Gliezel Ann Pajarilla CMSC 197 - Machine Learning

In [ ]:
```
##### Standard Libraries #####
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
##### For preprocessing #####
import os
import re
import email
import codecs
##### For performance evaluation #####
import seaborn as sns
from sklearn import metrics
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import accuracy_score, recall_score, precision_score
```

(1) Initialize the main dataframe. The columns that are included are folder where the email is located, the email's filename, email message, and classification if ham or spam. Note: 0 if ham and 1 if spam.

In [ ]:
```
#### uploaded the files in the google drive and located the path

from google.colab import drive
drive.mount('/content/drive', force_remount = True)

data_path = '/content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/data/'
labels_path = '/content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/labels.txt'
stop_data_path = '/content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/stop_words.txt'
```

```
Mounted at /content/drive
```

In [ ]:
```
#### verified the content of the data directory 0 - 127

if os.path.exists(data_path):
    folders = os.listdir(data_path)
    sorted_folders = sorted(folders, key=lambda x: int(x))
    print('Files in the data directory:')
    for folder in sorted_folders:
        print(folder)
else:
    print(f'Directory {data_path} not found.')
```

```
Files in the data directory:
000
001
002
003
004
005
006
007
008
009
010
011
012
013
014
015
016
017
018
019
020
021
022
023
024
025
026
027
028
029
030
031
032
033
034
035
036
037
038
039
040
041
042
043
044
045
046
047
048
049
050
051
052
053
054
055
056
057
058
059
060
```

```
123
124
125
126
```

In [ ]:
```python
#### checked the content of the stop words

stop_df = pd.read_csv(stop_data_path, sep= ' ', header = None)
stop_words = set(stop_df[0].tolist())
stop_df.head(10)
stop_df.head(-10)
```

Out[ ]:

	0
0	a
1	able
2	about
3	above
4	abst
...	...
656	x
657	y
658	yes
659	yet
660	you

661 rows × 1 columns

(2) Turning the spam and ham into a numerical data

In [ ]:
```python
#### initializes the email dataframe

emails_df = pd.DataFrame(columns=['folder', 'file', 'message', 'classification'])
```

In [ ]:
```python
#### inititialize label dataframe
#### vectorized by turning ham = 0 and spam = 1

labels_df = pd.read_csv(labels_path, sep=' ', header=None, names=['classification', 'folder_fi
labels_df['classification'] = labels_df['classification'].apply(lambda x: 0 if x == 'ham' else
labels_df['folder'] = labels_df['folder_file'].apply(lambda x: x.replace('../data/', ''))
```

In [ ]:
```python
labels_df.head()
```

Out[ ]:

	classification	folder_file	folder
0	0	../data/000/000	000/000
1	1	../data/000/001	000/001
2	1	../data/000/002	000/002
3	0	../data/000/003	000/003
4	1	../data/000/004	000/004

In [ ]:

```
emails_df1 = labels_df[['classification', 'folder']]
emails_df1.head()
```

Out[ ]:

	classification	folder
0	0	000/000
1	1	000/001
2	1	000/002
3	0	000/003
4	1	000/004

In [ ]:

```
##### Inspecting the data with tot. no of ham and spam

emails_df1.groupby('classification').describe()
```

Out[ ]:

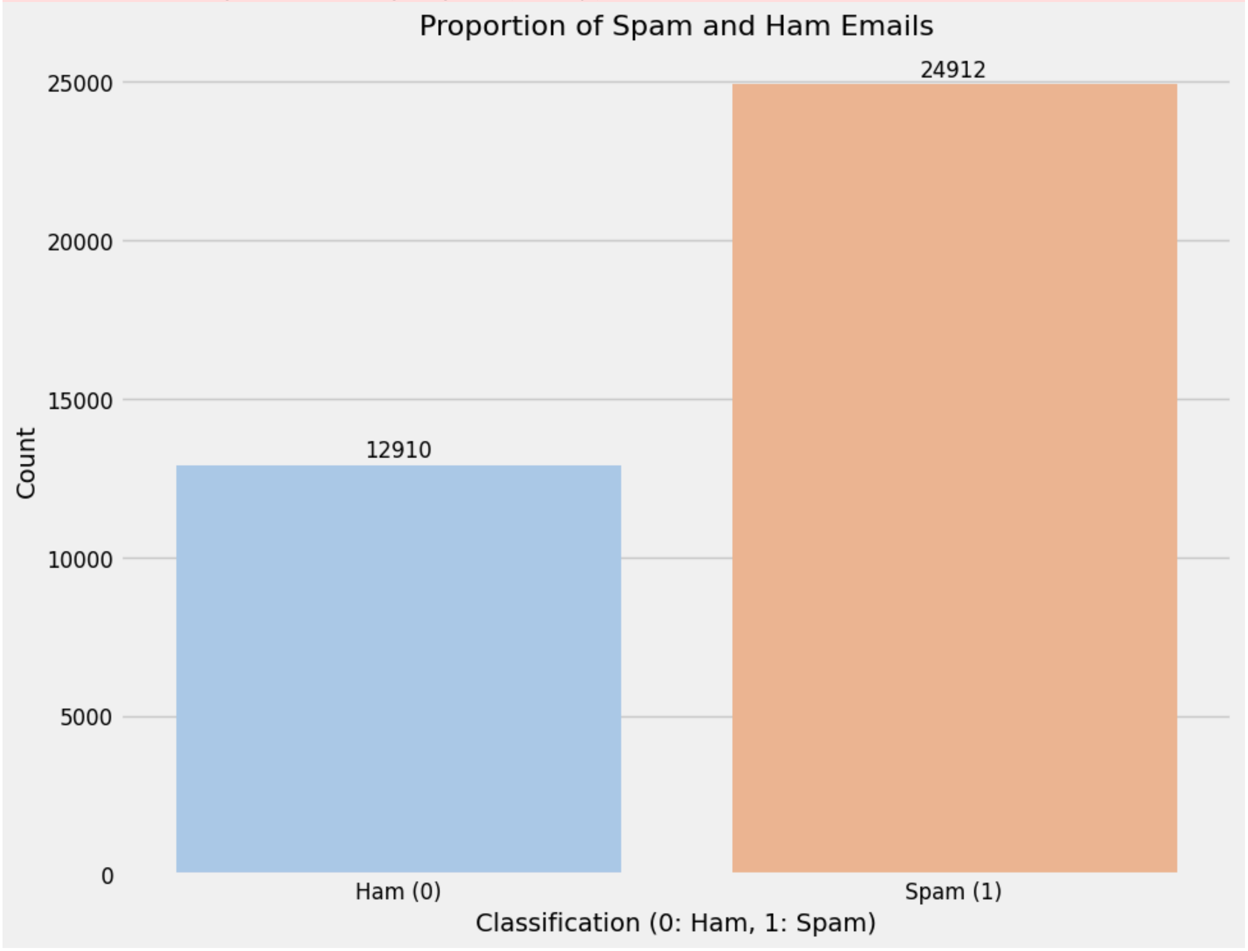
	folder			
	count	**unique**	**top**	**freq**
classification				
0	12910	12910	000/000	1
1	24912	24912	000/001	1

In [ ]:

```
#### plot visualizations for the no. of ham and spam
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt


plt.style.use('fivethirtyeight')
plt.figure(figsize=(10, 8))
sns.countplot(x='classification', data=emails_df1, palette= 'pastel')
plt.xlabel('Classification (0: Ham, 1: Spam)', fontsize=14)
plt.ylabel('Count', fontsize=14)

## calculating the counts
counts = emails_df1['classification'].value_counts().sort_index()

for index in counts.index:
    plt.text(index, counts[index] + 100, str(counts[index]), ha='center', va='bottom', fontsiz

## plot visualizations
```

```
plt.title('Proportion of Spam and Ham Emails', fontsize=16)
plt.xticks(ticks=[0, 1], labels=['Ham (0)', 'Spam (1)'], fontsize=12)
plt.yticks(fontsize=12)
plt.show()
proportions = counts / counts.sum()
print('Proportions of Classes:')
print(proportions)
```

```
<ipython-input-13-180ebca1b609>:9: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.0. Assign
the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.countplot(x='classification', data=emails_df1, palette= 'pastel')
/usr/local/lib/python3.10/dist-packages/seaborn/_base.py:949: FutureWarning: When grouping with
a length-1 list-like, you will need to pass a length-1 tuple to get_group in a future version o
f pandas. Pass `(name,)` instead of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
/usr/local/lib/python3.10/dist-packages/seaborn/_base.py:949: FutureWarning: When grouping with
a length-1 list-like, you will need to pass a length-1 tuple to get_group in a future version o
f pandas. Pass `(name,)` instead of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
```



```
Proportions of Classes:
classification
0    0.341336
1    0.658664
Name: count, dtype: float64
```

