COVID-19 Tweet Sentiment Analysis

LP2 Data Mining and Warehousing Mini Project

By
41233 Rutuja Kawade
41230 Rohith Kandlagunta
41232 Fatema Katawala

In [2]:

```
import pandas as pd
import numpy as np
import re
import nltk

from sklearn.pipeline import Pipeline
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectoriz
from sklearn.model_selection import train_test_split, cross_val_score, KFo

from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import LinearSVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier

from sklearn.model_selection import cross_val_score
from sklearn.metrics import accuracy_score, classification_report, confusi
```

In [3]:

```
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
plt.style.use('ggplot')
```

Importing Dataset

In [4]:

```
train_data = pd.read_csv('Corona_NLP_train.csv',encoding='latin1')
train_data
```

Out[4]:

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment
0	3799	48751	London	16-03-2020	@MeNyrbie @Phil_Gahan @Chrisitv https://t.co/i...	Neutral
1	3800	48752	UK	16-03-2020	advice Talk to your neighbours family to excha...	Positive
2	3801	48753	Vagabonds	16-03-2020	Coronavirus Australia: Woolworths to give elde...	Positive
3	3802	48754	NaN	16-03-2020	My food stock is not the only one which is emp...	Positive

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment
4	3803	48755	NaN	16-03-2020	Me, ready to go at supermarket during the #COV...	Extremely Negative
...	...	...	...	...	...	...
41152	44951	89903	Wellington City, New Zealand	14-04-2020	Airline pilots offering to stock supermarket s...	Neutral
41153	44952	89904	NaN	14-04-2020	Response to complaint not provided citing COVI...	Extremely Negative
41154	44953	89905	NaN	14-04-2020	You know itÂs getting tough when @KameronWild...	Positive
41155	44954	89906	NaN	14-04-2020	Is it wrong that the smell of hand sanitizer i...	Neutral
41156	44955	89907	i love you so much || he/him	14-04-2020	@TartiiCat Well new/used Rift S are going for ...	Negative

In [5]:

```
test_file = pd.read_csv('Corona_NLP_test.csv',encoding='latin1')
test_file
```

Out[5]:

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment
0	1	44953	NYC	02-03-2020	TRENDING: New Yorkers encounter empty supermar...	Extremely Negative
1	2	44954	Seattle, WA	02-03-2020	When I couldn't find hand sanitizer at Fred Me...	Positive
2	3	44955	NaN	02-03-2020	Find out how you can protect yourself and love...	Extremely Positive
3	4	44956	Chicagoland	02-03-2020	#Panic buying hits #NewYork City as anxious sh...	Negative
4	5	44957	Melbourne, Victoria	03-03-2020	#toiletpaper #dunnypaper #coronavirus #coronav...	Neutral
...	...	...	...	...	...	...
3793	3794	48746	Israel ??	16-03-2020	Meanwhile In A Supermarket in Israel -- People...	Positive
3794	3795	48747	Farmington, NM	16-03-2020	Did you panic buy a lot of non-perishable item...	Negative
3795	3796	48748	Haverford, PA	16-03-2020	Asst Prof of Economics @cconces was on @NBCPhi...	Neutral
3796	3797	48749	NaN	16-03-2020	Gov need to do somethings instead of biar je r...	Extremely Negative

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment
3797	3798	48750	Arlington, Virginia	16-03-2020	I and @ForestandPaper members are committed to...	Extremely Positive

In [6]:

```
print('Training Set Shape = {}'.format(train_data.shape))
print('Test Set Shape = {}'.format(test_file.shape))
```

```
Training Set Shape = (41157, 6)
Test Set Shape = (3798, 6)
```

Data Preprocessing: Removing Null Values

In [7]:

```
train_data.isnull().sum().sort_values(ascending=False)
```

Out[7]:

```
Location         8590
UserName            0
ScreenName          0
TweetAt             0
OriginalTweet       0
Sentiment           0
dtype: int64
```

In [8]:

```
train_data.drop(columns=['Location'], axis=1)
```

Out[8]:

