```
import nltk
nltk.download('stopwords')
```

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

```
import pandas as pd
import numpy as np
import re
import seaborn as sns
import matplotlib.pyplot as plt
from matplotlib import style
style.use('ggplot')
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
from nltk.corpus import stopwords
stop_words = set(stopwords.words('english'))
from wordcloud import WordCloud
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix, ConfusionMatrixDisplay
```

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

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", force_remount=True).
```

```
tweet_df = pd.read_csv("/content/drive/MyDrive/train.csv")
tweet_df.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

Next steps: Generate code with `tweet_df` View recommended plots

```
tweet_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 31962 entries, 0 to 31961
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   id      31962 non-null  int64
```

```
      1   label   31962 non-null  int64
      2   tweet   31962 non-null  object
     dtypes: int64(2), object(1)
     memory usage: 749.2+ KB
```

```
# printing random tweets
print(tweet_df['tweet'].iloc[0],"\n")
print(tweet_df['tweet'].iloc[1],"\n")
print(tweet_df['tweet'].iloc[2],"\n")
print(tweet_df['tweet'].iloc[3],"\n")
print(tweet_df['tweet'].iloc[4],"\n")
```

```
      @user when a father is dysfunctional and is so selfish he drags his kids into his dysfunction.   #run

     @user @user thanks for #lyft credit i can't use cause they don't offer wheelchair vans in pdx.    #disapointed #getthanked

       bihday your majesty

     #model   i love u take with u all the time in urð±!!! ðððð¦ð¦ð¦

      factsguide: society now    #motivation
```

```
def data_processing(tweet):
    tweet = tweet.lower()
    tweet = re.sub(r"https\S+|www\S+http\S+", '', tweet, flags = re.MULTILINE)
    tweet = re.sub(r'\@w+|\#','', tweet)
    tweet = re.sub(r'[^\w\s]','',tweet)
    tweet = re.sub(r'ð','',tweet)
    tweet_tokens = word_tokenize(tweet)
    filtered_tweets = [w for w in tweet_tokens if not w in stop_words]
    return " ".join(filtered_tweets)
```

```
import nltk
nltk.download('punkt')
```

```
     [nltk_data] Downloading package punkt to /root/nltk_data...
     [nltk_data]   Unzipping tokenizers/punkt.zip.
     True
```

```
tweet_df.tweet = tweet_df['tweet'].apply(data_processing)
```

```
tweet_df = tweet_df.drop_duplicates('tweet')
```

```
lemmatizer = WordNetLemmatizer()
def lemmatizing(data):
    tweet = [lemmatizer.lemmatize(word) for word in data]
    return data
```

```
import nltk
nltk.download('wordnet')
```

```
     [nltk_data] Downloading package wordnet to /root/nltk_data...
```

```
True
```

```
tweet_df['tweet'] = tweet_df['tweet'].apply(lambda x: lemmatizing(x))
```

```
# printing the data to see the effect of preprocessing
print(tweet_df['tweet'].iloc[0],"\n")
print(tweet_df['tweet'].iloc[1],"\n")
print(tweet_df['tweet'].iloc[2],"\n")
print(tweet_df['tweet'].iloc[3],"\n")
print(tweet_df['tweet'].iloc[4],"\n")
```

```
user father dysfunctional selfish drags kids dysfunction run

user user thanks lyft credit cant use cause dont offer wheelchair vans pdx disapointed getthanked

bihday majesty

model love u take u time ur

factsguide society motivation
```

```
tweet_df.info()
```