(3) Data Cleaning and Checking for the Missing Values

In [ ]:
```python
#### fuction for removing all unnecessary information
def messages_cleaning(message):
    punctuations = '!\'#$%&'()*+,-./:;<=>?@[\\]^_`{|}~'
    numbers = '0123456789'
    html_tags = re.compile('<.*?>')
    esc_chars = re.compile(r'\\[a-z][a-z]?[0-9]+')
    message = message.lower()
    message = re.sub(html_tags, '', message)
    message = message.translate(str.maketrans('', '', punctuations))
    message = message.translate(str.maketrans('', '', numbers))

    message = re.sub(esc_chars, '', message)
    message = re.sub(r'http\S+|www.\S+', '', message)

    words = message.split()
    words = [word for word in words if word not in stop_words]
    message = ''.join(words)
    return message
```

In [ ]:
```python
#### extracting original messages from the parsed email
def get_messages(parsed_email):
    message = ''
    if parsed_email.is_multipart():
        for part in parsed_email.walk():
            if part.get_content_type() == 'text/plain':
                message = part.get_payload(decode=True).decode(part.get_content_charset() or '
                break
    else:
        message = parsed_email.get_payload(decode=True).decode(parsed_email.get_content_charse
    return message.strip()
```

In [ ]:
```python
#### detect the character encoding of the email content.
import chardet

def get_email_charset(email_path):
    detector = chardet.UniversalDetector()
    with open(email_path, 'rb') as e_mail:
        for line in e_mail:
            detector.feed(line)
            if detector.done:
                break
    detector.close()
    return detector.result['encoding']
```

In [ ]:
```python
#### before going iterating through the files, check a test file if it is being preprocessed a
test_folder = '/content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/data/000'
test_file = '290'
test_path = os.path.join(test_folder, f'{test_file}')
charset = get_email_charset(test_path)

try:
    with open(test_path, 'r', encoding=charset) as e_mail:
        read_email = e_mail.read()
        parsed_email = email.message_from_string(read_email)

        ## extracting original message
        message = get_messages(parsed_email)
        print(f'Original message: {message}')

        ## processing the email message using the cleaning function
        processed_message = messages_cleaning(message)  # Correct function call
        print(f'Processed message: {processed_message}')

except Exception as e:
    print(f'Error occurred: {e}')
```

```
Original message: <html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=euc-kr">
<title></title>
<style type="text/css">
<!--
body {
        margin-left: 0px;
        margin-top: 0px;
        margin-right: 0px;
        margin-bottom: 0px;
}
-->
</style></head>

<body>
<table width="650" border="0" cellspacing="0" cellpadding="0">
<tr>
<td colspan="3"><img src="http://my.netian.com/~dhrwk1/spam3/1.jpg" width="650" height="243"></
td>
</tr>
<tr>
<td colspan="3"><img src="http://my.netian.com/~dhrwk1/spam3/2.jpg" width="650" height="187"></
td>
</tr>
<tr>
<td width="260"><img src="http://my.netian.com/~dhrwk1/spam3/3.jpg" width="260" height="66"></t
d>
<td width="144"><a href="http://%65%68%61%70%70%79%6c%6f%61%6e.%63%6f%6d/apply/apply_company01
_.loan?mCode444e048aaf542="><img src="http://my.netian.com/~dhrwk1/spam3/button_1.gif" width="1
44" height="66" border="0"></a></td>
<td width="246"><img src="http://my.netian.com/~dhrwk1/spam3/5.jpg" width="246" height="66"></t
d>
</tr>
<tr>
<td colspan="3"><img src="http://my.netian.com/~dhrwk1/spam3/6.jpg" width="650" height="59"></t
d>
</tr>
<tr>
<td colspan="3"><img src="http://my.netian.com/~dhrwk1/spam3/7.jpg" width="650" height="131"></
td>
</tr>
<tr>
<td><img src="http://my.netian.com/~dhrwk1/spam3/8.jpg" width="260" height="74"></td>
<td><a href="http://%65%68%61%70%70%79%6c%6f%61%6e.%63%6f%6d/apply/apply_card01_.loan?mCode=444
e048aaf542"><img src="http://my.netian.com/~dhrwk1/spam3/button_2.gif" width="144" height="74"
border="0"></a></td>
<td><img src="http://my.netian.com/~dhrwk1/spam3/10.jpg" width="246" height="74"></td>
</tr>
<tr>
<td colspan="3"><img src="http://my.netian.com/~dhrwk1/spam3/11.jpg" width="650" height="79"></
td>
</tr>
<tr>
<td colspan="3"><a href="http://%65%68%61%70%70%79%6c%6f%61%6e.%63%6f%6d/send/send.loan?mCode=4
44e048aaf542"><img src="http://my.netian.com/~dhrwk1/spam3/12.jpg" width="650" height="61" bord
er="0"></a></td>
</tr>
</table>
</body>
</html>
<img src='http://%65%68%61%70%70%79%6c%6f%61%6e.%63%6f%6d/action/mail_open_chk.loan?mCode=444e0
```

```
48aaf542' height=0 width=0>
Processed message: body marginleft px margintop px marginright px marginbottom px
```

