```
import os
import random
import numpy as np
import pandas as pd
import nltk

nltk.download('punkt')
nltk.download('stopwords')
nltk.download('averaged_perceptron_tagger')
nltk.download('wordnet')

from nltk.tokenize import sent_tokenize, word_tokenize
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem import WordNetLemmatizer
from nltk.corpus import wordnet
from nltk.tag import pos_tag
import re

from sklearn.svm import SVC
from sklearn.metrics import classification_report, confusion_matrix
import itertools
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split

!pip3 install sentence-transformers
from sentence_transformers import SentenceTransformer
import gensim
from gensim.models import Word2Vec
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     /root/nltk_data...
[nltk_data]   Unzipping taggers/averaged_perceptron_tagger.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...
[nltk_data]   Unzipping corpora/wordnet.zip.
Collecting sentence-transformers
  Downloading sentence-transformers-2.1.0.tar.gz (78 kB)
     |████████████████████████████████| 78 kB 3.4 MB/s
Collecting transformers<5.0.0,>=4.6.0
  Downloading transformers-4.12.5-py3-none-any.whl (3.1 MB)
```

```
     |████████████████████████████████| 3.1 MB 10.8 MB/s
Collecting tokenizers>=0.10.3
  Downloading tokenizers-0.10.3-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86
     |████████████████████████████████| 3.3 MB 68.5 MB/s
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: torch>=1.6.0 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: torchvision in /usr/local/lib/python3.7/dist-pa
Requirement already satisfied: numpy in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: scipy in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: nltk in /usr/local/lib/python3.7/dist-packages
Collecting sentencepiece
  Downloading sentencepiece-0.1.96-cp37-cp37m-manylinux_2_17_x86_64.manylinux2
     |████████████████████████████████| 1.2 MB 67.2 MB/s
Collecting huggingface-hub
  Downloading huggingface_hub-0.2.1-py3-none-any.whl (61 kB)
     |████████████████████████████████| 61 kB 462 kB/s
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.7/d
Requirement already satisfied: regex!=2019.12.17 in /usr/local/lib/python3.7/d
Collecting sacremoses
  Downloading sacremoses-0.0.46-py3-none-any.whl (895 kB)
     |████████████████████████████████| 895 kB 57.2 MB/s
Requirement already satisfied: packaging>=20.0 in /usr/local/lib/python3.7/dis
Requirement already satisfied: filelock in /usr/local/lib/python3.7/dist-packa
Requirement already satisfied: importlib-metadata in /usr/local/lib/python3.7/
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packa
Collecting pyyaml>=5.1
  Downloading PyYAML-6.0-cp37-cp37m-manylinux_2_5_x86_64.manylinux1_x86_64.man
     |████████████████████████████████| 596 kB 3.5 MB/s
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /usr/local/lib/pyth
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.7/dist-pack
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-p
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/d
Requirement already satisfied: joblib in /usr/local/lib/python3.7/dist-package
Requirement already satisfied: click in /usr/local/lib/python3.7/dist-packages
Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.
Requirement already satisfied: pillow!=8.3.0,>=5.3.0 in /usr/local/lib/python3
Building wheels for collected packages: sentence-transformers
  Building wheel for sentence-transformers (setup.py) ... done
  Created wheel for sentence-transformers: filename=sentence_transformers-2.1.
  Stored in directory: /root/.cache/pip/wheels/90/f0/bb/ed1add84da70092ea52640
Successfully built sentence-transformers
Installing collected packages: pyyaml, tokenizers, sacremoses, huggingface-hub
```

```
from google.colab import drive
drive.mount('/content/drive')
!unzip drive/MyDrive/aclImdb.zip
```

Streaming output truncated to the last 5000 lines.

