Twitter Sentiment Analysis - Using Deep Learning

```
# This Python 3 environment comes with many helpful analytics libraries installed
# It is defined by the kaggle/python Docker image: https://www.kaggle.com/datasets/kazanova/sentiment140
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list all files under the input directory


#What is WordNet in NLP?
#WordNet: A Lexical Taxonomy of English Words | by Lowri ...
#WordNet is a large lexical database of English words. Nouns, verbs, adjectives, and adverbs are grouped into sets of cognitive synonyms
#Synsets are interlinked using conceptual-semantic and lexical relations such as hyponymy and antonymy.
```

1. Importing and Discovering the Dataset

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import re
import string
import seaborn as sns
import nltk
from nltk import word_tokenize
from nltk.corpus import stopwords
from matplotlib import style
style.use('ggplot')
from textblob import TextBlob
from nltk.stem import PorterStemmer
nltk.download("wordnet")
from nltk.stem import WordNetLemmatizer

from wordcloud import WordCloud
from sklearn.feature_extraction.text import CountVectorizer

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.svm import LinearSVC
from nltk.stem import SnowballStemmer
from sklearn.model_selection import cross_val_score

from sklearn.model_selection import GridSearchCV
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report,ConfusionMatrixDisplay
```

```
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

```
#What is WordNet in NLP?
#WordNet: A Lexical Taxonomy of English Words | by Lowri ...
#WordNet is a large lexical database of English words. Nouns, verbs, adjectives, and adverbs are grouped into sets of cognitive synonyms
#Synsets are interlinked using conceptual-semantic and lexical relations such as hyponymy and antonymy.


df=pd.read_csv('/content/training.1600000.processed.noemoticon.csv',encoding='latin')
df.columns = ["label", "time", "date", "query", "username", "text"]
df
```

	label	time	date	query	username	text
0	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...

```
df
```

	label	time	date	query	username	text
0	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...
1	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@Kenichan I dived many times for the ball. Man...
2	0	1467811184	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	ElleCTF	my whole body feels itchy and like its on fire
3	0	1467811193	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	Karoli	@nationwideclass no, it's not behaving at all....
4	0	1467811372	Mon Apr 06 22:20:00	NO_QUERY	joy_wolf	@Kwesidei not the whole crew

2. Dataset Preprocessing & Data Reading Using Pandas.

```
# Checking the data's output balance
# The label '4' denotes positive sentiment and '0' denotes negative sentiment
df['label'].value_counts()
```

```
0    799999
4    323183
Name: label, dtype: int64
```

```
# Ommiting every column except for the text and the label, as we won't need any of the other information
df1 = df[['label', 'text']]
df1.head()
```

	label	text
0	0	is upset that he can't update his Facebook by ...
1	0	@Kenichan I dived many times for the ball. Man...
2	0	my whole body feels itchy and like its on fire
3	0	@nationwideclass no, it's not behaving at all....
4	0	@Kwesidei not the whole crew

```
# Separating positive and negative rows
df_pos = df[df['label'] == 4]
df_neg = df[df['label'] == 0]
print(len(df_pos), len(df_neg))
```

```
323183 799999
```

```
# Only retaining 1/4th of our data from each output group
# Feel free to alter the dividing factor depending on your workspace
# 1/64 is a good place to start if you're unsure about your machine's power
df_pos = df_pos.iloc[:int(len(df_pos)/4)]
df_neg = df_neg.iloc[:int(len(df_neg)/4)]
print(len(df_pos), len(df_neg))
```

```
80795 199999
```

3. Text Preprocessing

```
nltk.download('stopwords')
stop_words = set(stopwords.words('english'))
print(stop_words)
print('no of stop words',len(stop_words))
```

```
{'am', 'himself', 'aren', 'that', 'her', 'off', 'too', "don't", 'all', 'he', 'we', 'as', 'have', "couldn't", 'this', "you'd", 'ain',
no of stop words 179
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

```
df["text"] = df["text"].astype(str)
def toLower(text):
    return text.lower()

df["text"] = df["text"].apply(toLower)
df.head()
```

	label	time	date	query	username	text
0	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his facebook by ...
1	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@kenichan i dived many times for the ball. man...
2	0	1467811184	Mon Apr 06 22:19:57 PDT	NO_QUERY	ElleCTF	my whole body feels itchy

