MinhVo-FinalProject-MessageAnalysis

March 11, 2023

0.1 Big Data Platforms - Winter 2023

0.2 Final Project Education

0.2.1 Twitter - Unique Message Analysis

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[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

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

[2]:

```
pip install -U nltk
```

```
Requirement already satisfied: nltk in /opt/conda/miniconda3/lib/python3.8/site-
packages (3.8.1)
Requirement already satisfied: click in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (7.1.2)
Requirement already satisfied: tqdm in /opt/conda/miniconda3/lib/python3.8/site-
packages (from nltk) (4.64.1)
Requirement already satisfied: regex>=2021.8.3 in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (2022.10.31)
Requirement already satisfied: joblib in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (1.2.0)
```

```
WARNING: Running pip as the 'root' user can result in broken permissions
and conflicting behaviour with the system package manager. It is recommended to
use a virtual environment instead: https://pip.pypa.io/warnings/venv
Note: you may need to restart the kernel to use updated packages.
```

[3]:
```
import re
from pyspark.ml.feature import MinHashLSH
from pyspark.ml.feature import CountVectorizer,  IDF, CountVectorizerModel,␣
 ↪Tokenizer, RegexTokenizer, StopWordsRemover
from pyspark import SparkContext
from pyspark.sql import SQLContext
from pyspark.sql import Row
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
```

[4]:
```
from google.cloud import storage
```

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

0.2.2 Data Loading

[6]:
```
!hadoop fs -ls 'gs://msca-bdp-students-bucket/shared_data/mdvo/BDP-Final/
 ↪User-Groups/' | head -10
```

```
Found 341 items
-rwx------   3 root root          0 2023-03-10 00:12 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-Groups/_SUCCESS
-rwx------   3 root root   63332184 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00000-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   61951748 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00001-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   61932482 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00002-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   65444084 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00003-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   65033087 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00004-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
```

```
-rwx------   3 root root   64988348 2023-03-10 00:07 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00005-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   64801663 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00006-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
-rwx------   3 root root   64615189 2023-03-10 00:06 gs://msca-bdp-students-
bucket/shared_data/mdvo/BDP-Final/User-
Groups/part-00007-b009d9a6-e554-48e0-a750-de696a114c43-c000.snappy.parquet
```

[7]:
```
path = 'gs://msca-bdp-students-bucket/shared_data/mdvo/BDP-Final/User-Groups/'
```

[8]:
```
%%time

twtgroup_df = spark.read.parquet(path)
twtgroup_df.limit(5)
```

```
23/03/10 22:47:05 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'.
```

```
CPU times: user 5.08 ms, sys: 4.4 ms, total: 9.47 ms
Wall time: 7.3 s
```

[8]:
```
+-----------+--------------+------------+-----------------------+---------+-----
--------+--------------+--------------------+--------------------+-------+------
------+---------+----------+------------+-------------+-------------------+-----
---------------+---------------+---------------+--------------------+-----------
----+--------------+--------------------+--------+----+---------------+---------
------+
|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|is_original_twt|Twitterer_Group|
+-----------+--------------+------------+-----------------------+---------+-----
--------+--------------+--------------------+--------------------+-------+------
------+---------+----------+------------+-------------+-------------------+-----
---------------+---------------+---------------+--------------------+-----------
----+--------------+--------------------+--------+----+---------------+---------
------+
|       null|             0|         low|                   null|       RT|
0| David_Moscrop|{null, Fri May 13…|RT @David_Moscrop…|   null|        null|
null|      null|        null|1652469985395|1427351911410257934|
Mike|   Mike24084394|           null|Long time NDP mem…|            122|
2244|Mon Aug 16 19:29:…|   false|  en|              0|         Others|
|       null|             0|         low|                   null|       RT|
0|    NYANGBERRY|{null, Fri May 13…|RT @NYANGBERRY: A…|   null|        null|
null|      null|        null|1652469987924| 959799880322637825|       æ-Dani
(.  )|     JaemNoJeno|        she/her|Dreams Come True
…|           2521|         29441|Sat Feb 03 14:44:…|   false|  en|
0|         Others|
|       null|             0|         low|                   null|       RT|
0| realchrisrufo|{null, Fri May 13…|RT @realchrisrufo…|   null|        null|
null|      null|        null|1652469990292|1104477873270898688|
Jessthemess|JesstheMesstake|            USA|If the road to he…|
223|         15102|Sat Mar 09 20:23:…|   false|  en|              0|
Others|
|       null|             0|         low|           MattOswaltVA|         |
0|          null|                null|@MattOswaltVA I l…|   null|        null|
null|      null|        null|1652469990754|1491083841838239745|         Todd
Weaver| DreamWeaver_tw|Los Angeles, CA|Artist/Photograph…|              7|
68|Tue Feb 08 16:18:…|   false|  en|              1|         Others|
|       null|             0|         low|           CoachFelecia|         |
0|          null|                null|@CoachFelecia doe…|   null|        null|
null|      null|        null|1652469991702| 832788979393060867|Mrs_Pinky
Nic…|  MRSpinkston85|   Georgia, USA|Christian| Wife &…|          14863|
217346|Sat Feb 18 03:08:…|   false|  en|              1|         Others|
+-----------+--------------+------------+-----------------------+---------+-----
--------+--------------+--------------------+--------------------+-------+------
------+---------+----------+------------+-------------+-------------------+-----
---------------+---------------+---------------+--------------------+-----------
----+--------------+--------------------+--------+----+---------------+---------
------+
```

```
[9]: twtgroup_df.count()
```

```
[9]: 24721729
```

