Group name: **Arjohi**

Name: **Hiten Chadha**

Email: **hitenchadha1995@gmail.com**

Country: **Denmark**

College/Company: **Technical University of Denmark**

Specialization: **NLP**

GitHub repository link:

Problem description:

The term hate speech is understood as any type of verbal, written or behavioural communication that attacks or uses derogatory or discriminatory language against a person or group based on what they are, in other words, based on their religion, ethnicity, nationality, race, colour, ancestry, sex or another identity factor. In this problem, We will take you through a hate speech detection model with Machine Learning and Python.

Hate Speech Detection is generally a task of sentiment classification. So for training, a model that can classify hate speech from a certain piece of text can be achieved by training it on a data that is generally used to classify sentiments. So for the task of hate speech detection model, We will use the Twitter tweets to identify tweets containing Hate speech.

We will analyze a dataset CSV file from Kaggle containing 31,935 tweets. The dataset was heavily skewed with 93% of tweets or 29,695 tweets containing nonhate labeled Twitter data and 7% or 2,240 tweets containing hate-labeled Twitter data. We will try different classification algorithms after the preprocessing and data cleaning steps.

Final recommendation after EDA: We have 31962 and 17197 tweets in the training and test data set respectively. As it is quite complex data, there is scope to use multiple models like XGB, Bert along with other classifiers.

Importing the libraries

```
import numpy as np
import pandas as pd
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.pipeline import Pipeline
from sklearn.model_selection import train_test_split, GridSearchCV
from sklearn.metrics import confusion_matrix,f1_score
from sklearn.naive_bayes import MultinomialNB
from sklearn.ensemble import RandomForestClassifier


import os

import seaborn as sns
import re
import matplotlib.pyplot as plt
import missingno as ms
% matplotlib inline

import seaborn as sns
from plotly.offline import download_plotlyjs, init_notebook_mode,
plot, iplot
```

Importing the dataset

```
training_data = pd.read_csv('train_E6oV3lV.csv')
testing_data = pd.read_csv('test_tweets_anuFYb8.csv')

print("Training Set:"% training_data.columns, training_data.shape)
print("Test Set:"% testing_data.columns, testing_data.shape)

Training Set: (31962, 3)
Test Set: (17197, 2)
```

Taking care of missing data

```
print('Train_Set -----')
print(training_data.isnull().sum())
print('Test_set -----')
print(testing_data.isnull().sum())
training_data.head()

Train_Set -----
id       0
label    0
tweet    0
dtype: int64
Test_set -----
id       0
tweet    0
dtype: int64
```

```
   id  label                                              tweet
0   1      0   @user when a father is dysfunctional and is s...
1   2      0  @user @user thanks for #lyft credit i can't us...
2   3      0                                bihday your majesty
3   4      0  #model   i love u take with u all the time in ...
4   5      0             factsguide: society now    #motivation
```

```
training_data['label'].value_counts() #counting no of positives and negatives
```

```
0    29720
1     2242
Name: label, dtype: int64
```

Text Cleaning

```
import re
from sklearn.utils import resample
import nltk
from plotly.offline import download_plotlyjs, init_notebook_mode, plot, iplot
from wordcloud import WordCloud, STOPWORDS

from nltk.corpus import stopwords
nltk.download('stopwords')
nltk.download('wordnet')
nltk.download('omw-1.4')

eng_stops = set(stopwords.words("english"))
from nltk.stem import WordNetLemmatizer
lemmatizer = WordNetLemmatizer()

def cleandata(review_text):
    # remove all the special characters
    new_review_text = re.sub(r"(@[A-Za-z0-9]+)|([^0-9A-Za-z \t])|(\w+:\/\/\S+)|^rt|http.+?", "", review_text)
    # convert all letters to lower case
    words = new_review_text.lower().split()
    # remove stop words
    words = [w for w in words if not w in eng_stops]
    # lemmatizer
    words = [lemmatizer.lemmatize(word) for word in words]
    # join all words back to text
    return (" ".join(words))

training_data['clean_tweet']=training_data['tweet'].apply(lambda x: cleandata(x))
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data] Downloading package omw-1.4 to /root/nltk_data...
```

