main-fyp

August 15, 2024

Import Libraries

[ ]:
```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline
import string
import re
import random
# from collections import Counter

import warnings
warnings.filterwarnings("ignore")


from sklearn.feature_extraction.text import TfidfVectorizer, CountVectorizer
from gensim.models import Word2Vec

import nltk
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk import WordNetLemmatizer
from nltk.tokenize import word_tokenize
from gensim.models import Word2Vec

from sklearn.model_selection import train_test_split
from sklearn.svm import SVC
from sklearn.naive_bayes import MultinomialNB
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
from sklearn.metrics import accuracy_score

from sklearn.metrics import f1_score, accuracy_score, roc_auc_score,␣
 ↪roc_curve,auc,recall_score,precision_score
from sklearn.model_selection import RepeatedStratifiedKFold,cross_val_score

# from sklearn.neighbors import KNeighborsClassifier
# from sklearn.linear_model import LogisticRegression
```

```
[ ]: #dataset

     df = pd.read_excel("DATASET_R1.xlsx")
```

```
[ ]: df.head()
```

```
[ ]:                   ID                                        Description  \
     0          2752994783    // Kirby// they/them // 20 // ENG: ok // FR: ok
     1            21571977  Follow us for the latest headlines across the …
     2          3382041618                   Growing minds… Changing lives.
     3           348478568                                              NaN
     4  724097168152367104             One does not simply un-FeelTheBern!

        #Tweets  Date_time_creation_account Language  #Followers  #Friends  \
     0     2822  2014 , Aug , 28 , 01:49:22       en          34        68
     1     3085  2009 , Feb , 22 , 15:32:48       en       21083        31
     2       46  2015 , Aug , 29 , 13:45:01       en          82        68
     3     2007  2011 , Aug , 04 , 14:08:52       en          26       270
     4    13050  2016 , Apr , 24 , 04:46:32       en         166       287

                              Date&Time  #Favorite  #Retweet  \
     0  ['2017', 'Dec', '15', '15:42:41']          0       250
     1  ['2017', 'Dec', '15', '15:37:51']          0         0
     2  ['2017', 'Dec', '15', '15:37:37']          0         0
     3  ['2017', 'Dec', '15', '15:37:16']          0         0
     4  ['2017', 'Dec', '15', '15:35:34']          0       151

        Another Tweet Inside  Source            Tweet ID           Retweet ID  \
     0                     0  iPhone  941695012122910720  940977667104477185
     1                     0  iPhone  941693798056280064       Not a Retweet
     2                     0  iPhone  941693735678758912       Not a Retweet
     3                     0  Client  941693648634372097       Not a Retweet
     4                     0  iPhone  941693221704536064  941044904742006786

           Quote ID  Reply ID Frequency of tweet occurrences State of Tweet
     0  Not a quote       NaN                          213.0              r
     1  Not a quote       NaN                              1              n
     2  Not a quote       NaN                              1              n
     3  Not a quote       NaN                              1              n
     4  Not a quote       NaN                          140.0              a
```

State of the tweet which can be one of the following forms (achieved by an agreement between the annotators) :

```
r : The tweet/retweet is a rumor post

a : The tweet/retweet is an anti-rumor post
```

q : The tweet/retweet is a question about the rumor, however neither confirm nor deny it

n : The tweet/retweet is not related to the rumor (even though it contains the queries re

[ ]:
```
df.isnull().sum()
```

[ ]:
```
ID                                  0
Description                      1011
#Tweets                             0
Date_time_creation_account          0
Language                            0
#Followers                          0
#Friends                            0
Date&Time                           0
#Favorite                           0
#Retweet                            0
Another Tweet Inside                0
Source                              0
Tweet ID                            0
Retweet ID                          0
Quote ID                            0
Reply ID                         8118
Frequency of tweet occurrences      0
State of Tweet                      0
dtype: int64
```

