email-spam-2

November 12, 2024

[3]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

[4]:
```
df = pd.read_csv('C:\\Users\\ANUSHA\\Downloads\\archive (5).zip', encoding=␣
↪'latin')
```

[5]:
```
df.head()
```

[5]:
```
     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
```

[6]:
```
df.shape
```

[6]:
```
(5572, 5)
```

[7]:
```
df.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
```

[8]:
```
df.drop(columns=['Unnamed: 2','Unnamed: 3','Unnamed: 4'],inplace=True)
```

[9]:
```
df.sample(5)
```

[9]:

	v1	v2
3417	spam	LIFE has never been this much fun and great un…
1450	ham	Msg me when rajini comes.
434	ham	You available now? I'm like right around hills…
610	spam	22 days to kick off! For Euro2004 U will be ke…
3717	ham	Cool. Do you like swimming? I have a pool and …

[10]:
```
df.rename(columns={'v1':'result','v2':'emails'},inplace=True)
df.sample(5)
```

[10]:

	result	emails
608	ham	Neva mind it's ok..
1873	spam	You have WON a guaranteed å£1000 cash or a å£2…
2114	spam	Sunshine Hols. To claim ur med holiday send a …
886	ham	I like to talk pa but am not able to. I dont k…
457	ham	I hope you that's the result of being consiste…

[11]:
```
from sklearn.preprocessing import LabelEncoder
encoder = LabelEncoder()
df['result'] = encoder.fit_transform(df['result'])
```

[12]:
```
df.head()
```

[12]:

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

[13]:
```
df.isnull().sum()
```

[13]:
```
result    0
emails    0
dtype: int64
```

[14]:
```
df.duplicated().sum()
```

[14]:
```
403
```

[15]:
```
df = df.drop_duplicates(keep='first')
```

[16]:
```
df.duplicated().sum()
```

[16]:
```
0
```

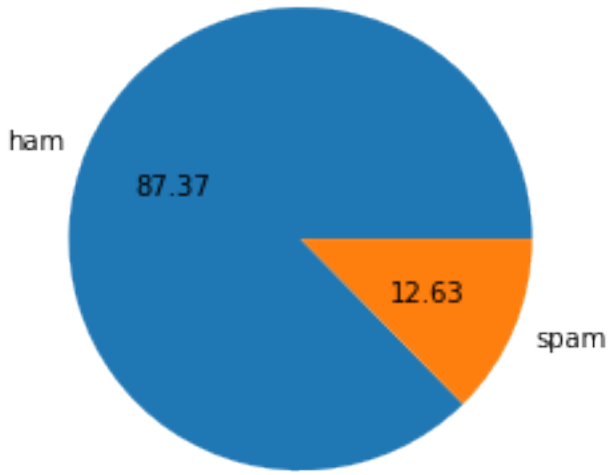
[17]:
```
df.shape
```

[17]:
```
(5169, 2)
```

[18]:
```
# EDA
df['result'].value_counts()
```

[18]:
```
0    4516
1     653
Name: result, dtype: int64
```

[19]:
```
import matplotlib.pyplot as plt
plt.pie(df['result'].value_counts(), labels=['ham','spam'],autopct="%0.2f")
plt.show()
```



[20]:
```
import nltk
nltk.download("punkt")
```

```
[nltk_data] Downloading package punkt to
```

```
[nltk_data]     C:\Users\ANUSHA\AppData\Roaming\nltk_data…
[nltk_data]   Package punkt is already up-to-date!
```

[20]:
```
True
```

[21]:
```
df['num_characters'] = df['emails'].apply(len)
df['num_words'] = df['emails'].apply(lambda x:len(nltk.word_tokenize(x)))
df['num_sentences'] = df['emails'].apply(lambda x:len(nltk.sent_tokenize(x)))
```