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

```
[10]:             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
```

0.2.3 How unique are the messages?

- Are they mostly unique? Or usually people are just copy-pasting the same text?
- You can use something like Jaccard similarity / Cosine Similarity / Simhash / Minhash to measure uniqueness / similarity
- Visualize message duplication for each group of Twitterers (government entities / non-profit organizations / news outlets / social media influencers / other) *Please note: this is not a topic modeling (LDA / LSA) – but text similarity analysis*

[11]:
```
# work on Original tweets only
original_twts_group = twtgroup_df.filter(col('is_original_twt')==1)
```

[12]:
```
original_twts_group.count()
```

[12]:
```
8174910
```

[13]:
```
original_twts_group.groupby('Twitterer_Group').count().
 ↪orderBy("count",ascending=False).toPandas()
```

[13]:
```
            Twitterer_Group    count
0                    Others  7933421
1  Social Media Influencers   129547
2              News Outlets    97068
3              Universities     6315
4                   Schools     3852
5       Government Entities     2764
6  Non-Profit Organizations     1943
```

[14]:
```
nonprofit_twt = original_twts_group.filter(col('Twitterer_Group')=='Non-Profit␣
 ↪Organizations')
gov_twt = original_twts_group.filter(col('Twitterer_Group')=='Government␣
 ↪Entities')
univ_twt = original_twts_group.filter(col('Twitterer_Group')=='Universities')
school_twt = original_twts_group.filter(col('Twitterer_Group')=='Schools')
news_twt = original_twts_group.filter(col('Twitterer_Group')=='News Outlets')
influencer_twt = original_twts_group.filter(col('Twitterer_Group')=='Social␣
 ↪Media Influencers')
other_twt = original_twts_group.filter(col('Twitterer_Group')=='Others')
```

[15]:

```
group_sample = tweets_sample.select('id_str','text','Twitterer_Group')
group_sample.limit(5).toPandas()
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[15], line 1
----> 1 group_sample = tweets_sample.select('id_str','text','Twitterer_Group')
      2 group_sample.limit(5).toPandas()

NameError: name 'tweets_sample' is not defined
```

[ ]:

```
# nonprofit_text = group_sample.filter(col('Twitterer_Group')=='Non-Profit␣
↪Organizations')
# gov_text = group_sample.filter(col('Twitterer_Group')=='Government Entities')
# univ_text = group_sample.filter(col('Twitterer_Group')=='Universities')
# school_text = group_sample.filter(col('Twitterer_Group')=='Schools')
# news_text = group_sample.filter(col('Twitterer_Group')=='News Outlets')
# influencer_text = group_sample.filter(col('Twitterer_Group')=='Social Media␣
↪Influencers')
# other_text = group_sample.filter(col('Twitterer_Group')=='Others')
```

Create a function to run the jaccard similarity

[23]:

```
def generate_jaccard_sim(df, jaccard_distance):
    text = df.rdd.map(lambda x : x['text']).filter(lambda x: x is not None)

    # remove stopwords and tokenize text
    Stop_Words = stopwords.words("english")
    tokens = text\
            .map( lambda document: document.strip().lower())\
            .map( lambda document: re.split(r"\s+", document))\
            .map( lambda word: [x for x in word if x.isalnum()])\
            .map( lambda word: [x for x in word if len(x) > 3] )\
            .map( lambda word: [x for x in word if x not in Stop_Words])\
            .zipWithIndex()

    row = Row('text')
    df_text = text.map(row).zipWithIndex().toDF(['text','id'])

    #Drop records with no tokens
    df_tokens = spark.createDataFrame(tokens, ["list_of_words", "id"])
    df_tokens = df_tokens.where(col('list_of_words').getItem(0).isNotNull())

    # vectorize tokens using CountVectorizer
    vectorize = CountVectorizer(inputCol="list_of_words", outputCol="features",␣
↪minDF=1.0)
```

```
    df_vectorize = vectorize.fit(df_tokens).transform(df_tokens)

    # hash vectorized tokens using MinHashLSH
    mh = MinHashLSH(inputCol="features", outputCol="hashes", numHashTables=5)
    model = mh.fit(df_vectorize)
    df_hashed = mh.fit(df_vectorize).transform(df_vectorize).cache()

    df_hashed_text = df_text.join(df_hashed, "id", how='left').cache()

    # apply approximate Jaccard similarity on hashed tokens
    dups_text = model.approxSimilarityJoin(df_hashed_text, df_hashed_text,␣
 ↪jaccard_distance).filter("datasetA.id < datasetB.id").select(
            col("distCol"),
            col("datasetA.id").alias("id_A"),
            col("datasetB.id").alias("id_B"),
            col('datasetA.text').alias('text_A'),
            col('datasetB.text').alias('text_B'))
    dups_text.cache()

    # calculate number of unique and total records
    dups = dups_text.select('id_A').distinct().count()
    records = df_hashed_text.count()
    uniques = records - dups

    return {'near_dups': dups, 'unique': uniques, 'records': records}
```

