wrangle_act

August 15, 2020

#

Udacity Data Analysis Nanodegree

##

Project: WeRateDogs Twitter Data

###

Noaman Mangera, July 2020

0.1 Table of Contents

0.2 Gather

0.2.1 General Properties

[344]:
```
# Import necessary modules
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import requests
from tweepy import OAuthHandler
import json
from timeit import default_timer as timer
```

Twitter Archive

[345]:
```
# read in locally sourced file
twitter_archive = pd.read_csv(r'C:\Users\noama\twitter-archive-enhanced-2.csv')
```

[346]:
```
#visually inspect first five rows of twitter_archive
twitter_archive.head()
```

[346]:

	tweet_id	in_reply_to_status_id	in_reply_to_user_id	timestamp	source	text	retweeted_status_id	retweeted_status_user_id	retweeted_status_timestamp	expanded_urls	rating_numerator	rating_denominator	name	doggo	floofer	pupper	puppo
0	892420643555336193	NaN	NaN	2017-08-01 16:23:56 +0000	<a href="http://twitter.com/download/iphone" r…	This is Phineas. He's a mystical boy. Only eve…	NaN	NaN	NaN	https://twitter.com/dog_rates/status/892420643…	13	10	Phineas	None	None	None	None
1	892177421306343426	NaN	NaN	2017-08-01 00:17:27 +0000	<a href="http://twitter.com/download/iphone" r…	This is Tilly. She's just checking pup on you…	NaN	NaN	NaN	https://twitter.com/dog_rates/status/892177421…	13	10	Tilly	None	None	None	None
2	891815181378084864	NaN	NaN	2017-07-31 00:18:03 +0000	<a href="http://twitter.com/download/iphone" r…	This is Archie. He is a rare Norwegian Pouncin…	NaN	NaN	NaN	https://twitter.com/dog_rates/status/891815181…	12	10	Archie	None	None	None	None
3	891689557279858688	NaN	NaN	2017-07-30 15:58:51 +0000	<a href="http://twitter.com/download/iphone" r…	This is Darla. She commenced a snooze mid meal…	NaN	NaN	NaN	https://twitter.com/dog_rates/status/891689557…	13	10	Darla	None	None	None	None
4	891327558926688256	NaN	NaN	2017-07-29 16:00:24 +0000	<a href="http://twitter.com/download/iphone" r…	This is Franklin. He would like you to stop ca…	NaN	NaN	NaN	https://twitter.com/dog_rates/status/891327558…	12	10	Franklin	None	None	None	None

```
4                  10  Franklin  None     None    None  None
```

[347]:
```
# number of columns and rows in the data set
print("This dataset has " + str(twitter_archive.shape[0]) + " observations" + "␣
 ↪and " + str(twitter_archive.shape[1]) + " columns")
```

```
This dataset has 2356 observations and 17 columns
```

[348]:
```
# display column names, data types and number of missing data in the␣
 ↪twitter_archive dataframe
twitter_archive.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2356 entries, 0 to 2355
Data columns (total 17 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    2356 non-null   int64
 1   in_reply_to_status_id       78 non-null     float64
 2   in_reply_to_user_id         78 non-null     float64
 3   timestamp                   2356 non-null   object
 4   source                      2356 non-null   object
 5   text                        2356 non-null   object
 6   retweeted_status_id         181 non-null    float64
 7   retweeted_status_user_id    181 non-null    float64
 8   retweeted_status_timestamp  181 non-null    object
 9   expanded_urls               2297 non-null   object
 10  rating_numerator            2356 non-null   int64
 11  rating_denominator          2356 non-null   int64
 12  name                        2356 non-null   object
 13  doggo                       2356 non-null   object
 14  floofer                     2356 non-null   object
 15  pupper                      2356 non-null   object
 16  puppo                       2356 non-null   object
dtypes: float64(4), int64(3), object(10)
memory usage: 313.0+ KB
```

Image Predictions File

[349]:
```
# point request library in the direction of the url, and download tsv file␣
 ↪programatically
url = "https://d17h27t6h515a5.cloudfront.net/topher/2017/August/
 ↪599fd2ad_image-predictions/image-predictions.tsv"

response = requests.get(url)

with open(r'C:\Users\noama\image-predictions-3.tsv', 'wb') as file:
    file.write(response.content)
```

[350]:
```
# read in image predictions data as dataframe
image_predictions = pd.read_csv(r'C:\Users\noama\image-predictions-3.tsv',␣
↪sep='\t')
```

[351]:
```
#visually inspect first five rows of image_predictions
image_predictions.head()
```

[351]:

	tweet_id	jpg_url	img_num	p1	p1_conf	p1_dog	p2	p2_conf	p2_dog	p3	p3_conf	p3_dog
0	666020888022790149	https://pbs.twimg.com/media/CT4udn0WwAA0aMy.jpg	1	Welsh_springer_spaniel	0.465074	True	collie	0.156665	True	Shetland_sheepdog	0.061428	True
1	666029285002620928	https://pbs.twimg.com/media/CT42GRgUYAA5iDo.jpg	1	redbone	0.506826	True	miniature_pinscher	0.074192	True	Rhodesian_ridgeback	0.072010	True
2	666033412701032449	https://pbs.twimg.com/media/CT4521TWwAEvMyu.jpg	1	German_shepherd	0.596461	True	malinois	0.138584	True	bloodhound	0.116197	True
3	666044226329800704	https://pbs.twimg.com/media/CT5Dr8HUEAA-lEu.jpg	1	Rhodesian_ridgeback	0.408143	True	redbone	0.360687	True	miniature_pinscher	0.222752	True
4	666049248165822465	https://pbs.twimg.com/media/CT5IQmsXIAAKY4A.jpg	1	miniature_pinscher	0.560311	True	Rottweiler	0.243682	True	Doberman	0.154629	True

[352]:
```
# number of columns and rows in the image_predictions dataset
print("The image predictions dataset has " + str(image_predictions.shape[0]) +␣
↪" observations" + "and " + str(image_predictions.shape[1]) + " columns")
```

```
The image predictions dataset has 2075 observationsand 12 columns
```

[353]:
```
# display column names, data types and number of missing data in the␣
↪image_predictions dataframe
image_predictions.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2075 entries, 0 to 2074
Data columns (total 12 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   tweet_id  2075 non-null   int64
 1   jpg_url   2075 non-null   object
 2   img_num   2075 non-null   int64
 3   p1        2075 non-null   object
```

```
 4   p1_conf    2075 non-null   float64
 5   p1_dog     2075 non-null   bool
 6   p2         2075 non-null   object
 7   p2_conf    2075 non-null   float64
 8   p2_dog     2075 non-null   bool
 9   p3         2075 non-null   object
 10  p3_conf    2075 non-null   float64
 11  p3_dog     2075 non-null   bool
dtypes: bool(3), float64(3), int64(2), object(4)
memory usage: 152.1+ KB
```

Twitter API

[354]:
```
# Query Twitter API for each tweet in the Twitter archive and save JSON in a␣
 ↪text file
# These are hidden to comply with Twitter's API terms and conditions
consumer_key = 'HIDDEN'
consumer_secret = 'HIDDEN'
access_token = 'HIDDEN'
access_secret = 'HIDDEN'
```

[355]:
```
#auth = OAuthHandler(consumer_key, consumer_secret)
#auth.set_access_token(access_token, access_secret)

#api = tweepy.API(auth, wait_on_rate_limit=True)
```

[356]:
```
# Query Twitter's API for JSON data for each tweet ID in the Twitter archive
#count = 0
#fails_dict = {}
#start = timer()
# Save each tweet's returned JSON as a new line in a .txt file
#with open('tweet_json.txt', 'w') as outfile:
    # This loop will likely take 20-30 minutes to run because of Twitter's rate␣
 ↪limit
 #   for tweet_id in tweet_ids:
  #      count += 1
   #     print(str(count) + ": " + str(tweet_id))
    #    try:
     #       tweet = api.get_status(tweet_id, tweet_mode='extended')
      #      print("Success")
       #     json.dump(tweet._json, outfile)
        #    outfile.write('\n')
        #except tweepy.TweepError as e:
         #   print("Fail")
          #  fails_dict[tweet_id] = e
           # pass
#end = timer()
#print(end - start)
```

```
#print(fails_dict)
```

