Email Spam Filtering Using Machine Learning Techniques

Submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering Degree

In

Computer Science and Engineering

By

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Danekula Siva Rama Krishna (Reg. No. 38110116)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING

SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

(DEEMED TO BE UNIVERSITY)

Accredited with Grade “A” by NAAC

JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119

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SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY

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SCHOOL OF COMPUTING

BONAFIDE CERTIFICATE

This is to certify that this Project Report is the Bonafide work of **Koppineedi Sai Krishna Chaitanya (Reg. No. 38110262), Danekula Siva Rama Krishna (Reg. No. 38110116)** who carried out the project entitled **"Email Spam Filtering Using Machine Learning Techniques"** under our supervision from December 2021 to March 2022.

Internal Guide

Dr. M. Selvi,

Head of the Department

Dr. S. VIGNESHWARI M.E., Ph.D.,

Submitted for Viva voce Examination heldon

InternalExaminer **ExternalExaminer**

DECLARATION

I **Koppineedi Sai Krishna Chaitanya (Reg. No. 38110262), Danekula Siva Rama Krishna(Reg.No.38110116)**herebydeclarethattheProjectReportentitled**“Email Spam Filtering Using Machine Learning Techniques”** done by me under the guidance ofDr. M. Selvi**.,** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering / Technology degree in Computer Science andEngineering.

DATE:

PLACE: **SIGNATURE OF THECANDIDATE**

ACKNOWLEDGEMENT

We are pleased to acknowledge my sincere thanks to Board of Management of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr. T. SASIKALA, M.E., Ph.D., Dean, School of Computing,** and **DR. S. VIGNESHWARI, M.E., Ph.D., Head of the Department, Department of Computer Science and Engineering** for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **, Dr.M.Selvi,** for her valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

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ABSTRACT

Nowadays, all the people are communicating official information through emails. Spam mails are the major issue on the internet. It is easy to send an email which contains spam message by the spammers. Spam fills our inbox with several irrelevant emails. Spammers can steal our sensitive information from our device like files, contact. Even we have the latest technology, it is challenging to detect spam emails. This paper aims to propose a Term Frequency Inverse Document Frequency (TFIDF) approach by implementing the Support Vector Machine algorithm. The results are compared in terms of the confusion matrix, accuracy, and precision. This approach gives an accuracy of 99.9% on training data and 98.2% on testing data achieved by using the Term Frequency Inverse Document Frequency (TFIDF) based Support Vector Machine(SVM) system.

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CHAPTER 1

INTRODUCTION:

The Internet has become a common thing in our lives.The same message sends multiple times which affects the organization financially and also irritates the receiving user. In this project, a Spam Mail Detection system is proposed will classify the given email as spam or ham email. Spam filtering mainly focuses on the content of the message. The classification algorithm classifies the given email based on the content. Feature extraction and selection plays a vital role in the classification. In spam mail detection, email data is collected through the dataset.

To obtain the accurate results, data needs to be pre-processed by removing stop words and word tokenization. Pre-processing of data is done by using TF-IDF Vectorizer module. SVM algorithm is used to detect the given email is spam or harm. In recent times, unwanted industrial bulk emails known as spam has become an enormous drawback on the net. The person causing the spam messages is noted because the sender. Such an individual gathers email addresses from completely different websites, chatrooms, and viruses. Spam prevents the user from creating full and sensible use of your time, storage capability and network information measure. the massive volume of spam mails flowing through the pc networks have damaging effects on the memory house of email servers, communication information measure, central processing unit power and user time. The menace of spam email is on the rise on yearly basis and is to blame for over seventy-seven of the entire international email traffic.

Users United Nations agency receive spam emails that they failed to request realize it terribly irritating. it's conjointly resulted to much loss to several users United Nations agency have fallen victim of web scams and different dishonest practices of spammers United Nations agency send emails pretence to be from honorable firms with the intention to influence people to disclose sensitive personal info like passwords, Bank Verification variety (BVN) and mastercard numbers.

CHAPTER 2

RELATED WORK:

To effectively handle the threat expose by email spams, leading email suppliers like Gmail, Yahoo mail and Outlook have utilized the mixture of various machine learning (ML) techniques like Neural Networks in its spam filters. These techniques have the capacity to be told and establish spam mails and phishing messages by analyzing many such messages throughout a massive assortment of computers. Since machine learning have the capability to adapt to variable conditions, Gmail and Yahoo mail spam filters do over simply checking junk emails victimization pre-existing rules. They generate new rules themselves supported what they need to learn as they continue in their spam filtering operation.

The machine learning model utilized by Google have currently advanced to the purpose that it will observe and separate spam and phishing emails with regarding 99% accuracy. The implication of this is often that one out of m messages reach evading their email spam filter. Statistics from Google discovered that between 50-70 % of emails that Gmail receives area unit direct mail. Google's detection models have conjointly incorporated tools referred to as Google Safe Browsing for distinctive websites that have malicious URLs.

The phishing-detection performance of Google are increased by introduction of a system that delay the delivery of some Gmail messages for a short while to hold out further comprehensive scrutiny of the phishing messages since easier to observe after they are analyzed and put together. The aim of delaying the delivery of a number of these suspicious emails is to conduct a deeper examination whereas a lot of messages arrive in due course of your time and therefore the algorithms are updated in real time. solely regarding zero.0.5 % of emails are unit plagued by this deliberate delay.

CHAPTER 3

METHODOLOGY:

The era of creation of this product includes models i.e., object-oriented model, Prototype model, waterfall model etc. for making the correct system. water model, the oldest model of creation of correct system. The product model used by our framework is that the cascade model.

Cascade model could be a precise and successive way to contend with the merchandise improvement. This incorporates framework coming up with and displaying that sets up requirements for all the framework parts and distribution some set of those conditions to programming. Framework building and examination incorporate requirement gathering at the framework level with modest amount of top-ranking arrange. Examination info building consolidate would like assortment at the key business level and at the business space level.

CHAPTER 4

EXISTING SYSTEM:

• Email Spam Classifier based on Machine Leaning Techniques had done by using SVM, KNN, Naive Bayes and Decision tree algorithms etc.

• SVM had an average accuracy of 99.6%.

• It had good accuracy when compared to the other algorithms in proposed system.

CHAPTER 5

PROPOSED SYSTEM:

• Email Spam Classifier is used to classify email data into spam and ham emails.

• This method is performed by using Support Vector Machine (SVM) algorithm.

• In this method, dataset is divided into two sets based on labels and given as input to algorithm.

• The accuracy of 99% on training data and 98.2% on test data is obtained through the proposed system.

CHAPTER 6

PROBLEM DEFINATION:

6.1 How Gmail, Yahoo and Outlook emails spam filters work?

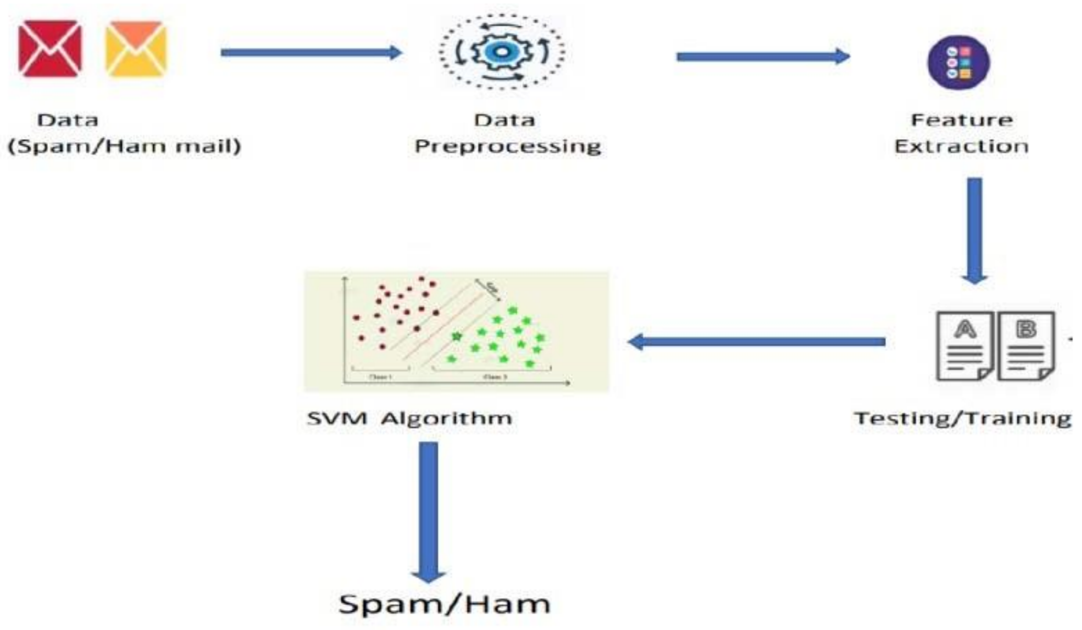
Different spam filtering formulas are used by Gmail, Outlook.com and Yahoo Mail to deliver solely the valid emails to their users and strain the illegitimate messages. Conversely, these filters additionally typically mistakenly block authentic messages. it's been according that concerning twenty p.c of authorization based mostly emails sometimes fail to urge to the inbox of the expected recipient. the e-mail suppliers have designed varied mechanisms to be used in email anti-spam filter to curtail the risks posed by phishing, email-borne malware and ransomware to email users. The mechanisms area unit wont to decide the danger level of every incoming email. samples of such mechanisms embody satisfactory spam limits, sender policy frameworks, whitelists and blacklists, and recipient verification tools. These mechanisms may be utilized by single or multiple users. once the satisfactory spam thresholds is simply too low it will cause a lot of spam evading the spam filter and getting into the users' inboxes. in the meantime having a awfully high threshold will cause some vital emails being isolated unless the administrator redirects them. This section discusses the operations of Gmail, Yahoo and Outlook emails anti-spam filters.

