```
import numpy as np
import time
import torch
import torch.nn as nn
import torch.nn.functional as F
import torch.optim as optim
import torchvision
from torch.utils.data.sampler import SubsetRandomSampler
import torchvision.transforms as transforms
import pandas as pd
import csv
from sklearn.utils import shuffle
import nltk
nltk.download('wordnet')
nltk.download('stopwords')
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
import os
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
from sklearn.metrics import f1_score
import matplotlib.pyplot as plt
```

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

```
'''NOTES:
THIS SCRIPT RANDOMELY SPLITS THE DATASET INTO 70% TRAINING,
15% Valid, 15% Test

Change the values as needed to change training params

It is then saved into the RawData Folder as a csv. Simply
Import the csv using pandas from_csv() function to recreate
the dataframes.

Have fun, boys.
'''

wnl = WordNetLemmatizer()
stopW = set(stopwords.words('english'))
totalData = []

with open('SMSSpamCollection.txt', newline = '') as csvfile:
    spamreader = csv.reader(csvfile, quotechar='|')
```

```
    for row in spamreader:
        totalData.append(row[0])

labels = []
values = []
for row in totalData:
    try:
        row.split()[1]
        labels.append(row.split()[0])
        #ans = " ".join(row.split()[1:]) #lower casing text and
lemmatize
        ans = row.split()[1:]
        #word_tokens = word_tokenize(ans)
        filtered_ans = [wnl.lemmatize(w) for w in ans if not w.lower()
in stopW]
        filtered_ans = " ".join(filtered_ans)
        values.append(filtered_ans)
    except:
        print("opp got em chief") #do not add data without a
label/value match. some only have a label

print(len(values), len(labels))
totalData = list(zip(labels, values))
print(totalData[:10])

totalData = pd.DataFrame(totalData)

df = shuffle(totalData)

print(totalData.head)
testData= df.iloc[int(len(df)*0.85):, :] #15%
validData = df.iloc[int(len(df)*0.7):int(len(df)*0.85), :]#15%
trainData = df.iloc[:int(len(df)*0.7), :]#70%

print(testData.shape, validData.shape, trainData.shape)
current_directory = os.getcwd()
testData.to_csv(os.path.join(current_directory, 'testData.csv'),
header=None)
validData.to_csv(os.path.join(current_directory, 'validData.csv'),
header=None)
trainData.to_csv(os.path.join(current_directory, 'trainData.csv'),
header=None)

opp got em chief
opp got em chief
opp got em chief
opp got em chief
5570 5570
[('ham', 'Go jurong point'), ('ham', 'Ok lar... Joking wif u oni...'),
('spam', "Free entry 2 wkly comp win FA Cup final tkts 21st May 2005.
```

```
Text FA 87121 receive entry question(std txt rate)T&C's apply
08452810075over18's"), ('ham', 'U dun say early hor... U c already
say...'), ('ham', 'Nah think go usf'), ('spam', "FreeMsg Hey darling 3
week's word back! I'd like fun still? Tb ok! XxX std chgs send"),
('ham', 'Even brother like speak me. treat like aid patent.'), ('ham',
"per request 'Melle Melle (Oru Minnaminunginte Nurungu Vettam)' set
callertune Callers. Press *9 copy friend Callertune"), ('spam',
'WINNER!! valued network customer selected receivea Â£900 prize
reward! claim call 09061701461. Claim code KL341. Valid 12 hour
only.'), ('spam', 'mobile 11 month more? U R entitled Update latest
colour mobile camera Free! Call Mobile Update Co FREE 08002986030')]
<bound method NDFrame.head of          0
1
0      ham                                       Go jurong point
1      ham                       Ok lar... Joking wif u oni...
2     spam  Free entry 2 wkly comp win FA Cup final tkts 2...
3      ham          U dun say early hor... U c already say...
4      ham                                    Nah think go usf
...    ...                                                ...