Pick a random sample to run the text similarity

[53]:

```
# Run on original tweets only
# Choose a random sample of 1% from the original tweets data for analysis to␣
 ↪avoid the crashing issue (due to the huge amount of data).
tweets_sample = original_twts_group.sample(fraction=0.01)
tweets_sample.count()
```

[53]:

```
81809
```

[54]:

```
tweets_sample.groupby('Twitterer_Group').count().
 ↪orderBy("count",ascending=False).toPandas()
```

[54]:

```
            Twitterer_Group  count
0                    Others  79393
1  Social Media Influencers   1329
2              News Outlets    930
```

```
3              Universities     77
4                   Schools     38
5        Government Entities     25
6  Non-Profit Organizations     17
```

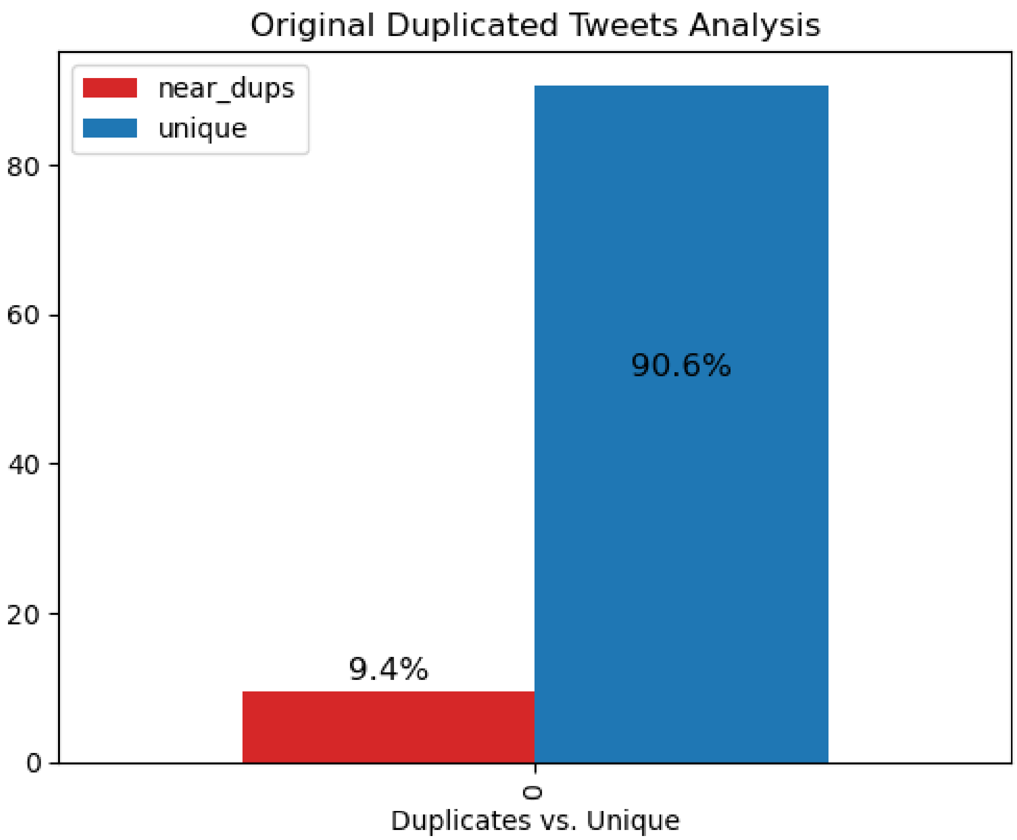
[56]:
```
text_sample = tweets_sample.select('id_str','text','Twitterer_Group')
text_sample_similarity = generate_jaccard_sim(text_sample, 0.3)
text_sample_similarity
```

[56]:
```
{'near_dups': 7689, 'unique': 74120, 'records': 81809}
```

[59]:
```
dups = text_sample_similarity['near_dups']/text_sample_similarity['records']*100
uniques = text_sample_similarity['unique']/text_sample_similarity['records']*100

text_sample_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups],␣
 ↪'unique': [uniques]})

ax = text_sample_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
 ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
 ↪xlabel="Duplicates vs. Unique")
ax.set_title('Original Duplicated Tweets Analysis', fontsize=12)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,21),
                   textcoords = 'offset points',
                   fontsize = 12)
```