	UserName	ScreenName	TweetAt	OriginalTweet	Sentiment
0	3799	48751	16-03-2020	@MeNyrbie @Phil_Gahan @Chrisitv https://t.co/i...	Neutral
1	3800	48752	16-03-2020	advice Talk to your neighbours family to excha...	Positive
2	3801	48753	16-03-2020	Coronavirus Australia: Woolworths to give elde...	Positive
3	3802	48754	16-03-2020	My food stock is not the only one which is emp...	Positive
4	3803	48755	16-03-2020	Me, ready to go at supermarket during the #COV...	Extremely Negative
...	...	...	...	...	...
41152	44951	89903	14-04-2020	Airline pilots offering to stock supermarket s...	Neutral
41153	44952	89904	14-04-2020	Response to complaint not provided citing COVI...	Extremely Negative
41154	44953	89905	14-04-2020	You know itÂs getting tough when @KameronWild...	Positive
41155	44954	89906	14-04-2020	Is it wrong that the smell of hand sanitizer i...	Neutral
41156	44955	89907	14-04-2020	@TartiiCat Well new/used Rift S are going for ...	Negative

41157 rows × 5 columns

In [9]:

```
train_data['text'] = train_data.OriginalTweet
train_data["text"] = train_data["text"].astype(str)

test_file['text'] = test_file.OriginalTweet
test_file["text"] = test_file["text"].astype(str)
```

Converting Categorical Labels to Numeric Labels

In [10]:

```
def classes_def(x):
    if x ==  "Extremely Positive":
        return "2"
    elif x == "Extremely Negative":
        return "0"
    elif x == "Negative":
        return "0"
    elif x ==  "Positive":
        return "2"
    else:
        return "1"


train_data['label']=train_data['Sentiment'].apply(lambda x:classes_def(x))
test_file['label']=test_file['Sentiment'].apply(lambda x:classes_def(x))


train_data.label.value_counts(normalize= True)
```

Out[10]:

```
2    0.438467
0    0.374128
1    0.187404
Name: label, dtype: float64
```

Removing URLs and HTML from Tweets

In [11]:

```
def remove_urls(text):
    url_remove = re.compile(r'https?://\S+|www\.\S+')
    return url_remove.sub(r'', text)
train_data['text_new']=train_data['text'].apply(lambda x:remove_urls(x))
test_file['text_new']=test_file['text'].apply(lambda x:remove_urls(x))

def remove_html(text):
    html=re.compile(r'<.*?>')
    return html.sub(r'',text)
train_data['text']=train_data['text_new'].apply(lambda x:remove_html(x))
test_file['text']=test_file['text_new'].apply(lambda x:remove_html(x))
```

Converting the Tweet text to lowercase

In [12]:

```
def lower(text):
    low_text= text.lower()
    return low_text
train_data['text_new']=train_data['text'].apply(lambda x:lower(x))
test_file['text_new']=test_file['text'].apply(lambda x:lower(x))
```

Removing numerical values from Tweet text

In [13]:

```
def remove_num(text):
    remove= re.sub(r'\d+', '', text)
    return remove
train_data['text']=train_data['text_new'].apply(lambda x:remove_num(x))
test_file['text']=test_file['text_new'].apply(lambda x:remove_num(x))
```

Removing Punctuation and Stopwords

In [15]:

```
from nltk.corpus import stopwords
", ".join(stopwords.words('english'))
STOPWORDS = set(stopwords.words('english'))

def punct_remove(text):
    punct = re.sub(r"[^\w\s\d]","", text)
    return punct
train_data['text_new']=train_data['text'].apply(lambda x:punct_remove(x))
test_file['text_new']=test_file['text'].apply(lambda x:punct_remove(x))
```

In [16]:

```
def remove_stopwords(text):
    return " ".join([word for word in str(text).split() if word not in STO
train_data['text']=train_data['text_new'].apply(lambda x:remove_stopwords(
test_file['text']=test_file['text_new'].apply(lambda x:remove_stopwords(x)
```

Removing @ Mentions, # Hashtags, and Spaces

In [17]:

```
def remove_mention(x):
    text=re.sub(r'@\w+','',x)
    return text
train_data['text_new']=train_data['text'].apply(lambda x:remove_mention(x)
test_file['text_new']=test_file['text'].apply(lambda x:remove_mention(x))

def remove_hash(x):
    text=re.sub(r'#\w+','',x)
    return text
train_data['text']=train_data['text_new'].apply(lambda x:remove_hash(x))
test_file['text']=test_file['text_new'].apply(lambda x:remove_hash(x))

def remove_space(text):
    space_remove = re.sub(r"\s+"," ",text).strip()
    return space_remove
train_data['text_new']=train_data['text'].apply(lambda x:remove_space(x))
test_file['text_new']=test_file['text'].apply(lambda x:remove_space(x))
test_file = test_file.drop(columns=['text_new'])
train_data = train_data.drop(columns=['text_new'])
```

