Chapter 4 - Exercise 4: Text Classification

Cho dữ liệu sklearn.datasets.fetch_20newsgroups chứa các văn bản ngắn được phân chia thành 20 loại khác nhau.

Yêu cầu: Đọc dữ liệu của 3 loại là 'comp.graphics', 'rec.sport.baseball', 'sci.electronics'; chuẩn hóa dữ liệu (nếu cần) và áp dụng thuật toán Naive Bayes để thực hiện việc dự đoán một văn bản thuộc vào loại nào trong ba loại nói trên.

1. Lấy train.data, train.target, test.data, test.target từ dữ liệu trên.
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(['The field is considered a subset of visual communication and communication design. They use typography, visual arts, and page layout techniques to create visual compositions.', 'Clubs are conducting Summer Camp at the ballparks in their home cities (not their Spring Training facilities).', 'NXP claims to be first to deliver in-vehicle multi-device simultaneous wireless charging driven by a single MWCT controller. NXP has expanded its offerings to the 15W wireless power standard, enabling faster charging.']) => sẽ là văn bản thuộc các loại nào?

In [1]:
```
import numpy as np
import pandas as pd
from sklearn.naive_bayes import MultinomialNB
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.datasets import fetch_20newsgroups
```

In [2]:
```
data = fetch_20newsgroups()
data.target_names
```

```
Downloading 20news dataset. This may take a few minutes.
Downloading dataset from https://ndownloader.figshare.com/files/5975967 (http
s://ndownloader.figshare.com/files/5975967) (14 MB)
```

Out[2]:
```
['alt.atheism',
 'comp.graphics',
 'comp.os.ms-windows.misc',
 'comp.sys.ibm.pc.hardware',
 'comp.sys.mac.hardware',
 'comp.windows.x',
 'misc.forsale',
 'rec.autos',
 'rec.motorcycles',
 'rec.sport.baseball',
 'rec.sport.hockey',
 'sci.crypt',
 'sci.electronics',
 'sci.med',
 'sci.space',
 'soc.religion.christian',
 'talk.politics.guns',
 'talk.politics.mideast',
 'talk.politics.misc',
 'talk.religion.misc']
```

In [8]:
```
categories = ['comp.graphics', 'rec.sport.baseball',
              'sci.electronics']
train = fetch_20newsgroups(subset='train', categories=categories)
test = fetch_20newsgroups(subset='test', categories=categories)
```

In [14]:
```
type(train.data)
```

Out[14]:
```
list
```

In [20]:
```
len(train.data)
```

Out[20]:
```
1772
```

In [22]:
```
train.data[0]
```

Out[22]:
```
"From: wellison@kuhub.cc.ukans.edu\nSubject: Re: electronic odometers\nArticle-
I.D.: kuhub.1993Apr15.153153.49197\nOrganization: University of Kansas Academic
Computing Services\nLines: 10\n\nI had the insturment panel go out in my car (a
1990 Lincoln Contenintal) which\nis a digital dash. They replaced the whole thi
ng with a 1991 dash (thank god it\nwas under the warrenty ! :-) Anyway, the odo
meter was reading the exact milage\nfrom the old panel. It must have a EEPROM o
f some sort in it that is up-dated.\nSeems to me that removing the battery woul
d erase it, but it doesn't. So I\nguess they swapped the NVM chip (non-volitile
memory) and installed it in the\nnew dash. No, they wouldn't let me have the ol
d dash to tinker with :-(\n\n\n-=-= Wes =-=-\n"
```

In [25]:
```
train.target[0]
```

Out[25]:
```
2
```

In [32]:
```
type(train.target)
```

Out[32]:
```
numpy.ndarray
```

In [33]:
```
train.target
```

Out[33]:
```
array([2, 1, 0, ..., 0, 1, 1], dtype=int64)
```

In [35]:
```
unique_elements, counts_elements = np.unique(train.target, return_counts=True)
print("Frequency of each category (train):")
print(np.asarray((unique_elements, counts_elements)))
```

```
Frequency of each category (train):
[[  0   1   2]
 [584 597 591]]
```

