Categorizing and analyzing comments under Recession in 2023 post on Reddit.

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Importing the necessary Libraries

```
import nltk
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from pandas_profiling import ProfileReport
from nltk.stem import WordNetLemmatizer
import re
from nltk.corpus import stopwords
from scipy.stats import pearsonr
import itertools
import collections

from sklearn.metrics import roc_auc_score, accuracy_score, roc_curve, classification_report,confusion_matrix

from sklearn.model_selection import cross_val_score,train_test_split, GridSearchCV, KFold
import warnings
%matplotlib inline
warnings.filterwarnings('ignore')


nltk.download("stopwords","wordnet") ## Download the packages Stopwords and wordnet
```

```
[nltk_data] Downloading package stopwords to wordnet...
[nltk_data]   Unzipping corpora/stopwords.zip.
True
```

The Data (Source:- Reddit)

```
messages = pd.read_csv('data.csv',error_bad_lines=False)
messages
```

	Post	Comments	Sentiment	Informative	Geography	I
0	World Economy Is Headed for Recession in 2023,...	This has become a game of semantics. We're in ...	Negative	Yes	USA	Unempl
1	NaN	So you're telling me what we've been going thr...	Negative	Yes	Italy	Ec
2	NaN	Inflation is already heading down, unemploymen...	Negative	Yes	USA	Ec
3	NaN	I wish it didn't have to be like this but tbh ...	Positive	Yes	USA	I
4	NaN	Absolutely. It's hard to claim recession witho...	Positive	Yes	USA	Unempl
...	...	...	...	...	...	
71	New Zealand forecasts recession in 2023 as it ...	LoL. That is exactly what is going to happen.\...	Negative	Yes	New Zealand	I
72	NaN	Before anyone panics, EU is in stagflation, UK...	Negative	Yes	New Zealand	Ec
73	World Bank warns global economy could tip into...	Thanks tips. Havnt hears this type of news onc...	Negative	Yes	Global	Ec
74	Chile Recession: Will Chile enter recession in...	Qué miedo da ahora escuchar esa frase. Por qué...	NaN	NaN	NaN	
75	NaN	Is Chile in recession?\nChile's GDP growth slo...	Negative	Yes	Chile	Ec

76 rows × 7 columns

```
messages[['Comments','Sentiment','Geography ','Impact ']].dropna()
```

	Comments	Sentiment	Geography	Impact
0	This has become a game of semantics. We're in ...	Negative	USA	Unemployment
1	So you're telling me what we've been going thr...	Negative	Italy	Economy
2	Inflation is already heading down, unemploymen...	Negative	USA	Economy
3	I wish it didn't have to be like this but tbh ...	Positive	USA	Inflation
4	Absolutely. It's hard to claim recession witho...	Positive	USA	Unemployment
...	...	...	...	...
70	Yes, they'd rather destroy the whole economy w...	Negative	Global	Inflation
71	LoL. That is exactly what is going to happen.\...	Negative	New Zealand	Inflation
72	Before anyone panics, EU is in stagflation, UK...	Negative	New Zealand	Economy

```
messages.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 76 entries, 0 to 75
Data columns (total 7 columns):
 #   Column              Non-Null Count  Dtype 
---  ------              --------------  ----- 
 0   Post                19 non-null     object
 1   Comments            76 non-null     object
 2   Sentiment           72 non-null     object
 3   Informative         71 non-null     object
 4   Geography           73 non-null     object
 5   Impact              71 non-null     object
 6   Unrelated Comments  76 non-null     object
dtypes: object(7)
memory usage: 4.3+ KB
```

```
messages.describe()
```

	Post	Comments	Sentiment	Informative	Geography	Imp
count	19	76	72	71	73	
unique	19	76	3	1	10	
top	World Economy Is Headed for Recession in 2023,...	This has become a game of semantics. We're in ...	Negative	Yes	USA	Econ
freq	1	1	38	71	24	

```
messages['Sentiment'].value_counts()
```

```
Negative    38
Positive    28
Neutral      6
Name: Sentiment, dtype: int64
```

Exploratory Data Analytics

```
messages['length'] = messages['Comments'].apply(len) ## Getting the length of each comment
messages
```