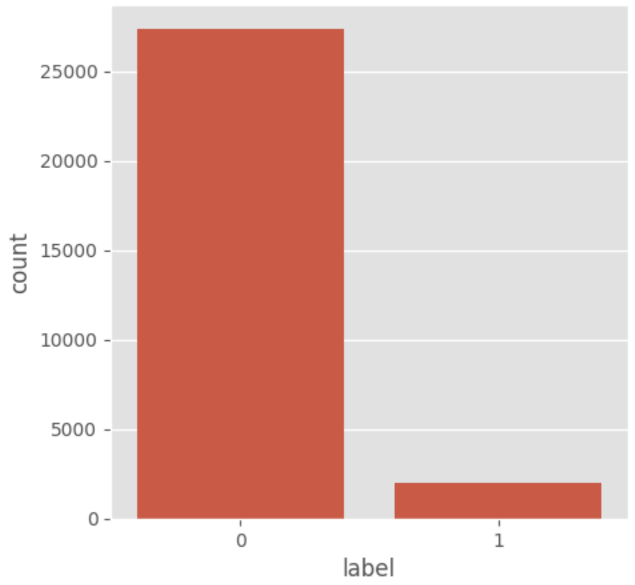
```
<class 'pandas.core.frame.DataFrame'>
Index: 29345 entries, 0 to 31961
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   id      29345 non-null  int64
 1   label   29345 non-null  int64
 2   tweet   29345 non-null  object
dtypes: int64(2), object(1)
memory usage: 917.0+ KB
```

```
tweet_df['label'].value_counts()
```

```
label
0    27352
1     1993
Name: count, dtype: int64
```

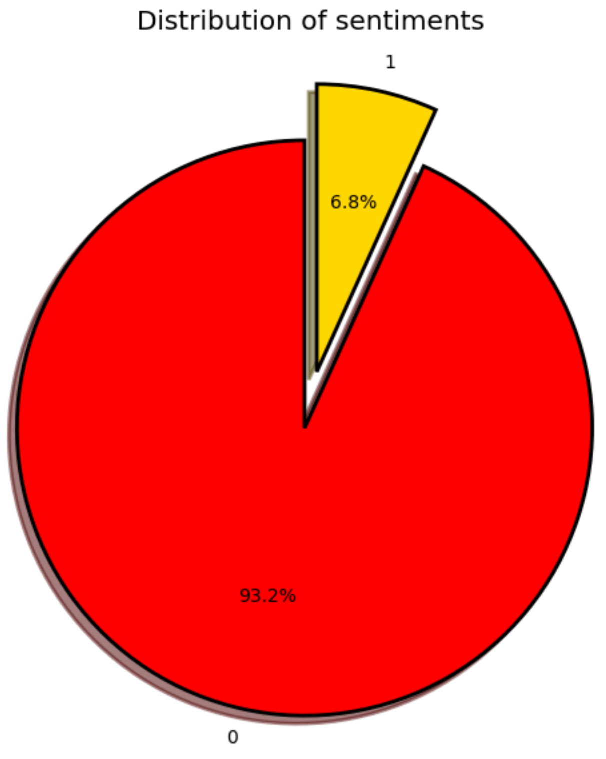
```
fig = plt.figure(figsize=(5,5))
sns.countplot(x='label', data = tweet_df)
```

```
<Axes: xlabel='label', ylabel='count'>
```



```
fig = plt.figure(figsize=(7,7))
colors = ("red", "gold")
wp = {'linewidth':2, 'edgecolor':"black"}
tags = tweet_df['label'].value_counts()
explode = (0.1, 0.1)
tags.plot(kind='pie',autopct = '%1.1f%%', shadow=True, colors = colors, startangle =90,
         wedgeprops = wp, explode = explode, label='')
plt.title('Distribution of sentiments')
```

```
Text(0.5, 1.0, 'Distribution of sentiments')
```



```
non_hate_tweets = tweet_df[tweet_df.label == 0]
non_hate_tweets.head()
```

