Kavan Prajapati - Brainwave Task 2

Import Libraries

```
import pandas as pd
import numpy as np
import re
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import classification_report, confusion_matrix,
accuracy_score
import matplotlib.pyplot as plt
from wordcloud import WordCloud
import seaborn as sns
from collections import Counter
```

Download Resources

```
# Download NLTK resources
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')
nltk.download('omw-1.4')
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     /Users/aradhya814/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package stopwords to
[nltk_data]     /Users/aradhya814/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package wordnet to
[nltk_data]     /Users/aradhya814/nltk_data...
[nltk_data] Downloading package omw-1.4 to
[nltk_data]     /Users/aradhya814/nltk_data...
```

```
True
```

Load Datasets

```
# Load datasets
train_df = pd.read_csv("twitter_training.csv")
validation_df = pd.read_csv("twitter_validation.csv")

print("Training Data Loaded. Shape:", train_df.shape)
print("Validation Data Loaded. Shape:", validation_df.shape)
```

```
Training Data Loaded. Shape: (74682, 4)
Validation Data Loaded. Shape: (1000, 4)

train_df

          id        topic sentiment  \
0      2401  Borderlands  Positive
1      2401  Borderlands  Positive
2      2401  Borderlands  Positive
3      2401  Borderlands  Positive
4      2401  Borderlands  Positive
...     ...          ...       ...
74677  9200       Nvidia  Positive
74678  9200       Nvidia  Positive
74679  9200       Nvidia  Positive
74680  9200       Nvidia  Positive
74681  9200       Nvidia  Positive

                                                    text
0      im getting on borderlands and i will murder yo...
1      I am coming to the borders and I will kill you...
2      im getting on borderlands and i will kill you ...
3      im coming on borderlands and i will murder you...
4      im getting on borderlands 2 and i will murder ...
...                                                  ...
74677  Just realized that the Windows partition of my...
74678  Just realized that my Mac window partition is ...
74679  Just realized the windows partition of my Mac ...
74680  Just realized between the windows partition of...
74681  Just like the windows partition of my Mac is l...

[74682 rows x 4 columns]

validation_df

       id                topic   sentiment  \
0    3364             Facebook  Irrelevant
1     352               Amazon     Neutral
2    8312            Microsoft    Negative
3    4371                CS-GO    Negative
4    4433               Google     Neutral
..    ...                  ...         ...
995  4891  GrandTheftAuto(GTA)  Irrelevant
996  4359                CS-GO  Irrelevant
997  2652          Borderlands    Positive
998  8069            Microsoft    Positive
999  6960      johnson&johnson     Neutral

                                                  text
0    I mentioned on Facebook that I was struggling ...
```

```
1    BBC News - Amazon boss Jeff Bezos rejects clai...
2    @Microsoft Why do I pay for WORD when it funct...
3    CSGO matchmaking is so full of closet hacking,...
4    Now the President is slapping Americans in the...
..                                                 ...
995   Toronto is the arts and culture capital of ...
996  tHIS IS ACTUALLY A GOOD MOVE TOT BRING MORE VI...
997  Today sucked so it’s time to drink wine n play...
998  Bought a fraction of Microsoft today. Small wins.
999  Johnson & Johnson to stop selling talc baby po...

[1000 rows x 4 columns]
```

Explore Datasets

```python
# Explore datasets
def explore_data(df, name):
    print(f"Dataset: {name}")
    print(f"Shape: {df.shape}")
    print(f"Columns: {df.columns.tolist()}")
    print(df.head())
    print()

explore_data(train_df, "Training Data")
explore_data(validation_df, "Validation Data")
```

```
Dataset: Training Data
Shape: (74682, 4)
Columns: ['id', 'topic', 'sentiment', 'text']
     id        topic sentiment  \
0  2401  Borderlands  Positive
1  2401  Borderlands  Positive
2  2401  Borderlands  Positive
3  2401  Borderlands  Positive
4  2401  Borderlands  Positive

                                                text
0  im getting on borderlands and i will murder yo...
1  I am coming to the borders and I will kill you...
2  im getting on borderlands and i will kill you ...
3  im coming on borderlands and i will murder you...
4  im getting on borderlands 2 and i will murder ...

Dataset: Validation Data
Shape: (1000, 4)
Columns: ['id', 'topic', 'sentiment', 'text']
     id      topic   sentiment  \
0  3364   Facebook  Irrelevant
1   352     Amazon     Neutral
2  8312  Microsoft    Negative
```

```
3  4371      CS-GO    Negative
4  4433     Google     Neutral

                                                text
0  I mentioned on Facebook that I was struggling ...
1  BBC News - Amazon boss Jeff Bezos rejects clai...
2  @Microsoft Why do I pay for WORD when it funct...
3  CSGO matchmaking is so full of closet hacking,...
4  Now the President is slapping Americans in the...
```