6.2 Email spam filtering method:

An email message is created from 2 major elements that area unit the header and also the body. The header is that the space that have broad data concerning the content of the e-mail. It includes the topic, sender and receiver. The body is that the heart of the e-mail. It will embody data that doesn't have a pre-defined information. Examples embody website, audio, video, analog information, images, files, and hypertext mark-up language markup. the email header is comprised of fields like sender's address, the recipient's address, or timestamp that indicate once the message was sent by negotiant servers to the Message Transport Agents (MTAs) that operate as associate workplace for organising mails. The header line typically starts with a "From" associated it goes through some modification whenever it moves from one server to a different through an mediate server. Headers enable the user to look at the route the e-mail passes through, and also the time taken by every server to treat the mail. The on the market data ought to submit to some process before the classifier will build use of it for filtering.

CHAPTER 7

ARCHITECTURE DIAGRAM



CHAPTER 8

MODULES

- Dataset Collection
- Data Cleaning
- Modules used in the code.
- Preprocessing of dataset.
- Feature Extraction
- Model Training
- Testing Model

Dataset collection:

Informational index assortment: Information assortment can assist you with tracking down ways of following previous occasions utilizing information examination to record them. This permits you to foresee the way and make prescient models utilizing AI devices to anticipate future changes. Since the prescient model is just pretty much as great as the data acquired, the most effective way to gather information is to further develop execution. The data of got to be faultless (garbage, open air squander) and bought to incorporate data about the work you are doing. For instance, a non-performing advance may not profit from the sum got, yet may profit from gas costs over the long run. In this module, we gather data from the Kaggle data set. These figures contain data on yearly contrasts.

Data Cleaning:

Data Cleanliness is a significant piece of all AI exercises. The data cleanliness of this module is excepted for the arrangement of information for the annihilation and transformation of wrong, inadequate, misdirecting data. You can utilize it to look for data. Discover what cleaning you can do.

Feature Extraction:

This is done to lessen the quantity of capacities in the informational index, which will accelerate preparing and increment proficiency. In AI, picture acknowledgment, and picture handling, mining starts at the front line of estimated, useful data (ascribes) pointed toward guaranteeing, adjusting, following, and normalizing data, and now and again prompting more prominent clearness.

Take out the properties related with aspect decrease On the off chance that the calculation's feedback is excessively enormous, it won't be handled, and assuming it is suspected to be excessively huge (like estimating one foot and meter, or rehashing the picture displayed in pixels), it tends to be switched. properties (likewise called vector properties). Characterize the initial segment, called highlight choice. The chose things ought to contain data about the data got so they can fill the ideal role utilizing this portrayal rather than complete data.

Model training: An illustration of this preparation is the informational collection used to prepare the ML calculation. It comprises of significant info definitions that influence information inspecting and yield. The preparation model is utilized to utilize the information through the result and result change calculations. The aftereffects of this connection will be utilized to alter the layout. This strategy for assault is designated "matching model". Information preparing definition or informational collection approval is significant for demonstrating. Plan language preparing is a method for giving data about the ML calculation and assist with deciding and become familiar with the best significance of every one of its highlights. There are many kinds of Al, the majority of which are controlled and uncontrolled.

Testing Model:

In this module, we test an AI machine planned utilizing research information Quality protection is needed to make the product framework work appropriately. All chance settled upon? Does the program fill in true to form? All program testing standards should be remembered for the specialized detail. What's more, programming testing can uncover every one of the defects and shortcomings that have happened during improvement. Once the application is delivered, you don't need your clients to come to your home together. Various kinds of tests just take into account recognition of blunders during activity.

CHAPTER 9

FUTURE SCOPE:

However, varied endeavors are actualized towards grappling the problem of spam SMS utilizing body, social and innovative measures, the arrangement planned aren't finished arrangements. 1) Achieving precise grouping, with zero % (0%) misclassification of Ham SMS as spam and spam SMS as Ham. 2) The endeavors would be applied to stand phishing SMS that conveys the phishing assaults and now-days that is more and more matter of concern. The framework we tend to area unit making are going to be operating simply on windows. As increasing utilization of cellular phone step by step, there's a requirement to recollect this workplace as AN application for cellphone too.

Tools:

Installation and Software Requirements:

In this project, we have used Anaconda which has various inbuilt software's like Spyder, PyCharm, Jupyter, and much more…

For this specific project, I had used Jupyter notebook to run the codes

Anaconda is a distribution of the Python programming languages for scientific computing, that aims to simplify package management and deployment.

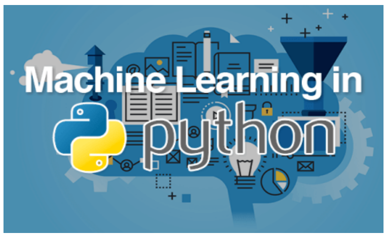
Languages Used:

In this project, I have used python with machine learning Python is an interpreted high-level general-purpose programming language.

Python is an interactive and object-oriented scripting language. Python is designed to be highly readable. It supports functional and structured programming methods as well as OOP. It can be used as a scripting language or can be compiled to bytecode for building large applications. It provides very high-level dynamic data types and supports dynamic type checking. It supports automatic garbage collection.

About Machine Learning!!

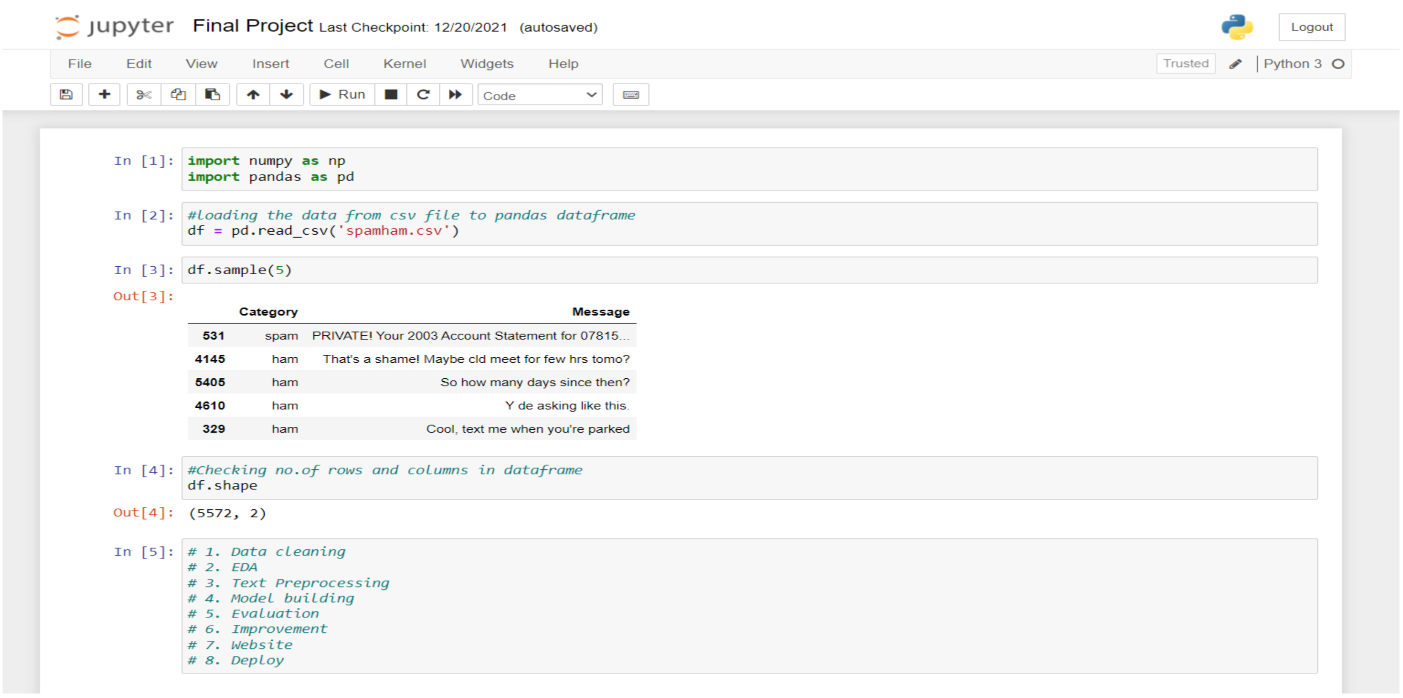
Machine Learning:



Machine Learning is an application of Artificial Intelligence (AI) which enables a program(software) to learn from the experiences and improve itself at a task without being explicitly programmed. For example, how would you write a program that can identify fruits based on their various properties, such as color, shape, size, or any other Machine Learning today has all the attention it needs. Machine Learning can automate many tasks, especially the ones that only humans can perform with their innate intelligence. Replicating this intelligence to machines can be achieved only with the help of machine learning.

Unsupervised Learning:

Unsupervised learning is a machine learning technique in which models are not supervised using a training dataset. Instead, models themselves find the hidden patterns and insights from the given data. It can be compared to learning which takes place in the human brain while learning new things. Unsupervised learning cannot be directly applied to a regression or classification problem because, unlike supervised learning, we have the input data but no corresponding output data. The goal of unsupervised learning is to find the underlying structure of the dataset, group that data according to similarities, and represent that dataset in a compressed format.