```
nltk.download('punkt')
def data_preprocessing(text):
    text = re.sub(r"https\S+|www\S+https\S+","",text,flags = re.MULTILINE)
    text = re.sub(r"\@w+|\#","",text)
    text = re.sub(r'[^\w\s]','',text)
    text_tokens = word_tokenize(text)
    filtered_text = [w for w in text_tokens if not w in stop_words]
    return " ".join(filtered_text)
```

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

```
df.text = df['text'].apply(data_preprocessing)
```

```
df.text.head(10)
```

```
0    upset cant update facebook texting might cry r...
1    kenichan dived many times ball managed save 50...
2                      whole body feels itchy like fire
3              nationwideclass behaving im mad cant see
4                                   kwesidei whole crew
5                                             need hug
6    loltrish hey long time see yes rains bit bit l...
7                                 tatiana_k nope didnt
8                                   twittera que muera
9                       spring break plain city snowing
Name: text, dtype: object
```

```
stemmer = PorterStemmer()
def data_preprocessing_stem(text):
    text = re.sub(r"https\S+|www\S+https\S+","",text,flags = re.MULTILINE)
    text = re.sub(r"\@w+|\#","",text)
    text = re.sub(r'[^\w\s]','',text)
    text_tokens = word_tokenize(text)
    filtered_text = [w for w in text_tokens if not w in stop_words]
    stem_words = [stemmer.stem(w) for w in filtered_text]
    return " ".join(stem_words)
```

```
df.text = df['text'].apply(data_preprocessing_stem)
```

```
df.text.head(5)
```

```
0    upset cant updat facebook text might cri resul...
1    kenichan dive mani time ball manag save 50 res...
2                       whole bodi feel itchi like fire
3                nationwideclass behav im mad cant see
4                                   kwesidei whole crew
Name: text, dtype: object
```

```
# Lets drop the duplicate values

df = df.drop_duplicates('text')


df.text
```

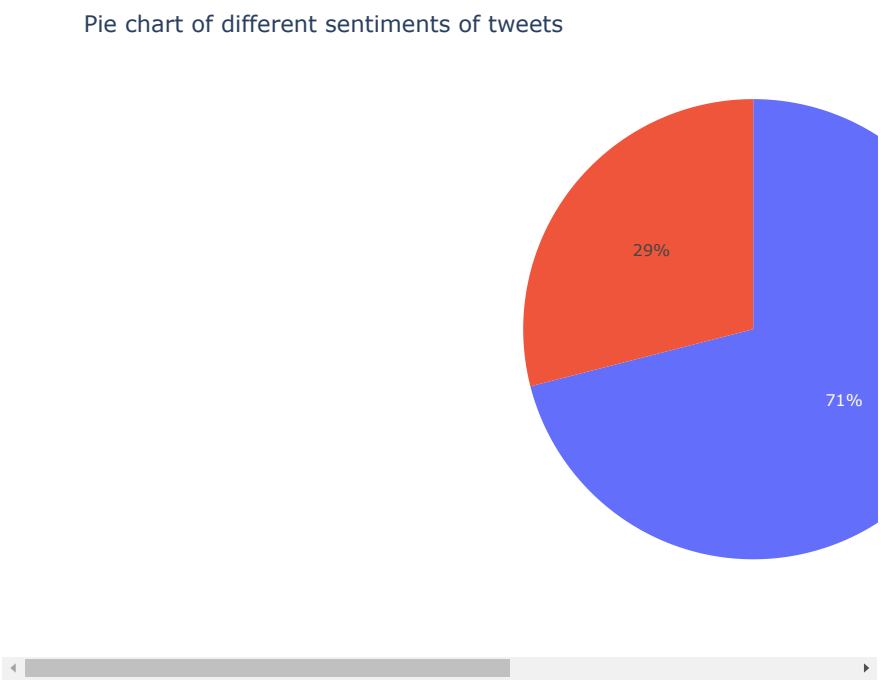
```
0          upset cant updat facebook text might cri resul...
1          kenichan dive mani time ball manag save 50 res...
2                           whole bodi feel itchi like fire
3                     nationwideclass behav im mad cant see
4                                    kwesidei whole crew
                                ...
1123177                                       morkargo true
1123178                    laubow_ oh yeah rememb soooo proud
1123179               boon565 well obvious shitest tast music
1123180    riter993 let bravelad answer one sinc origin b...
1123181                                                  nan
Name: text, Length: 1087557, dtype: object
```

```
print(df['text'].iloc[0],'\n')
print(df['text'].iloc[1],'\n')
print(df['text'].iloc[2],'\n')
```

```
upset cant updat facebook text might cri result school today also blah

kenichan dive mani time ball manag save 50 rest go bound

whole bodi feel itchi like fire
```

4. Exploratory Data Analysis using WordCloud.

