Statistics/Plots

We have analyzed the frequencies and distributions of the existence and existence_confidence columns. The distribution of the scores for existence_confidence are most frequent around 0.6 to 0.75 and highest at 1.0. We have an imbalance where there are more tweets believing in climate change compared to those that don't. This is further confirmed by the existence distribution histogram. The top twenty words do not change much before and after preprocessing. One interesting pattern is that the words "climate", "change", and "global" stay as the top twenty either way. One interesting finding from the word clouds is that the words pertaining to links (bit.ly, tinyurl) are showing up as the most impactful. After preprocessing, words/phrases such as greenhouse, conscious, and oil spill show up as the most impactful. This confirms that preprocessing helped in bringing out the most relevant words in the analysis.

In [ ]:
```
import numpy as np
import pandas as pd
import spacy
from nltk.stem import PorterStemmer
import matplotlib.pyplot as plt
from itertools import chain
from wordcloud import WordCloud, STOPWORDS

!pip install xlrd==1.2.0
```

```
Looking in indexes: https://pypi.org/simple, (https://pypi.org/simple,) h
ttps://us-python.pkg.dev/colab-wheels/public/simple/ (https://us-python.p
kg.dev/colab-wheels/public/simple/)
Requirement already satisfied: xlrd==1.2.0 in /usr/local/lib/python3.7/di
st-packages (1.2.0)
```

In [ ]:
```
import cufflinks as cf
cf.go_offline()
cf.set_config_file(offline=False, world_readable=True)
```

In [ ]:
```
from google.colab import drive
drive.mount('/content/gdrive')
```

```
Drive already mounted at /content/gdrive; to attempt to forcibly remount,
call drive.mount("/content/gdrive", force_remount=True).
```

In [ ]:
```
data = pd.read_excel('/content/gdrive/My Drive/CMPE257-ML-Group-13/glob
data.head()
```

Out[3]:

	tweet	existence	existence.confidence
0	Global warming report urges governments to act...	Yes	1.0000
1	Fighting poverty and global warming in Africa ...	Yes	1.0000
2	Carbon offsets: How a Vatican forest failed to...	Yes	0.8786
3	Carbon offsets: How a Vatican forest failed to...	Yes	1.0000
4	URUGUAY: Tools Needed for Those Most Vulnerabl...	Yes	0.8087

In [ ]:
```
data['word_count'] = data['tweet'].apply(lambda x: len(x.split(" ")))
data.loc[data['existence'] == 'Y','existence'] = "Yes"
data.loc[data['existence'] == 'N','existence'] = "No"
data.dropna()
print(data['existence'].value_counts())
data.head()
```

```
Yes    3111
No     1114
Name: existence, dtype: int64
```

Out[4]:

	tweet	existence	existence.confidence	word_count
0	Global warming report urges governments to act...	Yes	1.0000	18
1	Fighting poverty and global warming in Africa ...	Yes	1.0000	8
2	Carbon offsets: How a Vatican forest failed to...	Yes	0.8786	12
3	Carbon offsets: How a Vatican forest failed to...	Yes	1.0000	12
4	URUGUAY: Tools Needed for Those Most Vulnerabl...	Yes	0.8087	11

In [ ]:
```
tweets = data["tweet"]
tweets = tweets.drop_duplicates()
tweets
```

Out[5]:
```
0       Global warming report urges governments to act...
1       Fighting poverty and global warming in Africa ...
2       Carbon offsets: How a Vatican forest failed to...
4       URUGUAY: Tools Needed for Those Most Vulnerabl...
5       RT @sejorg: RT @JaymiHeimbuch: Ocean Saltiness...
                              ...
6085    @bloodless_coup "The phrase 'global warming' s...
6086    Virginia to Investigate Global Warming Scienti...
6087    Global warming you tube parody you will enjoy ...
6088    One-Eyed Golfer: Don't dare tell me about glob...
6089    man made global warming a hair brained theory ...
Name: tweet, Length: 5541, dtype: object
```

For Preprocessing we have used

In [ ]:
```
### Source: https://spacy.io/usage/linguistic-features

def spacyPipeline(tweets):
    ps = PorterStemmer()
    nlp = spacy.load('en_core_web_sm')

    preprocessed_tweets = []
    for t in tweets:
        doc = nlp(t)
        filtered_tweet = []

        for token in doc:
            if (not token.is_stop) and token.is_alpha:
                filtered_tweet.append(ps.stem(str(token)))

        preprocessed_tweets.append(filtered_tweet)

    return preprocessed_tweets
```