[22]:
```
df.head()
```

[22]:

	result	emails	num_characters	num_words	num_sentences
0	0	Go until jurong point, crazy.. Available only …	104	22	2
1	0	Ok lar… Joking wif u oni…	29	8	2
2	1	Free entry in 2 a wkly comp to win FA Cup fina…	155	37	2
3	0	U dun say so early hor… U c already then say…	49	13	1
4	0	Nah I don't think he goes to usf, he lives aro…	61	15	1

[23]:
```
#ham
df[df['result'] == 0][['num_characters','num_words','num_sentences']].describe()
```

[23]:

	num_characters	num_words	num_sentences
count	4516.000000	4516.000000	4516.000000
mean	70.457706	17.120461	1.799601
std	56.357188	13.493532	1.278465
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	220.000000	28.000000

[24]:
```
#spam
df[df['result'] == 1][['num_characters','num_words','num_sentences']].describe()
```

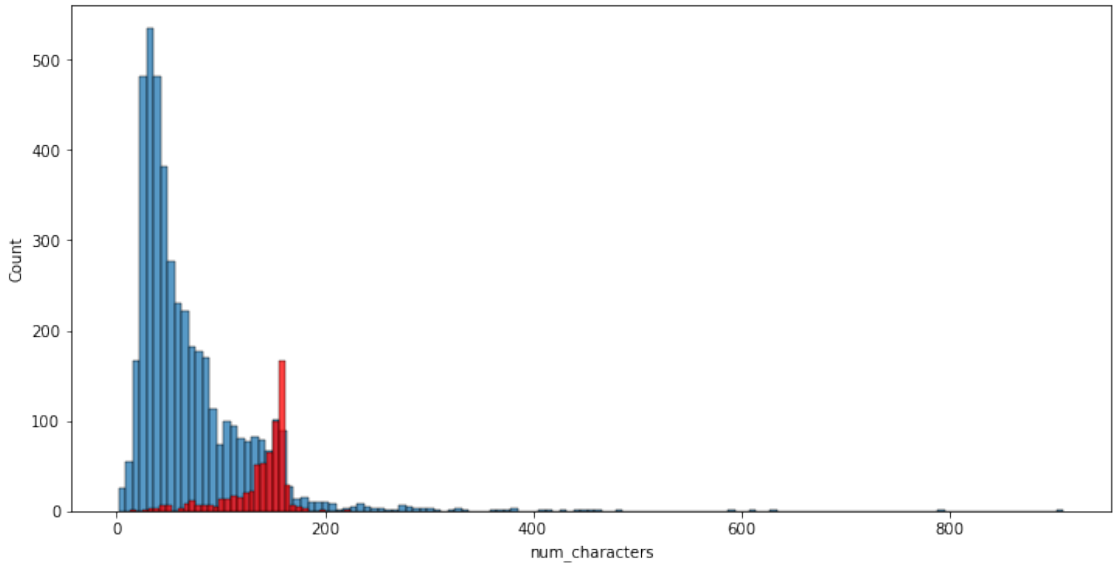
[24]:

	num_characters	num_words	num_sentences
count	653.000000	653.000000	653.000000
mean	137.891271	27.667688	2.967841
std	30.137753	7.008418	1.483201
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    46.000000       8.000000
```

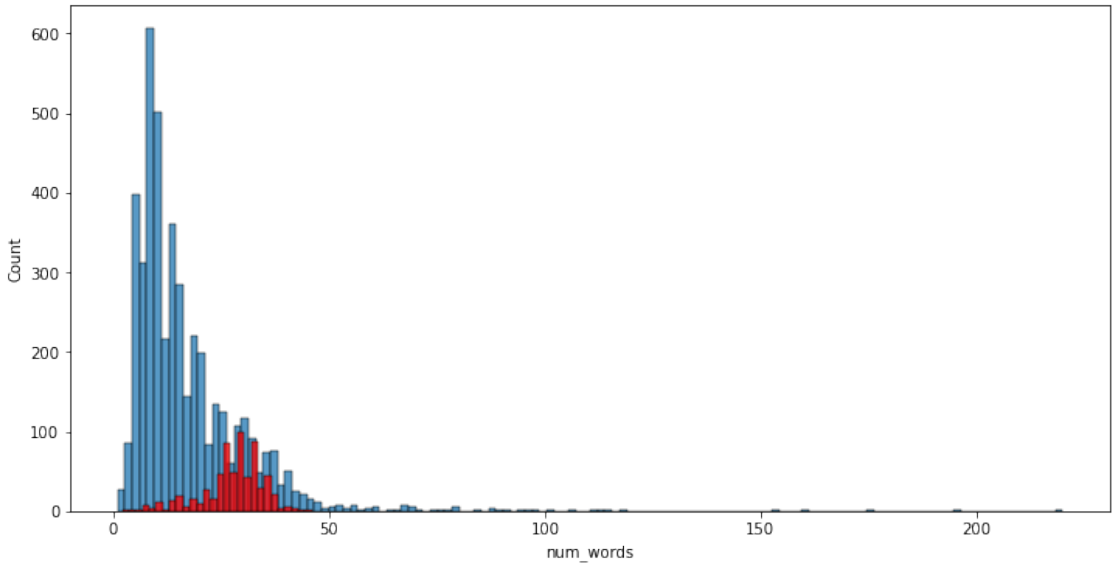
[25]:
```
import seaborn as sns
plt.figure(figsize=(12,6))
sns.histplot(df[df['result'] == 0]['num_characters'])
sns.histplot(df[df['result'] == 1]['num_characters'],color='red')
```

[25]: <AxesSubplot:xlabel='num_characters', ylabel='Count'>



[26]:
```
plt.figure(figsize=(12,6))
sns.histplot(df[df['result'] == 0]['num_words'])
sns.histplot(df[df['result'] == 1]['num_words'],color='red')
```

[26]: <AxesSubplot:xlabel='num_words', ylabel='Count'>



[27]:
```
nltk.download('stopwords')
from nltk.corpus import stopwords
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\ANUSHA\AppData\Roaming\nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
```

[28]:
```
import string
from nltk.stem.porter import PorterStemmer
ps = PorterStemmer()
```

[29]:
```
def transform_text(emails):
    emails = emails.lower()
    emails = nltk.word_tokenize(emails)

    y = []
    for i in emails:
        if i.isalnum():
            y.append(i)

    emails = y[:]
    y.clear()

    for i in emails:
        if i not in stopwords.words('english') and i not in string.punctuation:
            y.append(i)

    emails = y[:]
```

```
    y.clear()
    for i in emails:
        y.append(ps.stem(i))


    return " ".join(y)
```

[30]:
```
df['emails'][10]
```

[30]:
```
"I'm gonna be home soon and i don't want to talk about this stuff anymore
tonight, k? I've cried enough today."
```

[31]:
```
transform_text("I'm gonna be home soon and i don't want to talk about this␣
↪stuff anymore tonight, k? I've cried enough today.")
```

[31]:
```
'gon na home soon want talk stuff anymor tonight k cri enough today'
```

[32]:
```
df['transformed_text'] = df['emails'].apply(transform_text)
```

[33]:
```
df.head()
```

[33]:
```
   result                                             emails  num_characters  \
0       0  Go until jurong point, crazy.. Available only …             104
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                                transformed_text
0         22              2  go jurong point crazi avail bugi n great world…
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
```

1. Accuracy: How often the model's predictions are correct overall.
2. Confusion Matrix: A table that shows correct and incorrect predictions for each type (e.g., spam and ham).
3. Precision: When the model says "spam," how often it's actually spam.
4. Recall: Out of all the real spam emails, how many the model correctly found.
5. F1 Score: A single score that balances Precision and Recall to give a sense of overall performance.

   Accuracy: High (Above 90%)

   Precision: High (Above 90%)

Recall: High (Above 90%)

F1 Score: High (Above 90%)

A score of 0.98 in accuracy, precision, recall, or F1 indicates excellent performance, with the model making very few errors in classifying spam and ham emails.

[36]:
```
from sklearn.feature_extraction.text import CountVectorizer,TfidfVectorizer
cv = CountVectorizer()
tfidf = TfidfVectorizer(max_features=3000)
```

[37]:
```
X = tfidf.fit_transform(df['transformed_text']).toarray()
```

[38]:
```
X.shape
```

[38]:
```
(5169, 3000)
```

[40]:
```
y = df['result'].values
```

[41]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.
 ↪2,random_state=2)
```

