```
import numpy as np
import matplotlib.pyplot as plt
import os, os.path
import re
from collections import Counter
from random import seed
from random import randrange
from tabulate import tabulate
from sklearn.neighbors import KNeighborsClassifier
from sklearn.utils import shuffle
from sklearn.metrics import accuracy_score
from sklearn.naive_bayes import MultinomialNB
from sklearn import svm
from scipy.sparse import csr_matrix
from sklearn.model_selection import KFold
from sklearn.preprocessing import MinMaxScaler
from sklearn.metrics import classification_report
```

```
import pickle
import time

from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.decomposition import TruncatedSVD
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import Normalizer
                                 ighborsClassifier
```

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```
from google.colab import drive
drive.mount('/content/drive')
# !rm -r /content/drive/My\ Drive/Pattern\ Recognition/Project/dataset_large
# !apt-get install zip unzip
# !unzip /content/drive/My\ Drive/Pattern\ Recognition/Project/dataset_large.zip -d /conte
# # *****      IF YOU WANT TO IMPORT DATASET FROM LOCAL MACHINE KINDLY PASS THE FOLDER LOC
datasetPath = "/content/drive/My Drive/Pattern Recognition/Project/dataset_large/"
#datasetPath = "/content/drive/My Drive/Pattern Recognition/Project/dataset_large/"
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mour
```

```
X_train = []
y_train = []
X_test = []
y_test = []
for files in os.listdir(datasetPath):
  for f in os.listdir(datasetPath+files):
    d = open(datasetPath+files+"/"+f, "r")
    data = str(d.read())
    label = re.search("[\d]*_([\d]*)",f).group(1)
    if files == "train":
      #print(f)
      X_train.append(data)
      if (int(label) == 1):
        y_train.append(1)
      if (int(label) == 2):
        y_train.append(1)
      if (int(label) == 3):
        y_train.append(2)
      if (int(label) == 4):
        y_train.append(2)
      if (int(label) == 7):
        y_train.append(3)
      if (int(label) == 8):
        y_train.append(3)
      if (int(label) == 9):
        y_train.append(4)
      if (int(label) == 10):
        y_train.append(4)


    if files == "test":
      #print(f)
      X_test.append(data)
      if (int(label) == 1):
        y_test.append(1)
```

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```
        y_test.append(2)
      if (int(label) == 4):
        y_test.append(2)
      if (int(label) == 7):
        y_test.append(3)
      if (int(label) == 8):
        y_test.append(3)
      if (int(label) == 9):
        y_test.append(4)
      if (int(label) == 10):
        y_test.append(4)
```

```
X_train_raw = np.array(X_train)
y_train  = np.array(y_train)
X_test_raw = np.array(X_test)
y_test = np.array(y_test)
target_names = []
labels = np.unique(y_train)
for label in labels:
  target_names.append('Rating '+str(label))
print(X_train_raw.shape)
print(y_train.shape)
print(X_test_raw.shape)
print(y_test.shape)
```

```
  (25000,)
  (25000,)
  (25000,)
  (25000,)
```

```
import nltk
nltk.download('wordnet')
from nltk.stem import WordNetLemmatizer

def clean_dataset(X):
  documents = []
  stemmer = WordNetLemmatizer()
  for sen in range(0, len(X)):

      # Remove all the special characters
      document = re.sub(r'\W', ' ', str(X[sen]))

      # remove all single characters
      document = re.sub(r'\s+[a-zA-Z]\s+', ' ', document)

      # Remove single characters from the start
      document = re.sub(r'\^[a-zA-Z]\s+', ' ', document)

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                                  ', document, flags=re.I)

      # Removing prefixed 'b'
      document = re.sub(r'^b\s+', '', document)

      # Converting to Lowercase
      document = document.lower()

      # Lemmatization
      document = document.split()

      document = [stemmer.lemmatize(word) for word in document]
      document = ' '.join(document)

      documents.append(document)
  return documents
X_train_raw = clean_dataset(X_train_raw)
X_test_raw = clean_dataset(X_test_raw)
```

```
  [nltk_data] Downloading package wordnet to /root/nltk_data...
  [nltk_data]   Package wordnet is already up-to-date!
```

```
# Tfidf vectorizer:
```

```
vectorizer = TfidfVectorizer(max_df=0.7, max_features=500,
                             min_df=5, stop_words='english',
                             use_idf=True)

# Build the tfidf vectorizer from the training data ("fit"), and apply it
# ("transform").
X_train_tfidf = vectorizer.fit_transform(X_train_raw)

print("  Actual number of tfidf features: %d" % X_train_tfidf.get_shape()[1])

print("\nPerforming dimensionality reduction using LSA")
t0 = time.time()

# Project the tfidf vectors onto the first N principal components.
# Though this is significantly fewer features than the original tfidf vector,
# they are stronger features, and the accuracy is higher.
svd = TruncatedSVD(100)
lsa = make_pipeline(svd, Normalizer(copy=False))

# Run SVD on the training data, then project the training data.
X_train_lsa = lsa.fit_transform(X_train_tfidf)

print("  done in %.3fsec" % (time.time() - t0))

# explained_variance = svd.explained_variance_ratio_.sum()
# print("  Explained variance of the SVD step: {}%".format(int(explained_variance * 100)))

```

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```
                                          o the test data as well.
X_test_tfidf = vectorizer.transform(X_test_raw)
X_test_lsa = lsa.transform(X_test_tfidf)
```