5565  spam  2nd time tried 2 contact u. U Â£750 Pound priz...
5566   ham                       Ã¼ b going esplanade fr home?
5567   ham                                         Pity
5568   ham  guy bitching acted like i'd interested buying ...
5569   ham                                    Rofl. true name

[5570 rows x 2 columns]>
(836, 2) (836, 2) (3898, 2)
```

```
train_data = pd.read_csv('trainData.csv', header=None)
train_data[2].fillna("", inplace=True)
train_data.iloc[:, 1] = train_data.iloc[:, 1].astype(str).map({'ham':
0, 'spam': 1}).astype(int)
train_data[1].astype(int)
```

```
0       0
1       0
2       0
3       0
4       0
       ..
3893    0
3894    0
3895    0
3896    0
3897    0
Name: 1, Length: 3898, dtype: int32
```

```
valid_data = pd.read_csv('validData.csv', header=None)
valid_data[2].fillna("", inplace=True)
valid_data.iloc[:, 1] = valid_data.iloc[:, 1].astype(str).map({'ham':
```

```
0, 'spam': 1}).astype(int)
valid_data[1].astype(int)
```

```
0      0
1      0
2      0
3      0
4      0
      ..
831    0
832    0
833    0
834    0
835    0
Name: 1, Length: 836, dtype: int32
```

```
test_data = pd.read_csv('testData.csv', header=None)
test_data[2].fillna("", inplace=True)
test_data.iloc[:, 1] = test_data.iloc[:, 1].astype(str).map({'ham': 0,