In [21]:
```
len(test.data)
```

Out[21]:
```
1179
```

In [28]:
```
test.data[100]
```

Out[28]:
```
"From: 9130037@golum.riv.csu.edu.au (CHAN Yin Mei)\nSubject: help! colour displ
ay restriction/limitation\nOriginator: 9130037@golum.riv.csu.edu.au\nOrganizati
on: Charles Sturt University - Riverina, Wagga Wagga, NSW, Australia\nLines: 29
\n\nhi netters,\n\n\tI'm doing a project which is about image analysis.  Firstl
y, I\nhave to find out any restrictions or limitations on the colour display\no
n various kind of workstations, they are DECstation, HP, Amiga, Apollo.\n\n\tSe
condly, I read from some graphic texts that image is displayed\nin 24 bites(ple
ase point out to me if I got it wrong).  But, the images\nwhich I will deal wit
h are displayed in 16 bites by the software they\nare using currently.  So, wil
l there be any problems to display them\nunder X-windows in the future? Because
we are thinking to implement the\nGUI by X-windows for our project\n\n\n\tIs th
ere any person here can help me to solve the problem or\nquery above?  Or, give
me some advice or suggestion where I can find\nthem out. \n\n\tPlease send me a
n e-mail if there are any.  Thanks in advance.\n\n\n\n\t\t\t\t\t\tYours\n\t\t\t
\n\t\t\t\t\t\tChristine Chan\n\n\nmy address : 9130037@golum.riv.csu.edu.au\n\t
\t\t\t\t\t\n"
```

In [31]:
```
test.target[100]
```

Out[31]:
```
0
```

Pre-processing data

In [36]:
```
count = CountVectorizer()
count.fit(train.data)
bag_of_words_train = count.transform(train.data)
bag_of_words_train
```

Out[36]:
```
<1772x26378 sparse matrix of type '<class 'numpy.int64'>'
        with 226969 stored elements in Compressed Sparse Row format>
```

In [42]:
```
bag_of_words_test = count.transform(test.data)
bag_of_words_test
```

Out[42]:
```
<1179x26378 sparse matrix of type '<class 'numpy.int64'>'
        with 154176 stored elements in Compressed Sparse Row format>
```

In [37]:
```
X_train = bag_of_words_train.toarray()
X_train
```

Out[37]:
```
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, 2, 0, ..., 0, 0, 0]], dtype=int64)
```

In [38]:
```
X_train.shape
```

Out[38]:
```
(1772, 26378)
```

In [43]:
```
X_test = bag_of_words_test.toarray()
X_test
```

Out[43]:
```
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 [44]:
```
X_test.shape
```

Out[44]:
```
(1179, 26378)
```

In [40]:
```
y_train = np.array(train.target)
```

In [41]:
```
y_train.shape
```

Out[41]:
```
(1772,)
```

In [45]:
```
y_test = np.array(test.target)
```

In [46]:
```
y_test.shape
```

Out[46]:
```
(1179,)
```

Build model

In [47]:
```
nb = MultinomialNB()
model = nb.fit(X_train, y_train)
```

In [48]:
```
y_pred = model.predict(X_test)
```

In [49]:
```
print('score Scikit learn - train: ', model.score(X_train,y_train))
```

```
score Scikit learn - train:  0.9971783295711061
```

In [50]:
```
print('score Scikit learn: ', model.score(X_test,y_test))
```

```
score Scikit learn:  0.9431721798134012
```

In [51]:
```
from sklearn.metrics import accuracy_score
print("Accuracy is ", accuracy_score(y_test,y_pred)*100,"%")
```

```
Accuracy is  94.31721798134012 %
```

In [0]:
```
# Nhận xét: Cả training và testing đều có Score cao,
# model có độ chính xác cao
```

In [52]:
```
from sklearn.metrics import confusion_matrix
```

In [58]:
```
cm = confusion_matrix(y_test, y_pred)
```

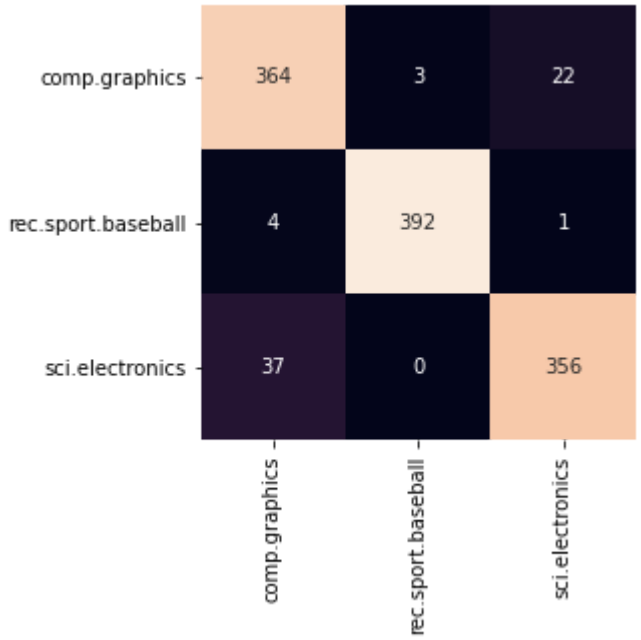
In [59]:
```
cm
```

Out[59]:
```
array([[364,   3,  22],
       [  4, 392,   1],
       [ 37,   0, 356]], dtype=int64)
```

In [57]:
```
import matplotlib.pyplot as plt
import seaborn as sns
```

In [63]:
```
sns.heatmap(cm, square=True, annot=True, fmt='d', cbar=False,
            xticklabels=train.target_names, yticklabels=train.target_names)
```

Out[63]: <AxesSubplot:>



In [54]:
```
from sklearn. metrics import classification_report, roc_auc_score, roc_curve
```

In [55]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.90      0.94      0.92       389
           1       0.99      0.99      0.99       397
           2       0.94      0.91      0.92       393

    accuracy                           0.94      1179
   macro avg       0.94      0.94      0.94      1179
weighted avg       0.94      0.94      0.94      1179
```

In [0]:
```
# Nhận xét: Có precision cao, recall cao
```

In [64]:
```
y_prob = model.predict_proba(X_test)
y_prob
```

Out[64]:
```
array([[1.00000000e+00, 3.42558816e-40, 3.42505634e-11],
       [8.36429377e-15, 3.58304405e-17, 1.00000000e+00],
       [6.56547024e-19, 1.55118818e-25, 1.00000000e+00],
       ...,
       [1.29684570e-32, 3.82855312e-34, 1.00000000e+00],
       [3.72461935e-34, 1.72589031e-52, 1.00000000e+00],
       [2.44615747e-25, 7.21330233e-70, 1.00000000e+00]])
```

In [0]:
```
# Dựa trên tất cả các đánh giá => Model phù hợp
```

In [0]:
```
# Ghi model
```

In [65]:
```
import pickle
pkl_filename = "newsgroups_model.pkl"
with open(pkl_filename, 'wb') as file:
    pickle.dump(model, file)
# luu model CountVectorizer (count) theo cach tren
```

In [66]:
```
# Đọc model
import pickle
with open(pkl_filename, 'rb') as file:
    ham_spam_model = pickle.load(file)
# doc model count len
```

In [74]:
```
X_new = np.array(['The field is considered a subset of visual communication and 
                  'Clubs are conducting Summer Camp at the ballparks in their hor
                  'NXP  claims to be first to deliver in-vehicle multi-device sir
X_new = count.transform(X_new)
```

In [75]:
```
y_pred_new = ham_spam_model.predict(X_new)
y_pred_new
```

Out[75]:
```
array([0, 1, 2], dtype=int64)
```