Final_Project_1

March 10, 2023

Import and Overview

[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)
```

[5]:
```
!pip install simhash
```

```
Collecting simhash
  Downloading simhash-2.1.2-py3-none-any.whl (4.7 kB)
Requirement already satisfied: numpy in
/opt/conda/miniconda3/lib/python3.8/site-packages (from simhash) (1.19.5)
Installing collected packages: simhash
```

```
Successfully installed simhash-2.1.2
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
```

[6]:
```
from simhash import Simhash, SimhashIndex
```

Data Import

[28]:
```
%%time
twitter = spark.read.json('gs://chen26-bdp/final_project')
```

```
23/02/25 18:22:13 WARN
org.apache.spark.sql.execution.datasources.SharedInMemoryCache: Evicting cached
table partition metadata from memory due to size constraints
(spark.sql.hive.filesourcePartitionFileCacheSize = 262144000 bytes). This may
impact query planning performance.

CPU times: user 2.88 s, sys: 688 ms, total: 3.57 s
Wall time: 17min 18s

23/02/25 18:38:13 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'.
```

[6]:
```
twitter.count()
```

[6]:
```
99994342
```

[7]:
```
twitter.printSchema()
```

```
root
 |-- coordinates: struct (nullable = true)
 |    |-- coordinates: array (nullable = true)
 |    |    |-- element: double (containsNull = true)
 |    |-- type: string (nullable = true)
 |-- created_at: string (nullable = true)
 |-- display_text_range: array (nullable = true)
 |    |-- element: long (containsNull = true)
 |-- entities: struct (nullable = true)
 |    |-- hashtags: array (nullable = true)
 |    |    |-- element: struct (containsNull = true)
 |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |-- text: string (nullable = true)
```

```
|    |-- media: array (nullable = true)
|    |    |-- element: struct (containsNull = true)
|    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |-- title: string (nullable = true)
|    |    |    |-- description: string (nullable = true)
|    |    |    |-- display_url: string (nullable = true)
|    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |-- id: long (nullable = true)
|    |    |    |-- id_str: string (nullable = true)
|    |    |    |-- indices: array (nullable = true)
|    |    |    |    |-- element: long (containsNull = true)
|    |    |    |-- media_url: string (nullable = true)
|    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |-- resize: string (nullable = true)
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|    |    |    |    |-- medium: struct (nullable = true)
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|    |    |    |    |    |-- resize: string (nullable = true)
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|    |    |    |    |-- thumb: struct (nullable = true)
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|    |    |    |    |    |-- resize: string (nullable = true)
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|    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |-- type: string (nullable = true)
|    |    |    |-- url: string (nullable = true)
|    |-- symbols: array (nullable = true)
|    |    |-- element: struct (containsNull = true)
|    |    |    |-- indices: array (nullable = true)
|    |    |    |    |-- element: long (containsNull = true)
|    |    |    |-- text: string (nullable = true)
|    |-- urls: array (nullable = true)
|    |    |-- element: struct (containsNull = true)
|    |    |    |-- display_url: string (nullable = true)
|    |    |    |-- expanded_url: string (nullable = true)
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|    |    |    |-- indices: array (nullable = true)
|    |    |    |    |-- element: long (containsNull = true)
|    |    |    |-- url: string (nullable = true)
|    |-- user_mentions: array (nullable = true)
|    |    |-- element: struct (containsNull = true)
|    |    |    |-- id: long (nullable = true)
|    |    |    |-- id_str: string (nullable = true)
|    |    |    |-- indices: array (nullable = true)
|    |    |    |    |-- element: long (containsNull = true)
|    |    |    |-- name: string (nullable = true)
|    |    |    |-- screen_name: string (nullable = true)
|-- extended_entities: struct (nullable = true)
|    |-- media: array (nullable = true)
|    |    |-- element: struct (containsNull = true)
|    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |-- monetizable: boolean (nullable = true)
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|    |    |    |-- description: string (nullable = true)
|    |    |    |-- display_url: string (nullable = true)
|    |    |    |-- expanded_url: string (nullable = true)
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|    |    |    |-- id_str: string (nullable = true)
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|    |    |    |    |-- element: long (containsNull = true)
|    |    |    |-- media_url: string (nullable = true)
|    |    |    |-- media_url_https: string (nullable = true)
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|    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |-- source_user_id: long (nullable = true)
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|    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |-- type: string (nullable = true)
|    |    |    |-- url: string (nullable = true)
|    |    |    |-- video_info: struct (nullable = true)
|    |    |    |    |-- aspect_ratio: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- duration_millis: long (nullable = true)
|    |    |    |    |-- variants: array (nullable = true)
|    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |-- bitrate: long (nullable = true)
|    |    |    |    |    |    |-- content_type: string (nullable = true)
|    |    |    |    |    |    |-- url: string (nullable = true)
|-- extended_tweet: struct (nullable = true)
|    |-- display_text_range: array (nullable = true)
|    |    |-- element: long (containsNull = true)
|    |-- entities: struct (nullable = true)
|    |    |-- hashtags: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- text: string (nullable = true)
|    |    |-- media: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
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|    |    |    |    |    |-- monetizable: boolean (nullable = true)
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|    |    |    |    |-- description: string (nullable = true)
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|    |    |    |    |-- expanded_url: string (nullable = true)
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|    |    |    |    |-- media_url_https: string (nullable = true)
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|    |    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |    |-- video_info: struct (nullable = true)
|    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
|    |    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |    |-- duration_millis: long (nullable = true)
|    |    |    |    |    |    |-- variants: array (nullable = true)
|    |    |    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
|    |    |    |    |    |    |    |    |-- content_type: string (nullable = true)
|    |    |    |    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |-- symbols: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
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|    |    |    |-- urls: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |-- user_mentions: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- name: string (nullable = true)
|    |    |    |    |    |-- screen_name: string (nullable = true)
|    |    |-- extended_entities: struct (nullable = true)
|    |    |    |-- media: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
```

```
|    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
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|    |    |    |    |    |-- small: struct (nullable = true)
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|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- thumb: struct (nullable = true)
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|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- video_info: struct (nullable = true)
|    |    |    |    |    |-- aspect_ratio: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- duration_millis: long (nullable = true)
|    |    |    |    |    |-- variants: array (nullable = true)
|    |    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
|    |    |    |    |    |    |    |-- content_type: string (nullable = true)
|    |    |    |    |    |    |    |-- url: string (nullable = true)
|    |-- full_text: string (nullable = true)
|-- favorite_count: long (nullable = true)
|-- favorited: boolean (nullable = true)
|-- filter_level: string (nullable = true)
|-- geo: struct (nullable = true)
|    |-- coordinates: array (nullable = true)
```