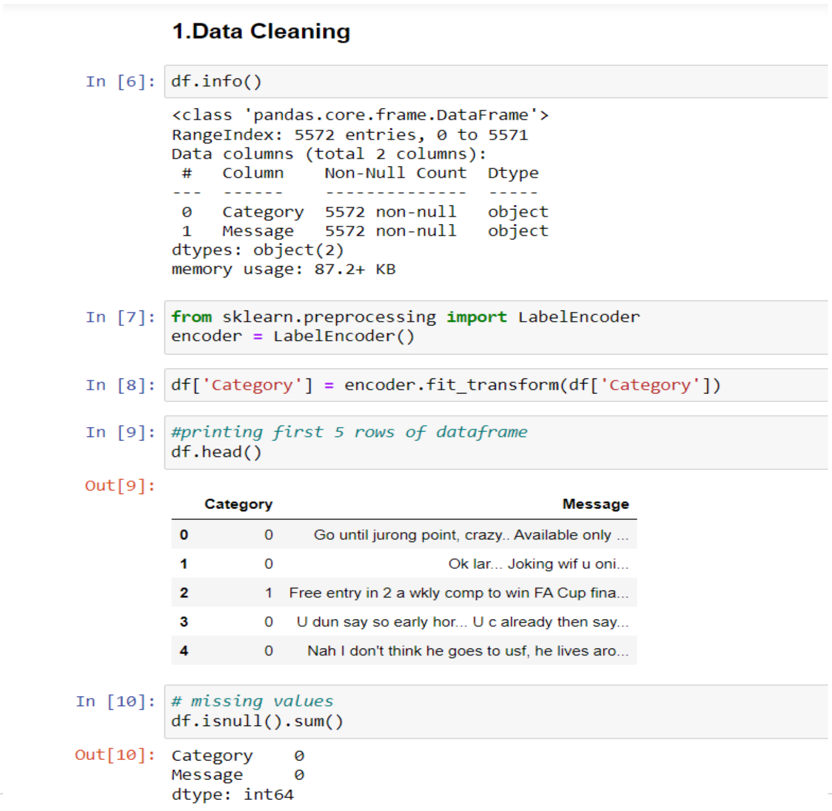

jupyter Final Project Last Checkpoint: 12/20/2021 (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3
Run
Code

```
In [1]: import numpy as np
        import pandas as pd

In [2]: #loading the data from csv file to pandas dataframe
        df = pd.read_csv('spamham.csv')

In [3]: df.sample(5)
Out[3]:
```

	Category	Message
531	spam	PRIVATE! Your 2003 Account Statement for 07815...
4145	ham	That's a shame! Maybe cld meet for few hrs tomo?
5405	ham	So how many days since then?
4610	ham	Y de asking like this.
329	ham	Cool, text me when you're parked

```
In [4]: #Checking no.of rows and columns in dataframe
        df.shape
Out[4]: (5572, 2)

In [5]: # 1. Data cleaning
        # 2. EDA
        # 3. Text Preprocessing
        # 4. Model building
        # 5. Evaluation
        # 6. Improvement
        # 7. Website
        # 8. Deploy
```

CODE



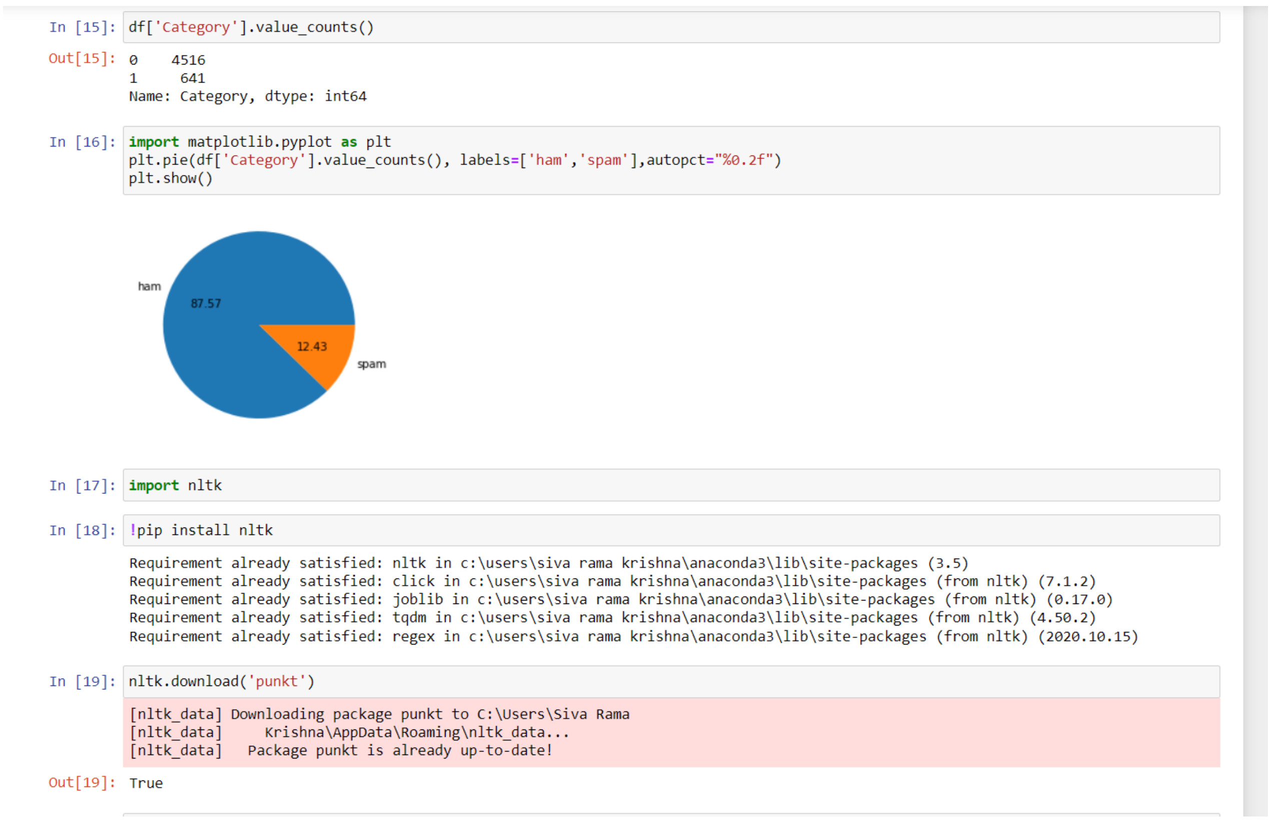
SCREENSHOTS

1.Data Cleaning

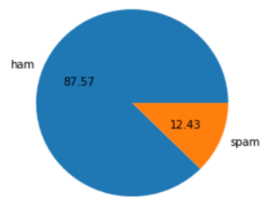
```
In [6]: df.info()

        <class 'pandas.core.frame.DataFrame'>
        RangeIndex: 5572 entries, 0 to 5571
        Data columns (total 2 columns):
         #   Column    Non-Null Count  Dtype 
        ---  ------    --------------  ----- 
         0   Category  5572 non-null   object
         1   Message   5572 non-null   object
        dtypes: object(2)
        memory usage: 87.2+ KB

In [7]: from sklearn.preprocessing import LabelEncoder
        encoder = LabelEncoder()

In [8]: df['Category'] = encoder.fit_transform(df['Category'])

In [9]: #printing first 5 rows of dataframe
        df.head()

Out[9]:
```

	Category	Message
0	0	Go until jurong point, crazy.. Available only ...
1	0	Ok lar... Joking wif u oni...
2	1	Free entry in 2 a wkly comp to win FA Cup fina...
3	0	U dun say so early hor... U c already then say...
4	0	Nah I don't think he goes to usf, he lives aro...