Data Preprocessing

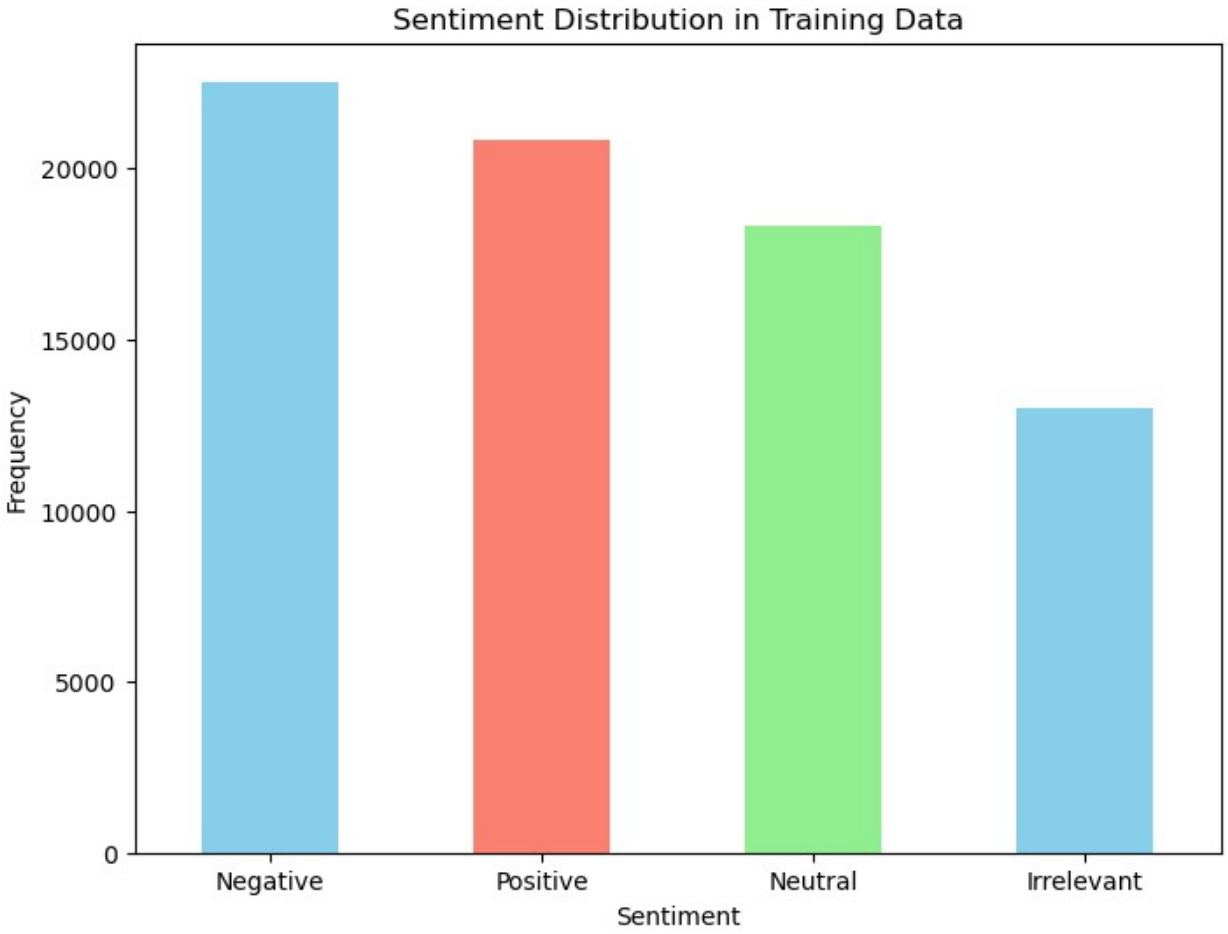
```
def preprocess_text(text):
    if not isinstance(text, str):  # Check if the input is a string
        return ""  # Return an empty string for non-string values
    text = text.lower()  # Convert to lowercase
    text = re.sub(r'http\S+', '', text)  # Remove URLs
    text = re.sub(r'@[A-Za-z0-9_]+|#[A-Za-z0-9_]+', '', text)  #
Remove mentions and hashtags
    text = re.sub(r'[^a-zA-Z]', ' ', text)  # Remove special
characters and numbers
    tokens = word_tokenize(text)  # Tokenize
    stop_words = set(stopwords.words('english'))
    tokens = [word for word in tokens if word not in stop_words]  #
Remove stopwords
    lemmatizer = WordNetLemmatizer()
    tokens = [lemmatizer.lemmatize(word) for word in tokens]  #
Lemmatize
    return ' '.join(tokens)

# Apply preprocessing
train_df['processed_text'] = train_df['text'].apply(preprocess_text)
validation_df['processed_text'] =
validation_df['text'].apply(preprocess_text)

# Validate results
print(train_df[['text', 'processed_text']].head())
print(validation_df[['text', 'processed_text']].head())
```

