email-spam-classification

June 20, 2024

[168]:
```python
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import nltk
```

[169]:
```python
data=pd.read_csv('spam.csv', encoding='ISO-8859-1')
data.head()
```

[169]:
```
     v1                                                 v2 Unnamed: 2  \
0   ham  Go until jurong point, crazy.. Available only ...        NaN
1   ham                      Ok lar... Joking wif u oni...        NaN
2  spam  Free entry in 2 a wkly comp to win FA Cup fina...        NaN
3   ham  U dun say so early hor... U c already then say...        NaN
4   ham  Nah I don't think he goes to usf, he lives aro...        NaN

  Unnamed: 3 Unnamed: 4
0        NaN        NaN
1        NaN        NaN
2        NaN        NaN
3        NaN        NaN
4        NaN        NaN
```

Data Cleaning

[170]:
```python
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   v1          5572 non-null   object
 1   v2          5572 non-null   object
 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
```

```
memory usage: 217.8+ KB
```

[171]:
```
# dropping unncessary columns
data.drop(['Unnamed: 2','Unnamed: 3','Unnamed: 4'],axis=1,inplace=True)
```

[172]:
```
data.head()
```

[172]:
```
     v1                                                 v2
0   ham  Go until jurong point, crazy.. Available only …
1   ham                      Ok lar… Joking wif u oni…
2  spam  Free entry in 2 a wkly comp to win FA Cup fina…
3   ham  U dun say so early hor… U c already then say…
4   ham  Nah I don't think he goes to usf, he lives aro…
```

[173]:
```
# renaming columns
data=data.rename(columns={'v1':'target','v2':'Email'})
data.head()
```

[173]:
```
  target                                              Email
0    ham  Go until jurong point, crazy.. Available only …
1    ham                      Ok lar… Joking wif u oni…
2   spam  Free entry in 2 a wkly comp to win FA Cup fina…
3    ham  U dun say so early hor… U c already then say…
4    ham  Nah I don't think he goes to usf, he lives aro…
```

[174]:
```
data.isna().sum()
```

[174]:
```
target    0
Email     0
dtype: int64
```

[175]:
```
data.duplicated().sum()
```

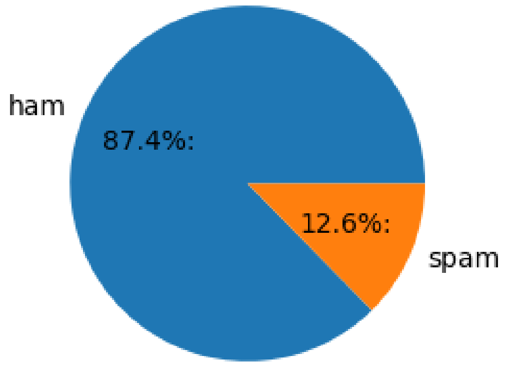
[175]:
```
403
```

[176]:
```
# Dropping duplicate values
data=data.drop_duplicates()
```

EDA

[177]:
```
labels=data['target'].unique()
```

[178]:
```
plt.figure(figsize=(4,3))
plt.pie(x=data['target'].value_counts(),labels=labels,autopct='%1.1f%%:')
plt.show()
```



```
[179]: # checking total characters in each email
       data['num_characters']=data['Email'].apply(len)
```

```
[180]: # checking for no of words in each email
       data['num_words']=data['Email'].apply(lambda x:len(nltk.word_tokenize(x)))
```

```
[181]: # checking for no of sentences in each mail
       data['num_sentences']=data['Email'].apply(lambda x:len(nltk.sent_tokenize(x)))
```

```
[182]: data.head()
```

```
[182]:   target                                              Email  num_characters  \
       0    ham  Go until jurong point, crazy.. Available only …             111
       1    ham                      Ok lar… Joking wif u oni…              29
       2   spam  Free entry in 2 a wkly comp to win FA Cup fina…             155
       3    ham  U dun say so early hor… U c already then say…              49
       4    ham  Nah I don't think he goes to usf, he lives aro…              61

          num_words  num_sentences
       0         23              2
       1          8              2
       2         37              2
       3         13              1
       4         15              1
```

```
[183]: # stats for not spam Emails
       data[data['target']=='ham'].describe()
```

```
[183]:        num_characters    num_words  num_sentences
       count     4516.000000  4516.000000    4516.000000
       mean        70.459256    16.957484       1.815545
```

```
std        56.358207   13.394052       1.364098
min         2.000000    1.000000       1.000000
25%        34.000000    8.000000       1.000000
50%        52.000000   13.000000       1.000000
75%        90.000000   22.000000       2.000000
max       910.000000  219.000000      38.000000
```

