Twitter Sentiment Analysis for COVID-19 tweets

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Abstract

Sentiment analysis deals with analyzing or examining the opinions, thoughts and views expressed in a source tex. Twitter is a popular social networking site that allows users to post messages called "tweets". Twitter users are restricted to 280 characters per "tweet". Owing to Twitter's prominence, there is a huge amount of source data that can be analyzed using sentiment analysis.

Goal

The goal of this project is to do sentiment analysis for tweets (determine whether the tweet is positive, negative or neutral) related to the COVID-19 pandemic. It is used the TextBlob library, and polarity results from this library can be compared with both a dictionary-based analysis and a KNN algorithm.

Data

The dataset has been extracted from https://www.kaggle.com/smid80/coronavirus-covid19-tweets-late-april (https://www.kaggle.com/smid80/coronavirus-covid19-tweets-late-april) This dataset contains 22 columns, as follows:

COLUMN	DESCRIPTION
status_id	The ID of the actual Tweet.
user_id	The ID of the user account that Tweeted.
created_at	The date and time of the Tweet.
screen_name	The screen name of the account that Tweeted.
text	The text of the Tweet.
source	The type of app used.
reply_to_status_id	The ID of the Tweet to which this was a reply.
reply_to_user_id	The ID of the user to whom this Tweet was a reply.
reply_to_screen_name	The screen name of the user to whom this Tweet was a reply.
is_quote	Whether this Tweet is a quote of another Tweet.
is_retweet	Whether this Tweet is a retweet.
favourites_count	The number of favourites this Tweet has received.
retweet_count	The number of times this Tweet has been retweeted.
country_code	The country code of the account that Tweeted.
place_full_name	The name of the place of the account that Tweeted.
place_type	A description of the type of place corresponding with place_full_name.
followers_count	The number of followers of the account that Tweeted.
friends_count	The number of friends of the account that Tweeted.
account_lang	The language of the account that Tweeted.
account_created_at	The date and time that the account that Tweeted was created.
verified	Whether the account that Tweeted is verified.
lang	The language of the Tweet.

Loading

The steps we used for the data loading are as follows;

1. Authentication and creation of the PyDrive client
2. Choosing a local (colab) directory to store the data.
3. Auto-iterate using the query syntax
4. Load data using the “pd.read_csv” function

In [0]:

```
!pip install -U pycld3
```

```
Collecting pycld3
  Downloading https://files.pythonhosted.org/packages/da/28/17938836
d8bfcc621068c332555d4fba57bb7bbba5734e6991ca6a4a36a4/pycld3-0.20-cp3
6-cp36m-manylinux1_x86_64.whl (13.3MB)
     |████████████████████████████████| 13.3MB 296kB/s
Installing collected packages: pycld3
Successfully installed pycld3-0.20
```

In [0]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.dates import DateFormatter

import cld3
import regex
import regex as re
import nltk.data
from nltk.stem import WordNetLemmatizer
from nltk.stem.porter import PorterStemmer
from nltk.corpus import stopwords
from nltk.tokenize import TweetTokenizer, TreebankWordTokenizer, word_tokenize
from nltk.util import bigrams
from wordcloud import WordCloud
from textblob import TextBlob

import warnings

warnings.filterwarnings('ignore')
nltk.download('stopwords')
nltk.download('punkt')
```

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

Out[0]:

```
True
```

In [0]:

```python
!pip install -U -q PyDrive
import os
from pydrive.auth import GoogleAuth
from pydrive.drive import GoogleDrive
from google.colab import auth
from oauth2client.client import GoogleCredentials

# 1. Authenticate and create the PyDrive client.
auth.authenticate_user()
gauth = GoogleAuth()
gauth.credentials = GoogleCredentials.get_application_default()
drive = GoogleDrive(gauth)

# choose a local (colab) directory to store the data.
local_download_path = os.path.expanduser('~/data')
try:
  os.makedirs(local_download_path)
except:
  pass

# 2. Auto-iterate using the query syntax
#    https://developers.google.com/drive/v2/web/search-parameters
file_list = drive.ListFile({
  'q': "'1IaFTSq4LIBz7sRS0rjLarW1I95Itfjo1' in parents"
}).GetList()

# 3. Load data only for the last day and Twitter sentiment data
for i in (-1, -2):
  fname = os.path.join(local_download_path, file_list[i]['title'])

  print('title: %s, id: %s' % (file_list[i]['title'], file_list[i]['id']))
  print('downloading to {}'.format(fname))
  f_ = drive.CreateFile({'id': file_list[i]['id']})
  f_.GetContentFile(fname)
```

