SentimentAnalysis

August 14, 2021

0.0.1 Data Classes

[1]:
```python
import random

class Review:
    def __init__(self, text, score):
        self.text = text
        self.score = score
        self.sentiment = self.get_sentiment()

    def get_sentiment(self):
        if self.score <= 2:
            return Sentiment.NEGATIVE
        elif self.score >= 4:
            return Sentiment.POSITIVE
        # let's ignore the reviews with 3 stars

class ReviewContainer:
    def __init__(self, reviews):
        self.reviews = reviews

    def get_text(self):
        return [x.text for x in self.reviews]

    def get_sentiment(self):
        return [x.sentiment for x in self.reviews]

    # class to evenly distribute positive and negative samples inside the set
    def evenly_distribute(self):
        negative = list(filter(lambda x: x.sentiment == Sentiment.NEGATIVE,␣
 ↪self.reviews))
        positive = list(filter(lambda x: x.sentiment == Sentiment.POSITIVE,␣
 ↪self.reviews))
        positive_shrunk = positive[:len(negative)]
        self.reviews = negative + positive_shrunk
        random.shuffle(self.reviews)

class Sentiment:
    NEGATIVE = "NEGATIVE"
    POSITIVE = "POSITIVE"
```

0.0.2 Data Loading

[2]:
```
import json

file_name = 'C:/Electronics_5_small.json'     # 75k entries

reviews = []
with open(file_name) as f:
    for line in f:
        review = json.loads(line)
        reviews.append(Review(review['reviewText'], review['overall']))

reviews[0].text
```

[2]:
```
'I really like the length and quality of this cable.  All of the other micro usb
cables I have are not long enough to allow me to use my phone while it is
plugged in.  This cable makes that possible and is much better quality than
previous ones that I have purchased.  So far, all three of the ones I purchased
are holding up perfectly.'
```

0.0.3 Data Preparation

[3]:
```
from sklearn.model_selection import train_test_split

training, test = train_test_split(reviews, test_size=0.33, random_state=42) #␣
 ↪let's use 42 since it is the answer to everything
train_container = ReviewContainer(training)
test_container = ReviewContainer(test)
```

[4]:
```
train_container.evenly_distribute()
train_x = train_container.get_text()
train_y = train_container.get_sentiment()

test_container.evenly_distribute()
test_x = test_container.get_text()
test_y = test_container.get_sentiment()

print(train_y.count(Sentiment.POSITIVE))
print(train_y.count(Sentiment.NEGATIVE))
```

```
5697
5697
```

Bag of words vectorization

[5]:
```
from sklearn.feature_extraction.text import CountVectorizer, TfidfVectorizer

vectorizer = TfidfVectorizer()
train_x_vectors = vectorizer.fit_transform(train_x)
test_x_vectors = vectorizer.transform(test_x)

print(train_x[0])
print(train_x_vectors[0].toarray())
```

```
These sound no better than $25 dollar Sennheiser HD 202 II. And the build
quality is no better either.Comfort is slightly better but for $300 more (tax
included)… No way!Noise cancellation is not any better either than $25 dollar
Sennheiser HD 202 II and the Senn's are just passive noise isolation. Plus with
the Bose you need batteries.These headphones are a complete rip-off for $300. I
would only pay $20-$30 dollars for these. No more.Look into some other brands
like Sennheiser. They are a respected German audio company which caters to all
budgets. For $300 dollars, you can buy Sennheiser's which will completely eat
these overpriced headphones for lunch.They are other brands too. Please do your
full research if you really are going to drop $300 on a pair of headphones
because these Bose ones are all just marketing hype for uneducated consumers.
You are not really getting $300 worth of sound nor worth of noise cancellation.
[[0. 0. 0. … 0. 0. 0.]]
```

0.1 Classification

Linear SVM

[6]:
```
from sklearn import svm

clf_svm = svm.SVC(kernel='linear')
clf_svm.fit(train_x_vectors, train_y)
clf_svm.predict(test_x_vectors[0])
```

[6]:
```
array(['POSITIVE'], dtype='<U8')
```

Decision Tree

[7]:
```
from sklearn.tree import DecisionTreeClassifier

clf_dec = DecisionTreeClassifier()
clf_dec.fit(train_x_vectors, train_y)
clf_dec.predict(test_x_vectors[0])
```

[7]:
```
array(['POSITIVE'], dtype='<U8')
```

Naive Bayes

[8]:
```
from sklearn.naive_bayes import GaussianNB

clf_gnb = DecisionTreeClassifier()
clf_gnb.fit(train_x_vectors, train_y)
clf_gnb.predict(test_x_vectors[0])
```

[8]:
```
array(['POSITIVE'], dtype='<U8')
```

Logistic Regression

[9]:
```
from sklearn.linear_model import LogisticRegression

clf_log = LogisticRegression()
clf_log.fit(train_x_vectors, train_y)
clf_log.predict(test_x_vectors[0])
```

[9]:
```
array(['POSITIVE'], dtype='<U8')
```

0.2 Results Evaluation

[10]:
```
# Mean Accuracy
print(clf_svm.score(test_x_vectors, test_y))
print(clf_dec.score(test_x_vectors, test_y))
print(clf_gnb.score(test_x_vectors, test_y))
print(clf_log.score(test_x_vectors, test_y))
```

```
0.8622357577929057
0.6929415979935507
0.6997491938373342
0.8609817269795772
```

[11]:
```
# F1 Scores
from sklearn.metrics import f1_score
# Linear SVM
f1_score(test_y, clf_svm.predict(test_x_vectors), average=None,␣
 ↪labels=[Sentiment.POSITIVE, Sentiment.NEGATIVE])
```

[11]:
```
array([0.86166577, 0.86280107])
```

[12]:
```
# Decision Tree
f1_score(test_y, clf_dec.predict(test_x_vectors), average=None,␣
 ↪labels=[Sentiment.POSITIVE, Sentiment.NEGATIVE])
```

[12]:
```
array([0.69566761, 0.69016631])
```

[13]:
```
# Gaussian Naive Bayes
f1_score(test_y, clf_gnb.predict(test_x_vectors), average=None,␣
 ↪labels=[Sentiment.POSITIVE, Sentiment.NEGATIVE])
```

[13]:
```
array([0.70220327, 0.69725434])
```

[14]:
```
# Logistic Regression
```

```
f1_score(test_y, clf_log.predict(test_x_vectors), average=None,␣
 ↪labels=[Sentiment.POSITIVE, Sentiment.NEGATIVE])
```

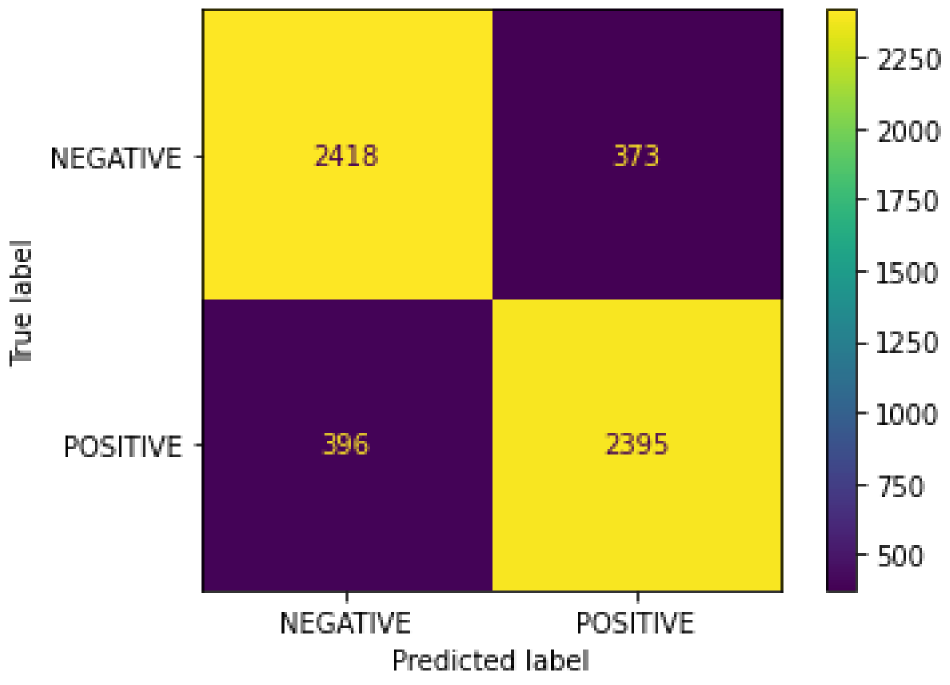
```
[14]: array([0.86023055, 0.86172488])
```

```
[15]: # Arbitrary strings
test_set = ["nice product!", "incredibly good device", "not good at all", "it␣
 ↪broke after 3 days",
            "it doesn't work properly", "it's amazing", "I had to return it",␣
 ↪"it feels old", "it fell apart quickly",
            "I don't know why Amazon still sells this", "it went straight to␣
 ↪the trash", "it's garbage", "it does what it's meant to do",
            "it works fine", "recommended", "you should buy it now", "it looks␣
 ↪good but it does not work as intended",
            "today is a sunny day", "good morning my dear", "traffic around␣
 ↪here has been quite noisy in the past few days",
            "I crashed my car into a tree", "today is a rainy day"]
new_test = vectorizer.transform(test_set)
clf_svm.predict(new_test)
```

```
[15]: array(['POSITIVE', 'POSITIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE',
       'POSITIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE',
       'NEGATIVE', 'NEGATIVE', 'POSITIVE', 'POSITIVE', 'POSITIVE',
       'NEGATIVE', 'NEGATIVE', 'NEGATIVE', 'POSITIVE', 'NEGATIVE',
       'NEGATIVE', 'NEGATIVE'], dtype='<U8')
```

```
[16]: # Confusion matrix
from sklearn.metrics import plot_confusion_matrix
import matplotlib.pyplot as plt

plot_confusion_matrix(clf_svm, test_x_vectors, test_y)
plt.show()
```



[17]:
```
clf_svm.get_params()
```

[17]:
```
{'C': 1.0,
 'break_ties': False,
 'cache_size': 200,
 'class_weight': None,
 'coef0': 0.0,
 'decision_function_shape': 'ovr',
 'degree': 3,
 'gamma': 'scale',
 'kernel': 'linear',
 'max_iter': -1,
 'probability': False,
 'random_state': None,
 'shrinking': True,
 'tol': 0.001,
 'verbose': False}
```

0.2.1 Model tuning

[18]:
```
from sklearn.model_selection import GridSearchCV

parameters = {'kernel': ('linear', 'rbf'), 'C': (1,4,8,16,32)}
```

```
svc = svm.SVC()
clf = GridSearchCV(svc, parameters, cv=5)
clf.fit(train_x_vectors, train_y)
```

```
[18]: GridSearchCV(cv=5, estimator=SVC(),
                   param_grid={'C': (1, 4, 8, 16, 32), 'kernel': ('linear', 'rbf')})
```

```
[19]: clf.get_params()
```

```
[19]: {'cv': 5,
       'error_score': nan,
       'estimator__C': 1.0,
       'estimator__break_ties': False,
       'estimator__cache_size': 200,
       'estimator__class_weight': None,
       'estimator__coef0': 0.0,
       'estimator__decision_function_shape': 'ovr',
       'estimator__degree': 3,
       'estimator__gamma': 'scale',
       'estimator__kernel': 'rbf',
       'estimator__max_iter': -1,
       'estimator__probability': False,
       'estimator__random_state': None,
       'estimator__shrinking': True,
       'estimator__tol': 0.001,
       'estimator__verbose': False,
       'estimator': SVC(),
       'n_jobs': None,
       'param_grid': {'kernel': ('linear', 'rbf'), 'C': (1, 4, 8, 16, 32)},
       'pre_dispatch': '2*n_jobs',
       'refit': True,
       'return_train_score': False,
       'scoring': None,
       'verbose': 0}
```

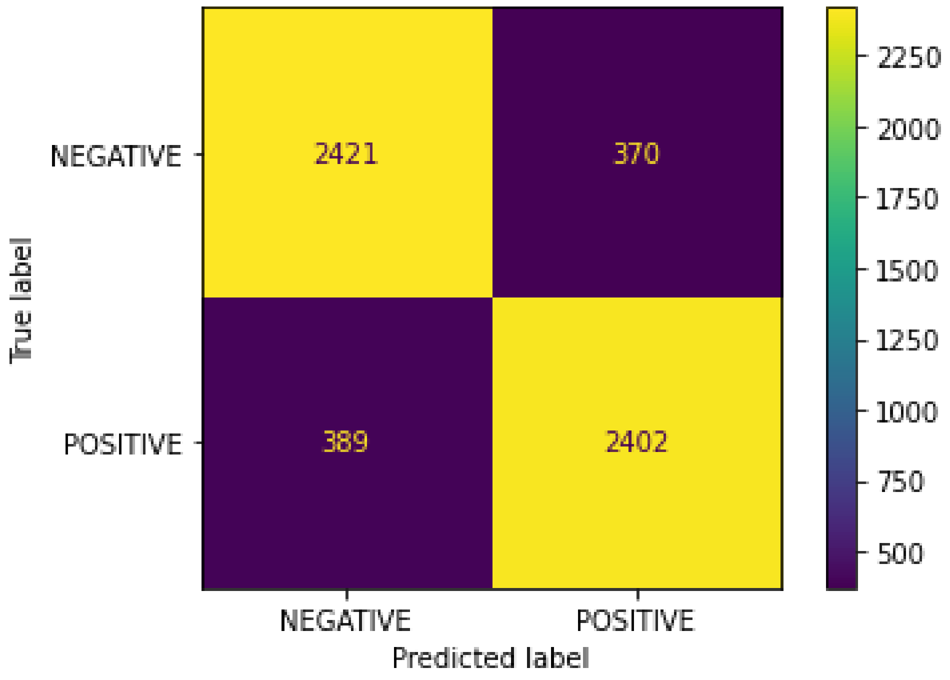
```
[20]: print(clf.score(test_x_vectors, test_y))
      test_set = ["nice product!", "incredibly good device", "not good at all", "it␣
       ↪broke after 3 days",
                  "it doesn't work properly", "it's amazing", "I had to return it",␣
       ↪"it feels old", "it fell apart quickly",
                  "I don't know why Amazon still sells this", "it went straight to␣
       ↪the trash", "it's garbage", "it does what it's meant to do",
                  "it works fine", "recommended", "you should buy it now", "it looks␣
       ↪good but it does not work as intended",
                  "today is a sunny day", "good morning my dear", "traffic around␣
       ↪here has been quite noisy in the past few days",
                  "I crashed my car on a tree", "today is a rainy day"]
```

```
clf_test = vectorizer.transform(test_set)
clf.predict(new_test)
```

```
0.8640272303833751
```

[20]:
```
array(['POSITIVE', 'POSITIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE',
       'POSITIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE', 'NEGATIVE',
       'NEGATIVE', 'NEGATIVE', 'POSITIVE', 'POSITIVE', 'POSITIVE',
       'NEGATIVE', 'NEGATIVE', 'NEGATIVE', 'POSITIVE', 'NEGATIVE',
       'NEGATIVE', 'NEGATIVE'], dtype='<U8')
```

[21]:
```
# Confusion matrix after model tuning
plot_confusion_matrix(clf, test_x_vectors, test_y)
plt.show()
```



0.3 Model saving for future use

[22]:
```
import pickle

with open('./amazon_sentiment_analysis_SVMmodel.pkl', 'wb') as f:
    pickle.dump(clf, f)
```