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Task 4 - EMAIL SPAM DETECTION WITH MACHINE LEARNING

Problem Statement:

- Use Python to develop Email Spam Detector.
- Use Machine Learning to train Spam Detector to recognize and classify Emails into Spam and Non- Spam mails.

In [1]:
```
#importing necessary libraries
import numpy as np
import pandas as pd
import warnings
warnings.filterwarnings('ignore')
```

In [2]:
```
#importing Data
data_frame = pd.read_csv('C:/Users/sinun/OneDrive/Documents/oasis infobyte/email_spam/spam.csv')
```

Performing descriptive analysis. Understand the variables and their corresponding values.

In [3]:
```
# Understanding the dimensions of data
data_frame.shape
```

Out[3]:
```
(5572, 5)
```

In [4]:
```
# Understanding the Data Variables
data_frame.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
```

```
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   v1          5572 non-null   object
 1   v2          5572 non-null   object
 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
memory usage: 217.8+ KB
```

In [5]:
```
data_frame.columns
```

Out[5]:
```
Index(['v1', 'v2', 'Unnamed: 2', 'Unnamed: 3', 'Unnamed: 4'], dtype='object')
```

*** Column v2 contains texts of emails and v1 contains whether those emails are spam or not**

In [6]:
```
# Show the top 10 Rows of data
data_frame.head(10)
```

Out[6]:

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN
5	spam	FreeMsg Hey there darling it's been 3 week's n...	NaN	NaN	NaN
6	ham	Even my brother is not like to speak with me. ...	NaN	NaN	NaN
7	ham	As per your request 'Melle Melle (Oru Minnamin...	NaN	NaN	NaN
8	spam	WINNER!! As a valued network customer you have...	NaN	NaN	NaN
9	spam	Had your mobile 11 months or more? U R entitle...	NaN	NaN	NaN

In [7]:
```
# Checking for any Duplicated Entries
data_frame.duplicated().sum()
```

Out[7]:
```
403
```

In [8]:
```
data_frame.drop_duplicates(keep = 'first', inplace = True)
data_frame.shape
```

Out[8]:
```
(5169, 5)
```

In [9]:
```
#Detecting missing values
data_frame.isna().sum()
```

Out[9]:
```
v1              0
v2              0
Unnamed: 2    5126
Unnamed: 3    5159
Unnamed: 4    5164
dtype: int64
```

In [10]:
```
#Dropping unwanted Columns from data
data_frame.drop(columns=['Unnamed: 2','Unnamed: 3','Unnamed: 4'], inplace=True )
data_frame.head()
```

Out[10]:

	v1	v2
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

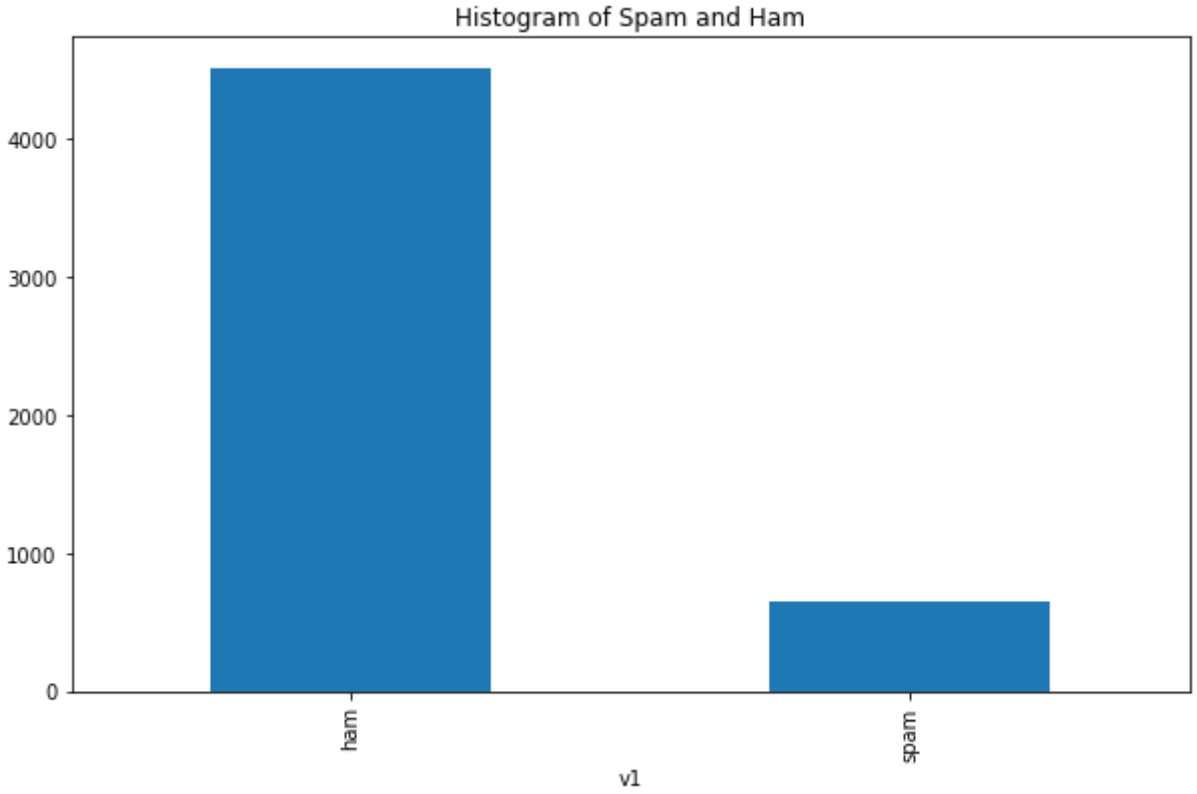
Data Visualization

In [11]:
```
# Finding the number of spam and non-spam mails in dataset
data_frame['v1'].value_counts()
```