```
|    |    |-- element: double (containsNull = true)
|    |-- type: string (nullable = true)
|-- id: long (nullable = true)
|-- id_str: string (nullable = true)
|-- in_reply_to_screen_name: string (nullable = true)
|-- in_reply_to_status_id: long (nullable = true)
|-- in_reply_to_status_id_str: string (nullable = true)
|-- in_reply_to_user_id: long (nullable = true)
|-- in_reply_to_user_id_str: string (nullable = true)
|-- is_quote_status: boolean (nullable = true)
|-- lang: string (nullable = true)
|-- place: struct (nullable = true)
|    |-- bounding_box: struct (nullable = true)
|    |    |-- coordinates: array (nullable = true)
|    |    |    |-- element: array (containsNull = true)
|    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |-- element: double (containsNull = true)
|    |    |-- type: string (nullable = true)
|    |-- country: string (nullable = true)
|    |-- country_code: string (nullable = true)
|    |-- full_name: string (nullable = true)
|    |-- id: string (nullable = true)
|    |-- name: string (nullable = true)
|    |-- place_type: string (nullable = true)
|    |-- url: string (nullable = true)
|-- possibly_sensitive: boolean (nullable = true)
|-- quote_count: long (nullable = true)
|-- quoted_status: struct (nullable = true)
|    |-- coordinates: struct (nullable = true)
|    |    |-- coordinates: array (nullable = true)
|    |    |    |-- element: double (containsNull = true)
|    |    |-- type: string (nullable = true)
|    |-- created_at: string (nullable = true)
|    |-- display_text_range: array (nullable = true)
|    |    |-- element: long (containsNull = true)
|    |-- entities: struct (nullable = true)
|    |    |-- hashtags: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- text: string (nullable = true)
|    |    |-- media: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |-- title: string (nullable = true)
```

```
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |    |-- symbols: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- text: string (nullable = true)
|    |    |    |-- urls: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |-- user_mentions: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |-- id_str: string (nullable = true)
```

```
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- name: string (nullable = true)
|    |    |    |    |-- screen_name: string (nullable = true)
|    |-- extended_entities: struct (nullable = true)
|    |    |-- media: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- video_info: struct (nullable = true)
|    |    |    |    |    |-- aspect_ratio: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- duration_millis: long (nullable = true)
```

```
|    |    |    |    |    |-- variants: array (nullable = true)
|    |    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
|    |    |    |    |    |    |    |-- content_type: string (nullable = true)
|    |    |    |    |    |    |    |-- url: string (nullable = true)
|    |-- extended_tweet: struct (nullable = true)
|    |    |-- display_text_range: array (nullable = true)
|    |    |    |-- element: long (containsNull = true)
|    |    |-- entities: struct (nullable = true)
|    |    |    |-- hashtags: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- text: string (nullable = true)
|    |    |    |-- media: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- source_status_id: long (nullable = true)
```

```
 |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
 |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- content_type: string (nullable =
true)
 |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |-- symbols: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- text: string (nullable = true)
 |    |    |    |-- urls: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |-- user_mentions: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- name: string (nullable = true)
 |    |    |    |    |    |-- screen_name: string (nullable = true)
 |    |    |-- extended_entities: struct (nullable = true)
 |    |    |    |-- media: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- additional_media_info: struct (nullable = true)
 |    |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
 |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
 |    |    |    |    |    |    |-- title: string (nullable = true)
 |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |-- id_str: string (nullable = true)
```

```
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- media_url: string (nullable = true)
 |    |    |    |    |    |-- media_url_https: string (nullable = true)
 |    |    |    |    |    |-- sizes: struct (nullable = true)
 |    |    |    |    |    |    |-- large: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- medium: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- small: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- thumb: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |-- source_status_id: long (nullable = true)
 |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
 |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- content_type: string (nullable =
true)
 |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |-- full_text: string (nullable = true)
 |    |-- favorite_count: long (nullable = true)
 |    |-- favorited: boolean (nullable = true)
 |    |-- filter_level: string (nullable = true)
 |    |-- geo: struct (nullable = true)
 |    |    |-- coordinates: array (nullable = true)
 |    |    |    |-- element: double (containsNull = true)
 |    |    |-- type: string (nullable = true)
 |    |-- id: long (nullable = true)
 |    |-- id_str: string (nullable = true)
 |    |-- in_reply_to_screen_name: string (nullable = true)
```

```
|    |-- in_reply_to_status_id: long (nullable = true)
|    |-- in_reply_to_status_id_str: string (nullable = true)
|    |-- in_reply_to_user_id: long (nullable = true)
|    |-- in_reply_to_user_id_str: string (nullable = true)
|    |-- is_quote_status: boolean (nullable = true)
|    |-- lang: string (nullable = true)
|    |-- place: struct (nullable = true)
|    |    |-- bounding_box: struct (nullable = true)
|    |    |    |-- coordinates: array (nullable = true)
|    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |    |-- element: double (containsNull = true)
|    |    |    |-- type: string (nullable = true)
|    |    |-- country: string (nullable = true)
|    |    |-- country_code: string (nullable = true)
|    |    |-- full_name: string (nullable = true)
|    |    |-- id: string (nullable = true)
|    |    |-- name: string (nullable = true)
|    |    |-- place_type: string (nullable = true)
|    |    |-- url: string (nullable = true)
|    |-- possibly_sensitive: boolean (nullable = true)
|    |-- quote_count: long (nullable = true)
|    |-- quoted_status_id: long (nullable = true)
|    |-- quoted_status_id_str: string (nullable = true)
|    |-- reply_count: long (nullable = true)
|    |-- retweet_count: long (nullable = true)
|    |-- retweeted: boolean (nullable = true)
|    |-- scopes: struct (nullable = true)
|    |    |-- followers: boolean (nullable = true)
|    |-- source: string (nullable = true)
|    |-- text: string (nullable = true)
|    |-- truncated: boolean (nullable = true)
|    |-- user: struct (nullable = true)
|    |    |-- contributors_enabled: boolean (nullable = true)
|    |    |-- created_at: string (nullable = true)
|    |    |-- default_profile: boolean (nullable = true)
|    |    |-- default_profile_image: boolean (nullable = true)
|    |    |-- description: string (nullable = true)
|    |    |-- favourites_count: long (nullable = true)
|    |    |-- followers_count: long (nullable = true)
|    |    |-- friends_count: long (nullable = true)
|    |    |-- geo_enabled: boolean (nullable = true)
|    |    |-- id: long (nullable = true)
|    |    |-- id_str: string (nullable = true)
|    |    |-- is_translator: boolean (nullable = true)
|    |    |-- listed_count: long (nullable = true)
|    |    |-- location: string (nullable = true)
|    |    |-- name: string (nullable = true)
```