Run the text similarity on each user group

Non-profit organizations

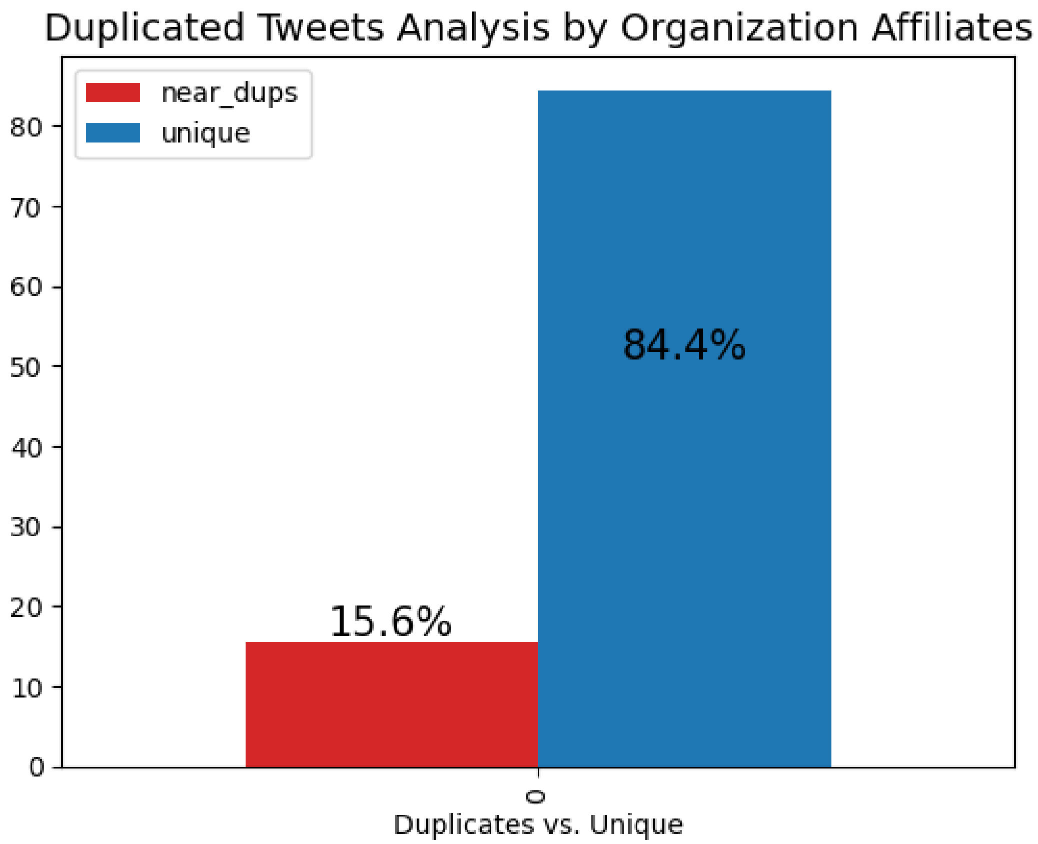
```
[ ]: nonprofit_twt = original_twts_group.filter(col('Twitterer_Group')=='Non-Profit␣
     ↪Organizations').select('id_str','text','Twitterer_Group')
     nonprofit_similarity = generate_jaccard_sim(nonprofit_twt, 0.3)
     nonprofit_similarity
```

```
[ ]: {'near_dups': 303, 'unique': 1640, 'records': 1943}
```

```
[63]: dups = nonprofit_similarity['near_dups']/nonprofit_similarity['records']*100
      uniques = nonprofit_similarity['unique']/nonprofit_similarity['records']*100

      nonprofit_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':
      ↪ [uniques]})
```

```
ax = nonprofit_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
↪xlabel="Duplicates vs. Unique")
ax.set_title('Duplicated Tweets Analysis by Organization Affiliates',␣
↪fontsize=14)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,30),
                   textcoords = 'offset points',
                   fontsize = 15)
```



Government Entities

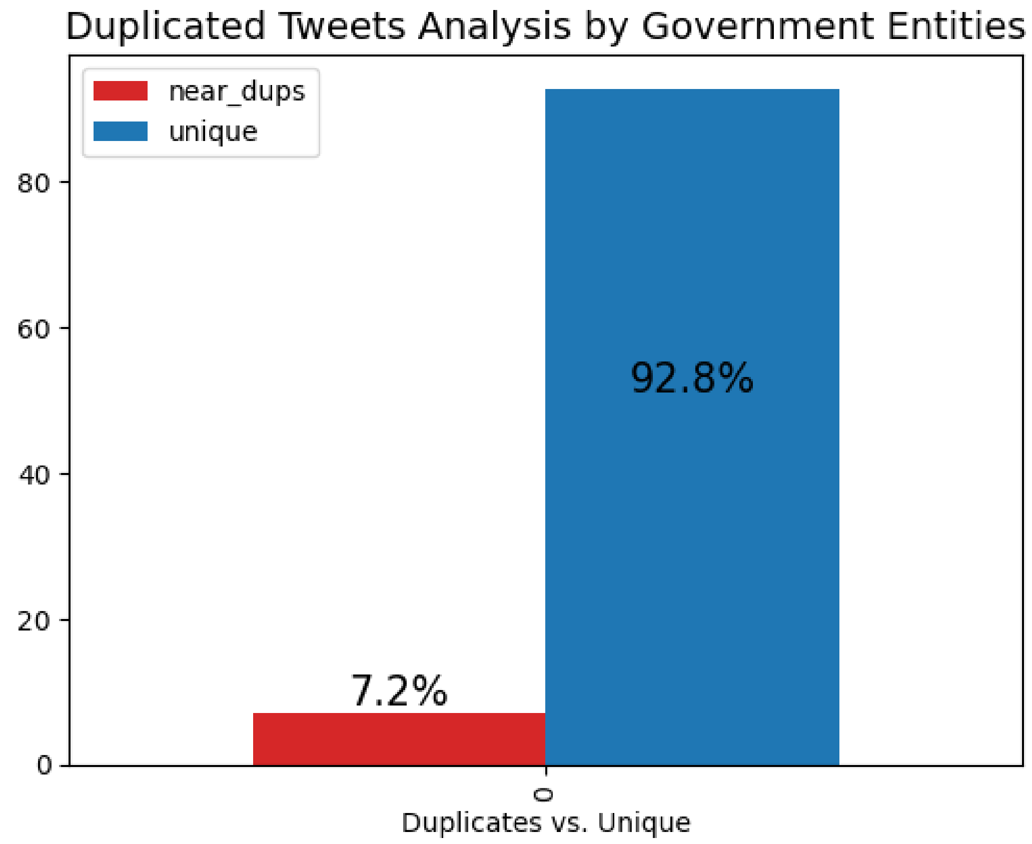
[64]:
```
gov_twt = original_twts_group.filter(col('Twitterer_Group')=='Government␣
↪Entities').select('id_str','text','Twitterer_Group')
gov_similarity = generate_jaccard_sim(gov_twt, 0.3)
gov_similarity
```

```
[64]: {'near_dups': 199, 'unique': 2565, 'records': 2764}
```

```
[65]: dups = gov_similarity['near_dups']/gov_similarity['records']*100
      uniques = gov_similarity['unique']/gov_similarity['records']*100

      gov_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':␣
       ↪[uniques]})

      ax = gov_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
       ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
       ↪xlabel="Duplicates vs. Unique")
      ax.set_title('Duplicated Tweets Analysis by Government Entities', fontsize=14)
      for p in ax.patches:
             ax.annotate(f"{format(p.get_height(), '.1f')}%",
                         (p.get_x() + p.get_width() / 2., p.get_height()/2),
                         ha = 'center', va = 'center',
                         xytext = (0,17),
                         textcoords = 'offset points',
                         fontsize = 15)
```



