Assignment 2

September 1, 2018

0.1 Exercise 2: t-SNE visualization of Amazon reviews with polarity based color-coding

Given Dataset consists of reviews of fine foods from amazon. Reviews describe (1)product and user information, (2)ratings, and (3) a plain text review.

0.2 Objective:

- To determine given review is positive (Rating of 4 or 5) or negative (rating of 1 or 2).
- To visualize Amazon reviews with polarity based color-coding via t-SSNE

0.3 2.1 Loading data:

The dataset is available in two forms

- 2.1(a)csv file
- 2.1(b)SQLite Database

```
In [1]: # All necessary module
        %matplotlib inline
        #import  sys
        import re
        import sqlite3
        import pandas as pd
        import numpy as np
        import nltk
        import string
        import matplotlib.pyplot as plt
        import seaborn as sn
        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
```

```
In [2]: # Reading CSV file and printing first five rows
        amz1 = pd.read_csv('Reviews.csv') # reviews.csv is  dataset file
        print(amz1.head())
```

```
   Id   ProductId          UserId                      ProfileName  \
0   1  B001E4KFG0  A3SGXH7AUHU8GW                       delmartian
1   2  B00813GRG4  A1D87F6ZCVE5NK                           dll pa
2   3  B000LQOCH0   ABXLMWJIXXAIN  Natalia Corres "Natalia Corres"
3   4  B000UA0QIQ  A395BORC6FGVXV                             Karl
4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

   HelpfulnessNumerator  HelpfulnessDenominator  Score        Time  \
0                     1                       1      5  1303862400
1                     0                       0      1  1346976000
2                     1                       1      4  1219017600
3                     3                       3      2  1307923200
4                     0                       0      5  1350777600

                 Summary                                               Text
0  Good Quality Dog Food  I have bought several of the Vitality canned d...
1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut...
2  "Delight" says it all  This is a confection that has been around a fe...
3         Cough Medicine  If you are looking for the secret ingredient i...
4            Great taffy  Great taffy at a great price.  There was a wid...
```

```
In [3]: # dimensions of dataset and columns name
        amz=amz1[0:10000]
        print(amz.shape)
        print(amz.columns)
```

```
(10000, 10)
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text'],
      dtype='object')
```