```
|    |    |-- profile_background_color: string (nullable = true)
|    |    |-- profile_background_image_url: string (nullable = true)
|    |    |-- profile_background_image_url_https: string (nullable = true)
|    |    |-- profile_background_tile: boolean (nullable = true)
|    |    |-- profile_banner_url: string (nullable = true)
|    |    |-- profile_image_url: string (nullable = true)
|    |    |-- profile_image_url_https: string (nullable = true)
|    |    |-- profile_link_color: string (nullable = true)
|    |    |-- profile_sidebar_border_color: string (nullable = true)
|    |    |-- profile_sidebar_fill_color: string (nullable = true)
|    |    |-- profile_text_color: string (nullable = true)
|    |    |-- profile_use_background_image: boolean (nullable = true)
|    |    |-- protected: boolean (nullable = true)
|    |    |-- screen_name: string (nullable = true)
|    |    |-- statuses_count: long (nullable = true)
|    |    |-- translator_type: string (nullable = true)
|    |    |-- url: string (nullable = true)
|    |    |-- verified: boolean (nullable = true)
|    |    |-- verified_type: string (nullable = true)
|    |    |-- withheld_in_countries: array (nullable = true)
|    |    |    |-- element: string (containsNull = true)
|    |-- withheld_copyright: boolean (nullable = true)
|    |-- withheld_in_countries: array (nullable = true)
|    |    |-- element: string (containsNull = true)
|-- quoted_status_id: long (nullable = true)
|-- quoted_status_id_str: string (nullable = true)
|-- quoted_status_permalink: struct (nullable = true)
|    |-- display: string (nullable = true)
|    |-- expanded: string (nullable = true)
|    |-- url: string (nullable = true)
|-- quoted_text: string (nullable = true)
|-- reply_count: long (nullable = true)
|-- retweet_count: long (nullable = true)
|-- retweeted: string (nullable = true)
|-- retweeted_from: string (nullable = true)
|-- retweeted_status: struct (nullable = true)
|    |-- coordinates: struct (nullable = true)
|    |    |-- coordinates: array (nullable = true)
|    |    |    |-- element: double (containsNull = true)
|    |    |-- type: string (nullable = true)
|    |-- created_at: string (nullable = true)
|    |-- display_text_range: array (nullable = true)
|    |    |-- element: long (containsNull = true)
|    |-- entities: struct (nullable = true)
|    |    |-- hashtags: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
```

```
|    |    |    |    |-- text: string (nullable = true)
|    |    |-- media: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |-- symbols: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- text: string (nullable = true)
|    |    |-- urls: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- display_url: string (nullable = true)
```

```
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |-- user_mentions: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- name: string (nullable = true)
|    |    |    |    |-- screen_name: string (nullable = true)
|    |-- extended_entities: struct (nullable = true)
|    |    |-- media: array (nullable = true)
|    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |-- source_status_id_str: string (nullable = true)
```

```
|    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- video_info: struct (nullable = true)
|    |    |    |    |    |-- aspect_ratio: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- duration_millis: long (nullable = true)
|    |    |    |    |    |-- variants: array (nullable = true)
|    |    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
|    |    |    |    |    |    |    |-- content_type: string (nullable = true)
|    |    |    |    |    |    |    |-- url: string (nullable = true)
|    |-- extended_tweet: struct (nullable = true)
|    |    |-- display_text_range: array (nullable = true)
|    |    |    |-- element: long (containsNull = true)
|    |    |-- entities: struct (nullable = true)
|    |    |    |-- hashtags: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- text: string (nullable = true)
|    |    |    |-- media: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- small: struct (nullable = true)
```

```
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- thumb: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- source_status_id: long (nullable = true)
 |    |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
 |    |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
 |    |    |    |    |    |    |    |    |    |-- content_type: string (nullable =
true)
 |    |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |-- symbols: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- text: string (nullable = true)
 |    |    |    |-- urls: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |-- user_mentions: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- name: string (nullable = true)
 |    |    |    |    |    |-- screen_name: string (nullable = true)
 |    |    |-- extended_entities: struct (nullable = true)
 |    |    |    |-- media: array (nullable = true)
 |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |-- additional_media_info: struct (nullable = true)
 |    |    |    |    |    |    |-- description: string (nullable = true)
```

```
 |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
 |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
 |    |    |    |    |    |    |-- title: string (nullable = true)
 |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |-- media_url: string (nullable = true)
 |    |    |    |    |    |-- media_url_https: string (nullable = true)
 |    |    |    |    |    |-- sizes: struct (nullable = true)
 |    |    |    |    |    |    |-- large: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- medium: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- small: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- thumb: struct (nullable = true)
 |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |-- source_status_id: long (nullable = true)
 |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
 |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- content_type: string (nullable =
true)
 |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |-- full_text: string (nullable = true)
 |    |-- favorite_count: long (nullable = true)
 |    |-- favorited: boolean (nullable = true)
```