[184]:
```
# stats for spam Emails
data[data['target']=='spam'].describe()
```

[184]:
```
       num_characters   num_words  num_sentences
count      653.000000  653.000000     653.000000
mean       137.891271   27.474732       2.969372
std         30.137753    6.893007       1.488910
min         13.000000    2.000000       1.000000
25%        132.000000   25.000000       2.000000
50%        149.000000   29.000000       3.000000
75%        157.000000   32.000000       4.000000
max        224.000000   44.000000       9.000000
```

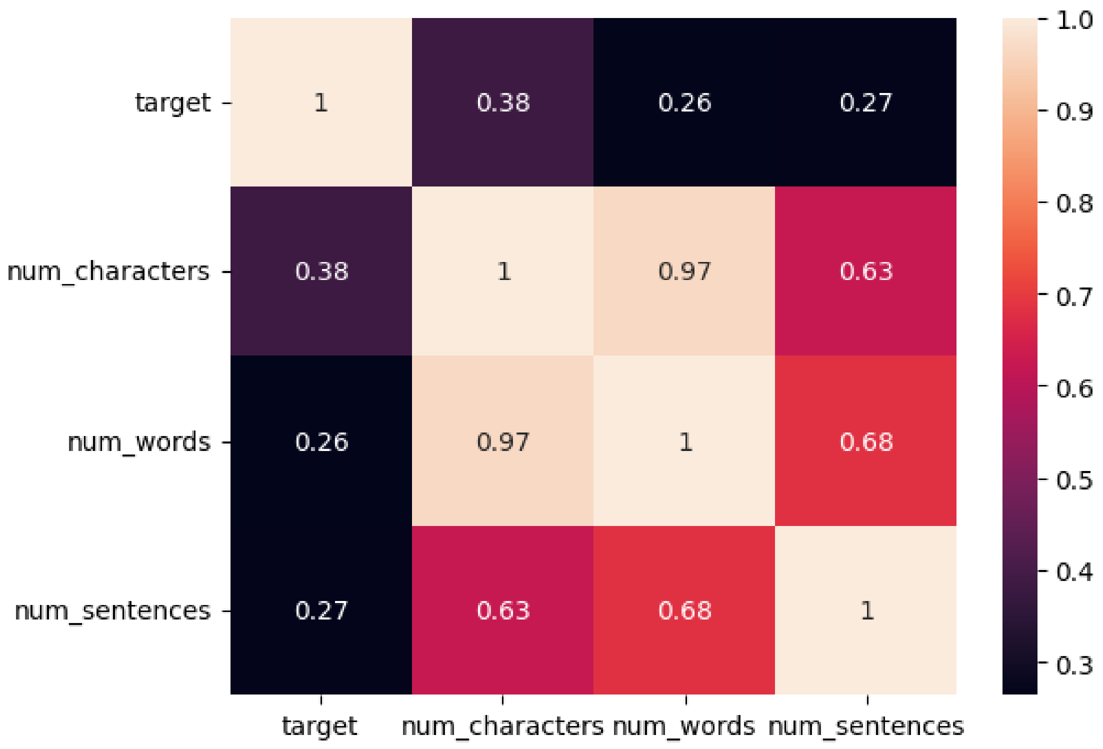
[185]:
```
from sklearn.preprocessing import LabelEncoder
encoder=LabelEncoder()
data['target']=encoder.fit_transform(data['target'])
```

[186]:
```
data['target'].value_counts()
```

[186]:
```
target
0    4516
1     653
Name: count, dtype: int64
```

[187]:
```
sns.heatmap(data.corr(numeric_only=True),annot=True)
```

[187]:
```
<Axes: >
```



Preprocessing

[188]:
```
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /usr/share/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
```

[188]:
```
True
```

[189]:
```
from nltk.corpus import stopwords
import string
from nltk.stem.porter import PorterStemmer
ps = PorterStemmer()
```

[190]:
```
def transform_text(text):
    # Convert text to lowercase
    text = text.lower()
    # Tokenize the text
    tokens = nltk.word_tokenize(text)

    # Remove punctuation and stopwords, and perform stemming
    transformed_tokens = [ps.stem(token) for token in tokens if token.isalnum()␣
 ↪and token not in stopwords.words('english')]
```

```
    return " ".join(transformed_tokens)
```

[191]:
```
data['Email_transformed']=data['Email'].apply(transform_text)
```

[192]:
```
data.head()
```

[192]:
```
   target                                              Email  num_characters  \
0       0  Go until jurong point, crazy.. Available only …             111
1       0                      Ok lar… Joking wif u oni…              29
2       1  Free entry in 2 a wkly comp to win FA Cup fina…             155
3       0  U dun say so early hor… U c already then say…              49
4       0  Nah I don't think he goes to usf, he lives aro…              61

   num_words  num_sentences                                  Email_transformed
0         23              2  go jurong point avail bugi n great world la e …
1          8              2                              ok lar joke wif u oni
2         37              2  free entri 2 wkli comp win fa cup final tkt 21…
3         13              1                u dun say earli hor u c alreadi say
4         15              1               nah think goe usf live around though
```

