Выполнил: Дьяконова С.С.

Группа: ИУ5-21М

Задание: Необходимо решить задачу классификации текстов, сформировав два варианта векторизации признаков - на основе CountVectorizer и на основе TfidfVectorizer. В качестве классификаторов необходимо использовать два классификатора:

- LogisticRegression
- Complement Naive Bayes

```
import numpy as np
import pandas as pd
from typing import Dict, Tuple
from sklearn.feature_extraction.text import CountVectorizer,
TfidfVectorizer
from sklearn.model_selection import GridSearchCV, RandomizedSearchCV
from sklearn.metrics import accuracy_score, balanced_accuracy_score
from sklearn.metrics import precision_score, recall_score, f1_score,
classification_report
from sklearn.metrics import confusion_matrix
from sklearn.model_selection import cross_val_score
from sklearn.pipeline import Pipeline
from sklearn.metrics import mean_absolute_error, mean_squared_error,
mean_squared_log_error, median_absolute_error, r2_score
from sklearn.metrics import roc_curve, roc_auc_score
from sklearn.naive_bayes import MultinomialNB
from sklearn.linear_model import LogisticRegression
import seaborn as sns
from collections import Counter
from sklearn.datasets import fetch_20newsgroups
import matplotlib.pyplot as plt

%matplotlib inline
sns.set(style="ticks")

categories = ["rec.motorcycles", "rec.sport.baseball",
"sci.electronics","sci.med"]
newsgroups = fetch_20newsgroups(subset='train', categories=categories)
data = newsgroups['data']

def accuracy_score_for_classes(
    y_true: np.ndarray,
    y_pred: np.ndarray) -> Dict[int, float]:
    """
    Вычисление метрики accuracy для каждого класса
    y_true - истинные значения классов
    y_pred - предсказанные значения классов
    Возвращает словарь: ключ - метка класса,
    значение - Accuracy для данного класса
```

```
    """
    # Для удобства фильтрации сформируем Pandas DataFrame
    d = {'t': y_true, 'p': y_pred}
    df = pd.DataFrame(data=d)
    # Метки классов
    classes = np.unique(y_true)
    # Результирующий словарь
    res = dict()
    # Перебор меток классов
    for c in classes:
        # отфильтруем данные, которые соответствуют
        # текущей метке класса в истинных значениях
        temp_data_flt = df[df['t']==c]
        # расчет accuracy для заданной метки класса
        temp_acc = accuracy_score(
            temp_data_flt['t'].values,
            temp_data_flt['p'].values)
        # сохранение результата в словарь
        res[c] = temp_acc
    return res

def print_accuracy_score_for_classes(
    y_true: np.ndarray,
    y_pred: np.ndarray):
    """
    Вывод метрики accuracy для каждого класса
    """
    accs = accuracy_score_for_classes(y_true, y_pred)
    if len(accs)>0:
        print('Метка \t Accuracy')
    for i in accs:
        print('{} \t {}'.format(i, accs[i]))

vocabVect = CountVectorizer()
vocabVect.fit(data)
corpusVocab = vocabVect.vocabulary_
print('Количество сформированных признаков -
{}'.format(len(corpusVocab)))
```

```
Количество сформированных признаков - 33448
```

```
for i in list(corpusVocab)[1:10]:
    print('{}={}'.format(i, corpusVocab[i]))
```

```
nrmendel=22213
unix=31462
amherst=5287
edu=12444
nathaniel=21624
mendell=20477
subject=29220
```

```
re=25369
bike=6898

test_features = vocabVect.transform(data)
test_features
```

```
<2380x33448 sparse matrix of type '<class 'numpy.int64'>'
     with 335176 stored elements in Compressed Sparse Row format>
```

```
# Размер нулевой строки
len(test_features.todense()[0].getA1())
```

```
33448
```

```
vocabVect.get_feature_names()[100:120]
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/utils/
deprecation.py:87: FutureWarning: Function get_feature_names is
deprecated; get_feature_names is deprecated in 1.0 and will be removed
in 1.2. Please use get_feature_names_out instead.
  warnings.warn(msg, category=FutureWarning)
```

```
['01810',
 '01830',
 '018801285',
 '019',
 '02',
 '020',
 '0200',
 '020347',
 '0205',
 '020533',
 '020555',
 '020646',
 '02086551',
 '02115',
 '02118',
 '02138',
 '02139',
 '02142',
 '02154',
 '0216']
```

```
def VectorizeAndClassify(vectorizers_list, classifiers_list):
    for v in vectorizers_list:
        for c in classifiers_list:
            pipeline1 = Pipeline([("vectorizer", v), ("classifier",
c)])
            score = cross_val_score(pipeline1, newsgroups['data'],
newsgroups['target'], scoring='accuracy', cv=3).mean()
