Decision Trees on amazon reviews

June 30, 2018

```
In [1]: import sqlite3
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import plotly.plotly as py
        import plotly.graph_objs as go
        from sklearn.cross_validation import train_test_split
        from sklearn.neighbors import KNeighborsClassifier
        from sklearn.metrics import accuracy_score
        from sklearn.cross_validation import cross_val_score
        from collections import Counter
        from sklearn.metrics import accuracy_score
        from sklearn import cross_validation
        from sklearn.feature_extraction.text import TfidfTransformer
        from sklearn.feature_extraction.text import TfidfVectorizer
        from sklearn.feature_extraction.text import CountVectorizer
        from sklearn.metrics import confusion_matrix
        from sklearn import metrics
        from sklearn.metrics import roc_curve, auc
        from nltk.stem.porter import PorterStemmer
        from sklearn.decomposition import TruncatedSVD
        from sklearn.model_selection import TimeSeriesSplit
        from sklearn.model_selection import GridSearchCV
        from sklearn.linear_model import LogisticRegression
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/cross_validation.py:41: DeprecationWarning:

This module was deprecated in version 0.18 in favor of the model_selection module into which al
```

1 Loading the data

```
In [0]: final_data = pd.read_csv("final.csv")

        final_data = final_data.drop(["Text"], axis = 1)
        final_data = final_data.drop(final_data.columns[0], axis = 1)
```

2 Sorting and train/test split

```
In [0]: labels = final_data.Score
        final_data = final_data.sort_values("Time")
        final_data.shape
```

```
In [0]: n = final_data.shape[0]
        train_size = 0.7

        train_set = final_data.iloc[:int(n*train_size)]
        test_set =final_data.iloc[int(n*train_size):]

        X_train = train_set.CleanedText
        y_train = train_set.Score

        X_test = test_set.CleanedText
        y_test= test_set.Score
```

3 Cleaning the data

```
In [7]: import nltk
        nltk.download('stopwords')
        import re
        # Tutorial about Python regular expressions: https://pymotw.com/2/re/
        import string
        from nltk.corpus import stopwords
        from nltk.stem import PorterStemmer
        from nltk.stem.wordnet import WordNetLemmatizer

        stop = set(stopwords.words('english')) #set of stopwords
        sno = nltk.stem.SnowballStemmer('english') #initialising the snowball stemmer

        def cleanhtml(sentence): #function to clean the word of any html-tags
            cleanr = re.compile('<.*?>')
            cleantext = re.sub(cleanr, ' ', sentence)
            return cleantext
        def cleanpunc(sentence): #function to clean the word of any punctuation or special cha
            cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
            cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
            return  cleaned
        print(stop)
        print('************************************')
        print(sno.stem('tasty'))
```

```
[nltk_data] Downloading package stopwords to /content/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
{'am', 'below', 'through', 'mustn', 'mightn', 'itself', "didn't", 'm', 'the', 'haven', 'couldn
************************************
```

```
tasti
```

4 Creating Word2vec model

```
In [0]: import gensim
        i=0
        train_sent=[]
        for sent in X_train:
            filtered_sentence=[]
            sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            train_sent.append(filtered_sentence)
```

```
In [0]: test_sent=[]
        for sent in X_test:
            filtered_sentence=[]
            sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            test_sent.append(filtered_sentence)
```

```
In [0]: from gensim.models import Word2Vec
        from gensim.models import KeyedVectors

        w2v_model = gensim.models.Word2Vec(train_sent,min_count=5,size=50, workers=4)
```

4.1 Average Word2Vec

```
In [12]: #AVG-W2V
         sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
         for sent in train_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             cnt_words =0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     cnt_words = 1
                     pass
             sent_vec /= cnt_words
             sent_vectors.append(sent_vec)
         print(len(sent_vectors))
         print(len(sent_vectors[0]))
```

```
254919
50
```

```
In [13]: sent_vectors2 = []; # the avg-w2v for each sentence/review is stored in this list
         for sent in test_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             cnt_words =0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     cnt_words = 1
                     pass
             sent_vec /= cnt_words
             sent_vectors2.append(sent_vec)
         print(len(sent_vectors2))
         print(len(sent_vectors2[0]))
```

```
109252
50
```

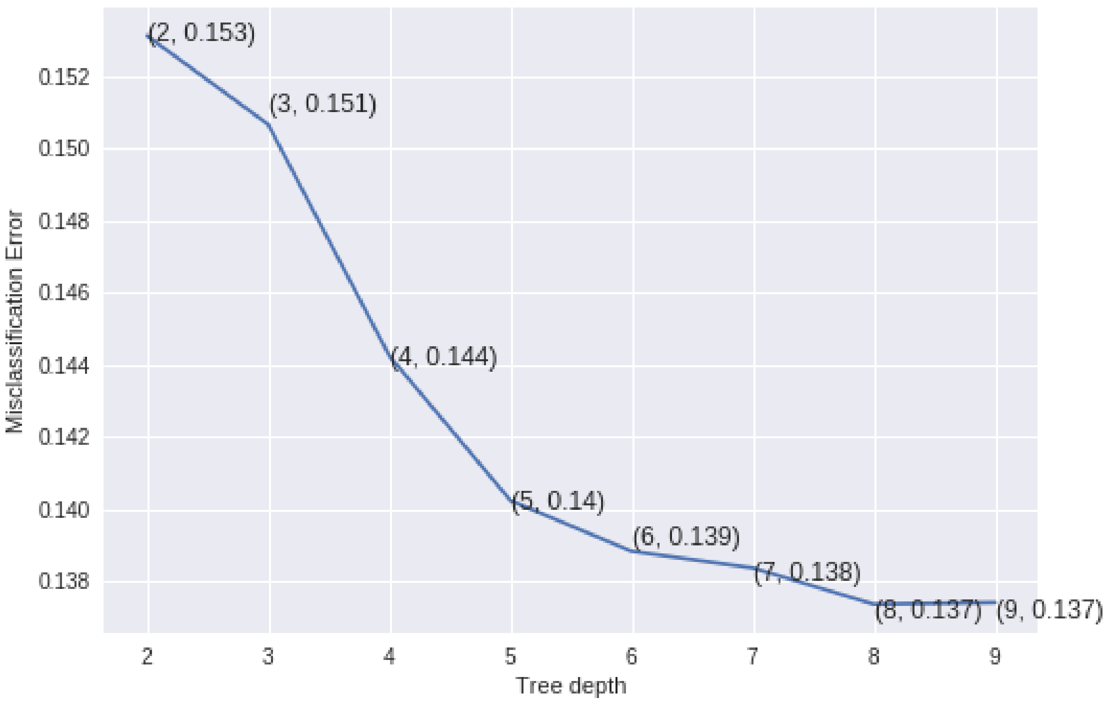
```
In [0]: X_train1 = sent_vectors
        X_test1 = sent_vectors2
```

5 Applying DecisionTree Classifier

```
In [17]: from sklearn.tree import DecisionTreeClassifier


         depth = list(range(2,10))
```

```python
# empty list that will hold cv scores
cv_scores = []
my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train1)]
# perform 10-fold cross validation
for d in depth:
    dt = DecisionTreeClassifier(max_depth = d, min_samples_split = 1000, min_samples_
    scores = cross_val_score(dt, X_train1, y_train, cv = my_cv, scoring='accuracy')
    cv_scores.append(scores.mean())


# changing to misclassification error
MSE = [1 - x for x in cv_scores]

# determining best k
optimal_d = depth[MSE.index(min(MSE))]
print('\nThe optimal depth of the tree is %d.' % optimal_d)

# plot misclassification error vs k
plt.plot(depth, MSE)

for xy in zip(depth, np.round(MSE,3)):
    plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')

plt.xlabel('Tree depth')
plt.ylabel('Misclassification Error')
plt.show()
```

```
The optimal depth of the tree is 8.
```



```
In [18]: dt = DecisionTreeClassifier(max_depth = 8, min_samples_split = 1000, min_samples_leaf
         dt.fit(X_train1,y_train)
         pred = dt.predict(X_test1)

         acc = accuracy_score(y_test, pred, normalize=True) * float(100)
         x = dt.predict(X_train1)
         tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
         print('\n****Train accuracy for k = {} is {:.2f}'.format(8,tr_acc))
         print('\n****Test accuracy for k = {} is {:.2f}'.format(8,acc))
```

```
****Train accuracy for k = 8 is 87.32

****Test accuracy for k = 8 is 85.31
```

6 Word2Vec-Tfidf

6.0.1 Note : Performed with sampled 50k datapoints

```
In [12]: from sklearn.feature_extraction.text import TfidfTransformer
         from sklearn.feature_extraction.text import TfidfVectorizer
         tf_idf_vect = TfidfVectorizer()
         final_tf_idf = tf_idf_vect.fit_transform(X_train)
         tfidf_feat = tf_idf_vect.get_feature_names()
          # tfidf words/col-names
         # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

         train_vectors = []; # the tfidf-w2v for each sentence/review is stored in this list
         row=0;
         for sent in train_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             weight_sum = 0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model.wv[word]
                     # obtain the tf_idf of a word in a sentence/review
                     tfidf = final_tf_idf[row, tfidf_feat.index(word)]
                     sent_vec += (vec * tfidf)
                     weight_sum += tfidf


                 except:
                     weight_sum = 1
                     pass

             sent_vec /= weight_sum
             #print(np.isnan(np.sum(sent_vec)))

             train_vectors.append(sent_vec)
             row += 1
         print(len(train_vectors))
         print(len(train_vectors[0]))
```

```
35000
50
```

```
In [13]: final_tf_idf = tf_idf_vect.fit_transform(X_test)
         tfidf_feat = tf_idf_vect.get_feature_names()
          # tfidf words/col-names
         # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

         test_vectors = []; # the tfidf-w2v for each sentence/review is stored in this list
         row=0;
         for sent in test_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             weight_sum = 0; # num of words with a valid vector in the sentence/review
```

```
    for word in sent: # for each word in a review/sentence
        try:
            vec = w2v_model2.wv[word]
            # obtain the tf_idf of a word in a sentence/review
            tfidf = final_tf_idf[row, tfidf_feat.index(word)]
            sent_vec += (vec * tfidf)
            weight_sum += tfidf


        except:
            weight_sum = 1
            pass

    sent_vec /= weight_sum
    #print(np.isnan(np.sum(sent_vec)))

    test_vectors.append(sent_vec)
    row += 1
print(len(test_vectors))
print(len(test_vectors[0]))
```

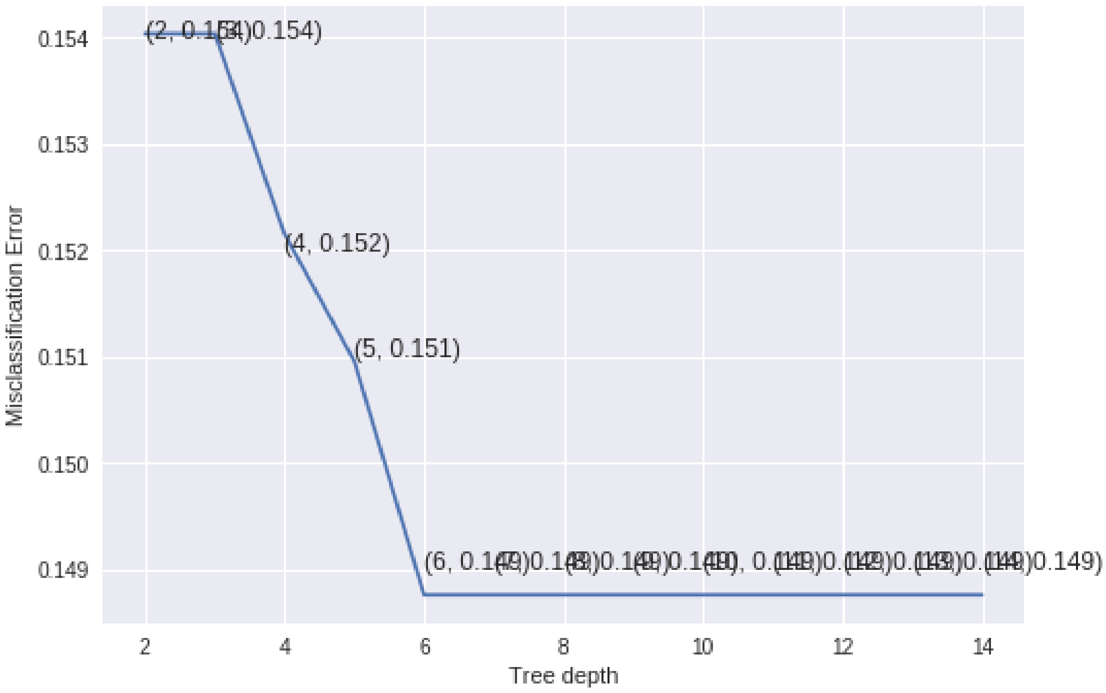
```
15000
50
```

```
In [0]: X_train2 = train_vectors
        X_test2 = test_vectors
```

7 Applying DecisionTree Classifier

```
In [15]: from sklearn.tree import DecisionTreeClassifier


         depth = list(range(2,15))

         # empty list that will hold cv scores
         cv_scores = []
         my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train2)]
         # perform 10-fold cross validation
         for d in depth:
             dt = DecisionTreeClassifier(max_depth = d, min_samples_split = 500, min_samples_le
             scores = cross_val_score(dt, X_train2, y_train, cv = my_cv, scoring='accuracy')
             cv_scores.append(scores.mean())


         # changing to misclassification error
         MSE = [1 - x for x in cv_scores]
         # determining best k
         optimal_d = depth[MSE.index(min(MSE))]
         print('\nThe optimal depth of the tree is %d.' % optimal_d)

         # plot misclassification error vs k
         plt.plot(depth, MSE)

         for xy in zip(depth, np.round(MSE,3)):
             plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')

         plt.xlabel('Tree depth')
         plt.ylabel('Misclassification Error')
         plt.show()
```

```
The optimal depth of the tree is 6.
```



```
In [17]: dt = DecisionTreeClassifier(max_depth = 6, min_samples_split = 500, min_samples_leaf
         dt.fit(X_train2,y_train)
         pred = dt.predict(X_test2)

         acc = accuracy_score(y_test, pred, normalize=True) * float(100)
         x = dt.predict(X_train2)
         tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
```

```
        print('\n****Train accuracy for k = {} is {:.2f}'.format(6,tr_acc))
        print('\n****Test accuracy for k = {} is {:.2f}'.format(6,acc))
```

```
****Train accuracy for k = 6 is 86.09

****Test accuracy for k = 6 is 83.13
```

---

8 Conclusion

- #### 8.0.1 Average word2vec gives a training accuracy of 87.3 % and testing accuracy of 85.3 % with best depth of tree being '8'.

- #### 8.0.2 Tf-idf word2vec gives a training accuracy of 86 % and testing accuracy of 83.1 % with best depth of tree being '6'.