Feature Selection

[212]:
```
from sklearn.feature_extraction.text import CountVectorizer,TfidfVectorizer
tfid = TfidfVectorizer()
X = tfid.fit_transform(data['Email_transformed']).toarray()
```

[213]:
```
y=data['target']
```

[214]:
```
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score, confusion_matrix
import time
```

[215]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
 ↪random_state=101)
```

[216]:
```
model=MultinomialNB()
```

[217]:
```
start_time = time.time()
model.fit(X_train, y_train)
train_time = time.time() - start_time
print("Training Time:", train_time)
```

```
Training Time: 0.05539870262145996
```

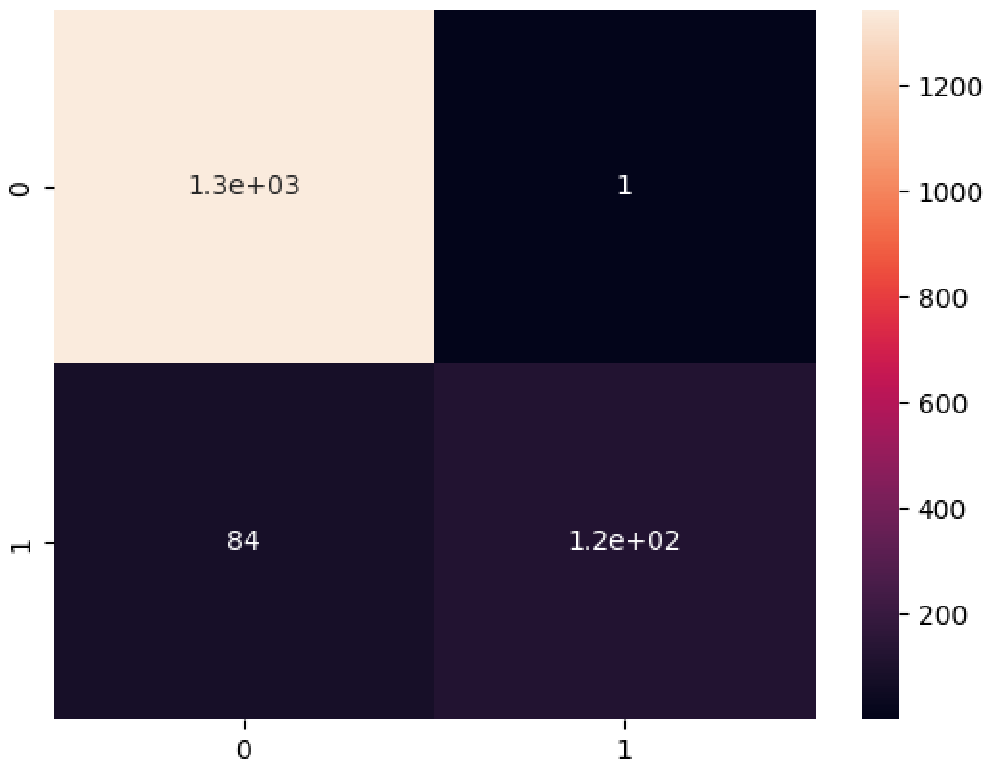
Model Evaluation

[218]:
```
y_pred = model.predict(X_test)
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.9451966473243069
```

[219]:
```
conf_matrix = confusion_matrix(y_test, y_pred)
sns.heatmap(conf_matrix,annot=True)
```

[219]:
```
<Axes: >
```



[220]:
```
from sklearn.naive_bayes import GaussianNB,BernoulliNB
```

[221]:
```
nb_classifier = GaussianNB()

