Installing and Importing Packages

In [ ]:

```
!pip install stop-words
!pip install nltk
!pip install scikit-multilearn
!pip install contractions
```

In [ ]:

```
import pandas as pd;
import numpy as np;
import matplotlib.pyplot as plt;
import seaborn as sns;
import nltk
import copy
import re
import contractions
from scipy.sparse import csr_matrix
from sklearn.feature_extraction.text import CountVectorizer, TfidfTransformer, TfidfVecto
rizer
from skmultilearn.problem_transform import BinaryRelevance
from sklearn.naive_bayes import MultinomialNB, GaussianNB
from sklearn.multiclass import OneVsRestClassifier
from sklearn.ensemble import VotingClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.svm import LinearSVC, SVC
from sklearn.pipeline import Pipeline
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')
nltk.download('averaged_perceptron_tagger')
from nltk import word_tokenize, pos_tag;
from nltk.corpus import stopwords, wordnet;
from nltk.tokenize import WhitespaceTokenizer
nltk.download('omw-1.4')
#from stop_words import get_stop_words
from nltk.stem import WordNetLemmatizer
from sklearn.metrics import roc_auc_score
from sklearn.metrics import accuracy_score
```

In [3]:

```
from google.colab import drive
 drive.mount('/content/drive/')
```

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

Initial data analysis

In [4]:

```
train = pd.read_csv('/content/drive/MyDrive/ML_Project/train.csv')
test = pd.read_csv('/content/drive/MyDrive/ML_Project/test.csv')
#train.head()
test.head()
```

Out[4]:

	id	text
0	e0ae9d9474a5689a5791	in an interview before his execution
1	b64a191301cad4f11287	He knew what he was doing. The below posts are...

	id	text
2	5e1953d9ae04bdc66408	Zzzzzzz... youre a real bore. Now go bore some...
3	23128f98196c8e8f7b90	"\n\nYet, it remains confusion because the 910...
4	2d3f1254f71472bf2b78	I was referring to them losing interest in van...

In [5]:

```
train[train.duplicated(['text'])] #To find duplicated data; Written by; Dewanshi Dewan
```

Out[5]:

id	text	harsh	extremely_harsh	vulgar	threatening	disrespect	targeted_hate

In [6]:

```
train.describe() #Done together
```

Out[6]:

	harsh	extremely_harsh	vulgar	threatening	disrespect	targeted_hate
count	89359.000000	89359.000000	89359.000000	89359.000000	89359.000000	89359.000000
mean	0.095782	0.010262	0.053067	0.002999	0.049150	0.008975
std	0.294294	0.100781	0.224168	0.054683	0.216182	0.094311
min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
50%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
75%	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
max	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

In [7]:

```
train.isna().sum()   # To find the number of null values
```

Out[7]:

```
id                 0
text               0
harsh              0
extremely_harsh    0
vulgar             0
threatening        0
disrespect         0
targeted_hate      0
dtype: int64
```

In [8]:

```
output = train.iloc[:, 2:8]    #Splitting the data into input and output data.
input = train.iloc[:, 0:2]

testInput = test.iloc[:, 0:2]
```

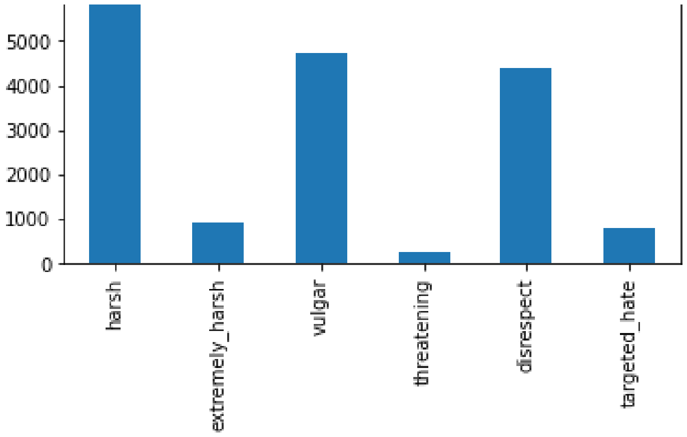
In [9]:

```
output.sum(axis=0).plot.bar()    #Plot for the distribution of data points for each category
```

Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f619ea1ee50>
```

8000
7000
6000



Test-train split

In [10]:

```
#Performing the train-test split. For the sake of testing the model, we used 80-20 split.
X_train = input.iloc[:71451]
X_test = input.iloc[71451:]
Y_train = output.iloc[:71451]
Y_test = output.iloc[71451:]
# X_test = testInput[:] #For running it on the actual test dataset.
```

Preprocessing

In [11]:

```
#Dry implementation of finding the POS tag first and then lemmatizing the word.