Schools

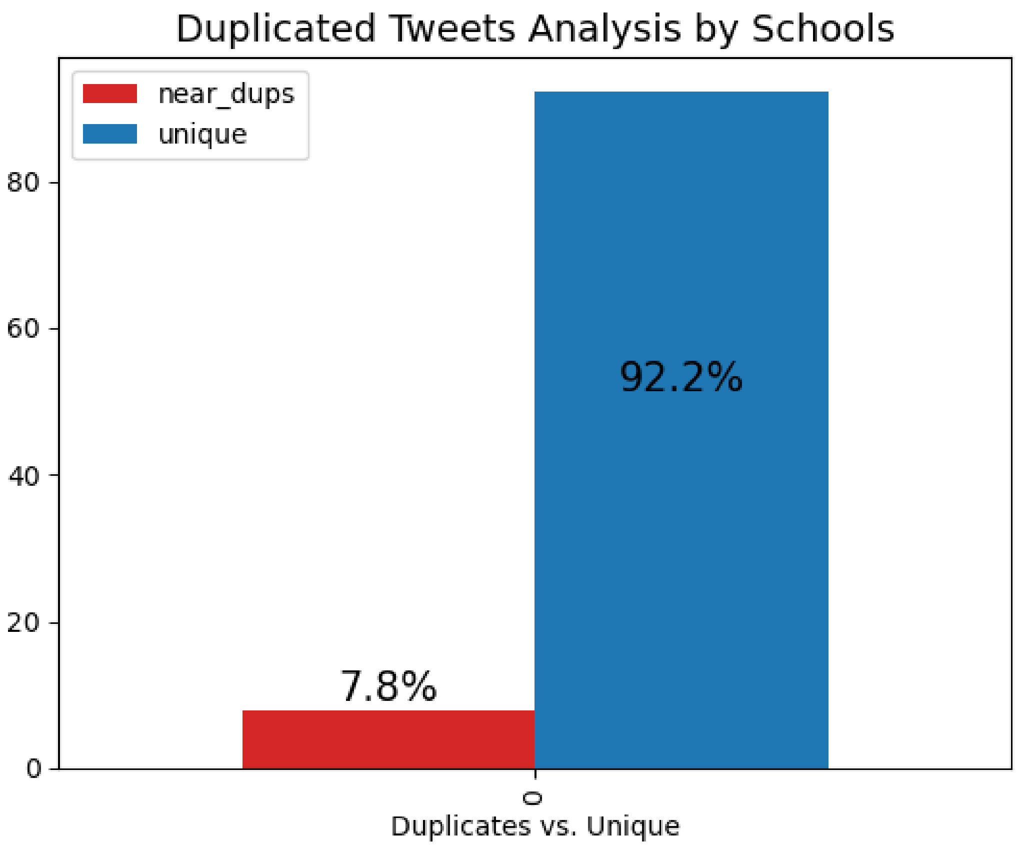
[32]:
```
school_twt = original_twts_group.filter(col('Twitterer_Group')=='Schools').
 ↪select('id_str','text','Twitterer_Group')
school_similarity = generate_jaccard_sim(school_twt, 0.3)
school_similarity
```

[32]:
```
{'near_dups': 299, 'unique': 3553, 'records': 3852}
```

[66]:
```
dups = school_similarity['near_dups']/school_similarity['records']*100
uniques = school_similarity['unique']/school_similarity['records']*100

school_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':␣
 ↪[uniques]})

ax = school_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
 ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
 ↪xlabel="Duplicates vs. Unique")
ax.set_title('Duplicated Tweets Analysis by Schools', fontsize=14)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,19),
                   textcoords = 'offset points',
                   fontsize = 15)
```



Universities

[36]:
```
univ_twt = original_twts_group.filter(col('Twitterer_Group')=='Universities').
 ↪select('id_str','text','Twitterer_Group')
univ_similarity = generate_jaccard_sim(univ_twt, 0.3)
univ_similarity
```