```
  inflating: aclImdb/train/pos/9260_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._9260_7.txt
  inflating: aclImdb/train/pos/1599_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._1599_7.txt
  inflating: aclImdb/train/pos/2174_8.txt
  inflating: __MACOSX/aclImdb/train/pos/._2174_8.txt
  inflating: aclImdb/train/pos/2309_9.txt
  inflating: __MACOSX/aclImdb/train/pos/._2309_9.txt
  inflating: aclImdb/train/pos/12034_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._12034_10.txt
  inflating: aclImdb/train/pos/11703_9.txt
  inflating: __MACOSX/aclImdb/train/pos/._11703_9.txt
  inflating: aclImdb/train/pos/5619_9.txt
  inflating: __MACOSX/aclImdb/train/pos/._5619_9.txt
  inflating: aclImdb/train/pos/2928_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._2928_10.txt
  inflating: aclImdb/train/pos/7096_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._7096_10.txt
  inflating: aclImdb/train/pos/793_9.txt
  inflating: __MACOSX/aclImdb/train/pos/._793_9.txt
  inflating: aclImdb/train/pos/7693_9.txt
  inflating: __MACOSX/aclImdb/train/pos/._7693_9.txt
  inflating: aclImdb/train/pos/8293_8.txt
  inflating: __MACOSX/aclImdb/train/pos/._8293_8.txt
  inflating: aclImdb/train/pos/29_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._29_10.txt
  inflating: aclImdb/train/pos/8642_8.txt
  inflating: __MACOSX/aclImdb/train/pos/._8642_8.txt
  inflating: aclImdb/train/pos/3187_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._3187_7.txt
  inflating: aclImdb/train/pos/4497_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._4497_7.txt
  inflating: aclImdb/train/pos/2659_8.txt
  inflating: __MACOSX/aclImdb/train/pos/._2659_8.txt
  inflating: aclImdb/train/pos/10119_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._10119_7.txt
  inflating: aclImdb/train/pos/1665_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._1665_7.txt
  inflating: aclImdb/train/pos/11078_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._11078_10.txt
  inflating: aclImdb/train/pos/4840_7.txt
  inflating: __MACOSX/aclImdb/train/pos/._4840_7.txt
  inflating: aclImdb/train/pos/11729_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._11729_10.txt
  inflating: aclImdb/train/pos/7570_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._7570_10.txt
  inflating: aclImdb/train/pos/6047_10.txt
  inflating: __MACOSX/aclImdb/train/pos/._6047_10.txt
  inflating: aclImdb/train/pos/9292_10.txt
```

```
inflating: __MACOSX/aclImdb/train/pos/._9292_10.txt
inflating: aclImdb/train/pos/5798_8.txt
inflating: __MACOSX/aclImdb/train/pos/._5798_8.txt
inflating: aclImdb/train/pos/639_10.txt
inflating: __MACOSX/aclImdb/train/pos/._639_10.txt
inflating: aclImdb/train/pos/8508_7.txt
inflating: __MACOSX/aclImdb/train/pos/._8508_7.txt
inflating: aclImdb/train/pos/10216_8.txt
inflating: __MACOSX/aclImdb/train/pos/._10216_8.txt
inflating: aclImdb/train/pos/9125_10.txt
```

```
"""
READS Text File and return all of body as a string
"""



def read_input(input_path:str) -> str:
    file_data = open(input_path , 'r')

    return file_data.read()

def read_directory(input_dir:str):
  data = []
  #print(input_dir)
  files = [f for f in os.listdir(input_dir)]
  print(files)
  for x in range(100):
  #for f in files:
    #print("entered")
    #with open (input_dir+"/"+f, "r") as myfile:
    with open (input_dir+"/"+files[x], "r") as myfile:
      # print(myfile.read())
      data.append(myfile.read())

  df = pd.DataFrame(data)
  return df

train_pos = read_directory('/content/aclImdb/train/pos')
train_neg = read_directory('/content/aclImdb/train/neg')
test_pos = read_directory('/content/aclImdb/test/pos')
test_neg = read_directory('/content/aclImdb/test/neg')
#read_directory('/content/aclImdb/train/pos')
```

```
['3961_3.txt', '8546_3.txt', '5647_3.txt', '2185_1.txt', '9786_2.txt', '5749_1
['953_10.txt', '8666_9.txt', '11101_8.txt', '12229_9.txt', '8248_8.txt', '810
['6327_2.txt', '5345_2.txt', '10794_4.txt', '12363_4.txt', '5758_3.txt', '222
```

```
train_pos
```

	0
0	Far richer in texture and character than even ...
1	"Hitler, the rise of Evil" is clearly produced...