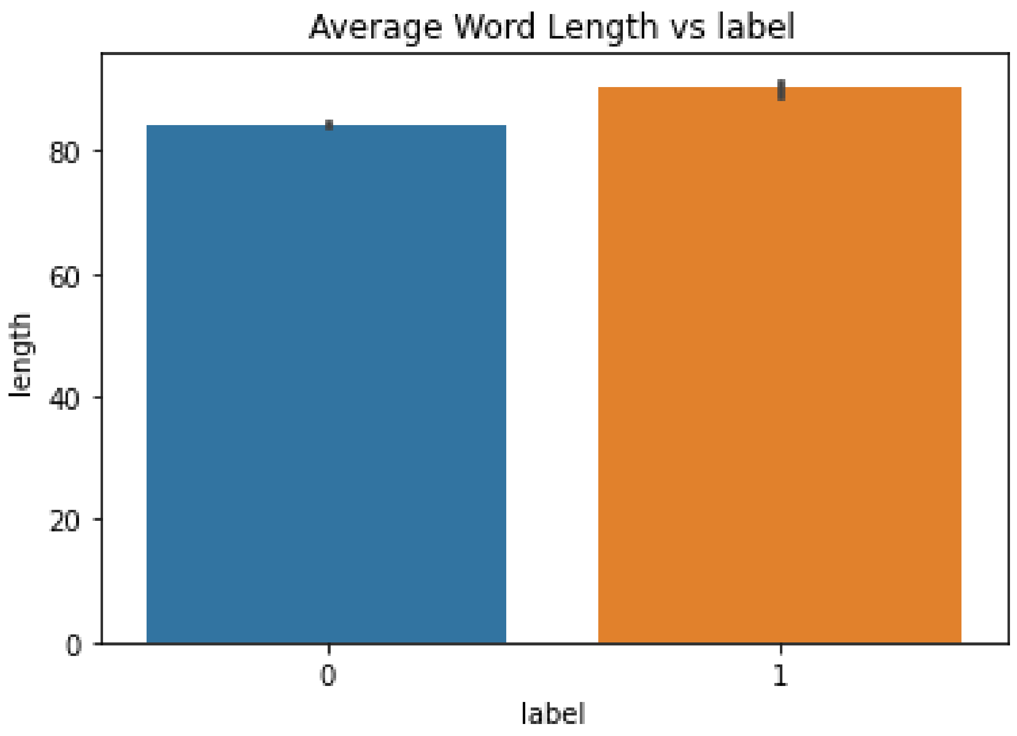
```
training_data.head()
```

```
   id  label                                              tweet  \
0   1      0   @user when a father is dysfunctional and is s...
1   2      0  @user @user thanks for #lyft credit i can't us...
2   3      0                                bihday your majesty
3   4      0  #model   i love u take with u all the time in ...
4   5      0             factsguide: society now    #motivation

                                         clean_tweet
0  father dysfunctional selfish drag kid dysfunct...
1  thanks lyft credit cant use cause dont offer w...
2                                     bihday majesty
3                          model love u take u time ur
4                        factsguide society motivation
```