'spam': 1}).astype(int)
test_data[1].astype(int)
```

```
0      0
1      0
2      0
3      0
4      1
      ..
831    1
832    0
833    0
834    0
835    0
Name: 1, Length: 836, dtype: int32
```

```
print(train_data[1].value_counts())
print(valid_data[1].value_counts())
print(test_data[1].value_counts())

print(519/(519+3379))
print(110/(110+726))
print(118/(118+718))
#we can see that the dataset is imbalanced where spam is only ~13% of
the dataset.
```

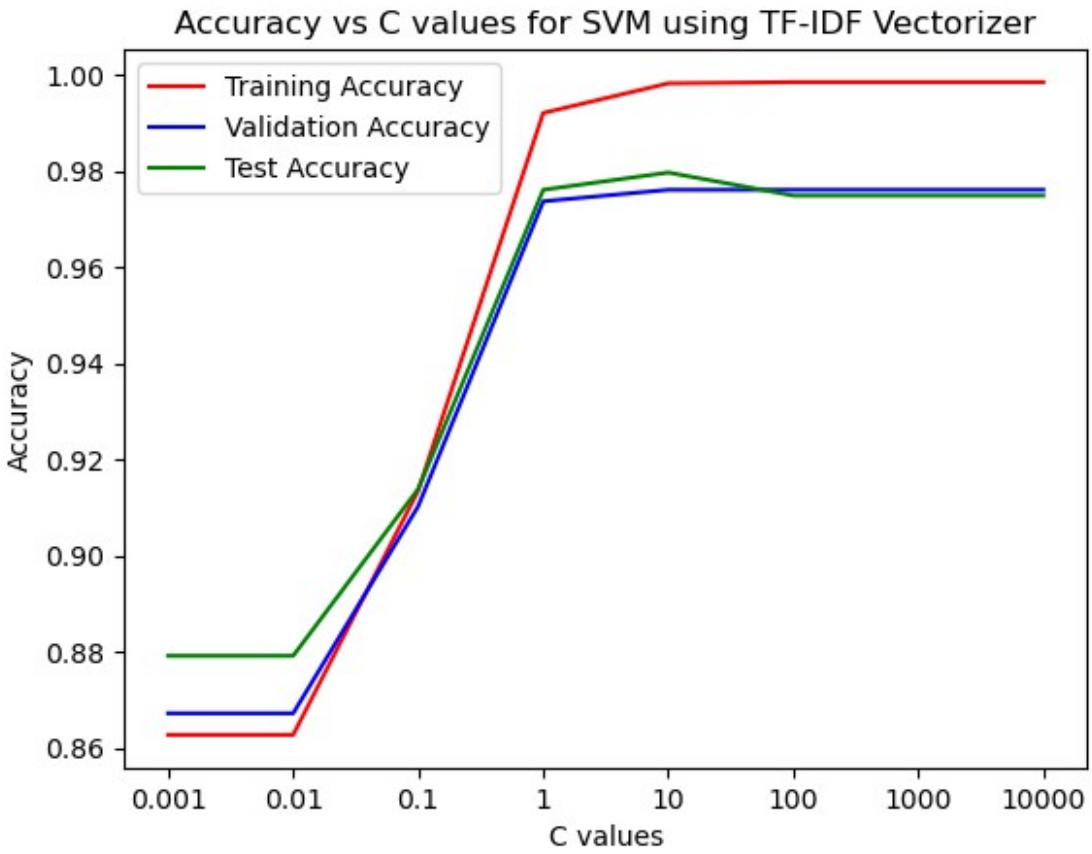
```
1
0    3363
1     535
Name: count, dtype: int64
1
```

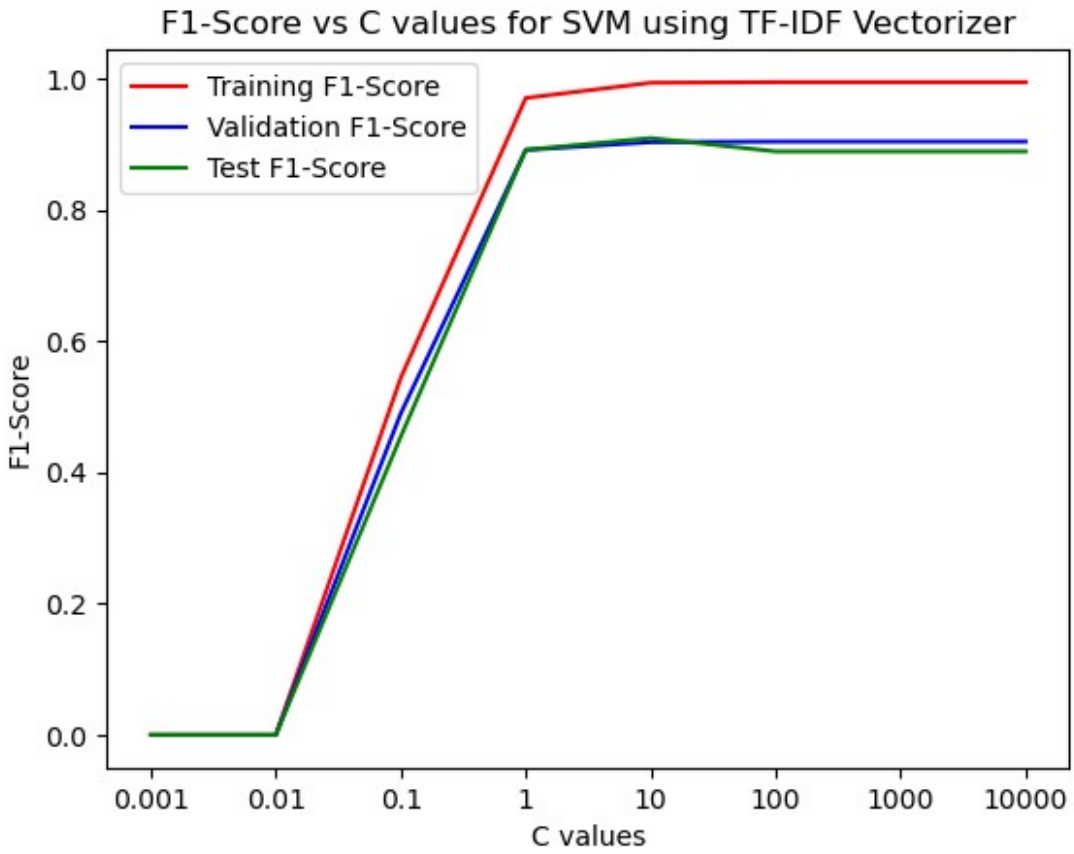
```
0    725
1    111
Name: count, dtype: int64
1
0    735
1    101
Name: count, dtype: int64
0.1331452026680349
0.13157894736842105
0.14114832535885166
```

Tf-idf Vectorizer

```
from sklearn.feature_extraction.text import TfidfVectorizer

tfidf_vectorizer = TfidfVectorizer()
X_train = tfidf_vectorizer.fit_transform(train_data[2])
y_train = train_data[1].astype(int)

X_valid = tfidf_vectorizer.transform(valid_data[2])
y_valid = valid_data[1].astype(int)

X_test = tfidf_vectorizer.transform(test_data[2])
y_test = test_data[1].astype(int)

train_accuracy = []
train_f1 = []
validation_accuracy = []
validation_f1 = []
test_accuracy = []
test_f1 = []