2	It's been so long since I've seen this movie (...
3	Caught the tail end of this movie channel surf...
4	It takes a little while to get used to Nick No...
...	...
95	Whoever says pokemon is stupid can die. This m...
96	I hated the first episode of this show ('Prot...
97	This is an evocative and idealized portrait of...
98	Idiotic hack crooks, a babe, a safe, a plan an...
99	I am only 11 years old but I discovered Full H...

100 rows × 1 columns

```
def mean(z): # used for BERT (word version) and Word2Vec
    return sum(itertools.chain(z))/len(z)

def cleanText(text):

    text = re.sub(r'<.*?>', ' ', text)
    text = re.sub(r"won't", "will not", text)
    text = re.sub(r"can't", "can not", text)
    text = re.sub(r"n't", " not", text)
    text = re.sub(r"'ve", " have", text)
    text = re.sub(r"'ll", " will", text)
    text = re.sub(r"'re", " are", text)


    # Replace punctuations with space
    # save ! ? . for end of the sentence detection [,/():;']
    filters='"#$%&*+<=>@[\\]^_`{|}~\t\n'
    text = re.sub(r'\!+', '!', text)
    text = re.sub(r'\?+', '?', text)
```

```
    translate_dict = dict((i, " ") for i in filters)
    translate_map = str.maketrans(translate_dict)
    text = text.translate(translate_map)


    text = re.sub(r'\( *\)', ' ', text)

    # Replace multiple space with one space
    text = re.sub(' +', ' ', text)

    text = ''.join(text)

    return text

def embeddToBERT(text):
    sentences = re.split('!|\?|\.',text)
    sentences = list(filter(None, sentences))

    ## encoding the sentence
    result = bert_transformers.encode(sentences)
    #sys.stdout.write('\r'+"in")
    feature = [mean(x) for x in zip(*result)]

    return np.asarray(feature).reshape((768,1))



embedding = 'BERT'
# for Word2Vec with stop words
train_pos['clean_text'] = train_pos[0].apply(cleanText)
train_neg['clean_text'] = train_neg[0].apply(cleanText)
test_pos['clean_text'] = test_pos[0].apply(cleanText)
test_neg['clean_text'] = test_neg[0].apply(cleanText)


train_pos["label"]=1
train_neg["label"]=0
test_pos["label"]=1
test_neg["label"]=0
```

```
frames = [train_pos, train_neg]
train_data = pd.concat(frames)
frames = [test_pos, test_neg]
test_data = pd.concat(frames)
```

```
X_train, X_test, y_train, y_test = train_test_split(train_data['clean_text'], train
X_train.head()
```

```
55    This movie is one of the most awful I have eve...
85    In one word: excruciating. I was advised to re...
3     ... or an audience. A quick recap.... So you h...