The amazon reviews datafile contains 568454 rows of entry and 10 columns.For given objective, processing of data is necessary.“Score” and “text” columns is processed for required result.

```
In [4]: '''
        amz_spl = amz.head(10000)
        #print(amz_spl)
        '''
```

```
Out[4]: '\namz_spl = amz.head(10000)\n#print(amz_spl)\n'
```

```
In [5]: # Processing
        #Give reviews with Score>3 a positive rating, and reviews with a score<3 a
        def score_part(x):
            if x < 3:
                return 'negative'
            return 'positive'

        actualScore = amz['Score']
        New_score = actualScore.map(score_part)
        #print(New_score)
        amz['Score']=New_score

        # If score is equal to 3,it is considered as neutral score.
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:12: SettingWithCop
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/i
  if sys.path[0] == '':
```

```
In [6]: print(amz.shape)
        amz.head(5)

        #Now,check the Score column  for postive and negative entry of reviews
        #
```

```
(10000, 10)
```

```
Out[6]:    Id   ProductId          UserId                          ProfileName  \
        0   1  B001E4KFG0  A3SGXH7AUHU8GW                           delmartian
        1   2  B00813GRG4  A1D87F6ZCVE5NK                               dll pa
        2   3  B000LQOCH0   ABXLMWJIXXAIN  Natalia Corres "Natalia Corres"
        3   4  B000UA0QIQ  A395BORC6FGVXV                                 Karl
        4   5  B006K2ZZ7K  A1UQRSCLF8GW1T    Michael D. Bigham "M. Wassir"

           HelpfulnessNumerator  HelpfulnessDenominator     Score        Time  \
        0                     1                       1  positive  1303862400
        1                     0                       0  negative  1346976000
        2                     1                       1  positive  1219017600
        3                     3                       3  negative  1307923200
        4                     0                       0  positive  1350777600

                         Summary                                               Text
        0  Good Quality Dog Food  I have bought several of the Vitality canned d...
        1      Not as Advertised  Product arrived labeled as Jumbo Salted Peanut...
        2  "Delight" says it all  This is a confection that has been around a fe...
        3         Cough Medicine  If you are looking for the secret ingredient i...
        4            Great taffy  Great taffy at a great price.  There was a wid...
```

```
In [7]: #Processing of ProductId
        #Sorting data according to ProductId in ascending order
        sorted_data=amz.sort_values('ProductId', axis=0, ascending=True, inplace=Fa
```

```
In [8]: print(sorted_data.head()) # printing sorted data
```

```
        Id   ProductId          UserId      ProfileName  HelpfulnessNumerator  \
2774  2775  B00002NCJC  A13RRPGE79XFFH         reader48                     0
2773  2774  B00002NCJC  A196AJHU9EASJN     Alex Chaffee                     0
1243  1244  B00002Z754  A3B8RCEI0FXFI6        B G Chase                    10
1244  1245  B00002Z754  A29Z5PI9BW2PU3           Robbie                     7
9524  9525  B00005V3DC  A2ZYCEEYBUQZND  Robby "Robby C"                     5

      HelpfulnessDenominator     Score        Time  \
2774                       0  positive  1281052800
2773                       0  positive  1282953600
1243                      10  positive   962236800
1244                       7  positive   961718400
9524                       7  positive  1176249600

                             Summary  \
2774                    Flies Begone
2773                   thirty bucks?
1243  WOW Make your own 'slickers' !
1244                   Great Product
9524   Best herbal tea for digestion

                                                   Text
2774  We have used the Victor fly bait for 3 seasons...
2773  Why is this $[...] when the same product is av...
1243  I just received my shipment and could hardly w...
1244  This was a really good idea and the final prod...
9524  If you're new to this product you need to be v...
```

```
In [9]: # To check the duplications in raw data
        dupli=sorted_data[sorted_data.duplicated(["UserId","ProfileName","Time","Te
        print(dupli.head(5))
```

```
        Id   ProductId          UserId    ProfileName  HelpfulnessNumerator  \
2334  2335  B0001FQVCK   A5D06XJHDXK75          C. Po                     3
29      30  B0001PB9FY  A3HDKO7OW0QNK4   Canadian Fan                     1
2323  2324  B0001VWE0C   AQM74O8Z4FMS0       Sunshine                     0
2309  2310  B0001VWE0M   AQM74O8Z4FMS0       Sunshine                     0
4640  4641  B0002NYO9I   A5DVX3B075B09  Patricia Kays                     0
```

```
      HelpfulnessDenominator     Score        Time  \
2334                       3  positive  1190592000
29                         1  positive  1107820800
2323                       0  negative  1127606400
2309                       0  negative  1127606400
4640                       0  positive  1338940800

                                          Summary  \
2334  Chocolate Italian kisses - need I say more?
29                The Best Hot Sauce in the World
2323                               Below standard
2309                               Below standard
4640                       LOVELY JUNIPER BERRIES

                                                   Text
2334  My family has been in love with Baci's ever si...
29    I don't know if it's the cactus or the tequila...
2323  Too much of the white pith on this orange peel...
2309  Too much of the white pith on this orange peel...
4640  Dried berries, still with texture and the quin...
```

observation:

- Same profile ID gave samiliar reviews at the same time.
- Repitation of text,summary,time,profile-ID for same product

```
In [10]: # Remove Deduplication of entries
         final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","T
         final.shape
```

```
Out[10]: (9515, 10)
```

```
In [11]: #Checking to see how much % of data still remains
         (final['Id'].size*1.0)/(amz['Id'].size*1.0)*100
```

```
Out[11]: 95.15
```

```
In [12]: final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenominator]
```

```
In [13]: #Before starting the next phase of preprocessing lets see the number of en
         print(final.shape)

         #How many positive and negative reviews are present in our dataset?
         final['Score'].value_counts()
```

```
(9515, 10)
```

```
Out[13]: positive    8082
         negative    1433
         Name: Score, dtype: int64
```

Data Pre-processing on raw data: Every datasets contains some unwanted data.Raw data is preprocessed by removing duplication. here, Data is preprocessed on csv data. Given amazon datasets is also avaliable in form of SQLite Database.

0.4 .1(b)SQLite Database

SQLITE dataset is easier to query the data and visualise the data efficiently.

```
In [14]: # using the SQLite Table to read data.
         con = sqlite3.connect('database.sqlite')



         #filtering only positive and negative reviews i.e.

         filtered_data = pd.read_sql_query("""
         SELECT *
         FROM Reviews
         WHERE Score != 3
         """, con)
```

Above query is used the SQLite Table to read data.Here, data is preprocessed using csv file and output is final['Score'].