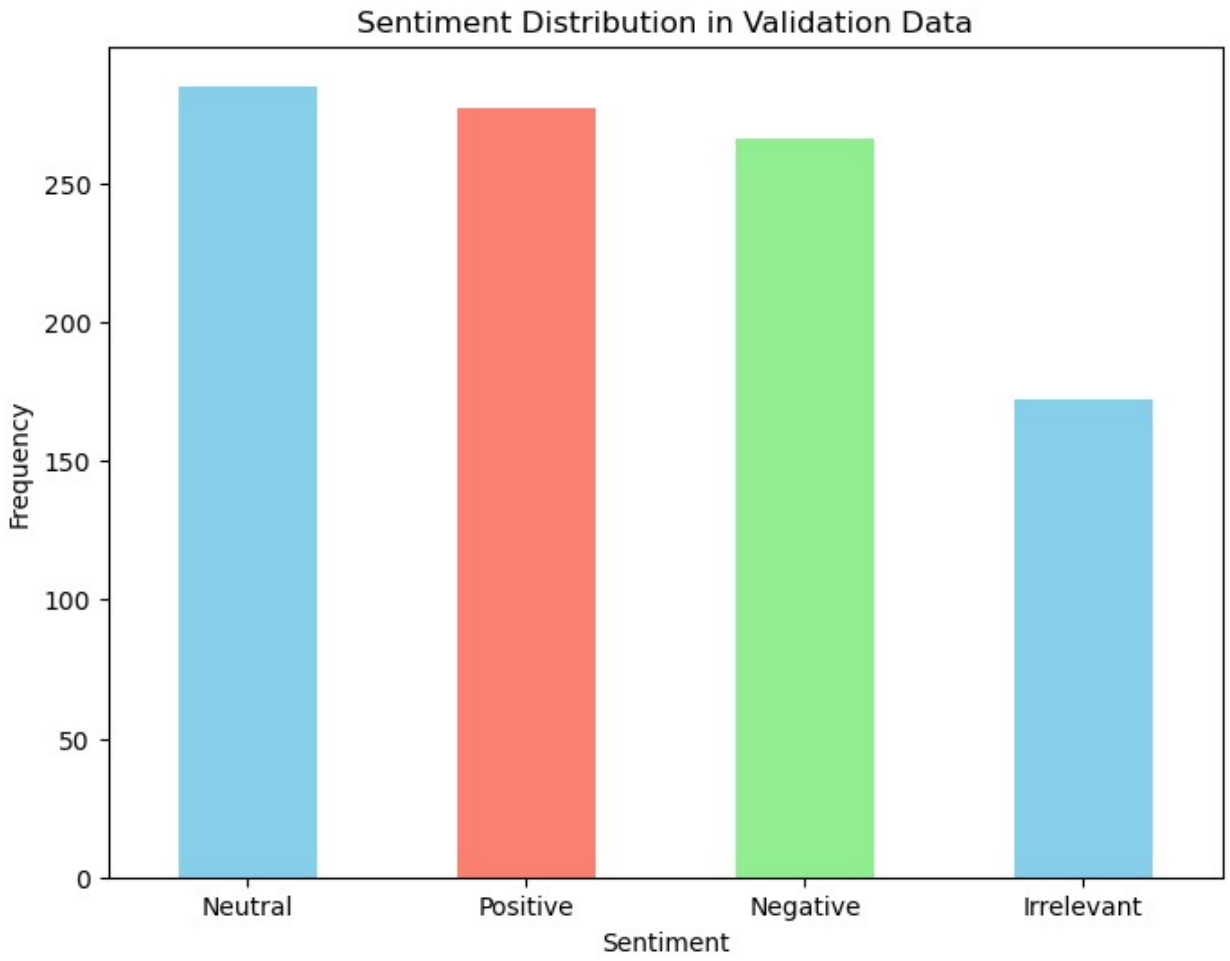
```
                                                text  \
0  im getting on borderlands and i will murder yo...
1  I am coming to the borders and I will kill you...
2  im getting on borderlands and i will kill you ...
3  im coming on borderlands and i will murder you...
4  im getting on borderlands 2 and i will murder ...

                 processed_text
0  im getting borderland murder
1            coming border kill
```

```
2    im getting borderland kill
3   im coming borderland murder
4  im getting borderland murder
                                                   text  \
0  I mentioned on Facebook that I was struggling ...
1  BBC News - Amazon boss Jeff Bezos rejects clai...
2  @Microsoft Why do I pay for WORD when it funct...
3  CSGO matchmaking is so full of closet hacking,...
4  Now the President is slapping Americans in the...

                                        processed_text
0  mentioned facebook struggling motivation go ru...
1  bbc news amazon bos jeff bezos reject claim co...
2                pay word function poorly chromebook
3  csgo matchmaking full closet hacking truly awf...
4  president slapping american face really commit...
```