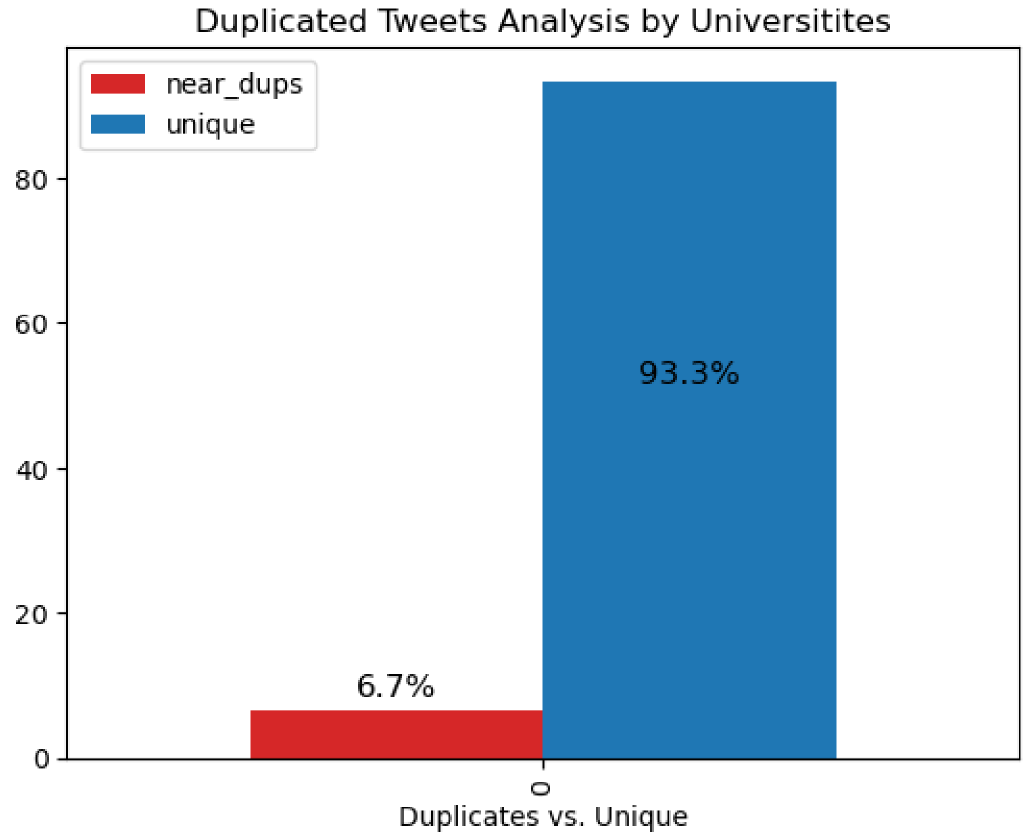
[36]:
```
{'near_dups': 423, 'unique': 5892, 'records': 6315}
```

[38]:
```
dups = univ_similarity['near_dups']/univ_similarity['records']*100
uniques = univ_similarity['unique']/univ_similarity['records']*100

univ_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':␣
 ↪[uniques]})

ax = univ_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
 ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
 ↪xlabel="Duplicates vs. Unique")
```

```
ax.set_title('Duplicated Tweets Analysis by Universitites', fontsize=12)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,17),
                   textcoords = 'offset points',
                   fontsize = 12)
```



News Outlet

```
[39]: news_twt = original_twts_group.filter(col('Twitterer_Group')=='News Outlets').
       ↪select('id_str','text','Twitterer_Group')
      news_twt_sample = news_twt.sample(fraction=0.1)
      news_similarity = generate_jaccard_sim(news_twt_sample, 0.3)
      news_similarity
```

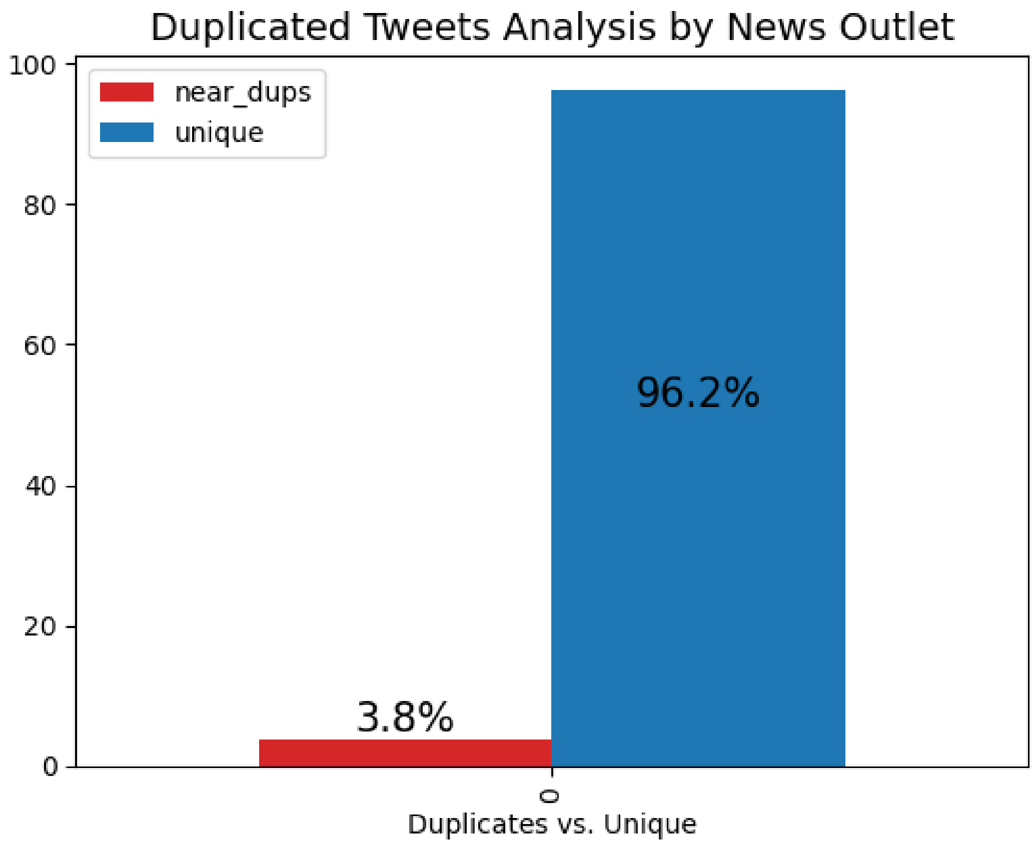
```
[39]: {'near_dups': 361, 'unique': 9227, 'records': 9588}
```