21    If derivative and predictable rape-revenge thr...
4     OK, I bought this film from Woolworths for my ...
Name: clean_text, dtype: object
```

```
bert_transformers = SentenceTransformer('bert-base-nli-mean-tokens')
```

```
Downloading: 100%  391/391 [00:00<00:00, 9.51kB/s]
Downloading: 100%  3.95k/3.95k [00:00<00:00, 73.8kB/s]
Downloading: 100%  2.00/2.00 [00:00<00:00, 50.2B/s]
Downloading: 100%  625/625 [00:00<00:00, 16.0kB/s]
Downloading: 100%  122/122 [00:00<00:00, 2.31kB/s]
Downloading: 100%  229/229 [00:00<00:00, 5.65kB/s]
Downloading: 100%  438M/438M [00:26<00:00, 18.0MB/s]
Downloading: 100%  53.0/53.0 [00:00<00:00, 818B/s]
Downloading: 100%  112/112 [00:00<00:00, 2.87kB/s]
Downloading: 100%  466k/466k [00:00<00:00, 2.29MB/s]
Downloading: 100%  399/399 [00:00<00:00, 9.81kB/s]
Downloading: 100%  232k/232k [00:00<00:00, 2.36MB/s]
Downloading: 100%  190/190 [00:00<00:00, 4.51kB/s]
```

```
import sys
#bert_versio= 'SENTENCE'
c=0
bert_sentence_training_features=[]
for i in X_train:
    sys.stdout.write('\r'+str(c))
    bert_sentence_training_features.append(embeddToBERT(i))
    c=c+1
```

```
 133
```

```
feature = [x.T for x in bert_sentence_training_features]
bert_sentence_training_features = np.asarray(feature).reshape(len(X_train),768)

print(bert_sentence_training_features.shape)
```

```
 (134, 768)
```

```
# bert_sentence_test_features = X_test.apply(embeddToBERT)
#bert_version = 'SENTENCE'
c=0
bert_sentence_test_features=[]
for i in X_test:
    sys.stdout.write('\r'+str(c))
    bert_sentence_test_features.append(embeddToBERT(i))
    c=c+1
```

```
 65
```

```
feature = [x.T for x in bert_sentence_test_features]
bert_sentence_test_features = np.asarray(feature).reshape(len(X_test),768)
print(bert_sentence_test_features.shape)
```

```
 (66, 768)
```

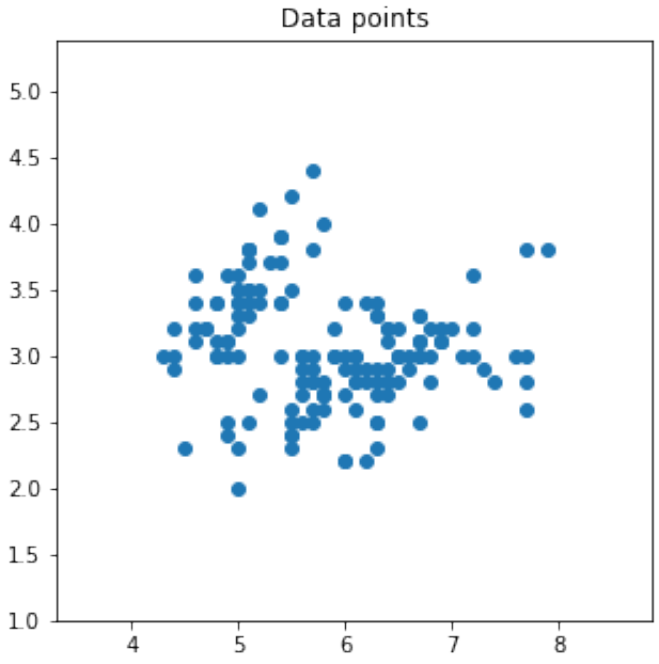
```
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import classification_report

clf = GaussianNB()
clf.fit(bert_sentence_training_features, y_train)
y_pred=clf.predict(bert_sentence_test_features)
print(classification_report(y_test, y_pred))
```

```
                  precision    recall  f1-score   support

               0       0.87      0.81      0.84        32
               1       0.83      0.88      0.86        34

        accuracy                           0.85        66
       macro avg       0.85      0.85      0.85        66
    weighted avg       0.85      0.85      0.85        66
```

```
#KNN Classifier
from sklearn.metrics import accuracy_score
#KNN Libraries
from sklearn.preprocessing import StandardScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import classification_report, confusion_matrix