```
title: SemEval2015-English-Twitter-Lexicon.txt, id: 1ocAUafVcHm8DKX8
622zbqHt6uR0jHF0F
downloading to /root/data/SemEval2015-English-Twitter-Lexicon.txt
title: 2020-04-16 Coronavirus Tweets.CSV, id: 1Dw6gWcsscHhMHK-wXpPA5
pC0A-vviFET
downloading to /root/data/2020-04-16 Coronavirus Tweets.CSV
```

In [0]:

```
df = pd.read_csv("/root/data/2020-04-16 Coronavirus Tweets.CSV")[:10000]
df.head()
```

Out[0]:

	status_id	user_id	created_at	screen_name	text
0	1250574628726214658	817072420947247104	2020-04-16T00:00:00Z	Tu_IMSS_Coah	Para complementar la higiene de tus manos, el ...
1	1250574627127975938	44728980	2020-04-16T00:00:00Z	ANCALERTS	PWDs from Tahanang Walang Hagdan get aid amid ...
2	1250574628671467521	1235017593649418241	2020-04-16T00:00:00Z	julycio	#France ได้รับความทุกข์ทรมานจาก #ชุดการแยกตัว...
3	1250574628575010816	92174767	2020-04-16T00:00:00Z	DZMMTeleRadyo	Target ng Department of Health na magkaroon ng...
4	1250574628201717760	1042498579909107712	2020-04-16T00:00:00Z	ContraReplicaMX	La @SSalud_mx lanzó una nueva convocatoria esp...

In [0]:

```
df.describe()
```

Out[0]:

	status_id	user_id	reply_to_status_id	reply_to_user_id	favourites_count	re
count	1.000000e+04	1.000000e+04	1.282000e+03	1.550000e+03	10000.00000	
mean	1.250579e+18	3.242098e+17	1.249990e+18	2.338391e+17	12736.47920	
std	2.785757e+12	4.912705e+17	6.712420e+15	4.343449e+17	36236.27277	
min	1.250575e+18	3.840000e+03	1.115750e+18	6.215330e+05	0.00000	
25%	1.250577e+18	1.276234e+08	1.250496e+18	4.987209e+07	279.00000	
50%	1.250579e+18	8.475217e+08	1.250571e+18	2.925746e+08	1898.00000	
75%	1.250582e+18	8.743674e+17	1.250578e+18	3.292061e+09	8970.00000	
max	1.250584e+18	1.250582e+18	1.250584e+18	1.250573e+18	633937.00000	

In [0]:

```
df.count()
```

Out[0]:

```
status_id                  10000
user_id                    10000
created_at                 10000
screen_name                10000
text                       10000
source                     10000
reply_to_status_id          1282
reply_to_user_id            1550
reply_to_screen_name        1550
is_quote                   10000
is_retweet                 10000
favourites_count           10000
retweet_count              10000
country_code                 486
place_full_name              486
place_type                   486
followers_count            10000
friends_count              10000
account_lang                   0
account_created_at         10000
verified                   10000
lang                       10000
dtype: int64
```

Preprocessing

The aim of the following data preprocessing is to create a **Bag-of-Words** representation of the data. The preprocessing steps is as follows:

1. Cleansing

- Remove usernames (mentions)
- Remove URLs
- Remove tweets with *Not Available* text
- Remove special characters
- Remove numbers

1. Text processing

- Tokenization
- Transform to lowercase
- Stemming

1. Build word list for Bag-of-Words

In [0]:

```
df.lang = df.text.apply(lambda i: cld3.get_language(i).language)
```

In [0]:

```
indexNames = df[df['lang'] != 'en'].index
df.drop(indexNames, inplace=True)
df.reset_index(inplace=True)
df.lang.head()
```

Out[0]:

```
0    en
1    en
2    en
3    en
4    en
Name: lang, dtype: object
```

In [0]:

```
tweets_all = df[['user_id', 'screen_name','favourites_count',
                 'retweet_count', 'created_at', 'text']]
tweets_all.head()
```

Out[0]:

	user_id	screen_name	favourites_count	retweet_count	created_at	text
0	15872418	ABSCBNNews	1075	0	2020-04-16T00:00:00Z	G20 agrees to debt relief for poorest countrie...
1	171548670	RadioNLNews	501	0	2020-04-16T00:00:00Z	B.C. health officials are urging people to kin...
2	23517017	953WDAE	13891	0	2020-04-16T00:00:00Z	The Lovely Lisa Ann Joins The Show LIVE From N...
3	613510703	matanock	327	0	2020-04-16T00:00:00Z	@allisonnamias @ArriolaLR As @ethanbdm referen...
4	38489678	JAMA_current	1357	130	2020-04-16T00:00:00Z	Study suggests higher rates of co-infection be...

In [0]:

```
tweets_all.describe()
```

Out[0]:

	user_id	favourites_count	retweet_count
count	4.924000e+03	4924.000000	4924.000000
mean	3.205641e+17	14971.877742	3.501625
std	4.853154e+17	40092.491756	43.100224
min	3.840000e+03	0.000000	0.000000
25%	1.079392e+08	326.250000	0.000000
50%	9.220033e+08	2181.500000	0.000000
75%	8.719640e+17	10781.500000	1.000000
max	1.250578e+18	599171.000000	1619.000000

In [0]:

```
def preprocessing(tweets_all):
    url_pattern = re.compile('http[s]?://(?:[a-zA-Z]|[0-9]|[$-_@.&+]|[!*\(\),]|
(?:%[0-9a-fA-F][0-9a-fA-F]))+')
    pic_pattern = re.compile('pic\.twitter\.com/.{10}')
    tweets_all['text'] = tweets_all['text'].apply(lambda buf: url_pattern.sub(''
,buf))
    tweets_all['text'] = tweets_all['text'].apply(lambda buf: pic_pattern.sub(''
,buf))

    # removing space in mentions and hashtags
    tweets_all['text'] = tweets_all['text'].apply(lambda buf: buf.replace('@ ',
'@'))
    tweets_all['text'] = tweets_all['text'].apply(lambda buf: buf.replace('# ',
'#'))
    return tweets_all
```

In [0]:

```
tweets_all = preprocessing(tweets_all)
```

1. Removing Twitter Handles (@user)

In [0]:

```
def remove_pattern(input_txt, pattern):
    r = re.findall(pattern, input_txt)
    for i in r:
        input_txt = re.sub(i, '', input_txt)

    return input_txt
```

In [0]:

```
tweets_all['tidy_tweet'] = np.vectorize(remove_pattern)(
    tweets_all['text'], "@[\w]*"
)
tweets_all.tidy_tweet.head()
```

Out[0]:

```
0    G20 agrees to debt relief for poorest countrie...
1    B.C. health officials are urging people to kin...
2    The Lovely Lisa Ann Joins The Show LIVE From N...
3      As  referenced, just saw this op-ed version ...
4    Study suggests higher rates of co-infection be...
Name: tidy_tweet, dtype: object
```

1. Removing Punctuations, Numbers, and Special Characters

In [0]:

```
tweets_all['tidy_tweet'] = tweets_all['tidy_tweet'].str.replace(
    "[^a-z0-9A-Z#]", " "
)
tweets_all.tidy_tweet.head()
```

Out[0]:

```
0    G20 agrees to debt relief for poorest countrie...
1    B C  health officials are urging people to kin...
2    The Lovely Lisa Ann Joins The Show LIVE From N...
3      As  referenced  just saw this op ed version ...
4    Study suggests higher rates of co infection be...
Name: tidy_tweet, dtype: object
```

1. Removing Short Words

In [0]:

```
tweets_all.tidy_tweet = tweets_all.tidy_tweet.apply(
    lambda x: ' '.join([w for w in x.split() if len(w) > 3])
)
tweets_all.tidy_tweet.head()
```

Out[0]:

```
0    agrees debt relief poorest countries amid pand...
1    health officials urging people kind jump concl...
2    Lovely Lisa Joins Show LIVE From #NFL #MLB #CO...
3    referenced just this version Ebola lessons #CO...
4    Study suggests higher rates infection between ...
Name: tidy_tweet, dtype: object
```

In [0]:

```
tweets_all['tidy_tweet'] = tweets_all['tidy_tweet'].str \
  .replace(r"http.?://[^\s]+[\s]?", " ") \
  .replace(r"https.?://[^\s]+[\s]?", " ") \
  .replace("@[^\s]+[\s]?", " ")

tweets_all.tidy_tweet.head()
```

Out[0]:

```
0    agrees debt relief poorest countries amid pand...
1    health officials urging people kind jump concl...
2    Lovely Lisa Joins Show LIVE From #NFL #MLB #CO...
3    referenced just this version Ebola lessons #CO...
4    Study suggests higher rates infection between ...
Name: tidy_tweet, dtype: object
```

In [0]:

```
def remove_special_chars(tweets):  # it unrolls the hashtags to normal words
  for remove in map(lambda r: regex.compile(regex.escape(r)),
                     [",", ":", "\"", "=", "&", ";", "%", "$",
                      "@", "%", "^", "*", "(", ")", "{", "}",
                      "[", "]", "|", "/", "\\", ">", "<", "-",
                      "!", "?", ".", "'",
                      "--", "---", "#"]):
        tweets.loc[:, "text"].replace(remove, "", inplace=True)
  return tweets

tweets_all = remove_special_chars(tweets_all)
tweets_all.tidy_tweet.head()
```

Out[0]:

```
0    agrees debt relief poorest countries amid pand...
1    health officials urging people kind jump concl...
2    Lovely Lisa Joins Show LIVE From #NFL #MLB #CO...
3    referenced just this version Ebola lessons #CO...
4    Study suggests higher rates infection between ...
Name: tidy_tweet, dtype: object
```

1. Text Normalization

In [0]:

```
STOP_WORDS = set(stopwords.words('english'))
```

In [0]:

```
tokenized_tweet = tweets_all['tidy_tweet'].apply(lambda x: x.split(' '))
tokenized_tweet.head()
```

Out[0]:

```
0    [agrees, debt, relief, poorest, countries, ami...
1    [health, officials, urging, people, kind, jump...
2    [Lovely, Lisa, Joins, Show, LIVE, From, #NFL, ...
3    [referenced, just, this, version, Ebola, lesso...
4    [Study, suggests, higher, rates, infection, be...
Name: tidy_tweet, dtype: object
```

In [0]:

```
stemmer = PorterStemmer()
tweets_all.tidy_tweet = tokenized_tweet.apply(
    lambda x: ' '.join([
        stemmer.stem(i) for i in x if i not in STOP_WORDS
    ]).strip()
)
```

In [0]:

```
tweets_all.tidy_tweet.replace("", float('NaN'), inplace=True)
tweets_all.dropna(subset=["tidy_tweet"], inplace=True)
```

In [0]:

```
tweets_all.describe()
```

Out[0]:

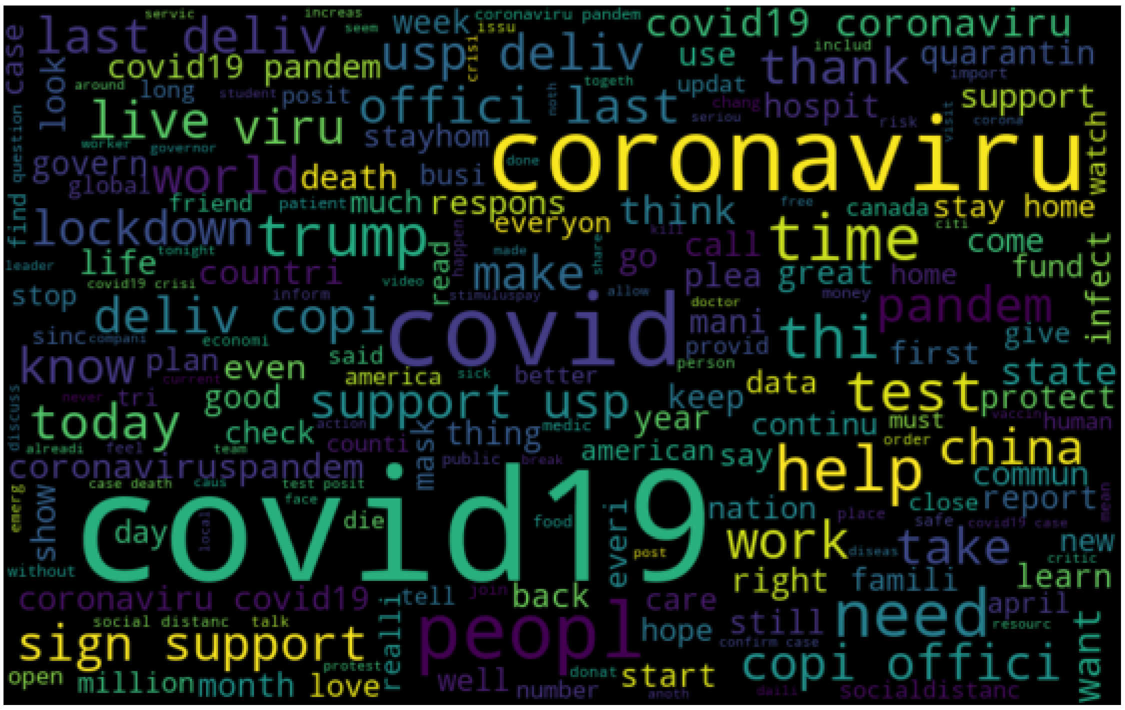
	user_id	favourites_count	retweet_count
count	4.924000e+03	4924.000000	4924.000000
mean	3.205641e+17	14971.877742	3.501625
std	4.853154e+17	40092.491756	43.100224
min	3.840000e+03	0.000000	0.000000
25%	1.079392e+08	326.250000	0.000000
50%	9.220033e+08	2181.500000	0.000000
75%	8.719640e+17	10781.500000	1.000000
max	1.250578e+18	599171.000000	1619.000000

Story Generation and Visualization from Tweets

In [0]:

```
all_words = ' '.join([text for text in tweets_all['tidy_tweet']])
wordcloud = WordCloud(width=800, height=500, random_state=21, max_font_size=110)
.generate(all_words)

plt.figure(figsize=(10, 7))
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis('off')
plt.show()
```



Methodology

The methodology we used for this project is Dictionary-based analysis, Textblob, and KNN.

Dictionary-based analysis is the method where a specific collection of words of opinion is first compiled manually, then newly discovered words are added to the list. In this method too, manual inspection is required to remove erros. The searching process continues being executed up to the stage when no new words are detected. The main reason we used dictionary based analysis is to compare words in a dictionary to know if a word is positive or negative.

Textblob is a Python module used to measure text sentiment in the production-ready state.

KNN which is an instance-based learning algorithm assumes that similar items are near to each other. In this project, KNN was used to generate predictions using unique instances.

Additionally we used Precision and Recall as metrics to calculate the prediction's performance. Precision is used as a metric to measure the relevance of the result and Recall is used as a metric to measure how many of the actually important results are returned.

TextBlob

In [0]:

```
sentiment_list = pd.Series([
    TextBlob(tweet).sentiment.polarity
    for tweet in tweets_all.tidy_tweet
], name="Sentiment")
sentiment_list.head()
```

Out[0]:

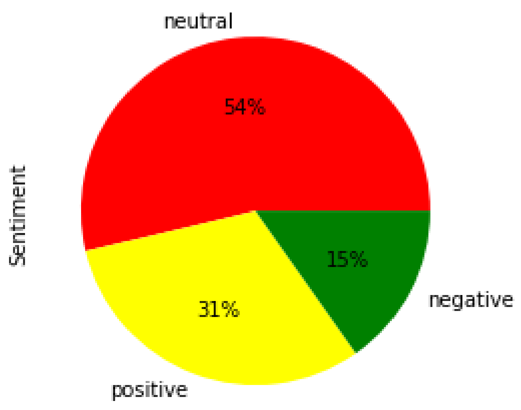
```
0    0.000000
1    0.600000
2    0.318182
3    0.000000
4    0.041667
Name: Sentiment, dtype: float64
```

In [0]:

```
sentiment_list.apply(
    lambda x: 'positive' if x > 0.05 else 'negative' if x < -0.05 else 'neutral'
).value_counts().plot(kind='pie', autopct='%1.0f%%', colors=["red", "yellow", "g
reen"])
```

Out[0]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f089509f828>
```



In [0]:

```
df = pd.concat([tweets_all['tidy_tweet'], sentiment_list], axis=1)
df.head()
```

Out[0]:

	tidy_tweet	Sentiment
0	agre debt relief poorest countri amid pandem #...	0.000000
1	health offici urg peopl kind jump conclus trav...	0.600000
2	love lisa join show live from #nfl #mlb #covid...	0.318182
3	referenc version ebola lesson #covid19 oeindri...	0.000000
4	studi suggest higher rate infect #sarscov2 res...	0.041667

In [0]:

```
sentiment_list.describe()
```

Out[0]:

```
count    4924.000000
mean        0.056855
std         0.248101
min        -1.000000
25%         0.000000
50%         0.000000
75%         0.136364
max         1.000000
Name: Sentiment, dtype: float64
```

In [0]:

```
sentiment_list_copy_2=sentiment_list.copy()
labels = ["negative", "neutral", "positive"]
label_states = ["predicted", "real"]
conditions = [
    (sentiment_list_copy_2.values > 0.05),
    (sentiment_list_copy_2.values < - 0.05)
]
choices = [1,-1]
sentiment_list_copy_2['label'] = np.select(conditions, choices, default=0)
print(sentiment_list_copy_2)
```

```
0                                                            0
1                                                          0.6
2                                                     0.318182
3                                                            0
4                                                    0.0416667
                                ...
4920                                                         0
4921                                                         0
4922                                                      0.25
4923                                                         0
label    [0, 1, 1, 0, 0, 1, 1, -1, -1, 0, 1, 0, 0, -1, ...
Name: Sentiment, Length: 4925, dtype: object
```

