Machine Learning Classifier to create a Spam Detection Filter:

Dataset source: University California Irvine

[https://archive.ics.uci.edu/ml/index.php (https://archive.ics.uci.edu/ml/index.php)](https://archive.ics.uci.edu/ml/index.php)

Import NLTK & Basic python packages:

In [1]:
```
import nltk
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

In [2]:
```
nltk.download_shell()
```

```
NLTK Downloader
---------------------------------------------------------------------------
    d) Download   l) List    u) Update   c) Config   h) Help   q) Quit
---------------------------------------------------------------------------
Downloader> d

Download which package (l=list; x=cancel)?
  Identifier> stopwords
    Downloading package stopwords to
        C:\Users\User.DESKTOP-3HHGVTH\AppData\Roaming\nltk_data...
      Package stopwords is already up-to-date!

---------------------------------------------------------------------------
    d) Download   l) List    u) Update   c) Config   h) Help   q) Quit
---------------------------------------------------------------------------
Downloader> q
```

Load Dataset:

In [22]:
```
pd.set_option('display.max_columns', None)
df = pd.read_csv('SpamDataCollection', sep='\t', names = ['Label', 'Message'])
df.head()
```

Out[22]:

	Label	Message
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...

Exploratory Data Analysis:

In [23]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
Label      5572 non-null object
Message    5572 non-null object
dtypes: object(2)
memory usage: 87.1+ KB
```

In [24]:
```
df.describe()
```

Out[24]:

	Label	Message
count	5572	5572
unique	2	5169
top	ham	Sorry, I'll call later
freq	4825	30

In [25]:
```
df.groupby('Label').describe()
```

Out[25]:

	Message			
	count	**unique**	**top**	**freq**
Label				
ham	4825	4516	Sorry, I'll call later	30
spam	747	653	Please call our customer service representativ...	4

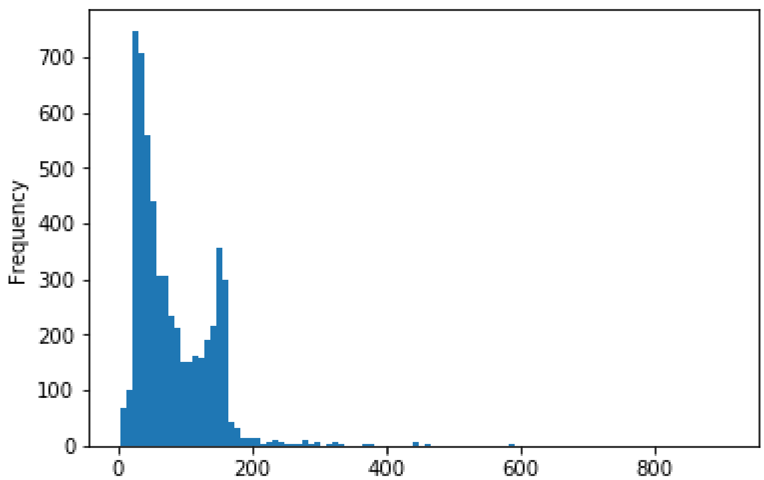
In [26]:
```
# Creating new column for message length:
df['Length'] = df['Message'].apply(len)
df.head()
```

Out[26]:

	Label	Message	Length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61

In [27]:
```
# Visualizing message length:
df['Length'].plot.hist(bins=100)
```

Out[27]: <matplotlib.axes._subplots.AxesSubplot at 0x20f5d884088>



In [28]:
```
df['Message'].describe()
```

Out[28]:
```
count                      5572
unique                     5169
top         Sorry, I'll call later
freq                         30
Name: Message, dtype: object
```

In [29]:
```
df['Label'].describe()
```

Out[29]:
```
count     5572
unique       2
top        ham
freq      4825
Name: Label, dtype: object
```