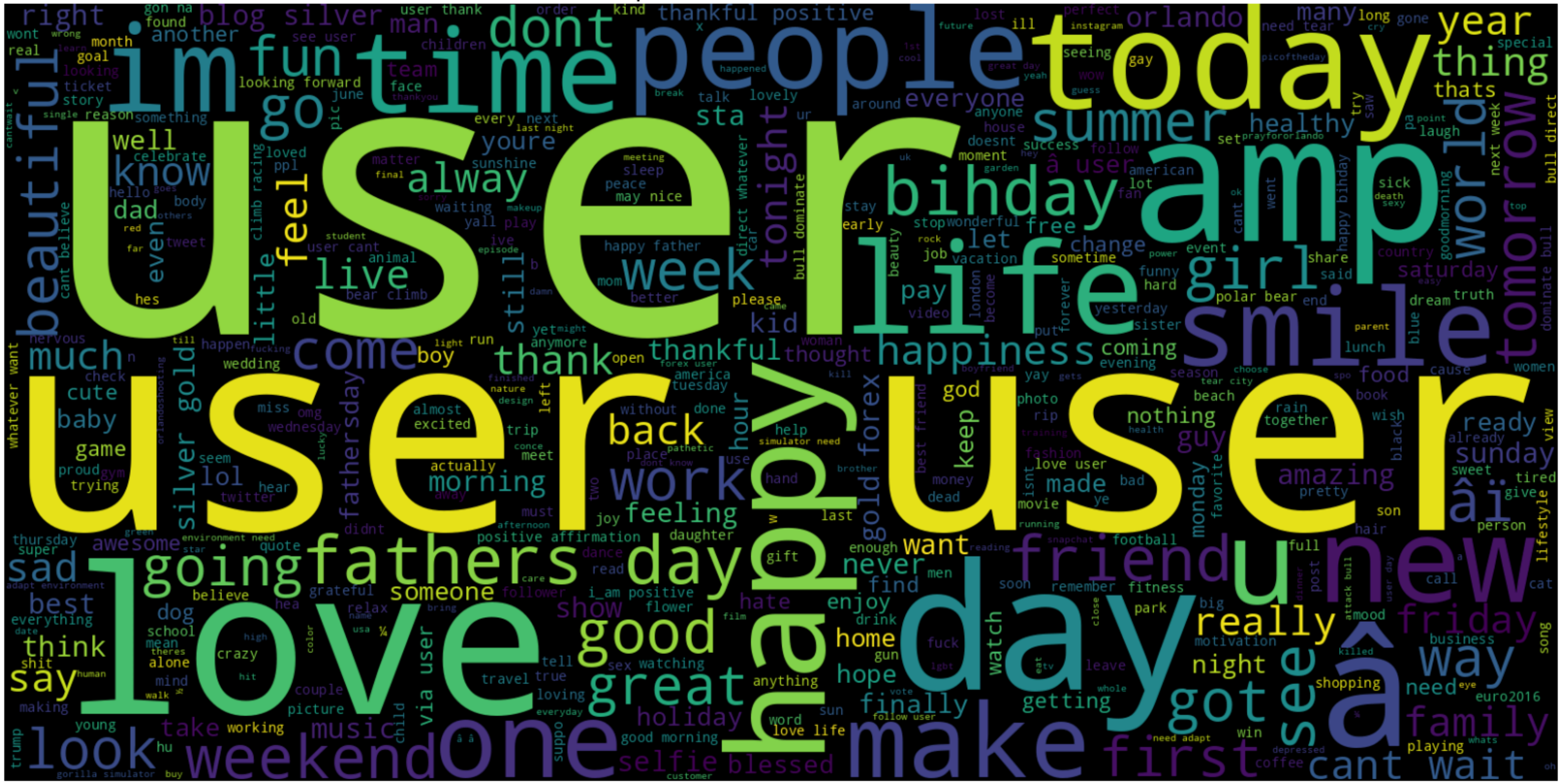
	id	label	tweet
0	1	0	user father dysfunctional selfish drags kids d...
1	2	0	user user thanks lyft credit cant use cause do...
2	3	0	bihday majesty
3	4	0	model love u take u time ur
4	5	0	factsguide society motivation

Next steps: Generate code with non_hate_tweets View recommended plots

```
text = ' '.join([word for word in non_hate_tweets['tweet']])
plt.figure(figsize=(20,15), facecolor='None')
wordcloud = WordCloud(max_words=500, width=1600, height=800).generate(text)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Most frequent words in non hate tweets', fontsize = 19)
```

```
    plt.show()
```