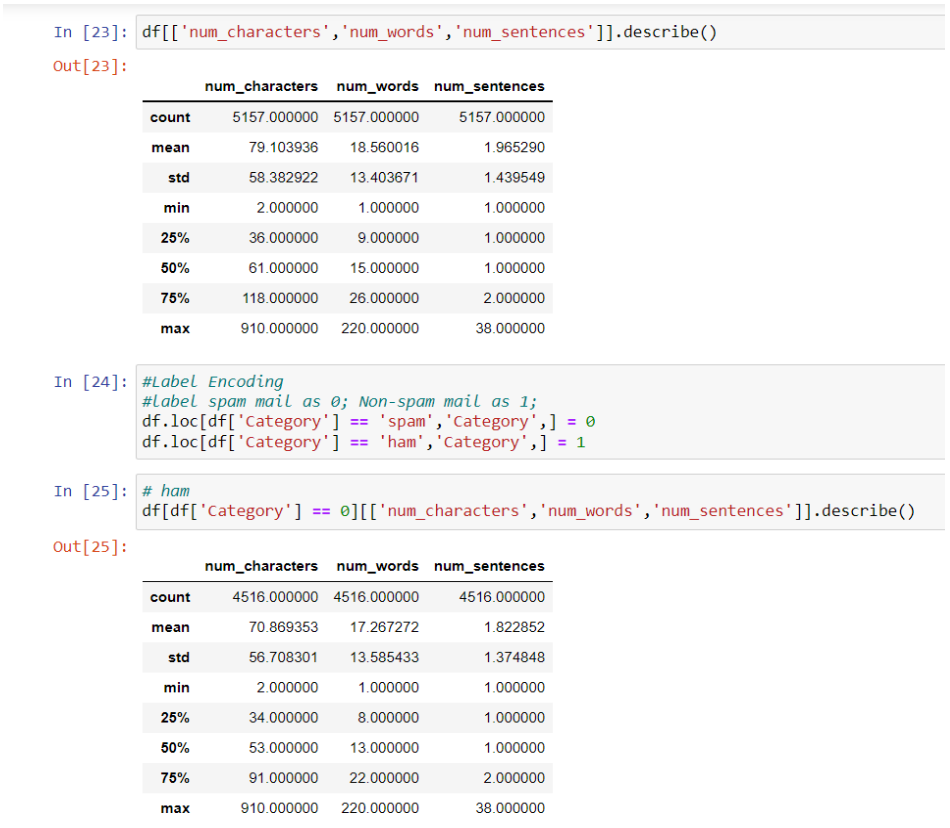
```
In [10]: # missing values
         df.isnull().sum()

Out[10]: Category    0
         Message     0
         dtype: int64
```



```
In [15]: df['Category'].value_counts()

Out[15]: 0    4516
         1     641
         Name: Category, dtype: int64

In [16]: import matplotlib.pyplot as plt
         plt.pie(df['Category'].value_counts(), labels=['ham','spam'],autopct="%0.2f")
         plt.show()
```



```
In [17]: import nltk

In [18]: !pip install nltk

         Requirement already satisfied: nltk in c:\users\siva rama krishna\anaconda3\lib\site-packages (3.5)
         Requirement already satisfied: click in c:\users\siva rama krishna\anaconda3\lib\site-packages (from nltk) (7.1.2)
         Requirement already satisfied: joblib in c:\users\siva rama krishna\anaconda3\lib\site-packages (from nltk) (0.17.0)
         Requirement already satisfied: tqdm in c:\users\siva rama krishna\anaconda3\lib\site-packages (from nltk) (4.50.2)
         Requirement already satisfied: regex in c:\users\siva rama krishna\anaconda3\lib\site-packages (from nltk) (2020.10.15)

In [19]: nltk.download('punkt')

         [nltk_data] Downloading package punkt to C:\Users\Siva Rama
         [nltk_data]     Krishna\AppData\Roaming\nltk_data...
         [nltk_data]   Package punkt is already up-to-date!

Out[19]: True
```



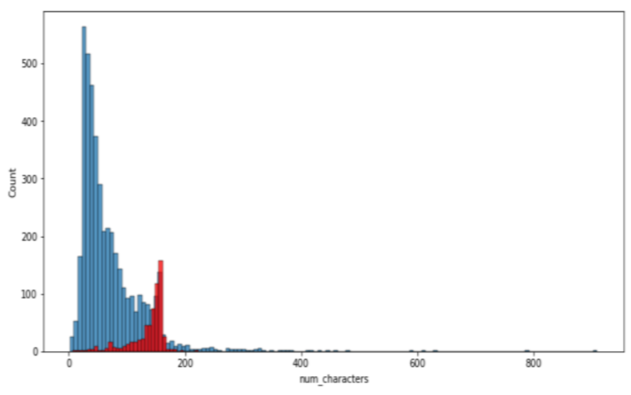
```
In [23]: df[['num_characters','num_words','num_sentences']].describe()

Out[23]:
```

	num_characters	num_words	num_sentences
count	5157.000000	5157.000000	5157.000000
mean	79.103936	18.560016	1.965290
std	58.382922	13.403671	1.439549
min	2.000000	1.000000	1.000000
25%	36.000000	9.000000	1.000000
50%	61.000000	15.000000	1.000000
75%	118.000000	26.000000	2.000000
max	910.000000	220.000000	38.000000

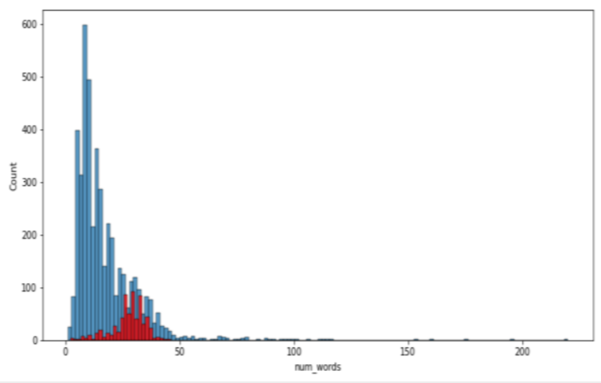
```
In [24]: #Label Encoding
         #label spam mail as 0; Non-spam mail as 1;
         df.loc[df['Category'] == 'spam','Category',] = 0
         df.loc[df['Category'] == 'ham','Category',] = 1

In [25]: # ham
         df[df['Category'] == 0][['num_characters','num_words','num_sentences']].describe()

Out[25]:
```

	num_characters	num_words	num_sentences
count	4516.000000	4516.000000	4516.000000
mean	70.869353	17.267272	1.822852
std	56.708301	13.585433	1.374848
min	2.000000	1.000000	1.000000
25%	34.000000	8.000000	1.000000
50%	53.000000	13.000000	1.000000
75%	91.000000	22.000000	2.000000
max	910.000000	220.000000	38.000000

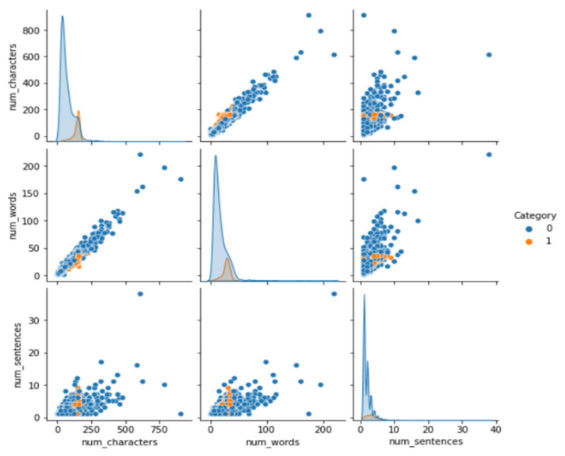
```
In [28]: #num_characters vs count
         plt.figure(figsize=(12,6))
         sns.histplot(df[df['Category'] == 0]['num_characters'])#spam
         sns.histplot(df[df['Category'] == 1]['num_characters'],color='red')#ham

Out[28]: <AxesSubplot:xlabel='num_characters', ylabel='Count'>
```



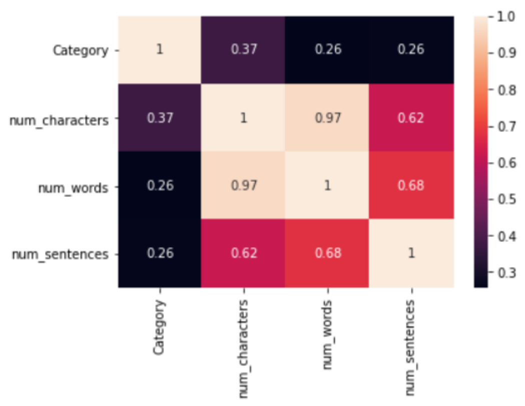
```
In [29]: #num_words vs Count
         plt.figure(figsize=(12,6))
         sns.histplot(df[df['Category'] == 0]['num_words'])
         sns.histplot(df[df['Category'] == 1]['num_words'],color='red')

Out[29]: <AxesSubplot:xlabel='num_words', ylabel='Count'>
```



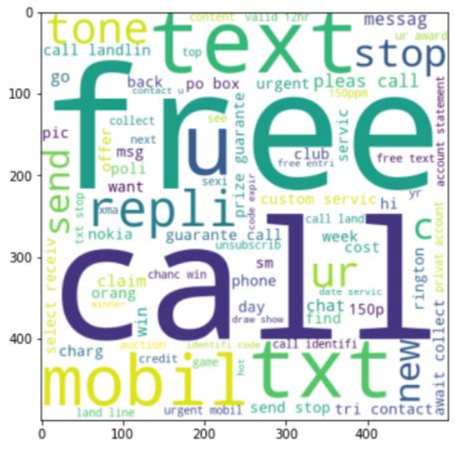
```
In [30]: sns.pairplot(df,hue='Category')

Out[30]: <seaborn.axisgrid.PairGrid at 0x28843c6bb50>
```



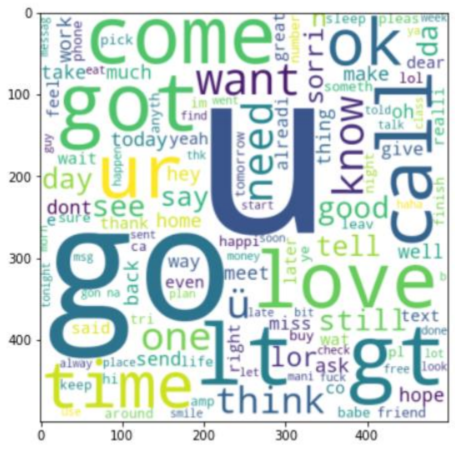
```
In [31]: sns.heatmap(df.corr(),annot=True)

Out[31]: <AxesSubplot:>
```



```
In [44]: plt.figure(figsize=(15,6))
         plt.imshow(spam_wc)

Out[44]: <matplotlib.image.AxesImage at 0x28845c96970>
```



```
In [46]: plt.figure(figsize=(15,6))
         plt.imshow(ham_wc)

Out[46]: <matplotlib.image.AxesImage at 0x2884618d8e0>
```



