language-detection-nlp

January 7, 2024

[40]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer

from sklearn import pipeline
from sklearn.preprocessing import LabelEncoder

from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import MultinomialNB

from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, confusion_matrix,␣
 ↪classification_report

import warnings
warnings.filterwarnings("ignore")
```

[41]:
```
df= pd.read_csv("/kaggle/input/languagedata/Language Detection.csv")
df
```

[41]:
```
                                                      Text Language
0       Nature, in the broadest sense, is the natural…  English
1      "Nature" can refer to the phenomena of the phy…  English
2      The study of nature is a large, if not the onl…  English
3      Although humans are part of nature, human acti…  English
4      [1] The word nature is borrowed from the Old F…  English
…                                                    …        …
10332                            …  Kannada
10333                           …  Kannada
10334     '                          …  Kannada
10335                             …  Kannada
```

```
10336                          …  Kannada

[10337 rows x 2 columns]
```

```
[42]: df.shape
```

```
[42]: (10337, 2)
```

```
[43]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10337 entries, 0 to 10336
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Text      10337 non-null  object
 1   Language  10337 non-null  object
dtypes: object(2)
memory usage: 161.6+ KB
```

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

```
[44]: Text        0
      Language    0
      dtype: int64
```

```
[45]: df[df.duplicated()]
```

```
[45]:                       Text   Language
      1141            i'm sorry.    English
      1180            oh my god.    English
      1196            i'm sorry.    English
      1724            .  Malayalam
      1767                .  Malayalam
      …                     …         …
      9706   Ach du lieber Gott.     German
      9726      Es tut mir Leid.     German
      10081           .    Kannada
      10125                 .    Kannada
      10141           .    Kannada

      [66 rows x 2 columns]
```

There are 66 duplicate rows, droping them

```
[46]: df.drop(df[df.duplicated()].index, axis=0, inplace=True)
```

```
[47]: df.shape
```

[47]: (10271, 2)

