Imports

```
import pandas as pd
import seaborn as sns

import re
import nltk
import scipy
import pickle
import numpy as np
import matplotlib.pyplot as plt

from sklearn.svm import SVC
from sklearn import naive_bayes
from sklearn.svm import LinearSVC
from sklearn.ensemble import VotingClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.ensemble import RandomForestClassifier
from sklearn.calibration import CalibratedClassifierCV

from scipy.sparse import hstack
from sklearn.pipeline import Pipeline
from nltk.tokenize import RegexpTokenizer
from sklearn.preprocessing import OneHotEncoder
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import accuracy_score, confusion_matrix,
mean_squared_error, classification_report
```

Feature Extraction

```
import pandas as pd

def process(df):
    df['NotHelpfulNumerator'] = df['HelpfulnessDenominator'] -
df['HelpfulnessNumerator']
    df['NotHelpfulNumerator'] = df['NotHelpfulNumerator'].fillna(0)
    return df

trainingSet = pd.read_csv("./data/train.csv")
train_processed = process(trainingSet)

submissionSet = pd.read_csv("./data/test.csv")
```

```python
testX = pd.merge(train_processed, submissionSet, left_on='Id',
right_on='Id')
testX = testX.drop(columns=['Score_x'])
testX = testX.rename(columns={'Score_y': 'Score'})

trainX =  train_processed[train_processed['Score'].notnull()]

testX.to_csv("./data/X_test.csv", index=False)
trainX.to_csv("./data/X_train.csv", index=False)
```