[42]:
```
from sklearn.naive_bayes import GaussianNB,MultinomialNB,BernoulliNB
from sklearn.metrics import accuracy_score,confusion_matrix,precision_score
gnb = GaussianNB()
mnb = MultinomialNB()
bnb = BernoulliNB()
```

Gaussian Naive Bayes

[56]:
```
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,␣
 ↪recall_score, f1_score
gnb.fit(X_train, y_train)
y_pred1 = gnb.predict(X_test)
accuracy = accuracy_score(y_test, y_pred1)
conf_matrix = confusion_matrix(y_test, y_pred1)
precision = precision_score(y_test, y_pred1)
recall = recall_score(y_test, y_pred1)
f1 = f1_score(y_test, y_pred1)

print("Accuracy:", accuracy)
print("Confusion Matrix:\n", conf_matrix)
print("Precision:", precision)
print("Recall:", recall)
print("F1 Score:", f1)
```

```
Accuracy: 0.8907156673114119
Confusion Matrix:
```

```
 [[797  92]
 [ 21 124]]
Precision: 0.5740740740740741
Recall: 0.8551724137931035
F1 Score: 0.6869806094182825
```

"The Accuracy is 90%, but we have achieved 89.07% which is just below the expected threshold of 90%"

Multinomial Naive Bayes

[58]:
```
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,␣
 ↪recall_score, f1_score
mnb.fit(X_train, y_train)
y_pred2 = mnb.predict(X_test)
accuracy = accuracy_score(y_test, y_pred2)
conf_matrix = confusion_matrix(y_test, y_pred2)
precision = precision_score(y_test, y_pred2)
recall = recall_score(y_test, y_pred2)
f1 = f1_score(y_test, y_pred2)

print("Accuracy:", accuracy)
print("Confusion Matrix:\n", conf_matrix)
print("Precision:", precision)
print("Recall:", recall)
print("F1 Score:", f1)
```

```
Accuracy: 0.97678916827853
Confusion Matrix:
 [[889   0]
 [ 24 121]]
Precision: 1.0
Recall: 0.8344827586206897
F1 Score: 0.9097744360902255
```

"The Accuracy is 90%, We achieved a high accuracy rate of 97.67% exceeding 90%."

Bernoulli Naive Bayes

[59]:
```
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,␣
 ↪recall_score, f1_score
bnb.fit(X_train, y_train)
y_pred3 = bnb.predict(X_test)
accuracy = accuracy_score(y_test, y_pred3)
conf_matrix = confusion_matrix(y_test, y_pred3)
precision = precision_score(y_test, y_pred3)
recall = recall_score(y_test, y_pred3)
f1 = f1_score(y_test, y_pred3)

print("Accuracy:", accuracy)
```

```
print("Confusion Matrix:\n", conf_matrix)
print("Precision:", precision)
print("Recall:", recall)
print("F1 Score:", f1)
```

```
Accuracy: 0.9825918762088974
Confusion Matrix:
 [[887   2]
 [ 16 129]]
Precision: 0.9847328244274809
Recall: 0.8896551724137931
F1 Score: 0.9347826086956521
```

"The Accuracy is 90%, We achieved a high accuracy rate of 98.25%, exceeding 90%."

Selecting MultinomialNB as final model as it has highest precision and 97.29% accuracy.