[357]:
```
#create empty dateframe with column headers
df_tweet_json = pd.DataFrame(columns=['tweet_id', 'retweet_count',␣
↪'favorite_count'])

#read json file line by line into dataFrame with tweet_id, retweet_count,␣
↪favorite_count
with open(r'C:\Users\noama\tweet-json.txt') as data_file:
    for line in data_file:
        tweet = json.loads(line)
        tweet_id = tweet['id_str']
        retweet_count = tweet['retweet_count']
        favorite_count = tweet['favorite_count']
        df_tweet_json = df_tweet_json.append(pd.DataFrame([[tweet_id,␣
↪retweet_count, favorite_count]],
        columns=['tweet_id', 'retweet_count', 'favorite_count']))
        df_tweet_json = df_tweet_json.reset_index(drop=True)
```

[358]:
```
#visually inspect first five rows of df_tweet_json dataframe
df_tweet_json.head()
```

[358]:

	tweet_id	retweet_count	favorite_count
0	892420643555336193	8853	39467
1	892177421306343426	6514	33819
2	891815181378084864	4328	25461
3	891689557279858688	8964	42908
4	891327558926688256	9774	41048

[359]:
```
# number of columns and rows in the df_tweet_json dataset
print("The image predictions dataset has " + str(df_tweet_json.shape[0]) + "␣
↪observations" + "and " + str(df_tweet_json.shape[1]) + " columns")
```

```
The image predictions dataset has 2354 observationsand 3 columns
```

[360]:
```
# display column names, data types and number of missing data in the␣
↪df_tweet_json dataframe
df_tweet_json.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2354 entries, 0 to 2353
Data columns (total 3 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   tweet_id        2354 non-null   object
 1   retweet_count   2354 non-null   object
 2   favorite_count  2354 non-null   object
```

```
dtypes: object(3)
memory usage: 55.3+ KB
```

Assess

0.2.2 Quality

[361]:
```
#visually inspect a random selection of 5 rows
twitter_archive.sample(5)
```

[361]:
```
               tweet_id  in_reply_to_status_id  in_reply_to_user_id  \
438   820013781606658049                    NaN                  NaN
1969  673317986296586240                    NaN                  NaN
126   868552278524837888                    NaN                  NaN
1716  680206703334408192                    NaN                  NaN
262   842765311967449089                    NaN                  NaN

                      timestamp  \
438   2017-01-13 21:04:55 +0000
1969  2015-12-06 01:48:12 +0000
126   2017-05-27 19:39:34 +0000
1716  2015-12-25 02:01:30 +0000
262   2017-03-17 15:51:22 +0000

                                                 source  \
438   <a href="http://twitter.com/download/iphone" r…
1969  <a href="http://twitter.com/download/iphone" r…
126   <a href="http://twitter.com/download/iphone" r…
1716  <a href="http://twitter.com/download/iphone" r…
262   <a href="http://twitter.com/download/iphone" r…

                                                 text  retweeted_status_id  \
438   RT @dog_rates: This is Oliver. He has dreams o…         8.199522e+17
1969  Take a moment and appreciate how these two dog…                  NaN
126   Say hello to Cooper. His expression is the sam…                  NaN
1716  I hope everyone enjoys this picture as much as…                  NaN
262   Meet Indie. She's not a fan of baths but she's…                  NaN

      retweeted_status_user_id retweeted_status_timestamp  \
438               4.196984e+09  2017-01-13 17:00:21 +0000
1969                       NaN                        NaN
126                        NaN                        NaN
1716                       NaN                        NaN
262                        NaN                        NaN

                                       expanded_urls  rating_numerator  \
438   https://www.gofundme.com/servicedogoliver,http…                13
1969  https://twitter.com/dog_rates/status/673317986…                10
```

```
126   https://www.gofundme.com/3ti3nps,https://twitt…                12
1716  https://twitter.com/dog_rates/status/680206703…                12
262   https://www.gofundme.com/get-indie-home/,https…                12

      rating_denominator    name doggo floofer pupper  puppo
438                   10  Oliver  None    None   None  puppo
1969                  10    None  None    None   None   None
126                   10  Cooper  None    None   None   None
1716                  10    Toby  None    None   None   None
262                   10   Indie  None    None   None   None
```

[362]:
```
# display column names, data types and number of missing data in the␣
↪twitter_archive dataframe
twitter_archive.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2356 entries, 0 to 2355
Data columns (total 17 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    2356 non-null   int64
 1   in_reply_to_status_id       78 non-null     float64
 2   in_reply_to_user_id         78 non-null     float64
 3   timestamp                   2356 non-null   object
 4   source                      2356 non-null   object
 5   text                        2356 non-null   object
 6   retweeted_status_id         181 non-null    float64
 7   retweeted_status_user_id    181 non-null    float64
 8   retweeted_status_timestamp  181 non-null    object
 9   expanded_urls               2297 non-null   object
 10  rating_numerator            2356 non-null   int64
 11  rating_denominator          2356 non-null   int64
 12  name                        2356 non-null   object
 13  doggo                       2356 non-null   object
 14  floofer                     2356 non-null   object
 15  pupper                      2356 non-null   object
 16  puppo                       2356 non-null   object
dtypes: float64(4), int64(3), object(10)
memory usage: 313.0+ KB
```

[363]:
```
#descriptive statistics
twitter_archive.describe().round()
```

[363]:
```
           tweet_id  in_reply_to_status_id  in_reply_to_user_id  \
count  2.356000e+03           7.800000e+01         7.800000e+01
mean   7.427716e+17           7.455079e+17         2.014171e+16
std    6.856705e+16           7.582492e+16         1.252797e+17
```

```
min    6.660209e+17           6.658147e+17         1.185634e+07
25%    6.783989e+17           6.757419e+17         3.086374e+08
50%    7.196279e+17           7.038708e+17         4.196984e+09
75%    7.993373e+17           8.257804e+17         4.196984e+09
max    8.924206e+17           8.862664e+17         8.405479e+17

       retweeted_status_id  retweeted_status_user_id  rating_numerator  \
count         1.810000e+02              1.810000e+02            2356.0
mean          7.720400e+17              1.241698e+16              13.0
std           6.236928e+16              9.599254e+16              46.0
min           6.661041e+17              7.832140e+05               0.0
25%           7.186315e+17              4.196984e+09              10.0
50%           7.804657e+17              4.196984e+09              11.0
75%           8.203146e+17              4.196984e+09              12.0
max           8.874740e+17              7.874618e+17            1776.0

       rating_denominator
count              2356.0
mean                 10.0
std                   7.0
min                   0.0
25%                  10.0
50%                  10.0
75%                  10.0
max                 170.0
```

[364]:
```
#visually inspect a random selection of 5 rows
image_predictions.sample(5)
```

[364]:
```
                tweet_id                                          jpg_url  \
1375  763103485927849985  https://pbs.twimg.com/media/CpcWknPXYAAeLP9.jpg
1058  714957620017307648  https://pbs.twimg.com/media/CewKKiOWwAIe3pR.jpg
170   668992363537309700  https://pbs.twimg.com/media/CUi9ARGWUAEyWqo.jpg
719   685906723014619143  https://pbs.twimg.com/media/CYTUhn7WkAEXocW.jpg
541   677187300187611136  https://pbs.twimg.com/media/CWXaQMBWcAAATDi.jpg

      img_num                p1   p1_conf  p1_dog        p2   p2_conf  \
1375        2          seat_belt  0.685821   False  ice_bear  0.081597
1058        1     Great_Pyrenees  0.251516    True   Samoyed  0.139346
170         1              lynx  0.287506   False     tabby  0.206048
719         1  Yorkshire_terrier  0.414963    True    briard  0.063505
541         1     English_setter  0.282396    True  Shih-Tzu  0.084112

      p2_dog                  p3   p3_conf  p3_dog
1375   False               chow  0.039085    True
1058    True             kuvasz  0.129005    True
170    False              koala  0.081419   False
```

```
719     True              Pekinese  0.053682    True
541     True  Old_English_sheepdog  0.059538    True
```