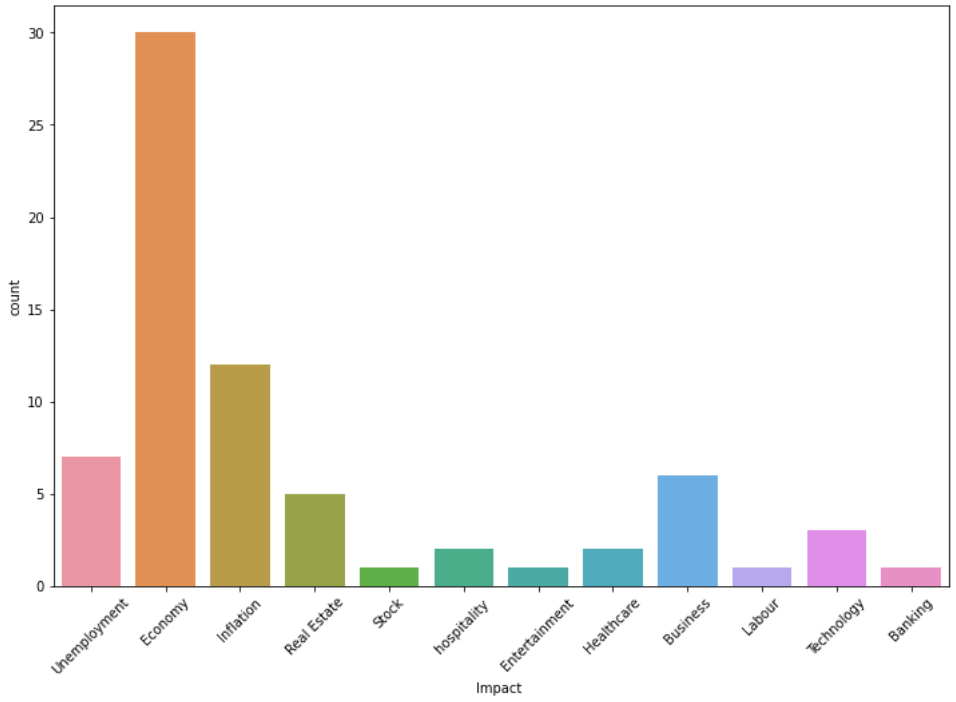
	Post	Comments	Sentiment	Informative	Geography	Impact
0	World Economy Is Headed for Recession in 2023,...	This has become a game of semantics. We're in ...	Negative	Yes	USA	Unemployment

```
messages['Impact '].value_counts()
```

```
Economy          30
Inflation        12
Unemployment      7
Business          6
Real Estate       5
Technology        3
hospitality       2
Healthcare        2
Stock             1
Entertainment     1
Labour            1
Banking           1
Name: Impact , dtype: int64
```

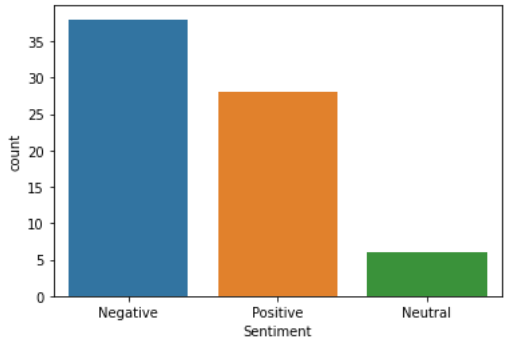
```
plt.figure(figsize=(12,8))
sns.countplot(messages['Impact '])
plt.annotate()
plt.xticks(rotation = 45)
```

```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11]),
 <a list of 12 Text major ticklabel objects>)
```



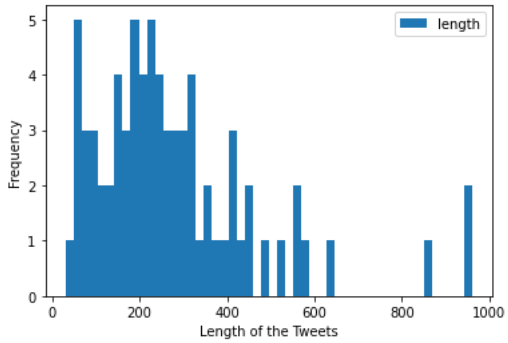

```
sns.countplot(messages['Sentiment'])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb4ac2cd880>
```