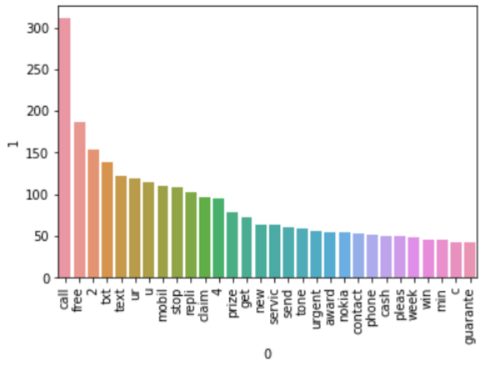
```
In [48]: spam_corpus = []
         for msg in df[df['Category'] == 1]['transformed_Message'].tolist():
             for word in msg.split():
                 spam_corpus.append(word)
```

```
In [49]: len(spam_corpus)
```

```
Out[49]: 9781
```

```
In [50]: from collections import Counter
         sns.barplot(pd.DataFrame(Counter(spam_corpus).most_common(30))[0],pd.DataFrame(Counter(spam_corpus).most_common(30))[1])
         plt.xticks(rotation='vertical')
         plt.show()
```

```
C:\Users\Siva Rama Krishna\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variables a
s keyword args: x, y. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without
an explicit keyword will result in an error or misinterpretation.
  warnings.warn(
```



```
In [53]: from collections import Counter
         sns.barplot(pd.DataFrame(Counter(ham_corpus).most_common(30))[0],pd.DataFrame(Counter(ham_corpus).most_common(30))[1])
         plt.xticks(rotation='vertical')
         plt.show()
```

```
C:\Users\Siva Rama Krishna\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWarning: Pass the following variables a
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  warnings.warn(
```
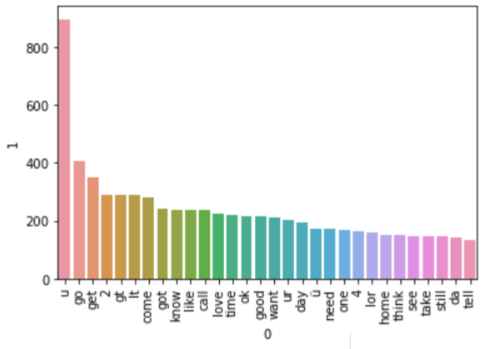



4. Model Building

```
In [55]: from sklearn.feature_extraction.text import CountVectorizer,TfidfVectorizer
         cv = CountVectorizer()
         tfidf = TfidfVectorizer(max_features=3000)
```

```
In [56]: X = tfidf.fit_transform(df['transformed_Message']).toarray()
```

```
In [57]: X.shape
```

```
Out[57]: (5157, 3000)
```

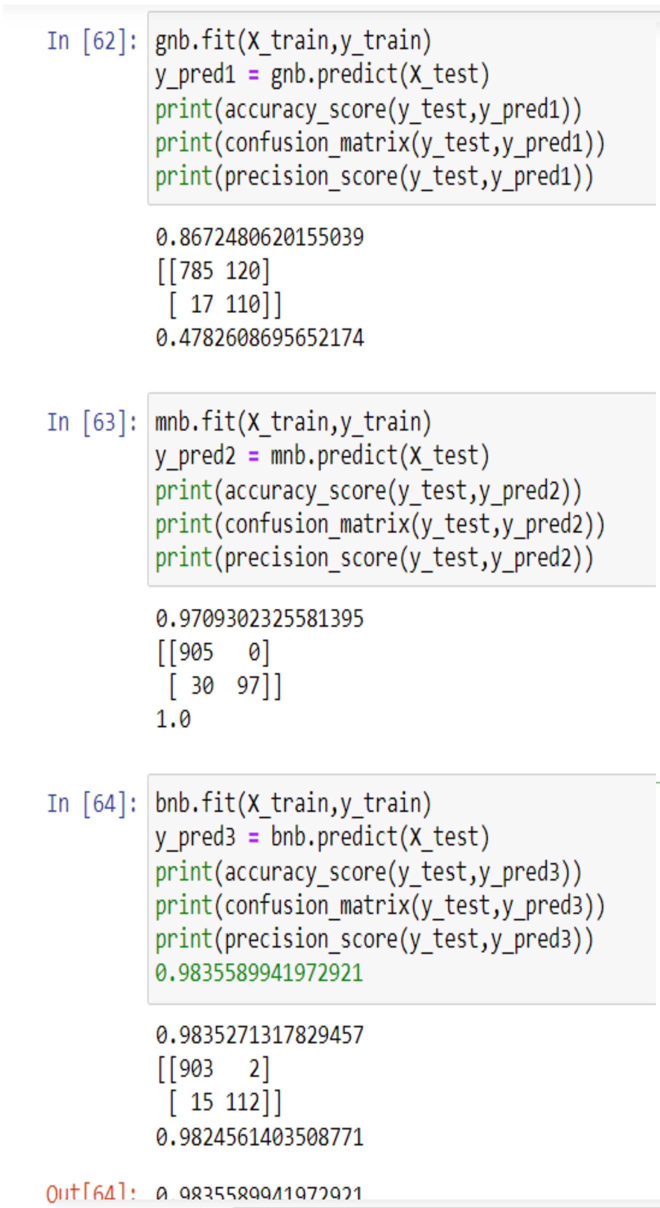
```
In [58]: y = df['Category'].values
```

```
In [59]: from sklearn.model_selection import train_test_split
```

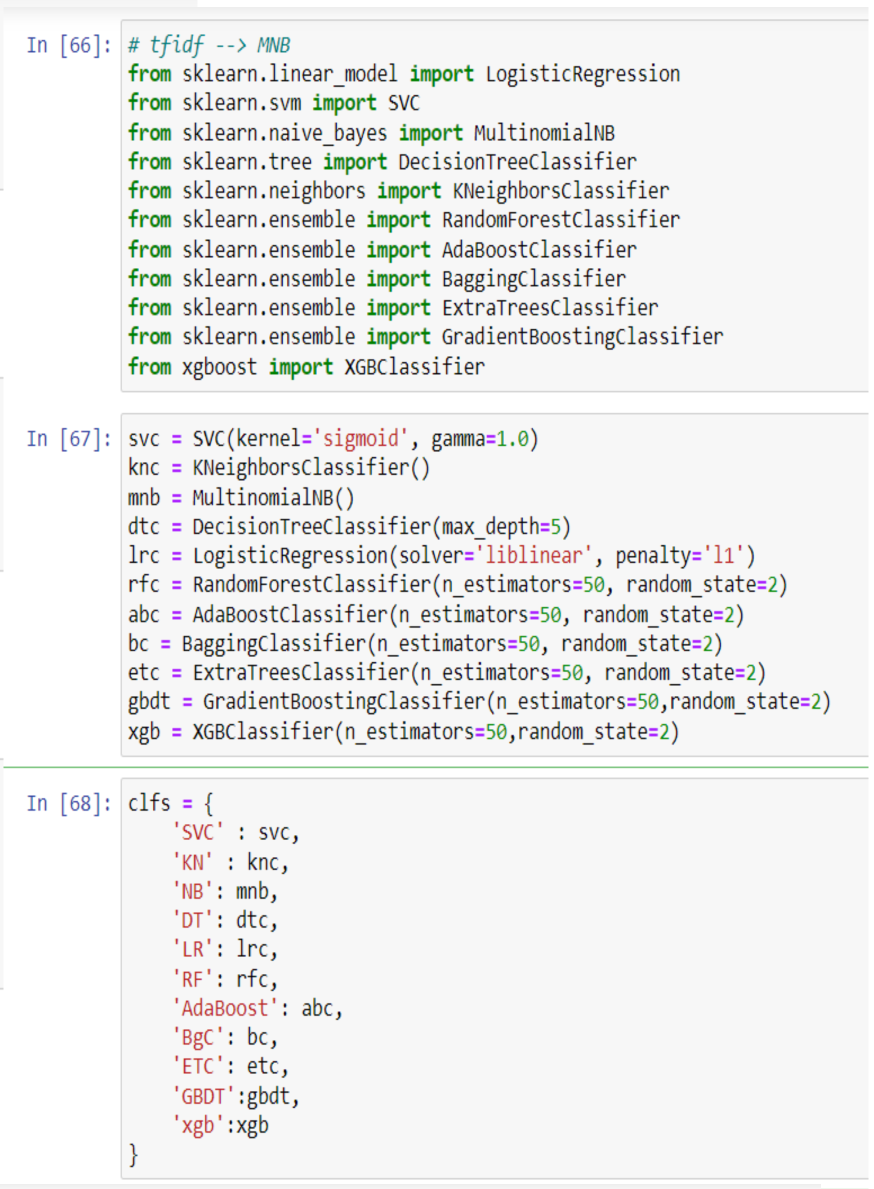
```
In [60]: X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=2)
```

```
In [61]: from sklearn.naive_bayes import GaussianNB,MultinomialNB,BernoulliNB
         from sklearn.metrics import accuracy_score,confusion_matrix,precision_score
         gnb = GaussianNB()
         mnb = MultinomialNB()
         bnb = BernoulliNB()
```