EDA

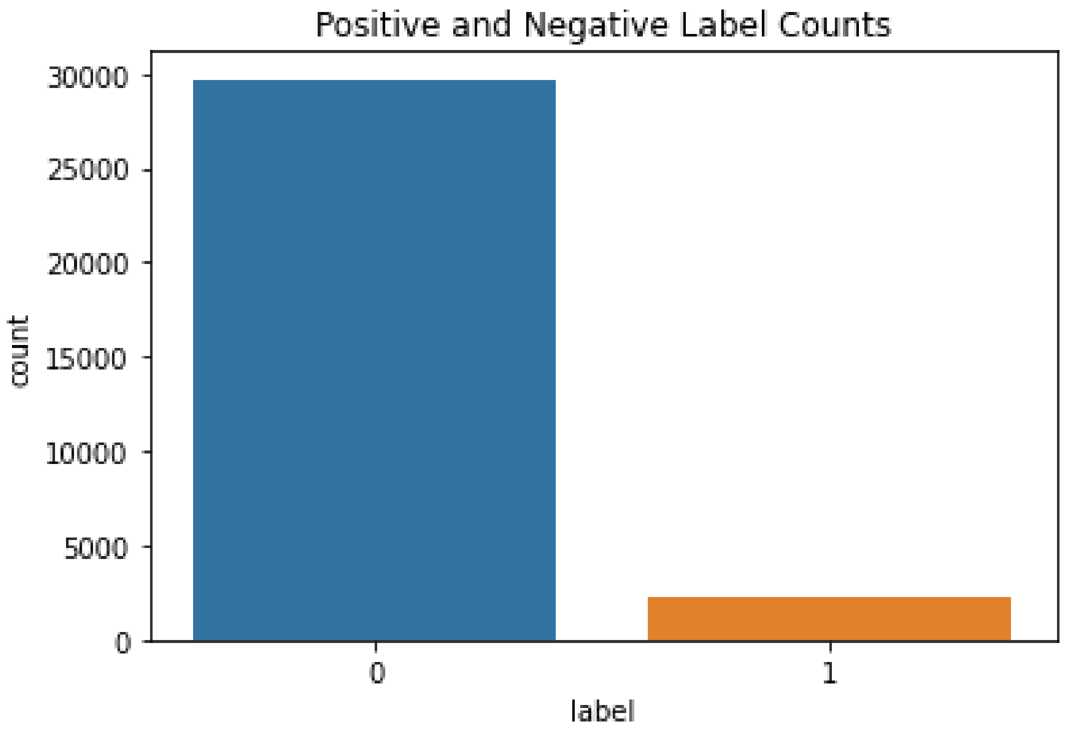
```
training_data['length'] = training_data['tweet'].apply(len)
fig1 = sns.barplot('label','length',data = training_data)
plt.title('Average Word Length vs label')
plot = fig1.get_figure()
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43:
FutureWarning:

Pass the following variables as 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.
```



```
fig2 = sns.countplot(x= 'label',data = training_data)
plt.title('Positive and Negative Label Counts')
```

```
Text(0.5, 1.0, 'Positive and Negative Label Counts')
```

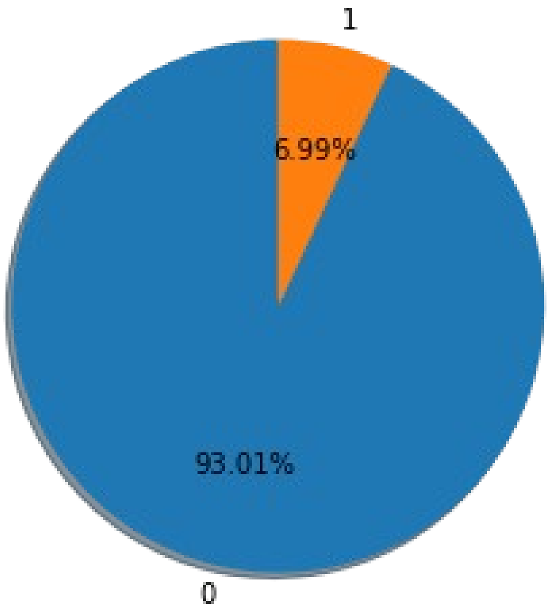


```
from wordcloud import WordCloud
import matplotlib.pyplot as plt

fig, axs = plt.subplots(1,2 , figsize=(16,8))
text_pos = " ".join(training_data['tweet'][training_data.label == 0])
text_neg = " ".join(training_data['tweet'][training_data.label == 1])
train_cloud_pos = WordCloud(collocations = False, background_color =
'white').generate(text_pos)
train_cloud_neg = WordCloud(collocations = False, background_color =
'black').generate(text_neg)
axs[0].imshow(train_cloud_pos, interpolation='bilinear')
axs[0].axis('off')
axs[0].set_title('Non-Hate Comments')
axs[1].imshow(train_cloud_neg, interpolation='bilinear')
axs[1].axis('off')
axs[1].set_title('Hate Comments')

plt.show()
```