[ ]:
```
df.duplicated().value_counts()
```

[ ]:
```
False    8610
Name: count, dtype: int64
```

[ ]:
```
df.shape
```

[ ]:
```
(8610, 18)
```

[ ]:
```
df['State of Tweet'].value_counts()
```

[ ]:
```
State of Tweet
n    4517
a    3024
r    1020
q      49
Name: count, dtype: int64
```

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8610 entries, 0 to 8609
```

```
Data columns (total 18 columns):
 #   Column                          Non-Null Count  Dtype
---  ------                          --------------  -----
 0   ID                              8610 non-null   int64
 1   Description                     7599 non-null   object
 2   #Tweets                         8610 non-null   int64
 3   Date_time_creation_account      8610 non-null   object
 4   Language                        8610 non-null   object
 5   #Followers                      8610 non-null   int64
 6   #Friends                        8610 non-null   int64
 7   Date&Time                       8610 non-null   object
 8   #Favorite                       8610 non-null   int64
 9   #Retweet                        8610 non-null   int64
 10  Another Tweet Inside            8610 non-null   int64
 11  Source                          8610 non-null   object
 12  Tweet ID                        8610 non-null   int64
 13  Retweet ID                      8610 non-null   object
 14  Quote ID                        8610 non-null   object
 15  Reply ID                        492 non-null    float64
 16  Frequency of tweet occurrences  8610 non-null   object
 17  State of Tweet                  8610 non-null   object
dtypes: float64(1), int64(8), object(9)
memory usage: 1.2+ MB
```

[ ]:
```python
# import nltk
nltk.download('punkt')
nltk.download('stopwords')
nltk.download('wordnet')
```

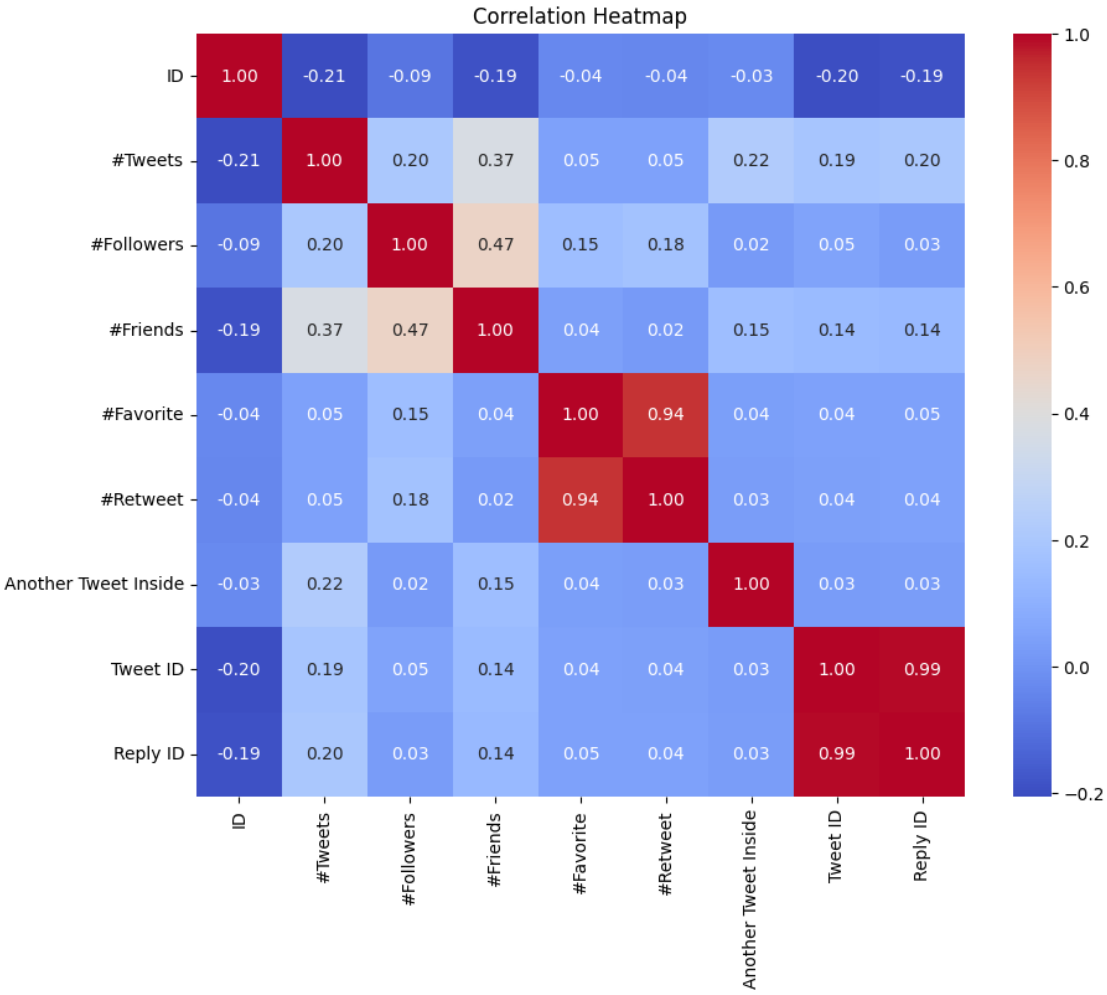
```
[nltk_data] Downloading package punkt to /root/nltk_data…
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package stopwords to /root/nltk_data…
[nltk_data]   Unzipping corpora/stopwords.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data…
```

[ ]:
```
True
```

Data Preprocessing and Vectorization:

[ ]:
```python
# Handle missing values in the 'Description' column
# df['Description'].fillna('', inplace=True)

