OPTIMIZING SPAM FILTERING WITH MACHINE LEARNING

1. INTRODUCTION

1.1 Overview

Over recent years, as the popularity of mobile phone devices has increased, Short Message Service (SMS) has grown into a multi-billion dollar industry. At the same time, reduction in the cost of messaging services has resulted in growth in unsolicited commercial advertisements (spams) being sent to mobile phones. Due to Spam SMS, Mobile service providers suffer from some sort of financial problems as well as it reduces calling time for users. Unfortunately, if the user accesses such Spam SMS they may face the problem of virus or malware. When SMS arrives at mobile it will disturb mobile user privacy and concentration. It may lead to frustration for the user. So Spam SMS is one of the major issues in the wireless communication world and it grows day by day.

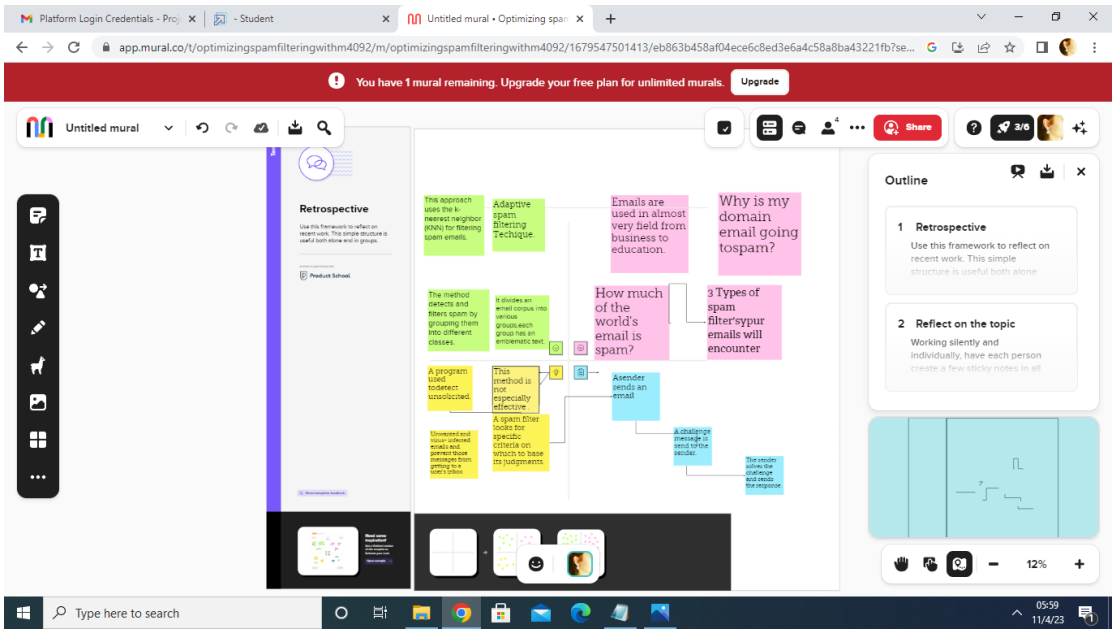
To avoid such Spam SMS people use white and black list of numbers. But this technique is not adequate to completely avoid Spam SMS. To tackle this problem it is needful to use a smarter technique which correctly identifies Spam SMS. Natural language processing technique is useful for Spam SMS identification. It analyses text content and finds patterns which are used to identify Spam and Non-Spam SMS.

1.2 Purpose

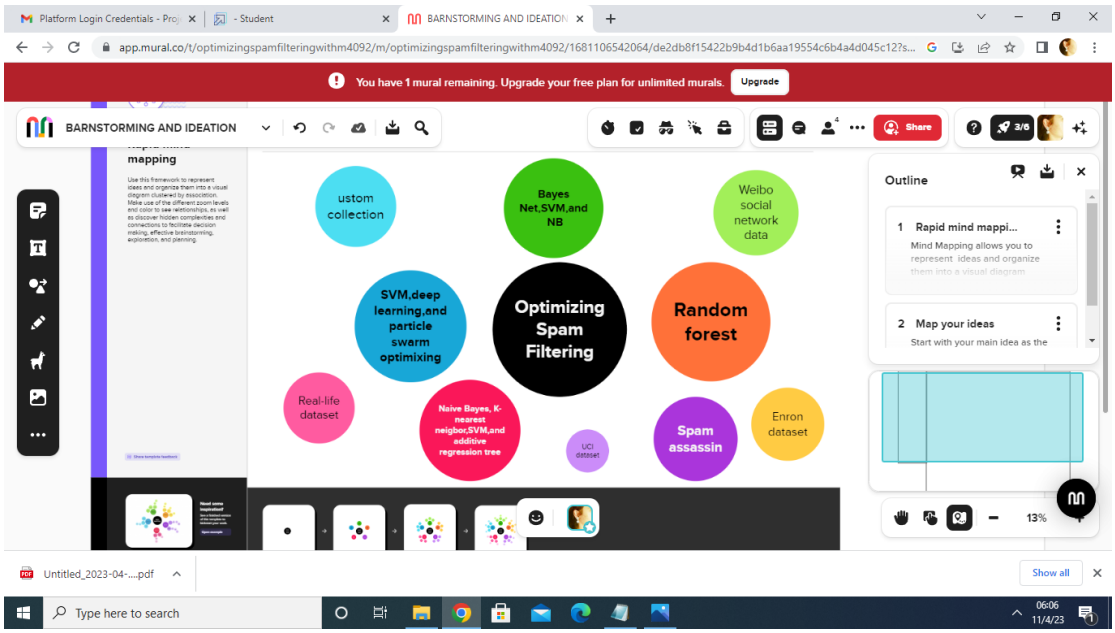
In today's society, practically everyone has a mobile phone, and they all get communications (SMS/ email) on their phone regularly. But the essential point is that majority of the messages received will be spam, with only a few being ham or necessary communications. Scammers create fraudulent text messages to deceive you into giving them your personal information, such as your password, account number, or Social Security number. If they have such information, they may be able to gain access to your email, bank, or other accounts. So we are going to develop various machine learning models using Tensor flow for SMS spam detection and also analyze the performance metrics of different models.