```
[48]: df["Language"].nunique()
```

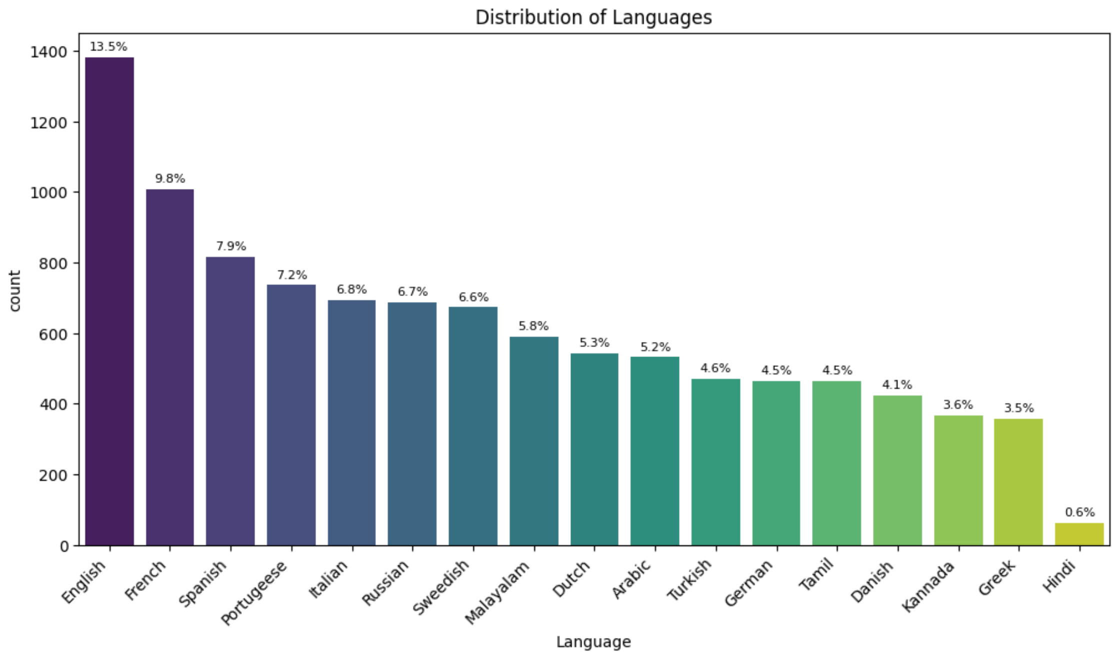
[48]: 17

The dataset contains texts from 17 different languages

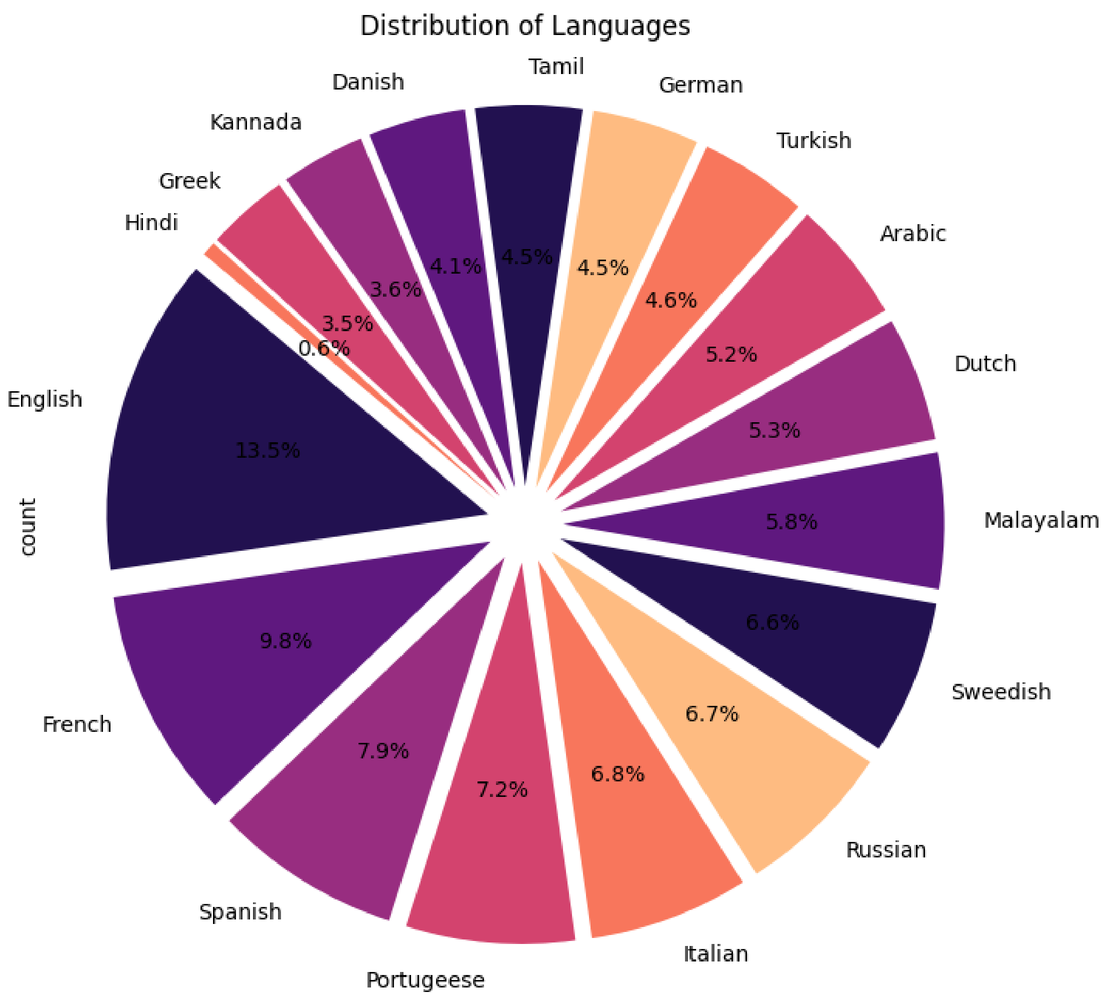
```
[49]: #How many rows belong to each language?
      df["Language"].value_counts()
```

```
[49]: Language
      English       1382
      French        1007
      Spanish        816
      Portugeese     736
      Italian        694
      Russian        688
      Sweedish       673
      Malayalam      591
      Dutch          542
      Arabic         532
      Turkish        471
      German         465
      Tamil          464
      Danish         424
      Kannada        366
      Greek          358
      Hindi           62
      Name: count, dtype: int64
```