[46]:
```
def text_check(emails):
    t_string = transform_text(emails)
    num_string = tfidf.transform([t_string])
    result = mnb.predict(num_string)[0]
    if result == 1:
        print("spam")
    else:
        print("Not spam")
```

[47]:
```
text1 = "England v Macedonia - dont miss the goals/team news. Txt ur national␣
 ↪team to 87077 eg ENGLAND to 87077 Try:WALES, SCOTLAND 4txt/Ì¼1.20␣
 ↪POBOXox36504W45WQ 16+"
text_check(text1)
```

```
spam
```

[48]:
```
text2 = "hi, how are you?"
text_check(text2)
```

```
Not spam
```

[49]:
```
import re
from nltk.tokenize import word_tokenize

df['transform_text'] = df['emails'].str.lower()
# Tokenization
df['transform_text'] = df['transform_text'].apply(word_tokenize)

# Removing special characters
df['transform_text'] = df['transform_text'].apply(lambda x: [re.
 ↪sub(r'[^a-zA-Z0-9\s]', '', word) for word in x])
```

```
# Removing stop words and punctuation
stop_words = set(stopwords.words('english'))
df['transform_text'] = df['transform_text'].apply(lambda x: [word for word in x␣
 ↪if word not in stop_words and word not in string.punctuation])

# Stemming
ps = PorterStemmer()
df['transform_text'] = df['transform_text'].apply(lambda x: [ps.stem(word) for␣
 ↪word in x])

# Convert the preprocessed text back to string
df['transform_text'] = df['transform_text'].apply(lambda x: ' '.join(x))

# Display the preprocessed data
print(df[['emails', 'transform_text']].head())
```

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

                                      transform_text
0  go jurong point crazi avail bugi n great world…
1                              ok lar joke wif u oni
2  free entri 2 wkli comp win fa cup final tkt 21…
3                u dun say earli hor u c alreadi say
4           nah nt think goe usf live around though
```

[50]:
```
encoder = LabelEncoder()
df['result'] = encoder.fit_transform(df['result'])
df.sample(2)
tfidf = TfidfVectorizer(max_features=3000)
X = tfidf.fit_transform(df['emails']).toarray()
y = df['result']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

[51]:
```
from sklearn.svm import SVC

svc_classifier = SVC()
svc_classifier.fit(X_train, y_train)
y_pred_svc = svc_classifier.predict(X_test)
accuracy_svc = accuracy_score(y_test, y_pred_svc)
print(f"SVM Accuracy: {accuracy_svc:.2f}")
```

```
print("confusion Matrix :",confusion_matrix(y_test,y_pred_svc))
print("Precision Score: ",precision_score(y_test,y_pred_svc))
```

```
SVM Accuracy: 0.99
confusion Matrix : [[889   0]
 [ 14 131]]
Precision Score:  1.0
```

[60]:
```
#Predict with new data
new_emails = [
    "Get a free iPhone now!",
    "Hey, how's it going?",
    "Congratulations! You've won a prize!",
    "Reminder: Meeting at 2 PM tomorrow."
]

new_X = tfidf.transform(new_emails)
new_X_dense = new_X.toarray()
svm_predictions = svc_classifier.predict(new_X_dense)
for email, prediction in zip(new_emails, svm_predictions):
    if prediction == 1:
        print(f"'{email}' is predicted as spam.")
    else:
        print(f"'{email}' is predicted as ham.")
```

```
'Get a free iPhone now!' is predicted as spam.
'Hey, how's it going?' is predicted as ham.
'Congratulations! You've won a prize!' is predicted as spam.
'Reminder: Meeting at 2 PM tomorrow.' is predicted as ham.
```

[55]:
```
#User Input Data Prediction
def predict_email(email):
    email_vector = tfidf.transform([email])
    email_vector_dense = email_vector.toarray()
    prediction = svc_classifier.predict(email_vector_dense)
    if prediction[0] == 1:
        print("The email is predicted as spam.")
    else:
        print("The email is predicted as ham.")
user_email = input("Enter the email text: ")
predict_email(user_email)
```

```
Enter the email text: Get a free iPhone now!
The email is predicted as spam.
```

[ ]:
```

```