[365]:
```
# display column names, data types and number of missing data in the␣
↪image_predictions dataframe
image_predictions.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2075 entries, 0 to 2074
Data columns (total 12 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   tweet_id  2075 non-null   int64
 1   jpg_url   2075 non-null   object
 2   img_num   2075 non-null   int64
 3   p1        2075 non-null   object
 4   p1_conf   2075 non-null   float64
 5   p1_dog    2075 non-null   bool
 6   p2        2075 non-null   object
 7   p2_conf   2075 non-null   float64
 8   p2_dog    2075 non-null   bool
 9   p3        2075 non-null   object
 10  p3_conf   2075 non-null   float64
 11  p3_dog    2075 non-null   bool
dtypes: bool(3), float64(3), int64(2), object(4)
memory usage: 152.1+ KB
```

[366]:
```
#descriptive statistics
image_predictions.describe()
```

[366]:

	tweet_id	img_num	p1_conf	p2_conf	p3_conf
count	2.075000e+03	2075.000000	2075.000000	2.075000e+03	2.075000e+03
mean	7.384514e+17	1.203855	0.594548	1.345886e-01	6.032417e-02
std	6.785203e+16	0.561875	0.271174	1.006657e-01	5.090593e-02
min	6.660209e+17	1.000000	0.044333	1.011300e-08	1.740170e-10
25%	6.764835e+17	1.000000	0.364412	5.388625e-02	1.622240e-02
50%	7.119988e+17	1.000000	0.588230	1.181810e-01	4.944380e-02
75%	7.932034e+17	1.000000	0.843855	1.955655e-01	9.180755e-02
max	8.924206e+17	4.000000	1.000000	4.880140e-01	2.734190e-01

[367]:
```
#visually inspect a random selection of 5 rows
df_tweet_json.sample(5)
```

[367]:

	tweet_id	retweet_count	favorite_count
1567	687807801670897665	801	2625
1980	672968025906282496	602	1405
94	873697596434513921	12518	0

```
276   840370681858686976          5146          17918
2205  668627278264475648           123            341
```

[368]:
```
# display column names, data types and number of missing data in the␣
↪df_tweet_json dataframe
df_tweet_json.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2354 entries, 0 to 2353
Data columns (total 3 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   tweet_id        2354 non-null   object
 1   retweet_count   2354 non-null   object
 2   favorite_count  2354 non-null   object
dtypes: object(3)
memory usage: 55.3+ KB
```

[369]:
```
#descriptive statistics
df_tweet_json.describe()
```

[369]:

	tweet_id	retweet_count	favorite_count
count	2354	2354	2354
unique	2354	1724	2007
top	670815497391357952	3652	0
freq	1	5	179

0.2.3 Missing Data

[370]:
```
#user defined function to calculate and display number missing values
def missing_values(df):
    '''
    Function that aggregates missing values values and creates an output table␣
↪with two columns
    one with the count and the other a percentage of total values for that␣
↪column.
    '''
    miss_val = df.isnull().sum()
    miss_val_perc = (df.isnull().sum() / len(df)) * 100
    miss_val_table = pd.concat([miss_val, miss_val_perc], axis=1)
    miss_val_table_ren_columns = miss_val_table.rename(
    columns = {0 : 'Missing Values', 1 : '% of Total Values'})
    miss_val_table_ren_columns =␣
↪miss_val_table_ren_columns[miss_val_table_ren_columns.iloc[:,1] != 0].
↪sort_values(
        '% of Total Values', ascending=False).round(1)
```

```
    print ("The selected dataframe has a total of " + str(df.shape[1]) + "␣
↪columns, of which " + str(miss_val_table_ren_columns.shape[0]) + " contain␣
↪missing values.")
    return miss_val_table_ren_columns
```

[371]:
```
missing_values(twitter_archive)
```

```
The selected dataframe has a total of 17 columns, of which 6 contain missing
values.
```

[371]:

	Missing Values	% of Total Values
in_reply_to_status_id	2278	96.7
in_reply_to_user_id	2278	96.7
retweeted_status_id	2175	92.3
retweeted_status_user_id	2175	92.3
retweeted_status_timestamp	2175	92.3
expanded_urls	59	2.5

[372]:
```
missing_values(image_predictions)
```

```
The selected dataframe has a total of 12 columns, of which 0 contain missing
values.
```

[372]:
```
Empty DataFrame
Columns: [Missing Values, % of Total Values]
Index: []
```

[373]:
```
missing_values(df_tweet_json)
```

```
The selected dataframe has a total of 3 columns, of which 0 contain missing
values.
```

[373]:
```
Empty DataFrame
Columns: [Missing Values, % of Total Values]
Index: []
```

0.2.4 Duplicates

[374]:
```
#count of more than one instance of tweet_id (unique key)
sum(twitter_archive.tweet_id.duplicated())
```

[374]:
```
0
```

[375]:
```
#count of more than one instance of tweet_id (unique key)
sum(image_predictions.tweet_id.duplicated())
```

[375]:
```
0
```

[376]:
```
#count of more than one instance of tweet_id (unique key)
sum(df_tweet_json.tweet_id.duplicated())
```

[376]:
```
0
```

[377]:
```
#identify retweets (not all are original)
retweets = twitter_archive[~twitter_archive['retweeted_status_id'].isnull()]
retweets
```

[377]:

	tweet_id	in_reply_to_status_id	in_reply_to_user_id	timestamp	source
19	888202515573088257	NaN	NaN	2017-07-21 01:02:36 +0000	<a href="http://twitter.com/download/iphone" r…
32	886054160059072513	NaN	NaN	2017-07-15 02:45:48 +0000	<a href="http://twitter.com/download/iphone" r…
36	885311592912609280	NaN	NaN	2017-07-13 01:35:06 +0000	<a href="http://twitter.com/download/iphone" r…
68	879130579576475649	NaN	NaN	2017-06-26 00:13:58 +0000	<a href="http://twitter.com/download/iphone" r…
73	878404777348136964	NaN	NaN	2017-06-24 00:09:53 +0000	<a href="http://twitter.com/download/iphone" r…
…	…	…	…	…	…
1023	746521445350707200	NaN	NaN	2016-06-25 01:52:36 +0000	<a href="http://twitter.com/download/iphone" r…
1043	743835915802583040	NaN	NaN	2016-06-17 16:01:16 +0000	<a href="http://twitter.com/download/iphone" r…
1242	711998809858043904	NaN	NaN	2016-03-21 19:31:59 +0000	<a href="http://twitter.com/download/iphone" r…
2259	667550904950915073	NaN	NaN	2015-11-20 03:51:52 +0000	<a href="http://twitter.com" rel="nofollow">Tw…
2260	667550882905632768	NaN	NaN	2015-11-20 03:51:47 +0000	<a href="http://twitter.com" rel="nofollow">Tw…

```
                                                  text  retweeted_status_id  \
19    RT @dog_rates: This is Canela. She attempted s…         8.874740e+17
32    RT @Athletics: 12/10 #BATP https://t.co/WxwJmv…         8.860537e+17
36    RT @dog_rates: This is Lilly. She just paralle…         8.305833e+17
68    RT @dog_rates: This is Emmy. She was adopted t…         8.780576e+17
73    RT @dog_rates: Meet Shadow. In an attempt to r…         8.782815e+17
…                                                   …                  …
1023  RT @dog_rates: This is Shaggy. He knows exactl…         6.678667e+17
1043  RT @dog_rates: Extremely intelligent dog here…        6.671383e+17
1242  RT @twitter: @dog_rates Awesome Tweet! 12/10. …         7.119983e+17
2259  RT @dogratingrating: Exceptional talent. Origi…         6.675487e+17
2260  RT @dogratingrating: Unoriginal idea. Blatant …         6.675484e+17

      retweeted_status_user_id retweeted_status_timestamp  \
19                4.196984e+09  2017-07-19 00:47:34 +0000
32                1.960740e+07  2017-07-15 02:44:07 +0000
36                4.196984e+09  2017-02-12 01:04:29 +0000
68                4.196984e+09  2017-06-23 01:10:23 +0000
73                4.196984e+09  2017-06-23 16:00:04 +0000
…                          …                          …
1023              4.196984e+09  2015-11-21 00:46:50 +0000
1043              4.196984e+09  2015-11-19 00:32:12 +0000
1242              7.832140e+05  2016-03-21 19:29:52 +0000
2259              4.296832e+09  2015-11-20 03:43:06 +0000
2260              4.296832e+09  2015-11-20 03:41:59 +0000

                                           expanded_urls  rating_numerator  \
19    https://twitter.com/dog_rates/status/887473957…                  13
32    https://twitter.com/dog_rates/status/886053434…                  12
36    https://twitter.com/dog_rates/status/830583320…                  13
68    https://twitter.com/dog_rates/status/878057613…                  14
73    https://www.gofundme.com/3yd6y1c,https://twitt…                  13
…                                                   …                 …
1023  https://twitter.com/dog_rates/status/667866724…                  10
1043  https://twitter.com/dog_rates/status/667138269…                  10
1242  https://twitter.com/twitter/status/71199827977…                  12
2259  https://twitter.com/dogratingrating/status/667…                  12
2260  https://twitter.com/dogratingrating/status/667…                   5

      rating_denominator    name doggo floofer pupper puppo
19                    10  Canela  None    None   None  None
32                    10    None  None    None   None  None
36                    10   Lilly  None    None   None  None
68                    10    Emmy  None    None   None  None
73                    10  Shadow  None    None   None  None
…                    …      …   …     …    …   …
```

```
1023                  10  Shaggy  None     None    None  None
1043                  10    None  None     None    None  None
1242                  10    None  None     None    None  None
2259                  10    None  None     None    None  None
2260                  10    None  None     None    None  None

[181 rows x 17 columns]
```

0.2.5 Outliers

[378]:
```
#count number of unique spelling of names
twitter_archive['name'].value_counts()
```

[378]:
```
None          745
a              55
Charlie        12
Oliver         11
Lucy           11
              ...
Taco            1
Newt            1
Howie           1
Sage            1
Brandonald      1
Name: name, Length: 957, dtype: int64
```

[379]:
```
# find observations where name is given in lowercase
twitter_archive.loc[twitter_archive['name'].str.islower()]
```

[379]:
```
                tweet_id  in_reply_to_status_id  in_reply_to_user_id  \
22    887517139158093824                    NaN                  NaN
56    881536004380872706                    NaN                  NaN
118   869988702071779329                    NaN                  NaN
169   859196978902773760                    NaN                  NaN
193   855459453768019968                    NaN                  NaN
...                   ...                    ...                  ...
2349  666051853826850816                    NaN                  NaN
2350  666050758794694657                    NaN                  NaN
2352  666044226329800704                    NaN                  NaN
2353  666033412701032449                    NaN                  NaN
2354  666029285002620928                    NaN                  NaN

                     timestamp  \
22    2017-07-19 03:39:09 +0000
56    2017-07-02 15:32:16 +0000
118   2017-05-31 18:47:24 +0000
169   2017-05-02 00:04:57 +0000
```

```
193   2017-04-21 16:33:22 +0000
…                          …
2349  2015-11-16 00:35:11 +0000
2350  2015-11-16 00:30:50 +0000
2352  2015-11-16 00:04:52 +0000
2353  2015-11-15 23:21:54 +0000
2354  2015-11-15 23:05:30 +0000

                                                  source  \
22    <a href="http://twitter.com/download/iphone" r…
56    <a href="http://twitter.com/download/iphone" r…
118   <a href="http://twitter.com/download/iphone" r…
169   <a href="http://twitter.com/download/iphone" r…
193   <a href="http://twitter.com/download/iphone" r…
…                                                   …
2349  <a href="http://twitter.com/download/iphone" r…
2350  <a href="http://twitter.com/download/iphone" r…
2352  <a href="http://twitter.com/download/iphone" r…
2353  <a href="http://twitter.com/download/iphone" r…
2354  <a href="http://twitter.com/download/iphone" r…

                                                   text  retweeted_status_id  \
22    I've yet to rate a Venezuelan Hover Wiener. Th…                    NaN
56    Here is a pupper approaching maximum borkdrive…                    NaN
118   RT @dog_rates: We only rate dogs. This is quit…          8.591970e+17
169   We only rate dogs. This is quite clearly a smo…                    NaN
193   Guys, we only rate dogs. This is quite clearly…                    NaN
…                                                   …                    …
2349  This is an odd dog. Hard on the outside but lo…                    NaN
2350  This is a truly beautiful English Wilson Staff…                    NaN
2352  This is a purebred Piers Morgan. Loves to Netf…                    NaN
2353  Here is a very happy pup. Big fan of well-main…                    NaN
2354  This is a western brown Mitsubishi terrier. Up…                    NaN

      retweeted_status_user_id retweeted_status_timestamp  \
22                         NaN                         NaN
56                         NaN                         NaN
118               4.196984e+09  2017-05-02 00:04:57 +0000
169                        NaN                         NaN
193                        NaN                         NaN
…                          …                           …
2349                       NaN                         NaN
2350                       NaN                         NaN
2352                       NaN                         NaN
2353                       NaN                         NaN
2354                       NaN                         NaN
```

```
                                          expanded_urls  rating_numerator  \
22    https://twitter.com/dog_rates/status/887517139…                14
56    https://twitter.com/dog_rates/status/881536004…                14
118   https://twitter.com/dog_rates/status/859196978…                12
169   https://twitter.com/dog_rates/status/859196978…                12
193   https://twitter.com/dog_rates/status/855459453…                12
…                                                  …                 …
2349  https://twitter.com/dog_rates/status/666051853…                 2
2350  https://twitter.com/dog_rates/status/666050758…                10
2352  https://twitter.com/dog_rates/status/666044226…                 6
2353  https://twitter.com/dog_rates/status/666033412…                 9
2354  https://twitter.com/dog_rates/status/666029285…                 7

      rating_denominator   name doggo floofer  pupper puppo
22                    10   such  None    None    None  None
56                    10      a  None    None  pupper  None
118                   10  quite  None    None    None  None
169                   10  quite  None    None    None  None
193                   10  quite  None    None    None  None
…                  …    …   …     …       …    …
2349                  10     an  None    None    None  None
2350                  10      a  None    None    None  None
2352                  10      a  None    None    None  None
2353                  10      a  None    None    None  None
2354                  10      a  None    None    None  None

[109 rows x 17 columns]
```

[380]:
```
#count number of unique sources
twitter_archive.source.value_counts()
```

[380]:
```
<a href="http://twitter.com/download/iphone" rel="nofollow">Twitter for
iPhone</a>     2221
<a href="http://vine.co" rel="nofollow">Vine - Make a Scene</a>
91
<a href="http://twitter.com" rel="nofollow">Twitter Web Client</a>
33
<a href="https://about.twitter.com/products/tweetdeck"
rel="nofollow">TweetDeck</a>      11
Name: source, dtype: int64
```

[381]:
```
#count number of unique values for the numerator rating
twitter_archive.rating_numerator.value_counts()
```