nb_classifier.fit(X_train, y_train)
```

[221]:
```
GaussianNB()
```

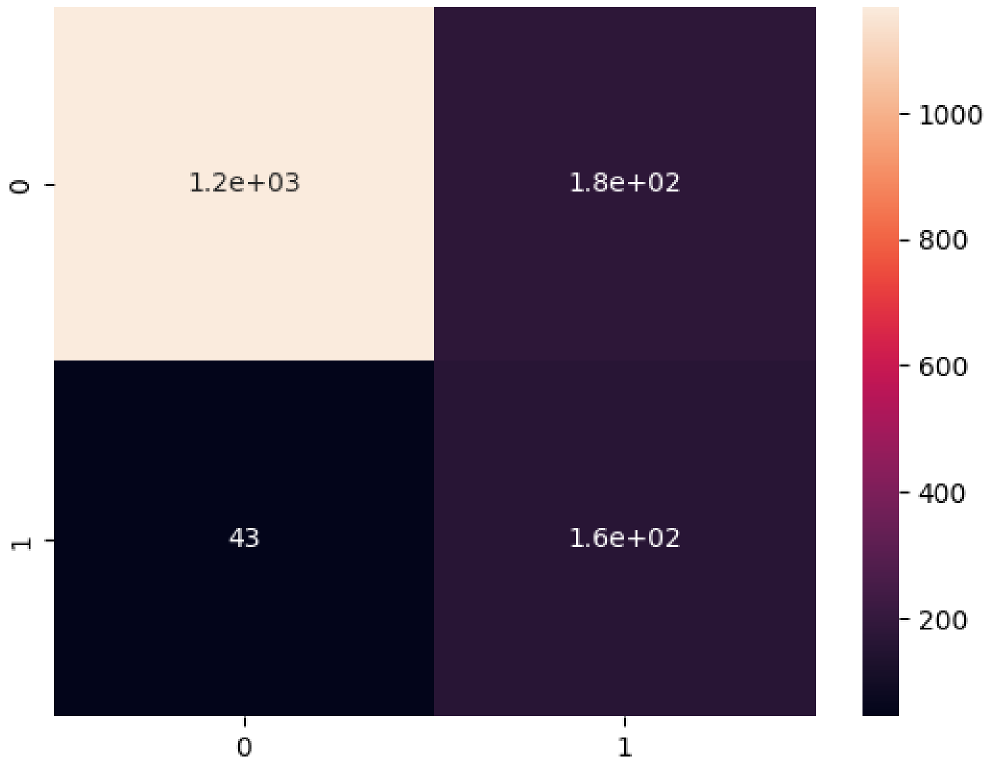
[222]:
```
y_pred = nb_classifier.predict(X_test)

# Calculate accuracy
```

```
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.8594455190199871
```

[223]:
```
# Generate confusion matrix
conf_matrix = confusion_matrix(y_test, y_pred)
sns.heatmap(conf_matrix,annot=True)
```

[223]:
```
<Axes: >
```



[224]:
```
nb_classifier = BernoulliNB()

# Train the classifier on the training data
nb_classifier.fit(X_train, y_train)

# Make predictions on the testing data
y_pred = nb_classifier.predict(X_test)

# Calculate accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.9593810444874274
```

Conclusion

Best Model is MultinomialNB with accuarcy of 97.43 %

Prediction on test data

[225]:
```
actual_inverse = encoder.inverse_transform(y_test)
predicted_inverse =encoder.inverse_transform(y_pred)

# Creating a new DataFrame with inverse transformed values
actual_vs_predicted = pd.DataFrame({'Actual': actual_inverse, 'Predicted':␣
 ↪predicted_inverse})
```

[226]:
```
actual_vs_predicted.head()
```

[226]:
```
  Actual Predicted
0    ham       ham
1    ham       ham
2   spam      spam
3    ham       ham
4    ham       ham
```

Predcition on user input

[227]:
```
import joblib
```

[238]:
```
model_1=joblib.load('/kaggle/working/nb_classifier.joblib')
tfid=joblib.load('/kaggle/working/tfid.joblib')
```

[ ]:
```

```

[239]:
```
input_email = input('Enter Email: ')

# Preprocess the user input
preprocessed_input = [transform_text(input_email)]

# Vectorize the preprocessed input using the already fitted vectorizer
preprocessed_input_vectorized =tfid.transform(preprocessed_input)

# Make predictions
prediction = model_1.predict(preprocessed_input_vectorized)

# Print the result
if prediction == 0:
    print('ham')
else:
    print('spam')
```

```
Enter Email:  input_email =input('Enter Email') # Preprocess the user input
preprocessed_input = [transform_text(input_email)]  # Vectorize tDon't miss out
on our exclusive offer! Get 50% off your next purchase when you shop with us
today. Limited time onlyhe preprocessed input preprocessed_input_vectorized =
vectorizer.fit_transform(preprocessed_input) print('') # Make predictions
prediction = model_1.predict(preprocessed_input_vectorized) if prediction==0:
print('ham') else:     print('spam')
```

```
ham
```

saving best model

[233]:
```
from joblib import dump

# Assuming your model is named 'model'
dump(nb_classifier, 'nb_classifier.joblib')
dump(tfid, 'tfid.joblib')
```

[233]:
```
['tfid.joblib']
```

[ ]:
```
dump(transform_text, 'preprocess_fn.joblib')
```

[ ]:
```

```