2. Problem Definition and Design Thinking

2.1Empathy Map

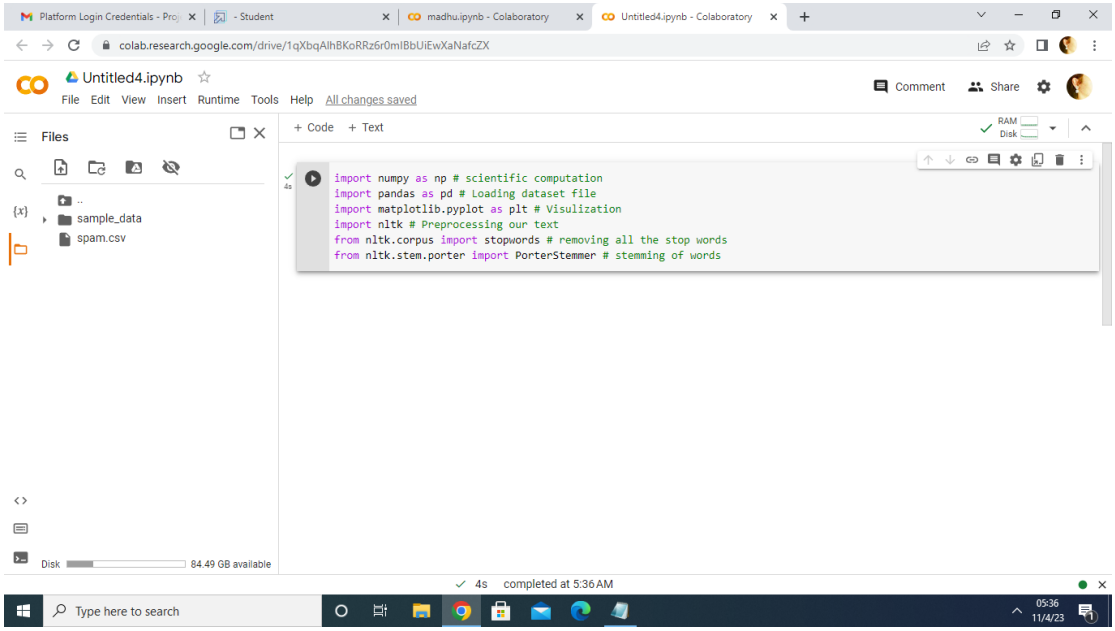


2.2 Ideation & Brainstorming Map

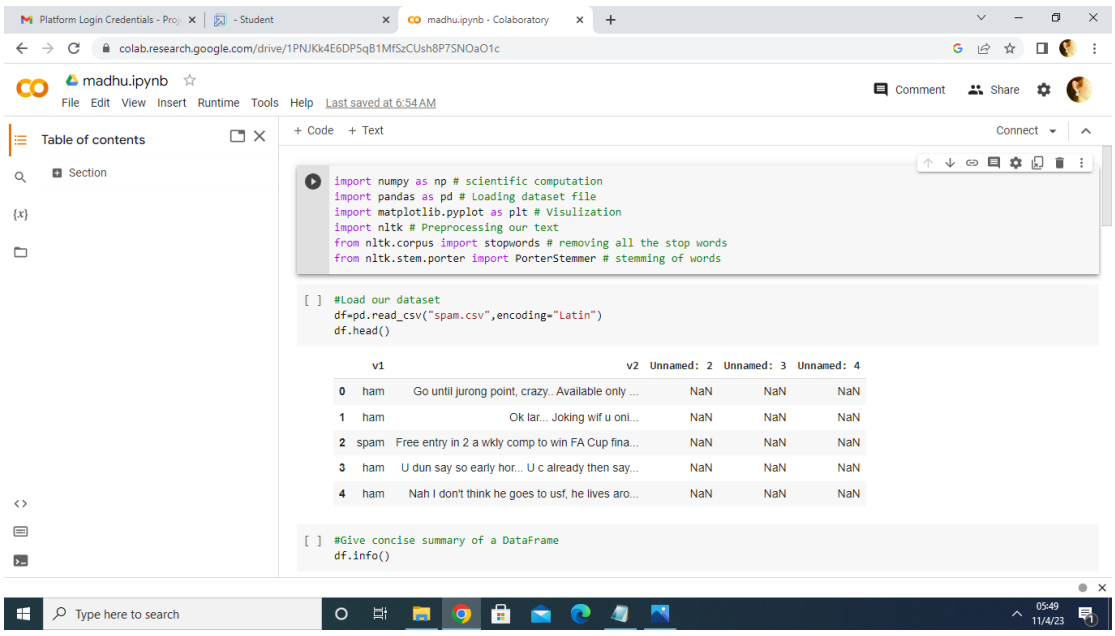


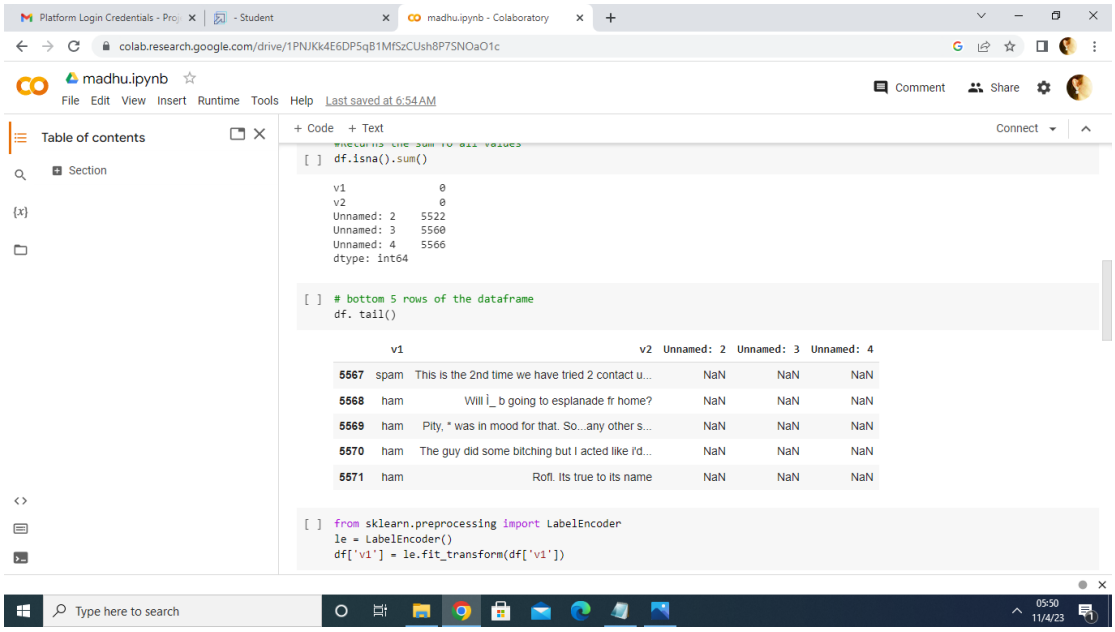
RESULT

Importing the libraries

