```
pip install wordcloud
```

```
Requirement already satisfied: wordcloud in c:\users\admin\anaconda3\
lib\site-packages (1.9.4)
Requirement already satisfied: numpy>=1.6.1 in c:\users\admin\
anaconda3\lib\site-packages (from wordcloud) (2.1.3)
Requirement already satisfied: pillow in c:\users\admin\anaconda3\lib\
site-packages (from wordcloud) (11.1.0)
Requirement already satisfied: matplotlib in c:\users\admin\anaconda3\
lib\site-packages (from wordcloud) (3.10.0)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (1.3.1)
Requirement already satisfied: cycler>=0.10 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (0.11.0)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (4.55.3)
Requirement already satisfied: kiwisolver>=1.3.1 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (1.4.8)
Requirement already satisfied: packaging>=20.0 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (24.2)
Requirement already satisfied: pyparsing>=2.3.1 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (3.2.0)
Requirement already satisfied: python-dateutil>=2.7 in c:\users\admin\
anaconda3\lib\site-packages (from matplotlib->wordcloud) (2.9.0.post0)
Requirement already satisfied: six>=1.5 in c:\users\admin\anaconda3\
lib\site-packages (from python-dateutil>=2.7->matplotlib->wordcloud)
(1.17.0)
Note: you may need to restart the kernel to use updated packages.
```

```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import nltk
from nltk.stem.porter import PorterStemmer
from nltk.corpus import stopwords
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import cross_val_score
from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import StratifiedKFold
from sklearn.metrics import accuracy_score

from xgboost import XGBClassifier
import pickle
import re

nltk.download('stopwords')
STOPWORDS = set(stopwords.words('english'))
```

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

Preprocessing and Modelling

To build the corpus from the 'verified_reviews' we perform the following -

1. Replace any non alphabet characters with a space
2. Covert to lower case and split into words
3. Iterate over the individual words and if it is not a stopword then add the stemmed form of the word to the corpus

```
data = pd.read_csv(r"..\Data\amazon_alexa.tsv", delimiter = '\t',
quoting = 3)

print("\nMissing values:\n", data.isnull().sum())
data.dropna(inplace=True)
data.head()
```

```
Missing values:
 rating              0
date                0
variation           0
verified_reviews    1
feedback            0
dtype: int64
```

	rating	date	variation	verified_reviews	feedback
0	5	31-Jul-18	Charcoal Fabric	Love my Echo!	1
1	5	31-Jul-18	Charcoal Fabric	Loved it!	1
2	4	31-Jul-18	Walnut Finish	"Sometimes while playing a game, you can answe...	1
3	5	31-Jul-18	Charcoal Fabric	"I have had a lot of fun with this thing. My 4...	1
4	5	31-Jul-18	Charcoal Fabric	Music	1

corpus = []

```
Initializes an empty list called corpus.
This list will eventually hold the cleaned, preprocessed versions of
all reviews.
```

stemmer = PorterStemmer()

