NLP Assignment 1 - News Article Classification

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1 News Article Classification Text Preprocessing and NLP models

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1.1 DESCRIPTION OF THE DATASET

The AG's news topic classification dataset is constructed by choosing 4 largest classes from the original corpus. Each class contains 30,000 training samples and 1,900 testing samples. The total number of training samples is 120,000 and testing 7,600.

The file classes.txt contains a list of classes corresponding to each label.

The files train.csv and test.csv contain all the training samples as comma-sparated values. There are 3 columns in them, corresponding to class index (1 to 4), title and description. The title and description are escaped using double quotes (“), and any internal double quote is escaped by 2 double quotes (””).

2 Classification of News Articles

It is a notebook for classification of News articles which are having classes numbered 1 to 4,

1 is “World News”,

2 is “Sports News”,

3 is “Business News” and

4 is “Science-Technology News”.

2.1 Step 1: Import necessary libraries

[1]:
```
import numpy as np
import pandas as pd
import nltk
import string as s
from nltk.corpus import stopwords
import seaborn as sns
```

```
import re
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import accuracy_score, classification_report,␣
 ↪confusion_matrix
nltk.download('wordnet')
```

```
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\vaibh\AppData\Roaming\nltk_data…
[nltk_data]   Package wordnet is already up-to-date!
```

[1]: True

2.2 Step 2: Load your dataset

[2]:
```
# Due to large amount of data , not able to run KNN so. ie limited resorces,␣
 ↪more memory required
# Specify the number of rows you want to read
# num_rows_to_read = 60000  # Replace this with the desired number of rows

# Read only the specified number of rows
train = pd.read_csv('train.csv')
test = pd.read_csv('test.csv')
```

[3]:
```
train.head()
```

[3]:

	Class Index	Title	Description
0	3	Wall St. Bears Claw Back Into the Black (Reuters)	Reuters - Short-sellers, Wall Street's dwindli…
1	3	Carlyle Looks Toward Commercial Aerospace (Reu…	Reuters - Private investment firm Carlyle Grou…
2	3	Oil and Economy Cloud Stocks' Outlook (Reuters)	Reuters - Soaring crude prices plus worries\ab…
3	3	Iraq Halts Oil Exports from Main Southern Pipe…	Reuters - Authorities have halted oil export\f…
4	3	Oil prices soar to all-time record, posing new…	AFP - Tearaway world oil prices, toppling reco…

[4]:
```
test.head()
```

[4]:

	Class Index	Title	Description
0	3	Fears for T N pension after talks	
1	4	The Race is On: Second Private Team Sets Launc…	

```
2            4      Ky. Company Wins Grant to Study Peptides (AP)
3            4      Prediction Unit Helps Forecast Wildfires (AP)
4            4        Calif. Aims to Limit Farm-Related Smog (AP)

                                                 Description
0  Unions representing workers at Turner   Newall…
1  SPACE.com - TORONTO, Canada -- A second\team o…
2  AP - A company founded by a chemistry research…
3  AP - It's barely dawn when Mike Fitzpatrick st…
4  AP - Southern California's smog-fighting agenc…
```

[5]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 120000 entries, 0 to 119999
Data columns (total 3 columns):
 #   Column       Non-Null Count   Dtype 
---  ------       --------------   ----- 
 0   Class Index  120000 non-null  int64 
 1   Title        120000 non-null  object
 2   Description  120000 non-null  object
dtypes: int64(1), object(2)
memory usage: 2.7+ MB
```

[6]:
```
print(train.shape)
print(test.shape)
```

```
(120000, 3)
(7600, 3)
```

2.2.1 Spliting data into input and label

[7]:
```
train_x = train.Description
test_x = test.Description

train_y =  train['Class Index']
test_y = test['Class Index']
```

2.3 Step 3: Preprocessing the dataset

2.3.1 Removal of HTML Tag

[8]:
```
def striphtml(data):
    p = re.compile(r'<.*?>')
    return p.sub('', data)
```

[9]:
```
train_x = train_x.apply(striphtml)
test_x = test_x.apply(striphtml)
```

2.3.2 Removal of URL

[10]:
```
def remove_url(data):
    return  re.sub(r'\s*(?:https?://)?www\.\S*\.[A-Za-z]{2,5}\s*', ' ', data).
 ↪strip()
```

[11]:
```
train_x = train_x.apply(remove_url)
test_x = test_x.apply(remove_url)
```

2.3.3 Tokenization of Data

[12]:
```
def word_tok(data):
    tokens = re.findall("[\w']+", data)
    return tokens
```