# text = "HI bitches I am laughing."
# tag = pos_tag(["detailed"])
# tag = tag[0][1]
# print(tag)
# tag_to_map = {"JJ": wordnet.ADJ,
#               "NN": wordnet.NOUN,
#               "VBG": wordnet.VERB,
#               "RB": wordnet.ADV}
# lemma = WordNetLemmatizer()
# lemma.lemmatize("detailed", tag_to_map.get(tag))
```

In [12]:

```
def summarizer(text): #Takes text as a comment and finds the summary of the text and returns the summary as tokens.
  def tokenize(text):
    return word_tokenize(text)    #To tokenize the words.
  def removeURL(text):
    return re.sub(r"http\S+", "", text)
  def toLower(text):               #To convert all words into lowercase
    return [text.lower() for text in text]
  def removePunc(text):             #To remove punctuation marks from the text.
    w = []
    for word in text:
      if(word.isalnum()):
        w.append(word)
    return w
  def modify(text):   #Remove words of length< 2
    w = []
    for word in text:
      if(len(word) > 2):
        w.append(word)
    return w
  def stopwordRem(text):            #To remove stopwords from the text.
    stopword = stopwords.words('english')
    text = list(filter(lambda word: word not in stopword, text))
    return text
  def remove_numbers(text):
      pattern = r'[^a-zA-z.,!?/:;\"\'\s]'
      return re.sub(pattern, '', text)
  def lemmatize(text):          #To lemmatize the text using the parts of speech tag.
    def PartOfSpeechTag(text):
      tag = pos_tag([text])
      pos = tag[0][1]
      tag_to_map = {"JJ": wordnet.ADJ,
                  "NN": wordnet.NOUN,
                  "VBG": wordnet.VERB,
                  "RB": wordnet.ADV}
      return tag_to_map.get(pos, wordnet.NOUN)
    lemma = WordNetLemmatizer()
    lemmatized_text = ""
    for w in text:
      pos = PartOfSpeechTag(w)
      lemmatized_text += lemma.lemmatize(w, pos) + " "
    return lemmatized_text

  text = removeURL(text)
  text = remove_numbers(text)
  text = tokenize(text)
  # text = modify(text)
  text = toLower(text)
  text = removePunc(text)
  text = stopwordRem(text)
  text = lemmatize(text)
  return text
```

In [ ]:

```
preprocessed_comments = []  #Calling the summarizer function and passing the text into th
e summarizer for training comments
for i in range(len(X_train)):
  if(i%1000 == 1):
    print(i)
  text = X_train._get_value(i, 'text', takeable=False)
  preprocessed_comments.append(summarizer(text))
preprocessed_comments
```

In [ ]:

```
preprocessed_test_comments = [] ##alling the summarizer function and passing the text int
o the summarizer for test comments
for i in range(len(X_test)):
  if((i%1000) == 1):
    print(i)
  text = X_test._get_value(i+71451, 'text', takeable=False)
  preprocessed_test_comments.append(summarizer(text))
preprocessed_test_comments
```

Training the model

In [15]:

```
Vectorizer = TfidfVectorizer() #Takes words can returns a matrix represnting the text in
terms of the occurences and frequencies of the vocabulary of the whole dataset.
X_train_TFrep = Vectorizer.fit_transform(preprocessed_comments)
X_test_TFrep = Vectorizer.transform(preprocessed_test_comments)
X_test_TFrep.shape
```

Out[15]:

```
(17908, 100993)
```

Testing and evaluating the model

In [16]:

```
#OVR is a multiclass classifier. It creates a classifier for each column like for eg: [harsh, rest] and LR is used for each classifier to find the predicted probabilities.
classifier = OneVsRestClassifier(LogisticRegression(solver = 'saga'))
categories = ["harsh", "extremely_harsh", "vulgar", "disrespect", "threatening", "targeted_hate"]
answer = pd.DataFrame()
classifier.fit(X_train_TFrep, Y_train)
probability = classifier.predict_proba(X_test_TFrep)
probability = np.round_(probability, decimals = 2)
prediction = classifier.predict(X_test_TFrep)
print('Test accuracy is {}'.format(roc_auc_score(Y_test, prediction)))
#After fitting and predicting the data, we dump the outputs into a .csv
# print(probability)
prediction.shape
df = pd.DataFrame()
df = X_test.iloc[:, 0:1]
df2 = pd.DataFrame(probability)
df = pd.concat([df, df2], axis=1, ignore_index=True)
# df.info()
df.to_csv("data1.csv")
# df.head()
```

```
Test accuracy is 0.6893262275451937
```

We have implemented the same OVR classifier but with multinomial NB to predict the probabilities

In [17]:

```
classifier2 = OneVsRestClassifier(MultinomialNB(fit_prior = True, class_prior = None))
categories = ["harsh", "extremely_harsh", "vulgar", "disrespect", "threatening", "targeted_hate"]

classifier2.fit(X_train_TFrep, Y_train)
# compute the testing accuracy
prediction = classifier2.predict(X_test_TFrep)
print('Test accuracy is {}'.format(roc_auc_score(Y_test, prediction)))
print(prediction)
```

```
Test accuracy is 0.5287017167637192
[[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]]
```

An ensemble of both the models implemented above.

In [18]:

```
ensemble = VotingClassifier(estimators =[('lr', classifier), ('NB_ovr', classifier2)],voting='soft')
categories = ["harsh", "extremely_harsh", "vulgar", "disrespect", "threatening", "targeted_hate"]
for category in categories:
  ensemble.fit(X_train_TFrep, Y_train[category])
  a = ensemble.predict_proba(X_test_TFrep)
  prediction = ensemble.predict(X_test_TFrep)
  print("for category: " + category + " " + str(roc_auc_score(Y_test[category], prediction)))
#create our voting classifier, inputting our models
# ensemble = VotingClassifier(estimators, voting='hard')
```

```
for category: harsh 0.6885307034203868
for category: extremely_harsh 0.5
for category: vulgar 0.6871354520715647
for category: disrespect 0.5958839231386318
for category: threatening 0.5
for category: targeted_hate 0.5029411764705882
for category: targeted_hate 0.5029411764705882
```