[381]:
```
12      558
11      464
10      461
```

```
13      351
9       158
8       102
7        55
14       54
5        37
6        32
3        19
4        17
1         9
2         9
420       2
0         2
15        2
75        2
80        1
20        1
24        1
26        1
44        1
50        1
60        1
165       1
84        1
88        1
144       1
182       1
143       1
666       1
960       1
1776      1
17        1
27        1
45        1
99        1
121       1
204       1
Name: rating_numerator, dtype: int64
```

[382]:
```
#count numnber of unique values for the denominator rating
twitter_archive.rating_denominator.value_counts()
```

[382]:
```
10     2333
11        3
50        3
80        2
20        2
```

```
2          1
16         1
40         1
70         1
15         1
90         1
110        1
120        1
130        1
150        1
170        1
7          1
0          1
Name: rating_denominator, dtype: int64
```

[383]:
```
#extract numerator and denominator rating using pattern matching, and join each␣
↪column to end of twitter archive dataset
twitter_archive[['numerator_test', 'denominator_test']] = twitter_archive.text.
↪str.extract('((?:\d+\.)?\d+)\/(\d+)', expand=True)
```

[384]:
```
#convert data type of newly created rating test columns
twitter_archive['numerator_test'] = twitter_archive['numerator_test'].
↪astype(float)
twitter_archive['denominator_test'] = twitter_archive['denominator_test'].
↪astype(float)
```

[385]:
```
#perform logical test to identify, and isolate obervastions where there is a␣
↪mismatch between supplied numerator rating values and regex extracted␣
↪ratings
twitter_archive.loc[twitter_archive['rating_numerator'] !=␣
↪twitter_archive['numerator_test']]
```

[385]:
```
                tweet_id  in_reply_to_status_id  in_reply_to_user_id  \
45    883482846933004288                    NaN                  NaN
340   832215909146226688                    NaN                  NaN
695   786709082849828864                    NaN                  NaN
763   778027034220126208                    NaN                  NaN
1689  681340665377193984           6.813394e+17         4.196984e+09
1712  680494726643068929                    NaN                  NaN

                     timestamp  \
45    2017-07-08 00:28:19 +0000
340   2017-02-16 13:11:49 +0000
695   2016-10-13 23:23:56 +0000
763   2016-09-20 00:24:34 +0000
1689  2015-12-28 05:07:27 +0000
1712  2015-12-25 21:06:00 +0000
```

```
                                                  source  \
45    <a href="http://twitter.com/download/iphone" r…
340   <a href="http://twitter.com/download/iphone" r…
695   <a href="http://twitter.com/download/iphone" r…
763   <a href="http://twitter.com/download/iphone" r…
1689  <a href="http://twitter.com/download/iphone" r…
1712  <a href="http://twitter.com/download/iphone" r…

                                                   text  retweeted_status_id  \
45    This is Bella. She hopes her smile made you sm…                    NaN
340   RT @dog_rates: This is Logan, the Chow who liv…          7.867091e+17
695   This is Logan, the Chow who lived. He solemnly…                    NaN
763   This is Sophie. She's a Jubilant Bush Pupper. …                    NaN
1689  I've been told there's a slight possibility he…                    NaN
1712  Here we have uncovered an entire battalion of …                    NaN

      retweeted_status_user_id retweeted_status_timestamp  \
45                         NaN                         NaN
340               4.196984e+09  2016-10-13 23:23:56 +0000
695                        NaN                         NaN
763                        NaN                         NaN
1689                       NaN                         NaN
1712                       NaN                         NaN

                                          expanded_urls  rating_numerator  \
45    https://twitter.com/dog_rates/status/883482846…                 5
340   https://twitter.com/dog_rates/status/786709082…                75
695   https://twitter.com/dog_rates/status/786709082…                75
763   https://twitter.com/dog_rates/status/778027034…                27
1689                                              NaN                 5
1712  https://twitter.com/dog_rates/status/680494726…                26

      rating_denominator    name doggo floofer  pupper puppo  numerator_test  \
45                    10   Bella  None    None    None  None           13.50
340                   10   Logan  None    None    None  None            9.75
695                   10   Logan  None    None    None  None            9.75
763                   10  Sophie  None    None  pupper  None           11.27
1689                  10    None  None    None    None  None            9.50
1712                  10    None  None    None    None  None           11.26

      denominator_test
45                10.0
340               10.0
695               10.0
763               10.0
1689              10.0
```

```
1712              10.0
```

[386]:
```
#perform logical test to identify, and isolate obervastions where there is a␣
↪mismatch between supplied denomiator rating values and regex extracted␣
↪ratings
twitter_archive.loc[twitter_archive['rating_denominator'] !=␣
↪twitter_archive['denominator_test']]
```

[386]:
```
Empty DataFrame
Columns: [tweet_id, in_reply_to_status_id, in_reply_to_user_id, timestamp,
source, text, retweeted_status_id, retweeted_status_user_id,
retweeted_status_timestamp, expanded_urls, rating_numerator, rating_denominator,
name, doggo, floofer, pupper, puppo, numerator_test, denominator_test]
Index: []
```

0.2.6 Tidiness

[387]:
```
#count numnber of unique dog type in doggo column
twitter_archive['doggo'].value_counts()
```

[387]:
```
None     2259
doggo      97
Name: doggo, dtype: int64
```

[388]:
```
#count numnber of unique dog type in floofer column
twitter_archive['floofer'].value_counts()
```

[388]:
```
None       2346
floofer      10
Name: floofer, dtype: int64
```

[389]:
```
#count numnber of unique dog type in pupper column
twitter_archive['pupper'].value_counts()
```

[389]:
```
None      2099
pupper     257
Name: pupper, dtype: int64
```

[390]:
```
#count numnber of unique dog type in puppo column
twitter_archive['puppo'].value_counts()
```

[390]:
```
None     2326
puppo      30
Name: puppo, dtype: int64
```

0.3 Summary

Quality

1. Some tweets do not have images (expanded_urls)

2. Values in the source column have extranous info

3. Missing values encoded as "None" in the name column

4. Contains retweets
5. Incorrect data types for columns: retweeted_status_timestamp, timestamp, dog_stage, tweet_id, in_reply_to_status_id, in_reply_to_user_id, rating_numerator, and rating_denominator, retweet_count and favorite_count

6. Values under the name column given in lowercase are unlikley to be actual dog names such as "quite", "such", and "a"
7. Ambigious column names: p1, p2, p3
8. Extreme (unlikely) values in the rating_numertor and rating_denominator columns

9. Rating_numerator column contains anomalous values
10. Columns not relevant to analysis present

Tidiness

1. Dog stage uneccesarily split into four columns: doggo, floofer, pupper and puppo.
2. Data split over three datasets: twitter_archive, image_predictions and df_tweet_json.