```
[50]: # Count plot with percentage annotations
      plt.figure(figsize=(12, 6))
      ax = sns.countplot(x='Language', data=df, palette='viridis',␣
       ↪order=df['Language'].value_counts().index)
      plt.title('Distribution of Languages')
      plt.xticks(rotation=45, ha='right')

      # Add percentage annotations
      total = len(df)
      for p in ax.patches:
          percentage = '{:.1f}%'.format(100 * p.get_height() / total)
          x = p.get_x() + p.get_width() / 2
          y = p.get_height() + 20
          ax.text(x, y, percentage, ha='center', fontsize=8)
      plt.show()
```



[51]:
```
# Pie plot
plt.figure(figsize=(8, 8))
df['Language'].value_counts().loc[df['Language'].value_counts().index].plot.
  ↪pie(autopct='%1.1f%%', startangle=140, colors=sns.color_palette('magma'),␣
  ↪explode=[0.1] * len(df['Language'].unique()))
plt.title('Distribution of Languages')
plt.show()
```



```
[52]: data= df.copy()
      data['Cleaned_Text']= ""
      data
```

```
[52]:                                                     Text Language Cleaned_Text
      0       Nature, in the broadest sense, is the natural…  English
      1      "Nature" can refer to the phenomena of the phy…  English
      2      The study of nature is a large, if not the onl…  English
      3      Although humans are part of nature, human acti…  English
      4      [1] The word nature is borrowed from the Old F…  English
      …                                                    …        …            …
      10332                           …  Kannada
      10333                          …  Kannada
      10334     '                      …  Kannada
      10335                            …  Kannada
      10336                            …  Kannada
```

```
[10271 rows x 3 columns]
```

[53]:
```python
import re
def clean_function(Text):
    # removing the symbols and numbers
    Text = re.sub(r'[\([{})\]!@#$,"%^*?:;~`0-9]', ' ', Text)

    # converting the text to lower case
    Text = Text.lower()
    Text = re.sub('http\S+\s*', ' ', Text)  # remove URLs
    Text = re.sub('RT|cc', ' ', Text)  # remove RT and cc
    Text = re.sub('#\S+', '', Text)  # remove hashtags
    Text = re.sub('@\S+', '  ', Text)  # remove mentions
    Text = re.sub('\s+', ' ', Text)  # remove extra whitespace

    return Text
```

[54]:
```python
data['Cleaned_Text'] = data['Text'].apply(lambda x: clean_function(x))
data
```

[54]:
```
                                                     Text Language  \
0         Nature, in the broadest sense, is the natural…  English
1        "Nature" can refer to the phenomena of the phy…  English
2        The study of nature is a large, if not the onl…  English
3        Although humans are part of nature, human acti…  English
4        [1] The word nature is borrowed from the Old F…  English
…                                                    …       …
10332                             …  Kannada
10333                            …  Kannada
10334     '                        …  Kannada
10335                              …  Kannada
10336                              …  Kannada

                                             Cleaned_Text
0         nature in the broadest sense is the natural p…
1         nature can refer to the phenomena of the phys…
2        the study of nature is a large if not the only…
3        although humans are part of nature human activ…
4         the word nature is borrowed from the old fren…
…                                                    …
10332                             …
10333                            …
10334     '                        …
10335                              …
10336                              …
```