C_values = [0.001,0.01,0.1,1,10,100,1000,10000]
for c in C_values:
    base_model = SVC(C=c,kernel="linear")
    base_model.fit(X_train,y_train)

    y_pred_train = base_model.predict(X_train)
    y_pred_valid = base_model.predict(X_valid)
    y_pred_test = base_model.predict(X_test)

    train_accuracy.append(accuracy_score(y_train, y_pred_train))
    train_f1.append(f1_score(y_train, y_pred_train))

    validation_accuracy.append(accuracy_score(y_valid, y_pred_valid))
    validation_f1.append(f1_score(y_valid, y_pred_valid))
```

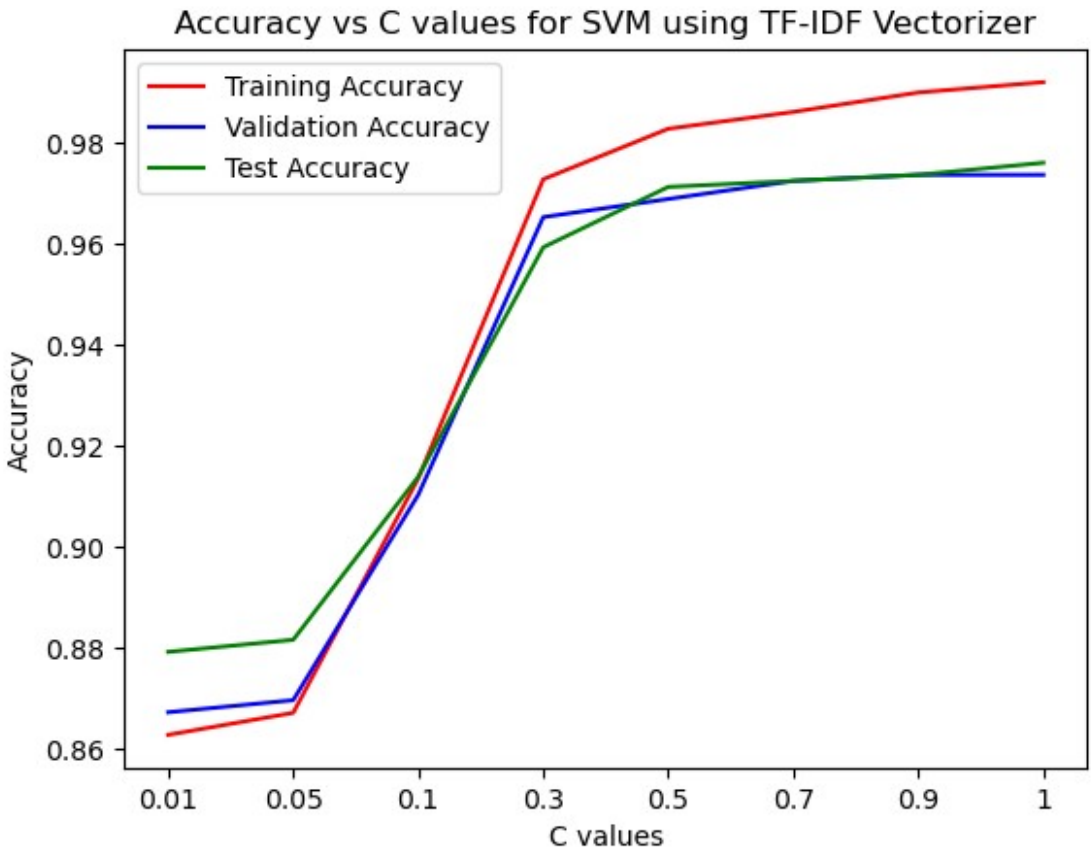
```
    test_accuracy.append(accuracy_score(y_test, y_pred_test))
    test_f1.append(f1_score(y_test, y_pred_test))

index = list(range(len(C_values)))

plt.plot(index, train_accuracy, linestyle='-', color='r',
label='Training Accuracy')
plt.plot(index, validation_accuracy, linestyle='-', color='b',
label='Validation Accuracy')
plt.plot(index, test_accuracy, linestyle='-', color='g', label='Test
Accuracy')
plt.xticks(index, C_values)
plt.xlabel('C values')
plt.ylabel('Accuracy')
plt.title('Accuracy vs C values for SVM using TF-IDF Vectorizer')
plt.legend()

plt.show()

plt.plot(index, train_f1, linestyle='-', color='r', label='Training
F1-Score')
plt.plot(index, validation_f1, linestyle='-', color='b',