```
import plotly.express as px
fig = px.pie(df, names='label', title ='Pie chart of different sentiments of tweets')
fig.show()
```

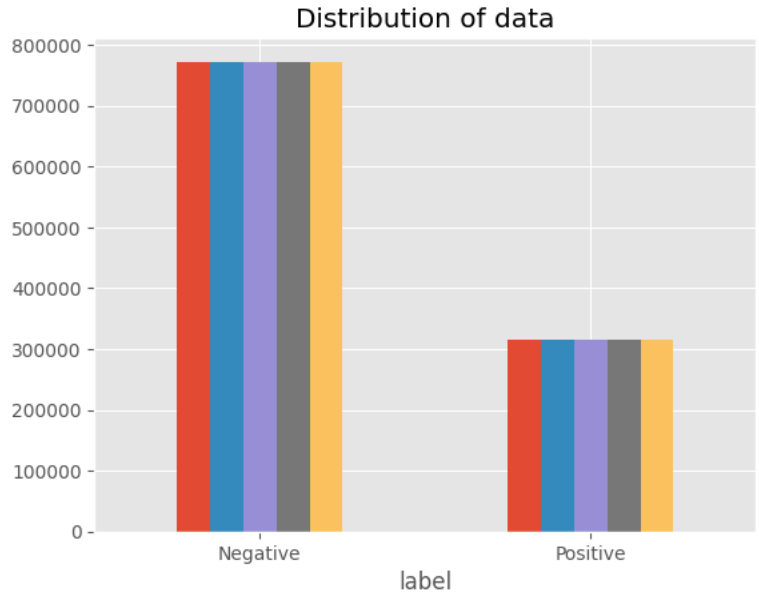



```
lab_to_sentiment = {0:"Negative", 4:"Positive"}
def label_decoder(label):
  return lab_to_sentiment[label]
df.label = df.label.apply(lambda x: label_decoder(x))
df.head()
```

```
<ipython-input-302-72815473027d>:4: SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/us
```

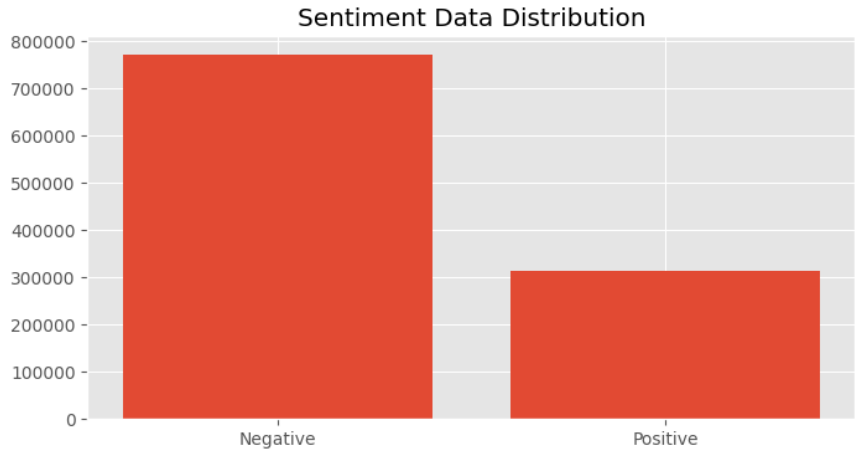
	label	time	date	query	username	text

```
# Plotting the distribution for dataset.
ax = df.groupby('label').count().plot(kind='bar', title='Distribution of data',legend=False)
ax.set_xticklabels(['Negative','Positive'], rotation=0)
# Storing data in lists.
text, sentiment = list(df['text']), list(df['label'])
```




```
val_count = df.label.value_counts()

plt.figure(figsize=(8,4))
plt.bar(val_count.index, val_count.values)
plt.title("Sentiment Data Distribution")
```

```
Text(0.5, 1.0, 'Sentiment Data Distribution')
```




```
import random
random_idx_list = [random.randint(1,len(df.text)) for i in range(10)] # creates random indexes to choose from dataframe
df.loc[random_idx_list,:].head(10) # Returns the rows with the index and display it
```

	label	time	date	query	username	text
793412	Negative	2326621007	Thu Jun 25 07:17:16 PDT 2009	NO_QUERY	Elmogyrl	dont think cut 95 need somebodi hous wife acti...
385329	Negative	2053581414	Sat Jun 06 05:02:54 PDT 2009	NO_QUERY	Paolinazola	hey read answer hey kind ooooo happi