In [ ]:
```
folders = os.listdir(data_path)
folders.sort(key=lambda x: int(x))
for folder in folders:
    files = os.listdir(os.path.join(data_path, folder))
    files.sort()
    for file in files:
        try:
            with open(os.path.join(data_path, folder, file), 'r', encoding='ISO-8859-1') as e_
                read_email = e_mail.read()
                parsed_email = email.message_from_string(read_email)
                message = get_messages(parsed_email)
                message = messages_cleaning(message)

                ## obtaining category based on df
                category_label = emails_df1[emails_df1['folder'] == f'{folder}/{file}']['class

                ## emails_df = pd.DataFrame(columns=['folder', 'file', 'message', 'classificat

                ## concatenate the data to emails_df
                emails_df = pd.concat([emails_df, pd.DataFrame([[folder, file, message, catego

        except Exception:
            continue

emails_df.head()
```

Out[ ]:

	folder	file	message	classification
0	000	000	mailing list queried weeks ago running set arc...	0
1	000	001	luxury watches buy rolex rolex cartier bvlgari...	1
2	000	002	academic qualifications prestigious nonacc red...	1
3	000	003	greetings verify subscription planfans list ch...	0
4	000	004	chauncey conferred luscious continued tonsillitis	1

In [ ]:
```
emails_df.head(-20)
```

Out[ ]:

	folder	file	message	classification
0	000	000	mailing list queried weeks ago running set arc...	0
1	000	001	luxury watches buy rolex rolex cartier bvlgari...	1
2	000	002	academic qualifications prestigious nonacc red...	1
3	000	003	greetings verify subscription planfans list ch...	0
4	000	004	chauncey conferred luscious continued tonsillitis	1
...	...	...	...	...
35274	125	294	ra side forest streams springs road mirkwood d...	1
35275	125	295		1
35276	125	297	spruce education touching book will real piece...	1
35277	125	298	ra whistling voices released grasses hissed ta...	1
35278	125	299	txtadd	1

35279 rows × 4 columns

In [ ]:

```
#### preprocessed_emails.csv are exported inside a folder
from google.colab import drive
drive.mount('/content/drive', force_remount=True)

preprocessed_folder = '/content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/preprocess
if not os.path.exists(preprocessed_folder):
    os.makedirs(preprocessed_folder)


## save to csv
emails_df.to_csv(os.path.join(preprocessed_folder, 'preprocessed_emails.csv'), index=False, es

print(f'Preprocessed emails path: {preprocessed_folder}/preprocessed_emails.csv')
```

```
Mounted at /content/drive
Preprocessed emails path: /content/drive/My Drive/FOURTH YEAR/Subjects/CMSC 197/trec06/preproce
ssed_data/preprocessed_emails.csv
```