Most frequent words in non hate tweets



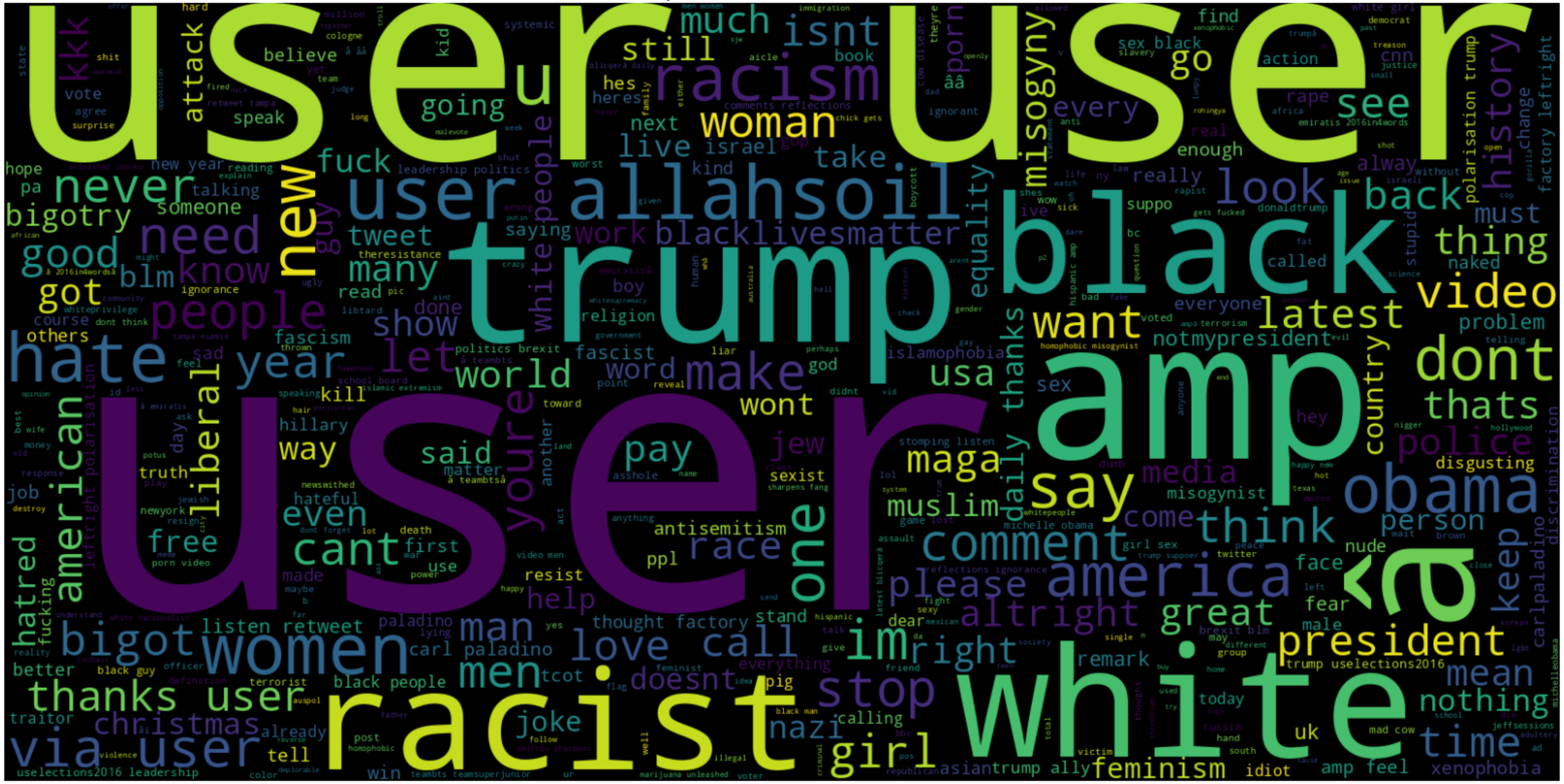
```
neg_tweets = tweet_df[tweet_df.label == 1]
neg_tweets.head()
```

	id	label	tweet
13	14	1	user cnn calls michigan middle school build wa...
14	15	1	comment australia opkillingbay seashepherd hel...
17	18	1	retweet agree
23	24	1	user user lumpy says prove lumpy
34	35	1	unbelievable 21st century wed need something l...

