CS145 Howework 4, Naive Bayes

Due date: 11:59 PM PT, May 31 (Wednesday). Please submit on GradeScope.

Print Out Your Name and UID

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Before You Start

You need to first create HW6 conda environment using `cs145hw4.yml` file.

```
conda env create -f cs145hw4.yml
conda activate hw4
conda deactivate
```

OR

```
conda env create --name NAMEOFYOURCHOICE -f cs145hw4.yml
conda activate NAMEOFYOURCHOICE
conda deactivate
```

To view the list of your environments, use the following command:

```
conda env list
```

In this notebook, you must not delete any code cells in this notebook. If you change any code outside the blocks (such as hyperparameters) that you are allowed to edit (between `STRART/END YOUR CODE HERE`), you need to highlight these changes. You may add some additional cells to help explain your results and observations.

In [1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from pylab import rcParams
rcParams['figure.figsize'] = 8,8
import seaborn as sns; sns.set()
from sklearn.metrics import confusion_matrix
%load_ext autoreload
%autoreload 2
```

Note that `seaborn` in HW6 is only used for ploting classification confusion matrix (in a "heatmap" style). If you encounter installation problem and cannot solve it, you can also use alternative libaries methods to show the results.

Naive Bayes for Text

In the problem, you are given a document in `dataset` folder. The original data comes from "20 newsgroups" (http://qwone.com/~jason/20Newsgroups/). You can use the provided data files to avoid repetitive preprocessing.

Note: The code and dataset are under the subfolder named `nb` .

In [2]:
```
### Data processing and preparation
# read train/test labels from files
train_label = pd.read_csv('./nb/dataset/train.label',names=['t'])
train_label = train_label['t'].tolist()
test_label = pd.read_csv('./nb/dataset/test.label', names=['t'])
test_label= test_label['t'].tolist()

# read train/test documents from files
train_data = open('./nb/dataset/train.data')
df_train = pd.read_csv(train_data, delimiter=' ', names=['docIdx', 'wo
test_data = open('./nb/dataset/test.data')
df_test = pd.read_csv(test_data, delimiter=' ', names=['docIdx', 'word

# read vocab
vocab = open('./nb/dataset/vocabulary.txt')
vocab_df = pd.read_csv(vocab, names = ['word'])
vocab_df = vocab_df.reset_index()
vocab_df['index'] = vocab_df['index'].apply(lambda x: x+1)

# add label column to original df_train
docIdx = df_train['docIdx'].values
i = 0
new_label = []
for index in range(len(docIdx)-1):
    new_label.append(train_label[i])
    if docIdx[index] != docIdx[index+1]:
        i += 1
new_label.append(train_label[i])
df_train['classIdx'] = new_label
```

If you have the data prepared properly, the following line of code would return the head of the `df_train` dataframe, which is,

	docIdx	wordIdx	count	classIdx
0	1	1	4	1
1	1	2	2	1
2	1	3	10	1
3	1	4	4	1
4	1	5	2	1

In [3]:
```
# check the head of 'df_train'
print(df_train.head())
```

```
   docIdx  wordIdx  count  classIdx
0       1        1      4         1
1       1        2      2         1
2       1        3     10         1
3       1        4      4         1
4       1        5      2         1
```

Complete the implementation of Naive Bayes model for text classification `nbm.py` . After that, run `nbm_sklearn.py` , which uses `sklearn` to implement naive bayes model for text classification. (Note that the dataset is slightly different loaded in `nbm_sklearn.py` and also you don't need to change anything in `nbm_sklearn.py` and directly run it.)

If your implementation is correct, you can expect around 0.9 training accuracy and >0.7 test accuracy.

In [14]:
```
from nb.nbm import NB_model

# model training
nbm = NB_model()
nbm.fit(df_train, train_label, vocab_df)
```

```
Prior Probability of each class:
1: 0.04259472890229834
2: 0.05155736977549028
3: 0.05075871860857219
4: 0.05208980388676901
5: 0.051024935664211554
6: 0.052533498979501284
7: 0.051646108794036735
8: 0.052533498979501284
9: 0.052888455053687104
10: 0.0527109770165942
11: 0.05306593309078002
12: 0.0527109770165942
13: 0.05244475996095483
14: 0.0527109770165942
15: 0.052622237998047744
16: 0.05315467210932647
17: 0.04836276510781791
18: 0.05004880646020055
19: 0.04117490460555506
20: 0.033365870973467035
------------------------------------------------------------------------
-----------
Training completed!
```

In [15]:
```
# make predictions on train set to validate the model
predict_train_labels = nbm.predict(df_train)
train_acc = (np.array(train_label) == np.array(predict_train_labels)).
print("Accuracy on training data by my implementation: {}".format(trai

# make predictions on test data
predict_test_labels = nbm.predict(df_test)
test_acc = (np.array(test_label) == np.array(predict_test_labels)).mea
print("Accuracy on testing data by my implementation: {}".format(test_
```

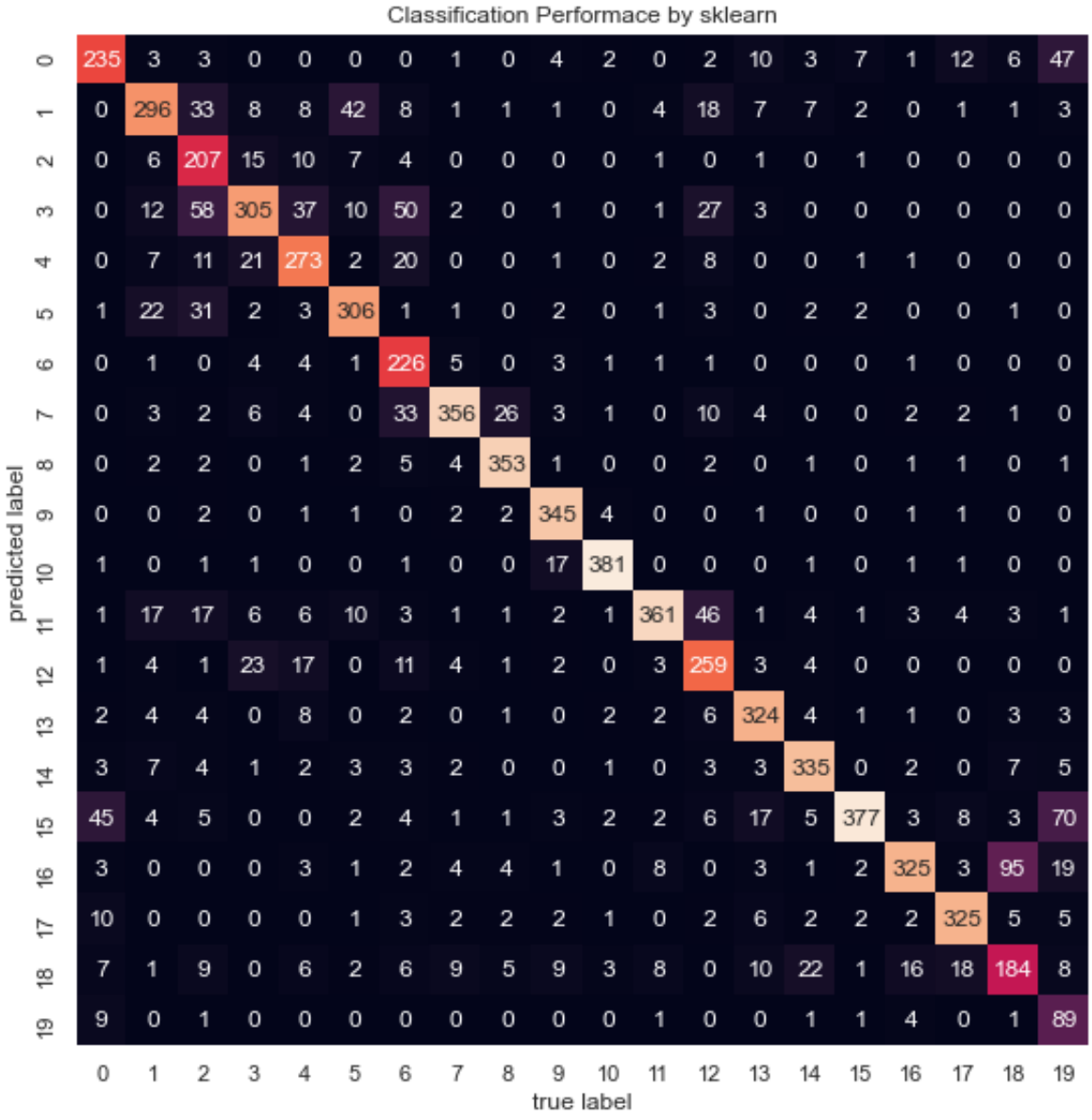
```
Accuracy on training data by my implementation: 0.941077291685154
Accuracy on testing data by my implementation: 0.7810792804796802
```

In [26]:
```
for i,e in enumerate(zip(predict_test_labels, test_label)):
    if e[0] != e[1]:
        print(i)
        break

# output = 3
print(df_test.head(4))
print(predict_test_labels[3], test_label[3])
```

```
3
   docIdx  wordIdx  count
0       1        3      1
1       1       10      1
2       1       12      8
3       1       17      1
16 1
```

In [16]:
```
# plot classification matrix
mat = confusion_matrix(test_label, predict_test_labels)
sns.heatmap(mat.T, square=True, annot=True, fmt='d', cbar=False)
plt.title('Classification Performace by sklearn')
plt.xlabel('true label')
plt.ylabel('predicted label')
plt.tight_layout()
plt.savefig('./nb/output/nbm_mine.png')
plt.show()
```



Reminder: Do not forget to run nbm_sklearn.py to compare the results to get the accuracy and confusion matrix by sklearn implementation. You can run `python nbm_sklearn.py` under the folder path of `./hw6/nb/` .