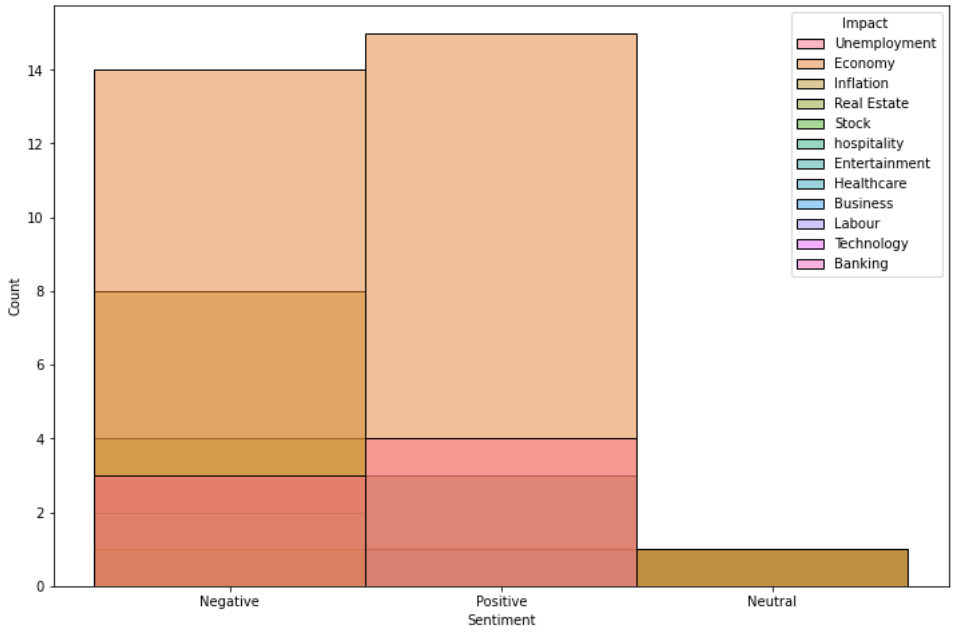
```
messages[messages['length']<1000].plot(bins=50, kind='hist')
plt.xlabel('Length of the Comments')
```

```
Text(0.5, 0, 'Length of the Tweets')
```




```
plt.figure(figsize=(12,8))
sns.histplot(data=messages,x='Sentiment',hue='Impact ')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb4b4459520>
```

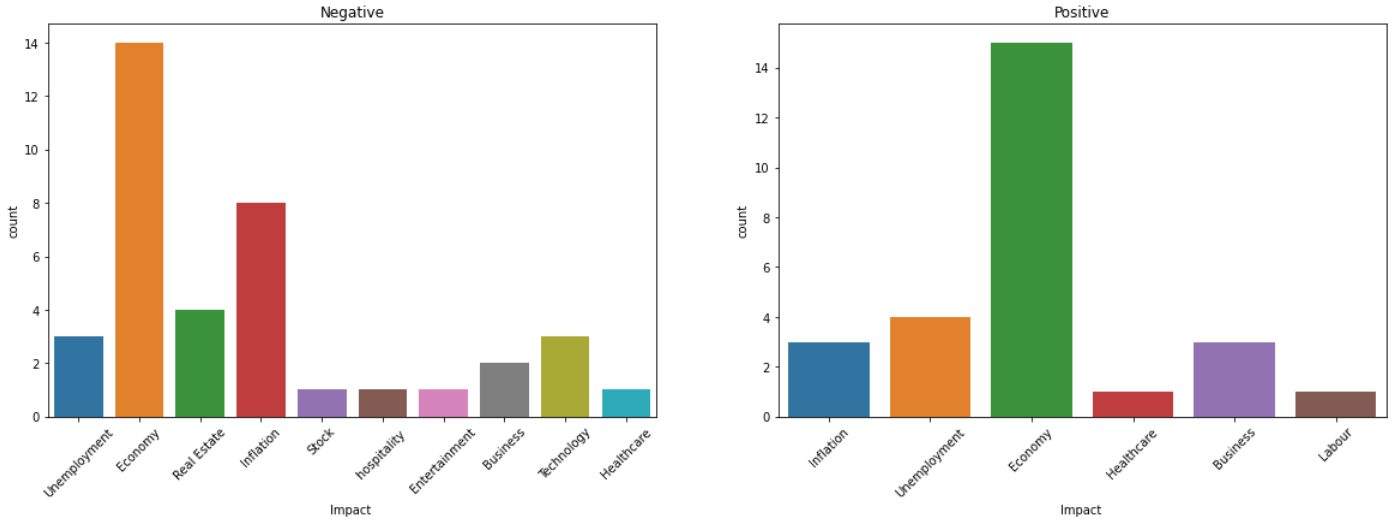



```
plt.figure(figsize=(12,8))
sns.countplot(data=messages,x='Sentiment',hue='Impact ')
plt.legend(loc='upper right', title='Industry')
```

```
<matplotlib.legend.Legend at 0x7fb4ac41e2e0>
```