Clean

[391]:
```
# make a copy of dataframes
twitter_archive_clean = twitter_archive.copy()
image_predictions_clean= image_predictions.copy()
df_tweet_json_clean = df_tweet_json.copy()
```

Define

Merge 'doggo', 'floofer', 'pupper' and 'puppo' columns into one column 'dog_stage'

Code

[392]:
```
# replace 'None' entries with empty string
twitter_archive_clean.doggo.replace('None', '', inplace=True)
twitter_archive_clean.floofer.replace('None', '', inplace=True)
twitter_archive_clean.pupper.replace('None', '', inplace=True)
twitter_archive_clean.puppo.replace('None', '', inplace=True)

# merge multiple dog stage columns into one
twitter_archive_clean['dog_stage'] = twitter_archive_clean.doggo +␣
↪twitter_archive_clean.floofer + twitter_archive_clean.pupper +␣
↪twitter_archive_clean.puppo
```

```
# identify and label multiple stages
twitter_archive_clean.loc[twitter_archive_clean.dog_stage == 'doggopupper',␣
↪'dog_stage'] = 'multiple'
twitter_archive_clean.loc[twitter_archive_clean.dog_stage == 'doggopuppo',␣
↪'dog_stage'] = 'multiple'
twitter_archive_clean.loc[twitter_archive_clean.dog_stage == 'doggofloofer',␣
↪'dog_stage'] = 'multiple'

# assign empty strings as missing values
twitter_archive_clean.loc[twitter_archive_clean.dog_stage == '', 'dog_stage'] =␣
↪np.nan
```

Test

[393]:
```
#display column names, data types and missing values
twitter_archive_clean.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2356 entries, 0 to 2355
Data columns (total 20 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    2356 non-null   int64
 1   in_reply_to_status_id       78 non-null     float64
 2   in_reply_to_user_id         78 non-null     float64
 3   timestamp                   2356 non-null   object
 4   source                      2356 non-null   object
 5   text                        2356 non-null   object
 6   retweeted_status_id         181 non-null    float64
 7   retweeted_status_user_id    181 non-null    float64
 8   retweeted_status_timestamp  181 non-null    object
 9   expanded_urls               2297 non-null   object
 10  rating_numerator            2356 non-null   int64
 11  rating_denominator          2356 non-null   int64
 12  name                        2356 non-null   object
 13  doggo                       2356 non-null   object
 14  floofer                     2356 non-null   object
 15  pupper                      2356 non-null   object
 16  puppo                       2356 non-null   object
 17  numerator_test              2356 non-null   float64
 18  denominator_test            2356 non-null   float64
 19  dog_stage                   380 non-null    object
dtypes: float64(6), int64(3), object(11)
memory usage: 368.2+ KB
```

[394]:
```
#count number of each dog_stage
twitter_archive_clean['dog_stage'].value_counts()
```

[394]:
```
pupper      245
doggo        83
puppo        29
multiple     14
floofer       9
Name: dog_stage, dtype: int64
```

Define

Merge twitter_archive, image_predictions and df_tweet_json into one dataset

Code

[395]:
```
#column wise join twitter_archive with image_predictions on common field␣
↪(tweet_id)
archive_image_merge = twitter_archive_clean.merge(image_predictions_clean,␣
↪on='tweet_id')
```

[396]:
```
#convert tweet_id in df_tweet_json_clean dataframw to float data type
df_tweet_json_clean['tweet_id'] = df_tweet_json_clean['tweet_id'].astype(float)
```

[397]:
```
#column wise join archive_imagine_merge with df_tweet_json_clean on common␣
↪field (tweet_id)
df = archive_image_merge.merge(df_tweet_json_clean, on='tweet_id')
```

Test

[398]:
```
#number of rows and columns in twitter_archive dataframe
twitter_archive.shape
```

[398]:
```
(2356, 19)
```

[399]:
```
#number of rows and columns in image_predictions dataframe
image_predictions_clean.shape
```

[399]:
```
(2075, 12)
```

[400]:
```
#number of rows and columns in  archive_imagine_merge dataframe
archive_image_merge.shape
```

[400]:
```
(2075, 31)
```

[401]:
```
#number of rows and columns in df_tweet_json_clean dataframe
df_tweet_json_clean.shape
```

[401]:
```
(2354, 3)
```

[402]:
```
#number of rows and columns in complete dataframe
df.shape
```

[402]:
```
(1349, 33)
```

Define

Remove records where dog name is lowercase, i.e invalid

Code

[403]:
```
# subset for observations where given dog name is uppercase
df = df.loc[df['name'] != df['name'].str.lower()]
```

Test

[404]:
```
df['name'].value_counts()
```

[404]:
```
None       392
Oliver       8
Winston      7
Tucker       7
Cooper       6
          ...
Mister       1
Thor         1
Rontu        1
Mike         1
Eevee        1
Name: name, Length: 656, dtype: int64
```

Define

Change missing values in 'name' from 'None' to NaN

Code

[405]:
```
df['name'] = df['name'].replace('None', np.NaN)
```

Test

[406]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1282 entries, 0 to 1343
Data columns (total 33 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    1282 non-null   int64
 1   in_reply_to_status_id       15 non-null     float64
 2   in_reply_to_user_id         15 non-null     float64
```

```
 3   timestamp                   1282 non-null   object
 4   source                      1282 non-null   object
 5   text                        1282 non-null   object
 6   retweeted_status_id         48 non-null     float64
 7   retweeted_status_user_id    48 non-null     float64
 8   retweeted_status_timestamp  48 non-null     object
 9   expanded_urls               1282 non-null   object
 10  rating_numerator            1282 non-null   int64
 11  rating_denominator          1282 non-null   int64
 12  name                        890 non-null    object
 13  doggo                       1282 non-null   object
 14  floofer                     1282 non-null   object
 15  pupper                      1282 non-null   object
 16  puppo                       1282 non-null   object
 17  numerator_test              1282 non-null   float64
 18  denominator_test            1282 non-null   float64
 19  dog_stage                   205 non-null    object
 20  jpg_url                     1282 non-null   object
 21  img_num                     1282 non-null   int64
 22  p1                          1282 non-null   object
 23  p1_conf                     1282 non-null   float64
 24  p1_dog                      1282 non-null   bool
 25  p2                          1282 non-null   object
 26  p2_conf                     1282 non-null   float64
 27  p2_dog                      1282 non-null   bool
 28  p3                          1282 non-null   object
 29  p3_conf                     1282 non-null   float64
 30  p3_dog                      1282 non-null   bool
 31  retweet_count               1282 non-null   object
 32  favorite_count              1282 non-null   object
dtypes: bool(3), float64(9), int64(4), object(17)
memory usage: 314.2+ KB
```

Define

Strip extraneous information from source column to make it more human friendly

Code

[407]:
```
# Remove url from source column
df['source'] = df['source'].str.replace('<a href="http://twitter.com/download/
 ↪iphone" rel="nofollow">Twitter for iPhone</a>', 'Twitter for iPhone')
df['source'] = df['source'].str.replace('<a href="http://vine.co"␣
 ↪rel="nofollow">Vine - Make a Scene</a>', 'Vine')
df['source'] = df['source'].str.replace('<a href="http://twitter.com"␣
 ↪rel="nofollow">Twitter Web Client</a>', 'Twitter Web Client')
df['source'] = df['source'].str.replace('<a href="https://about.twitter.com/
 ↪products/tweetdeck" rel="nofollow">TweetDeck</a>', 'TweetDeck')
```

Test

[408]:
```
# count number of categories in source column
df.source.value_counts()
```

[408]:
```
Twitter for iPhone    1257
Twitter Web Client      17
TweetDeck                8
Name: source, dtype: int64
```

Define

Remove rows where there are no expanded_urls (images)

Code

[409]:
```
#drop rows with missing values in the expanded_urls column
df = df.dropna(subset=['expanded_urls'])
```

Test

[410]:
```
#count number of records with no images
sum(df['expanded_urls'].isnull())
```

[410]:
```
0
```

Define

Remove retweets

Code

[411]:
```
#identify and isolate for records with no retweeted_status_ids (original)
df = df[df['retweeted_status_id'].isnull()]
```

Test

[412]:
```
#display column names, data types and missing values
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1234 entries, 0 to 1343
Data columns (total 33 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    1234 non-null   int64
 1   in_reply_to_status_id       15 non-null     float64
 2   in_reply_to_user_id         15 non-null     float64
 3   timestamp                   1234 non-null   object
 4   source                      1234 non-null   object
 5   text                        1234 non-null   object
 6   retweeted_status_id         0 non-null      float64
```