Next steps: Generate code with `neg_tweets` View recommended plots

```
text = ' '.join([word for word in neg_tweets['tweet']])
plt.figure(figsize=(20,15), facecolor='None')
wordcloud = WordCloud(max_words=500, width=1600, height=800).generate(text)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Most frequent words in hate tweets', fontsize = 19)
plt.show()
```

Most frequent words in hate tweets



```
vect = TfidfVectorizer(ngram_range=(1,2)).fit(tweet_df['tweet'])
```

```
feature_names = vect.get_feature_names_out()
print("Number of features: {}\n".format(len(feature_names)))
print("First 20 features: \n{}".format(feature_names[:20]))
```

```
    Number of features: 208579

    First 20 features:
    ['0000001' '0000001 polluting' '00027' '00027 photooftheday' '001' '0035'
     '00h30' '01' '01 4995' '01 7900' '01 blog' '01 croatia' '01 may'
```

```
       '01 shopalyssas' '0115' '0115 8599968' '0161' '0161 manny' '019'
       '019 previous']
```

```
vect = TfidfVectorizer(ngram_range=(1,3)).fit(tweet_df['tweet'])
```

```
feature_names = vect.get_feature_names_out()
print("Number of features: {}\n".format(len(feature_names)))
print("First 20 features: \n{}".format(feature_names[:20]))
```

```
Number of features: 380305

First 20 features:
['0000001' '0000001 polluting' '0000001 polluting niger' '00027'
 '00027 photooftheday' '00027 photooftheday music' '001' '0035' '00h30'
 '01' '01 4995' '01 4995 rustic' '01 7900' '01 7900 shopalyssas' '01 blog'
 '01 blog silver' '01 croatia' '01 croatia happy' '01 may' '01 may actual']
```

```
% Model building
```

```
X = tweet_df['tweet']
Y = tweet_df['label']
X = vect.transform(X)
```

```
x_train, x_test, y_train, y_test = train_test_split(X, Y, test_size=0.2, random_state=42)
```

```
print("Size of x_train:", (x_train.shape))
print("Size of y_train:", (y_train.shape))
print("Size of x_test: ", (x_test.shape))
print("Size of y_test: ", (y_test.shape))
```

```
Size of x_train: (23476, 380305)
Size of y_train: (23476,)
Size of x_test:  (5869, 380305)
Size of y_test:  (5869,)
```

```
logreg = LogisticRegression()
logreg.fit(x_train, y_train)
logreg_predict = logreg.predict(x_test)
logreg_acc = accuracy_score(logreg_predict, y_test)
print("Test accuarcy: {:.2f}%".format(logreg_acc*100))
```

```
Test accuarcy: 93.17%
```

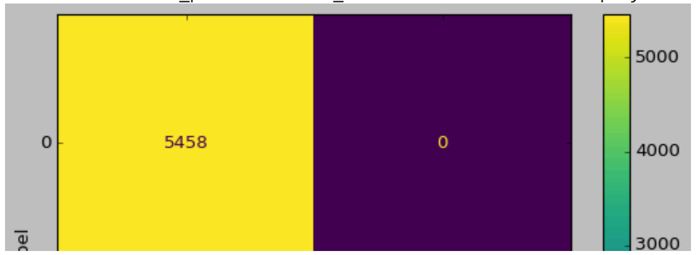
```
print(confusion_matrix(y_test, logreg_predict))
print("\n")
print(classification_report(y_test, logreg_predict))
```

```
[[5458    0]
 [ 401   10]]


              precision    recall  f1-score   support
```

```
                   0       0.93      1.00      0.96      5458
                   1       1.00      0.02      0.05       411

            accuracy                           0.93      5869
           macro avg       0.97      0.51      0.51      5869
        weighted avg       0.94      0.93      0.90      5869
```

```
style.use('classic')
cm = confusion_matrix(y_test, logreg_predict, labels=logreg.classes_)
disp = ConfusionMatrixDisplay(confusion_matrix=cm, display_labels=logreg.classes_)
disp.plot()
```

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7ebe53661300>
```


0
5458
0
5000
4000
3000