```
|    |-- filter_level: string (nullable = true)
|    |-- geo: struct (nullable = true)
|    |    |-- coordinates: array (nullable = true)
|    |    |    |-- element: double (containsNull = true)
|    |    |-- type: string (nullable = true)
|    |-- id: long (nullable = true)
|    |-- id_str: string (nullable = true)
|    |-- in_reply_to_screen_name: string (nullable = true)
|    |-- in_reply_to_status_id: long (nullable = true)
|    |-- in_reply_to_status_id_str: string (nullable = true)
|    |-- in_reply_to_user_id: long (nullable = true)
|    |-- in_reply_to_user_id_str: string (nullable = true)
|    |-- is_quote_status: boolean (nullable = true)
|    |-- lang: string (nullable = true)
|    |-- place: struct (nullable = true)
|    |    |-- bounding_box: struct (nullable = true)
|    |    |    |-- coordinates: array (nullable = true)
|    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |    |-- element: double (containsNull = true)
|    |    |    |-- type: string (nullable = true)
|    |    |-- country: string (nullable = true)
|    |    |-- country_code: string (nullable = true)
|    |    |-- full_name: string (nullable = true)
|    |    |-- id: string (nullable = true)
|    |    |-- name: string (nullable = true)
|    |    |-- place_type: string (nullable = true)
|    |    |-- url: string (nullable = true)
|    |-- possibly_sensitive: boolean (nullable = true)
|    |-- quote_count: long (nullable = true)
|    |-- quoted_status: struct (nullable = true)
|    |    |-- coordinates: struct (nullable = true)
|    |    |    |-- coordinates: array (nullable = true)
|    |    |    |    |-- element: double (containsNull = true)
|    |    |    |-- type: string (nullable = true)
|    |    |-- created_at: string (nullable = true)
|    |    |-- display_text_range: array (nullable = true)
|    |    |    |-- element: long (containsNull = true)
|    |    |-- entities: struct (nullable = true)
|    |    |    |-- hashtags: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- text: string (nullable = true)
|    |    |    |-- media: array (nullable = true)
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
```

```
|    |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- symbols: array (nullable = true)
|    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |    |-- text: string (nullable = true)
|    |    |    |    |-- urls: array (nullable = true)
|    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- user_mentions: array (nullable = true)
```

```
|    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |-- name: string (nullable = true)
|    |    |    |    |    |-- screen_name: string (nullable = true)
|    |    |    |-- extended_entities: struct (nullable = true)
|    |    |    |    |-- media: array (nullable = true)
|    |    |    |    |    |-- element: struct (containsNull = true)
|    |    |    |    |    |    |-- additional_media_info: struct (nullable = true)
|    |    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
|    |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
|    |    |    |    |    |    |    |-- title: string (nullable = true)
|    |    |    |    |    |    |-- description: string (nullable = true)
|    |    |    |    |    |    |-- display_url: string (nullable = true)
|    |    |    |    |    |    |-- expanded_url: string (nullable = true)
|    |    |    |    |    |    |-- id: long (nullable = true)
|    |    |    |    |    |    |-- id_str: string (nullable = true)
|    |    |    |    |    |    |-- indices: array (nullable = true)
|    |    |    |    |    |    |    |-- element: long (containsNull = true)
|    |    |    |    |    |    |-- media_url: string (nullable = true)
|    |    |    |    |    |    |-- media_url_https: string (nullable = true)
|    |    |    |    |    |    |-- sizes: struct (nullable = true)
|    |    |    |    |    |    |    |-- large: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- medium: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- small: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |    |-- thumb: struct (nullable = true)
|    |    |    |    |    |    |    |    |-- h: long (nullable = true)
|    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
|    |    |    |    |    |    |    |    |-- w: long (nullable = true)
|    |    |    |    |    |    |-- source_status_id: long (nullable = true)
|    |    |    |    |    |    |-- source_status_id_str: string (nullable = true)
|    |    |    |    |    |    |-- source_user_id: long (nullable = true)
|    |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
|    |    |    |    |    |    |-- type: string (nullable = true)
|    |    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |    |    |-- video_info: struct (nullable = true)
```

```
 |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |    |-- bitrate: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- content_type: string (nullable =
true)
 |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |-- extended_tweet: struct (nullable = true)
 |    |    |    |-- display_text_range: array (nullable = true)
 |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |-- entities: struct (nullable = true)
 |    |    |    |    |-- hashtags: array (nullable = true)
 |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- text: string (nullable = true)
 |    |    |    |    |-- media: array (nullable = true)
 |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |-- additional_media_info: struct (nullable =
true)
 |    |    |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
 |    |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
 |    |    |    |    |    |    |    |-- title: string (nullable = true)
 |    |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- media_url: string (nullable = true)
 |    |    |    |    |    |    |-- media_url_https: string (nullable = true)
 |    |    |    |    |    |    |-- sizes: struct (nullable = true)
 |    |    |    |    |    |    |    |-- large: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- medium: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- small: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
```

```
 |    |    |    |    |    |    |    |-- thumb: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- source_status_id: long (nullable = true)
 |    |    |    |    |    |    |    |-- source_status_id_str: string (nullable =
true)
 |    |    |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |    |    |-- element: struct (containsNull =
true)
 |    |    |    |    |    |    |    |    |    |    |-- bitrate: long (nullable =
true)
 |    |    |    |    |    |    |    |    |    |    |-- content_type: string (nullable
= true)
 |    |    |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |-- symbols: array (nullable = true)
 |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |-- text: string (nullable = true)
 |    |    |    |    |    |-- urls: array (nullable = true)
 |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |-- user_mentions: array (nullable = true)
 |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |-- name: string (nullable = true)
 |    |    |    |    |    |    |    |-- screen_name: string (nullable = true)
 |    |    |    |    |-- extended_entities: struct (nullable = true)
 |    |    |    |    |    |-- media: array (nullable = true)
 |    |    |    |    |    |    |-- element: struct (containsNull = true)
 |    |    |    |    |    |    |    |-- additional_media_info: struct (nullable =
true)
```