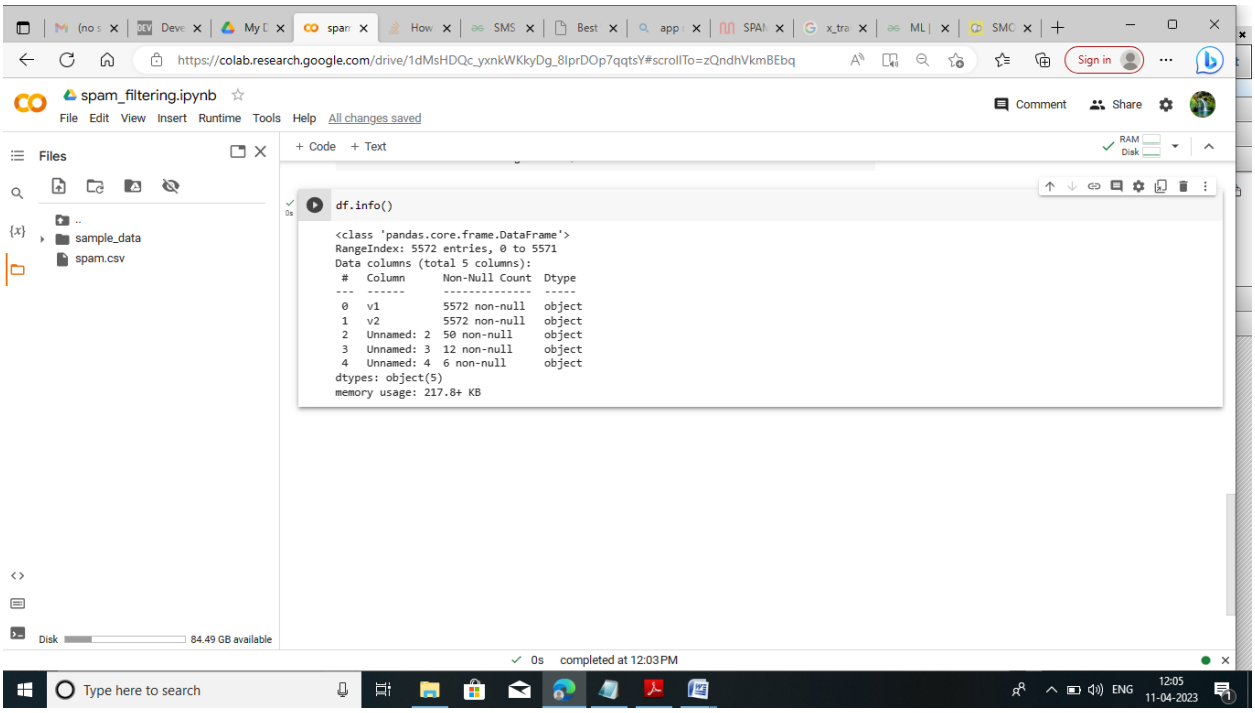


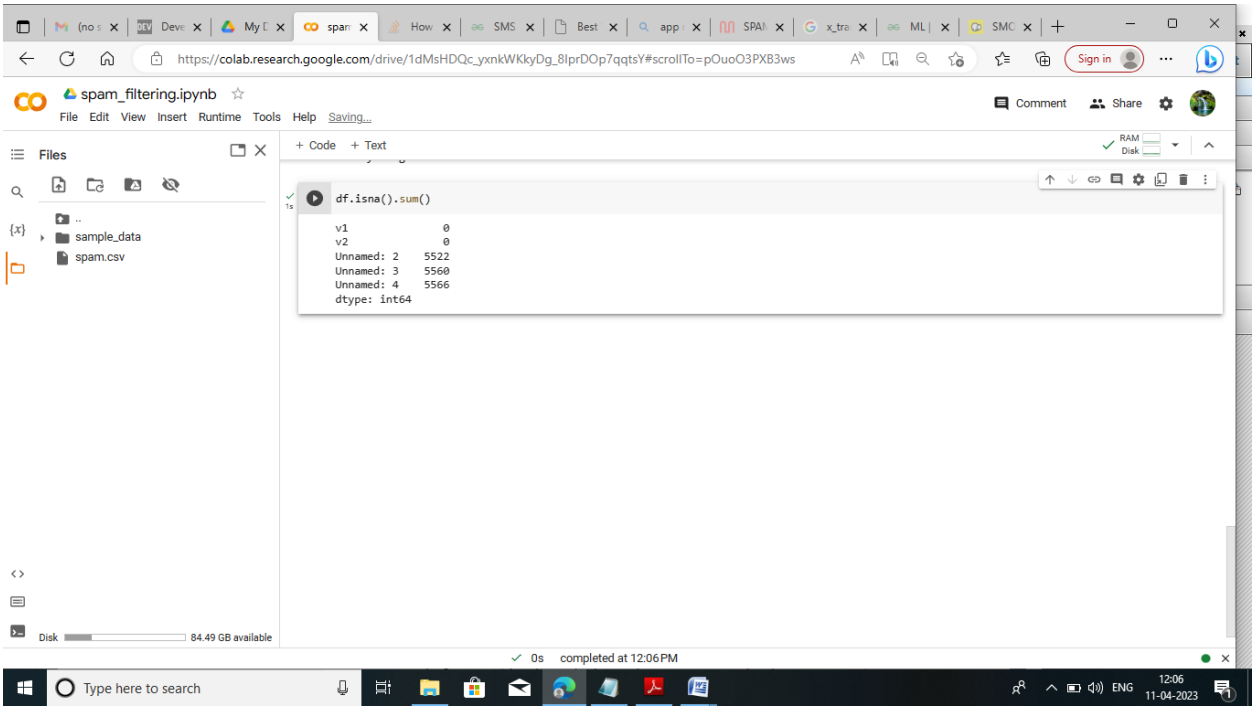
Read and Dataset

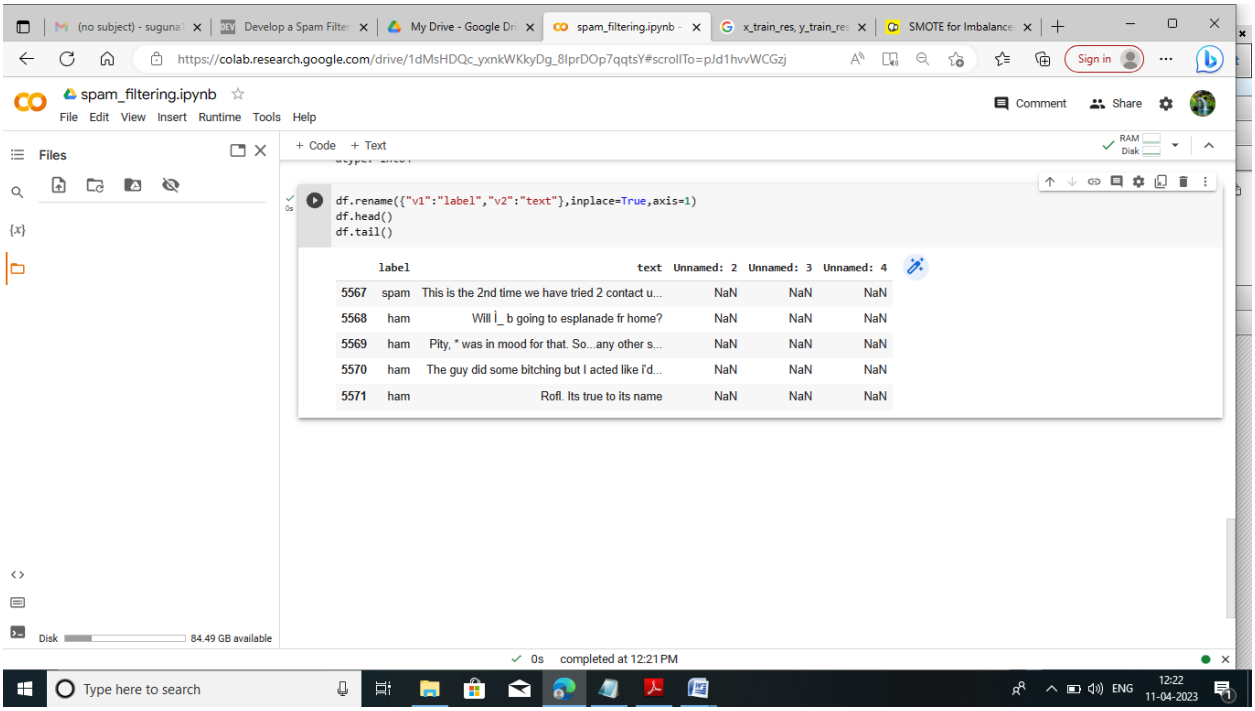




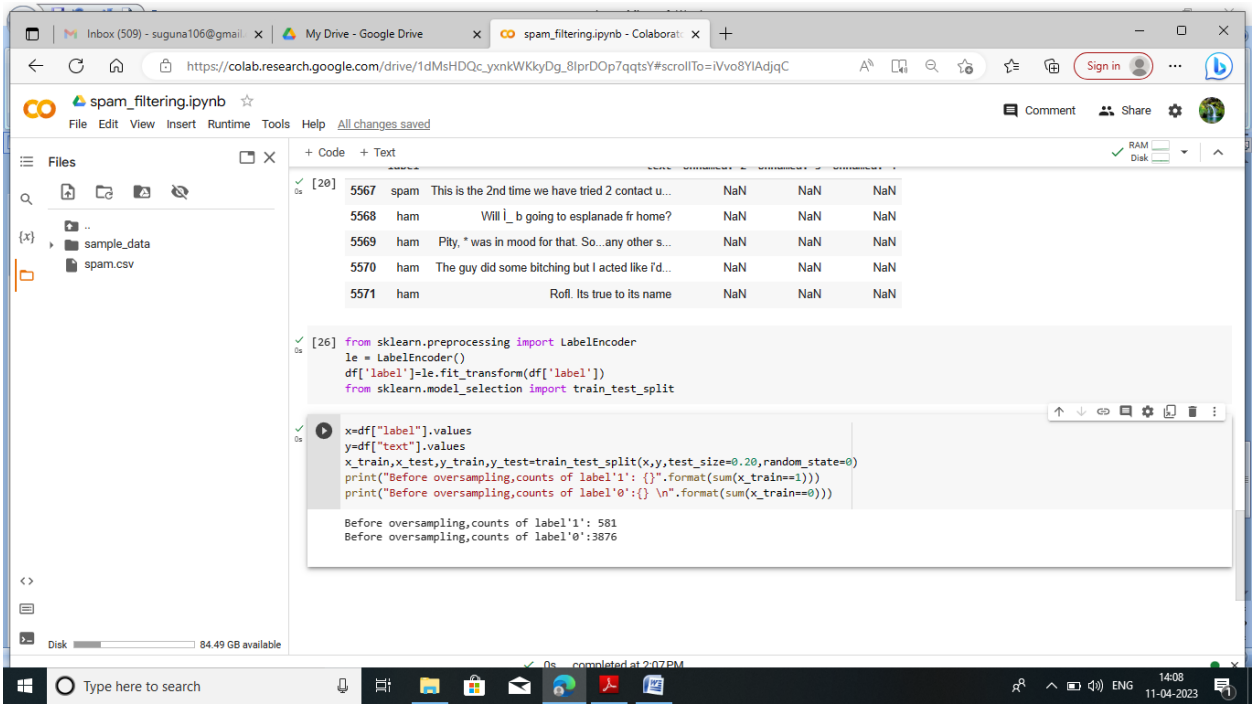
Handling missing values

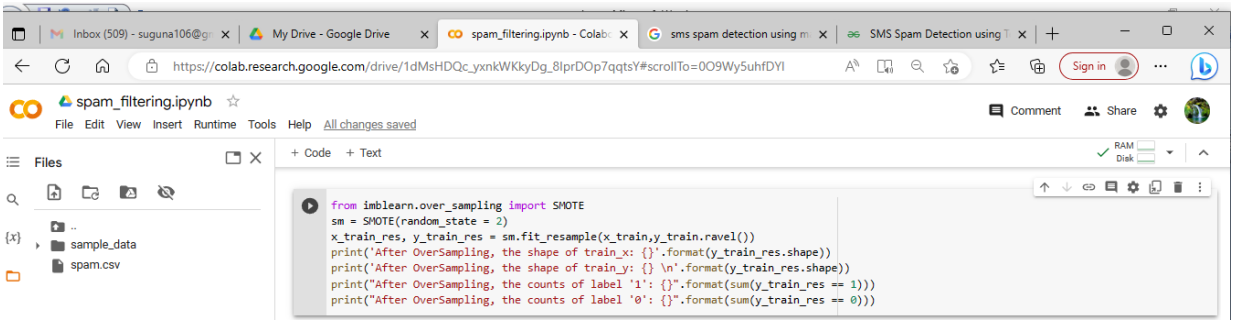