label='Validation F1-Score')
plt.plot(index, test_f1, linestyle='-', color='g', label='Test F1-
Score')
plt.xticks(index, C_values)
plt.xlabel('C values')
plt.ylabel('F1-Score')
plt.title('F1-Score vs C values for SVM using TF-IDF Vectorizer')
plt.legend()

plt.show()
```

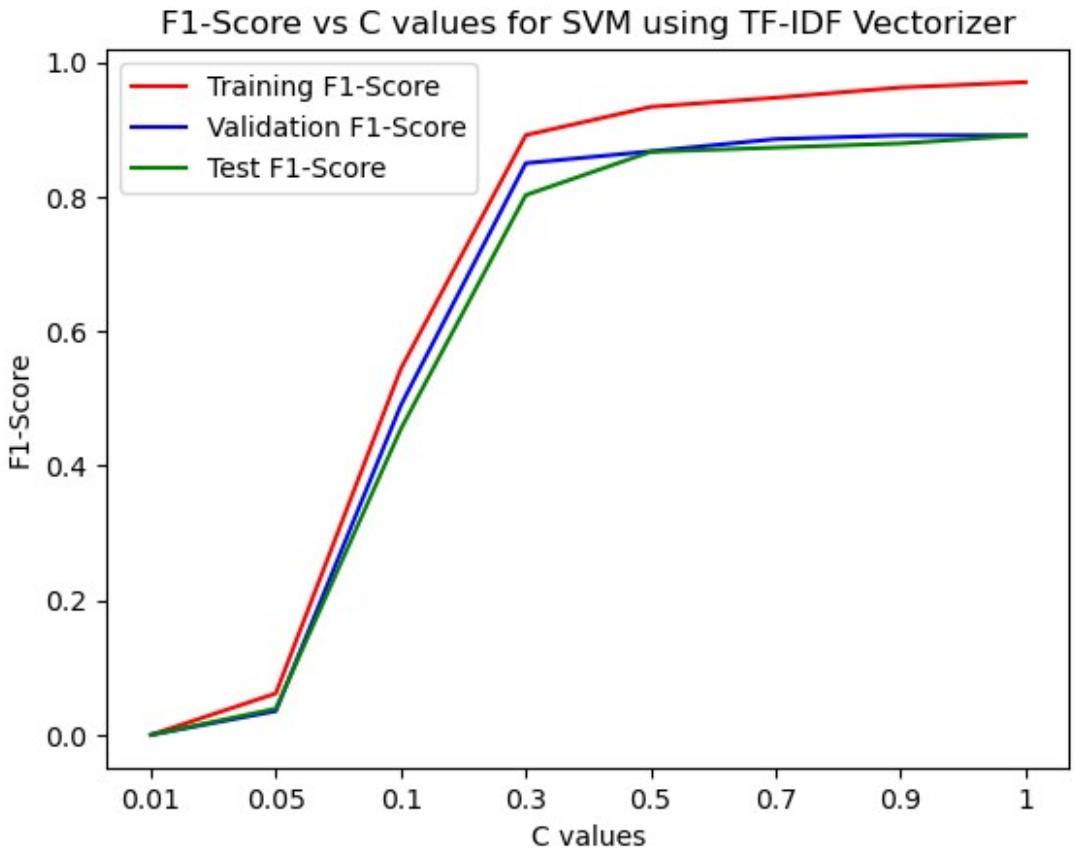

Accuracy vs C values for SVM using TF-IDF Vectorizer
Training Accuracy
Validation Accuracy
Test Accuracy
Accuracy
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.001
0.01
0.1
1
10
100
1000
10000
C values




```
train_accuracy = []
train_f1 = []
validation_accuracy = []
validation_f1 = []
test_accuracy = []
test_f1 = []

C_values = [0.01,0.05,0.1,0.3,0.5,0.7,0.9,1]
for c in C_values:
    base_model = SVC(C=c,kernel="linear")
    base_model.fit(X_train,y_train)

    y_pred_train = base_model.predict(X_train)
    y_pred_valid = base_model.predict(X_valid)
    y_pred_test = base_model.predict(X_test)

    train_accuracy.append(accuracy_score(y_train, y_pred_train))
    train_f1.append(f1_score(y_train, y_pred_train))

    validation_accuracy.append(accuracy_score(y_valid, y_pred_valid))
    validation_f1.append(f1_score(y_valid, y_pred_valid))
```

```
    test_accuracy.append(accuracy_score(y_test, y_pred_test))
    test_f1.append(f1_score(y_test, y_pred_test))