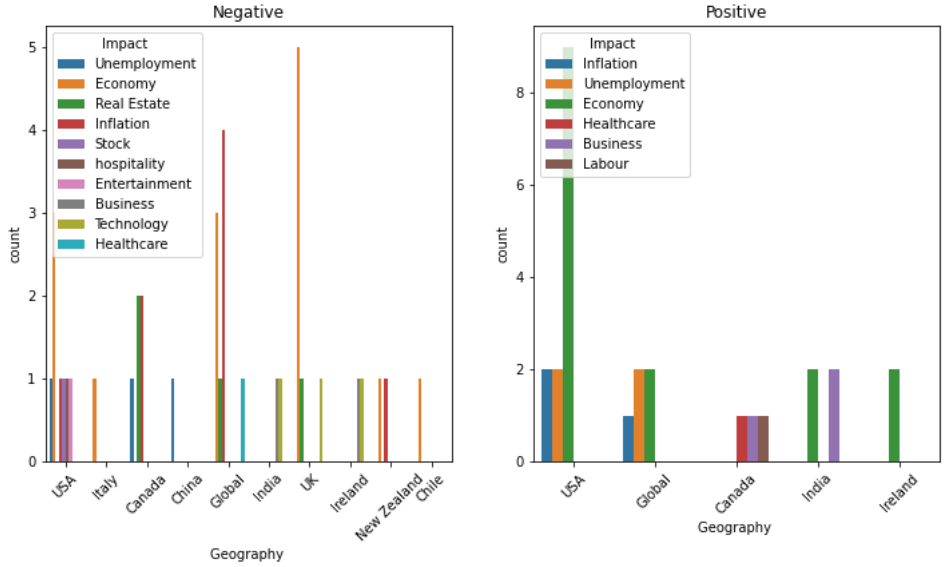

```
plt.figure(figsize=(20,6))
plt.subplot(1,2,1)
plt.title('Negative')
plt.xticks(rotation = 45)
sns.countplot(messages[messages['Sentiment']=='Negative']['Impact '])
plt.subplot(1,2,2)
plt.title('Positive')
plt.xticks(rotation = 45)
sns.countplot(messages[messages['Sentiment']=='Positive']['Impact '])
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb4b3d36cd0>
```




```
plt.figure(figsize=(12,6))
plt.subplot(1,2,1)
plt.title('Negative')
plt.xticks(rotation = 45)
sns.countplot(data=messages[messages['Sentiment']=='Negative'],x='Geography ',hue='Impact ')
plt.subplot(1,2,2)
plt.title('Positive')
plt.xticks(rotation = 45)
sns.countplot(data=messages[messages['Sentiment']=='Positive'],x='Geography ',hue='Impact ')
```

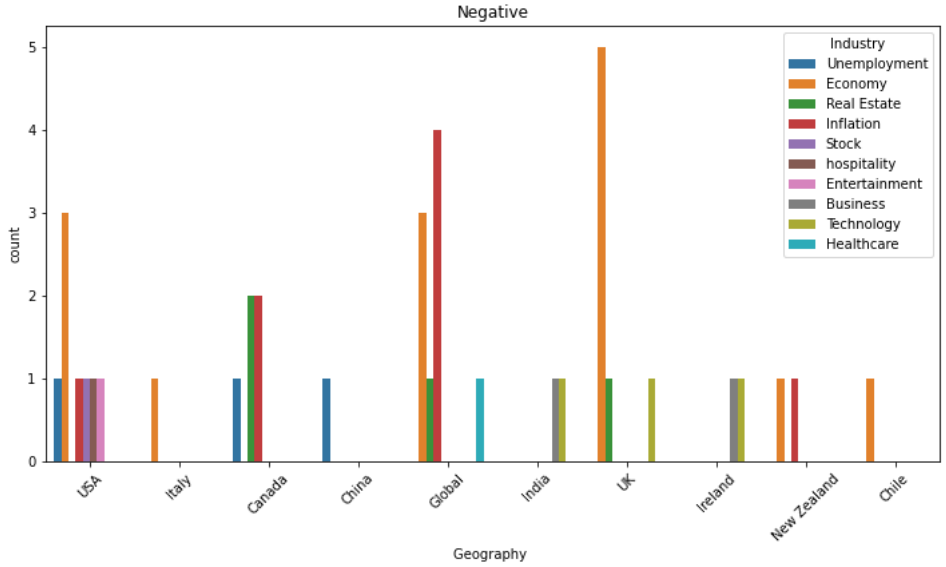
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb4b4006580>
```