```
<>:4: SyntaxWarning: invalid escape sequence '\w'
<>:4: SyntaxWarning: invalid escape sequence '\w'
C:\Users\vaibh\AppData\Local\Temp\ipykernel_18984\882723685.py:4: SyntaxWarning:
invalid escape sequence '\w'
  tokens = re.findall("[\w']+", data)
```

[13]:
```
train_x = train_x.apply(word_tok)
test_x =test_x.apply(word_tok)
```

2.3.4 Removal of stopwords

[14]:
```
def remove_stopwords(data):
    stopWords = stopwords.words('english')
    new_list = []
    for i in data:
        if i.lower() not in stopWords:
            new_list.append(i)
    return new_list
```

[15]:
```
train_x = train_x.apply(remove_stopwords)
test_x = test_x.apply(remove_stopwords)
```

2.3.5 Removal of Punctuation Symbols

[16]:
```
def remove_punctuations(data):
    new_list = []
    for i in data:
        for j in s.punctuation:
```

```
            i = i.replace(j,'')
        new_list.append(i)
    return new_list
```

[17]:
```
train_x = train_x.apply(remove_punctuations)
test_x = test_x.apply(remove_punctuations)
```

2.3.6 Removal of numbers

[18]:
```
def remove_number(data):
    no_digit_list = []
    new_list = []

    for i in data:
        for j in s.digits:
            i = i.replace(j,'')
        no_digit_list.append(i)

    for i in no_digit_list:
        if i!='':
            new_list.append(i)
    return new_list
```

[19]:
```
train_x = train_x.apply(remove_number)
test_x = test_x.apply(remove_number)
```

2.3.7 Stemming of dataset

[20]:
```
import nltk

def stemming(data):
    porter_stemmer = nltk.PorterStemmer()
    roots = [porter_stemmer.stem(i) for i in data]
    return roots
```

[21]:
```
train_x = train_x.apply(stemming)
test_x = test_x.apply(stemming)
```

2.3.8 Lemmatization of data

[22]:
```
def lemmatization(data):
    lemmatizer = nltk.stem.WordNetLemmatizer()
    roots = [lemmatizer.lemmatize(i) for i in data]
    return roots
```

[23]:
```
train_x = train_x.apply(lemmatization)
test_x = test_x.apply(lemmatization)
```

2.3.9 Remove extra words

[24]:
```
def remove_extraWords(data):
    extra_words =['href','iii','lt','gt','ii','com','quot']