```
stop_words = stopwords.words('english')
stemmer = SnowballStemmer('english')

text_cleaning_re = "@\S+|https?:\S+|http?:\S|[^A-Za-z0-9]+"
```

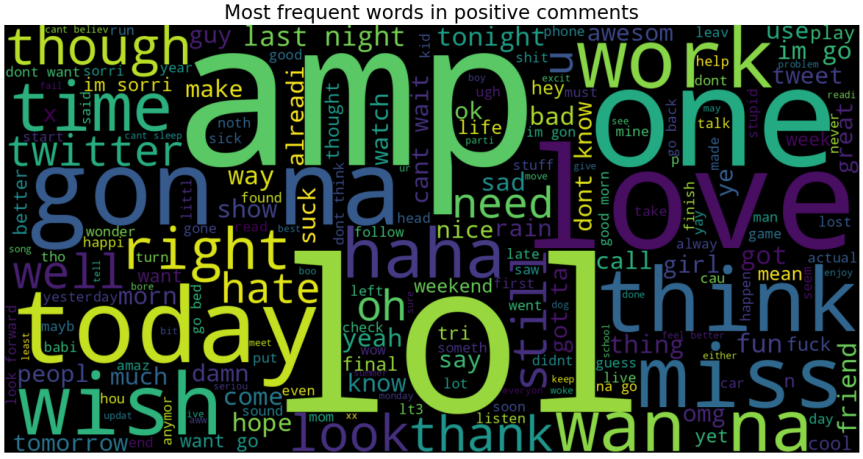
17 sigh heck

```
def preprocess(text, stem=False):
  text = re.sub(text_cleaning_re, ' ', str(text).lower()).strip()
  tokens = []
  for token in text.split():
    if token not in stop_words:
      if stem:
        tokens.append(stemmer.stem(token))
      else:
        tokens.append(token)
  return " ".join(tokens)


df.text = df.text.apply(lambda x: preprocess(x))
```

```
<ipython-input-309-8fcf10b40797>:1: SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus
```

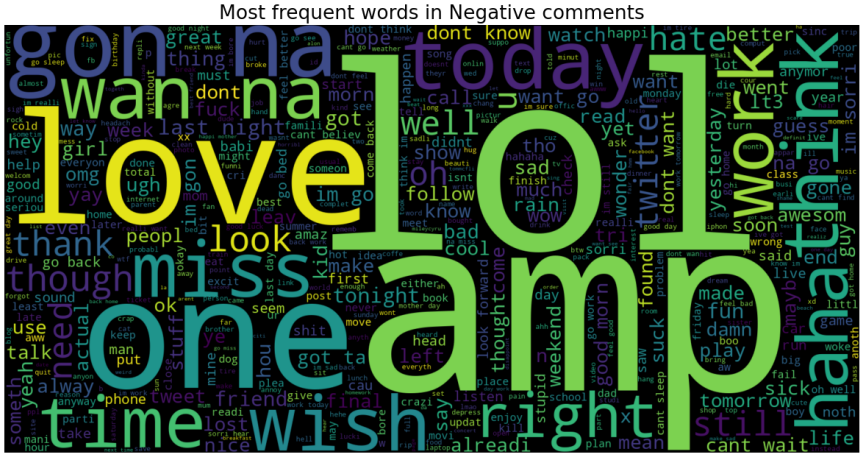
```
text = ' '.join([word for word in df['text']])
plt.figure(figsize = (15,15), facecolor='None')
# Word cloud object for generating and drawing
wordcloud = WordCloud(max_words=200, width=1600, height=800).generate(text)
plt.imshow(wordcloud,interpolation='bilinear')
plt.axis('off')
plt.title('Most frequent words in Positive comments', fontsize=19)
plt.show()
```

Most frequent words in positive comments



```
text = ' '.join([word for word in df['text']])
plt.figure(figsize = (15,15), 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 Negative comments', fontsize=19)
plt.show()
```

Most frequent words in Negative comments




```
from sklearn.feature_extraction.text import CountVectorizer
```

```
vect = CountVectorizer(ngram_range=(1,2)).fit(df['text'])
```

```
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: 3919812

First 20 features:
['00' '00 00' '00 10' '00 access' '00 amp' '00 awww' '00 cartoon'
 '00 draw' '00 except' '00 follow' '00 girl' '00 good' '00 graduat'
 '00 heart' '00 hurt' '00 im' '00 kill' '00 kiss' '00 lightn' '00 oh']
```

6.Train and Test Split

