In [ ]:
```
import pandas as pd
```

In [ ]:
```
email_data=pd.read_csv('spam.csv',encoding='ISO-8859-1')
email_data
```

Out[ ]:

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN
...	...	...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	NaN	NaN	NaN
5568	ham	Will Ì_ b going to esplanade fr home?	NaN	NaN	NaN
5569	ham	Pity, * was in mood for that. So...any other s...	NaN	NaN	NaN
5570	ham	The guy did some bitching but I acted like i'd...	NaN	NaN	NaN
5571	ham	Rofl. Its true to its name	NaN	NaN	NaN

5572 rows × 5 columns

In [ ]:
```
email_data.drop(columns=['Unnamed: 2'   ,'Unnamed: 3'   ,'Unnamed: 4'],inpla
email_data
```

Out[ ]:

	v1	v2
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...
...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...
5568	ham	Will Ì_ b going to esplanade fr home?
5569	ham	Pity, * was in mood for that. So...any other s...
5570	ham	The guy did some bitching but I acted like i'd...
5571	ham	Rofl. Its true to its name

5572 rows × 2 columns

In [ ]:
```
from sklearn.preprocessing import LabelEncoder
label_encoder=LabelEncoder()
```

```
email_data['v1']=label_encoder.fit_transform(email_data['v1'])
email_data
```

Out[ ]:

	v1	v2
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...
...	...	...
5567	1	This is the 2nd time we have tried 2 contact u...
5568	0	Will Ì_ b going to esplanade fr home?
5569	0	Pity, * was in mood for that. So...any other s...
5570	0	The guy did some bitching but I acted like i'd...
5571	0	Rofl. Its true to its name

5572 rows × 2 columns

In [ ]:
```
X=email_data.iloc[:,-1]
y=email_data.iloc[:,0]
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)
```

In [ ]:
```
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.naive_bayes import MultinomialNB
```

In [ ]:
```
from sklearn.pipeline import Pipeline
clf=Pipeline([
    ('vectorizer',CountVectorizer()),
    ('nb',MultinomialNB())
])
```

In [ ]:
```
clf.fit(X_train,y_train)
y_pred = clf.predict(X_test)
```

In [ ]:
```
from sklearn.metrics import classification_report, accuracy_score

accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy}')

report = classification_report(y_test, y_pred)
print(report)
```

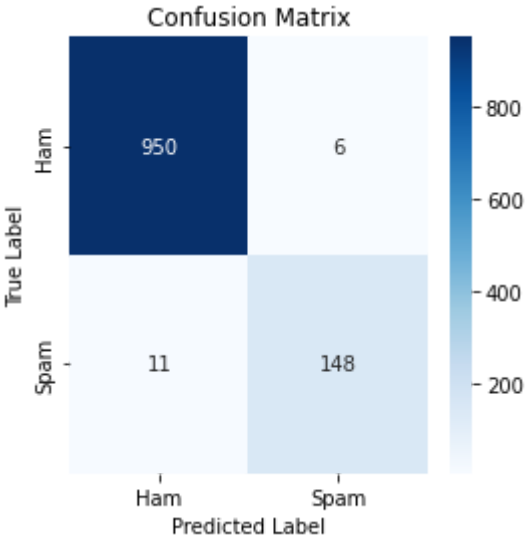
```
Accuracy: 0.9847533632286996
              precision    recall  f1-score   support

           0       0.99      0.99      0.99       956
           1       0.96      0.93      0.95       159

    accuracy                           0.98      1115
   macro avg       0.97      0.96      0.97      1115
weighted avg       0.98      0.98      0.98      1115
```

In [ ]:
```
from sklearn.metrics import confusion_matrix
import matplotlib.pyplot as plt
import seaborn as sns
cm = confusion_matrix(y_test, y_pred)

plt.figure(figsize=(4, 4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', xticklabels=['Ham', 'Spam
plt.xlabel('Predicted Label')
plt.ylabel('True Label')
plt.title('Confusion Matrix')
plt.show()
```



In [ ]:
```
results = pd.DataFrame({'True Label': y_test, 'Predicted Label': y_pred})
results['Index'] = results.index
plt.figure(figsize=(12, 6))
sns.scatterplot(data=results, x='Index', y='True Label', label='True Label',
sns.scatterplot(data=results, x='Index', y='Predicted Label', label='Predict
plt.xlabel('Index')
plt.ylabel('Label')
plt.title('True vs Predicted Labels')
plt.legend()
plt.show()
```