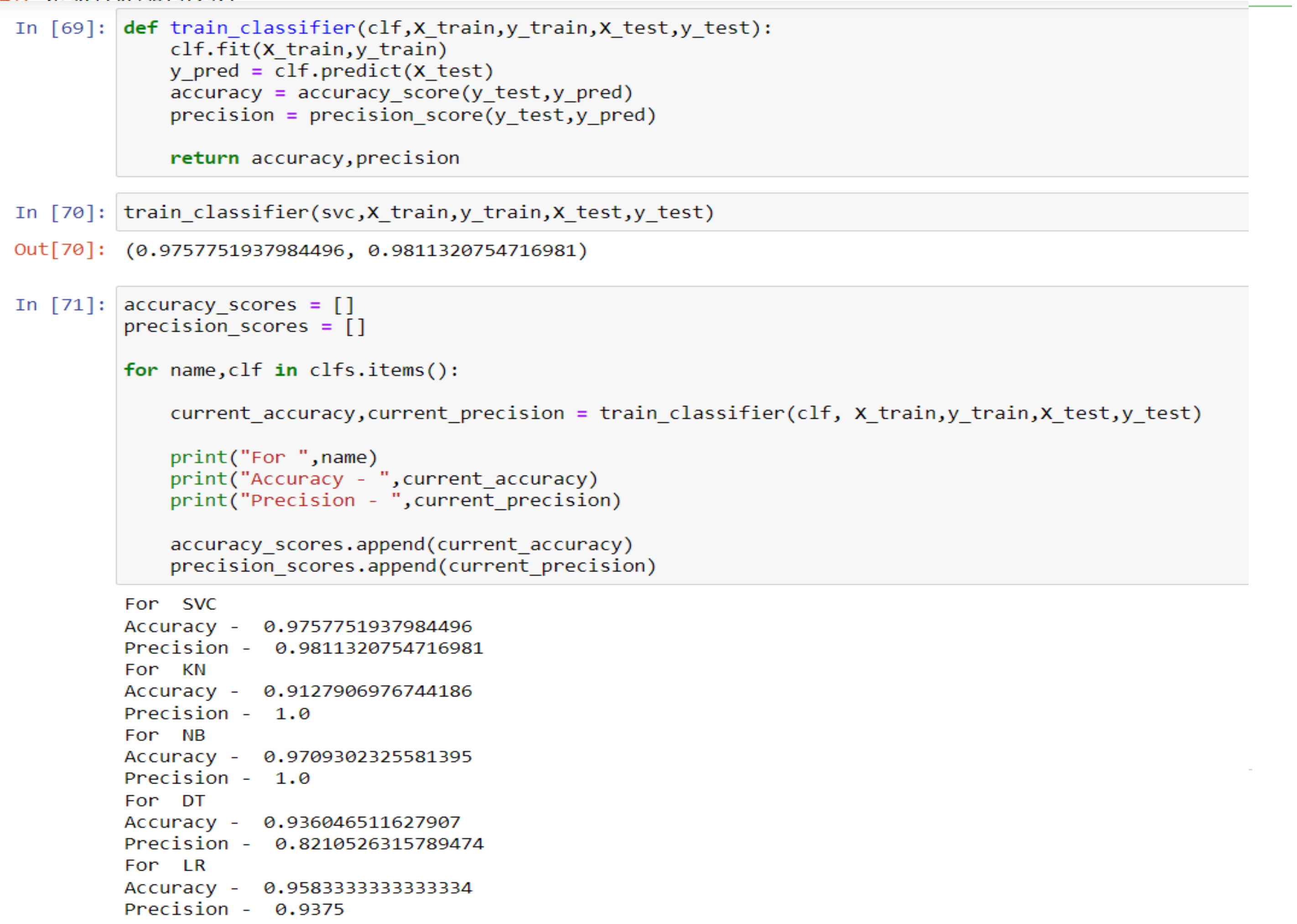
```
In [62]: gnb.fit(X_train,y_train)
         y_pred1 = gnb.predict(X_test)
         print(accuracy_score(y_test,y_pred1))
         print(confusion_matrix(y_test,y_pred1))
```



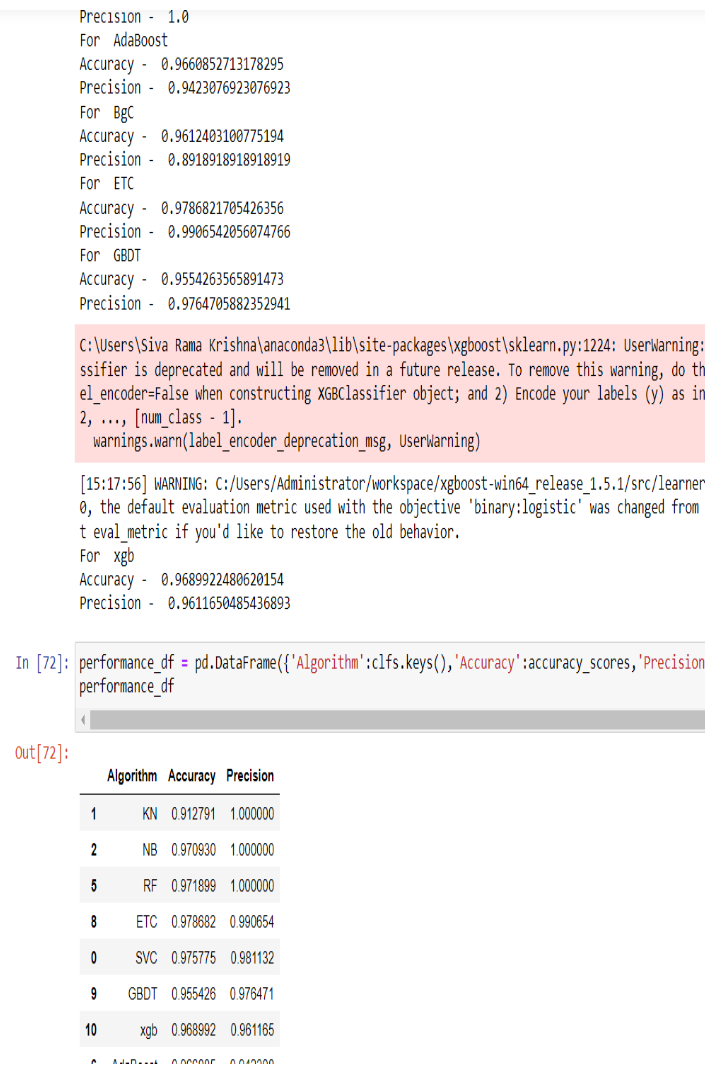
```
In [62]: gnb.fit(X_train,y_train)
         y_pred1 = gnb.predict(X_test)
         print(accuracy_score(y_test,y_pred1))
         print(confusion_matrix(y_test,y_pred1))
         print(precision_score(y_test,y_pred1))

         0.8672480620155039
         [[785 120]
          [ 17 110]]
         0.4782608695652174

In [63]: mnb.fit(X_train,y_train)
         y_pred2 = mnb.predict(X_test)
         print(accuracy_score(y_test,y_pred2))
         print(confusion_matrix(y_test,y_pred2))
         print(precision_score(y_test,y_pred2))

         0.9709302325581395
         [[905   0]
          [ 30  97]]
         1.0

In [64]: bnb.fit(X_train,y_train)
         y_pred3 = bnb.predict(X_test)
         print(accuracy_score(y_test,y_pred3))
         print(confusion_matrix(y_test,y_pred3))
         print(precision_score(y_test,y_pred3))
         0.9835589941972921

         0.9835271317829457
         [[903   2]
          [ 15 112]]
         0.9824561403508771

Out[64]: 0.9835589941972921
```



```
In [66]: # tfidf --> MNB
         from sklearn.linear_model import LogisticRegression
         from sklearn.svm import SVC
         from sklearn.naive_bayes import MultinomialNB
         from sklearn.tree import DecisionTreeClassifier
         from sklearn.neighbors import KNeighborsClassifier
         from sklearn.ensemble import RandomForestClassifier
         from sklearn.ensemble import AdaBoostClassifier
         from sklearn.ensemble import BaggingClassifier
         from sklearn.ensemble import ExtraTreesClassifier
         from sklearn.ensemble import GradientBoostingClassifier
         from xgboost import XGBClassifier

In [67]: svc = SVC(kernel='sigmoid', gamma=1.0)
         knc = KNeighborsClassifier()
         mnb = MultinomialNB()
         dtc = DecisionTreeClassifier(max_depth=5)
         lrc = LogisticRegression(solver='liblinear', penalty='l1')
         rfc = RandomForestClassifier(n_estimators=50, random_state=2)
         abc = AdaBoostClassifier(n_estimators=50, random_state=2)
         bc = BaggingClassifier(n_estimators=50, random_state=2)
         etc = ExtraTreesClassifier(n_estimators=50, random_state=2)
         gbdt = GradientBoostingClassifier(n_estimators=50,random_state=2)
         xgb = XGBClassifier(n_estimators=50,random_state=2)

In [68]: clfs = {
             'SVC' : svc,
             'KN' : knc,
             'NB': mnb,
             'DT': dtc,
             'LR': lrc,
             'RF': rfc,
             'AdaBoost': abc,
             'BgC': bc,
             'ETC': etc,
             'GBDT':gbdt,
             'xgb':xgb
         }
```



```
In [69]: def train_classifier(clf,X_train,y_train,X_test,y_test):
             clf.fit(X_train,y_train)
             y_pred = clf.predict(X_test)
             accuracy = accuracy_score(y_test,y_pred)
             precision = precision_score(y_test,y_pred)

             return accuracy,precision

In [70]: train_classifier(svc,X_train,y_train,X_test,y_test)

Out[70]: (0.9757751937984496, 0.9811320754716981)

In [71]: accuracy_scores = []
         precision_scores = []

         for name,clf in clfs.items():

             current_accuracy,current_precision = train_classifier(clf, X_train,y_train,X_test,y_test)

             print("For ",name)
             print("Accuracy - ",current_accuracy)
             print("Precision - ",current_precision)

             accuracy_scores.append(current_accuracy)
             precision_scores.append(current_precision)

         For  SVC
         Accuracy -  0.9757751937984496
         Precision -  0.9811320754716981
         For  KN
         Accuracy -  0.9127906976744186
         Precision -  1.0
         For  NB
         Accuracy -  0.9709302325581395
         Precision -  1.0
         For  DT
         Accuracy -  0.936046511627907
         Precision -  0.8210526315789474
         For  LR
         Accuracy -  0.9583333333333334
         Precision -  0.9375
```