    new_list = []
    for i in data:
        if i not in extra_words:
            new_list.append(i)
    return new_list
```

[25]:
```
train_x = train_x.apply(remove_extraWords)
test_x = test_x.apply(remove_extraWords)
```

[26]:
```
train_x = [" ".join(map(str, lst)) for lst in train_x]
test_x = [" ".join(map(str, lst)) for lst in test_x]
```

2.4 Step 4: Feature Extraction

[27]:
```
# Vectorization with CountVectorizer
count_vect = CountVectorizer(min_df=8, ngram_range=(1, 3))
train_count = count_vect.fit_transform(train_x)
test_count = count_vect.transform(test_x)
```

[28]:
```
# Vectorization with TfidfVectorizer
tfidf_vect = TfidfVectorizer(min_df=8, ngram_range=(1, 3))
train_tfidf = tfidf_vect.fit_transform(train_x)
test_tfidf = tfidf_vect.transform(test_x)
```

2.5 Step 5: Train and Evaluate the models

[29]:
```
# Function to train and evaluate models
def train_and_evaluate_model(model, train_data, test_data, model_name):
    model.fit(train_data, train_y)
    predictions = model.predict(test_data)
    accuracy = accuracy_score(test_y, predictions)
    print(f"{model_name} Accuracy: {accuracy}")
    print("Classification Report:")
    print(classification_report(test_y, predictions))
    print("Confusion Matrix:")
    print(confusion_matrix(test_y, predictions))
    sns.heatmap(confusion_matrix(test_y, predictions), cmap="Blues", annot=True)
```

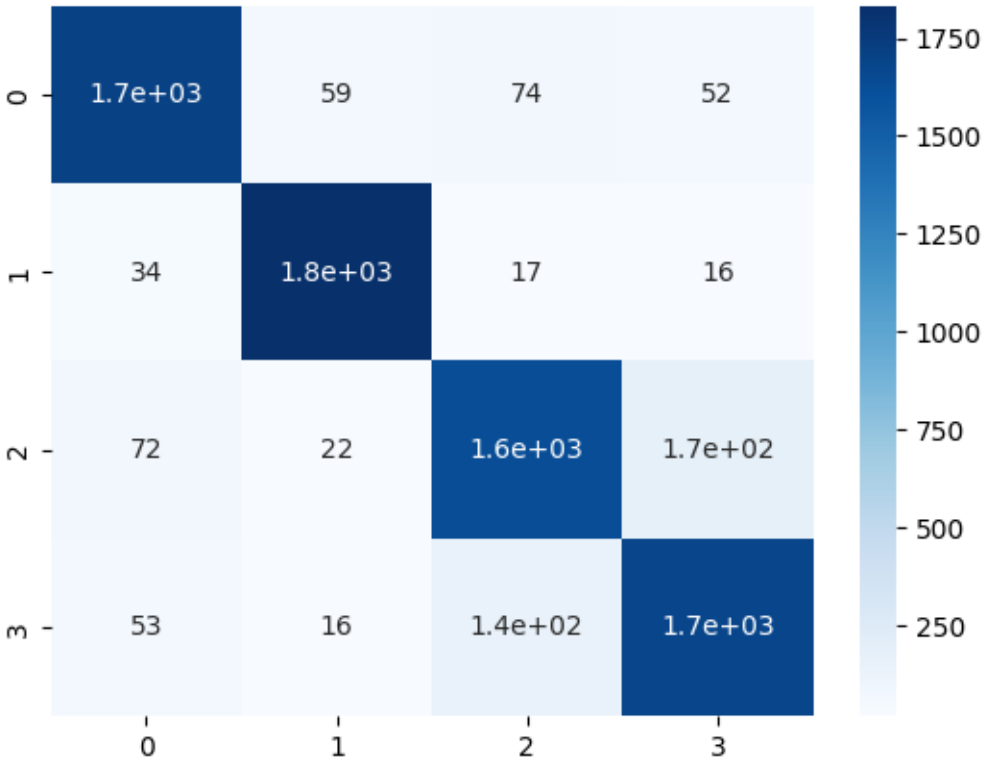
[30]:
```
# Logistic Regression
lr = LogisticRegression(max_iter=200)
print("Logistic Regression with CountVectorizer")
train_and_evaluate_model(
    lr, train_count, test_count, "Logistic Regression with CountVectorizer"
)
```

```
Logistic Regression with CountVectorizer
Logistic Regression with CountVectorizer Accuracy: 0.9035526315789474
Classification Report:
              precision    recall  f1-score   support

           1       0.92      0.90      0.91      1900
           2       0.95      0.96      0.96      1900
           3       0.87      0.86      0.87      1900
           4       0.87      0.89      0.88      1900

    accuracy                           0.90      7600
   macro avg       0.90      0.90      0.90      7600
weighted avg       0.90      0.90      0.90      7600