```
 7   retweeted_status_user_id    0 non-null      float64
 8   retweeted_status_timestamp  0 non-null      object
 9   expanded_urls               1234 non-null   object
 10  rating_numerator            1234 non-null   int64
 11  rating_denominator          1234 non-null   int64
 12  name                        862 non-null    object
 13  doggo                       1234 non-null   object
 14  floofer                     1234 non-null   object
 15  pupper                      1234 non-null   object
 16  puppo                       1234 non-null   object
 17  numerator_test              1234 non-null   float64
 18  denominator_test            1234 non-null   float64
 19  dog_stage                   197 non-null    object
 20  jpg_url                     1234 non-null   object
 21  img_num                     1234 non-null   int64
 22  p1                          1234 non-null   object
 23  p1_conf                     1234 non-null   float64
 24  p1_dog                      1234 non-null   bool
 25  p2                          1234 non-null   object
 26  p2_conf                     1234 non-null   float64
 27  p2_dog                      1234 non-null   bool
 28  p3                          1234 non-null   object
 29  p3_conf                     1234 non-null   float64
 30  p3_dog                      1234 non-null   bool
 31  retweet_count               1234 non-null   object
 32  favorite_count              1234 non-null   object
dtypes: bool(3), float64(9), int64(4), object(17)
memory usage: 302.5+ KB
```

Define

Change timestamp and retweeted_status_timestamp columns to datetime, dog_stage to categorical, and tweet_id, in_reply_to_status_id, and in_reply_to_user_id to strings

Code

[413]:
```
#convert columns identified to correct data types
df['tweet_id'] = df['tweet_id'].astype('str')
df['in_reply_to_status_id'] = df['in_reply_to_status_id'].astype('str')
df['in_reply_to_user_id'] = df['in_reply_to_user_id'].astype('str')
df['retweeted_status_timestamp'] = pd.to_datetime(df['timestamp'])
df['timestamp'] = pd.to_datetime(df['timestamp'])
df['rating_numerator'] = df['rating_numerator'].astype(float)
df['rating_denominator'] = df['rating_denominator'].astype(float)
df['dog_stage'] = df['dog_stage'].astype('category')
df['in_reply_to_status_id'] = df['in_reply_to_status_id'].astype('str')
df['in_reply_to_user_id'] = df['in_reply_to_user_id'].astype('str')
df['retweet_count'] = df['retweet_count'].astype(int)
df['favorite_count'] = df['favorite_count'].astype(int)
```

Test

[414]:
```
#display column names, data types and missing values
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1234 entries, 0 to 1343
Data columns (total 33 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   tweet_id                    1234 non-null   object
 1   in_reply_to_status_id       1234 non-null   object
 2   in_reply_to_user_id         1234 non-null   object
 3   timestamp                   1234 non-null   datetime64[ns, UTC]
 4   source                      1234 non-null   object
 5   text                        1234 non-null   object
 6   retweeted_status_id         0 non-null      float64
 7   retweeted_status_user_id    0 non-null      float64
 8   retweeted_status_timestamp  1234 non-null   datetime64[ns, UTC]
 9   expanded_urls               1234 non-null   object
 10  rating_numerator            1234 non-null   float64
 11  rating_denominator          1234 non-null   float64
 12  name                        862 non-null    object
 13  doggo                       1234 non-null   object
 14  floofer                     1234 non-null   object
 15  pupper                      1234 non-null   object
 16  puppo                       1234 non-null   object
 17  numerator_test              1234 non-null   float64
 18  denominator_test            1234 non-null   float64
 19  dog_stage                   197 non-null    category
 20  jpg_url                     1234 non-null   object
 21  img_num                     1234 non-null   int64
 22  p1                          1234 non-null   object
 23  p1_conf                     1234 non-null   float64
 24  p1_dog                      1234 non-null   bool
 25  p2                          1234 non-null   object
 26  p2_conf                     1234 non-null   float64
 27  p2_dog                      1234 non-null   bool
 28  p3                          1234 non-null   object
 29  p3_conf                     1234 non-null   float64
 30  p3_dog                      1234 non-null   bool
 31  retweet_count               1234 non-null   int32
 32  favorite_count              1234 non-null   int32
dtypes: bool(3), category(1), datetime64[ns, UTC](2), float64(9), int32(2),
int64(1), object(15)
memory usage: 284.6+ KB
```

Define

Remove implausible (extreme) values from the ratings_numerator and ratings_denominator columns

Code

[415]:
```
#identify and only keep values less than 100 and not zero
df = df[df['rating_numerator'] != 0 ]
df = df[df['rating_denominator'] <= 100 ]
df = df[df['rating_numerator'] <= 100 ]
```

Test

[416]:
```
#count number of values over 100 in rating_numerator column
len(df[df['rating_numerator'] > 100 ])
```

[416]:
```
0
```

[417]:
```
#count number of values over 100 in rating_denominator column
len(df[df['rating_denominator'] > 100 ])
```

[417]:
```
0
```

Define

Replace anomolous values in rating_numerator column with correct values

Code

[418]:
```
#replace erroneous values with correctly extracted ones
df['rating_numerator'] = df['numerator_test']
```

Test

[419]:
```
#logical test to check for mismatch in regex extracted rating values with␣
 ↪values in rating numerator column
df.loc[df['rating_numerator'] != df['numerator_test']]
```

[419]:
```
Empty DataFrame
Columns: [tweet_id, in_reply_to_status_id, in_reply_to_user_id, timestamp,
source, text, retweeted_status_id, retweeted_status_user_id,
retweeted_status_timestamp, expanded_urls, rating_numerator, rating_denominator,
name, doggo, floofer, pupper, puppo, numerator_test, denominator_test,
dog_stage, jpg_url, img_num, p1, p1_conf, p1_dog, p2, p2_conf, p2_dog, p3,
p3_conf, p3_dog, retweet_count, favorite_count]
Index: []

[0 rows x 33 columns]
```

Define

Change column names from neural network output to something more explicit

Code

[420]:
```
#rename column p1, p2, and p3
df = df.rename(columns={'p1':'Breed_Probability1', 'p2':'Breed_Probability2',␣
↪'p3':'Breed_Probability3'})
df = df.rename(columns={'p1_conf':'Breed_Confidence1', 'p2_conf':
↪'Breed_Confidence2', 'p3_conf':'Breed_Confidence3'})
df = df.rename(columns={'p1_dog':'Dog_Flag_1', 'p2_dog':'Dog_Flag_2', 'p3_dog':
↪'Dog_Flag_3'})
```

Test

[421]:
```
#display column names
df.columns
```

[421]:
```
Index(['tweet_id', 'in_reply_to_status_id', 'in_reply_to_user_id', 'timestamp',
       'source', 'text', 'retweeted_status_id', 'retweeted_status_user_id',
       'retweeted_status_timestamp', 'expanded_urls', 'rating_numerator',
       'rating_denominator', 'name', 'doggo', 'floofer', 'pupper', 'puppo',
       'numerator_test', 'denominator_test', 'dog_stage', 'jpg_url', 'img_num',
       'Breed_Probability1', 'Breed_Confidence1', 'Dog_Flag_1',
       'Breed_Probability2', 'Breed_Confidence2', 'Dog_Flag_2',
       'Breed_Probability3', 'Breed_Confidence3', 'Dog_Flag_3',
       'retweet_count', 'favorite_count'],
      dtype='object')
```

Define

Drop superflous columns

Code

[422]:
```
#create list of column names
columns = ['retweeted_status_id', 'retweeted_status_user_id',␣
↪'retweeted_status_timestamp', 'doggo', 'floofer', 'pupper', 'puppo',␣
↪'numerator_test', 'denominator_test']

#drop columns in list
df = df.drop(columns, axis=1)
```

Test

[424]:
```
#display data type and columns names of final tableau
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1229 entries, 0 to 1343
Data columns (total 24 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
```