knn = KNeighborsClassifier(n_neighbors=3,p=2,metric='euclidean')
clf = knn.fit(bert_sentence_training_features, y_train)
predicted = clf.predict(bert_sentence_test_features)
print(predicted)
print('Confusion Matrix: ',confusion_matrix(y_test,predicted), sep = '')
print('Accuracy Score: ',accuracy_score(y_test,predicted)*100,'%',sep='\n')
print(classification_report(y_test, predicted))
```

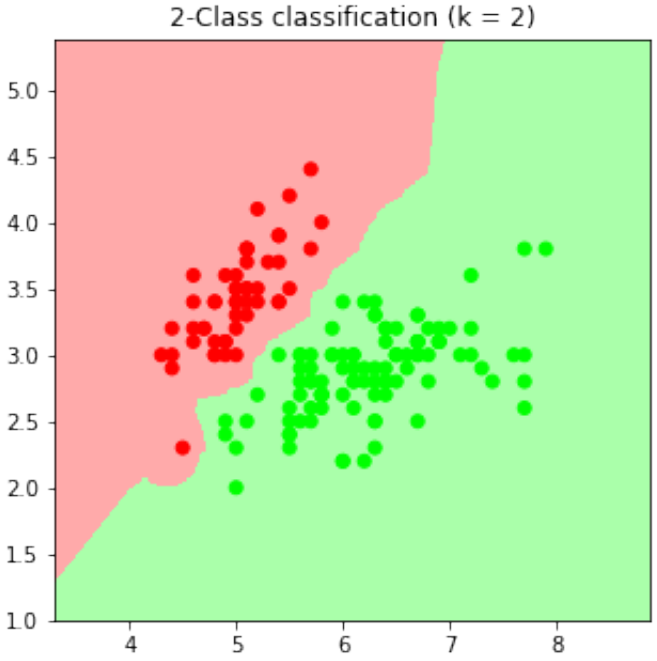
```
[1 0 1 1 1 1 1 1 0 1 0 0 1 1 1 0 1 1 0 1 1 0 1 1 1 1 1 0 0 1 0 0 0 0 0 0 0
 1 1 1 1 1 1 0 0 1 1 1 0 1 0 0 0 1 0 0 1 0 1 0 1 0 1 0 1 0 1 0]
Confusion Matrix: [[25  7]
 [ 4 30]]
Accuracy Score:
83.33333333333334
%
              precision    recall  f1-score   support

           0       0.86      0.78      0.82        32
           1       0.81      0.88      0.85        34

    accuracy                           0.83        66
   macro avg       0.84      0.83      0.83        66
weighted avg       0.84      0.83      0.83        66
```

```
import matplotlib

import numpy as np
import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap
from sklearn import neighbors, datasets


# Calculate min, max and limits
x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min, y_max, h))

# Put the result into a color plot
plt.figure()
plt.scatter(X[:, 0], X[:, 1])
plt.xlim(xx.min(), xx.max())
plt.ylim(yy.min(), yy.max())
plt.title("Data points")
plt.show()
```




```
import matplotlib

import numpy as np
import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap
```

```
from sklearn import neighbors, datasets
cmap_light = ListedColormap(['#FFAAAA', '#AAFFAA'])
cmap_bold = ListedColormap(['#FF0000', '#00FF00'])

# we create an instance of Neighbours Classifier and fit the data.
clf = neighbors.KNeighborsClassifier(3, weights='distance')
clf.fit(X, y)

# calculate min, max and limits
x_min, x_max = X[:, 0].min() - 1, X[:, 0].max() + 1
y_min, y_max = X[:, 1].min() - 1, X[:, 1].max() + 1
xx, yy = np.meshgrid(np.arange(x_min, x_max, h),
np.arange(y_min, y_max, h))

# predict class using data and kNN classifier
Z = clf.predict(np.c_[xx.ravel(), yy.ravel()])

# Put the result into a color plot
Z = Z.reshape(xx.shape)
plt.figure()
plt.pcolormesh(xx, yy, Z, cmap=cmap_light)

# Plot also the training points
plt.scatter(X[:, 0], X[:, 1], c=y, cmap=cmap_bold)
plt.xlim(xx.min(), xx.max())
plt.ylim(yy.min(), yy.max())
plt.title("2-Class classification (k = %i)" % (2))
plt.show()
```


2-Class classification (k = 2)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
4
5
6
7
8