```
!pip install nltk scikit-learn seaborn
```

```
Requirement already satisfied: nltk in /usr/local/lib/python3.10/dist-packages (3.9.1)
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.10/dist-packages (1.6.0)
Requirement already satisfied: seaborn in /usr/local/lib/python3.10/dist-packages (0.13.2)
Requirement already satisfied: click in /usr/local/lib/python3.10/dist-packages (from nltk) (8.1.7)
Requirement already satisfied: joblib in /usr/local/lib/python3.10/dist-packages (from nltk) (1.4.2)
Requirement already satisfied: regex>=2021.8.3 in /usr/local/lib/python3.10/dist-packages (from nltk) (2024.11.6)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from nltk) (4.67.1)
Requirement already satisfied: numpy>=1.19.5 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.26.4)
Requirement already satisfied: scipy>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (1.13.1)
Requirement already satisfied: threadpoolctl>=3.1.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn) (3.5.0)
Requirement already satisfied: pandas>=1.2 in /usr/local/lib/python3.10/dist-packages (from seaborn) (2.2.2)
Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in /usr/local/lib/python3.10/dist-packages (from seaborn) (3.8.0)
Requirement already satisfied: contourpy>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (1.3.
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (4.5
Requirement already satisfied: kiwisolver>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (1.4
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (24.2)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (11.0.0)
Requirement already satisfied: pyparsing>=2.3.1 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (3.2.
Requirement already satisfied: python-dateutil>=2.7 in /usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn) (
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.2->seaborn) (2024.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-packages (from pandas>=1.2->seaborn) (2024.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-packages (from python-dateutil>=2.7->matplotlib!=3.6.1,>=3.4->
```

```
# Import necessary 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.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, precision_score, recall_score, f1_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt
```

```
# Download necessary NLTK resources
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')
```

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

```
from google.colab import files
uploaded = files.upload()

# Load the dataset
df = pd.read_csv('amazon.csv')  # Ensure 'amazon.csv' is the correct file name
```

Choose files No file chosen   Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
# Check the first few rows of the dataset
df.head()
```

	Text	label
0	This is the best apps acording to a bunch of ...	1
1	This is a pretty good version of the game for ...	1
2	this is a really . there are a bunch of levels...	1
3	This is a silly game and can be frustrating, b...	1
4	This is a terrific game on any pad. Hrs of fun...	1

```
# Download necessary NLTK resources
import nltk
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')
```

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

```
import nltk
nltk.download('punkt')  # Ensure the correct 'punkt' resource is downloaded
```

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

```
import nltk
nltk.data.path.append('/usr/share/nltk_data')  # Add the resource path
nltk.download('punkt', download_dir='/usr/share/nltk_data')  # Force download to this directory
```

```
[nltk_data] Downloading package punkt to /usr/share/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
True
```

```
import nltk

# Add the resource path to NLTK
nltk.data.path.append('/usr/share/nltk_data')  # Ensure nltk looks in the correct directory

# Download the punkt resource and punkt_tab resource
nltk.download('punkt', download_dir='/usr/share/nltk_data')  # Force download to the specified path
nltk.download('punkt_tab', download_dir='/usr/share/nltk_data')  # Ensure punkt_tab is also downloaded
```

```
[nltk_data] Downloading package punkt to /usr/share/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package punkt_tab to /usr/share/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt_tab.zip.
True
```

```
# Data Preprocessing Functions

# Clean the text data
def clean_text(text):
    text = re.sub(r'\W', ' ', text)  # Remove non-alphanumeric characters
    text = re.sub(r'\s+', ' ', text)  # Remove extra spaces
    text = text.lower()  # Convert to lowercase
    text = re.sub(r'\d+', '', text)  # Remove numbers
    stop_words = set(stopwords.words('english'))  # Stopwords
    text = ' '.join([word for word in text.split() if word not in stop_words])
    return text

# Lemmatize words
lemmatizer = WordNetLemmatizer()

def lemmatize_words(text):
    tokens = word_tokenize(text)
    return ' '.join([lemmatizer.lemmatize(word) for word in tokens])

# Apply the cleaning and lemmatization functions
# Apply the cleaning and lemmatization functions
df['cleaned_reviews'] = df['Text'].apply(clean_text)  # Use 'Text' as the column name
df['lemmatized_reviews'] = df['cleaned_reviews'].apply(lemmatize_words)
```

```
# Vectorization using TF-IDF
vectorizer = TfidfVectorizer(max_features=5000)
X = vectorizer.fit_transform(df['lemmatized_reviews']).toarray()
```