```
plt.figure(figsize=(12,6))
plt.title('Negative')
```

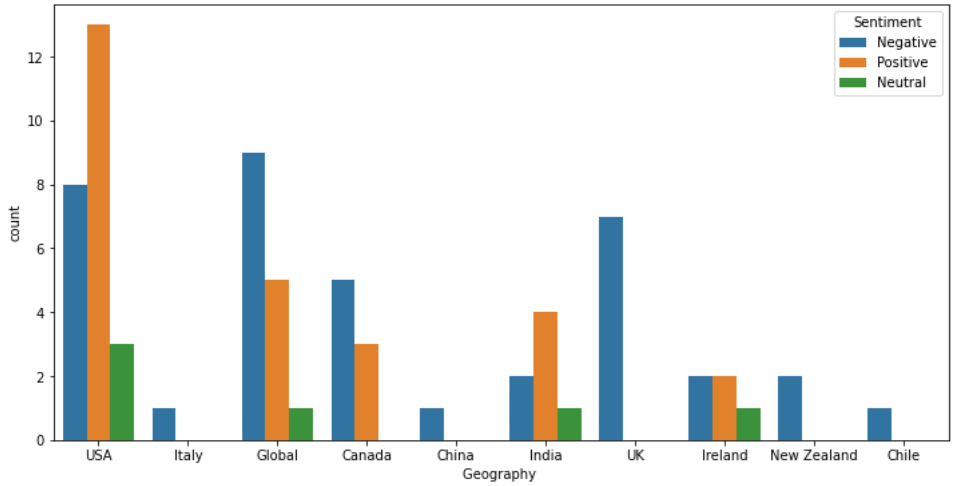
```
plt.xticks(rotation = 45)
sns.countplot(data=messages[messages['Sentiment']=='Negative'],x='Geography ',hue='Impact ')
plt.legend(loc='upper right',title='Industry')
```

```
<matplotlib.legend.Legend at 0x7fb4ac50d0a0>
```




```
plt.figure(figsize=(12,6))
sns.countplot(data=messages,x='Geography ',hue='Sentiment')
plt.legend(loc='upper right',title='Sentiment')
```

```
<matplotlib.legend.Legend at 0x7fb4b3873f70>
```




```
messages[messages['Sentiment']=='Neutral']['Impact ']
```

```
12         Economy
15    hospitality
20       Inflation
31        Business
49     Real Estate
Name: Impact , dtype: object
```

```
messages.length.describe()
```

```
count      52.000000
mean      303.153846
std       238.107439
min        31.000000
25%       159.000000
50%       238.500000
75%       355.750000
max      1116.000000
Name: length, dtype: float64
```

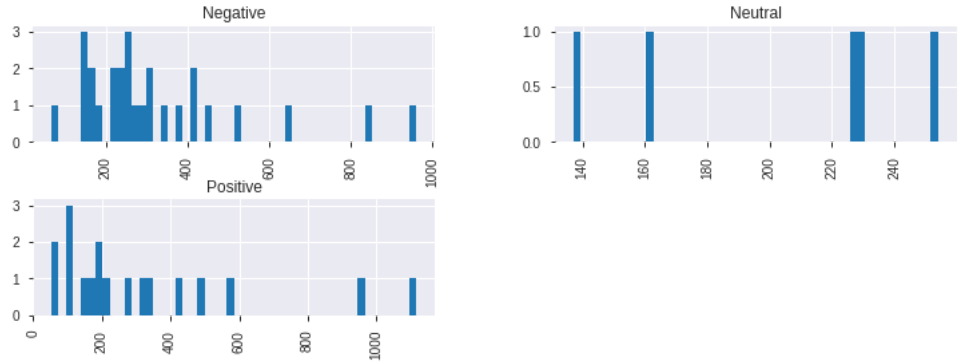
The maximum length of the tweets is 374. Let's see what that tweet is