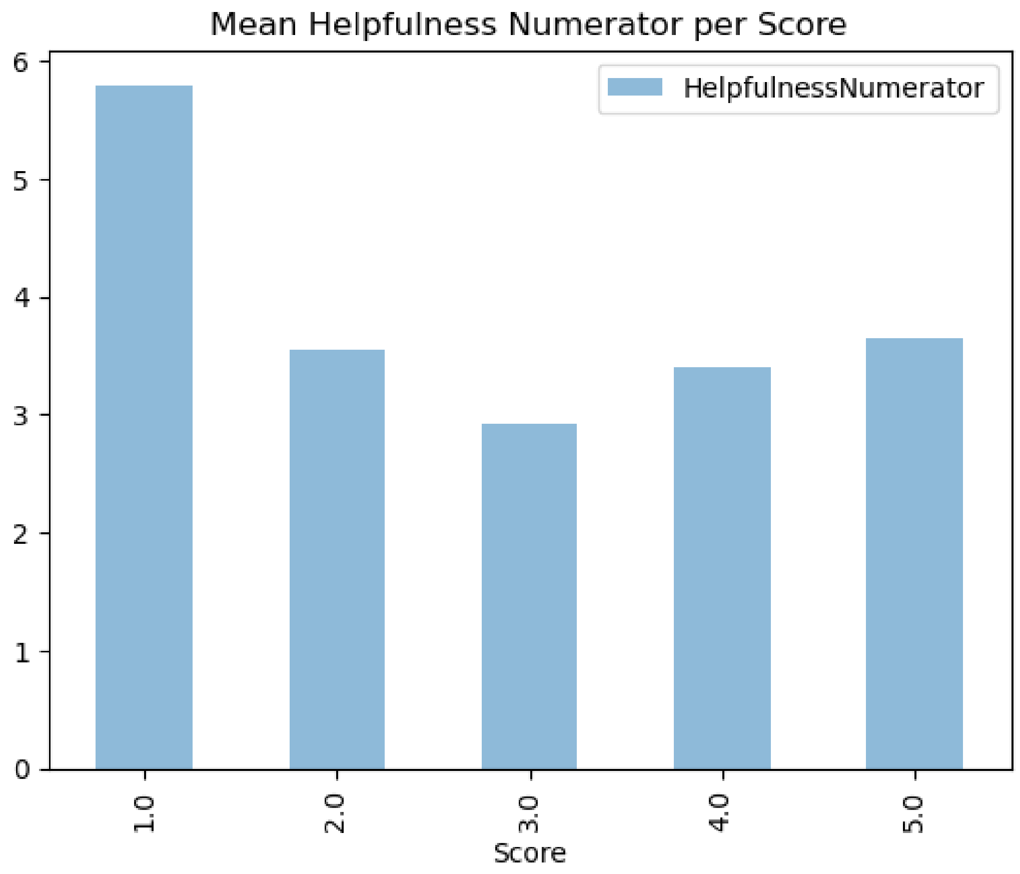
Exploration

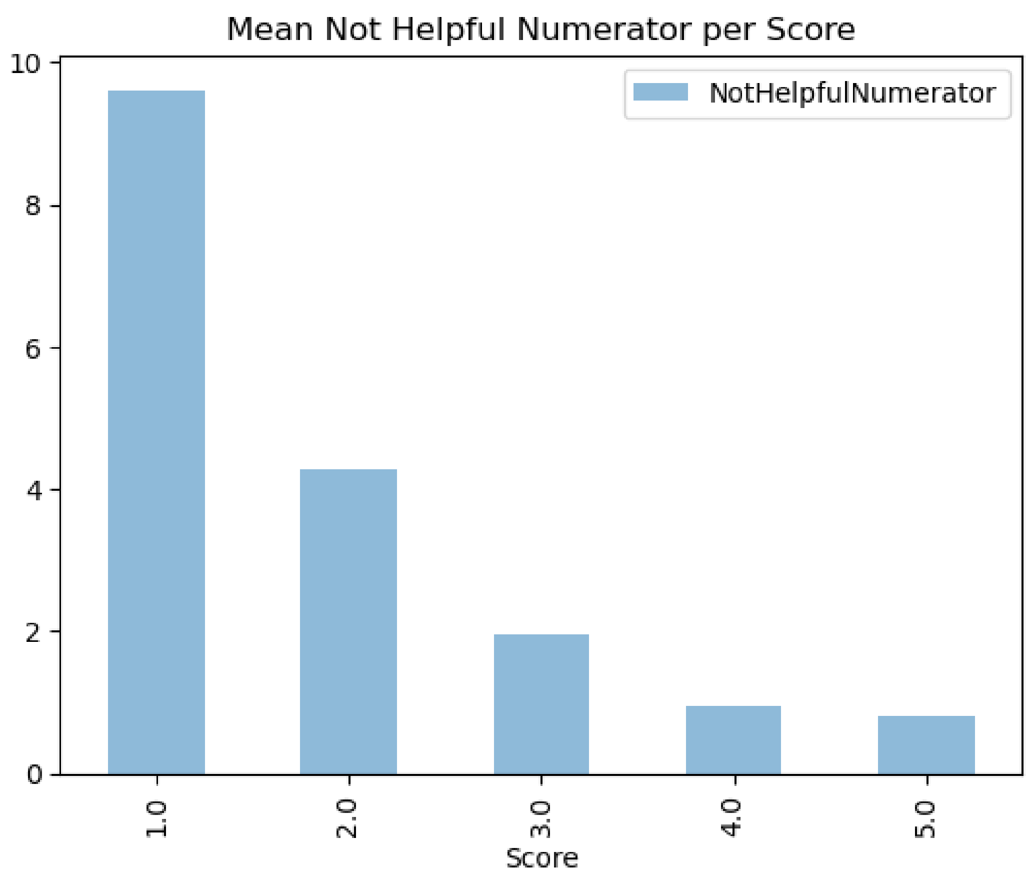
```python
trainingSet = pd.read_csv("./data/X_train.csv")
testingSet = pd.read_csv("./data/X_test.csv")

print("train.csv shape is ", trainingSet.shape)
print("test.csv shape is ", testingSet.shape)
```

```
train.csv shape is  (122283, 10)
test.csv shape is  (17470, 10)
```

```python
trainingSet[['Score',
'HelpfulnessNumerator']].groupby('Score').mean().plot(kind='bar',
legend=True, alpha=.5)
plt.title("Mean Helpfulness Numerator per Score")

trainingSet[['Score',
'NotHelpfulNumerator']].groupby('Score').mean().plot(kind='bar',
legend=True, alpha=.5)
plt.title("Mean Not Helpful Numerator per Score")
```

```
Text(0.5, 1.0, 'Mean Not Helpful Numerator per Score')
```