In [0]:

```
positive_words = []
negative_words = []
neutral_words = []

mylist = list(zip(sentiment_list_copy_2['label'], tokenized_tweet))
for feeling, tweet in mylist:
    if feeling == 1:
        for word in tweet:
            positive_words.append(word)
    elif feeling == -1:
        for word in tweet:
            negative_words.append(word)
    elif feeling == 0:
        for word in tweet:
            neutral_words.append(word)
```

In [0]:

```python
from collections import Counter

pos_dict = dict(Counter(positive_words))
neu_dict = dict(Counter(neutral_words))
neg_dict = dict(Counter(negative_words))

pos_data = list(zip(pos_dict.keys(), pos_dict.values()))
pos_df = pd.DataFrame(pos_data, columns=['Words','Positive'], dtype=int)

neu_data = list(zip(neu_dict.keys(), neu_dict.values()))
neu_df = pd.DataFrame(neu_data, columns=['Words','Neutral'], dtype=int)

neg_data = list(zip(neg_dict.keys(), neg_dict.values()))
neg_df = pd.DataFrame(neg_data, columns=['Words','Negative'], dtype=int)

first_df = pd.merge(pos_df, neu_df, how='outer', on=['Words', 'Words'])
all_df = pd.merge(first_df, neg_df, how='outer', on=['Words', 'Words'])
all_df = all_df.sort_values(by=['Positive', 'Neutral', 'Negative'],
                            ascending=False)
all_df = all_df.set_index('Words')
all_df
```

Out[0]:

	Positive	Neutral	Negative
Words			
#COVID19	869.0	1613.0	439.0
this	285.0	349.0	155.0
that	282.0	350.0	148.0
with	255.0	356.0	135.0
#coronavirus	241.0	440.0	110.0
...	...	...	...
Hotels	NaN	NaN	1.0
Billionaire	NaN	NaN	1.0
Nope	NaN	NaN	1.0
Fail	NaN	NaN	1.0
planes	NaN	NaN	1.0