```
messages[messages['length'] == 1116]['Comments'].iloc[0]
```

```
'"and unemployment was allowed to fall so low"\n\nThat\'s it in a nutshell. Business actually likes unemployment as high as 10%. This gives them a large unemployed labour pool in order to suppress wage growth and ensure labour has zero leverage for any gains like working hours, etc etc.\n\nThe looming recession is your fault for having a job.\n\nWhat\'s to blame for inflation and recession? Workers. Plain and simple. You have a job? You\'re to blame. You want a raise? You\'re to blame. You received CERB during the pandemic and it allowed you to not lose your house? You\'re to blame.\n\nBusiness is blameless, always. Record profits are "deserved" and not causing inflation. All input costs must be passed along to consumers, even if there\'s a healthy profit margin that would allow absorption. Profits must always be not only preserved, but rising, or workers are to blame.\n\nRecessions are loved by capital. The price of labour is decreased, asset prices drop and are scooped up by t
```

```
messages.hist(column='length', by='Sentiment', bins=50,figsize=(12,4))
```

```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7f182f2112b0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f182f15e520>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f182eb7bc10>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f182eb00070>]],
      dtype=object)
```



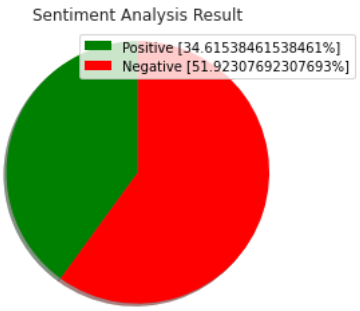

```
n = (len(messages[messages['Sentiment'] == 'Negative'])/len(messages))*100
n
```

```
51.92307692307693
```

```
p = (len(messages[messages['Sentiment'] == 'Positive'])/len(messages))*100
p
```

```
34.61538461538461
```

```
labels = ['Positive ['+str(p)+'%]' ,'Negative ['+str(n)+'%]']
sizes = [p, n]
colors = ['green','red']
patches, texts = plt.pie(sizes,colors=colors, startangle=90,shadow=True)
plt.style.use('default')
plt.legend(labels)
plt.title("Sentiment Analysis Result")
plt.axis('equal')
plt.show()
```




```
print(pearsonr(messages['length'],messages['Sentiment']))
```

```
(-0.011232976285413889, 3.120074564252326e-45)
```

Preprocessing of the Data

```
messages.drop(['ItemID','SentimentSource'],axis=1,inplace=True)
```

```
messages.head()
```

	Sentiment	SentimentText	length
0	0	is so sad for my APL frie...	61
1	0	I missed the New Moon trail...	51
2	1	omg its already 7:30 :O	37
3	0	.. Omgaga. Im sooo im gunna CRy. I'...	132
4	0	i think mi bf is cheating on me!!! ...	53

```
stopwords.words('english')
```

```
['i',
 'me',
 'my',
 'myself',
 'we',
 'our',
 'ours',
 'ourselves',
 'you',
 "you're",
 "you've",
 "you'll",
 "you'd",
 'your',
 'yours',
 'yourself',
 'yourselves',
 'he',
 'him',
 'his',
 'himself',
 'she',
 "she's",
 'her',
 'hers',
 'herself',
 'it',
 "it's",
 'its',
 'itself',
 'they',
 'them',
 'their',
 'theirs',
 'themselves',
 'what',
 'which',
 'who',
 'whom',
 'this',
 'that',
 "that'll",
 'these',
 'those',
 'am',
 'is',
 'are',
 'was',
 'were',
 'be',
 'been',
 'being',
 'have',
 'has',
 'had',
 'having',
 'do',
 'does',
```

As the dataset is too big for us to train on our Local Machine we are Slicing the Data

```
messages = messages.sample(n=50000)
messages.reset_index(inplace=True)
messages
```

	index	Sentiment	SentimentText	length
0	260048	0	@kimgasm i wanna visit youuu! I need moneys	44
1	904527	1	I'm in Aldershot waiting for my bestest matey ...	93
2	75295	1	@BTUB40 if I was only a few miles nearer!! Tha...	64
3	1063997	1	@mikerdzign You going next Thursday too? If so...	98
4	1106752	1	no tests	9
...	...	...	...	...
49995	1027209	0	just woke up day off and need to go in to work...	134
49996	679593	0	Gah, I really hate it when my posts get Stumbl...	116
49997	969885	1	@LAL_rk_JB YAYYYYYYYY!!!!!!!!!!!! good job la...	52
49998	1275389	0	Trying to focus n do this scholarship but I'm ...	79
49999	763197	1	Goingg too sleeep See ya tomorrow guys <3	46

50000 rows × 4 columns