In [ ]:
```
def preprocess(tweets):
    # Convert all to lowercase
    tweets = [t.lower() for t in tweets]

    # Process tweets through spaCy pipeline
    tweets = spacyPipeline(tweets)

    # Filter out words
    tweets = [list(filter(lambda w: w != 'link', t)) for t in tweets]

    # Remove words less than length 2
    tweets = [list(filter(lambda w: len(w) > 2, t)) for t in tweets]

    print(tweets)
    return tweets
```

In [ ]:
```
def generateWordCloud(tweets):
    allwords = " ".join(set(chain.from_iterable(tweets)))
    wordcloud = WordCloud(width = 800, height = 800,
                    background_color ='white',
                    stopwords = set(STOPWORDS),
                    min_font_size = 10).generate(allwords)

    plt.axis("off")
    plt.tight_layout(pad = 0)

    plt.figure(figsize = (7, 7), facecolor = 'white', edgecolor='blue')
    plt.imshow(wordcloud)

    plt.show()
```

In [ ]:
```
1 preprocessed_tweets = preprocess(tweets)
```

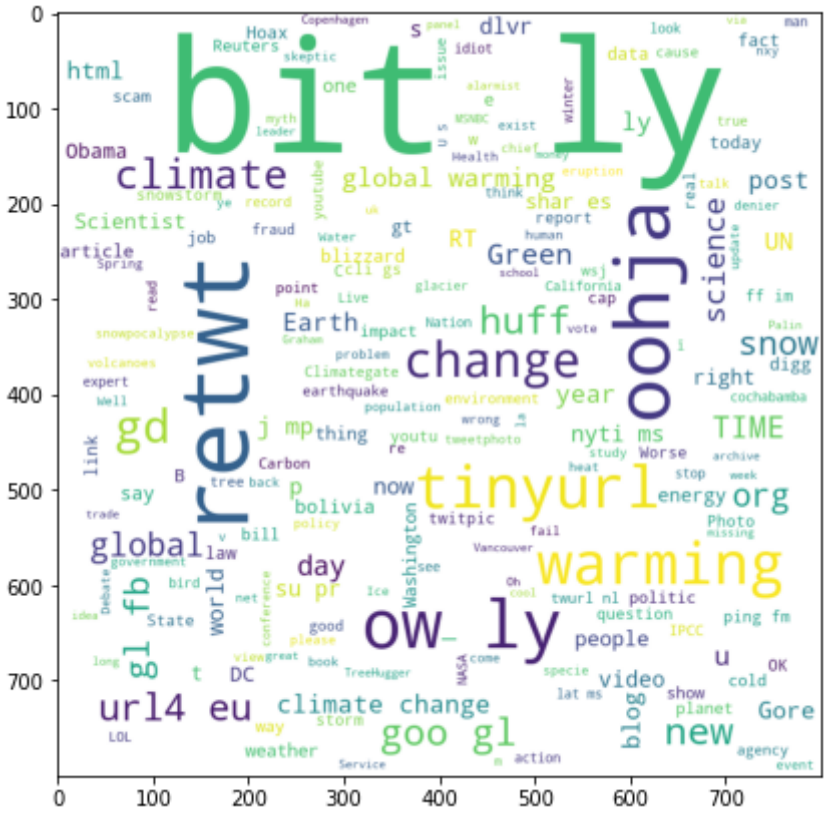
```
[['global', 'warm', 'report', 'urg', 'govern', 'belgium', 'world', 'fac
e', 'increas', 'hunger'], ['fight', 'poverti', 'global', 'warm', 'afric
a'], ['carbon', 'offset', 'vatican', 'forest', 'fail', 'reduc', 'globa
l', 'warm'], ['uruguay', 'tool', 'need', 'vulner', 'climat', 'chang'],
['ocean', 'salti', 'show', 'global', 'warm', 'intensifi', 'water', 'cyc
l'], ['global', 'warm', 'evid', 'messag', 'global', 'warm', 'denier',
'doubter', 'look'], ['migratori', 'bird', 'new', 'climat', 'chang', 'st
rategi', 'stay', 'home'], ['southern', 'africa', 'compet', 'limpopo',
'water', 'climat', 'chang', 'bring', 'higher', 'temperatur', 'south'],
['global', 'warm', 'impact', 'wheat', 'rice', 'product', 'apr', 'scarci
ti', 'water'], ['solv', 'global', 'warm', 'thing'], ['preliminari', 'an
alysi', 'suggest', 'natur', 'contribut', 'far', 'global', 'warm', 'prev
ious'], ['ecoton', 'climat', 'chang', 'popul', 'perspect'], ['climat',
'chang', 'blame', 'coastal', 'whale', 'migrat', 'dwindl', 'ventura', 'c
ounti'], ['spring', 'storm', 'season', 'start', 'littl', 'late', 'yea
r', 'global', 'warm'], ['govern', 'report', 'say', 'global', 'warm', 'c
aus', 'cancer', 'mental', 'ill'], ['earthday', 'global', 'warm', 'affec
t', 'patient', 'symptom'], ['wait', 'idea', 'natur', 'climat', 'chang',
'human', 'induc', 'global', 'warm'], ['epa', 'issu', 'report', 'clima
```