```
[10271 rows x 3 columns]
```

[55]:
```
X= data["Cleaned_Text"]
y= data["Language"]
```

[56]:
```
from sklearn.preprocessing import LabelEncoder
encoder= LabelEncoder()
y= encoder.fit_transform(y)
```

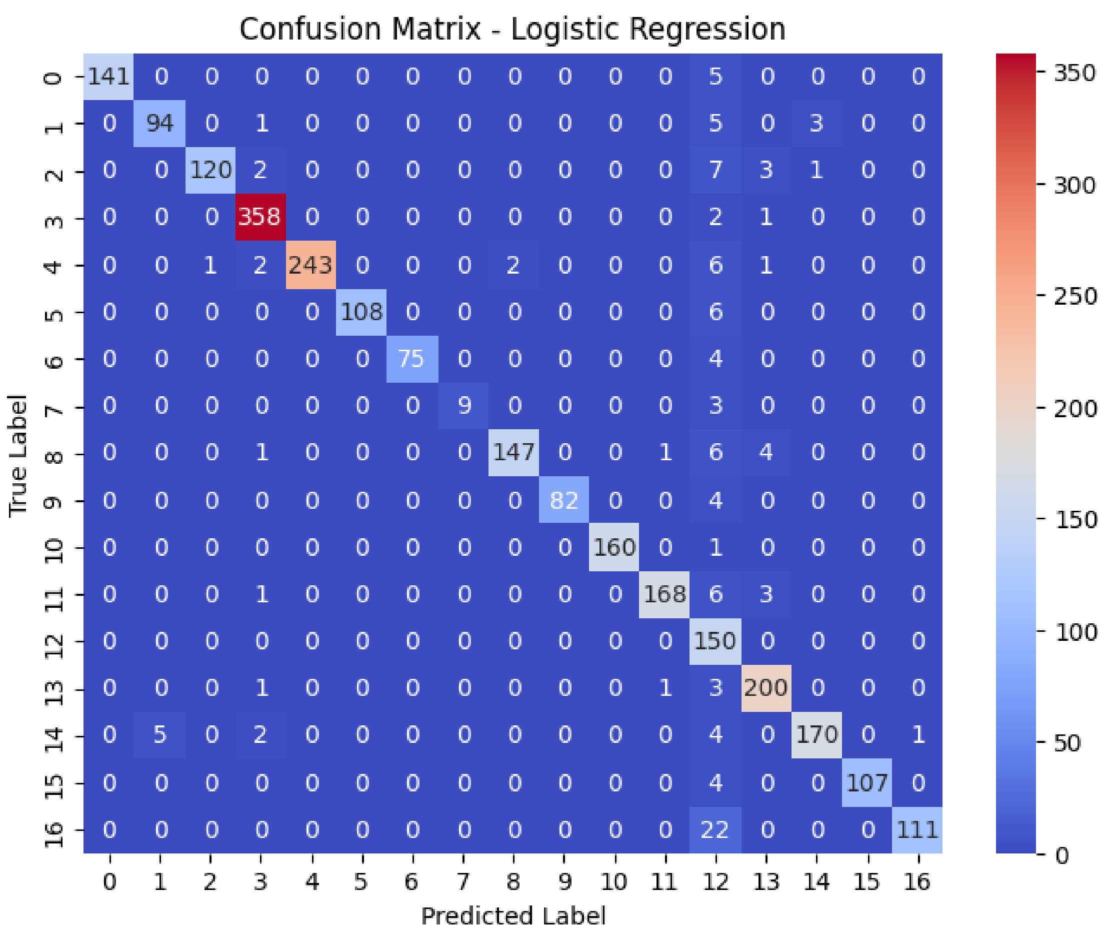
[57]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test= train_test_split(X, y, random_state=42)
```

[58]:
```
# Text Vectorization
tfidf_vectorizer = TfidfVectorizer(max_features=5000)
X_train_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_tfidf = tfidf_vectorizer.transform(X_test)
```

[59]:
```
# Model Training
models = {
    'Logistic Regression': LogisticRegression(),
    'K-Nearest Neighbors': KNeighborsClassifier(),
    'Random Forest': RandomForestClassifier(),
    'Naive Bayes': MultinomialNB()
}

for model_name, model in models.items():
    model.fit(X_train_tfidf, y_train)
    y_pred = model.predict(X_test_tfidf)

    # Model Evaluation
    accuracy = accuracy_score(y_test, y_pred)
    conf_matrix = confusion_matrix(y_test, y_pred)
    classification_report_str = classification_report(y_test, y_pred)

    print(f'Model: {model_name}')
    print(f'Accuracy: {accuracy}')
    print(f'Classification Report:\n{classification_report_str}')


    # Plot Confusion Matrix Heatmap
    plt.figure(figsize=(8, 6))
    sns.heatmap(conf_matrix, annot=True, fmt='d', cmap='coolwarm')
    plt.title(f'Confusion Matrix - {model_name}')
    plt.xlabel('Predicted Label')
    plt.ylabel('True Label')
    plt.show()
```

```
print('\n' + '='*50 + '\n')
```