```
pos = messages[messages['Sentiment'] == 'Positive']['Comments']


positive = pos.reset_index()['Comments']


pos_join = []
for i in range(len(positive)):
    sent = re.sub('[^a-zA-Z]',' ',positive[i])
    pos_join.append(sent)


neg = messages[messages['Sentiment'] == 'Negative']['Comments']


negative = neg.reset_index()['Comments']


neg_join = []
for i in range(len(negative)):
    sent = re.sub('[^a-zA-Z]',' ',negative[i])
    neg_join.append(sent)


neg_joinget = []
for i in range(len(neg_join)):
    sent = re.sub('get',' ',neg_join[i])
    neg_joinget.append(sent)


import nltk
nltk.download('stopwords')
```

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

```
from wordcloud import WordCloud
text_pos = " ".join(x for x in pos_join)
wordcloud = WordCloud(stopwords=stopwords.words('english')).generate(text_pos)
plt.figure(figsize=(15,15))
plt.title('positive comments')
plt.imshow(wordcloud, interpolation='bilinear')
```

```
<matplotlib.image.AxesImage at 0x7fb4b299cd90>
```


```
from wordcloud import WordCloud
text_neg = " ".join(x for x in neg_join)
wordcloud = WordCloud(stopwords=stopwords.words('english')).generate(text_neg)
plt.figure(figsize=(15,15))
plt.title('negative comments')
plt.imshow(wordcloud, interpolation='bilinear')
```

```
<matplotlib.image.AxesImage at 0x7fb4b110f6a0>
```


```
lem = WordNetLemmatizer()
```

```
import nltk
nltk.download('wordnet')
nltk.download('omw-1.4')
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data] Downloading package omw-1.4 to /root/nltk_data...
True
```

```
re.sub('[^a-zA-Z]',' ',messages['Comments'][0])
```

```
'This has become a game of semantics  We re in a particularly turbulent political economic environment that is combining ele
ments of recession with those of a strong labor market in a way not really seen in modern times   at least within the US  Wh
ether it is a recession or not is up to an obscure board to determine   usually post hoc  Indeed  once we re  officially  in
a recession  it will have already been going on for several quarters   I really wish there was more focus on the unique natu
re of the current market and global political economy rather than trying to shove it into preconceived holes that no longer
line up with reality '
```

```
clean_data = []
for i in range(len(messages)):
    sent = re.sub('[^a-zA-Z]',' ',messages['Comments'][i])
    sent = sent.lower()
    sent = sent.split()
    sent = [lem.lemmatize(word) for word in sent if word not in stopwords.words('english')]
    sent = ' '.join(sent)
    clean_data.append(sent)
    #if i%1000==0:
    #    print(i)


count = {}
for i in clean_data:
  for j in i.split():
    if j in count.keys():
      count[j]+=1
    else:
      count[j]=1


w_count = []
for r in sorted(count, key=count.get, reverse=True):
    w_count.append((r,count[r]))


w_count[:15]
```

```
[('recession', 48),
 ('economy', 18),
 ('market', 17),
 ('year', 16),
 ('going', 13),
 ('people', 12),
 ('think', 11),
 ('rate', 10),
 ('money', 10),
 ('like', 9),
 ('much', 9),
 ('job', 9),
 ('tech', 9),
 ('economic', 8),
 ('already', 8)]
```