```
    Actual number of tfidf features: 500

  Performing dimensionality reduction using LSA
    done in 2.065sec
```

```
#scaling vector between 0 - 1
scaler = MinMaxScaler()
scaler.fit(X_train_lsa)
X_train_lsa_scaled =scaler.transform(X_train_lsa)

scaler = MinMaxScaler()
scaler.fit(X_test_lsa)
X_test_lsa_scaled =scaler.transform(X_test_lsa)
```

```
erageK = 0
tMean = 0
an(array,column,folds=5):
= 0
i in range(1,folds+1):
```

```
n = sum + float(array[i][column])
rn round(sum / folds,3)

rmatMean(array):
al highestMean,bestAverageK
0
attedMean = ["Mean"]
i in range(1,20):
= mean(resultTable,i)

rmattedMean.append(m)
 highestMean < m:
highestMean = m
bestAverageK = i
rn formattedMean
Table = [[]]

Fold(n_splits=5, random_state=None, shuffle=False)
in range(kf.get_n_splits(X_train_tfidf)):
train_index, test_index in kf.split(X_train_tfidf):
split_input_train_dataset , split_label_train_dataset = X_train_tfidf[train_index],y_train[
split_input_test_dataset , split_label_test_dataset = X_train_tfidf[test_index],y_train[tes

ltRow = [j+1]
i in range(1 , 20):
knn = KNeighborsClassifier(n_neighbors=i)
knn.fit(split_input_train_dataset , split_label_train_dataset)
cy_score(split_label_test_dataset,knn.predict(split_input_


late average for all value of K

Table.append(formatMean(resultTable))
= tabulate(resultTable, headers=['Folds', "1","2","3","4","5","6","7","8","9","10","11","12
"Classification complete printing results")
table)
f"Highest mean is {highestMean} so the best K using 5 fold cross validation is {bestAverage

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```
Classification complete printing results
| Folds    |     1 |    2 |     3 |     4 |     5 |     6 |     7 |     8 |     9 |    10
|---------+-------+------+-------+-------+-------+-------+-------+-------+-------+------
|          |       |      |       |       |       |       |       |       |       |
| 1        | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
| 2        | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
| 3        | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
| 4        | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
| 5        | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
| Mean     | 0.365 | 0.37 | 0.375 | 0.392 | 0.394 | 0.406 | 0.408 | 0.416 | 0.418 | 0.424
Highest mean is 0.442 so the best K using 5 fold cross validation is 18
```

```
#Using best k to classify test database
print(f"Classifying using KNN test dataset using best K {bestAverageK}")
clf = KNeighborsClassifier(n_neighbors=bestAverageK)
clf.fit(X_train_lsa , y_train)
knn_accuracy = accuracy_score(y_test, clf.predict(X_test_lsa))
print(f"Test dataset accuracy for best K {bestAverageK} is {knn_accuracy} ")
print(classification_report(y_test, clf.predict(X_test_lsa), target_names=target_names))

```

```
Classifying using KNN test dataset using best K 18
Test dataset accuracy for best K 18 is 0.46436
              precision    recall  f1-score   support

    Rating 1       0.49      0.73      0.59      7324
    Rating 2       0.35      0.22      0.27      5176
    Rating 3       0.36      0.27      0.31      5157
    Rating 4       0.54      0.51      0.52      7343

    accuracy                           0.46     25000
   macro avg       0.43      0.43      0.42     25000
weighted avg       0.45      0.46      0.45     25000
```

```
print(f"Classifying using multinomialNB")
clf = MultinomialNB()
clf.fit(X_train_lsa_scaled, y_train)
nb_accuracy = accuracy_score(y_test, clf.predict(X_test_lsa_scaled))
print(f"Test dataset accuracy is {nb_accuracy} ")
                                          t, clf.predict(X_test_lsa_scaled), target_names=target_na
```

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```
Classifying using multinomialNB
Test dataset accuracy is 0.4126
              precision    recall  f1-score   support

    Rating 1       0.36      0.98      0.52      7324
    Rating 2       0.00      0.00      0.00      5176
    Rating 3       0.00      0.00      0.00      5157
    Rating 4       0.64      0.43      0.51      7343

    accuracy                           0.41     25000
   macro avg       0.25      0.35      0.26     25000
weighted avg       0.29      0.41      0.30     25000

/usr/local/lib/python3.6/dist-packages/sklearn/metrics/_classification.py:1272: Undefine
  _warn_prf(average, modifier, msg_start, len(result))
```

```
print(f"Classifying using SVM")
clf = svm.SVC()
clf.fit(X_train_lsa_scaled , y_train)
svm_accuracy = accuracy_score(y_test, clf.predict(X_test_lsa_scaled))
print(f"Test dataset accuracy is {svm_accuracy} ")
print(classification_report(y_test, clf.predict(X_test_lsa_scaled), target_names=target_na
print(classification_report(y_test, clf.predict(X_test_lsa_scaled), target_names=target_na
```

```
Classifying using SVM
Test dataset accuracy is 0.56256
              precision    recall  f1-score   support

    Rating 1       0.59      0.79      0.68      7324
    Rating 2       0.45      0.32      0.37      5176
    Rating 3       0.50      0.24      0.33      5157
    Rating 4       0.59      0.73      0.66      7343

    accuracy                           0.56     25000
   macro avg       0.53      0.52      0.51     25000
weighted avg       0.54      0.56      0.54     25000
```

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