VISUALIZATIONS

https://towardsdatascience.com/a-complete-exploratory-data-analysis-and-visualization-for-text-data-29fb1b96fb6a (https://towardsdatascience.com/a-complete-exploratory-data-analysis-and-visualization-for-text-data-29fb1b96fb6a)

https://github.com/yrtnsari/Sentiment-Analysis-NLP-with-Python/blob/main/wordcloud.ipynb (https://github.com/yrtnsari/Sentiment-Analysis-NLP-with-Python/blob/main/wordcloud.ipynb)

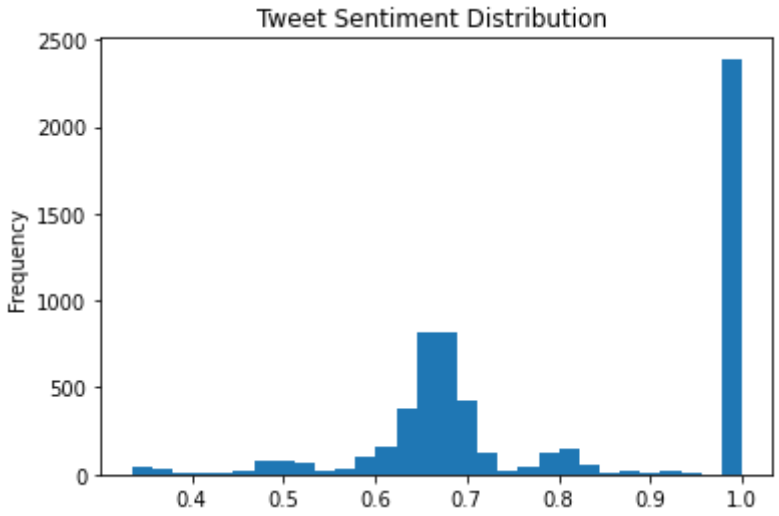
In [ ]:
```
generateWordCloud([t.split(' ') for t in tweets])
generateWordCloud(preprocessed_tweets)
```



0
100
200
300
400
500
600
700
new
abu
sen
consciou
greenhou
expen
previou
focu
chanc
sean
sheppard
increa
hou
tale
rehabilit
wor
relea
cuccinelli
premier
interestig
clockwork
influenc
lighthous
brilliant
debat
emir
era
idioci
flu
clergi
hazard
fade
patient
gingrich
antarctica
happend
orchestr
doug
john
mer
bald
novel
parliament
asid
oilspil
jasencomstock
program
voter
dedic
milton
chemistri
chron
asthma
looney
creepi
michellemalkin
kenya
bite
yale
internet
stratospher
ammonia
thursd
temperatur
lindsey
clarendon
park
hlp
cst
snarl
rsrh
guy
yuval
rightw
bodi
panelist
untrustworthi
climatewir
unusu
instapundit
polar
face
aisl
claim
achiev
duchess
money
cleanup
jerri
qut
silli
barometr
hockey
nualight
esti
cara
posit
todat
erupt
talkiesinvas
particularli
krishna
ritual
stonesoupdayton
broadcast
photojourn
combat
metaphor