```
counts_nsw = collections.Counter(clean_data)
counts_nsw.most_common(15)
```

```
[('become game semantics particularly turbulent political economic environment combining element recession strong labor
market way really seen modern time least within u whether recession obscure board determine usually post hoc indeed
officially recession already going several quarter really wish focus unique nature current market global political economy
rather trying shove preconceived hole longer line reality',
  1),
 ('telling going alaskan bull worm starting notice theme economy great worker suffer great worker suffer forecast correct
regular people get laid rich buy asset cheap economics starting feel like pretext ongoing abusive relationship',
  1),
 ('inflation already heading unemployment u low due baby boomer retirement covid death interest rate hike taken effect yet
economy already heading towards recession fed horribly mismanaged already',
  1),
 ('wish like tbh recession becoming absolutely necessary desperately need reset home still completely unaffordable grocery
ridiculously expensive wage havent caught despite certain labor market like wild west getting bid war employee others facing
labor shortage chaos artificial bubble created giving american much money covid prevent recession almost caused runaway
inflation road road facing consequence fed cannot pivot either moment rate come going another run house stock car etc alot
american money saved waiting thing turn around fed need bring bat economy need get real think painful alot',
  1),
 ('absolutely hard claim recession without job loss unemployment covid supply chain disruption energy market volatility due
war ukraine end fed money injection accompanying interest rate hike intersecting time think mid late style stagflation
scenario rather typical recession',
  1),
 ('really rule cannot post paywall article without bypass link', 1),
 ('inflation lowered housing price going lower employment still prime age working adult moving career equity price gotten
absolutely justed year destroying trillion wealth actually super impressive wish people could open eye positive stride
made',
  1),
 ('hike taken effect lost home buyer', 1),
 ('dollar ever created covid year inflation impossible stop whatever data may see positive overcome supply dollar working
way system',
  1),
 ('people think kind downturn could happen almost one expects another using benchmark recession realistic opinion anyway',
  1),
 ('sir yes sir brb lemme liquidate', 1),
 ('market pumping fed say pivot coming year everyone expects recession contrary say market money seems betting recession
happen',
```

```
  1),
 ('clearly understand lady saying going recession club empty people like start going club empty ergo recession want',
  1),
 ('funniest quote tbh think recession since fall hmm coincide major pandemic infected killed million worldwide overwhelming
message stay crowded unventilated space',
  1),
 ('tbh think recession since back stock crashing spy went started printing money name liquidity reverse repo everyone
believed never stopped printing money lol',
  1)]
```

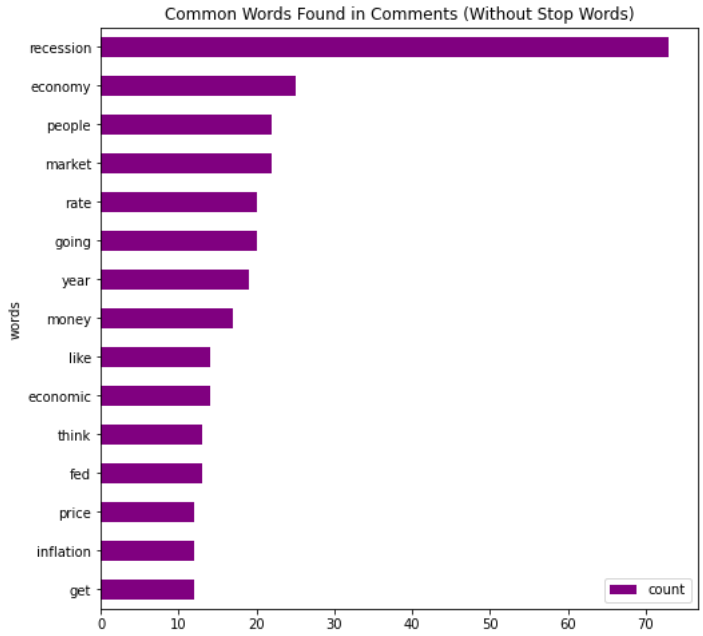
```
clean_tweets_nsw = pd.DataFrame(w_count[:15],
                                columns=['words', 'count'])

fig, ax = plt.subplots(figsize=(8, 8))

# Plot horizontal bar graph
clean_tweets_nsw.sort_values(by='count').plot.barh(x='words',
                      y='count',
                      ax=ax,
                      color="purple")

ax.set_title("Common Words Found in Comments (Without Stop Words)")

plt.show()
```



3) Converting words into Vectors

```
from sklearn.feature_extraction.text import TfidfVectorizer
tf = TfidfVectorizer(max_features=5000)
```

```
X = tf.fit_transform(clean_data).toarray()
```

```
X = pd.concat([pd.DataFrame(X),messages['length']],axis=1)
X.head()
```

	0	1	2	3	4	5	6	7	8	9	...	4991	4992	4993	4994	4995	4996	4997	4998	4999	length
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	0.0	0.0	44
1	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	0.0	93
2	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	0.0	64
3	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	0.0	98
4	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	0.0	9

5 rows × 5001 columns

```
y = pd.get_dummies(messages['Sentiment'],drop_first=True)

from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

Thank you