Visualize Sentiment Distribution

```
def plot_sentiment_distribution(df, title):
    sentiment_counts = df['sentiment'].value_counts()
    sentiment_counts.plot(kind='bar', color=['skyblue', 'salmon',
'lightgreen'], figsize=(8, 6))
    plt.title(title)
    plt.xlabel('Sentiment')
    plt.ylabel('Frequency')
    plt.xticks(rotation=0)
    plt.show()

plot_sentiment_distribution(train_df, "Sentiment Distribution in
Training Data")
plot_sentiment_distribution(validation_df, "Sentiment Distribution in
Validation Data")
```


Sentiment Distribution in Training Data
Frequency
0
5000
10000
15000
20000
Negative
Positive
Neutral
Irrelevant
Sentiment

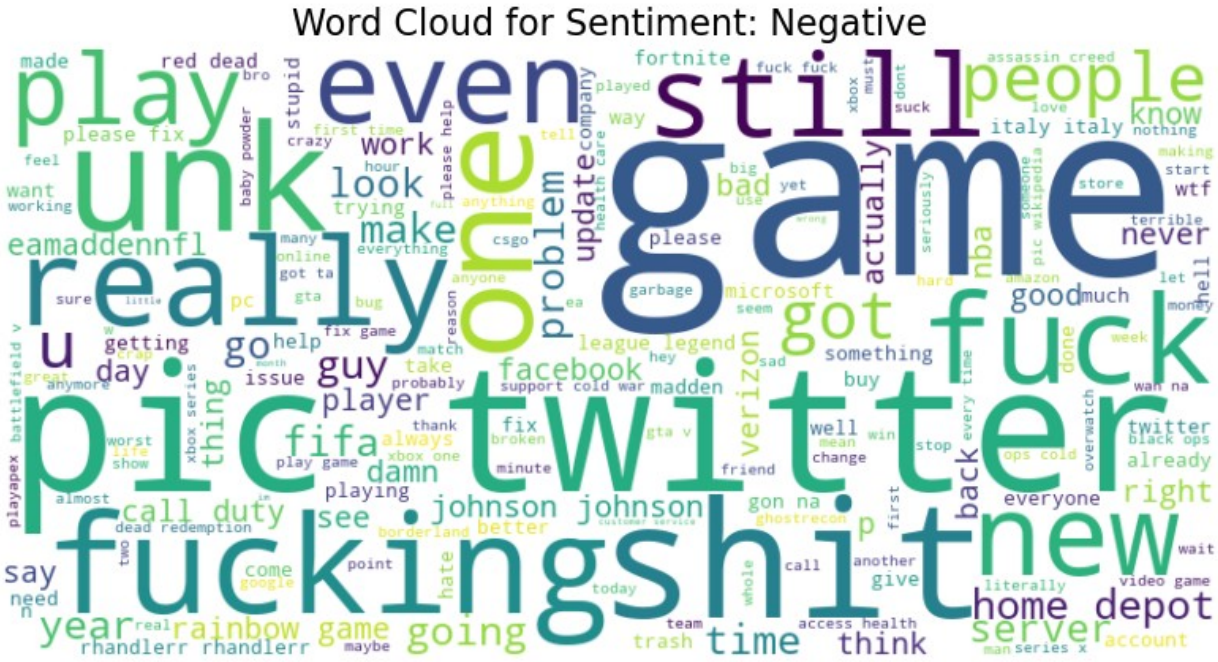


Generate Word Clouds

```
def plot_wordcloud(df, sentiment, title):
    text = ' '.join(df[df['sentiment'] == sentiment]
['processed_text'].tolist())
    wordcloud = WordCloud(width=800, height=400,
background_color='white').generate(text)
    plt.figure(figsize=(10, 5))
    plt.imshow(wordcloud, interpolation='bilinear')
    plt.axis('off')
    plt.title(title, fontsize=16)
    plt.show()

for sentiment in train_df['sentiment'].unique():
    plot_wordcloud(train_df, sentiment, f"Word Cloud for Sentiment:
{sentiment}")
```

Word Cloud for Sentiment: Positive

Word Cloud for Sentiment: Neutral



Feature Extraction with TF-IDF

```
vectorizer = TfidfVectorizer(max_features=5000)
X_train =
vectorizer.fit_transform(train_df['processed_text']).toarray()
X_val =
vectorizer.transform(validation_df['processed_text']).toarray()
```

```
y_train = train_df['sentiment']
y_val = validation_df['sentiment']
```

Train Random Forest Classifier

```
model = RandomForestClassifier(n_estimators=100, random_state=42)
model.fit(X_train, y_train)

RandomForestClassifier(random_state=42)
```