Confusion Matrix:
[[1715   59   74   52]
 [  34 1833   17   16]
 [  72   22 1632  174]
 [  53   16  144 1687]]
```



[31]:
```
print("Logistic Regression with TfidfVectorizer")
train_and_evaluate_model(
    lr, train_tfidf, test_tfidf, "Logistic Regression with TfidfVectorizer"
)
```

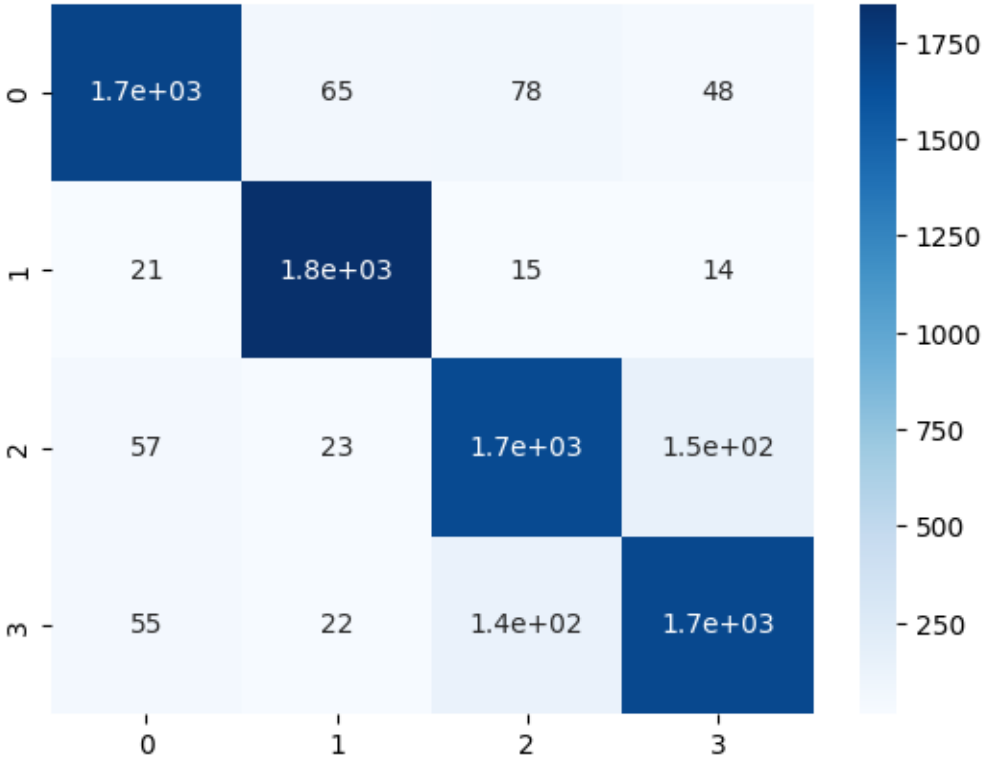
```
Logistic Regression with TfidfVectorizer
Logistic Regression with TfidfVectorizer Accuracy: 0.9090789473684211
Classification Report:
              precision    recall  f1-score   support

           1       0.93      0.90      0.91      1900
           2       0.94      0.97      0.96      1900
           3       0.88      0.88      0.88      1900
           4       0.89      0.89      0.89      1900

    accuracy                           0.91      7600
   macro avg       0.91      0.91      0.91      7600
weighted avg       0.91      0.91      0.91      7600