```
 |    |    |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |    |    |-- embeddable: boolean (nullable = true)
 |    |    |    |    |    |    |    |-- monetizable: boolean (nullable = true)
 |    |    |    |    |    |    |    |-- title: string (nullable = true)
 |    |    |    |    |    |    |-- description: string (nullable = true)
 |    |    |    |    |    |    |-- display_url: string (nullable = true)
 |    |    |    |    |    |    |-- expanded_url: string (nullable = true)
 |    |    |    |    |    |    |-- id: long (nullable = true)
 |    |    |    |    |    |    |-- id_str: string (nullable = true)
 |    |    |    |    |    |    |-- indices: array (nullable = true)
 |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |-- media_url: string (nullable = true)
 |    |    |    |    |    |    |-- media_url_https: string (nullable = true)
 |    |    |    |    |    |    |-- sizes: struct (nullable = true)
 |    |    |    |    |    |    |    |-- large: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- medium: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- small: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |    |-- thumb: struct (nullable = true)
 |    |    |    |    |    |    |    |    |-- h: long (nullable = true)
 |    |    |    |    |    |    |    |    |-- resize: string (nullable = true)
 |    |    |    |    |    |    |    |    |-- w: long (nullable = true)
 |    |    |    |    |    |    |-- source_status_id: long (nullable = true)
 |    |    |    |    |    |    |-- source_status_id_str: string (nullable =
true)
 |    |    |    |    |    |    |-- source_user_id: long (nullable = true)
 |    |    |    |    |    |    |-- source_user_id_str: string (nullable = true)
 |    |    |    |    |    |    |-- type: string (nullable = true)
 |    |    |    |    |    |    |-- url: string (nullable = true)
 |    |    |    |    |    |    |-- video_info: struct (nullable = true)
 |    |    |    |    |    |    |    |-- aspect_ratio: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: long (containsNull = true)
 |    |    |    |    |    |    |    |-- duration_millis: long (nullable = true)
 |    |    |    |    |    |    |    |-- variants: array (nullable = true)
 |    |    |    |    |    |    |    |    |-- element: struct (containsNull =
true)
 |    |    |    |    |    |    |    |    |    |-- bitrate: long (nullable =
true)
 |    |    |    |    |    |    |    |    |    |-- content_type: string (nullable
= true)
```

```
|    |    |    |    |    |    |    |    |    |-- url: string (nullable = true)
|    |    |    |    |-- full_text: string (nullable = true)
|    |    |-- favorite_count: long (nullable = true)
|    |    |-- favorited: boolean (nullable = true)
|    |    |-- filter_level: string (nullable = true)
|    |    |-- geo: struct (nullable = true)
|    |    |    |-- coordinates: array (nullable = true)
|    |    |    |    |-- element: double (containsNull = true)
|    |    |    |-- type: string (nullable = true)
|    |    |-- id: long (nullable = true)
|    |    |-- id_str: string (nullable = true)
|    |    |-- in_reply_to_screen_name: string (nullable = true)
|    |    |-- in_reply_to_status_id: long (nullable = true)
|    |    |-- in_reply_to_status_id_str: string (nullable = true)
|    |    |-- in_reply_to_user_id: long (nullable = true)
|    |    |-- in_reply_to_user_id_str: string (nullable = true)
|    |    |-- is_quote_status: boolean (nullable = true)
|    |    |-- lang: string (nullable = true)
|    |    |-- place: struct (nullable = true)
|    |    |    |-- bounding_box: struct (nullable = true)
|    |    |    |    |-- coordinates: array (nullable = true)
|    |    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |    |-- element: array (containsNull = true)
|    |    |    |    |    |    |    |-- element: double (containsNull = true)
|    |    |    |    |-- type: string (nullable = true)
|    |    |    |-- country: string (nullable = true)
|    |    |    |-- country_code: string (nullable = true)
|    |    |    |-- full_name: string (nullable = true)
|    |    |    |-- id: string (nullable = true)
|    |    |    |-- name: string (nullable = true)
|    |    |    |-- place_type: string (nullable = true)
|    |    |    |-- url: string (nullable = true)
|    |    |-- possibly_sensitive: boolean (nullable = true)
|    |    |-- quote_count: long (nullable = true)
|    |    |-- quoted_status_id: long (nullable = true)
|    |    |-- quoted_status_id_str: string (nullable = true)
|    |    |-- reply_count: long (nullable = true)
|    |    |-- retweet_count: long (nullable = true)
|    |    |-- retweeted: boolean (nullable = true)
|    |    |-- scopes: struct (nullable = true)
|    |    |    |-- followers: boolean (nullable = true)
|    |    |-- source: string (nullable = true)
|    |    |-- text: string (nullable = true)
|    |    |-- truncated: boolean (nullable = true)
|    |    |-- user: struct (nullable = true)
|    |    |    |-- contributors_enabled: boolean (nullable = true)
|    |    |    |-- created_at: string (nullable = true)
|    |    |    |-- default_profile: boolean (nullable = true)
```

```
|    |    |    |-- default_profile_image: boolean (nullable = true)
|    |    |    |-- description: string (nullable = true)
|    |    |    |-- favourites_count: long (nullable = true)
|    |    |    |-- followers_count: long (nullable = true)
|    |    |    |-- friends_count: long (nullable = true)
|    |    |    |-- geo_enabled: boolean (nullable = true)
|    |    |    |-- id: long (nullable = true)
|    |    |    |-- id_str: string (nullable = true)
|    |    |    |-- is_translator: boolean (nullable = true)
|    |    |    |-- listed_count: long (nullable = true)
|    |    |    |-- location: string (nullable = true)
|    |    |    |-- name: string (nullable = true)
|    |    |    |-- profile_background_color: string (nullable = true)
|    |    |    |-- profile_background_image_url: string (nullable = true)
|    |    |    |-- profile_background_image_url_https: string (nullable = true)
|    |    |    |-- profile_background_tile: boolean (nullable = true)
|    |    |    |-- profile_banner_url: string (nullable = true)
|    |    |    |-- profile_image_url: string (nullable = true)
|    |    |    |-- profile_image_url_https: string (nullable = true)
|    |    |    |-- profile_link_color: string (nullable = true)
|    |    |    |-- profile_sidebar_border_color: string (nullable = true)
|    |    |    |-- profile_sidebar_fill_color: string (nullable = true)
|    |    |    |-- profile_text_color: string (nullable = true)
|    |    |    |-- profile_use_background_image: boolean (nullable = true)
|    |    |    |-- protected: boolean (nullable = true)
|    |    |    |-- screen_name: string (nullable = true)
|    |    |    |-- statuses_count: long (nullable = true)
|    |    |    |-- translator_type: string (nullable = true)
|    |    |    |-- url: string (nullable = true)
|    |    |    |-- verified: boolean (nullable = true)
|    |    |    |-- verified_type: string (nullable = true)
|    |    |    |-- withheld_in_countries: array (nullable = true)
|    |    |    |    |-- element: string (containsNull = true)
|    |    |-- withheld_in_countries: array (nullable = true)
|    |    |    |-- element: string (containsNull = true)
|    |-- quoted_status_id: long (nullable = true)
|    |-- quoted_status_id_str: string (nullable = true)
|    |-- quoted_status_permalink: struct (nullable = true)
|    |    |-- display: string (nullable = true)
|    |    |-- expanded: string (nullable = true)
|    |    |-- url: string (nullable = true)
|    |-- reply_count: long (nullable = true)
|    |-- retweet_count: long (nullable = true)
|    |-- retweeted: boolean (nullable = true)
|    |-- scopes: struct (nullable = true)
|    |    |-- followers: boolean (nullable = true)
|    |    |-- place_ids: array (nullable = true)
|    |    |    |-- element: string (containsNull = true)
```