# Check for null values and remove them
df.dropna(inplace=True)
# Define a function for text preprocessing
def preprocess_text(text):
    text = text.lower()  # Convert text to lowercase
    tokens = word_tokenize(text)  # Tokenize text
```

```
    tokens = [re.sub(r'[^a-zA-Z0-9]', '', token) for token in tokens]  # Remove␣
 ↪punctuation and special characters
    stop_words = set(stopwords.words('english'))  # Get English stopwords
    tokens = [token for token in tokens if token not in stop_words]  # Remove␣
 ↪stopwords
    lemmatizer = WordNetLemmatizer()  # Initialize WordNetLemmatizer
    tokens = [lemmatizer.lemmatize(token) for token in tokens]  # Lemmatize␣
 ↪tokens
    return ' '.join(tokens)  # Join tokens back into text

# Apply text preprocessing to the 'Description' column
df['Description'] = df['Description'].apply(preprocess_text)


# Vectorize text data using TF-IDF
tfidf_vectorizer = TfidfVectorizer()
X_tfidf = tfidf_vectorizer.fit_transform(df['Description'])

# Vectorize text data using Bag of Words
bow_vectorizer = CountVectorizer()
X_bow = bow_vectorizer.fit_transform(df['Description'])

# Drop non-numeric columns before calculating the correlation matrix
numeric_df = df.select_dtypes(include=['int64', 'float64'])
correlation_matrix = numeric_df.corr()

# Set up the matplotlib figure
plt.figure(figsize=(10, 8))

# Create the heatmap
sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', fmt=".2f")

# Add title
plt.title('Correlation Heatmap')

# Show the plot
plt.show()
```



Model Training and Evaluation:

TF-IDF Vectorizer

```
[ ]: X_train, X_test, y_train, y_test = train_test_split(X_tfidf, df['State of␣
     ↪Tweet'], test_size=0.2, random_state=32)
```

```
[ ]: # Initialize and train SVM classifier
     svm_classifier = SVC()
     svm_classifier.fit(X_train, y_train)
     svm_pred = svm_classifier.predict(X_test)
     svm_accuracy = accuracy_score(y_test, svm_pred)
```

```
[ ]: # Initialize and train Naive Bayes classifier
     nb_classifier = MultinomialNB()
     nb_classifier.fit(X_train, y_train)
     nb_pred = nb_classifier.predict(X_test)
```

