Ex 3: Spam or ham

Cho dữ liệu spam.csv

Yêu cầu: đọc dữ liệu về, chuẩn hóa dữ liệu (nếu cần) và áp dụng thuật toán Naive Bayes để thực hiện việc dự đoán khả năng email là spam hay không dựa trên các thuộc tính v2

1. Tạo X_train, X_test, y_train, y_test từ dữ liệu đọc được với tỷ lệ dữ liệu test là 0.2
2. Áp dụng thuật toán Naive Bayer => kết quả
3. Đánh giá mô hình
4. Ghi mô hình
5. Đọc mô hình vừa ghi => dự đoán kết quả cho câu 6
6. Cho dữ liệu Test: x_new = np.array(['Dear Ms. Phuong. I will come on time.', 'URGENT! We are trying to contact you. Today is the last day of sale. Discount up to 50%']) => sẽ là ham hay spam?

In [1]:
```python
import numpy as np
import pandas as pd
from sklearn.naive_bayes import MultinomialNB
from sklearn.feature_extraction.text import CountVectorizer
```

In [2]:
```python
data = pd.read_csv("spam.csv", encoding='latin-1')
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 5 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   v1          5572 non-null   object
 1   v2          5572 non-null   object
 2   Unnamed: 2  50 non-null     object
 3   Unnamed: 3  12 non-null     object
 4   Unnamed: 4  6 non-null      object
dtypes: object(5)
memory usage: 217.8+ KB
```

In [3]:
```python
data['v1'].head()
```

Out[3]:
```
0     ham
1     ham
2    spam
3     ham
4     ham
Name: v1, dtype: object
```

In [4]:
```python
source = data['v2']
type(source)
```

Out[4]:
```
pandas.core.series.Series
```

In [5]:
```python
source[:5]
```

Out[5]:
```
0    Go until jurong point, crazy.. Available only ...
1                        Ok lar... Joking wif u oni...
2    Free entry in 2 a wkly comp to win FA Cup fina...
3    U dun say so early hor... U c already then say...
4    Nah I don't think he goes to usf, he lives aro...
Name: v2, dtype: object
```