Handling categorical values



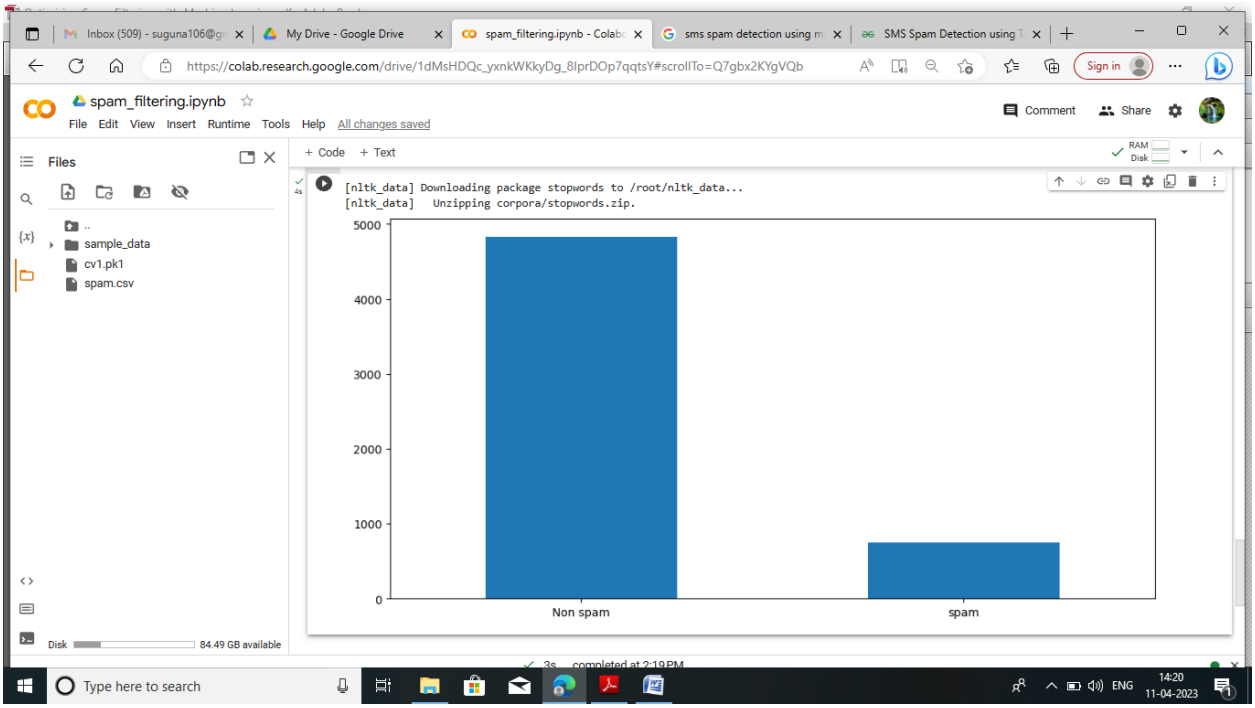



```
Before OverSampling, counts of label '1': 581
Before OverSampling, counts of label '0': 3876

After OverSampling, the shape of train_X: (7752, 7163)
After OverSampling, the shape of train_y: (7752,)

After OverSampling, counts of label '1': 3876
After OverSampling, counts of label '0': 3876
```

Visual analysis



Testing the model

```
y_pred=model.predict(X_test)
y_pred
```

```
35/35 [==============================] - 2s 29ms/step

array([[1.5844109e-15],
       [4.4117199e-04],
       [1.1517070e-18],
       ...,
       [2.0661259e-08],
       [3.8018154e-17],
       [1.2099350e-12]], dtype=float32)
```

```
y_pr = np.where(y_pred>0.5,1,0)
```

```
y_test
```

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

```
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy Score Is:- ' ,score*100)
```

```
[[937  12]
 [ 16 150]]
Accuracy Score Is:-  97.48878923766816
```

Compare the model

```
from sklearn.metrics import confusion_matrix,accuracy_score, classification_report
cm = confusion_matrix(y_test, y_pred)
score = accuracy_score(y_test,y_pred)
print(cm)
print('Accuracy Score Is Naive Bayes:- ' ,score*100)
```

```
[[935  14]
 [ 13 153]]
Accuracy Score Is:-  97.57847533632287
```

```
cm = confusion_matrix(y_test, y_pred)
score = accuracy_score(y_test,y_pred)
print(cm)
print('Accuracy Score Is:- ' ,score*100)

cm1 = confusion_matrix(y_test, y_pred1)
score1 = accuracy_score(y_test,y_pred1)
print(cm1)
print('Accuracy Score Is:- ' ,score1*100)
```

```
[[796 153]
 [ 17 149]]
Accuracy Score Is:-  84.75336322869956
[[855  94]
 [ 14 152]]
Accuracy Score Is:-  90.31390134529148

121/121 [==============================] - 24s 196ms/step - loss: 0.0120 - accuracy: 0.9974
Epoch 9/10
121/121 [==============================] - 23s 193ms/step - loss: 0.0103 - accuracy: 0.9977
Epoch 10/10
111/121 [==========================>...] - ETA: 1s - loss: 0.0128 - accuracy: 0.9972WARNING:tens
```

```
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy Score Is:- ' ,score*100)
```

```
[[937  12]
 [ 16 150]]
Accuracy Score Is:-  97.48878923766816
```


```
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy Score Is:- ' ,score*100)
```

```
[[937  12]
 [ 16 150]]
Accuracy Score Is:-  97.48878923766816
```

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Detection of spam is important for securing message and e-mail communication
- Classification based on two algorithms.
- Combination of machine learning algorithm with user generated features.
- Used a weighting mechanism to reduce false negatives.
- Lightweight and focuses on runtime.

DISADVANTAGES

- Spam emails can be the source of a great amount of malware like viruses, Trojans, worms, and others which are specifically designed to disrupt or damage computer systems.

- The dangers of spam messages for the users are many: undesired advertisement, exposure of private information, becoming a victim of a fraud or financial scheme, being lured into malware and phishing websites, involuntary exposition to inappropriate content, etc….

- User need to select feature manually.

- No classification algorithm is used.

- Suffers from implementation complexity.

- Challenge-response technique suffers from severe side traffic and user interaction problems

APPLICATION

MOBILE PHONE

CONCLUSION

From the above discussion and experimentation we are concluded that machine learning algorithm can play a vital role in identifying SPAM SMS.

FUTURE SCOPE

In the future we plan to deal with more challenging problem such as the analysis and management of report in spam filters storing. Solution for this problem is another focus of work in the future