[69]:

```
dups = news_similarity['near_dups']/news_similarity['records']*100
uniques = news_similarity['unique']/news_similarity['records']*100

news_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':␣
 ↪[uniques]})

ax = news_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
 ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
 ↪xlabel="Duplicates vs. Unique")
ax.set_title('Duplicated Tweets Analysis by News Outlet', fontsize=14)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,12),
                   textcoords = 'offset points',
                   fontsize = 15)
```



Social Media Influencer

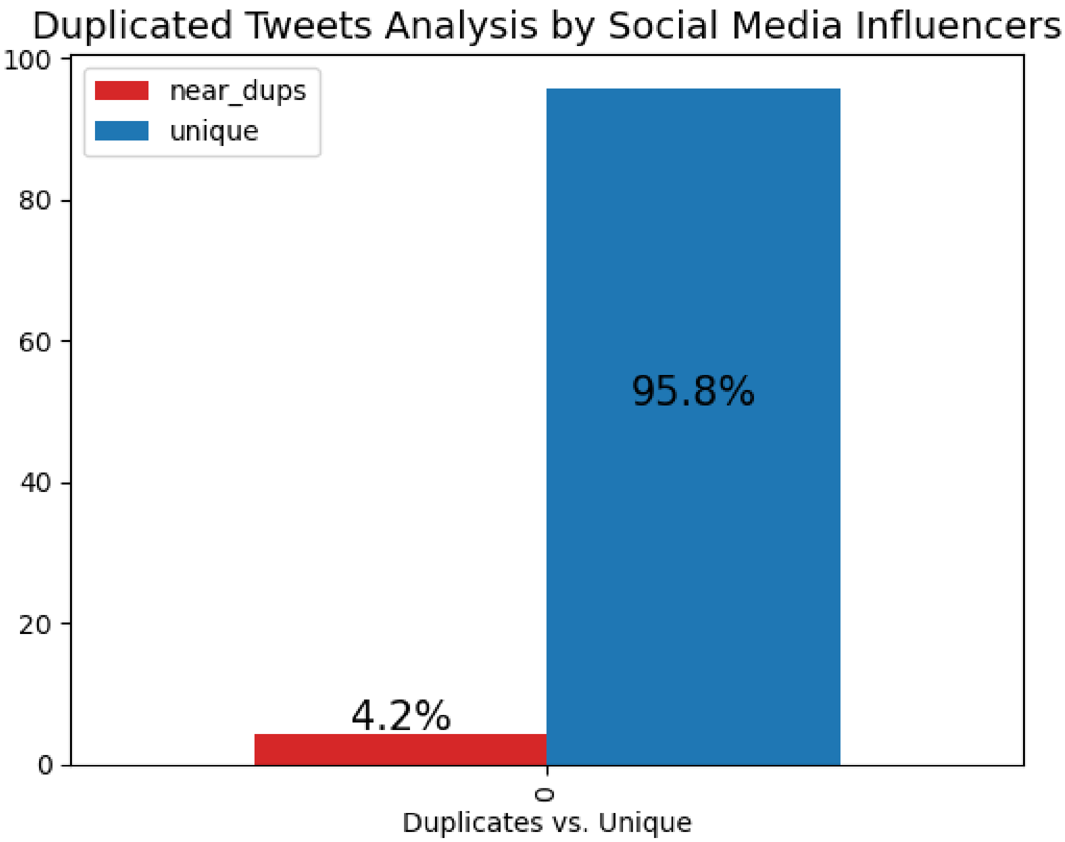
```
[41]: influencer_twt = original_twts_group.filter((col('Twitterer_Group')=='Social␣
       ↪Media Influencers') & (col('verified')==True)).
       ↪select('id_str','text','Twitterer_Group')
      influencer_twt_sample = influencer_twt.sample(fraction=0.1)
      influencer_similarity = generate_jaccard_sim(influencer_twt_sample, 0.3)
      influencer_similarity
```

```
[41]: {'near_dups': 547, 'unique': 12410, 'records': 12957}
```

```
[70]: dups = influencer_similarity['near_dups']/influencer_similarity['records']*100
      uniques = influencer_similarity['unique']/influencer_similarity['records']*100

      influencer_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups],␣
       ↪'unique': [uniques]})

      ax = influencer_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
       ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
       ↪xlabel="Duplicates vs. Unique")
      ax.set_title('Duplicated Tweets Analysis by Social Media Influencers',␣
       ↪fontsize=14)
      for p in ax.patches:
             ax.annotate(f"{format(p.get_height(), '.1f')}%",
                         (p.get_x() + p.get_width() / 2., p.get_height()/2),
                         ha = 'center', va = 'center',
                         xytext = (0,12),
                         textcoords = 'offset points',
                         fontsize = 15)
```