index = list(range(len(C_values)))

plt.plot(index, train_accuracy, linestyle='-', color='r',
label='Training Accuracy')
plt.plot(index, validation_accuracy, linestyle='-', color='b',
label='Validation Accuracy')
plt.plot(index, test_accuracy, linestyle='-', color='g', label='Test
Accuracy')
plt.xticks(index, C_values)
plt.xlabel('C values')
plt.ylabel('Accuracy')
plt.title('Accuracy vs C values for SVM using TF-IDF Vectorizer')
plt.legend()

plt.show()

plt.plot(index, train_f1, linestyle='-', color='r', label='Training
F1-Score')
plt.plot(index, validation_f1, linestyle='-', color='b',
label='Validation F1-Score')
plt.plot(index, test_f1, linestyle='-', color='g', label='Test F1-
Score')
plt.xticks(index, C_values)
plt.xlabel('C values')
plt.ylabel('F1-Score')
plt.title('F1-Score vs C values for SVM using TF-IDF Vectorizer')
plt.legend()

plt.show()
```


Accuracy vs C values for SVM using TF-IDF Vectorizer
Training Accuracy
Validation Accuracy
Test Accuracy
Accuracy
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.01
0.05
0.1
0.3
0.5
0.7
0.9
1
C values


F1-Score vs C values for SVM using TF-IDF Vectorizer
Training F1-Score
Validation F1-Score
Test F1-Score
F1-Score
1.0
0.8
0.6
0.4
0.2
0.0
0.01
0.05
0.1
0.3
0.5
0.7
0.9
1
C values