```
|    |-- source: string (nullable = true)
|    |-- text: string (nullable = true)
|    |-- truncated: boolean (nullable = true)
|    |-- user: struct (nullable = true)
|    |    |-- contributors_enabled: boolean (nullable = true)
|    |    |-- created_at: string (nullable = true)
|    |    |-- default_profile: boolean (nullable = true)
|    |    |-- default_profile_image: boolean (nullable = true)
|    |    |-- description: string (nullable = true)
|    |    |-- favourites_count: long (nullable = true)
|    |    |-- followers_count: long (nullable = true)
|    |    |-- friends_count: long (nullable = true)
|    |    |-- geo_enabled: boolean (nullable = true)
|    |    |-- id: long (nullable = true)
|    |    |-- id_str: string (nullable = true)
|    |    |-- is_translator: boolean (nullable = true)
|    |    |-- listed_count: long (nullable = true)
|    |    |-- location: string (nullable = true)
|    |    |-- name: string (nullable = true)
|    |    |-- profile_background_color: string (nullable = true)
|    |    |-- profile_background_image_url: string (nullable = true)
|    |    |-- profile_background_image_url_https: string (nullable = true)
|    |    |-- profile_background_tile: boolean (nullable = true)
|    |    |-- profile_banner_url: string (nullable = true)
|    |    |-- profile_image_url: string (nullable = true)
|    |    |-- profile_image_url_https: string (nullable = true)
|    |    |-- profile_link_color: string (nullable = true)
|    |    |-- profile_sidebar_border_color: string (nullable = true)
|    |    |-- profile_sidebar_fill_color: string (nullable = true)
|    |    |-- profile_text_color: string (nullable = true)
|    |    |-- profile_use_background_image: boolean (nullable = true)
|    |    |-- protected: boolean (nullable = true)
|    |    |-- screen_name: string (nullable = true)
|    |    |-- statuses_count: long (nullable = true)
|    |    |-- translator_type: string (nullable = true)
|    |    |-- url: string (nullable = true)
|    |    |-- verified: boolean (nullable = true)
|    |    |-- verified_type: string (nullable = true)
|    |    |-- withheld_in_countries: array (nullable = true)
|    |    |    |-- element: string (containsNull = true)
|    |-- withheld_in_countries: array (nullable = true)
|    |    |-- element: string (containsNull = true)
|-- source: string (nullable = true)
|-- text: string (nullable = true)
|-- timestamp_ms: string (nullable = true)
|-- truncated: boolean (nullable = true)
|-- tweet_text: string (nullable = true)
|-- user: struct (nullable = true)
```

```
|    |-- contributors_enabled: boolean (nullable = true)
|    |-- created_at: string (nullable = true)
|    |-- default_profile: boolean (nullable = true)
|    |-- default_profile_image: boolean (nullable = true)
|    |-- description: string (nullable = true)
|    |-- favourites_count: long (nullable = true)
|    |-- followers_count: long (nullable = true)
|    |-- friends_count: long (nullable = true)
|    |-- geo_enabled: boolean (nullable = true)
|    |-- id: long (nullable = true)
|    |-- id_str: string (nullable = true)
|    |-- is_translator: boolean (nullable = true)
|    |-- listed_count: long (nullable = true)
|    |-- location: string (nullable = true)
|    |-- name: string (nullable = true)
|    |-- profile_background_color: string (nullable = true)
|    |-- profile_background_image_url: string (nullable = true)
|    |-- profile_background_image_url_https: string (nullable = true)
|    |-- profile_background_tile: boolean (nullable = true)
|    |-- profile_banner_url: string (nullable = true)
|    |-- profile_image_url: string (nullable = true)
|    |-- profile_image_url_https: string (nullable = true)
|    |-- profile_link_color: string (nullable = true)
|    |-- profile_sidebar_border_color: string (nullable = true)
|    |-- profile_sidebar_fill_color: string (nullable = true)
|    |-- profile_text_color: string (nullable = true)
|    |-- profile_use_background_image: boolean (nullable = true)
|    |-- protected: boolean (nullable = true)
|    |-- screen_name: string (nullable = true)
|    |-- statuses_count: long (nullable = true)
|    |-- translator_type: string (nullable = true)
|    |-- url: string (nullable = true)
|    |-- verified: boolean (nullable = true)
|    |-- verified_type: string (nullable = true)
|    |-- withheld_in_countries: array (nullable = true)
|    |    |-- element: string (containsNull = true)
|-- withheld_in_countries: array (nullable = true)
|    |-- element: string (containsNull = true)
```

[9]:
```
data = twitter.select([twitter.created_at,
                       twitter.id_str.alias('tweet_id'),
                       twitter.user['id_str'].alias('user_id'),
                       twitter.user['name'].alias('user_name'),
                       twitter.user['verified'].alias('verified'),
                       twitter.user['followers_count'].
↪alias('followers_count'),
```

```
                                twitter.user['location'],
                                twitter.user['created_at'],

                                twitter.text,
                                twitter.lang.alias('tweet_language'),
                                twitter.retweet_count,
                                twitter.favorite_count,
                                twitter.quote_count,
                                twitter.entities.hashtags['text'].
↪alias('hashtag_text'),

                                twitter.retweeted,
                                twitter.retweeted_from,
                                #twitter.retweeted_status
                                twitter.retweeted_status.retweet_count.
↪alias('rt_count'),
                                twitter.retweeted_status.id_str.alias('rt_id'),
                                twitter.retweeted_status.created_at.
↪alias('rt_create'),
                                twitter.retweeted_status.favorite_count.
↪alias('rt_fav'),
                                twitter.retweeted_status.quote_count.
↪alias('rt_quo'),
                                twitter.retweeted_status.entities.
↪hashtags['text'].alias('rt_hashtag_text'),
                                twitter.retweeted_status.user['id_str'].
↪alias('rt_user_id'),
                                twitter.retweeted_status.user['name'].
↪alias('rt_user_name'),


                                #twitter.quoted_status.alias('tweet_quote'),
                                twitter.place.country.alias('tweet_country'),
                                twitter.place.full_name.alias('tweet_location')])
```

[10]:
```
data.printSchema()
```

```
root
 |-- created_at: string (nullable = true)
 |-- tweet_id: string (nullable = true)
 |-- user_id: string (nullable = true)
 |-- user_name: string (nullable = true)
 |-- verified: boolean (nullable = true)
 |-- followers_count: long (nullable = true)
 |-- user.location: string (nullable = true)
 |-- user.created_at: string (nullable = true)
 |-- text: string (nullable = true)
```

```
 |-- tweet_language: string (nullable = true)
 |-- retweet_count: long (nullable = true)
 |-- favorite_count: long (nullable = true)
 |-- quote_count: long (nullable = true)
 |-- hashtag_text: array (nullable = true)
 |    |-- element: string (containsNull = true)
 |-- retweeted: string (nullable = true)
 |-- retweeted_from: string (nullable = true)
 |-- rt_count: long (nullable = true)
 |-- rt_id: string (nullable = true)
 |-- rt_create: string (nullable = true)
 |-- rt_fav: long (nullable = true)
 |-- rt_quo: long (nullable = true)
 |-- rt_hashtag_text: array (nullable = true)
 |    |-- element: string (containsNull = true)
 |-- rt_user_id: string (nullable = true)
 |-- rt_user_name: string (nullable = true)
 |-- tweet_country: string (nullable = true)
 |-- tweet_location: string (nullable = true)
```

[34]:
```
data.select('retweeted','retweeted_from').show(5)
```

```
+---------+--------------+
|retweeted|retweeted_from|
+---------+--------------+
|       RT|   AaronParnas|
|         |          null|
|       RT|   MoneyMiaaaa|
|       RT|   MoneyMiaaaa|
|         |          null|
+---------+--------------+
only showing top 5 rows
```

[36]:
```
place = data.select('tweet_country', 'tweet_location')
place.filter(col('tweet_country').isNotNull()).show(5)
```

```
+--------------+--------------------+
|  tweet_country|      tweet_location|
+--------------+--------------------+
|  United States|          Smyrna, TN|
|  United States|   Pompano Beach, FL|
|  United States|          Keizer, OR|
|  United States|     Los Angeles, CA|
|The Netherlands|Rotterdam, The Ne…|
+--------------+--------------------+
only showing top 5 rows
```

[35]:
```
retweets = data.select('retweeted','retweeted_from', 'rt_count', 'rt_fav')
retweets = retweets.filter(col('retweeted_from').isNotNull())
retweets.orderBy(col('rt_count').desc()).show(5)
```

```
[Stage 21:=================================================>(5739 + 2) / 5741]

+---------+-------------+--------+-------+
|retweeted|retweeted_from|rt_count| rt_fav|
+---------+-------------+--------+-------+
|       RT|        nickjr|  516855|2036787|
|       RT|        nickjr|  516850|2036713|
|       RT|        nickjr|  516795|2036562|
|       RT|        nickjr|  516791|2036584|
|       RT|        nickjr|  516779|2036505|
+---------+-------------+--------+-------+
only showing top 5 rows
```

[37]:
```
country_count = place.groupby('tweet_country').agg(count('*').
 ↪alias('Number_of_tweets'))
country_count.orderBy(col('Number_of_tweets').desc()).show(5)
```

```
[Stage 25:=========================================>             (15 + 5) / 20]

+--------------------+----------------+
|       tweet_country|Number_of_tweets|
+--------------------+----------------+
|                null|        99112826|
|       United States|          554287|
|      United Kingdom|           73793|
|               India|           46194|
|Kingdom of Saudi …|           38942|
+--------------------+----------------+
only showing top 5 rows
```

[39]:
```
language = data.select('tweet_language').groupby('tweet_language').
 ↪agg(count('*').alias('count_by_language'))
language.orderBy(col('count_by_language').desc()).show(5)
```

```
[Stage 30:>                                                         (0 + 1) / 1]

+--------------+-----------------+
|tweet_language|count_by_language|
```

```
+--------------+-----------------+
|            en|         99994342|
+--------------+-----------------+
```

[43]:
```
data.select('text').filter(col('text').isNull()).show(5)
```

```
+----+
|text|
+----+
+----+
```

First, clean the text

[5]:
```
!pip uninstall -y nltk
!pip install nltk --upgrade --no-cache-dir
```

```
Found existing installation: nltk 3.6.4
Uninstalling nltk-3.6.4:
  Successfully uninstalled nltk-3.6.4
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
Collecting nltk
  Downloading nltk-3.8.1-py3-none-any.whl (1.5 MB)
                             1.5/1.5 MB
26.6 MB/s eta 0:00:00 0:00:01
Requirement already satisfied: tqdm in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (4.64.1)
Requirement already satisfied: joblib in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (1.2.0)
Collecting regex>=2021.8.3
  Downloading
regex-2022.10.31-cp38-cp38-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (772
kB)
                           772.3/772.3 kB
286.2 MB/s eta 0:00:00
Requirement already satisfied: click in
/opt/conda/miniconda3/lib/python3.8/site-packages (from nltk) (7.1.2)
Installing collected packages: regex, nltk
  Attempting uninstall: regex
    Found existing installation: regex 2021.4.4
    Uninstalling regex-2021.4.4:
```

```
      Successfully uninstalled regex-2021.4.4
Successfully installed nltk-3.8.1 regex-2022.10.31
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
```

[6]:
```
import re
import nltk
nltk.download('stopwords')
from nltk.corpus import stopwords
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data…
[nltk_data]   Unzipping corpora/stopwords.zip.
```

[11]:
```
text_data = data.select('text')

text = text_data.rdd.map(lambda x : x['text']).filter(lambda x: x is not None)