```
nb_accuracy = accuracy_score(y_test, nb_pred)
```

[ ]:
```
# Initialize and train Random Forest classifier
rf_classifier = RandomForestClassifier()
rf_classifier.fit(X_train, y_train)
rf_pred = rf_classifier.predict(X_test)
rf_accuracy = accuracy_score(y_test, rf_pred)
```

[ ]:
```
# Initialize and train Gradient Boosting classifier
gb_classifier = GradientBoostingClassifier()
gb_classifier.fit(X_train, y_train)
gb_pred = gb_classifier.predict(X_test)
gb_accuracy = accuracy_score(y_test, gb_pred)
```

[ ]:
```
print("SVM Accuracy:", svm_accuracy)
print("Naive Bayes Accuracy:", nb_accuracy)
print("Random Forest Accuracy:", rf_accuracy)
print("Gradient Boosting Accuracy:", gb_accuracy)
```

```
SVM Accuracy: 0.8275862068965517
Naive Bayes Accuracy: 0.8275862068965517
Random Forest Accuracy: 0.8390804597701149
Gradient Boosting Accuracy: 0.7931034482758621
```

[ ]:
```
svm_f1_score = f1_score(y_test, svm_pred, average='weighted')
nb_f1_score = f1_score(y_test, nb_pred, average='weighted')
rf_f1_score = f1_score(y_test, svm_pred, average='weighted')
gb_f1_score = f1_score(y_test, svm_pred, average='weighted')
```

[ ]:
```
print("SVM f1_score:", svm_f1_score)
print("Naive Bayes f1_score:", nb_f1_score)
print("Random Forest f1_score:", rf_f1_score)
print("Gradient Boosting f1_score:", gb_f1_score)
```

```
SVM f1_score: 0.775429489556297
Naive Bayes f1_score: 0.7596731093052199
Random Forest f1_score: 0.775429489556297
Gradient Boosting f1_score: 0.775429489556297
```

Bag of words

[ ]:
```
X_train_bow, X_test_bow, y_train_bow, y_test_bow = train_test_split(X_bow,␣
↪df['State of Tweet'], test_size=0.2, random_state=2)
```

[ ]:
```
# Initialize and train SVM classifier
svm_classifier = SVC()
svm_classifier.fit(X_train_bow, y_train_bow)
svm_pred_bow = svm_classifier.predict(X_test_bow)
```

```
svm_accuracy_bow = accuracy_score(y_test_bow, svm_pred_bow)
```

[ ]:
```
# Initialize and train Naive Bayes classifier
nb_classifier = MultinomialNB()
nb_classifier.fit(X_train_bow, y_train_bow)
nb_pred_bow = nb_classifier.predict(X_test_bow)
nb_accuracy_bow = accuracy_score(y_test_bow, nb_pred_bow)
```

[ ]:
```
# Initialize and train Random Forest classifier
rf_classifier = RandomForestClassifier()
rf_classifier.fit(X_train_bow, y_train_bow)
rf_pred_bow = rf_classifier.predict(X_test_bow)
rf_accuracy_bow = accuracy_score(y_test_bow, rf_pred_bow)
```

[ ]:
```
# Initialize and train Gradient Boosting classifier
gb_classifier = GradientBoostingClassifier()
gb_classifier.fit(X_train_bow, y_train_bow)
gb_pred_bow = gb_classifier.predict(X_test_bow)
gb_accuracy_bow = accuracy_score(y_test_bow, gb_pred_bow)
```

[ ]:
```
print("SVM Accuracy:", svm_accuracy_bow)
print("Naive Bayes Accuracy:", nb_accuracy_bow)
print("Random Forest Accuracy:", rf_accuracy_bow)
print("Gradient Boosting Accuracy:", gb_accuracy_bow)
```