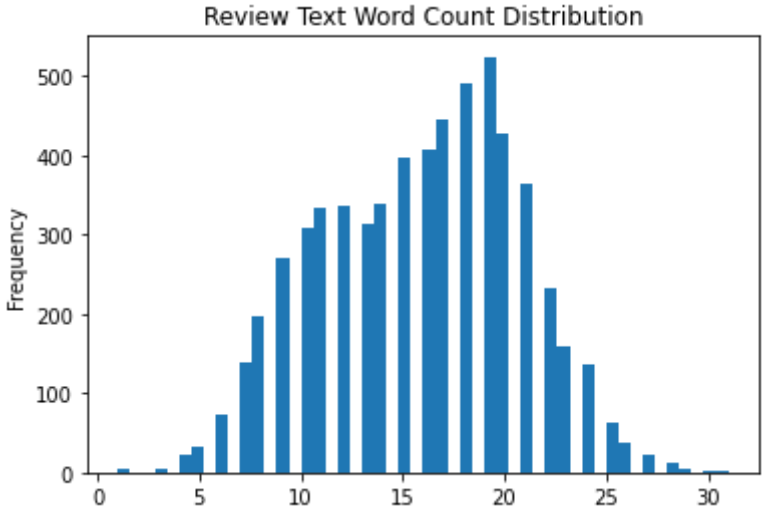
In [ ]:
```
1 data['existence.confidence'].plot(
2     kind='hist',
3     bins=30,
4     title='Tweet Sentiment Distribution ')
```

Out[11]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff753e6f690>



In [ ]:
```
data['word_count'].plot(
    kind='hist',
    # xTitle = "Word Count",
    bins=50,
    title='Tweet Word Count Distribution')
```

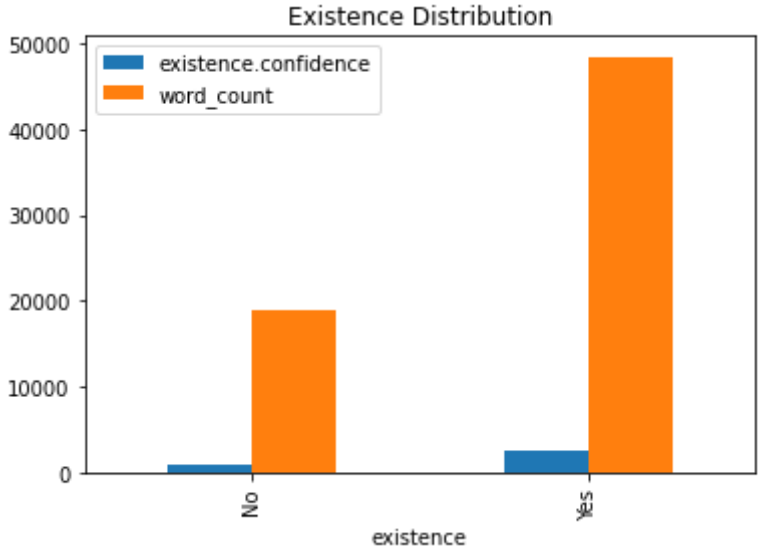
Out[27]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff744da9090>



In [ ]:
```
print(data.groupby(by=["existence"]).sum())
data.groupby(by=["existence"]).sum().plot(kind = 'bar',title = "Existen
```

```
           existence.confidence  word_count
existence
No                      849.8694       19016
Yes                    2555.6852       48464
```