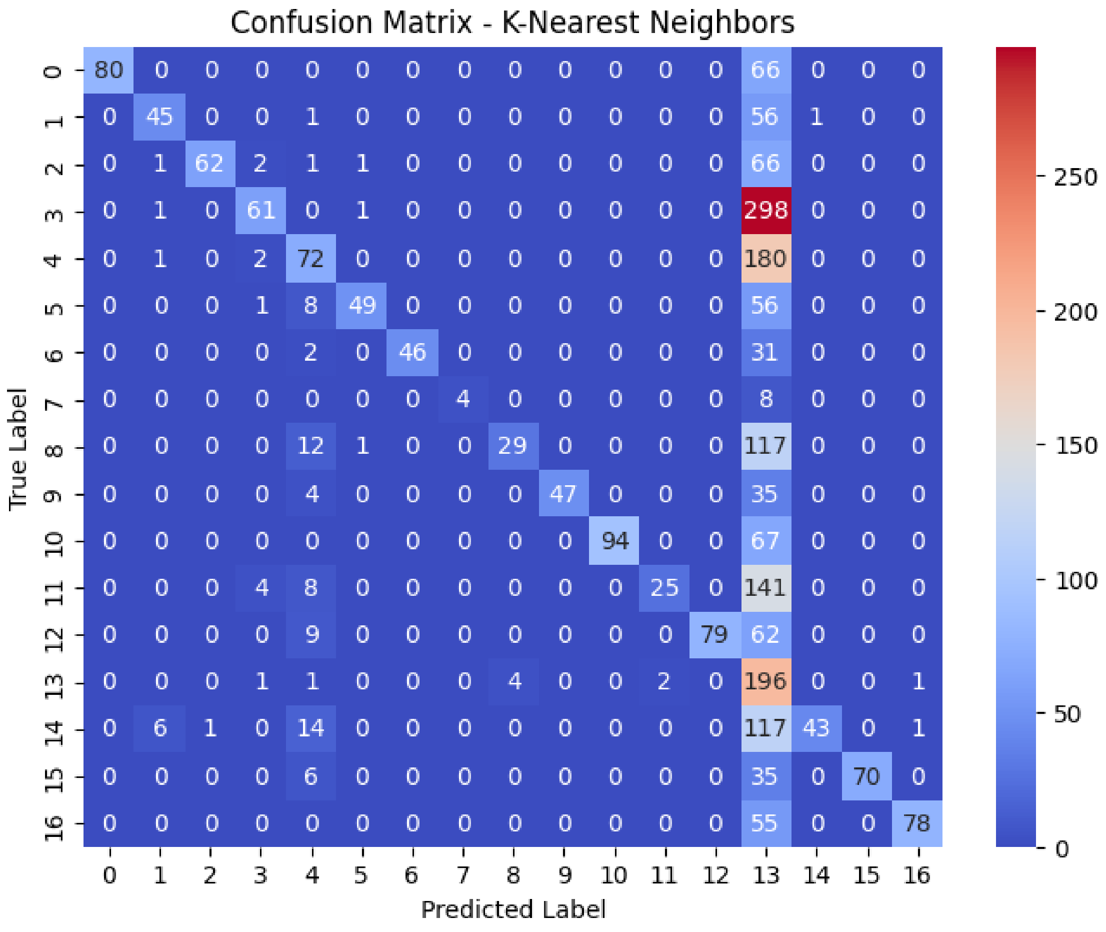
```
Model: Logistic Regression
Accuracy: 0.9513239875389408
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.97      0.98       146
           1       0.95      0.91      0.93       103
           2       0.99      0.90      0.94       133
           3       0.97      0.99      0.98       361
           4       1.00      0.95      0.98       255
           5       1.00      0.95      0.97       114
           6       1.00      0.95      0.97        79
           7       1.00      0.75      0.86        12
           8       0.99      0.92      0.95       159
           9       1.00      0.95      0.98        86
          10       1.00      0.99      1.00       161
          11       0.99      0.94      0.97       178
          12       0.63      1.00      0.77       150
          13       0.94      0.98      0.96       205
          14       0.98      0.93      0.96       182
          15       1.00      0.96      0.98       111
          16       0.99      0.83      0.91       133

    accuracy                           0.95      2568
   macro avg       0.97      0.94      0.95      2568
weighted avg       0.96      0.95      0.95      2568
```