In [6]:
```python
data.groupby('v1').v2.count()
```

Out[6]:
```
v1
ham     4825
spam     747
Name: v2, dtype: int64
```

In [7]:
```python
target = data['v1']
type(target)
```

Out[7]:
```
pandas.core.series.Series
```

In [8]:
```python
# ham = 0, spam = 1
```

In [9]:
```python
target = target.replace("ham", 0)
```

In [10]:
```python
target = target.replace("spam", 1)
```

In [11]:
```python
target[:5]
```

```
Out[11]: 0    0
         1    0
         2    1
         3    0
         4    0
         Name: v1, dtype: int64
```

```
In [12]: text_data = np.array(source)
         text_data
```

```
Out[12]: array(['Go until jurong point, crazy.. Available only in bugis n great world la e buffet... Cine there got amore wat...',
                'Ok lar... Joking wif u oni...',
                "Free entry in 2 a wkly comp to win FA Cup final tkts 21st May 2005. Text FA to 87121 to receive entry question(std tx
         t rate)T&C's apply 08452810075over18's",
                ..., 'Pity, * was in mood for that. So...any other suggestions?',
                "The guy did some bitching but I acted like i'd be interested in buying something else next week and he gave it to us
         for free",
                'Rofl. Its true to its name'], dtype=object)
```

```
In [13]: count = CountVectorizer()
         count.fit(text_data)
         bag_of_words = count.transform(text_data)
         bag_of_words
```

```
Out[13]: <5572x8672 sparse matrix of type '<class 'numpy.int64'>'
                 with 73916 stored elements in Compressed Sparse Row format>
```

```
In [14]: X = bag_of_words.toarray()
         X
```

```
Out[14]: array([[0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                ...,
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0],
                [0, 0, 0, ..., 0, 0, 0]], dtype=int64)
```

```
In [15]: X.shape
```

```
Out[15]: (5572, 8672)
```

```
In [16]: y = np.array(target)
```

```
In [17]: y.shape
```

```
Out[17]: (5572,)
```

```
In [18]: from sklearn.model_selection import train_test_split
         X_train, X_test, y_train, y_test = train_test_split(X, y,
                                                             test_size=0.20)
```

```
In [19]: clf = MultinomialNB()
         model = clf.fit(X_train, y_train)
```

```
In [20]: y_pred = clf.predict(X_test)
```

```
In [21]: print('score Scikit learn - train: ', model.score(X_train,y_train))

         score Scikit learn - train:  0.9948395781916087
```

```
In [22]: print('score Scikit learn: ', model.score(X_test,y_test))

         score Scikit learn:  0.967713004484305
```

```
In [23]: from sklearn.metrics import accuracy_score
         print("Accuracy is ", accuracy_score(y_test,y_pred)*100,"%")

         Accuracy is  96.7713004484305 %
```

```
In [24]: # Nhận xét: Cả training và testing đều có Score cao
```

```
In [25]: from sklearn.metrics import confusion_matrix
```

```
In [26]: confusion_matrix(y_test, y_pred, labels=[0, 1])
```

```
Out[26]: array([[946,  24],
                [ 12, 133]], dtype=int64)
```

```
In [27]: # Đánh giá model
         from sklearn. metrics import classification_report, roc_auc_score, roc_curve
```

```
In [28]: print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.99      0.98      0.98       970
           1       0.85      0.92      0.88       145

    accuracy                           0.97      1115
   macro avg       0.92      0.95      0.93      1115
weighted avg       0.97      0.97      0.97      1115
```

In [29]:
```
# Nhận xét: Có precision cao, recall cao
```

In [30]:
```
y_prob = model.predict_proba(X_test)
y_prob
```

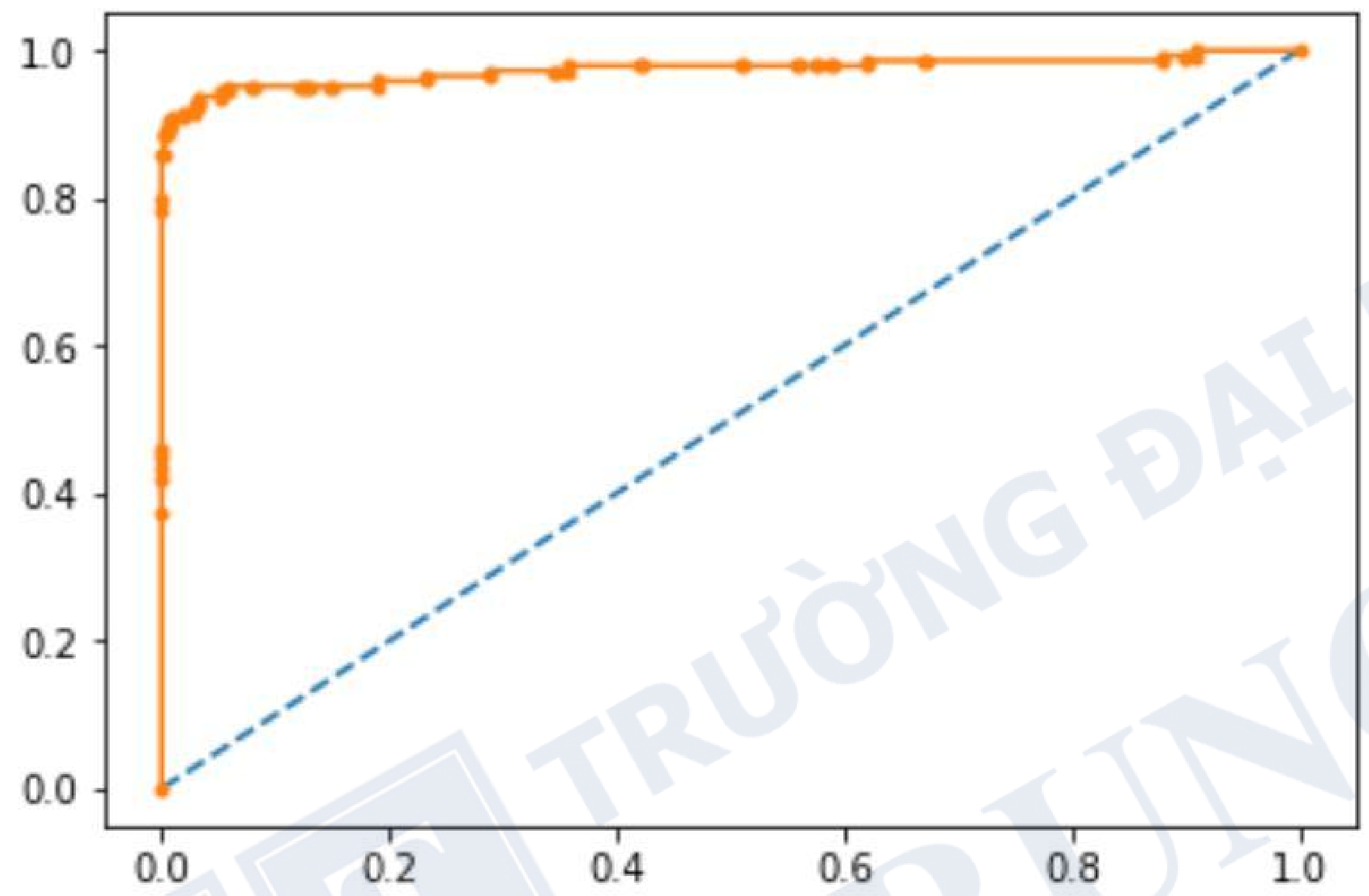
Out[30]:
```
array([[9.99970426e-01, 2.95736027e-05],
       [1.69064346e-14, 1.00000000e+00],
       [9.99999308e-01, 6.91794552e-07],
       ...,
       [8.75278975e-01, 1.24721025e-01],
       [9.98471447e-01, 1.52855276e-03],
       [9.99999916e-01, 8.42906002e-08]])
```

In [31]:
```
roc_auc_score(y_test, y_prob[:, 1])
```

Out[31]:
```
0.9743654461429079
```

In [32]:
```
import matplotlib.pyplot as plt
```

In [33]:
```
# calculate roc curve
fpr, tpr, thresholds = roc_curve(y_test, y_prob[:, 1])
# plot no skill
plt.plot([0, 1], [0, 1], linestyle='--')
plt.plot(fpr, tpr, marker='.')
plt.show()
```



In [34]:
```
# ROC cao
# Dựa trên tất cả các đánh giá => Model phù hợp
```

In [35]:
```
# Ghi model
```

In [36]:
```
import pickle
pkl_filename = "ham_spam_model.pkl"
with open(pkl_filename, 'wb') as file:
    pickle.dump(model, file)

# luu model CountVectorizer (count) theo cach tren
pkl_count = "count_model.pkl"
with open(pkl_count, 'wb') as file:
    pickle.dump(count, file)
```

In [37]:
```
# Đọc model
# import pickle
with open(pkl_filename, 'rb') as file:
    ham_spam_model = pickle.load(file)
# doc model count len
with open(pkl_count, 'rb') as file:
    count_model = pickle.load(file)
```

In [38]:
```
x_new = np.array(['Dear Ms. Phuong. I will come on time.',
                  'URGENT! We are trying to contact you. Today is the last day of sale. Discount up to 50%'])
x_new = count_model.transform(x_new)
```

In [39]:
```
y_pred_new = ham_spam_model.predict(x_new)
y_pred_new
```

Out[39]:
```
array([0, 1], dtype=int64)
```