StopWords = stopwords.words("english")

tokens = text\
    .map( lambda document: document.strip().lower())\
    .map( lambda document: re.split(" ", 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 StopWords])\
    #.zipWithIndex()
```

[61]:
```
tokens.take(5)
```

[61]:
```
[['upset', 'beto', 'interrupting', 'press', 'conference', 'school'],
 ['homeschooling', 'effectively', 'must', 'send', 'child', 'accredited'],
 ['school', 'shootings', 'worried', 'ridiculous'],
 ['school', 'shootings', 'worried', 'ridiculous'],
 ['uncompleted', 'structure', 'fenced', 'gated', 'adebisi']]
```

[12]:
```
wordCounts = tokens.flatMap(lambda x: x) \
    .map(lambda x: (x, 1)) \
    .reduceByKey(lambda x, y: x+y) \
    .map(lambda x:(x[1],x[0]))
```

[13]:
```
wordCountsSorted = wordCounts.sortByKey(ascending=False)
```

[14]:
```
wordCountsSorted.take(20)
```

[14]:
```
[(35321364, 'school'),
 (10222592, 'college'),
 (7962524, 'high'),
 (7763989, 'university'),
 (5370633, 'schools'),
 (4097465, 'students'),
 (3793172, 'like'),
 (2894026, 'kids'),
 (2851083, 'professor'),
 (2734429, 'people'),
 (2344286, 'student'),
 (2329987, 'first'),
 (2313212, 'back'),
 (2311217, 'children'),
 (2150610, 'public'),
 (2055366, 'year'),
 (2021828, 'would'),
 (1954768, 'time'),
 (1873296, 'know'),
 (1814856, 'going')]
```

[19]:
```
word_counts_desc = wordCountsSorted.map(lambda x : (x[1], x[0]))\
    .toDF(["Words", "Counts"])
```

[21]:
```
word_counts_desc.show(30)
```

```
+----------+--------+
|     Words|  Counts|
+----------+--------+
|    school|35321364|
|   college|10222592|
|      high| 7962524|
|university| 7763989|
|   schools| 5370633|
|  students| 4097465|
|      like| 3793172|
|      kids| 2894026|
| professor| 2851083|
|    people| 2734429|
|   student| 2344286|
|     first| 2329987|
|      back| 2313212|
|  children| 2311217|
|    public| 2150610|
```

```
|      year| 2055366|
|     would| 2021828|
|      time| 1954768|
|      know| 1873296|
|     going| 1814856|
|      want| 1782043|
|  football| 1750798|
|     years| 1711423|
|     state| 1709843|
|      need| 1701804|
|      went| 1667016|
|   teacher| 1538729|
|      live| 1530527|
|     every| 1522680|
|     today| 1506946|
+----------+--------+
only showing top 30 rows
```

[40]:
```
keywords = ['college', 'high', 'university', 'students'
            , 'public', 'private', 'secondary', 'primary', 'education',␣
 ↪'undergraduate','graduate']
```

[41]:
```
#filter out rows that do not contain words in keywords
data = data.withColumn('lower', lower(col('text')))
filter_df = data.filter(col('lower').rlike('|'.join(keywords)))
```

[42]:
```
data_eng = filter_df.filter(col('tweet_language') == '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_en = data_eng.filter(filter_udf(eng_ord('text')) == True)
```

[43]:
```
tweets_en.count()
```

[43]: 39621120

[8]:
```
tweets_en.printSchema()
```

```
root
 |-- created_at: string (nullable = true)
 |-- tweet_id: string (nullable = true)
 |-- user_id: string (nullable = true)
 |-- user_name: string (nullable = true)
 |-- verified: boolean (nullable = true)
 |-- followers_count: long (nullable = true)
 |-- user.location: string (nullable = true)
 |-- user.created_at: string (nullable = true)
 |-- text: string (nullable = true)
 |-- tweet_language: string (nullable = true)
 |-- retweet_count: long (nullable = true)
 |-- favorite_count: long (nullable = true)
 |-- quote_count: long (nullable = true)
 |-- hashtag_text: array (nullable = true)
 |    |-- element: string (containsNull = true)
 |-- retweeted: string (nullable = true)
 |-- retweeted_from: string (nullable = true)
 |-- rt_count: long (nullable = true)
 |-- rt_id: string (nullable = true)
 |-- rt_create: string (nullable = true)
 |-- rt_fav: long (nullable = true)
 |-- rt_quo: long (nullable = true)
 |-- rt_hashtag_text: array (nullable = true)
 |    |-- element: string (containsNull = true)
 |-- rt_user_id: string (nullable = true)
 |-- rt_user_name: string (nullable = true)
 |-- tweet_country: string (nullable = true)
 |-- tweet_location: string (nullable = true)
 |-- lower: string (nullable = true)
```

[21]:
```
tweets_en.select('retweeted').show(5)
```

```
+---------+
|retweeted|
+---------+
|       RT|
|         |
|         |
|       RT|
|       RT|
+---------+
only showing top 5 rows
```

[48]:
```
retweets = tweets_en.select('retweeted','retweeted_from', 'rt_count', 'rt_fav')
retweets = retweets.filter(col('retweeted_from').isNotNull())
retweets.orderBy(col('rt_count').desc()).show(5)
```

```
[Stage 57:=================================================>(1319 + 4) / 1323]

+---------+--------------+--------+-------+
|retweeted|retweeted_from|rt_count| rt_fav|
+---------+--------------+--------+-------+
|       RT|        nickjr|  516855|2036787|
|       RT|        nickjr|  516850|2036713|
|       RT|        nickjr|  516795|2036562|
|       RT|        nickjr|  516791|2036584|
|       RT|        nickjr|  516779|2036505|
+---------+--------------+--------+-------+
only showing top 5 rows
```

Save the data to parquet

[44]:
```
%%time
tweets_en.write.format("parquet").\
mode('overwrite').\
save('gs://chen26-bdp/filtered')
```

```
CPU times: user 1.08 s, sys: 273 ms, total: 1.35 s
Wall time: 10min 15s
```

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

```
CPU times: user 5.04 s, sys: 1.05 s, total: 6.09 s
Wall time: 57min 31s
```

[22]:
```
%%time
word_counts_desc.write.format("parquet").\
mode('overwrite').\
save('gs://chen26-bdp/word_count')
```

```
CPU times: user 163 ms, sys: 101 ms, total: 265 ms
Wall time: 33.9 s
```

[24]:
```
%%time
twitter = spark.read.parquet('gs://chen26-bdp/original_data')
```

```
CPU times: user 3.47 ms, sys: 468 µs, total: 3.94 ms
Wall time: 1.49 s
```

[7]:
```
%%time
tweets_en = spark.read.parquet('gs://chen26-bdp/filtered')
```

```
CPU times: user 7.26 ms, sys: 456 µs, total: 7.71 ms
Wall time: 7.21 s
```

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