Out[11]:
```
ham     4516
spam     653
Name: v1, dtype: int64
```

In [12]:
```
data_frame['v1'].value_counts().plot(kind='bar',figsize=(10,6),title="Histogram of Spam and Ham",xlabel="v1")
```

Out[12]:
```
<AxesSubplot:title={'center':'Histogram of Spam and Ham'}, xlabel='v1'>
```



In [13]:
```
# Printing examples of ham messages
print("Some examples of ham messages:")
print(data_frame[data_frame['v1'] == 'ham']['v2'].head())
```

```
Some examples of ham messages:
0    Go until jurong point, crazy.. Available only ...
1                        Ok lar... Joking wif u oni...
3    U dun say so early hor... U c already then say...
4    Nah I don't think he goes to usf, he lives aro...
6    Even my brother is not like to speak with me. ...
Name: v2, dtype: object
```

In [14]:

```
# Printing examples of spam messages
print(" Some examples of spam messages:")
print(data_frame[data_frame['v1'] == 'spam']['v2'].head())
```

```
 Some examples of spam messages:
2     Free entry in 2 a wkly comp to win FA Cup fina...
5     FreeMsg Hey there darling it's been 3 week's n...
8     WINNER!! As a valued network customer you have...
9     Had your mobile 11 months or more? U R entitle...
11    SIX chances to win CASH! From 100 to 20,000 po...
Name: v2, dtype: object
```

In [15]:

```
# Labelling Spam mails as 1 and Non-Spam Mails as 0
data_frame['v1'] = np.where(data_frame['v1'] == 'spam',1,0)
data_frame
```

Out[15]:

	v1	v2
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...
...	...	...
5567	1	This is the 2nd time we have tried 2 contact u...
5568	0	Will b going to esplanade fr home?
5569	0	Pity, * was in mood for that. So...any other s...
5570	0	The guy did some bitching but I acted like i'd...

	v1	v2
5571	0	Rofl. Its true to its name

5169 rows × 2 columns

Building the Model

In [16]:
```
from sklearn.model_selection import train_test_split
```

In [17]:
```
#First step in building the model is to identify the Feature(Input) variables and Target (Output) variable
#Features are the emails
#Target represents the labels for spam and ham emails
features = data_frame['v2']
target = data_frame['v1']
```

*** Splitting data for training and testing the model**

In [18]:
```
# Splitting data for training the model and testing the model
# train size taken as 0.8
X_train, X_test, y_train, y_test = train_test_split(features, target, train_size = .8)
# Dimensions of Train and Test Data sets
print('Train set of features: ', X_train.shape)
print('Test set of features: ', X_test.shape)
print('Target for train: ', y_train.shape)
print('Target for test: ', y_test.shape)
```

```
Train set of features:  (4135,)
Test set of features:  (1034,)
Target for train:  (4135,)
Target for test:  (1034,)
```

Learn the model on train data

In [19]:
```
from sklearn.feature_extraction.text import CountVectorizer
```

In [20]:
```
#CountVectorizer transform text into a vector on the basis of the frequency/count of each word that occurs in entire text.
#Covert each word in Train dataset into vectors for using them in further text analysis.
cv=CountVectorizer()
X_train_vector=cv.fit_transform(X_train.values)
X_train_vector.toarray()
```

Out[20]:
```
array([[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]], dtype=int64)
```

In [21]:
```
# Here Multinomial Naive Bayes model which is a supervised learning classification
#Used for the analysis of the categorical text data.
from sklearn.naive_bayes import MultinomialNB
my_model=MultinomialNB()
```

In [22]:
```
# Fitting the model in train data set ie the MultinomialNB Model should learn from the Train Data
my_model.fit(X_train_vector, y_train)
```

Out[22]:
```
MultinomialNB()
```

In [23]:
```
#Coverting each word in Test dataset into vectors for using them in further text analysis.
X_test_vector=cv.transform(X_test.values)
X_test_vector.toarray()
```

Out[23]:
```
array([[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]], dtype=int64)
```

Prediction

In [24]:
```
# Predicting whether the mails in Test Dataset are spam or non-spam using our model from Feature Test values
y_pred = my_model.predict(X_test_vector)
y_pred
```

Out[24]:
```
array([0, 0, 1, ..., 0, 0, 0])
```

Testing the model

In [25]:
```
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score
```

In [26]:
```
# find Accurancy Score = (TP+TN)/(TP+TN+FP+FN)
accuracy_score(y_test, y_pred)
```

Out[26]:
```
0.988394584139265
```

In [27]:
```
# find Precision Score= TP/(TP+FP)
precision_score(y_test, y_pred)
```

Out[27]:
```
0.9915966386554622
```

In [28]:
```
# Recall = TP/(TP+FN)
# Recall gives the percentage of positives well predicted by our model.
recall_score(y_test, y_pred)
```

Out[28]:
```
0.9147286821705426
```

In [29]:
```
# f1_score= (Precition * Recall )/ (Precition + Recall)
f1_score(y_test, y_pred)
```

Out[29]:
```
0.9516129032258065
```