```
 0   tweet_id                1229 non-null   object
 1   in_reply_to_status_id   1229 non-null   object
 2   in_reply_to_user_id     1229 non-null   object
 3   timestamp               1229 non-null   datetime64[ns, UTC]
 4   source                  1229 non-null   object
 5   text                    1229 non-null   object
 6   expanded_urls           1229 non-null   object
 7   rating_numerator        1229 non-null   float64
 8   rating_denominator      1229 non-null   float64
 9   name                    861 non-null    object
 10  dog_stage               197 non-null    category
 11  jpg_url                 1229 non-null   object
 12  img_num                 1229 non-null   int64
 13  Breed_Probability1      1229 non-null   object
 14  Breed_Confidence1       1229 non-null   float64
 15  Dog_Flag_1              1229 non-null   bool
 16  Breed_Probability2      1229 non-null   object
 17  Breed_Confidence2       1229 non-null   float64
 18  Dog_Flag_2              1229 non-null   bool
 19  Breed_Probability3      1229 non-null   object
 20  Breed_Confidence3       1229 non-null   float64
 21  Dog_Flag_3              1229 non-null   bool
 22  retweet_count           1229 non-null   int32
 23  favorite_count          1229 non-null   int32
dtypes: bool(3), category(1), datetime64[ns, UTC](1), float64(5), int32(2),
int64(1), object(11)
memory usage: 197.0+ KB
```

Conclusions

0.3.1 Store

[425]:
```
# Store cleaned DataFrame in a csv file
df.to_csv('./twitter_archive_master.csv', index=False)
```

0.3.2 Analysis

[426]:
```
#statistical summary of numerical variables
df.describe().round(2)
```

[426]:

	rating_numerator	rating_denominator	img_num	Breed_Confidence1	\
count	1229.00	1229.00	1229.00	1229.00	
mean	10.67	10.12	1.19	0.59	
std	3.37	2.47	0.55	0.27	
min	1.00	7.00	1.00	0.04	
25%	10.00	10.00	1.00	0.35	
50%	11.00	10.00	1.00	0.58	
75%	12.00	10.00	1.00	0.84	

```
max                88.00                80.00     4.00                1.00

       Breed_Confidence2  Breed_Confidence3  retweet_count  favorite_count
count            1229.00            1229.00        1229.00         1229.00
mean                0.14               0.06        2607.41         8495.85
std                 0.10               0.05        4000.79        11147.37
min                 0.00               0.00          16.00           81.00
25%                 0.05               0.02         619.00         1860.00
50%                 0.12               0.05        1323.00         3999.00
75%                 0.20               0.09        3131.00        10943.00
max                 0.47               0.27       56625.00       107015.00
```

Observations

1. The bulk of the distribution for the variable rating_numerator is between 10 and 12, suggesting a rating within this range can be considered "normal".
2. The median value for Breed_Confidence1 is multiple times larger than its counterpart for Breed_Confidence2 and Breed_Confidence3, suggesting the results of the neural network should be weighted toward its primary estimation.
3. A more than doubling is required to move from the 25th percentile to the 50th percentile (and from the 50th percentile to the 75th percentile) for the variable favorite_count, suggesting an exponential relationship. Said otherwise, popular dogs garner vastly more attention than their less aesthetically-pleasing compatriots.

0.3.3 Visualisation

[427]:
```
#create correlation matrix using numerical data
cor = df[['rating_numerator', 'rating_denominator', 'Breed_Confidence1',␣
 ↪'Breed_Confidence2',
          'Breed_Confidence3', 'retweet_count', 'favorite_count']].corr()
cor
```

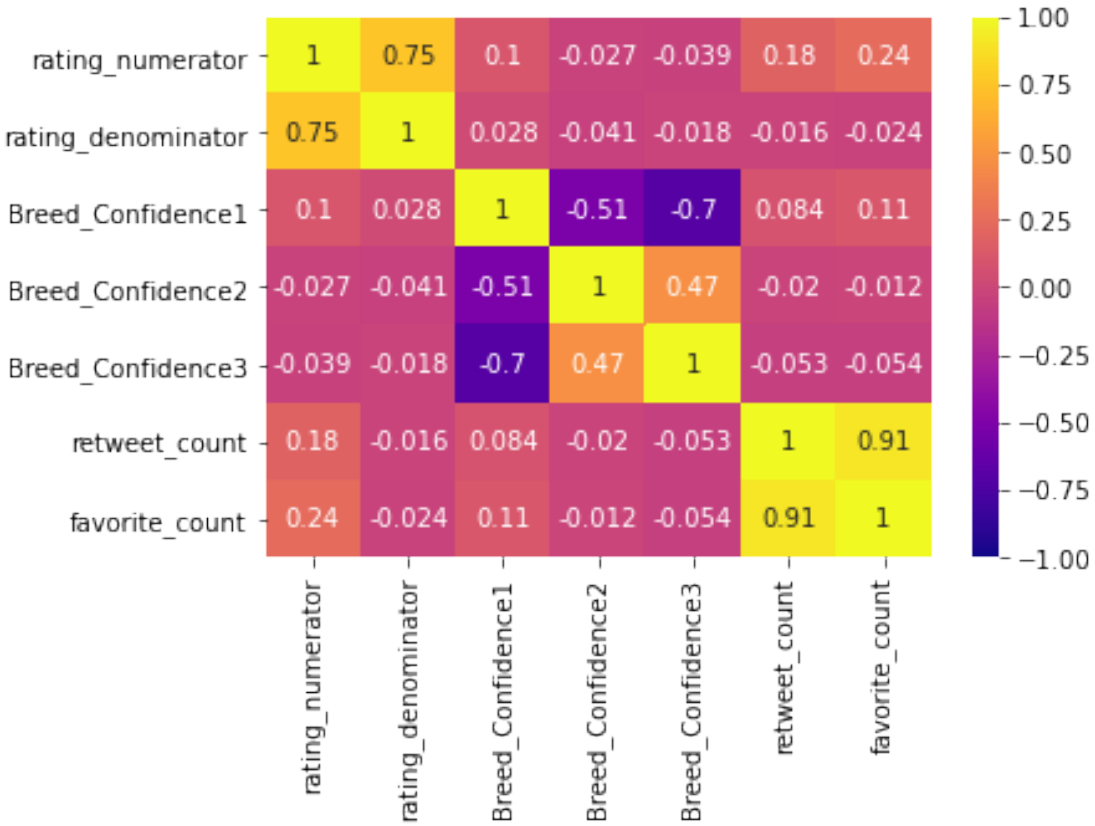
[427]:
```
                    rating_numerator  rating_denominator  Breed_Confidence1  \
rating_numerator            1.000000            0.751999           0.103165
rating_denominator          0.751999            1.000000           0.028493
Breed_Confidence1           0.103165            0.028493           1.000000
Breed_Confidence2          -0.027231           -0.040815          -0.507884
Breed_Confidence3          -0.038707           -0.018425          -0.699339
retweet_count               0.183269           -0.015906           0.083864
favorite_count              0.242858           -0.023633           0.114619

                    Breed_Confidence2  Breed_Confidence3  retweet_count  \
rating_numerator            -0.027231          -0.038707       0.183269
rating_denominator          -0.040815          -0.018425      -0.015906
Breed_Confidence1           -0.507884          -0.699339       0.083864
Breed_Confidence2            1.000000           0.470115      -0.019904
Breed_Confidence3            0.470115           1.000000      -0.053322
retweet_count               -0.019904          -0.053322       1.000000
```

```
favorite_count              -0.011812          -0.054011        0.914050
```

```
                    favorite_count
rating_numerator          0.242858
rating_denominator       -0.023633
Breed_Confidence1         0.114619
Breed_Confidence2        -0.011812
Breed_Confidence3        -0.054011
retweet_count             0.914050
favorite_count            1.000000
```

[428]:
```
#create heatmap of correlation between numerical variables
sns.heatmap(cor, annot=True, cmap='plasma', vmin=-1, vmax=1);
```



Observations

retweet_count and favorite_count are weakly correlated with rating_numerator, suggesting a difference in evaluations of 'likeability' and/or "popularity" between WeRateDogs and its audience.