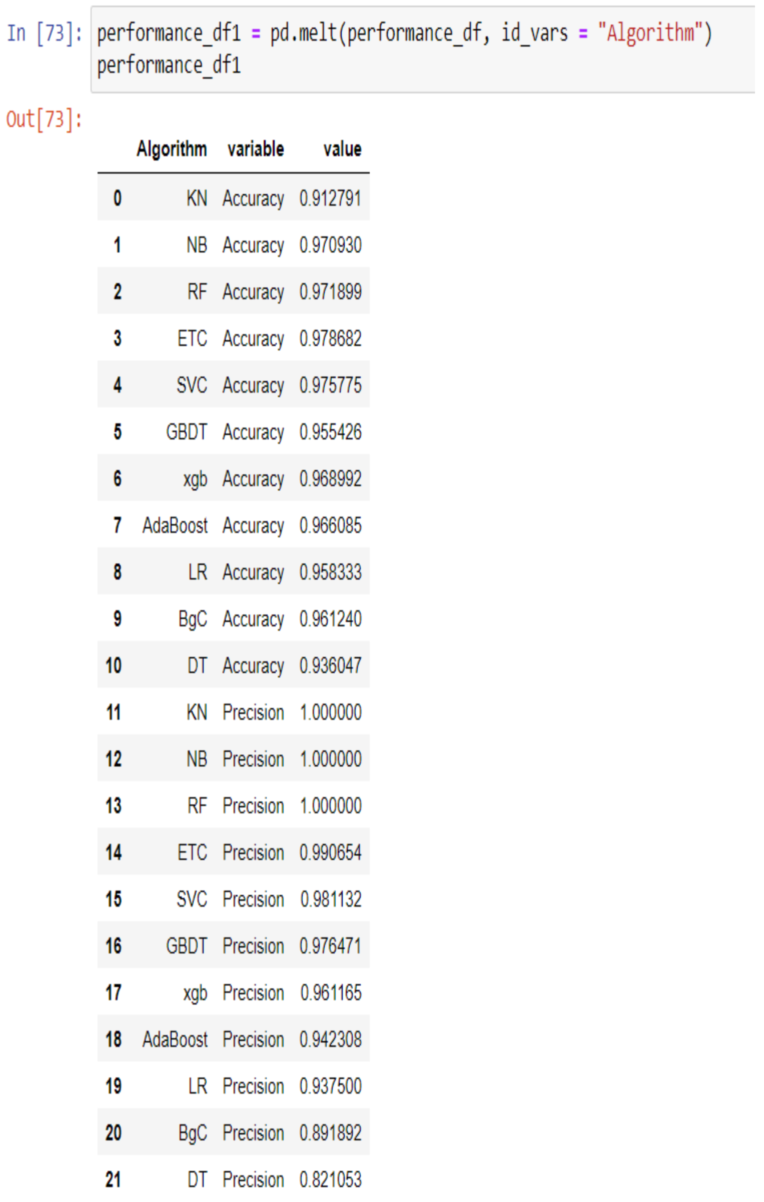


```
Precision -  1.0
For  AdaBoost
Accuracy -  0.9660852713178295
Precision -  0.9423076923076923
For  BgC
Accuracy -  0.9612403100775194
Precision -  0.8918918918918919
For  ETC
Accuracy -  0.9786821705426356
Precision -  0.9906542056074766
For  GBDT
Accuracy -  0.9554263565891473
Precision -  0.9764705882352941

C:\Users\Siva Rama Krishna\anaconda3\lib\site-packages\xgboost\sklearn.py:1224: UserWarning:
ssifier is deprecated and will be removed in a future release. To remove this warning, do th
el_encoder=False when constructing XGBClassifier object; and 2) Encode your labels (y) as in
2, ..., [num_class - 1].
  warnings.warn(label_encoder_deprecation_msg, UserWarning)

[15:17:56] WARNING: C:/Users/Administrator/workspace/xgboost-win64_release_1.5.1/src/learner
0, the default evaluation metric used with the objective 'binary:logistic' was changed from
t eval_metric if you'd like to restore the old behavior.
For  xgb
Accuracy -  0.9689922480620154
Precision -  0.9611650485436893
```

```
In [72]: performance_df = pd.DataFrame({'Algorithm':clfs.keys(),'Accuracy':accuracy_scores,'Precision
         performance_df
```

Out[72]:

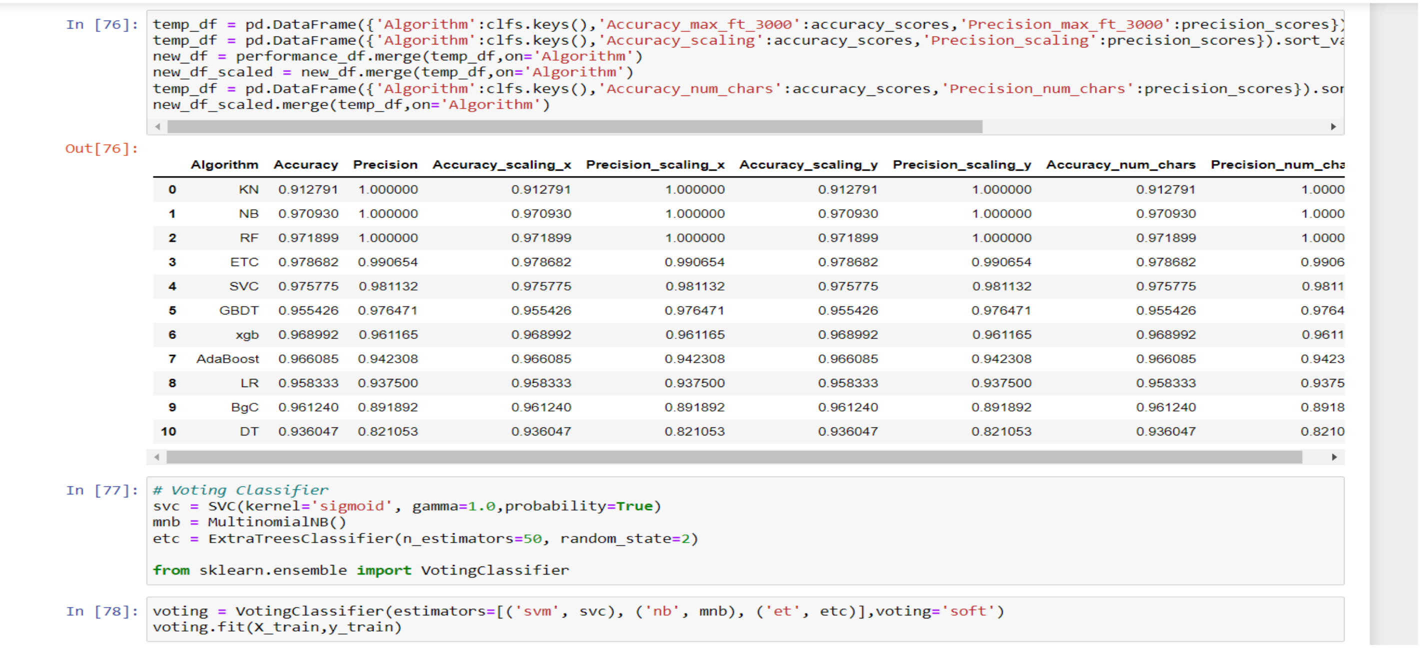
	Algorithm	Accuracy	Precision
1	KN	0.912791	1.000000
2	NB	0.970930	1.000000
5	RF	0.971899	1.000000
8	ETC	0.978682	0.990654
0	SVC	0.975775	0.981132
9	GBDT	0.955426	0.976471
10	xgb	0.968992	0.961165
6	AdaBoost	0.966085	0.942308



```
In [73]: performance_df1 = pd.melt(performance_df, id_vars = "Algorithm")
         performance_df1
```

Out[73]:

	Algorithm	variable	value
0	KN	Accuracy	0.912791
1	NB	Accuracy	0.970930
2	RF	Accuracy	0.971899
3	ETC	Accuracy	0.978682
4	SVC	Accuracy	0.975775
5	GBDT	Accuracy	0.955426
6	xgb	Accuracy	0.968992
7	AdaBoost	Accuracy	0.966085
8	LR	Accuracy	0.958333
9	BgC	Accuracy	0.961240
10	DT	Accuracy	0.936047
11	KN	Precision	1.000000
12	NB	Precision	1.000000
13	RF	Precision	1.000000
14	ETC	Precision	0.990654
15	SVC	Precision	0.981132
16	GBDT	Precision	0.976471
17	xgb	Precision	0.961165
18	AdaBoost	Precision	0.942308
19	LR	Precision	0.937500
20	BgC	Precision	0.891892
21	DT	Precision	0.821053