Others/Someone Else

[43]:
```
other_twt = original_twts_group.filter(col('Twitterer_Group')=='Others').
 ↪select('id_str','text','Twitterer_Group')
other_twt_sample = other_twt.sample(fraction=0.005)
other_similarity = generate_jaccard_sim(other_twt_sample, 0.3)
other_similarity
```

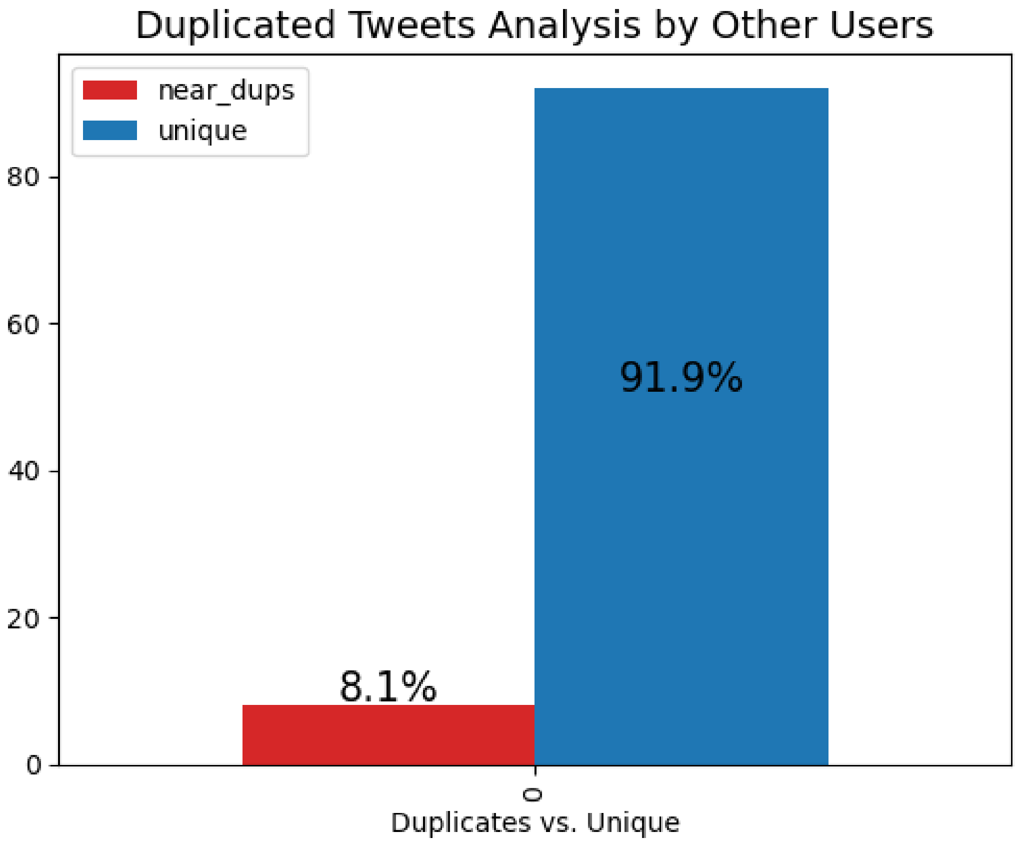
[43]:
```
{'near_dups': 3190, 'unique': 36300, 'records': 39490}
```

[ ]:
```
other_similarity = generate_jaccard_sim(other_twt_sample, 0.3)
other_similarity
```

[71]:
```
dups = other_similarity['near_dups']/other_similarity['records']*100
uniques = other_similarity['unique']/other_similarity['records']*100

other_similarity_df = pd.DataFrame.from_dict({'near_dups': [dups], 'unique':␣
 ↪[uniques]})
```

```
ax = other_similarity_df.plot(kind = 'bar',y=['near_dups', 'unique'],␣
 ↪fontsize=10, color=['C3', 'C0'], align='center', width=0.8,␣
 ↪xlabel="Duplicates vs. Unique")
ax.set_title('Duplicated Tweets Analysis by Other Users', fontsize=14)
for p in ax.patches:
       ax.annotate(f"{format(p.get_height(), '.1f')}%",
                   (p.get_x() + p.get_width() / 2., p.get_height()/2),
                   ha = 'center', va = 'center',
                   xytext = (0,17),
                   textcoords = 'offset points',
                   fontsize = 15)
```


Duplicated Tweets Analysis by Other Users
near_dups
unique
Duplicates vs. Unique