Preprocessed Data

In [18]:

```
train_data
```

Out[18]:

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment	te
0	3799	48751	London	16-03-2020	@MeNyrbie @Phil_Gahan @Chrisitv https://t.co/i...	Neutral	menyrb phil_gaha chrisi

	UserName	ScreenName	Location	TweetAt	OriginalTweet	Sentiment	tex
1	3800	48752	UK	16-03-2020	advice Talk to your neighbours family to excha...	Positive	advice ta neighbou fami exchang phone n.
2	3801	48753	Vagabonds	16-03-2020	Coronavirus Australia: Woolworths to give elde...	Positive	coronaviru australi woolworth give elder .
3	3802	48754	NaN	16-03-2020	My food stock is not the only one which is emp...	Positive	food stoc one empt please do panic enoug .
4	3803	48755	NaN	16-03-2020	Me, ready to go at supermarket during the #COV...	Extremely Negative	ready g supermark covi outbreak i paranoi.
...	...	...	...	...	...	...	.
41152	44951	89903	Wellington City, New Zealand	14-04-2020	Airline pilots offering to stock supermarket s...	Neutral	airline pilo offering stoc supermark shel.
41153	44952	89904	NaN	14-04-2020	Response to complaint not provided citing COVI...	Extremely Negative	respons complai provide citing covi relat.
41154	44953	89905	NaN	14-04-2020	You know itÂs getting tough when @KameronWild...	Positive	know itâ getting toug kameronwild rationing.
41155	44954	89906	NaN	14-04-2020	Is it wrong that the smell of hand sanitizer i...	Neutral	wrong sme han sanitize starting tur coron.
41156	44955	89907	i love you so much || he/him	14-04-2020	@TartiiCat Well new/used Rift S are going for ...	Negative	tartiicat we newused ri goin amazon al.

TF-IDF

In [19]:

```
tfidf = TfidfVectorizer(sublinear_tf=True, min_df=5, stop_words='english')

train_tfidf = tfidf.fit_transform(train_data.text)
test_tfidf = tfidf.transform(test_file.text)
```

Classifier #1: Multinomial Naive Bayes

In [20]:

```
nb = MultinomialNB()
nb.fit(train_tfidf, train_data.label)
nb_model = nb.predict(test_tfidf)

accuracy_score(test_file.label, nb_model)
```

Out[20]:

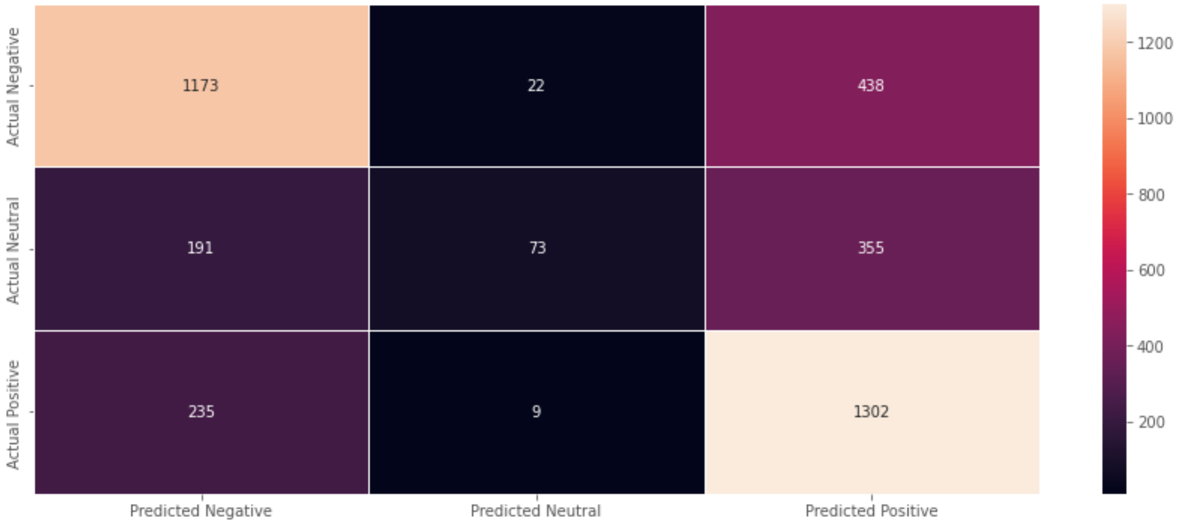
```
0.6708794102159031
```

In [21]:

```
nb_conf = confusion_matrix(test_file.label, nb_model)
ylabel = ["Actual Negative","Actual Neutral", "Actual Positive"]
xlabel = ["Predicted Negative","Predicted Neutral", "Predicted Positive"]
plt.figure(figsize=(15,6))
sns.heatmap(nb_conf, annot=True, xticklabels = xlabel, yticklabels = ylabe
```

Out[21]:

```
<AxesSubplot:>
```



Classifier #2: Linear Support Vector

In [22]:

```
lsvc = LinearSVC()
lsvc.fit(train_tfidf, train_data.label)
lsvc_model = lsvc.predict(test_tfidf)

accuracy_score(test_file.label, lsvc_model)
```

Out[22]:

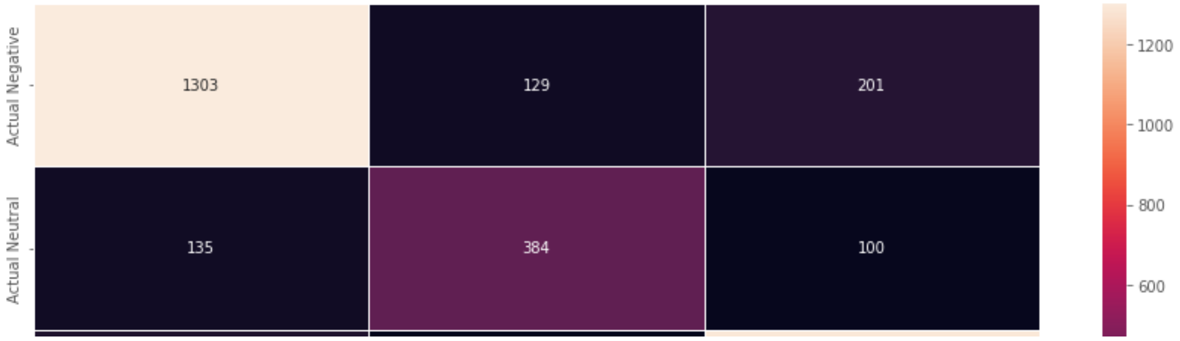
```
0.7838335966298051
```

In [23]:

```
lsv_conf = confusion_matrix(test_file.label, lsvc_model)
ylabel = ["Actual Negative","Actual Neutral", "Actual Positive"]
xlabel = ["Predicted Negative","Predicted Neutral", "Predicted Positive"]
plt.figure(figsize=(15,6))
sns.heatmap(lsv_conf, annot=True, xticklabels = xlabel, yticklabels = ylab
```

Out[23]:

```
<AxesSubplot:>
```



Classifier #3: Random Forest

In [24]:

```
rfc=RandomForestClassifier(n_estimators=100)
rfc.fit(train_tfidf, train_data.label)
rfc_model = rfc.predict(test_tfidf)

accuracy_score(test_file.label, rfc_model)
```

Out[24]:

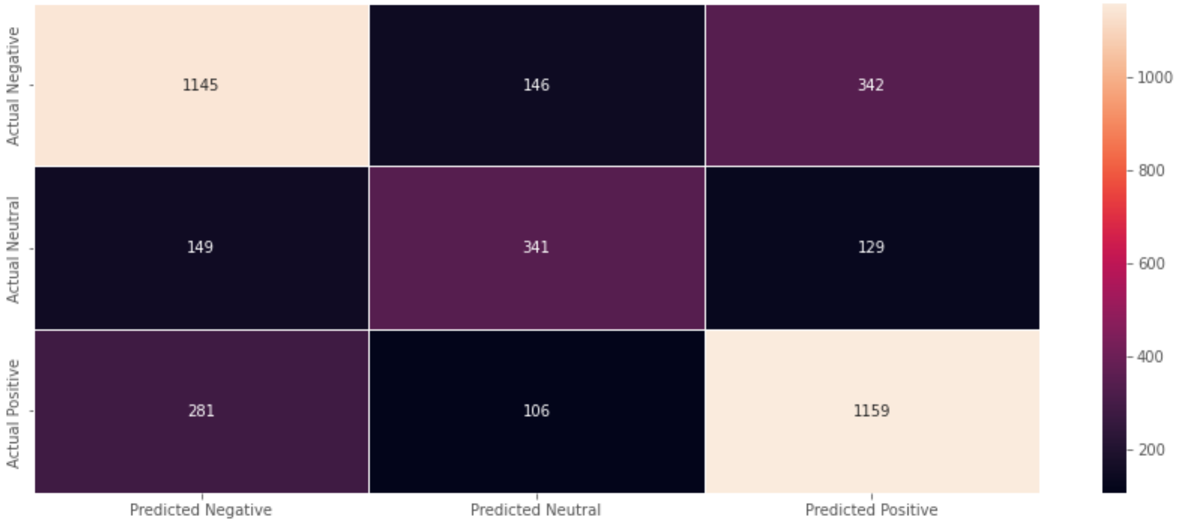
```
0.6964191679831491
```

In [25]:

```
rf_conf = confusion_matrix(test_file.label, rfc_model)
ylabel = ["Actual Negative","Actual Neutral", "Actual Positive"]
xlabel = ["Predicted Negative","Predicted Neutral", "Predicted Positive"]
plt.figure(figsize=(15,6))
sns.heatmap(rf_conf, annot=True, xticklabels = xlabel, yticklabels = ylabe
```

Out[25]:

```
<AxesSubplot:>
```



Comparing the 3 Models

In [26]:

```
from sklearn.metrics import make_scorer
from sklearn.metrics import accuracy_score
from sklearn.metrics import precision_score
from sklearn.metrics import recall_score
from sklearn.metrics import f1_score
from sklearn.model_selection import cross_validate

scoringDict = {'accuracy':make_scorer(accuracy_score),
           'precision':make_scorer(precision_score, average='weighted'),
           'recall':make_scorer(recall_score, average='weighted'),
           'f1_score':make_scorer(f1_score, average='weighted')}
```

In [27]:

```
df = pd.concat([train_data, test_file])
df_tfidf = tfidf.transform(df.text)

def models_evaluation(X, y, folds):
    '''
    X : data set features
    y : data set target
    folds : number of cross-validation folds

    '''
    # Perform cross-validation to each machine learning classifier
    LSVC = cross_validate(lsvc, X, y, cv=folds, scoring=scoringDict)
    RFC = cross_validate(rfc, X, y, cv=folds, scoring=scoringDict)
    MNB = cross_validate(nb, X, y, cv=folds, scoring=scoringDict)

    # Create a data frame with the models perfoamnce metrics scores
    models_scores_table = pd.DataFrame({'Linear Support Vector':[LSVC['tes
                                                                   LSVC['t
                                                                   LSVC['t
                                                                   LSVC['t

                                      'Random Forest':[RFC['test_accuracy'
                                                       RFC['test_precision
                                                       RFC['test_recall'].
                                                       RFC['test_f1_score'

                                      'Multinomial Naive Bayes':[MNB['test_
                                                              MNB['test_pr
                                                              MNB['test_re
                                                              MNB['test_f1_

                                      index=['Accuracy', 'Precision', 'Reca

    # Add 'Best Score' column
    models_scores_table['Best Score'] = models_scores_table.idxmax(axis=1)

    # Return models performance metrics scores data frame
    return(models_scores_table)

# Run models_evaluation function
cross_table = models_evaluation(df_tfidf, df.label, 5)
```

In [28]:

```
cross_nb = cross_table['Multinomial Naive Bayes']['Accuracy'] * 100
cross_lsv = cross_table['Linear Support Vector']['Accuracy'] * 100
cross_rf = cross_table['Random Forest']['Accuracy'] * 100
```

In [29]:

```
from tkinter import *
from tkinter import filedialog
```

In [30]:

```
def switchHelper(argument):
    print(argument)
    switcher = {
        "0": "Negative",
        "1": "Neutral",
        "2": "Positive",
    }
    return switcher.get(argument, "Neutral")
```

In [31]:

```
def predictSentence(text):
    text = lower(text)
    text = remove_num(text)
    text = punct_remove(text)
    text = remove_stopwords(text)
    text = remove_mention(text)
    text = remove_hash(text)
    text = remove_space(text)

    tfidfVector = tfidf.transform([text])

    nb_pred_label = nb.predict(tfidfVector)
    return nb_pred_label
```