Non-Hate Comments
Hate Comments

```
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer

train_df, test_df =  train_test_split(training_data, test_size = 0.2,
random_state = 42)

vectorizer = TfidfVectorizer()
train_tfidf_model = vectorizer.fit_transform(train_df.clean_tweet)
test_tfidf_model = vectorizer.transform(test_df.clean_tweet)
train_tfidf = pd.DataFrame(train_tfidf_model)

def createPieChartFor(t_df):
    Lst = 100*t_df.value_counts()/len(t_df)

    # set data for pie chart
    labels = t_df.value_counts().index.values
    sizes =  Lst

    # set labels
    fig1, ax1 = plt.subplots()
    ax1.pie(sizes, labels=labels, autopct='%1.2f%%', shadow=True,
startangle=90)
```

```
    ax1.axis('equal')  # Equal aspect ratio ensures that pie is drawn
as a circle.
    plt.show()


# to account for data imbalance

createPieChartFor(train_df.label)

print(train_df.label.value_counts())
```



```
0    23783
1     1786
Name: label, dtype: int64
```

```
#Downsample

count_hate = train_df[train_df['label'] == 1]['clean_tweet'].count()
df_non_hate_speech = train_df[train_df['label'] == 0]
df_hate_speech = train_df[train_df['label'] == 1]
df_hate_speech_undersample = df_non_hate_speech.sample(count_hate,
replace=True)
train_df_undersampled = pd.concat([df_hate_speech,
df_hate_speech_undersample], axis=0)

print('Random under-sampling:')
print(train_df_undersampled['label'].value_counts())
```

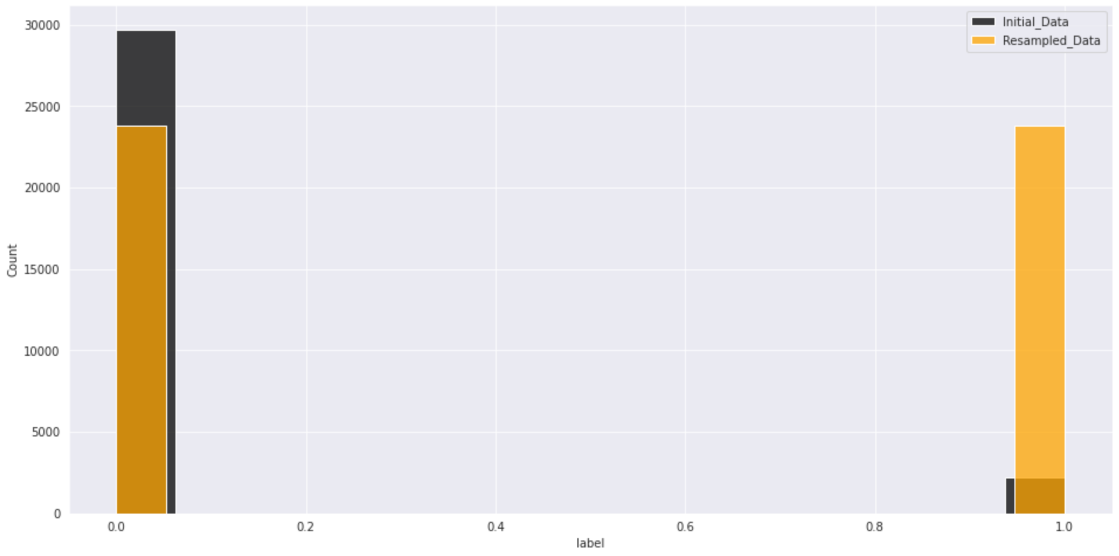
```
Random under-sampling:
1    1786
```

```
0    1786
Name: label, dtype: int64
```

```
#Upsample

count_non_hate = train_df[train_df['label'] == 0]
['clean_tweet'].count()
df_hate_speech = train_df[train_df['label'] == 1]
df_non_hate_speech = train_df[train_df['label'] == 0]
df_hate_speech_oversample = df_hate_speech.sample(count_non_hate,
replace=True)
train_df_oversampled = pd.concat([df_non_hate_speech,
df_hate_speech_oversample], axis=0)

print('Random over-sampling:')
print(train_df_oversampled['label'].value_counts())
```

```
Random over-sampling:
0    23783
1    23783
Name: label, dtype: int64
```

```
import seaborn as sns
import matplotlib.pyplot as plt

plt.figure(figsize=(16,8))
sns.set_style('darkgrid')
sns.histplot(data = training_data['label'], color='black',
legend=True)
sns.histplot(data = train_df_oversampled['label'], color = 'orange',
legend=True)
plt.legend(['Initial_Data', 'Resampled_Data'])
plt.show()
```


Initial_Data
Resampled_Data
Count
label