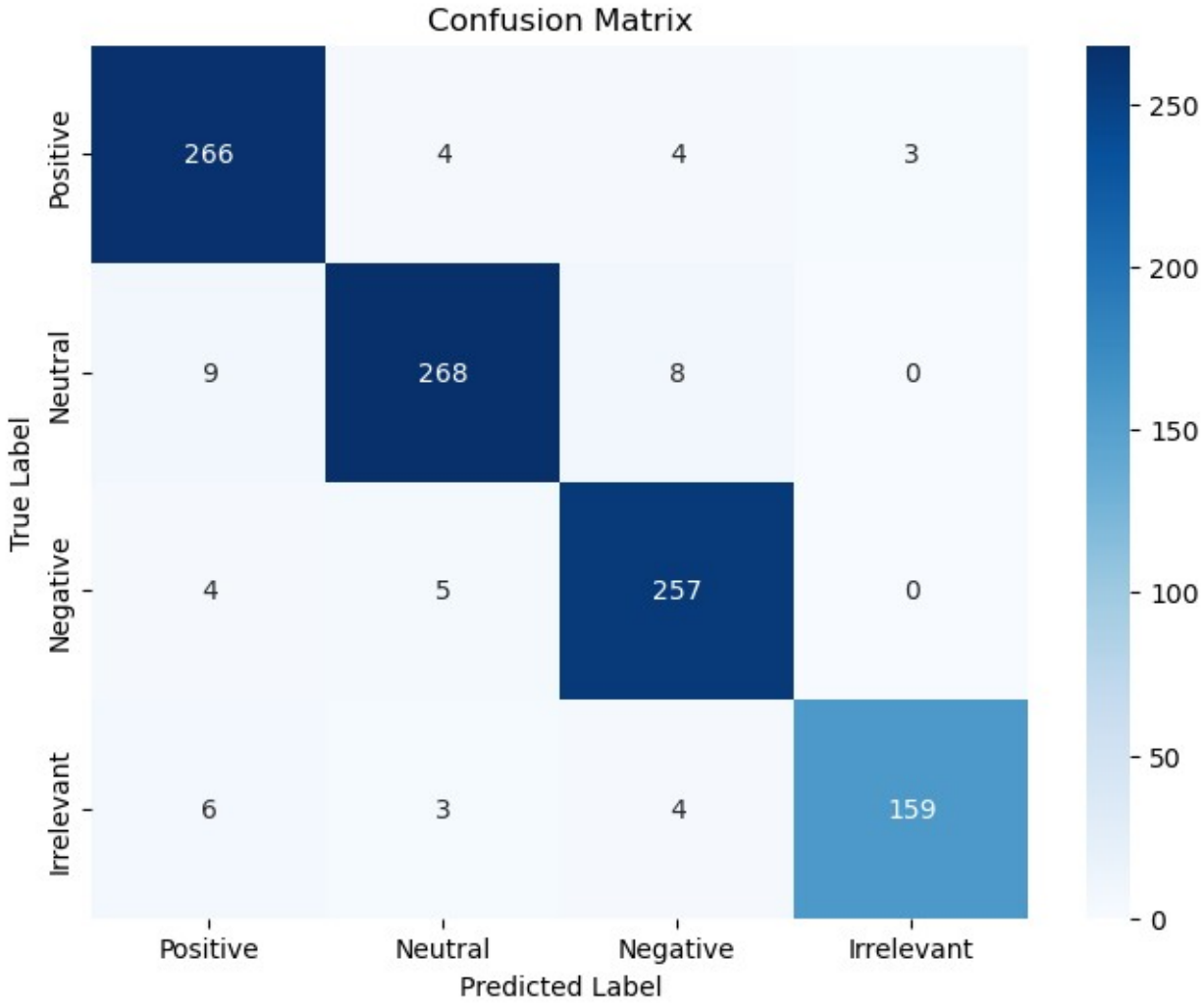
Evaluate Model Performance

```
y_pred = model.predict(X_val)

print("Classification Report:\n", classification_report(y_val,
y_pred))
print("Confusion Matrix:\n", confusion_matrix(y_val, y_pred))
print("Accuracy Score:", accuracy_score(y_val, y_pred))

Classification Report:
               precision    recall  f1-score   support

  Irrelevant       0.98      0.92      0.95       172
    Negative       0.94      0.97      0.95       266
     Neutral       0.96      0.94      0.95       285
    Positive       0.93      0.96      0.95       277

    accuracy                           0.95      1000
   macro avg       0.95      0.95      0.95      1000
weighted avg       0.95      0.95      0.95      1000

Confusion Matrix:
 [[159   4   3   6]
 [  0 257   5   4]
 [  0   8 268   9]
 [  3   4   4 266]]
Accuracy Score: 0.95
```

Visualize Confusion Matrix

```
def plot_confusion_matrix(y_true, y_pred, labels, title):
    cm = confusion_matrix(y_true, y_pred, labels=labels)
    plt.figure(figsize=(8, 6))
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
xticklabels=labels, yticklabels=labels)
    plt.title(title)
    plt.xlabel("Predicted Label")
    plt.ylabel("True Label")
    plt.show()
```

```
plot_confusion_matrix(y_val, y_pred,
labels=train_df['sentiment'].unique(), title="Confusion Matrix")
```



Feature Importance

```
def plot_feature_importance(vectorizer, model, top_n=20):
    feature_importances = model.feature_importances_
    feature_names = vectorizer.get_feature_names_out()
    top_features = np.argsort(feature_importances)[-top_n:]

    plt.figure(figsize=(10, 6))
    plt.barh([feature_names[i] for i in top_features],
feature_importances[top_features], color='seagreen')
    plt.title(f"Top {top_n} Important Features")
    plt.xlabel("Importance")
    plt.ylabel("Feature")
    plt.show()
```

```
plot_feature_importance(vectorizer, model, top_n=20)
```