	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	141	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
1	0	94	0	1	0	0	0	0	0	0	0	0	5	0	3	0	0
2	0	0	120	2	0	0	0	0	0	0	0	0	7	3	1	0	0
3	0	0	0	358	0	0	0	0	0	0	0	0	2	1	0	0	0
4	0	0	1	2	243	0	0	0	2	0	0	0	6	1	0	0	0
5	0	0	0	0	0	108	0	0	0	0	0	0	6	0	0	0	0
6	0	0	0	0	0	0	75	0	0	0	0	0	4	0	0	0	0
7	0	0	0	0	0	0	0	9	0	0	0	0	3	0	0	0	0
8	0	0	0	1	0	0	0	0	147	0	0	1	6	4	0	0	0
9	0	0	0	0	0	0	0	0	0	82	0	0	4	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	160	0	1	0	0	0	0
11	0	0	0	1	0	0	0	0	0	0	0	168	6	3	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	150	0	0	0	0
13	0	0	0	1	0	0	0	0	0	0	0	1	3	200	0	0	0
14	0	5	0	2	0	0	0	0	0	0	0	0	4	0	170	0	1
15	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	107	0
16	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	111

```
==================================================

Model: K-Nearest Neighbors
Accuracy: 0.4205607476635514
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.55      0.71       146
           1       0.83      0.44      0.57       103
           2       0.98      0.47      0.63       133
           3       0.86      0.17      0.28       361
           4       0.52      0.28      0.37       255
           5       0.94      0.43      0.59       114
           6       1.00      0.58      0.74        79
           7       1.00      0.33      0.50        12
           8       0.88      0.18      0.30       159
           9       1.00      0.55      0.71        86
```

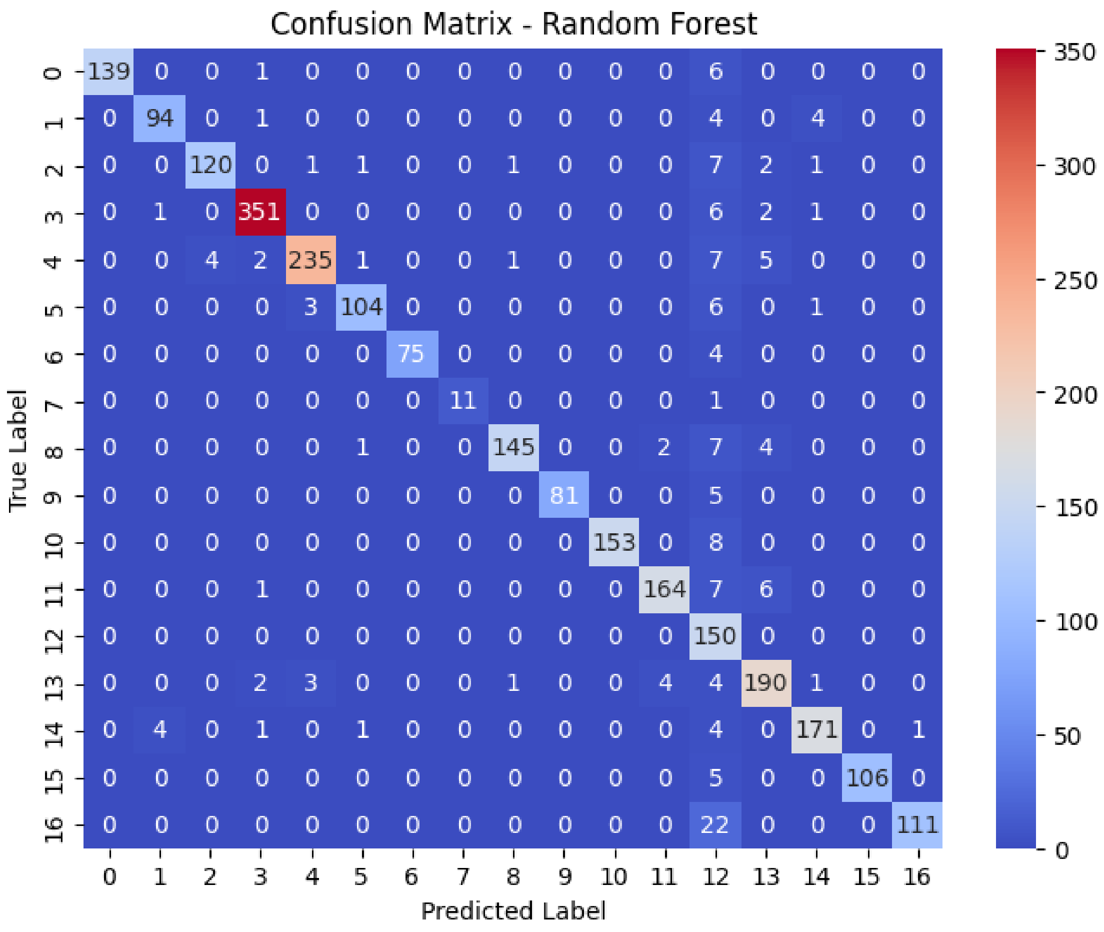
```
          10       1.00      0.58      0.74       161
          11       0.93      0.14      0.24       178
          12       1.00      0.53      0.69       150
          13       0.12      0.96      0.22       205
          14       0.98      0.24      0.38       182
          15       1.00      0.63      0.77       111
          16       0.97      0.59      0.73       133

    accuracy                           0.42      2568
   macro avg       0.88      0.45      0.54      2568
weighted avg       0.84      0.42      0.48      2568
```