```
X = df['text']
Y = df['label']
X = vect.transform(X)
```

```
xtrain, xtest, ytrain, ytest = train_test_split(X,Y,test_size = 0.2, random_state =42)
```

```
print('Size of Xtrain:',(xtrain.shape))
print('Size of ytrain:',(ytrain.shape))
print('Size of Xtest:',(xtest.shape))
print('Size of ytest:',(ytest.shape))
```

```
Size of Xtrain: (870045, 3919812)
Size of ytrain: (870045,)
Size of Xtest: (217512, 3919812)
Size of ytest: (217512,)
```

```
from sklearn.linear_model import LogisticRegression
```

```
from sklearn.metrics import accuracy_score, confusion_matrix, classification_report,ConfusionMatrixDisplay


logreg = LogisticRegression()
logreg.fit(xtrain,ytrain)
logreg_pred = logreg.predict(xtest)
logreg_acc =accuracy_score(logreg_pred,ytest)
print('Test accuracy : {:.2f}%'.format(logreg_acc*100))
```

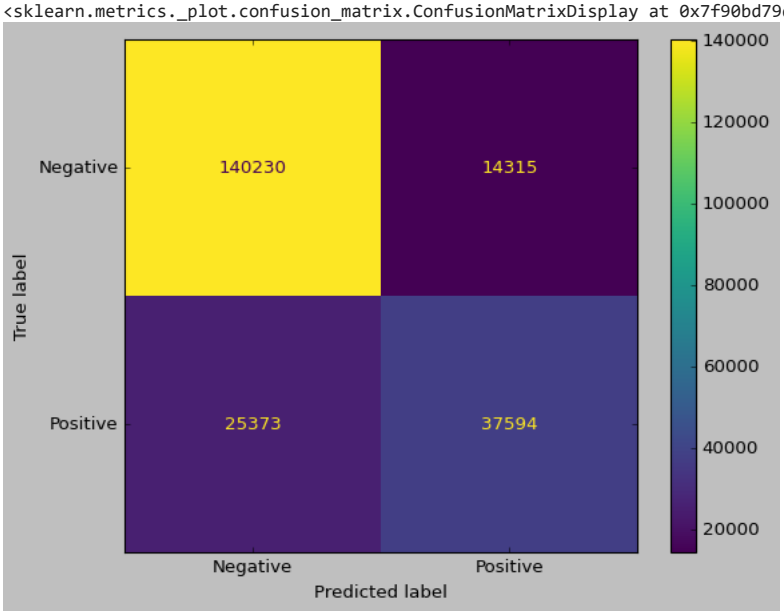
```
/usr/local/lib/python3.10/dist-packages/sklearn/linear_model/_logistic.py:458: ConvergenceWarning:

lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression

Test accuracy : 81.75%
```

```
print(confusion_matrix(ytest, logreg_pred))
print('\n')
print(classification_report(ytest, logreg_pred))
```

```
[[140230  14315]
 [ 25373  37594]]


              precision    recall  f1-score   support

    Negative       0.85      0.91      0.88    154545
    Positive       0.72      0.60      0.65     62967

    accuracy                           0.82    217512
   macro avg       0.79      0.75      0.77    217512
weighted avg       0.81      0.82      0.81    217512
```

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

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f90bd79da50>
```




```
SVCmodel = LinearSVC()
SVCmodel.fit(xtrain,ytrain)
```

```
/usr/local/lib/python3.10/dist-packages/sklearn/svm/_base.py:1244: ConvergenceWarning:

Liblinear failed to converge, increase the number of iterations.
```

```
▾ LinearSVC
LinearSVC()
```

```
svc_pred = SVCmodel.predict(xtest)
svc_acc = accuracy_score(svc_pred,ytest)
print("test accuracy : {:.2f}%".format(svc_acc*100))
```

```
test accuracy : 80.93%
```

```
print(confusion_matrix(ytest,svc_pred))
print('\n')
print(classification_report(ytest,svc_pred))
```

```
[[137378  17167]
 [ 24303  38664]]


              precision    recall  f1-score   support

    Negative       0.85      0.89      0.87    154545
    Positive       0.69      0.61      0.65     62967

    accuracy                           0.81    217512
   macro avg       0.77      0.75      0.76    217512
weighted avg       0.80      0.81      0.81    217512
```

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

```
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at 0x7f90588b55d0>
```