Confusion Matrix:
[[1709   65   78   48]
```

```
[  21 1850   15   14]
[  57   23 1666  154]
[  55   22  139 1684]]
```



3 Support Vector Classifier (SVC)

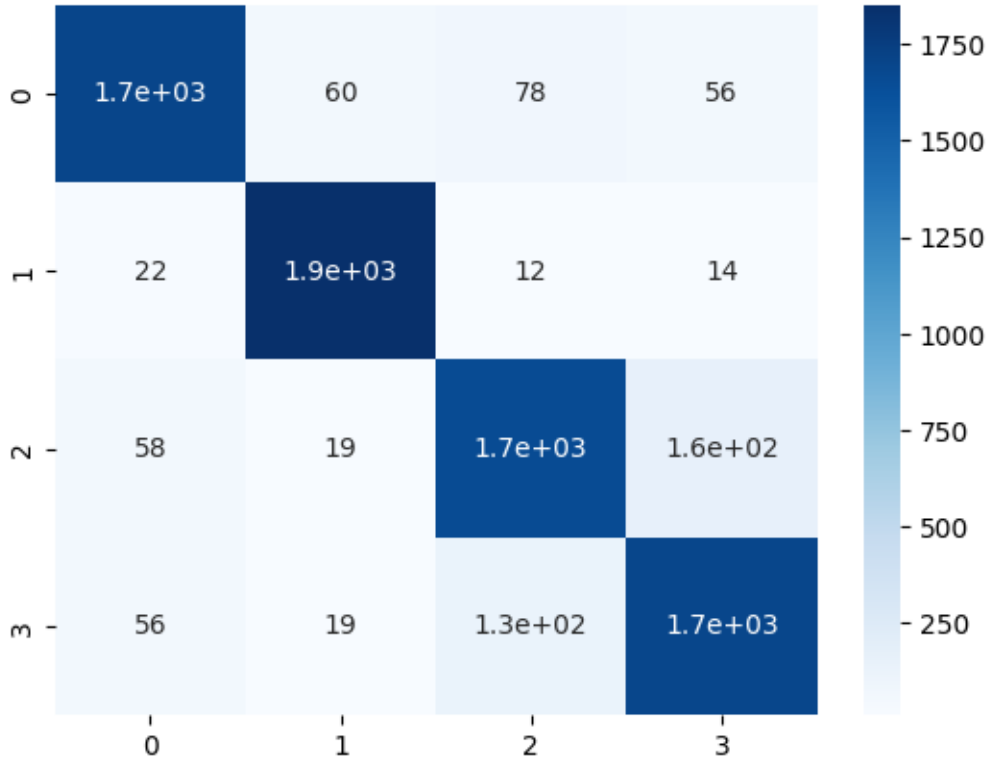
[32]:
```
svc = SVC()
print("SVC with CountVectorizer")
train_and_evaluate_model(svc, train_count, test_count, "SVC with␣
 ↪CountVectorizer")
```

```
SVC with CountVectorizer
SVC with CountVectorizer Accuracy: 0.9096052631578947
Classification Report:
              precision    recall  f1-score   support

           1       0.93      0.90      0.91      1900
           2       0.95      0.97      0.96      1900
           3       0.88      0.87      0.88      1900
           4       0.88      0.89      0.89      1900
```

```
    accuracy                           0.91      7600
   macro avg       0.91      0.91      0.91      7600
weighted avg       0.91      0.91      0.91      7600

Confusion Matrix:
[[1706   60   78   56]
 [  22 1852   12   14]
 [  58   19 1659  164]
 [  56   19  129 1696]]
```



[33]:
```
print("SVC with TfidfVectorizer")
train_and_evaluate_model(svc, train_tfidf, test_tfidf, "SVC with␣
↪TfidfVectorizer")
```

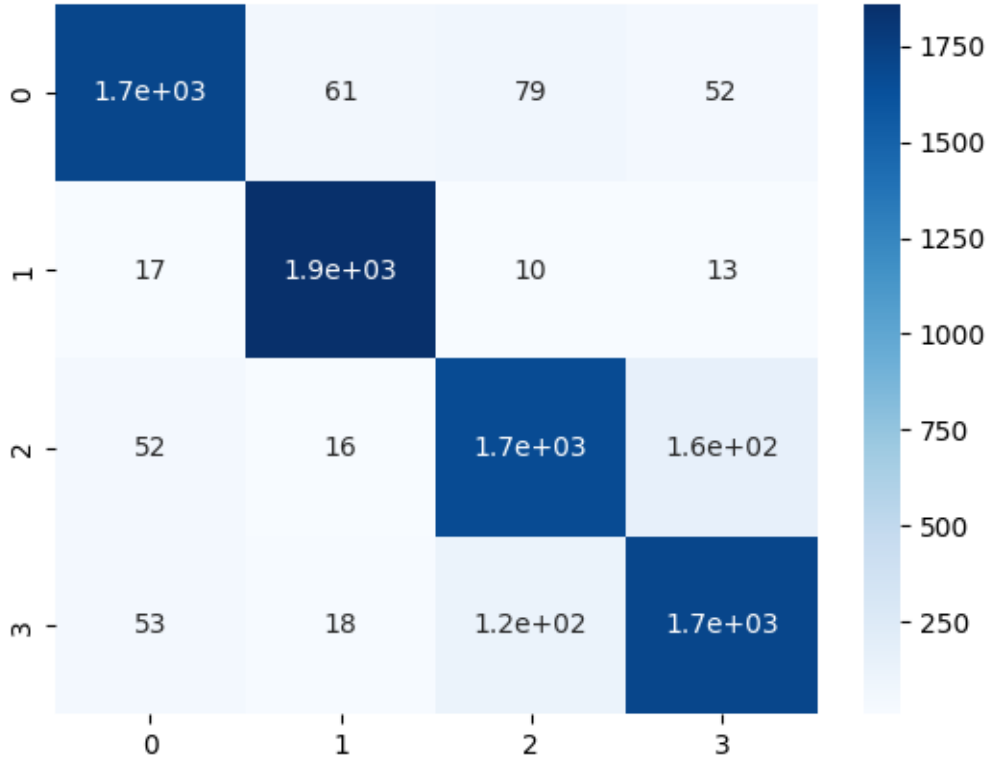
```
SVC with TfidfVectorizer
SVC with TfidfVectorizer Accuracy: 0.9132894736842105
Classification Report:
              precision    recall  f1-score   support