APPENDIX

SOURCE CODE

```
from scipy.sparse import data
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import nltk
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
df=pd.read_csv("spam.csv",encoding="latin")
df.head()
df.info()
df.isna().sum()
df.rename({"v1":"label","v2":"text"},inplace=True,axis=1)
df.head()
df.tail()
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
df['label']=le.fit_transform(df['label'])
from sklearn.model_selection import train_test_split
x=df["label"].values
y=df["text"].values
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size
=0.20,random_state=0)
print("Before oversampling,counts of label'1': {}".format(su
m(x_train==1)))
```

```
print("Before oversampling,counts of label'0':{} \n".format(
sum(x_train==0)))
from imblearn.over_sampling import SMOTE
sm = SMOTE(random_state = 2)
x_train_res, y_train_res = sm.fit_resample(x_train,y_train.r
avel())
print('After OverSampling, the shape of train_x: {}'.format(
y_train_res.shape))
print('After OverSampling, the shape of train_y: {} \n'.form
at(y_train_res.shape))
print("After OverSampling, the counts of label '1': {}".form
at(sum(y_train_res == 1)))
print("After OverSampling, the counts of label '0': {}".form
at(sum(y_train_res == 0)))
nltk.download("stopwords")
import nltk
from nltk.corpus import stopwords
from nltk.stem import Porterstemmer
import re
corpus = []
length=len(df)
for i in range(0,length):
    text = re.sub("[^a-zA-Z0-9]"," ",df["text"][i])
    text = text.lower()
    text = text.split()
    pe = PorterStemmer()
    stopword = stopwords.words("english")
    text = [pe.stem(word) for word in text if not word in se
t(stopword)]
    text = " ".join(text)
    corpus.append(text)
from sklearn.feature_extraction.text import CountVectorizer
cv=CountVectorizer(max_features=35000)
x=cv.fit_transform(corpus).toarray()
import pickle
pickle.dump(cv,open('cv1.pk1','wb'))
df.describe()
df["label"].value_counts().plot(kind="bar",figsize=(12,6))
plt.xticks(np.arange(2), ('Non spam', 'spam'),rotation=0);
from sklearn.preprocessing import StandardScaler
sc=StandardScaler()
x_bal=sc.fit_transform(x_bal)
x_bal=pd.DataFrame(x_bal,columns=names)
```

```
from sklearn.tree import DecisionTreeClassifier
model = DecisionTreeClassifier()
model.fit(x_train_res, y_train_res)
from sklearn.ensemble import RandomForestClassifier
model1 =  RandomForestClassifier()
model1.fit(x_train_res, y_train_res)
from sklearn.naive_bayes import MultinomialNB
model = MultinomialNB()
#Fitting the model to the training sets
model.fit(x_train_res, y_train_res)
from tensorflow.keras.models import Sequential
from tensorflow.keras.models import Dense
#fitting the model to the training sets
model = Sequential()
x_train.shape
(4457,7163)
model.add(Dense(units =x_train_res.shape[1],activation="relu
",kernel_initializer="random_uniform"))
model.add(Dense(units=100,activation="relu",kernel_initializ
er="random_uniform"))
model.add(Dense(units=100,activation="relu",kernel_initializ
er="random_uniform"))
model.add(Dense(units=1,activation="sigmoid"))
model.compile(optimizer="adam",loss=binary_crossentropy",met
rics=['accuracy'])
generator = model.fit(x_train_res,y_train_res.epochs=10,step
s_per_epoch=len(x_train_res)//64)
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy score Is:- ',score"100)
def new_review(new_review):
 new_review = new_review
 new_review = re.sub('[^a-zA-Z]', ' ', new_review)
 new_review = new_review.lower()
 new_review = new_review.split()
 ps = PorterStemmer()
 all_stopwords = stopwords.words('english')
 all_stopwords.remove('not')
 new_review = [ps.stem(word) for word in new_review if not w
ord in  set(all_stopwords)]
 new_review = ' '.join(new_review)
```

```
 new_corpus = [new_review]
 new_X_test = cv.transform(new_corpus).toarray()
 print(new_X_test)
 new_y_pred = loaded_model.predict(new_X_test)
 print(new_y_pred)
 new_x_pred = np.where(new_y_pred>0.5,1,0)
 return new_y_pred
new_review = new_review(str(input("Enter new review...")))
from sklearn.metrics import confusio_matrix,accuracy_score,
classification_report
cm = confusion_matrix(y_test, y_pred)
score = accuracy_score(y_test,y_pred)
print(cm)
print('Accuracy Score Is Naive Bayes:-' ,score*100)
cm = confusion_matrix(y_test,y_pred)
score = accuracy_score(y_test,y_pred)
print(cm)
print('Accuracy Scorew Is:- ' ,score*100)
cm1 = confusion_matrix(y_test, y_pred1)
score1 = accuracy_score(y_test,y_pred1)
print(cm1)
print('Accuracy Score Is:- ' ,score1*100)
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy Score Is:- ' ,score*100)
from sklearn.metrics import confusion_matrix,accuracy_score
cm = confusion_matrix(y_test, y_pr)
score = accuracy_score(y_test,y_pr)
print(cm)
print('Accuracy Score Is:- ' ,score*100)
model.save('spam.h5')
from flask import Flask, render_template, request
import pickle
import numpy as np
import re
import nltk
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from tensorflow.keras.models import load_model

loaded_model = load_model('spam.h5')
```

```
cv = pickle.load(open('cv1.pkL','rb'))
app = Flask(__name__)

@app.route('/') # rendering the html template
def home():
    return render_template('home.htmL')

@app.route('/spam',methods=['POST','GET'])
def prediction(): # route which will take you to the predict
ion page
    return render_template('spam.html')

@app.route('/predict',methods=['POST'])
def predict():
    if request.method == 'POST':
        messagev = request.form['message']
        data = message

    new_review = str(data)
    print(new_review)
    new_review = re.sub('[^a-zA-Z]','', new_review)
    new_review = new_review.lower()
    new_review = new_review.split()
    ps = PorterStemmer()
    all_stopwords = stopwords.words('english')
    all_stopwords remove('not')
    new_review = [ps.stem(word) for word in new_review if no
t word in   set(all_stopwords)]
    new_review = ''.join(new_review)
    new_corpus = [new_review]
    new_X_test = cv.transform(new_corpus).toarray()
    print(new_X_test)
    new_y_pred = loaded_model.predicate(new_X_test)
    new_X_pred = np.where(new_y_pred>0,5,1,0)
    print(new_X_pred)
    if new_review[0][0]==1:
       return render_template('result.html', predication="sp
am")
    else :
       return render_template('result.html', predication="No
t a Spam")
if __name__=="__main__":
```

```
    # app.run(host='0.0.0.0', port=8000,debug=True)    # runn
ing the
    port=int(os.environ.get('PORT',5000))
    app.run(debug=False)
```