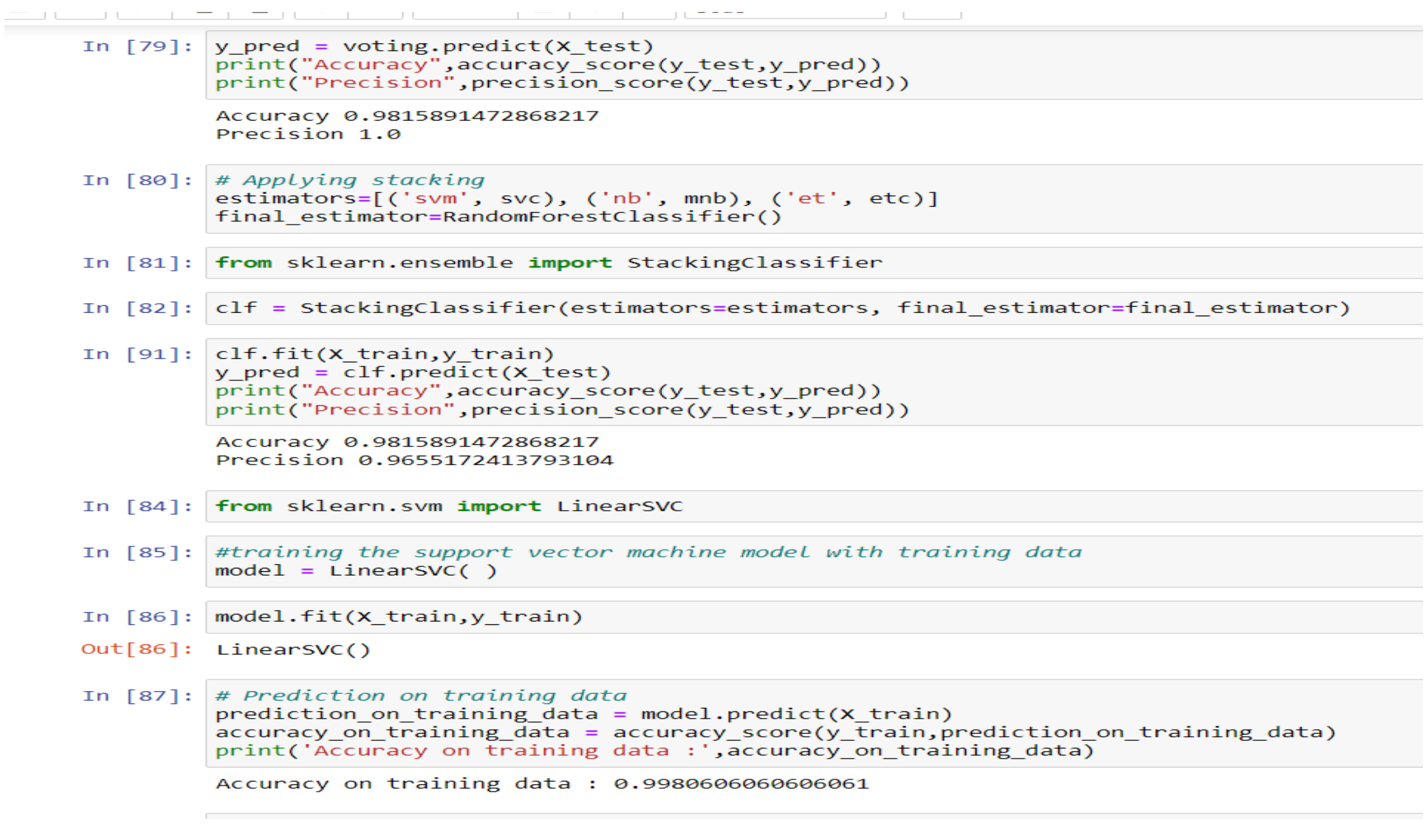
```
In [76]: temp_df = pd.DataFrame({'Algorithm':clfs.keys(),'Accuracy_max_ft_3000':accuracy_scores,'Precision_max_ft_3000':precision_scores})
         temp_df = pd.DataFrame({'Algorithm':clfs.keys(),'Accuracy_scaling':accuracy_scores,'Precision_scaling':precision_scores}).sort_va
         new_df = performance_df.merge(temp_df,on='Algorithm')
         new_df_scaled = new_df.merge(temp_df,on='Algorithm')
         temp_df = pd.DataFrame({'Algorithm':clfs.keys(),'Accuracy_num_chars':accuracy_scores,'Precision_num_chars':precision_scores}).sor
         new_df_scaled.merge(temp_df,on='Algorithm')
```

Out[76]:

	Algorithm	Accuracy	Precision	Accuracy_scaling_x	Precision_scaling_x	Accuracy_scaling_y	Precision_scaling_y	Accuracy_num_chars	Precision_num_cha
0	KN	0.912791	1.000000	0.912791	1.000000	0.912791	1.000000	0.912791	1.0000
1	NB	0.970930	1.000000	0.970930	1.000000	0.970930	1.000000	0.970930	1.0000
2	RF	0.971899	1.000000	0.971899	1.000000	0.971899	1.000000	0.971899	1.0000
3	ETC	0.978682	0.990654	0.978682	0.990654	0.978682	0.990654	0.978682	0.9906
4	SVC	0.975775	0.981132	0.975775	0.981132	0.975775	0.981132	0.975775	0.9811
5	GBDT	0.955426	0.976471	0.955426	0.976471	0.955426	0.976471	0.955426	0.9764
6	xgb	0.968992	0.961165	0.968992	0.961165	0.968992	0.961165	0.968992	0.9611
7	AdaBoost	0.966085	0.942308	0.966085	0.942308	0.966085	0.942308	0.966085	0.9423
8	LR	0.958333	0.937500	0.958333	0.937500	0.958333	0.937500	0.958333	0.9375
9	BgC	0.961240	0.891892	0.961240	0.891892	0.961240	0.891892	0.961240	0.8918
10	DT	0.936047	0.821053	0.936047	0.821053	0.936047	0.821053	0.936047	0.8210

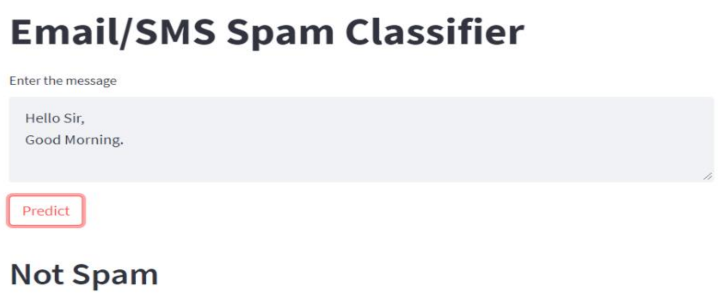
```
In [77]: # Voting Classifier
         svc = SVC(kernel='sigmoid', gamma=1.0,probability=True)
         mnb = MultinomialNB()
         etc = ExtraTreesClassifier(n_estimators=50, random_state=2)

         from sklearn.ensemble import VotingClassifier
```

```
In [78]: voting = VotingClassifier(estimators=[('svm', svc), ('nb', mnb), ('et', etc)],voting='soft')
         voting.fit(X_train,y_train)
```



```
In [79]: y_pred = voting.predict(X_test)
         print("Accuracy",accuracy_score(y_test,y_pred))
         print("Precision",precision_score(y_test,y_pred))

         Accuracy 0.9815891472868217
         Precision 1.0

In [80]: # Applying stacking
         estimators=[('svm', svc), ('nb', mnb), ('et', etc)]
         final_estimator=RandomForestClassifier()

In [81]: from sklearn.ensemble import StackingClassifier

In [82]: clf = StackingClassifier(estimators=estimators, final_estimator=final_estimator)

In [91]: clf.fit(X_train,y_train)
         y_pred = clf.predict(X_test)
         print("Accuracy",accuracy_score(y_test,y_pred))
         print("Precision",precision_score(y_test,y_pred))

         Accuracy 0.9815891472868217
         Precision 0.9655172413793104

In [84]: from sklearn.svm import LinearSVC

In [85]: #training the support vector machine model with training data
         model = LinearSVC( )

In [86]: model.fit(X_train,y_train)
Out[86]: LinearSVC()

In [87]: # Prediction on training data
         prediction_on_training_data = model.predict(X_train)
         accuracy_on_training_data = accuracy_score(y_train,prediction_on_training_data)
         print('Accuracy on training data :',accuracy_on_training_data)

         Accuracy on training data : 0.9980606060606061
```

OUTPUT RESULT

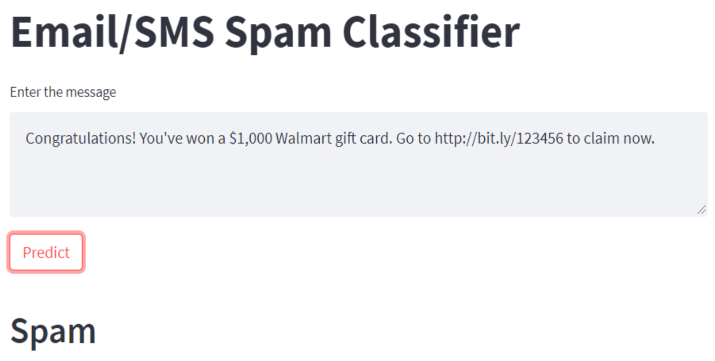


Email/SMS Spam Classifier

Enter the message

Hello Sir,
Good Morning.

Not Spam



Email/SMS Spam Classifier

Enter the message

Congratulations! You've won a $1,000 Walmart gift card. Go to http://bit.ly/123456 to claim now.

Spam

CONCLUSION

- Spam email is one of the most demanding and troublesome internet issues in today's world of communication and technology.
- It is almost impossible to think about e-mail without considering the issue of spam.
- Spammers by generating spam mails are misusing this communication facility and thus affectingorganizations and many email users.
- The machine learning model used by Google have now advanced to the point that it can detect and filterout spam and phishing emails with about 99.9 percent accuracy.
- The implication of this is that one out of a thousand messages succeed in evading their email spam filter.

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