Mean Helpfulness Numerator per Score
HelpfulnessNumerator
0
1
2
3
4
5
6
1.0
2.0
3.0
4.0
5.0
Score



Cleaning Data

```python
def preprocess_text_data(texts):
    processed_texts = []
    for text in texts:
        cleaned_text = removeSpecialChar(text)
        cleaned_text = toLowerCase(cleaned_text)
        cleaned_text = removeStopWords(cleaned_text)
        processed_texts.append(cleaned_text)
    return processed_texts

def toLowerCase(text):
    clean_text = " ".join(text.lower().split())
    return clean_text

stop_words = ['a', 'an', 'the', 'and', 'this', 'that']

def removeStopWords(text):
    words = text.split()
    filtered_words = [word for word in words if word not in 
stop_words]
    processed_text = ' '.join(filtered_words)
    return processed_text
```

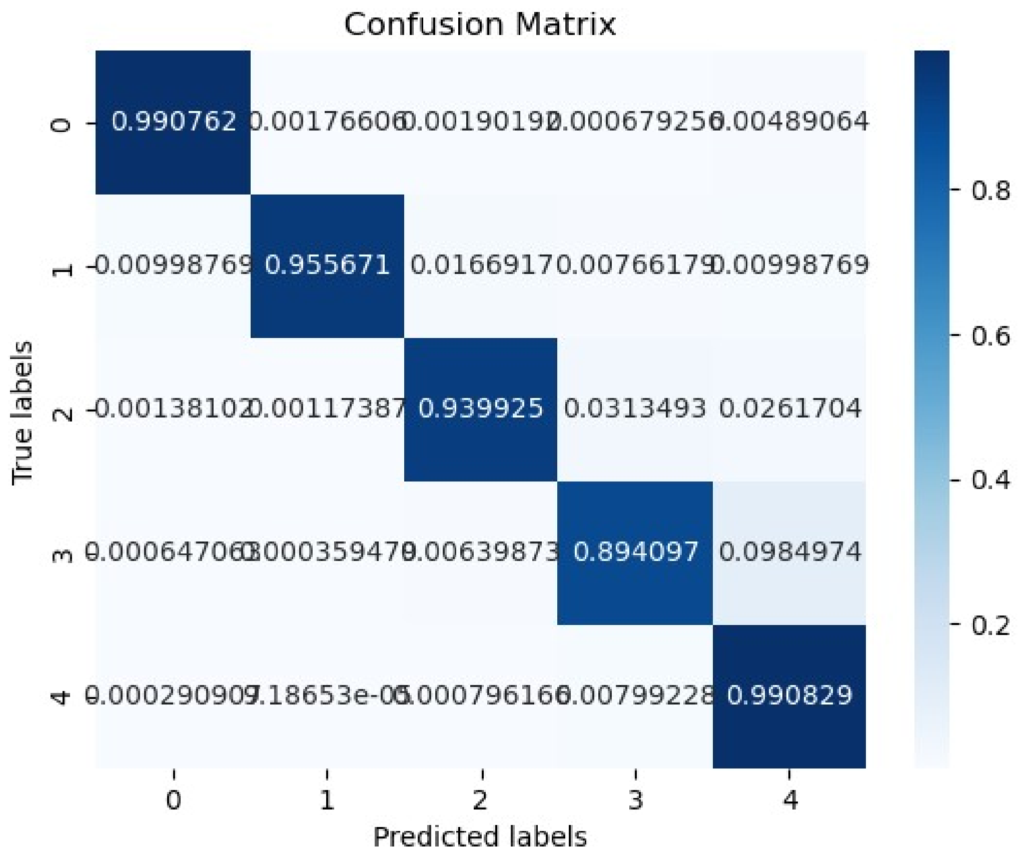
```python
def removeSpecialChar(text):
    if (type(text) == str):
        clean_text = re.sub("[^a-zA-Z]", " ", text)
    else:
        clean_text = "it was okay"
    return clean_text

train = pd.read_csv("./data/X_train.csv")
test = pd.read_csv("./data/X_test.csv")

OHE = OneHotEncoder(sparse=True, handle_unknown='ignore')
IDs = OHE.fit_transform(train[['ProductId', 'UserId']])
IDs_test = OHE.transform(test[['ProductId', 'UserId']])

scaler = StandardScaler()
num_features = ['HelpfulnessNumerator', 'NotHelpfulNumerator', 'Time']
train[num_features] = scaler.fit_transform(train[num_features])
test[num_features] = scaler.transform(test[num_features])

train['Text'].fillna('', inplace=True)
train['Summary'].fillna('', inplace=True)
test['Text'].fillna('', inplace=True)
test['Summary'].fillna('', inplace=True)

Xs_train_processed = preprocess_text_data(train['Summary'])
Xt_train_processed = preprocess_text_data(train['Text'])

Xs_test_processed = preprocess_text_data(test['Summary'])
Xt_test_processed = preprocess_text_data(test['Text'])

text_vectorizer = TfidfVectorizer(input='content')
summary_vectorizer = TfidfVectorizer(input='content')

text_matrix = text_vectorizer.fit_transform(Xt_train_processed)
summary_matrix = summary_vectorizer.fit_transform(Xs_train_processed )

text_matrix_test = text_vectorizer.transform(Xt_test_processed)
summary_matrix_test = summary_vectorizer.transform(Xs_test_processed)

numerical = train[num_features]
numerical_test = test[num_features]

X_train = hstack([text_matrix, summary_matrix, numerical, IDs])
y_train = train['Score']
X_test = hstack([text_matrix_test, summary_matrix_test,
numerical_test, IDs_test])
y_test = test['Score']
```

Creating Model

Linear SVC

```
model = Pipeline([
    ('SVC', SVC(kernel='linear', C=0.2, probability=True))
])

model.fit(X_train, y_train)
y_pred = model.predict(X_train)

y_pred = model.predict(X_train)
print("Accuracy on testing set = ", accuracy_score(y_train,y_pred))
print("RMSE on testing set = ", mean_squared_error(y_train,y_pred))

ax= plt.subplot()
cm=confusion_matrix(y_train,y_pred,normalize='true')
sns.heatmap(cm, annot=True, fmt='g', ax=ax,cmap='Blues');
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```

```
Accuracy on testing set =  0.9606895480156685
RMSE on testing set =  0.0657573006877489
```

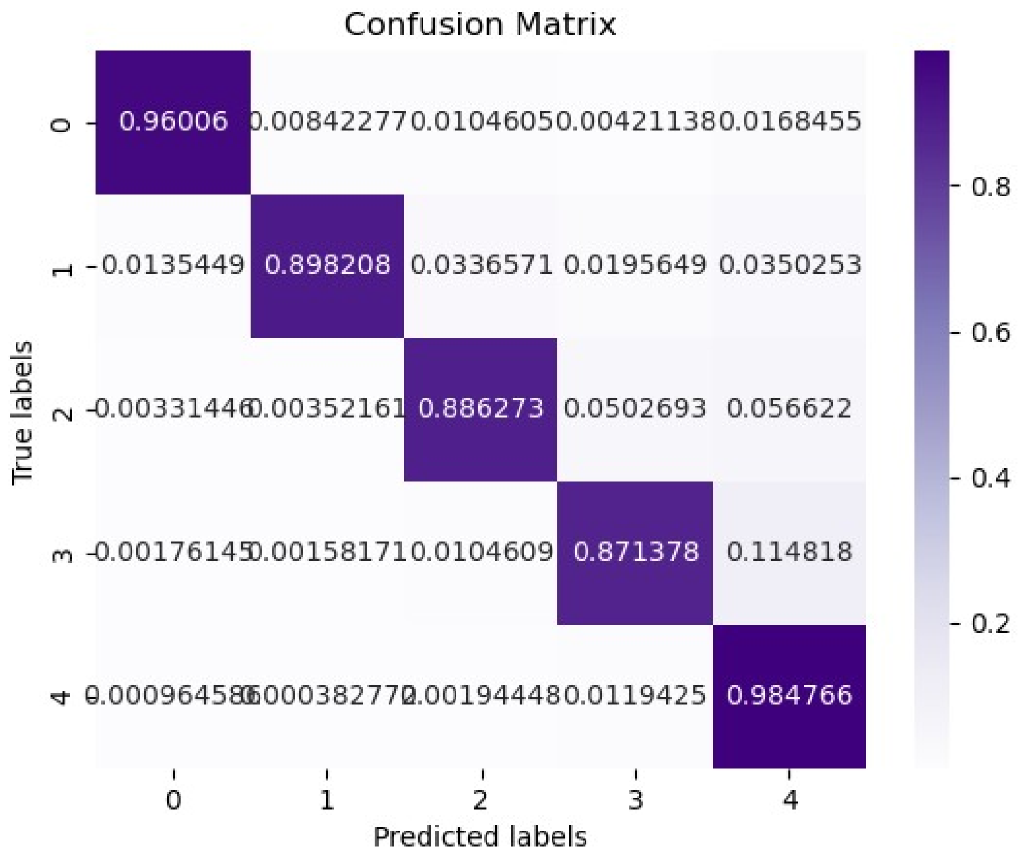


```
Y_test_predictions = model.predict(X_test)
X_submission = pd.read_csv("./data/X_test.csv")
X_submission_processed = X_submission.drop(columns=['Id', 'ProductId',
'UserId', 'Text', 'Summary', 'Score'])

X_submission['Score'] = Y_test_predictions
submission = X_submission[['Id', 'Score']]
submission.to_csv("./data/submissionlinsvc.csv", index=False)
```

Logistic Regression

```
model2 = Pipeline([('logistic_regression',
LogisticRegression(random_state=0, max_iter=1000))])
model2.fit(X_train, y_train)
y_pred = model2.predict(X_train)

print("Accuracy on testing set = ", accuracy_score(y_train,y_pred))
print("RMSE on testing set = ", mean_squared_error(y_train,y_pred))

ax= plt.subplot()
cm=confusion_matrix(y_train,y_pred,normalize='true')
sns.heatmap(cm, annot=True, fmt='g', ax=ax,cmap='Purples');
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');
```

```
Accuracy on testing set =  0.9406458788220766
RMSE on testing set =  0.13679742891489413
```

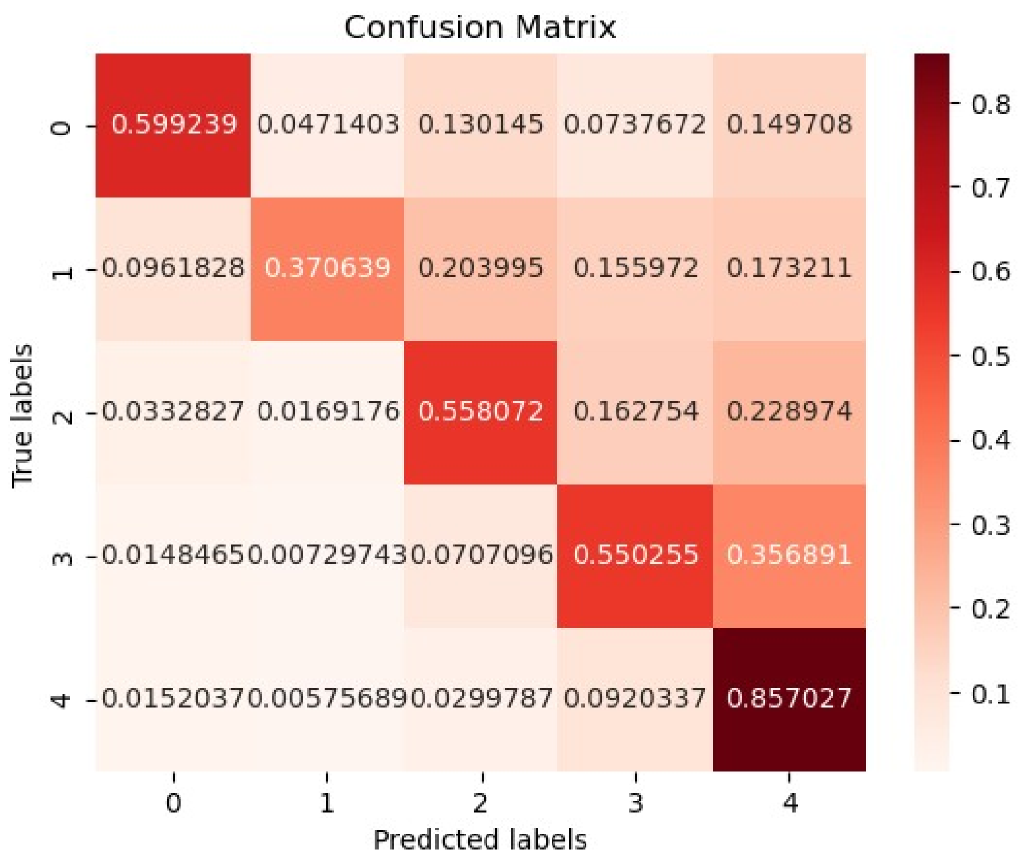


```
Y_test_predictions = model2.predict(X_test)
X_submission = pd.read_csv("./data/X_test.csv")
X_submission_processed = X_submission.drop(columns=['Id', 'ProductId',
'UserId', 'Text', 'Summary', 'Score'])

X_submission['Score'] = Y_test_predictions
submission = X_submission[['Id', 'Score']]
submission.to_csv("./data/submissionlr.csv", index=False)
```

Naive Bayes

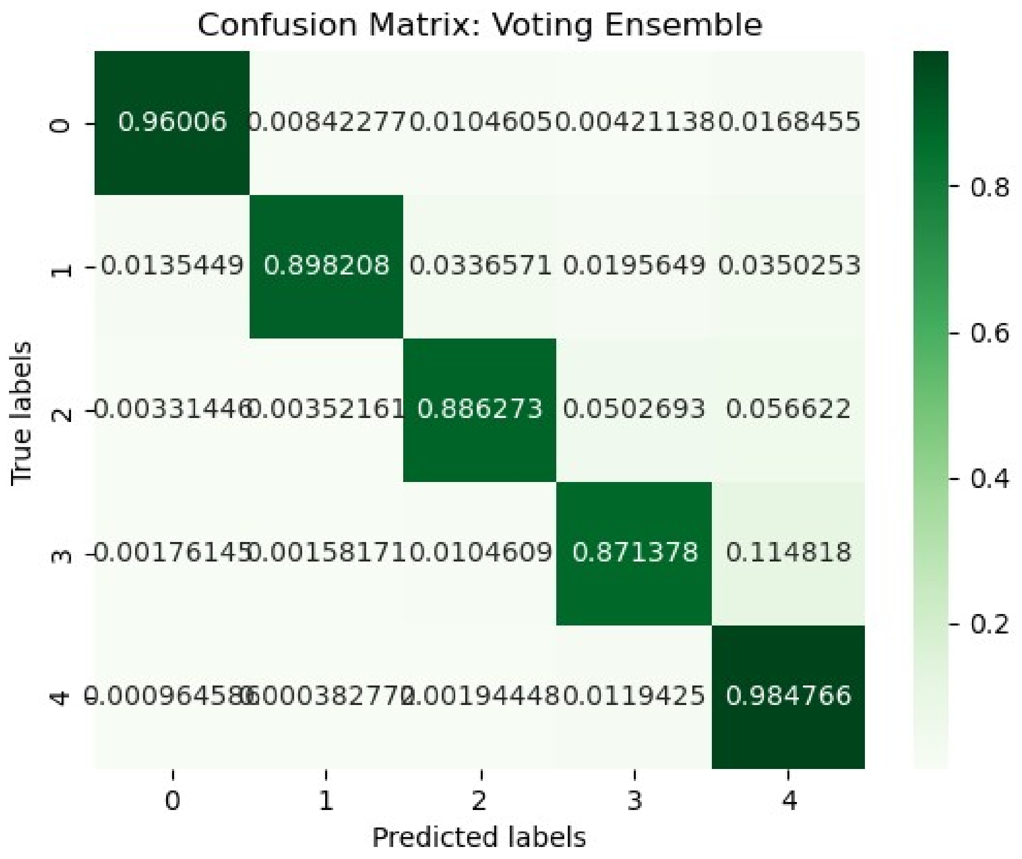
```
dataset = pd.read_csv("./data/X_train.csv")

dataset['Text'].fillna("it was okay", inplace=True)

token = RegexpTokenizer(r'[a-zA-Z0-9]+')
cv = CountVectorizer(stop_words='english',ngram_range =
(1,1),tokenizer = token.tokenize)
text_counts = cv.fit_transform(dataset['Text'])

X_train = text_counts
y_train = dataset['Score']
```

```
custom_class_prior = [0.2, 0.2, 0.2, 0.2, 0.2]
model3 = Pipeline([('clf',
MultinomialNB(class_prior=custom_class_prior))])
model3.fit(X_train, y_train)
y_pred = model3.predict(X_train)

print("Accuracy on testing set = ", accuracy_score(y_train,y_pred))
print("RMSE on testing set = ", mean_squared_error(y_train,y_pred))

ax= plt.subplot()
cm=confusion_matrix(y_train,y_pred,normalize='true')
sns.heatmap(cm, annot=True, fmt='g', ax=ax,cmap='Reds');
ax.set_xlabel('Predicted labels');ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix');

Accuracy on testing set =  0.7072446701503888
RMSE on testing set =  0.9173719977429405
```



```
estimators=[('LinearSVC', model),('logistic_regression', model2)]
voting = VotingClassifier(estimators, voting='soft')
voting.fit(X_train, y_train)
```

```
ensemble_predictions=voting.predict(X_train)
ax= plt.subplot()

print("RMSE on testing set = ", mean_squared_error(y_train,
ensemble_predictions))

cm=confusion_matrix(y_train, ensemble_predictions, normalize='true')
sns.heatmap(cm, annot=True, fmt='g', ax=ax,cmap='Greens');
ax.set_xlabel('Predicted labels'); ax.set_ylabel('True labels');
ax.set_title('Confusion Matrix: Voting Ensemble');

RMSE on testing set =  0.7317876344086022
```



Create the Kaggle submission

```
Y_test_predictions = voting.predict(X_test)
X_submission = pd.read_csv("./data/X_test.csv")
X_submission_processed = X_submission.drop(columns=['Id', 'ProductId',
'UserId', 'Text', 'Summary', 'Score'])

X_submission['Score'] = Y_test_predictions
submission = X_submission[['Id', 'Score']]
submission.to_csv("./data/submission.csv", index=False)
```

Now you can upload the `submission.csv` to kaggle