           1       0.93      0.90      0.92      1900
           2       0.95      0.98      0.96      1900
           3       0.89      0.88      0.88      1900
```

```
           4       0.88      0.90      0.89      1900

    accuracy                           0.91      7600
   macro avg       0.91      0.91      0.91      7600
weighted avg       0.91      0.91      0.91      7600

Confusion Matrix:
[[1708   61   79   52]
 [  17 1860   10   13]
 [  52   16 1667  165]
 [  53   18  123 1706]]
```



4 Random Forest

[34]:
```
rf = RandomForestClassifier(n_estimators=100, random_state=42)
print("Random Forest with CountVectorizer")
train_and_evaluate_model(
    rf, train_count, test_count, "Random Forest with CountVectorizer"
)
```

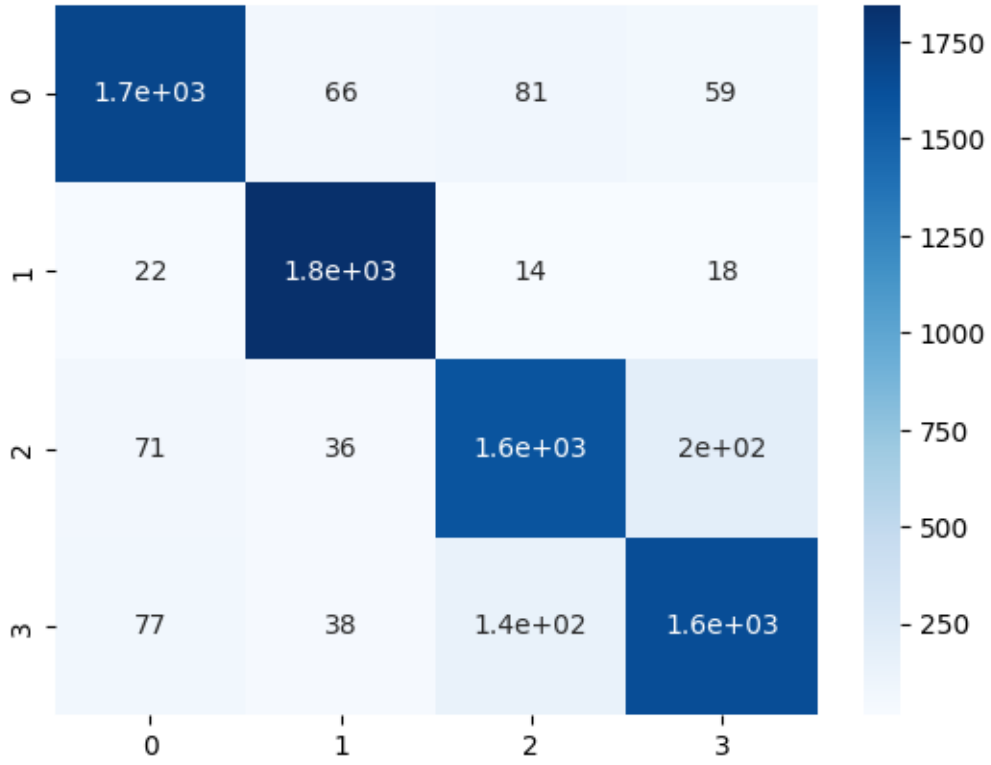
```
Random Forest with CountVectorizer
Random Forest with CountVectorizer Accuracy: 0.8914473684210527
```