In [30]:
```
df['Length'].describe()
```

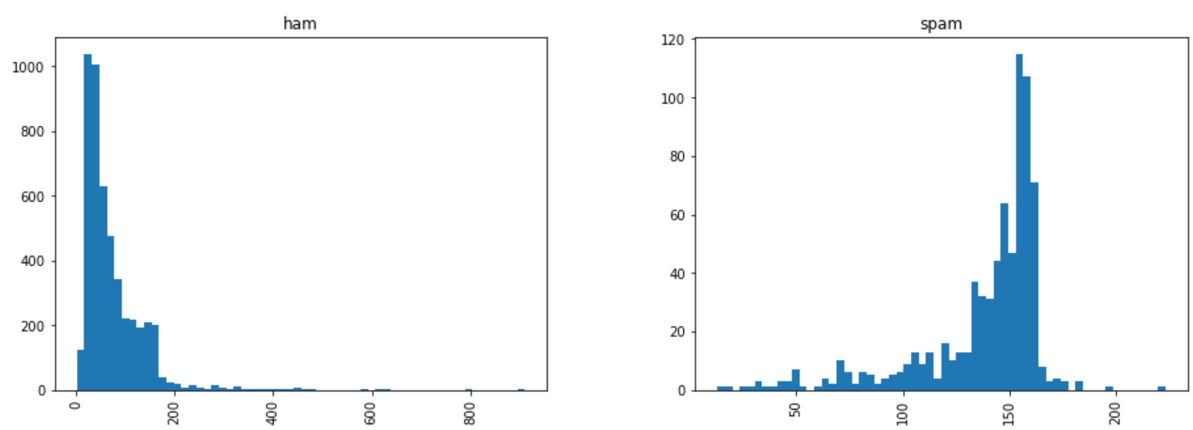
Out[30]:
```
count    5572.000000
mean       80.489950
std        59.942907
min         2.000000
25%        36.000000
50%        62.000000
75%       122.000000
max       910.000000
Name: Length, dtype: float64
```

In [31]:
```
# Checking highest and Lowest message:
print(df[df['Length']==910])
print(df[df['Length']==2])
```

```
     Label                                            Message  Length
1085   ham  For me the love should start with attraction.i...     910
     Label Message  Length
1925   ham      Ok       2
3051   ham      Ok       2
4498   ham      Ok       2
5357   ham      Ok       2
```

In [36]:
```
# Comparing Ham vs Spam:
df.hist(column='Length', by='Label', bins=60, figsize=(15,5))
```

Out[36]:
```
array([<matplotlib.axes._subplots.AxesSubplot object at 0x0000020F5E29B108>,
       <matplotlib.axes._subplots.AxesSubplot object at 0x0000020F5E446C48>],
      dtype=object)
```



Removing Punctuations:

In [37]:
```
import string
string.punctuation
```

Out[37]:
```
'!"#$%&\'()*+,-./:;<=>?@[\\]^_`{|}~'
```

In [42]:
```
# Checking punctuation removal
sample_message = 'This is a !@string with $lots of ,punctutations..'
nopunc = [p for p in sample_message if p not in string.punctuation]
''.join(nopunc)
```

Out[42]: 'This is a string with lots of punctutations'

Import Stopwords from NLTK Corpus:

In [44]:
```
from nltk.corpus import stopwords
stopwords.words('english')
```

Out[44]:
```
['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',
 'did',
 'doing',
 'a',
 'an',
 'the',
 'and',
 'but',
 'if',
 'or',
 'because',
 'as',
 'until',
 'while',
 'of',
 'at',
 'by',
 'for',
 'with',
 'about',
 'against',
 'between',
 'into',
 'through',
 'during',
 'before',
 'after',
 'above',
 'below',
 'to',
 'from',
 'up',
 'down',
 'in',
 'out',
 'on',
 'off',
 'over',
 'under',
 'again',
 'further',
 'then',
 'once',
 'here',
 'there',
 'when',
 'where',
 'why',
 'how',
 'all',
 'any',
 'both',
 'each',
 'few',
 'more',
 'most',
 'other',
```

```
 'some',
 'such',
 'no',
 'nor',
 'not',
 'only',
 'own',
 'same',
 'so',
 'than',
 'too',
 'very',
 's',
 't',
 'can',
 'will',
 'just',
 'don',
 "don't",
 'should',
 "should've",
 'now',
 'd',
 'll',
 'm',
 'o',
 're',
 've',
 'y',
 'ain',
 'aren',
 "aren't",
 'couldn',
 "couldn't",
 'didn',
 "didn't",
 'doesn',
 "doesn't",
 'hadn',
 "hadn't",
 'hasn',
 "hasn't",
 'haven',
 "haven't",
 'isn',
 "isn't",
 'ma',
 'mightn',
 "mightn't",
 'mustn',
 "mustn't",
 'needn',
 "needn't",
 'shan',
 "shan't",
 'shouldn',
 "shouldn't",
```

```
 'wasn',
 "wasn't",
 'weren',
 "weren't",
 'won',
 "won't",
 'wouldn',
 "wouldn't"]
```

Remove Stopwords & Punctuations from the Dataset:

In [45]:
```
# Create a method:
def stopword_removal(text):
    '''
    1. Remove punctuation
    2. Remove stopwords
    3. Return clean data
    '''
    nopunc = [mes for mes in text if mes not in string.punctuation]
    nopunc = ''.join(nopunc)

    return [word for word in nopunc.split() if word.lower() not in stopwords.w
ords('english')]
```

In [46]:
```
df.head()
```

Out[46]:

	Label	Message	Length
0	ham	Go until jurong point, crazy.. Available only ...	111
1	ham	Ok lar... Joking wif u oni...	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	155
3	ham	U dun say so early hor... U c already then say...	49
4	ham	Nah I don't think he goes to usf, he lives aro...	61

Stemming won't be helpful in this scenario due to presence of multiple shorthands. Hence now, we will move on to representing the text data in numerical manner for our Machine Learning model to interpret and predict

Vectorization: Word count from text:

In [48]:
```
from sklearn.feature_extraction.text import CountVectorizer
```

In [49]:
```
bag_of_words_transformer = CountVectorizer(analyzer=stopword_removal)
bag_of_words_transformer.fit(df['Message'])
```

Out[49]:
```
CountVectorizer(analyzer=<function stopword_removal at 0x0000020F6223C4C8>,
                binary=False, decode_error='strict', dtype=<class 'numpy.int64'>,
                encoding='utf-8', input='content', lowercase=True, max_df=1.0,
                max_features=None, min_df=1, ngram_range=(1, 1), preprocessor=None,
                stop_words=None, strip_accents=None,
                token_pattern='(?u)\\b\\w\\w+\\b', tokenizer=None, vocabulary=None)
```

In [51]:
```
# Checking vocabulary length for our dataset:
len(bag_of_words_transformer.vocabulary_)
```

Out[51]:
```
11425
```

Transformation: Sparse Matrix Creation:

In [52]:
```
messages_bag_of_words = bag_of_words_transformer.transform(df['Message'])
print('Shape of Sparse Matrix: ', messages_bag_of_words.shape)
```

```
Shape of Sparse Matrix:  (5572, 11425)
```

In [53]:
```
# Check the no of non zero occurences:
messages_bag_of_words.nnz
```

Out[53]:
```
50548
```

Perform TF-IDF Transformation:

In [54]:
```
from sklearn.feature_extraction.text import TfidfTransformer
tfidf_transformer = TfidfTransformer()
```

In [55]:
```
tfidf_transformer.fit(messages_bag_of_words)
messages_tfidf = tfidf_transformer.transform(messages_bag_of_words)
```

Split Dataset into Train & Test Split:

In [56]:
```
from sklearn.model_selection import train_test_split
msg_train, msg_test, label_train, label_test = train_test_split(df['Message'],
df['Label'], test_size=0.3)
```

Build Naive Bayes Classifier Model:

In [57]:
```
from sklearn.pipeline import Pipeline
from sklearn.naive_bayes import MultinomialNB
```

In [58]:
```
classifier = MultinomialNB()
```

In [59]:
```
pipeline = Pipeline(
[
    ('bagofwords',CountVectorizer(analyzer=stopword_removal)),
    ('tfidf',TfidfTransformer()),
    ('classifier',MultinomialNB())
])

pipeline.fit(msg_train, label_train)
```

Out[59]:
```
Pipeline(memory=None,
     steps=[('bagofwords', CountVectorizer(analyzer=<function stopword_remova
l at 0x0000020F6223C4C8>,
        binary=False, decode_error='strict', dtype=<class 'numpy.int64'>,
        encoding='utf-8', input='content', lowercase=True, max_df=1.0,
        max_features=None, min_df=1, ngram_range=(1, 1), ...f=False, use_idf=
True)), ('classifier', MultinomialNB(alpha=1.0, class_prior=None, fit_prior=T
rue))])
```

In [60]:
```
predictions = pipeline.predict(msg_test)
```

Model Evaluation Metrics:

In [61]:
```
from sklearn.metrics import classification_report, confusion_matrix
```

In [62]:
```
print(confusion_matrix(label_test,predictions))
```

```
[[1449    0]
 [  76  147]]
```

In [63]:
```
print(classification_report(label_test,predictions))
```

```
              precision    recall  f1-score   support

         ham       0.95      1.00      0.97      1449
        spam       1.00      0.66      0.79       223

   micro avg       0.95      0.95      0.95      1672
   macro avg       0.98      0.83      0.88      1672
weighted avg       0.96      0.95      0.95      1672
```