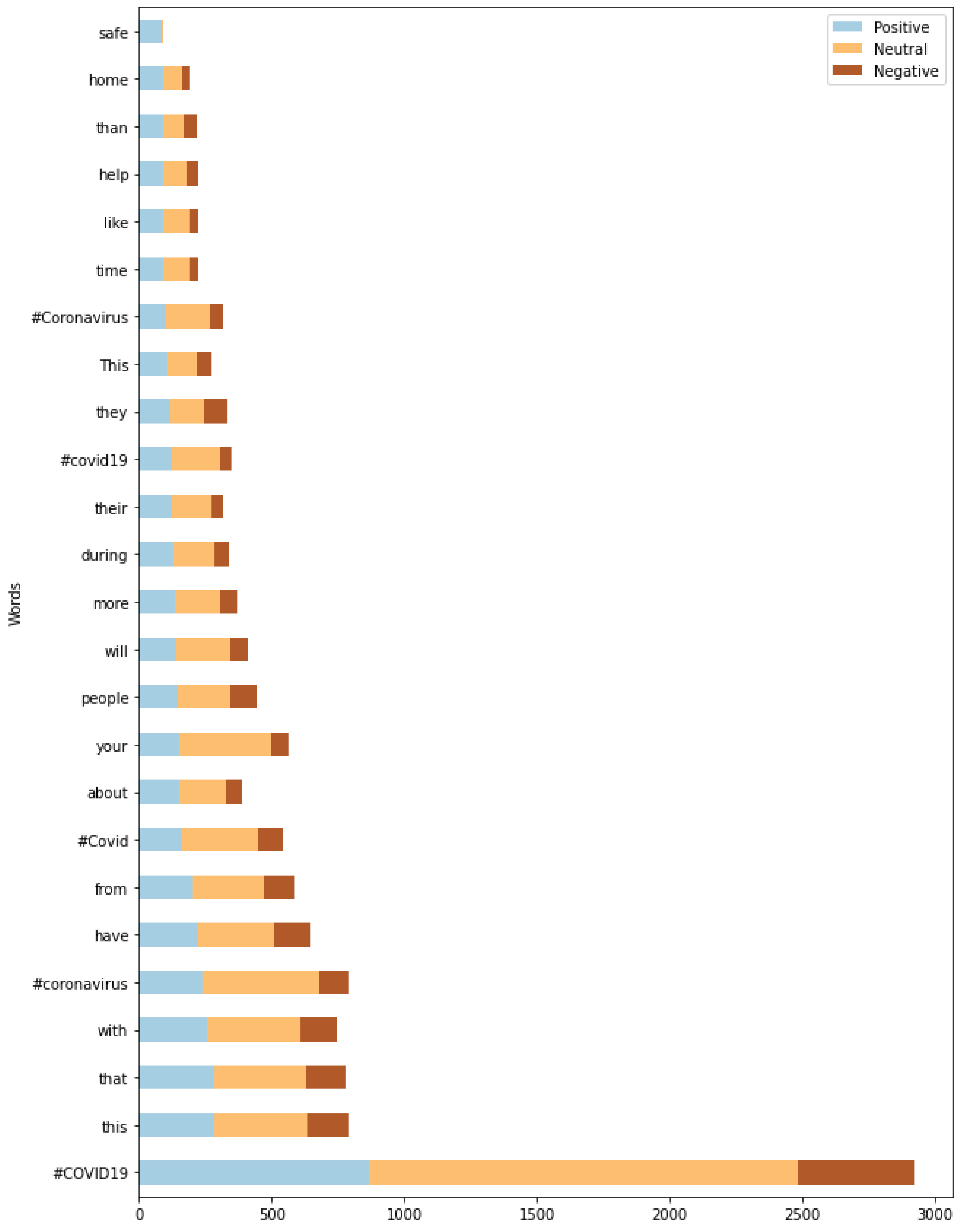
19170 rows × 3 columns

In [0]:

```
mydf = all_df[:25]      # we chose to display the first 25 most used words
mydf.plot.barh(figsize=(10,15), colormap='Paired', stacked=True)
```

Out[0]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f089497c208>
```



Dictionary-based analysis

In [0]:

```
def plot_sentiments(series):
  series.apply(
      lambda x: 'positive' if x > 0.05 else 'negative' if x < -0.05 else 'neutra
l'
  ).value_counts().plot(kind='pie', autopct='%1.0f%%', colors=["red", "yellow",
"green"])
```

In [0]:

```
sentiment_corpus = pd.read_csv("/root/data/SemEval2015-English-Twitter-Lexicon.t
xt",
                               delimiter="\t", header=None).set_index(1)[0].to_d
ict()
```

In [0]:

```
def calculate_sentiment(text):
  count = 0
  sum_value = 0

  for phrase in sentiment_corpus:
    if phrase in text:
      sum_value += sentiment_corpus[phrase]
      count += 1

  return sum_value / count if count > 0 else 0
```

In [0]:

```
sentiment_list_dict = pd.Series([
  calculate_sentiment(tweet)
  for tweet in tweets_all.tidy_tweet
])
```

In [0]:

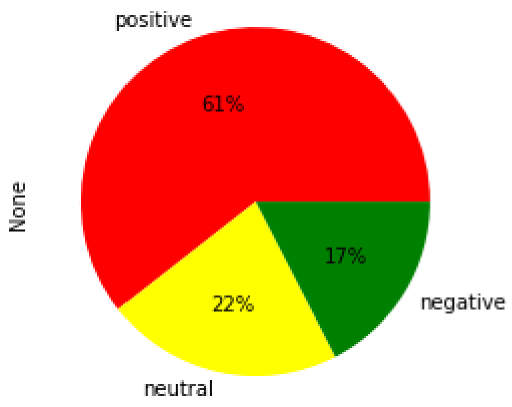
```
sentiment_list_dict.head()
```

Out[0]:

```
0   -0.6040
1    0.0000
2    0.2812
3   -0.2190
4    0.0000
dtype: float64
```

In [0]:

```
plot_sentiments(sentiment_list_dict)
```



In [0]:

```
sentiment_list_copy_1=sentiment_list_dict.copy()
labels = ["negative", "neutral", "positive"]
label_states = ["predicted", "real"]
conditions = [
    (sentiment_list_copy_1.values > 0.05),
    (sentiment_list_copy_1.values < - 0.05)
]
choices = [1,-1]
sentiment_list_copy_1['label'] = np.select(conditions, choices, default=0)
print(sentiment_list_copy_1)
```

```
0                                                     -0.604
1                                                          0
2                                                     0.2812
3                                                     -0.219
4                                                          0
                               ...
4920                                                   0.297
4921                                                   0.109
4922                                                  0.0376
4923                                               0.0624444
label    [-1, 0, 1, -1, 0, 1, 1, 0, 0, 1, 1, 1, 1, 1, 1...
Length: 4925, dtype: object
```

KNN

In [0]:

```
from sklearn.feature_extraction.text import CountVectorizer

vectorizer = CountVectorizer()
vectorizer
X = vectorizer.fit_transform(tweets_all['tidy_tweet'])
X.toarray()
```

Out[0]:

```
array([[0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       ...,
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0],
       [0, 0, 0, ..., 0, 0, 0]])
```

In [0]:

```
sentiment_list_copy=sentiment_list.copy()
```

In [0]:

```
#sentiment_list_copy['label'] = np.where(sentiment_list_copy.values>0.05, 1)
conditions = [
    (sentiment_list_copy.values > 0.05),
    (sentiment_list_copy.values < - 0.05)
]
choices = [1,-1]
sentiment_list_copy['label'] = np.select(conditions, choices, default=0)
print(sentiment_list_copy)
```

```
0                                                        0
1                                                      0.6
2                                                 0.318182
3                                                        0
4                                                0.0416667
                               ...
4920                                                     0
4921                                                     0
4922                                                  0.25
4923                                                     0
label    [0, 1, 1, 0, 0, 1, 1, -1, -1, 0, 1, 0, 0, -1, ...
Name: Sentiment, Length: 4925, dtype: object
```

In [0]:

```
XX = X.toarray()
YY = sentiment_list_copy['label']
```

```
<class 'numpy.ndarray'> 56990376
<class 'numpy.ndarray'> 4924
```

In [0]:

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
```

In [0]:

```
knn = KNeighborsClassifier(n_neighbors=5)
```

In [0]:

```
X_train, X_test, y_train, y_test = train_test_split(XX, YY, test_size=0.3, rando
m_state=42)
```

In [0]:

```
knn.fit(X_train, y_train)
```

Out[0]:

```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkows
ki',
                     metric_params=None, n_jobs=None, n_neighbors=5,
p=2,
                     weights='uniform')
```

In [0]:

```
YYY = knn.predict(X_test)
print(YYY)
```

```
[0 0 0 ... 0 0 0]
```

In [0]:

```
from sklearn.metrics import accuracy_score
accuracy_score(y_test, YYY)
```

Out[0]:

```
0.5419485791610285
```

Precision and recall calculation

In [0]:

```
from sklearn.metrics import classification_report
print('Results for KNN')
print(classification_report(y_test, YYY, target_names=labels)) #for KNN
print('Results for Dictionary-based analysis')
print(
    classification_report(
        sentiment_list_copy_2['label'],
        sentiment_list_copy_1['label'],
        target_names=labels
    )
)
```

```
Results for KNN
              precision    recall  f1-score   support

    negative       0.80      0.02      0.03       251
     neutral       0.54      1.00      0.70       783
    positive       0.89      0.04      0.07       444

    accuracy                           0.54      1478
   macro avg       0.74      0.35      0.27      1478
weighted avg       0.69      0.54      0.40      1478

Results for Dictionary-based analysis
              precision    recall  f1-score   support

    negative       0.27      0.31      0.29       750
     neutral       0.56      0.23      0.32      2643
    positive       0.38      0.74      0.50      1531

    accuracy                           0.40      4924
   macro avg       0.40      0.42      0.37      4924
weighted avg       0.46      0.40      0.37      4924
```

Discussion

Dictionary-based analysis and TextBlob results show the same 16% in the negative percentage. However, positive and neutral have different percentages, because the dictionary-based qualify 63% as positive and 21% as neutral, but TextBlob assigned 52% as positive and 32% as neutral. A possible cause is the dictionary, and the threshold selected to assign tweets as positive, negative or neutral.

List of references

File importing from Google Drive to Google Colab by PyDrive - https://buomsoo-kim.github.io/colab/2018/04/16/Importing-files-from-Google-Drive-in-Google-Colab.md/ (https://buomsoo-kim.github.io/colab/2018/04/16/Importing-files-from-Google-Drive-in-Google-Colab.md/)

NRC Hashtag Sentiment Lexicon - http://sentiment.nrc.ca/lexicons-for-research/ (http://sentiment.nrc.ca/lexicons-for-research/)

TextBlob Sentiment: Calculating Polarity and Subjectivity - https://planspace.org/20150607-textblob_sentiment/ (https://planspace.org/20150607-textblob_sentiment/)

D. S. Rajput, R.S. Thakur, S. M. Basha, “Sentiment Analysis and Knowledge Discovery in Contemporary Business”, IGI Global, 2019

TextBlob: Simplified Text Processing - https://github.com/sloria/textblob (https://github.com/sloria/textblob)