```
SVM Accuracy: 0.8390804597701149
Naive Bayes Accuracy: 0.6666666666666666
Random Forest Accuracy: 0.8505747126436781
Gradient Boosting Accuracy: 0.8390804597701149
```

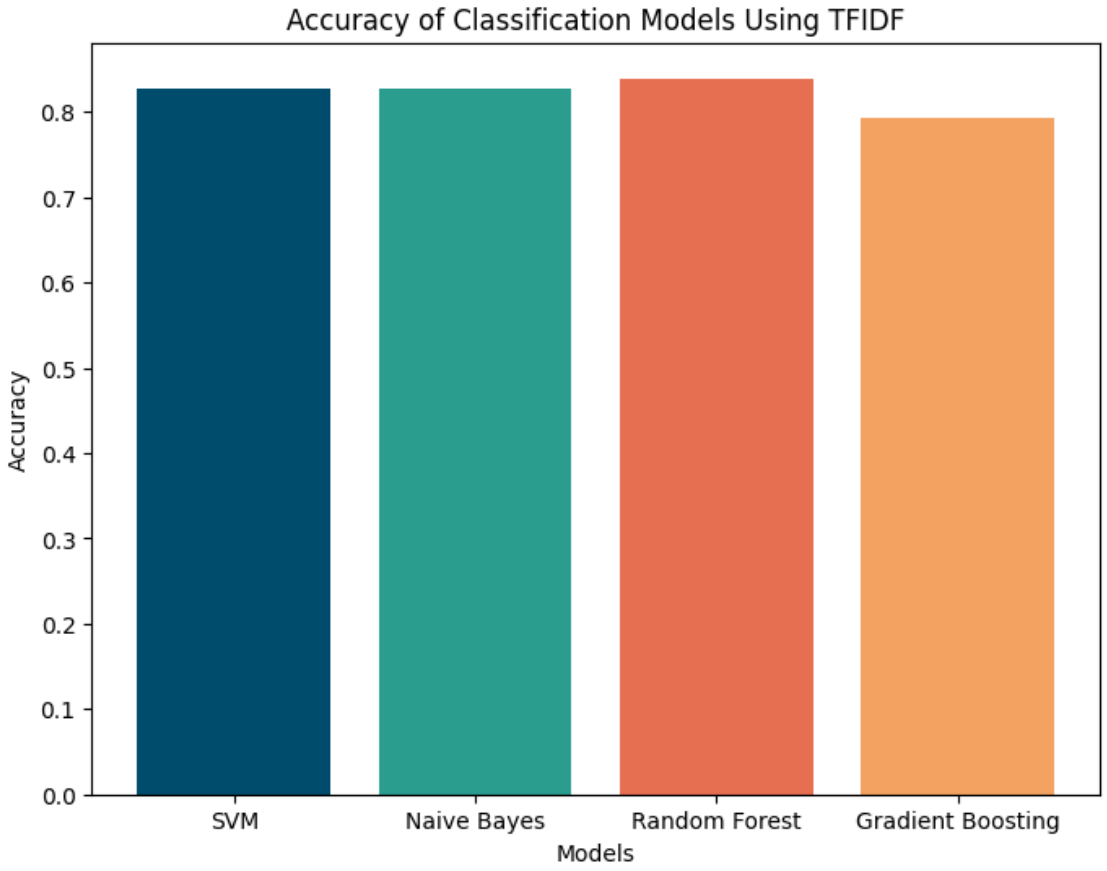
[ ]:
```
svm_bow_f1_score = f1_score(y_test_bow, svm_pred_bow, average='weighted')
nb_bow_f1_score = f1_score(y_test_bow, nb_pred_bow, average='weighted')
rf_bow_f1_score = f1_score(y_test_bow, rf_pred_bow, average='weighted')
gb_bow_f1_score = f1_score(y_test_bow, gb_pred_bow, average='weighted')
```

[ ]:
```
print("SVM f1_score:", svm_bow_f1_score)
print("Naive Bayes f1_score:", nb_bow_f1_score)
print("Random Forest f1_score:", rf_bow_f1_score)
print("Gradient Boosting f1_score:", gb_bow_f1_score)
```

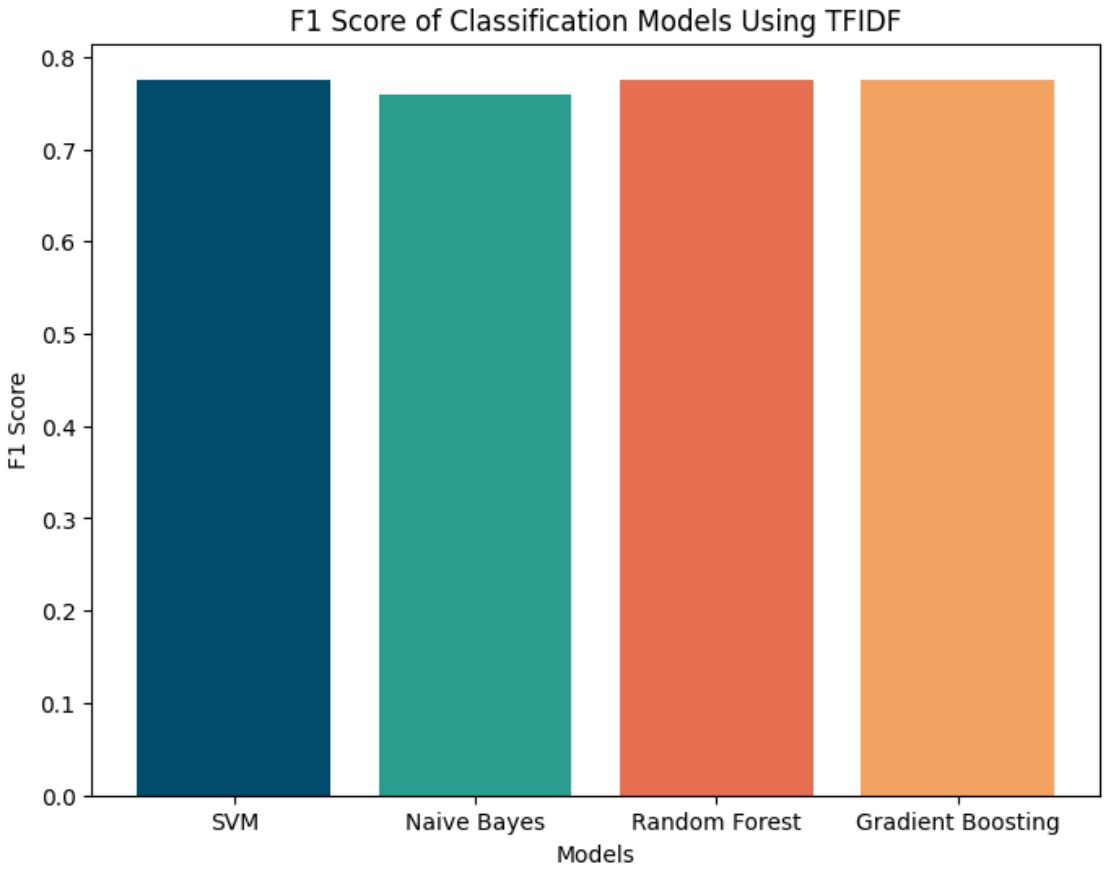
```
SVM f1_score: 0.7900972590627763
Naive Bayes f1_score: 0.7017994224076224
Random Forest f1_score: 0.8098998887652948
Gradient Boosting f1_score: 0.8010326387608334
```

Visualization

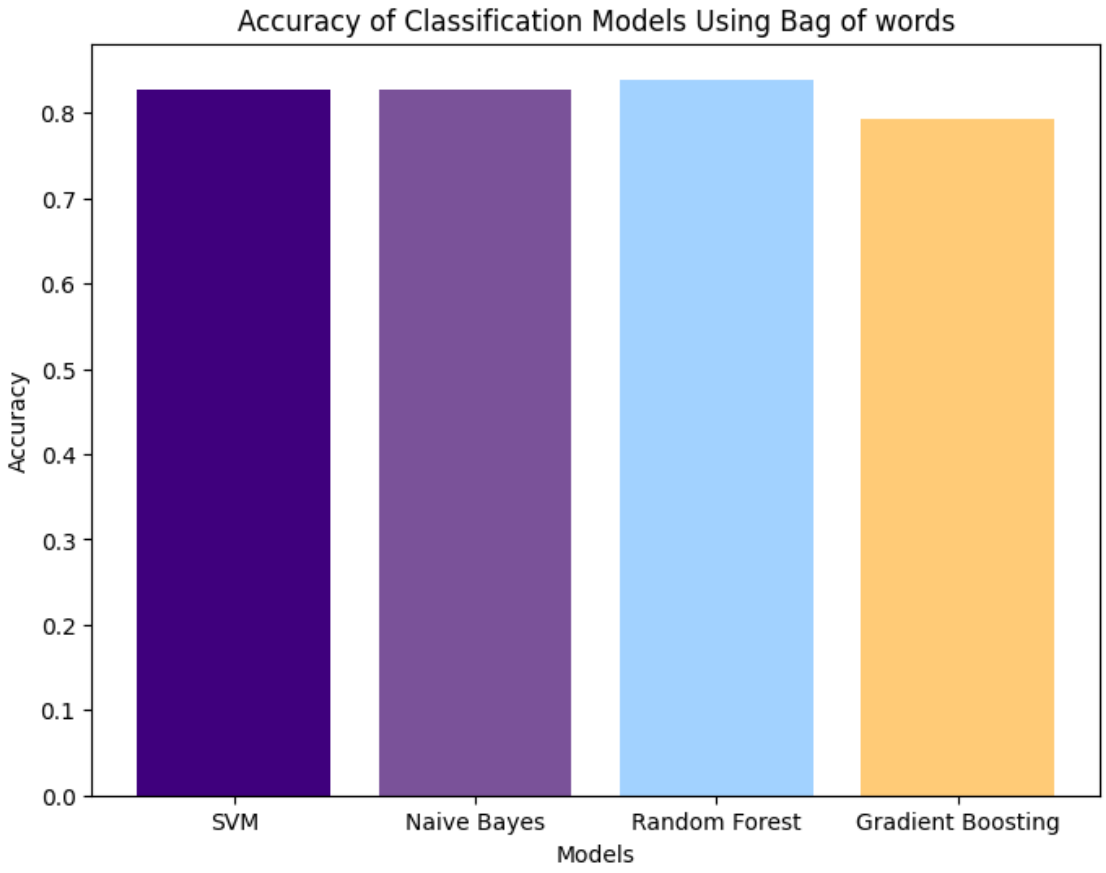
[ ]:
```
# Plot model accuracies for TFIDF
models = ['SVM', 'Naive Bayes', 'Random Forest', 'Gradient Boosting']
accuracies = [svm_accuracy, nb_accuracy, rf_accuracy, gb_accuracy]
plt.figure(figsize=(8, 6))
plt.bar(models, accuracies, color=['#004c6d', '#2a9d8f', '#e76f51', '#f4a261'])
plt.xlabel('Models')
plt.ylabel('Accuracy')
plt.title('Accuracy of Classification Models Using TFIDF')
plt.show()
```



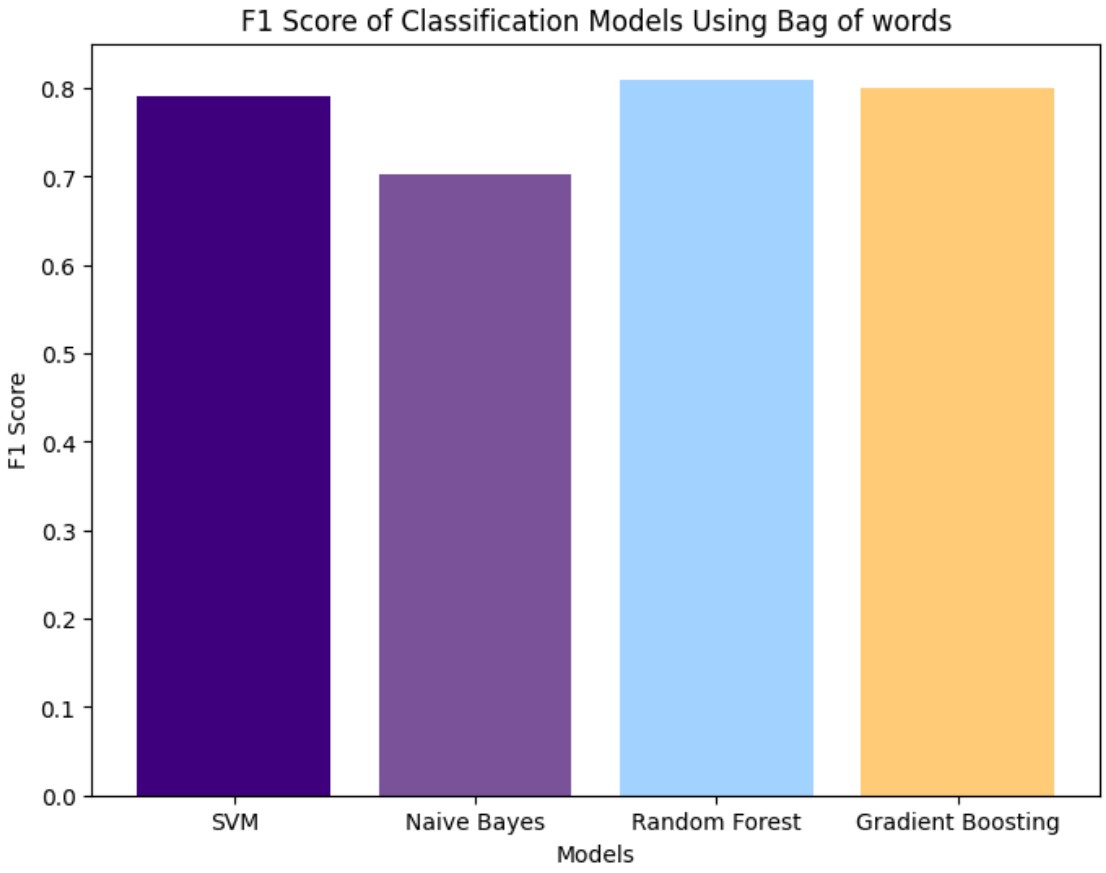
[ ]:
```
# Plot model accuracies for TFIDF F1 score
models = ['SVM', 'Naive Bayes', 'Random Forest', 'Gradient Boosting']
accuracies = [svm_f1_score, nb_f1_score, rf_f1_score, gb_f1_score]
plt.figure(figsize=(8, 6))
plt.bar(models, accuracies, color=['#004c6d', '#2a9d8f', '#e76f51', '#f4a261'])
plt.xlabel('Models')
plt.ylabel('F1 Score')
plt.title('F1 Score of Classification Models Using TFIDF')
plt.show()
```



[ ]:
```
# Plot model accuracies for Bag of words
models = ['SVM', 'Naive Bayes', 'Random Forest', 'Gradient Boosting']
accuracies = [svm_accuracy, nb_accuracy, rf_accuracy, gb_accuracy]
plt.figure(figsize=(8, 6))
plt.bar(models, accuracies, color=['#3f007d', '#7a5299', '#a2d2ff', '#ffcb77'])
plt.xlabel('Models')
plt.ylabel('Accuracy')
plt.title('Accuracy of Classification Models Using Bag of words')
plt.show()
```



[ ]:
```
# Plot model accuracies for Bag of words F1 score
models = ['SVM', 'Naive Bayes', 'Random Forest', 'Gradient Boosting']
accuracies = [svm_bow_f1_score, nb_bow_f1_score, rf_bow_f1_score,␣
 ↪gb_bow_f1_score]
plt.figure(figsize=(8, 6))
plt.bar(models, accuracies, color=['#3f007d', '#7a5299', '#a2d2ff', '#ffcb77'])
plt.xlabel('Models')
plt.ylabel('F1 Score')
plt.title('F1 Score of Classification Models Using Bag of words')
plt.show()
```


F1 Score of Classification Models Using Bag of words
F1 Score
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
SVM
Naive Bayes
Random Forest
Gradient Boosting
Models

[ ]: