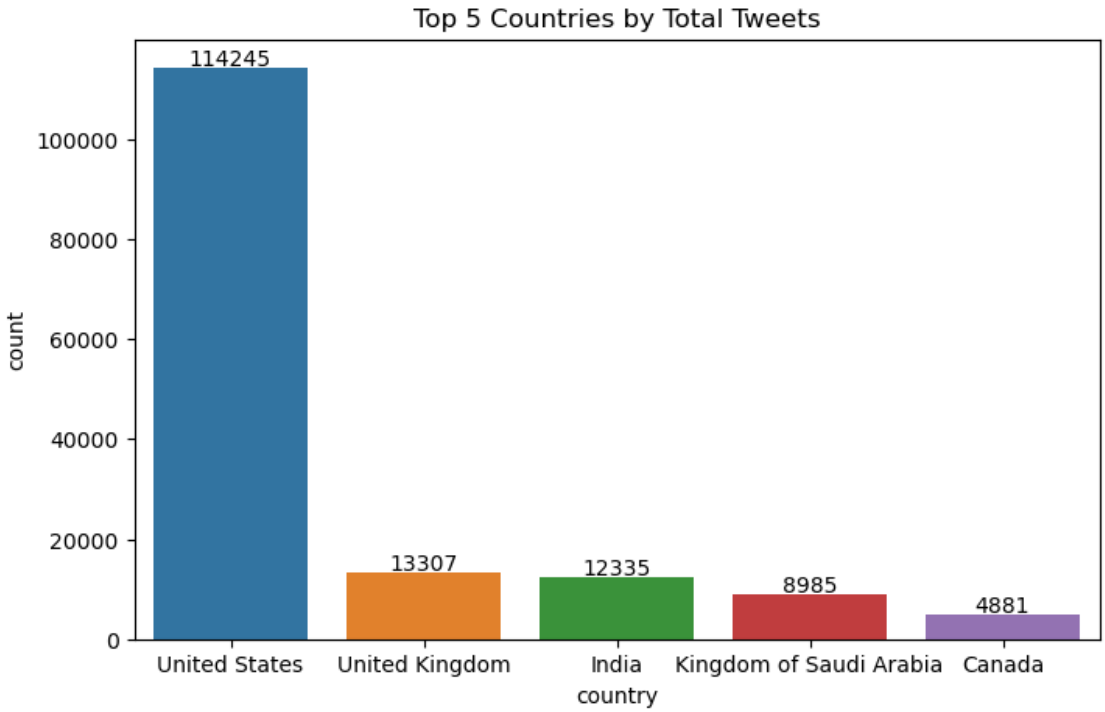
[53]:
```
# Table: top cities
twt_newdf.filter(col('country').isNotNull())\
         .groupBy('full_name').count().orderBy(col('count').desc()).limit(10).
 ↪toPandas()
```

[53]:

	full_name	count
0	Riyadh, Kingdom of Saudi Arabia	8852
1	Houston, TX	2108
2	Los Angeles, CA	2107
3	Florida, USA	2088
4	, 2037	
5	Texas, USA	1821
6	Georgia, USA	1706
7	Manhattan, NY	1658
8	Chicago, IL	1499
9	New Delhi, India	1251

[70]:
```
#location_twt_plot = location_twt.limit(5).toPandas()
plt.figure(figsize=(8,5))
ax = sns.barplot(data=location_twt_plot,x='country',y='count')
ax.set(title="Top 5 Countries by Total Tweets")
```

```
for p in ax.patches:
        ax.annotate(format(p.get_height(), '.0f'),
                    (p.get_x() + p.get_width() / 2., p.get_height()+1),
                    ha = 'center', va = 'center',
                    xytext = (0,4),
                    textcoords = 'offset points')
```



[ ]:
```
latlong = twt_newdf.filter(col('bounding_box').isNotNull()).
 ↪select(col('bounding_box').coordinates[0][0].alias('coords')).toPandas()
```

[10]:
```
latlong
```

[10]:

	coords
0	[31.208606, 30.576979]
1	[-88.399452, 42.168411]
2	[144.593742, -38.433859]
3	[-0.21607, 51.509879]
4	[30.804771, -30.127635]
…	…
181655	[-80.248423, 43.050553]
181656	[-80.260185, 25.845593]
181657	[-82.21201, 33.338854]

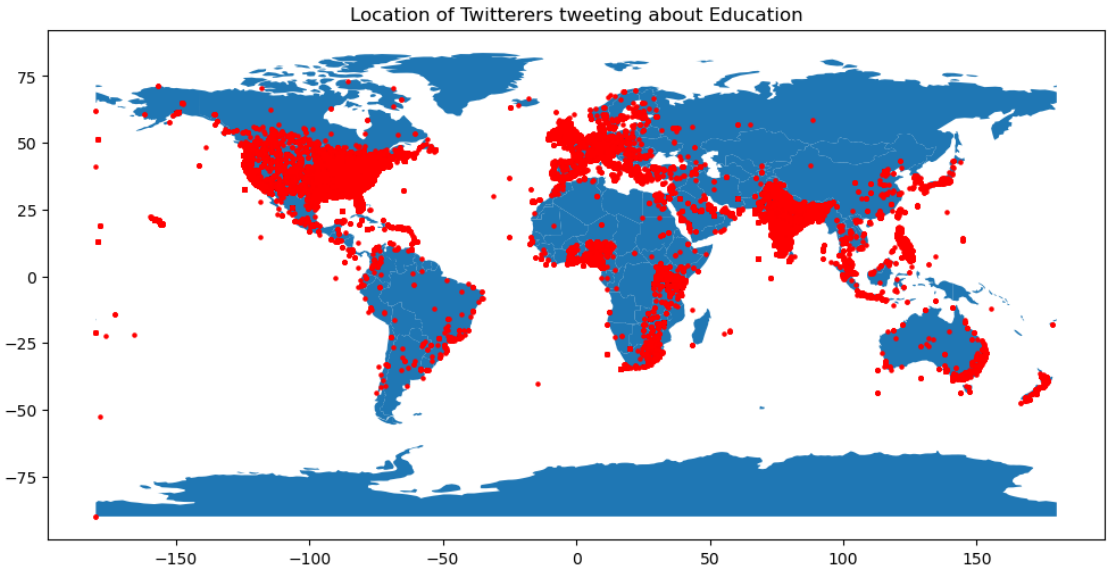
```
181658    [-2.033651, 52.381063]
181659    [-91.51308, 36.970298]

[181660 rows x 1 columns]
```

[11]:
```
# Retrieve the latitude & longitude
latlong['longitude'] = latlong.coords.str[0]
latlong['latitude'] = latlong.coords.str[1]
```

[12]:
```
from shapely.geometry import Point
import geopandas as gpd
from geopandas import GeoDataFrame
```

[13]:
```
geometry = [Point(xy) for xy in zip(latlong['longitude'], latlong['latitude'])]
geo_df = GeoDataFrame(latlong, geometry = geometry)

# map
world = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
geo_df.plot(ax=world.plot(figsize=(12,8)), marker='o', color='red',␣
 ↪markersize=5)
plt.title("Location of Twitterers tweeting about Education")
plt.show()
```

```
ERROR 1: PROJ: proj_create_from_database: Open of
/opt/conda/miniconda3/share/proj failed
```



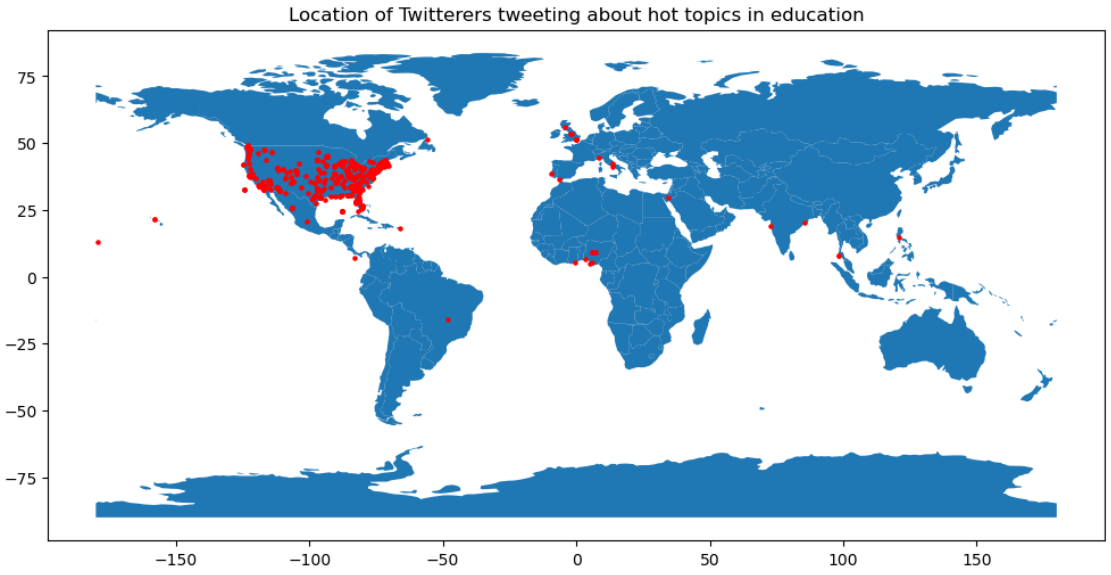
[ ]:
```
# Education hot topic by locations
df_edutopic = twt_newdf.filter(col('bounding_box').isNotNull() & (
```

```
                        lower(col('text')).contains('book ban') |␣
↪lower(col('text')).contains('banned book') |
                        lower(col('text')).contains('college loan') |␣
↪lower(col('text')).contains('student loan')))
df_edutopic.count()
```

[ ]: 510

[27]:
```
latlong2 = df_edutopic.select(col('bounding_box').coordinates[0][0].
↪alias('coords')).toPandas()
latlong2['longitude'] = latlong2.coords.str[0]
latlong2['latitude'] = latlong2.coords.str[1]
```

[28]:
```
geometry = [Point(xy) for xy in zip(latlong2['longitude'],␣
↪latlong2['latitude'])]
geo_df2 = GeoDataFrame(latlong2, geometry = geometry)

world2 = gpd.read_file(gpd.datasets.get_path('naturalearth_lowres'))
geo_df2.plot(ax=world2.plot(figsize=(12,8)), marker='o', color='red',␣
↪markersize=5)
plt.title("Location of Twitterers tweeting about hot topics in education")
plt.show()
```



[ ]:
```
topic_location = df_edutopic.filter(col('bounding_box').isNotNull())\
         .groupBy('country').count().orderBy(col('count').desc())
topic_location.limit(10).toPandas()
```

[ ]:

	country	count
0	United States	476
1	United Kingdom	8
2	Nigeria	6
3	Canada	4
4	Italy	2
5	Thailand	2
6	India	2
7	Vereinigte Staaten	1
8	Israel	1
9	Spain	1

What are the timelines of these tweets? Do you see significant peaks and valleys? Do you see any data collection gaps? Plot the timelines of these tweets

[8]:
```
from pyspark.sql.functions import date_format, to_timestamp, unix_timestamp,␣
↪from_unixtime
from pyspark.sql.functions import split
```

[9]:
```
twt_time = twt_newdf.filter(col('country').isNotNull() & col('created_at').
↪isNotNull()).groupBy('created_at').count().orderBy(col('count').desc())
twt_time.limit(10).toPandas()
```

[9]:

	created_at	count
0	Tue Apr 02 06:29:42 +0000 2019	215
1	Sun Nov 25 11:20:32 +0000 2012	201
2	Mon Jul 20 07:28:49 +0000 2009	177
3	Thu Dec 18 15:48:51 +0000 2014	166
4	Wed May 16 17:57:16 +0000 2012	150
5	Tue Nov 10 01:06:12 +0000 2020	142
6	Thu Nov 08 07:44:56 +0000 2018	118
7	Fri Apr 26 01:01:16 +0000 2019	117
8	Fri Oct 24 02:23:04 +0000 2008	105
9	Thu Jun 21 21:51:05 +0000 2012	97

[24]:
```
# tweet_time2 = twt_time.withColumn('created_time',␣
↪from_unixtime(unix_timestamp(col('created_at'), 'EEE MMM dd HH:mm:ss ZZZZ␣
↪yyyy')))
```

[11]:
```
twt_time2.head()
```

[11]:
```
                       created_at  count
0  Tue Apr 02 06:29:42 +0000 2019    215
1  Sun Nov 25 11:20:32 +0000 2012    201
2  Mon Jul 20 07:28:49 +0000 2009    177
3  Thu Dec 18 15:48:51 +0000 2014    166
4  Wed May 16 17:57:16 +0000 2012    150
```

[14]:
```
twt_time2['created_time'] = pd.to_datetime(twt_time2["created_at"],␣
↪errors='coerce')
twt_time2
```

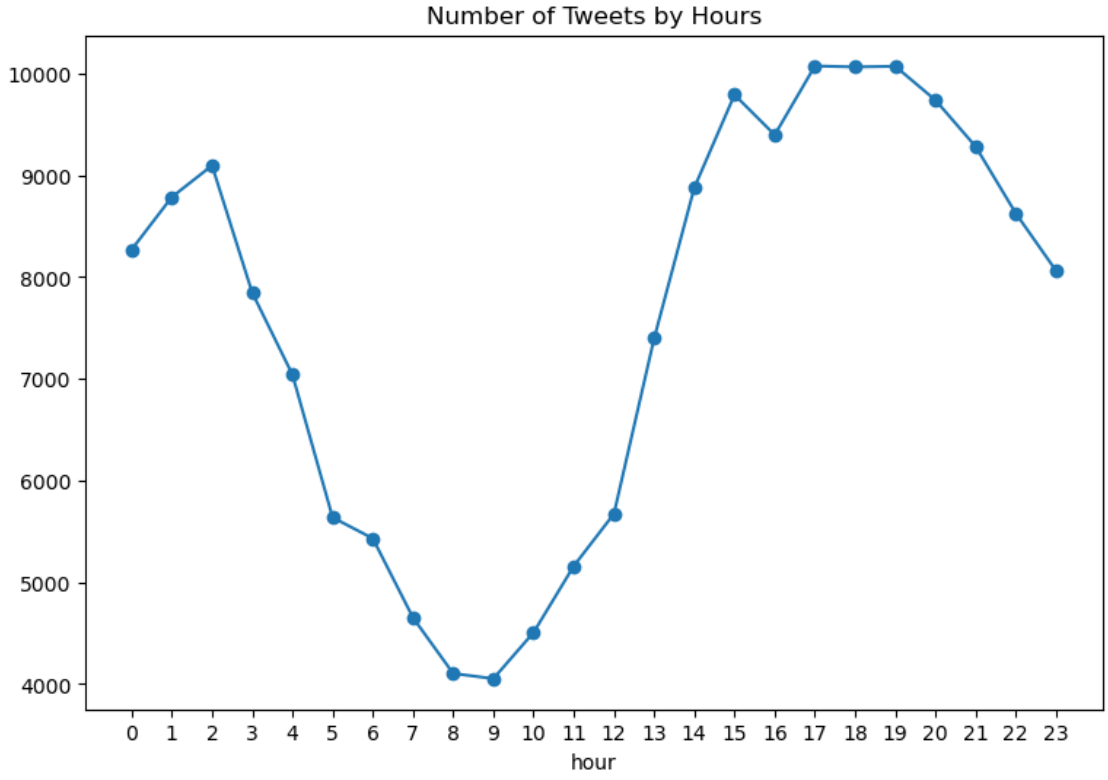
[14]:
```
                           created_at  count              created_time
0       Tue Apr 02 06:29:42 +0000 2019    215 2019-04-02 06:29:42+00:00
1       Sun Nov 25 11:20:32 +0000 2012    201 2012-11-25 11:20:32+00:00
2       Mon Jul 20 07:28:49 +0000 2009    177 2009-07-20 07:28:49+00:00
3       Thu Dec 18 15:48:51 +0000 2014    166 2014-12-18 15:48:51+00:00
4       Wed May 16 17:57:16 +0000 2012    150 2012-05-16 17:57:16+00:00
…                                     …    …                        …
114525  Sun Sep 25 01:52:09 +0000 2016      1 2016-09-25 01:52:09+00:00
114526  Sat Aug 28 17:28:50 +0000 2010      1 2010-08-28 17:28:50+00:00
114527  Tue Sep 13 03:58:34 +0000 2011      1 2011-09-13 03:58:34+00:00
114528  Fri Dec 29 21:50:00 +0000 2017      1 2017-12-29 21:50:00+00:00
114529  Wed Jul 08 21:53:40 +0000 2009      1 2009-07-08 21:53:40+00:00

[114530 rows x 3 columns]
```

[16]:
```
twt_time2['hour'] = twt_time2["created_time"].dt.hour
twt_by_hour = twt_time2.groupby('hour')['count'].sum()
twt_by_hour
```

[16]:
```
hour
0      8271
1      8787
2      9097
3      7847
4      7042
5      5638
6      5432
7      4653
8      4105
9      4054
10     4508
11     5161
12     5674
13     7398
```

```
14     8880
15     9792
16     9398
17    10075
18    10066
19    10072
20     9739
21     9283
22     8626
23     8063
Name: count, dtype: int64
```

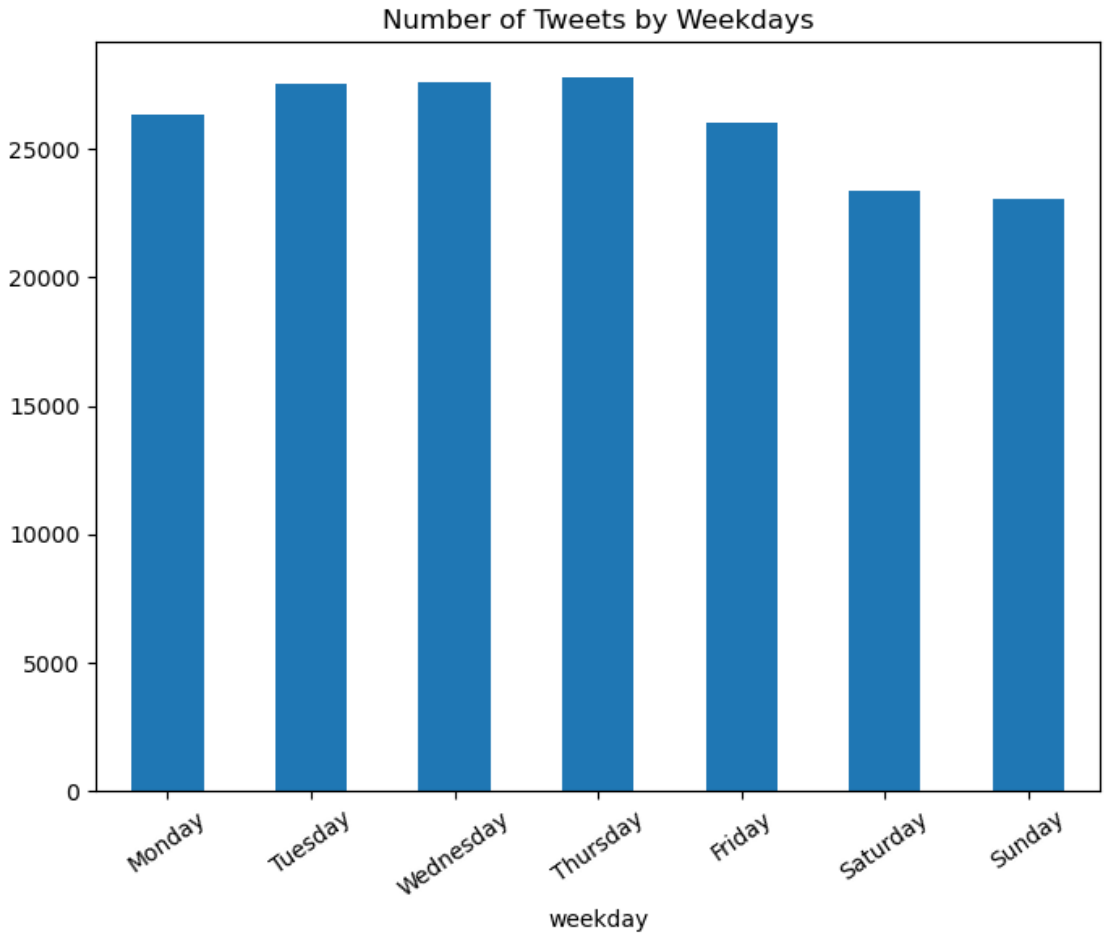
[28]:
```
twt_by_hour_plot = twt_by_hour.reset_index(name='count')
ax = twt_by_hour_plot.plot(kind='line', x='hour', y='count', legend=None,␣
↪marker='o',figsize=(9,6), title = 'Number of Tweets by Hours')
ax.set_xticks(twt_by_hour_plot['hour'])
plt.show()
```



[27]:
```
twt_time2['weekday'] = pd.to_datetime(twt_time2['created_at']).dt.day_name()
twt_time2
```

[27]:
```
                          created_at  count              created_time  hour  \
0       Tue Apr 02 06:29:42 +0000 2019    215 2019-04-02 06:29:42+00:00     6
1       Sun Nov 25 11:20:32 +0000 2012    201 2012-11-25 11:20:32+00:00    11
2       Mon Jul 20 07:28:49 +0000 2009    177 2009-07-20 07:28:49+00:00     7
3       Thu Dec 18 15:48:51 +0000 2014    166 2014-12-18 15:48:51+00:00    15
4       Wed May 16 17:57:16 +0000 2012    150 2012-05-16 17:57:16+00:00    17
…                                  …    …                         …    …
114525  Sun Sep 25 01:52:09 +0000 2016      1 2016-09-25 01:52:09+00:00     1
114526  Sat Aug 28 17:28:50 +0000 2010      1 2010-08-28 17:28:50+00:00    17
114527  Tue Sep 13 03:58:34 +0000 2011      1 2011-09-13 03:58:34+00:00     3
114528  Fri Dec 29 21:50:00 +0000 2017      1 2017-12-29 21:50:00+00:00    21
114529  Wed Jul 08 21:53:40 +0000 2009      1 2009-07-08 21:53:40+00:00    21

          weekday
0         Tuesday
1          Sunday
2          Monday
3        Thursday
4       Wednesday
…             …
114525     Sunday
114526   Saturday
114527    Tuesday
114528     Friday
114529  Wednesday

[114530 rows x 5 columns]
```

[62]:
```
twt_by_weekday = twt_time2.groupby('weekday')['count'].sum()
weekday_order = ['Monday', 'Tuesday', 'Wednesday', 'Thursday', 'Friday',␣
 ↪'Saturday', 'Sunday']

# Reindex the DataFrame based on weekday_order list
twt_by_weekday = twt_by_weekday.reindex(weekday_order)

twt_by_weekday_plot = twt_by_weekday.reset_index(name='count')
ax = twt_by_weekday_plot.plot(kind='bar', x='weekday', y='count', legend=None,␣
 ↪figsize=(8,6), title = 'Number of Tweets by Weekdays')
plt.xticks(rotation=35)
plt.show()
```



[13]:
```
tweet_time2 = tweet_time.
↪withColumn("weekday",from_unixtime(unix_timestamp(col("date_of_week"),'EEE'),'EE'))\
                        .
↪withColumn("month",from_unixtime(unix_timestamp(col("month"),'MMM'),'MM'))\
                        .
↪withColumn("date",from_unixtime(unix_timestamp(col("date_of_week"),'dd'),'dd'))\
                        .
↪withColumn("year",from_unixtime(unix_timestamp(col("date_of_week"),'yyyy'),'yyyy'))
```

[ ]:
```
tweet_time2.limit(10)
```