```
# Split the data into train and test sets
X_train, X_test, y_train, y_test = train_test_split(X, df['label'], test_size=0.2, random_state=42)
```

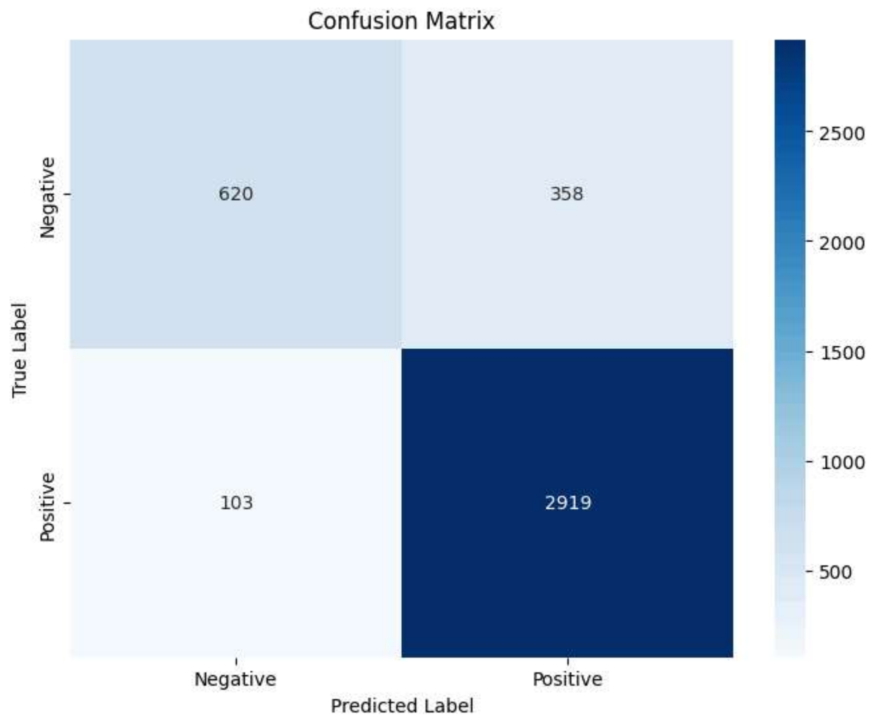
```
# Initialize the Logistic Regression model
model = LogisticRegression()

# Train the model
model.fit(X_train, y_train)
```

```
▾ LogisticRegression
LogisticRegression()
```

```
# Predict the sentiment of the test set
y_pred = model.predict(X_test)

# Evaluate model performance
accuracy = accuracy_score(y_test, y_pred)
precision = precision_score(y_test, y_pred, average='binary')  # Adjust for multiclass if needed
recall = recall_score(y_test, y_pred, average='binary')
f1 = f1_score(y_test, y_pred, average='binary')

print(f'Accuracy: {accuracy}')
print(f'Precision: {precision}')
print(f'Recall: {recall}')
print(f'F1 Score: {f1}')
```

```
Accuracy: 0.88475
Precision: 0.8907537381751602
Recall: 0.9659166115155526
F1 Score: 0.9268137799650739
```

```
# Generate and visualize the confusion matrix
cm = confusion_matrix(y_test, y_pred)

plt.figure(figsize=(8, 6))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['Negative', 'Positive'], yticklabels=['Negative', 'Positive'])
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.title('Confusion Matrix')
plt.show()
```



```
import joblib

# Save the model
joblib.dump(model, 'sentiment_model.pkl')

# Save the vectorizer
joblib.dump(vectorizer, 'vectorizer.pkl')
```

```
['vectorizer.pkl']
```

```
def predict_sentiment(text):
    cleaned_text = clean_text(text)
    lemmatized_text = lemmatize_words(cleaned_text)
    vectorized_text = vectorizer.transform([lemmatized_text]).toarray()
    return model.predict(vectorized_text)

# Test with a new review
new_review = "This product is amazing! Highly recommend it."
sentiment = predict_sentiment(new_review)
print(f"The sentiment of the review is: {sentiment[0]}")
```

```
The sentiment of the review is: 1
```

```
import joblib

# Save the trained model
joblib.dump(model, 'sentiment_model.pkl')

# Save the TF-IDF vectorizer
joblib.dump(vectorizer, 'vectorizer.pkl')
```

```
['vectorizer.pkl']
```

```
!zip sentiment_analysis_files384.zip sentiment_model.pkl vectorizer.pkl
```

```
  adding: sentiment_model.pkl (deflated 5%)
  adding: vectorizer.pkl (deflated 72%)
```

```
!ls
```

```
amazon.csv   sentiment_analysis_files384.zip  sentiment_model.pkl
sample_data  sentiment_analysis_files.zip     vectorizer.pkl
```

```
from google.colab import files
files.download('sentiment_analysis_files384.zip')
```