            print('Векторизация - {}'.format(v))
            print('Модель для классификации - {}'.format(c))
```

```
            print('Accuracy = {}'.format(score))
            print('============================')

vectorizers_list = [CountVectorizer(vocabulary = corpusVocab),
TfidfVectorizer(vocabulary = corpusVocab)]
classifiers_list = [LogisticRegression(), MultinomialNB()]
VectorizeAndClassify(vectorizers_list, classifiers_list)
```

```
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/
_logistic.py:818: ConvergenceWarning: lbfgs failed to converge
(status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as
shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/_logistic.
py:818: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as
shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,
/usr/local/lib/python3.7/dist-packages/sklearn/linear_model/_logistic.
py:818: ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as
shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:

https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG,

Векторизация - CountVectorizer(vocabulary={'00': 0, '000': 1, '0000':
2, '0000000004': 3,
                               '0000000005': 4, '0000000667': 5,
'0000001200': 6,
```

```
                            '0001': 7, '00014': 8, '0002': 9, '0003':
10,
                            '0005111312': 11, '0005111312na1em': 12,
                            '00072': 13, '000851': 14, '000rpm': 15,
                            '000th': 16, '001': 17, '0010': 18,
'001004': 19,
                            '0011': 20, '001211': 21, '0013': 22,
'001642': 23,
                            '001813': 24, '002': 25, '002222': 26,
                            '002251w': 27, '0023': 28, '002937':
29, ...})
Модель для классификации - LogisticRegression()
Accuracy = 0.9382336841146768
============================
Векторизация - CountVectorizer(vocabulary={'00': 0, '000': 1, '0000':
2, '0000000004': 3,
                            '0000000005': 4, '0000000667': 5,
'0000001200': 6,
                            '0001': 7, '00014': 8, '0002': 9, '0003':
10,
                            '0005111312': 11, '0005111312na1em': 12,
                            '00072': 13, '000851': 14, '000rpm': 15,
                            '000th': 16, '001': 17, '0010': 18,
'001004': 19,
                            '0011': 20, '001211': 21, '0013': 22,
'001642': 23,
                            '001813': 24, '002': 25, '002222': 26,
                            '002251w': 27, '0023': 28, '002937':
29, ...})
Модель для классификации - MultinomialNB()
Accuracy = 0.9747904364702481
============================
Векторизация - TfidfVectorizer(vocabulary={'00': 0, '000': 1, '0000':
2, '0000000004': 3,
                            '0000000005': 4, '0000000667': 5,
'0000001200': 6,
                            '0001': 7, '00014': 8, '0002': 9, '0003':
10,
                            '0005111312': 11, '0005111312na1em': 12,
                            '00072': 13, '000851': 14, '000rpm': 15,
                            '000th': 16, '001': 17, '0010': 18,
'001004': 19,
                            '0011': 20, '001211': 21, '0013': 22,
'001642': 23,
                            '001813': 24, '002': 25, '002222': 26,
                            '002251w': 27, '0023': 28, '002937':
29, ...})
Модель для классификации - LogisticRegression()
Accuracy = 0.9584091700786584
============================
```

```
Векторизация - TfidfVectorizer(vocabulary={'00': 0, '000': 1, '0000':
2, '0000000004': 3,
                               '0000000005': 4, '0000000667': 5,
'0000001200': 6,
                               '0001': 7, '00014': 8, '0002': 9, '0003':
10,
                               '0005111312': 11, '0005111312na1em': 12,
                               '00072': 13, '000851': 14, '000rpm': 15,
                               '000th': 16, '001': 17, '0010': 18,
'001004': 19,
                               '0011': 20, '001211': 21, '0013': 22,
'001642': 23,
                               '001813': 24, '002': 25, '002222': 26,
                               '002251w': 27, '0023': 28, '002937':
29, ...})
Модель для классификации - MultinomialNB()
Accuracy = 0.9722710153812272
============================
```

Как видно из результатов, лучшую точность показал CountVectorizer и MultinomialNB (Точность составила 97,4%)