True \ Predicted	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	80	0	0	0	0	0	0	0	0	0	0	0	0	66	0	0	0
1	0	45	0	0	1	0	0	0	0	0	0	0	0	56	1	0	0
2	0	1	62	2	1	1	0	0	0	0	0	0	0	66	0	0	0
3	0	1	0	61	0	1	0	0	0	0	0	0	0	298	0	0	0
4	0	1	0	2	72	0	0	0	0	0	0	0	0	180	0	0	0
5	0	0	0	1	8	49	0	0	0	0	0	0	0	56	0	0	0
6	0	0	0	0	2	0	46	0	0	0	0	0	0	31	0	0	0
7	0	0	0	0	0	0	0	4	0	0	0	0	0	8	0	0	0
8	0	0	0	0	12	1	0	0	29	0	0	0	0	117	0	0	0
9	0	0	0	0	4	0	0	0	0	47	0	0	0	35	0	0	0
10	0	0	0	0	0	0	0	0	0	0	94	0	0	67	0	0	0
11	0	0	0	4	8	0	0	0	0	0	0	25	0	141	0	0	0
12	0	0	0	0	9	0	0	0	0	0	0	0	79	62	0	0	0
13	0	0	0	1	1	0	0	0	4	0	0	2	0	196	0	0	1
14	0	6	1	0	14	0	0	0	0	0	0	0	0	117	43	0	1
15	0	0	0	0	6	0	0	0	0	0	0	0	0	35	0	70	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	55	0	0	78