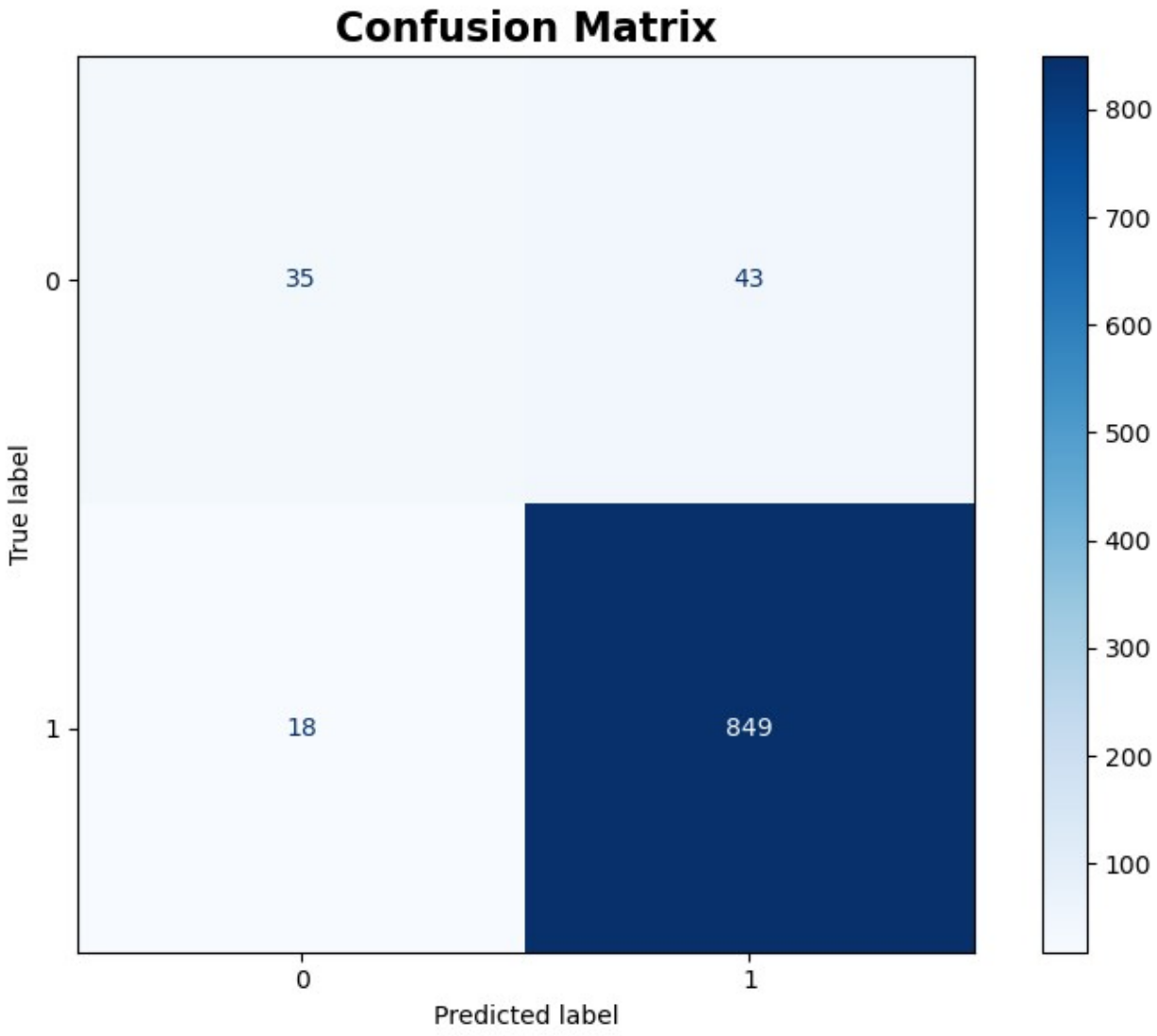
```
Creates an instance of the Porter Stemmer from the nltk library.
Stemming reduces words to their root form (e.g., "running" → "run",
"played" → "play").
This helps in treating different forms of the same word as one.

corpus = []
stemmer = PorterStemmer()
for i in range(0, data.shape[0]):
  review = re.sub('[^a-zA-Z]', ' ', data.iloc[i]['verified_reviews'])
  review = review.lower().split()
  review = [stemmer.stem(word) for word in review if not word in
STOPWORDS]
  review = ' '.join(review)
  corpus.append(review)

cv = CountVectorizer(max_features = 2500)

#Storing independent and dependent variables in X and y
X = cv.fit_transform(corpus).toarray()
y = data['feedback'].values

pickle.dump(cv, open('../Models/countVectorizer.pkl', 'wb'))

print(f"X shape: {X.shape}")
print(f"y shape: {y.shape}")

X shape: (3149, 2500)
y shape: (3149,)
```

Splitting data into train and test set with 30% data with testing.

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size =
0.3, random_state = 15)

print(f"X train: {X_train.shape}")
print(f"y train: {y_train.shape}")
print(f"X test: {X_test.shape}")
print(f"y test: {y_test.shape}")

X train: (2204, 2500)
y train: (2204,)
X test: (945, 2500)
y test: (945,)

print(f"X train max value: {X_train.max()}")
print(f"X test max value: {X_test.max()}")

X train max value: 12
X test max value: 10
```

```
scaler = MinMaxScaler()

X_train_scl = scaler.fit_transform(X_train)
X_test_scl = scaler.transform(X_test)

pickle.dump(scaler, open('../Models/scaler.pkl', 'wb'))

model_xgb = XGBClassifier()
model_xgb.fit(X_train_scl, y_train)

XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None,
early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None,
feature_types=None,
              feature_weights=None, gamma=None, grow_policy=None,
              importance_type=None, interaction_constraints=None,
              learning_rate=None, max_bin=None,
max_cat_threshold=None,
              max_cat_to_onehot=None, max_delta_step=None,
max_depth=None,
              max_leaves=None, min_child_weight=None, missing=nan,
              monotone_constraints=None, multi_strategy=None,
n_estimators=None,
              n_jobs=None, num_parallel_tree=None, ...)

#Accuracy of the model on training and testing data
print("Training Accuracy :", model_xgb.score(X_train_scl, y_train))
print("Testing Accuracy :", model_xgb.score(X_test_scl, y_test))

Training Accuracy : 0.9718693284936479
Testing Accuracy : 0.9375661375661376

y_preds = model_xgb.predict(X_test)

#Confusion Matrix
cm = confusion_matrix(y_test, y_preds)
print(cm)

[[ 35  43]
 [ 18 849]]

# Create ConfusionMatrixDisplay object with your confusion matrix and
class labels
cm_display = ConfusionMatrixDisplay(confusion_matrix=cm,
display_labels=model_xgb.classes_)

# Plot with a larger figure and a colormap for better visualization
plt.figure(figsize=(8, 6))
cm_display.plot(cmap='Blues', colorbar=True, ax=plt.gca())
```

```
# Add title and adjust layout
plt.title('Confusion Matrix', fontsize=16, weight='bold')
plt.tight_layout()
plt.show()
```




```
#Saving the XGBoost classifier
pickle.dump(model_xgb, open('../Models/model_xgb.pkl', 'wb'))
```