Out[53]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff74331d950>



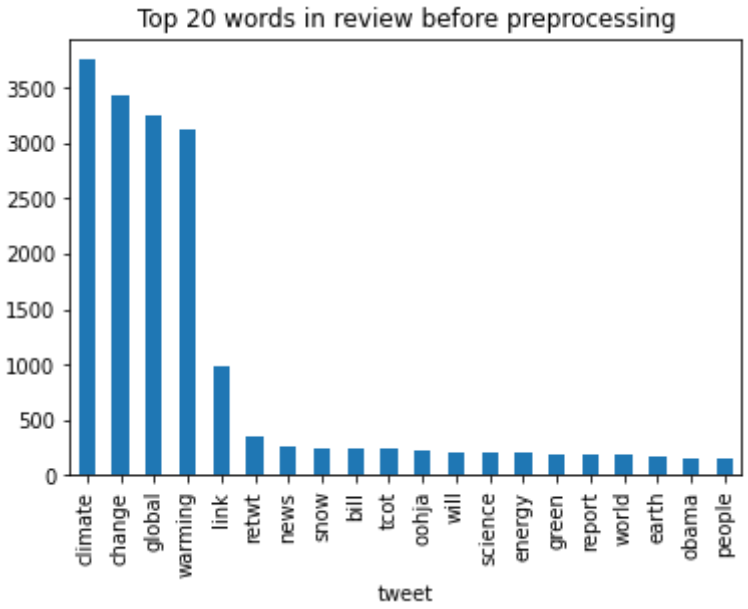
In [ ]:

```
# The distribution of top unigrams before removing stop words
from sklearn.feature_extraction.text import CountVectorizer

def get_top_n_words(corpus, n=None):
    vec = CountVectorizer().fit(corpus)
    bag_of_words = vec.transform(corpus)
    sum_words = bag_of_words.sum(axis=0)
    words_freq = [(word, sum_words[0, idx]) for word, idx in vec.vocabu
    # words_freq = [(word, sum_words[0, idx]) for word, idx in vec.voca
    words_freq =sorted(words_freq, key = lambda x: x[1], reverse=True)
    return words_freq[:n]

common_words = get_top_n_words(data['tweet'], 20)
for word, freq in common_words:
    print(word, freq)
df1 = pd.DataFrame(common_words, columns = ['tweet' , 'word_count'])
display(df1.head())

df1.groupby('tweet').sum()['word_count'].sort_values(ascending=False).p
    kind='bar', title='Top 20 words in review before preprocessing')


```

```
climate 3756
change 3438
global 3247
warming 3134
link 980
retwt 358
news 266
snow 248
bill 247
tcot 242
oohja 217
will 212
science 210
energy 204
green 192
report 179
world 178
earth 173
obama 155
people 149
```

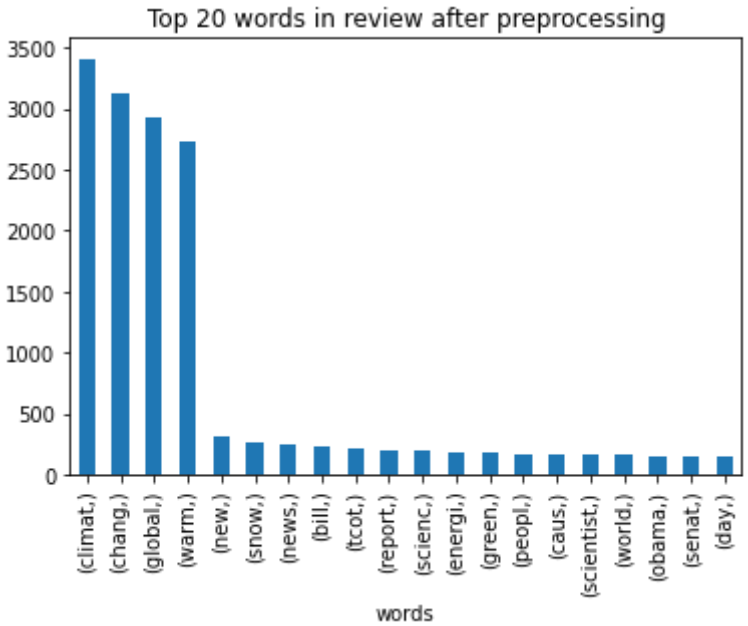
	tweet	word_count
0	climate	3756
1	change	3438
2	global	3247
3	warming	3134
4	link	980

Out[54]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff7432e5510>



In [ ]:
```
1 allwords = list(chain.from_iterable(preprocessed_tweets))
2 df2 = pd.DataFrame(allwords,columns = ["words"])
3 df2.value_counts()[:20].plot(kind='bar', title='Top 20 words in review
4 # allwords
5 # preprocessed_tweets
```

Out[51]: <matplotlib.axes._subplots.AxesSubplot at 0x7ff73bbc4bd0>



In [ ]:
```
1
```

In [ ]:
```
1
```