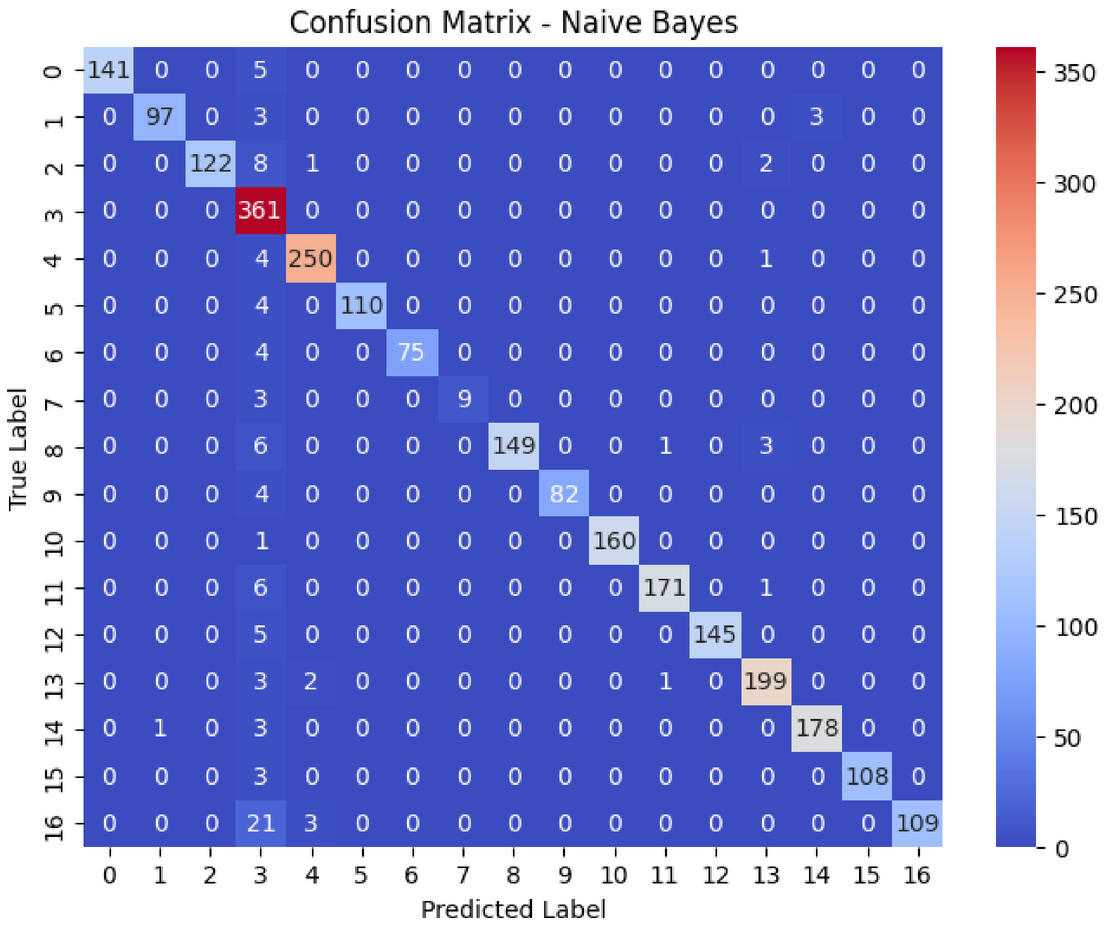
```
==================================================

Model: Random Forest
Accuracy: 0.9345794392523364
```

```
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.95      0.98       146
           1       0.95      0.91      0.93       103
           2       0.97      0.90      0.93       133
           3       0.98      0.97      0.97       361
           4       0.97      0.92      0.95       255
           5       0.96      0.91      0.94       114
           6       1.00      0.95      0.97        79
           7       1.00      0.92      0.96        12
           8       0.98      0.91      0.94       159
           9       1.00      0.94      0.97        86
          10       1.00      0.95      0.97       161
          11       0.96      0.92      0.94       178
          12       0.59      1.00      0.74       150
          13       0.91      0.93      0.92       205
          14       0.96      0.94      0.95       182
          15       1.00      0.95      0.98       111
          16       0.99      0.83      0.91       133

    accuracy                           0.93      2568
   macro avg       0.95      0.93      0.94      2568
weighted avg       0.95      0.93      0.94      2568
```



```
==================================================

Model: Naive Bayes
Accuracy: 0.9602803738317757
Classification Report:
              precision    recall  f1-score   support

           0       1.00      0.97      0.98       146
           1       0.99      0.94      0.97       103
           2       1.00      0.92      0.96       133
           3       0.81      1.00      0.90       361
           4       0.98      0.98      0.98       255
           5       1.00      0.96      0.98       114
           6       1.00      0.95      0.97        79
           7       1.00      0.75      0.86        12
           8       1.00      0.94      0.97       159
           9       1.00      0.95      0.98        86
```

```
          10       1.00      0.99      1.00       161
          11       0.99      0.96      0.97       178
          12       1.00      0.97      0.98       150
          13       0.97      0.97      0.97       205
          14       0.98      0.98      0.98       182
          15       1.00      0.97      0.99       111
          16       1.00      0.82      0.90       133

    accuracy                           0.96      2568
   macro avg       0.98      0.94      0.96      2568
weighted avg       0.97      0.96      0.96      2568
```



```
====================================================
[60]: def predict(text):
          lang = model.predict(tfidf_vectorizer.transform([text]))
          language = encoder.inverse_transform(lang)[0]
          print('The Language is in', language)
```

```
[61]: # English
      predict("LANGUAGE DETECTION MODEL CHECK")
      # French
      predict("VÉRIFICATION DU MODÈLE DE DÉTECTION DE LA LANGUE")
      # Arabic
      predict("                ")
      # Spanish
      predict("VERIFICACIÓN DEL MODELO DE DETECCIÓN DE IDIOMAS")
```

```
The Language is in English
The Language is in French
The Language is in Arabic
The Language is in Spanish
```