In [32]:

```
def predictSentenceHelper():
    pred = predictSentence(tweetInput.get())
    pred_class = switchHelper(pred[0])

    labelPredict = Label(root, text=pred_class)
    labelPredict.grid(row=6, column=1)
```

In [33]:

```
# f = 'Corona_NLP_test.csv'
def predictFile(f):
    test_data = pd.read_csv(f,encoding='latin1')

    #Preprocess test file
    test_data['text'] = test_data.OriginalTweet
    test_data["text"] = test_data["text"].astype(str)
    test_data['label']=test_data['Sentiment'].apply(lambda x:classes_def(x
    test_data['text_new']=test_data['text'].apply(lambda x:remove_urls(x))
    test_data['text']=test_data['text_new'].apply(lambda x:remove_html(x))
    test_data['text_new']=test_data['text'].apply(lambda x:lower(x))
    test_data['text']=test_data['text_new'].apply(lambda x:remove_num(x))
    test_data['text_new']=test_data['text'].apply(lambda x:remove_mention(
    test_data['text']=test_data['text_new'].apply(lambda x:remove_hash(x))
    test_data['text_new']=test_data['text'].apply(lambda x:remove_space(x)
    test_data = test_data.drop(columns=['text_new'])

    tfidf_file = tfidf.transform(test_data.text)
    nb_model = nb.predict(tfidf_file)
    model_acc = [accuracy_score(test_data.label, nb_model)*100]

    lsvc_model = lsvc.predict(tfidf_file)
    model_acc.append(accuracy_score(test_data.label, lsvc_model)*100)

    rfc_model = rfc.predict(tfidf_file)
    model_acc.append(accuracy_score(test_data.label, rfc_model)*100)

    return model_acc

# predictFile(f)
```

In [34]:

```
def predictFileHelper():
    filename = filedialog.askopenfilename(initialdir="/env/LP2/DMW_Mini/",
    model_acc = predictFile(filename)

    show_confusion(model_acc)
```

In [35]:

```
def clear_frame():
    for w in root.winfo_children():
        w.destroy()
```

In [36]:

```
def show_confusion(model_acc):
    clear_frame()

    labelTitle = Label(root, text='COVID-19 Tweet Sentiment Analysis', fon
    labelTitle.grid(row=2, columnspan=5)

    Label(root, text='Naive Bayes').grid(row=3,column=1)
    Label(root, text=f'Accuracy: {str(round(model_acc[0],2))}%').grid(row=
    Label(root, text=f'Confusion Matrix: ').grid(row=5,column=1 )
    Label(root, text=f'{nb_conf}').grid(row=6,column=1 )
    Label(root, text=f'Accuracy after Cross Validation: {str(round(cross_n

    Label(root, text='').grid(column=2)

    Label(root, text='Linear Support Vector').grid(row=3,column=3)
    Label(root, text=f'Accuracy: {str(round(model_acc[1],2))}%').grid(row=
    Label(root, text=f'Confusion Matrix: ').grid(row=5,column=3 )
    Label(root, text=f'{lsv_conf}').grid(row=6,column=3 )
    Label(root, text=f'Accuracy after Cross Validation: {str(round(cross_l

    Label(root, text='').grid(column=2)

    Label(root, text='Random Forest').grid(row=3,column=5)
    Label(root, text=f'Accuracy: {str(round(model_acc[2],2))}%').grid(row=
    Label(root, text=f'Confusion Matrix: ').grid(row=5,column=5 )
    Label(root, text=f'{rf_conf}').grid(row=6,column=5 )
    Label(root, text=f'Accuracy after Cross Validation: {str(round(cross_r
```

In [37]:

```
root = Tk()

#Custom Input

labelTitle = Label(root, text='COVID-19 Tweet Sentiment Analysis', font='H
labelTitle.grid(row=1, column=0,columnspan=5, rowspan=1)

tweetInput = Entry(root, width=15)
tweetInput.insert(0, 'Enter Tweet')

tweetInput.grid(row=4,column=0)

predictButton = Button(root, text="Predict", command=predictSentenceHelper
predictButton.grid(row=7,column=1)

labelOR = Label(root, text="OR")
labelOR.grid(row=4, column=1)

# File Input
button_file_open = Button(root, text="Browse File", command=predictFileHel
button_file_open.grid(row=4,column=2)

root.mainloop()
```

```
2
0
```

In [ ]: