Alexa_NLP_analysis

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1 Exploration of Alexa Reviews using NLP

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In this project I am going to predict user given ratings of Alexa using natural lanuage processing techniques. The data consists of the following fields: rating, date, variation, and review text from amazon

[1]:
```
# Importing library and dataset
import pandas as pd
df = pd.read_table('amazon_alexa.tsv')
```

```
C:\Users\pooja\Anaconda3\lib\site-packages\ipykernel_launcher.py:3:
FutureWarning: read_table is deprecated, use read_csv instead, passing sep='\t'.
  This is separate from the ipykernel package so we can avoid doing imports
until
```

1.1 Data Preprocessing

[2]:
```
# Showing first 5 columns of the data
df.head()
```

[2]:
```
   rating       date         variation  \
0       5  31-Jul-18  Charcoal Fabric
1       5  31-Jul-18  Charcoal Fabric
2       4  31-Jul-18    Walnut Finish
3       5  31-Jul-18  Charcoal Fabric
4       5  31-Jul-18  Charcoal Fabric

                                    verified_reviews  feedback
0                                      Love my Echo!         1
1                                          Loved it!         1
2  Sometimes while playing a game, you can answer...         1
3  I have had a lot of fun with this thing. My 4 ...         1
4                                              Music         1
```

[3]:
```
# Getting info of the data
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3150 entries, 0 to 3149
Data columns (total 5 columns):
rating              3150 non-null int64
date                3150 non-null object
variation           3150 non-null object
verified_reviews    3150 non-null object
feedback            3150 non-null int64
dtypes: int64(2), object(3)
memory usage: 123.1+ KB
```

[4]:

```
# Describing the data and getting mean, max, min, std, count
df.describe()
```

[4]:

```
            rating     feedback
count  3150.000000  3150.000000
mean      4.463175     0.918413
std       1.068506     0.273778
min       1.000000     0.000000
25%       4.000000     1.000000
50%       5.000000     1.000000
75%       5.000000     1.000000
max       5.000000     1.000000
```

[5]:

```
# Showing clumns of the data
df.columns
```

[5]:

```
Index(['rating', 'date', 'variation', 'verified_reviews', 'feedback'],
dtype='object')
```

[6]:

```
# As we can see that our one column is containing categorical values
# we are using one hot encoder which will encoding for the model to understand␣
 ↪this variable

df1 = df[['variation']]
df2 = df.drop(['variation'], axis = 1)
df1 = pd.get_dummies(df1)
df = pd.concat([df1,df2], axis = 1)
df.head()
```

[6]:

```
   variation_Black  variation_Black Dot  variation_Black Plus  \
0                0                    0                     0
1                0                    0                     0
2                0                    0                     0
3                0                    0                     0
4                0                    0                     0

   variation_Black Show  variation_Black Spot  variation_Charcoal Fabric   \
0                     0                     0                           1
1                     0                     0                           1
```

```
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   \
0                      0                            0
1                      0                            0
2                      0                            0
3                      0                            0
4                      0                            0

   variation_Walnut Finish   variation_White  variation_White  Dot  \
0                         0                0                     0
1                         0                0                     0
2                         1                0                     0
3                         0                0                     0
4                         0                0                     0

   variation_White  Plus  variation_White  Show  variation_White  Spot  \
0                      0                      0                      0
1                      0                      0                      0
2                      0                      0                      0
3                      0                      0                      0
4                      0                      0                      0

   rating       date                                   verified_reviews  \
0       5  31-Jul-18                                      Love my Echo!
1       5  31-Jul-18                                          Loved it!
2       4  31-Jul-18  Sometimes while playing a game, you can answer...
3       5  31-Jul-18  I have had a lot of fun with this thing. My 4 ...
4       5  31-Jul-18                                              Music

   feedback
0         1
1         1
2         1
3         1
4         1
```

[7]:
```python
# We have date column in our dataset which needs to be addressed and the model␣
 ↪which will accept only numeric inputs,
# will not be able to interpret this information.

df['Year'] = pd.DatetimeIndex(df['date']).year
df['Month'] = pd.DatetimeIndex(df['date']).month
df['Day'] = pd.DatetimeIndex(df['date']).day
df = df.drop(['date'], axis = 1)
df.head()
```

[7]:
```
   variation_Black  variation_Black  Dot  variation_Black  Plus  \
0                0                     0                      0
1                0                     0                      0
2                0                     0                      0
3                0                     0                      0
4                0                     0                      0

   variation_Black  Show  variation_Black  Spot  variation_Charcoal Fabric   \
0                      0                      0                           1
1                      0                      0                           1
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   ...  \
0                      0                            0  ...
1                      0                            0  ...
2                      0                            0  ...
3                      0                            0  ...
4                      0                            0  ...

   variation_White  Dot  variation_White  Plus  variation_White  Show  \
0                     0                      0                      0
1                     0                      0                      0
2                     0                      0                      0
3                     0                      0                      0
4                     0                      0                      0

   variation_White  Spot  rating  \
0                      0       5
```

```
1                       0       5
2                       0       4
3                       0       5
4                       0       5

                                    verified_reviews  feedback  Year  Month  \
0                                      Love my Echo!         1  2018      7
1                                          Loved it!         1  2018      7
2  Sometimes while playing a game, you can answer...         1  2018      7
3  I have had a lot of fun with this thing. My 4 ...         1  2018      7
4                                              Music         1  2018      7

   Day
0   31
1   31
2   31
3   31
4   31

[5 rows x 22 columns]
```

Now, we are going to use TextBlob. It will analyze text strings and provide numeric outputs relating to sentiment. TextBlob will output both the polarity (range -1 to 1) as well as subjectivity (range 0 to 1) in the form of a tuple. The results of this process can be mapped into columns containing polarity and subjectivity respectively.

[8]:

```
from textblob import TextBlob
```

[9]:

```
# Defining the function which will output sentiment given a string input and␣
 ↪that
# will return a neutral output if the input cannot be handled.

def sentiment_calc(text):
    try:
        return TextBlob(text).sentiment
    except:
        return TextBlob('hello').sentiment
```

[10]:

```
# Creating new column sentiment

df['sentiment'] = df['verified_reviews'].apply(lambda text:␣
 ↪sentiment_calc(text))
df[['polarity', 'subjectivity']] = df['sentiment'].apply(pd.Series)
df = df.drop(['sentiment'], axis = 1)
df.head()
```

[10]:

```
   variation_Black  variation_Black Dot  variation_Black Plus  \
0                0                    0                     0
1                0                    0                     0
```

```
2                0                     0                      0
3                0                     0                      0
4                0                     0                      0

   variation_Black  Show  variation_Black  Spot  variation_Charcoal Fabric   \
0                      0                      0                           1
1                      0                      0                           1
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   ...  \
0                      0                            0  ...
1                      0                            0  ...
2                      0                            0  ...
3                      0                            0  ...
4                      0                            0  ...

   variation_White  Show  variation_White  Spot  rating  \
0                      0                      0       5
1                      0                      0       5
2                      0                      0       4
3                      0                      0       5
4                      0                      0       5

                                    verified_reviews  feedback  Year  Month  \
0                                      Love my Echo!         1  2018      7
1                                          Loved it!         1  2018      7
2  Sometimes while playing a game, you can answer...         1  2018      7
3  I have had a lot of fun with this thing. My 4 ...         1  2018      7
4                                              Music         1  2018      7

  Day  polarity  subjectivity
0  31     0.625        0.6000
1  31     0.875        0.8000
2  31    -0.100        0.5125
3  31     0.350        0.4500
4  31     0.000        0.0000

[5 rows x 24 columns]
```

[11]:

```
# To return the average word length by defining a function

def avg_word(sentence):
  try:
    words = sentence.split()
    return (sum(len(word) for word in words)/len(words))
  except:
    return 0
```

[12]:

```
# Based on the review text column creating new columns

df['number_words'] = df['verified_reviews'].str.split().str.len()
df['number_character'] = df['verified_reviews'].str.len()
df['avg_word'] = df['verified_reviews'].apply(lambda x: avg_word(x))
```

[13]:

```
# creating a column that contains the number of stopwords in the review text.

import nltk
nltk.download("stopwords")
from nltk.corpus import stopwords
stop = stopwords.words('english')
df['stopwords'] = df['verified_reviews'].apply(lambda x: len([x for x in x.
 ↪split() if x in stop]))
df.head()
```

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

[13]:

```
   variation_Black  variation_Black  Dot  variation_Black  Plus  \
0                0                    0                      0
1                0                    0                      0
2                0                    0                      0
3                0                    0                      0
4                0                    0                      0

   variation_Black  Show  variation_Black  Spot  variation_Charcoal Fabric   \
0                      0                      0                           1
1                      0                      0                           1
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
```

```
4                                       0                               0

   variation_Oak Finish  variation_Sandstone Fabric  ...  feedback  Year  \
0                     0                           0  ...         1  2018
1                     0                           0  ...         1  2018
2                     0                           0  ...         1  2018
3                     0                           0  ...         1  2018
4                     0                           0  ...         1  2018

   Month  Day  polarity  subjectivity  number_words number_character  \
0      7   31     0.625        0.6000             3               13
1      7   31     0.875        0.8000             2                9
2      7   31    -0.100        0.5125            38              195
3      7   31     0.350        0.4500            34              172
4      7   31     0.000        0.0000             1                5

   avg_word  stopwords
0  3.666667          1
1  4.000000          0
2  4.131579         19
3  4.088235         12
4  5.000000          0

[5 rows x 28 columns]
```

[14]:

```python
# Using Minmaxscaler for better inetrpretation

from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
columns = ['number_character','number_words', 'avg_word', 'stopwords']
for col in columns:
  df[[col]] = scaler.fit_transform(df[[col]])
df.head()
```

[14]:

```
   variation_Black  variation_Black Dot  variation_Black Plus  \
0                0                    0                     0
1                0                    0                     0
2                0                    0                     0
3                0                    0                     0
4                0                    0                     0

   variation_Black Show  variation_Black Spot  variation_Charcoal Fabric  \
0                     0                     0                          1
1                     0                     0                          1
2                     0                     0                          0
3                     0                     0                          1
4                     0                     0                          1
```

```
   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   ...  feedback  Year  \
0                     0                            0  ...         1  2018
1                     0                            0  ...         1  2018
2                     0                            0  ...         1  2018
3                     0                            0  ...         1  2018
4                     0                            0  ...         1  2018

   Month  Day  polarity  subjectivity  number_words number_character  \
0      7   31     0.625        0.6000      0.005703         0.004211
1      7   31     0.875        0.8000      0.003802         0.002807
2      7   31    -0.100        0.5125      0.072243         0.068070
3      7   31     0.350        0.4500      0.064639         0.060000
4      7   31     0.000        0.0000      0.001901         0.001404

   avg_word  stopwords
0  0.056410   0.004484
1  0.061538   0.000000
2  0.063563   0.085202
3  0.062896   0.053812
4  0.076923   0.000000

[5 rows x 28 columns]
```

[15]:
```python
from gensim.summarization import summarize
def sum_text(text):
  try:
    summed_text = summarize(text)
    return summed_text
  except:
    return text
```

[16]:
```python
df['summed_text'] = df['verified_reviews'].apply(lambda x: sum_text(x))
df['sentiment_sum'] = df['summed_text'].apply(lambda text: sentiment_calc(text))
df[['polarity_sum', 'subjectivity_sum']] = df['sentiment_sum'].apply(pd.Series)
df = df.drop(['sentiment_sum'], axis = 1)
df.head()
```

[16]:
```
   variation_Black  variation_Black  Dot  variation_Black  Plus  \
0                0                      0                      0
1                0                      0                      0
2                0                      0                      0
```

```
3                0                     0                      0
4                0                     0                      0

   variation_Black  Show  variation_Black  Spot  variation_Charcoal Fabric   \
0                      0                      0                           1
1                      0                      0                           1
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   ...  Day  polarity  \
0                      0                            0  ...   31     0.625
1                      0                            0  ...   31     0.875
2                      0                            0  ...   31    -0.100
3                      0                            0  ...   31     0.350
4                      0                            0  ...   31     0.000

   subjectivity  number_words  number_character  avg_word  stopwords  \
0        0.6000      0.005703          0.004211  0.056410   0.004484
1        0.8000      0.003802          0.002807  0.061538   0.000000
2        0.5125      0.072243          0.068070  0.063563   0.085202
3        0.4500      0.064639          0.060000  0.062896   0.053812
4        0.0000      0.001901          0.001404  0.076923   0.000000

     summed_text  polarity_sum  subjectivity_sum
0  Love my Echo!         0.625               0.6
1      Loved it!         0.875               0.8
2                        0.000               0.0
3                        0.000               0.0
4          Music         0.000               0.0

[5 rows x 31 columns]
```

[17]:

```
# Creating a new dataframe which can be fed into the model

df2 = df.drop(['verified_reviews', 'summed_text'], axis = 1)
df2.head()
```

[17]:

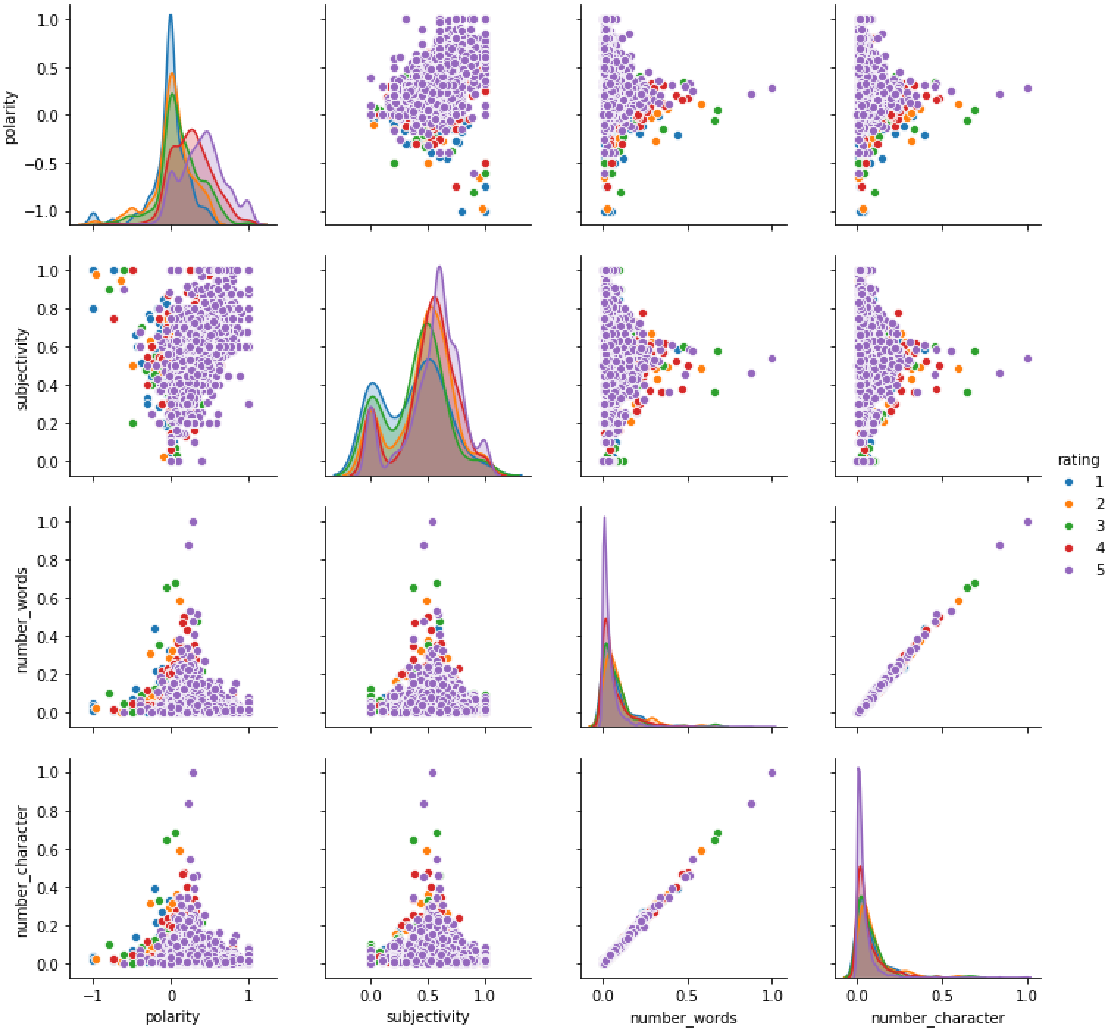
```
   variation_Black  variation_Black  Dot  variation_Black  Plus  \
0                0                     0                      0
1                0                     0                      0
```

```
2                0                     0                      0
3                0                     0                      0
4                0                     0                      0

   variation_Black  Show  variation_Black  Spot  variation_Charcoal Fabric   \
0                      0                      0                           1
1                      0                      0                           1
2                      0                      0                           0
3                      0                      0                           1
4                      0                      0                           1

   variation_Configuration: Fire TV Stick  variation_Heather Gray Fabric   \
0                                       0                               0
1                                       0                               0
2                                       0                               0
3                                       0                               0
4                                       0                               0

   variation_Oak Finish   variation_Sandstone Fabric   ...  Month  Day  \
0                      0                            0  ...      7   31
1                      0                            0  ...      7   31
2                      0                            0  ...      7   31
3                      0                            0  ...      7   31
4                      0                            0  ...      7   31

   polarity  subjectivity  number_words  number_character  avg_word  \
0     0.625        0.6000      0.005703          0.004211  0.056410
1     0.875        0.8000      0.003802          0.002807  0.061538
2    -0.100        0.5125      0.072243          0.068070  0.063563
3     0.350        0.4500      0.064639          0.060000  0.062896
4     0.000        0.0000      0.001901          0.001404  0.076923

   stopwords  polarity_sum  subjectivity_sum
0   0.004484         0.625               0.6
1   0.000000         0.875               0.8
2   0.085202         0.000               0.0
3   0.053812         0.000               0.0
4   0.000000         0.000               0.0

[5 rows x 29 columns]
```

1.2 Data Visualization

[18]:
```
import seaborn as sns
from matplotlib import pyplot as plt
```

[19]:
```
sns_plot = sns.pairplot(df, hue = 'rating', vars=['polarity','subjectivity',␣
↪'number_words', 'number_character'])
#sns_plot.savefig('name_of_file.png')
#files.download('name_of_file.png')
```



1.3 Building and Executing the Model

[20]:
```
from sklearn.model_selection import train_test_split
import numpy as np
df1=np.matrix(df2.drop(['rating'], axis = 1))
y=np.array(df2['rating'])
X_train, X_test, y_train, y_test = train_test_split(df1, y, test_size=0.2)
```

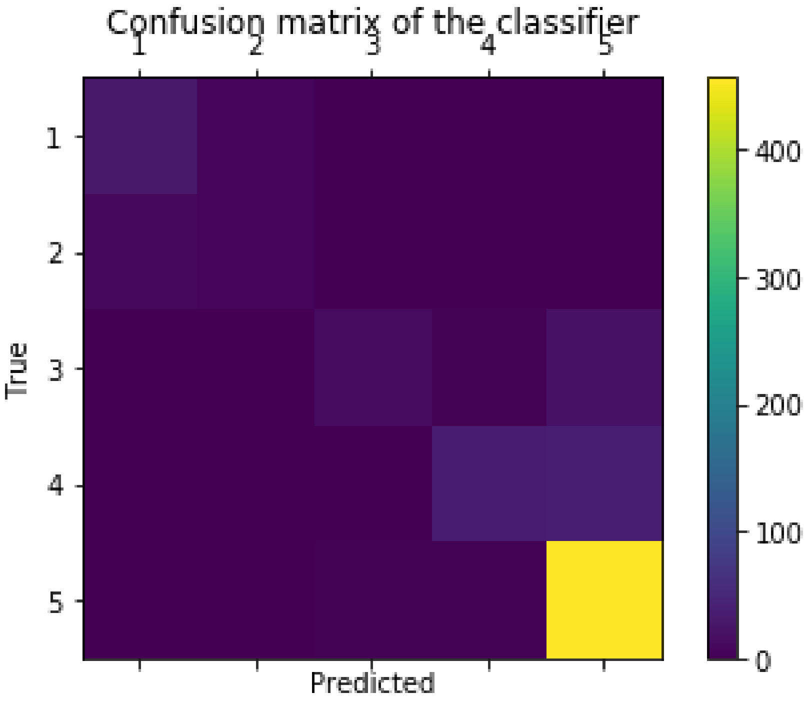
[21]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
```

```
rfc = RandomForestClassifier(n_estimators=500, criterion='gini', max_depth=None,
                             min_samples_split=2, min_samples_leaf=1,␣
 ↪min_weight_fraction_leaf=0.0,
                             max_features='auto', max_leaf_nodes=None,␣
 ↪min_impurity_decrease=0.0,
                             min_impurity_split=None, bootstrap=True,␣
 ↪oob_score=False, n_jobs=None,
                             random_state=None, verbose=0, warm_start=False,␣
 ↪class_weight=None)

rfc.fit(X_train,y_train)

score = rfc.score(X_test,y_test)

print(score)
```

```
0.8634920634920635
```

[22]:

```
from sklearn.metrics import confusion_matrix
predictions = rfc.predict(X_test)
cm = confusion_matrix(y_test, predictions)
labels = ['1','2','3','4','5']
fig = plt.figure()
ax = fig.add_subplot(111)
cax = ax.matshow(cm)
plt.title('Confusion matrix of the classifier')
fig.colorbar(cax)
ax.set_xticklabels([''] + labels)
ax.set_yticklabels([''] + labels)
plt.xlabel('Predicted')
plt.ylabel('True')
plt.show()
```



[23]:
```
print(cm)
```

```
[[ 31   6   0   0   0]
 [ 10   8   0   0   0]
 [  0   0  13   3  22]
 [  0   0   0  35  39]
 [  0   0   3   3 457]]
```

The results are pretty good. We achieved an accuracy of approximately 84%, with most of the incorrect predictions being in an adjacent square.