```
Classification Report:
              precision    recall  f1-score   support

           1       0.91      0.89      0.90      1900
           2       0.93      0.97      0.95      1900
           3       0.87      0.84      0.85      1900
           4       0.86      0.86      0.86      1900

    accuracy                           0.89      7600
   macro avg       0.89      0.89      0.89      7600
weighted avg       0.89      0.89      0.89      7600

Confusion Matrix:
[[1694   66   81   59]
 [  22 1846   14   18]
 [  71   36 1593  200]
 [  77   38  143 1642]]
```



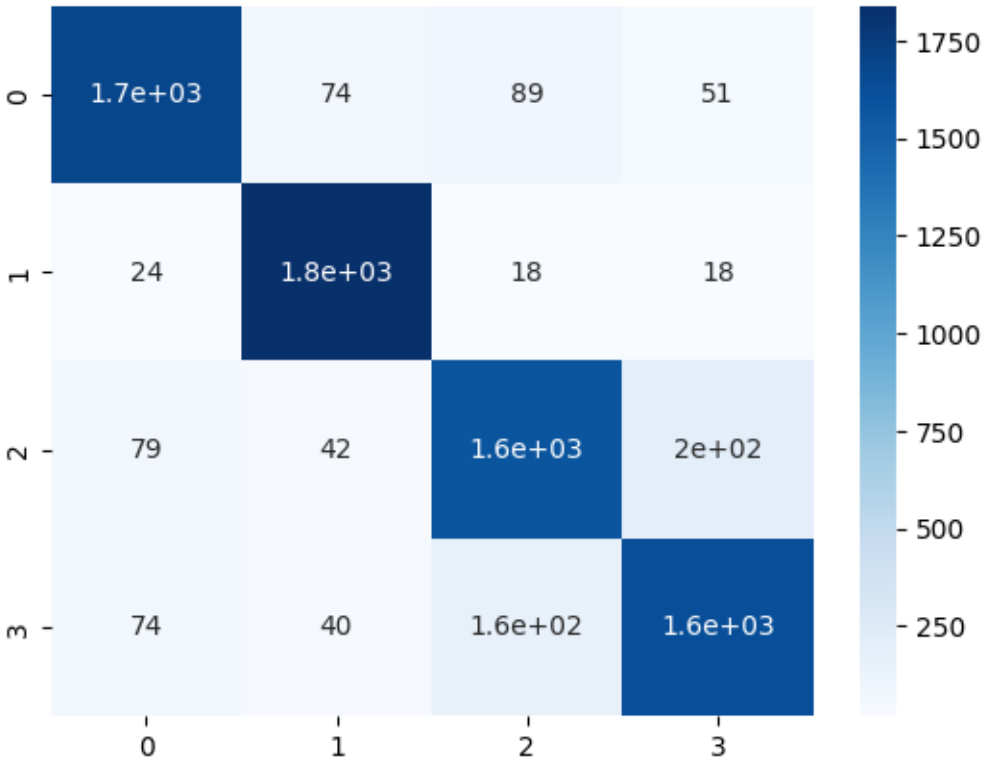
[35]:
```
print("\nRandom Forest with TfidfVectorizer")
train_and_evaluate_model(
    rf, train_tfidf, test_tfidf, "Random Forest with TfidfVectorizer"
)
```

```
Random Forest with TfidfVectorizer
Random Forest with TfidfVectorizer Accuracy: 0.8863157894736842
Classification Report:
              precision    recall  f1-score   support

           1       0.90      0.89      0.90      1900
           2       0.92      0.97      0.94      1900
           3       0.86      0.83      0.84      1900
           4       0.86      0.86      0.86      1900

    accuracy                           0.89      7600
   macro avg       0.89      0.89      0.89      7600
weighted avg       0.89      0.89      0.89      7600

Confusion Matrix:
[[1686   74   89   51]
 [  24 1840   18   18]
 [  79   42 1581  198]
 [  74   40  157 1629]]
```



[ ]:
```
!jupyter nbconvert --to pdf "/content/NLP Assignment 1 - News Article␣
↪Classification.ipynb"
```