1 Text Preprocessing:

```
In [15]: # find sentences containing HTML tags

         i=0;
         for sent in final['Text'].values:
             if (len(re.findall('<.*?>', sent))):
                 print(i)
                 print(sent)
                 break;
             i += 1;
```

```
1
Why is this $[...] when the same product is available for $[...] here?<br />http:/
```

Observations:

- Text containing html tags like <.*?> is removed for processing the data. Read the sentences and find html tags and remove it.

```
In [16]: import string
         import nltk
         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 ster

         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
             cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
             cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
             return  cleaned
         print(stop)
         print('************************************')
         print(sno.stem('tasty'))
```

```
{'didn', 'm', 'wasn', 'i', 'when', 'them', 'yours', 'of', 'can', "haven't", 'doing'
************************************
tasti
```

```
In [17]: #print(final['Text'][0:10000])
```

Observations:

- English stopwords , printed in above text wwhich are common in almost any sentence are removed using nltk SnowballStemmer .Then we are cleaning the punctuations and html tags.

```
In [18]: #Code for implementing step-by-step the checks mentioned in the pre-proces
         i=0
         str1=' '
         final_string=[]
         all_positive_words=[]
         all_negative_words=[]
         s=''
         for sent in final['Text'].values:
             filtered_sentence=[]
             #print(sent);
             sent=cleanhtml(sent) # remove HTMl tags
             for w in sent.split():
                 for cleaned_words in cleanpunc(w).split():
                     if((cleaned_words.isalpha()) & (len(cleaned_words)>2)):
                         if(cleaned_words.lower() not in stop):
                             s=(sno.stem(cleaned_words.lower())).encode('utf8')
                             filtered_sentence.append(s)
                             if (final['Score'].values)[i] == 'positive':
                                 all_positive_words.append(s) #list of all words us
                             if(final['Score'].values)[i] == 'negative':
                                 all_negative_words.append(s) #list of all words us
                         else:
                             continue
                     else:
                         continue
             #print(filtered_sentence)
             str1 = b" ".join(filtered_sentence) #final string of cleaned words
             #print("*************************************************************

             final_string.append(str1)
             i+=1

         print(all_positive_words[10])
         print(all_negative_words[10])
```

```
b'avail'
b'tast'
```

```
In [19]: final['CleanedText']=final_string #adding a column of CleanedText which di
```

```
In [20]: final.head(3) #below the processed review can be seen in the CleanedText
```

```
Out[20]:         Id   ProductId          UserId   ProfileName  HelpfulnessNumerator
         2774  2775  B00002NCJC  A13RRPGE79XFFH      reader48                    0
         2773  2774  B00002NCJC  A196AJHU9EASJN  Alex Chaffee                    0
         1243  1244  B00002Z754  A3B8RCEI0FXFI6     B G Chase                   10

               HelpfulnessDenominator     Score        Time  \
         2774                       0  positive  1281052800
         2773                       0  positive  1282953600
         1243                      10  positive   962236800

                                      Summary  \
         2774                    Flies Begone
         2773                   thirty bucks?
         1243  WOW Make your own 'slickers' !

                                                             Text  \
         2774  We have used the Victor fly bait for 3 seasons...
         2773  Why is this $[...] when the same product is av...
         1243  I just received my shipment and could hardly w...

                                                      CleanedText
         2774  b'use victor fli bait season cant beat great p...
```

```
        2773  b'product avail www amazon com victor trap unr...
        1243  b'receiv shipment could hard wait tri product ...
```

```
In [21]: k=final['CleanedText']
         R_data = k[0:10000]  # R_data is used for further processing
         pn_score =final['Score'][0:10000] # pn-score is positive or negative score
         print(pn_score.shape)
         print(R_data.shape)
```

```
(9515,)
(9515,)
```

After removing duplication & cleaning data, R_data is used for further processing and pn-score is positive or negative score

1.0.1 Methods:

- Bag of Words
- Avg word2vec
- Tf-idf
- tf-idf weighted Word2Vec

Using above four method is used for featurization of data.t-sne plot is observed based on reviews with polarity.The featurization of above four method is as follows:-

2 1. Bag of Words (BoW)

```
In [22]: count_vect = CountVectorizer() #in scikit-learn
         data = count_vect.fit_transform(R_data.values)
         data.get_shape()
         # bi-gram, tri-gram and n-gram#
         #count_vect = CountVectorizer(ngram_range=(1,2) ) #in scikit-learn
         #final_bigram_counts = count_vect.fit_transform(R_data.values)
         #final_bigram_counts.get_shape()
```

```
Out[22]: (9515, 11779)
```

```
In [23]: #for 10k reviews, bow
         data1= data[0:10000,:]
         print(data1.shape)
```

```
(9515, 11779)
```

3 2. Avg word2vec

Firstly, word2vec model is designed for amazon reviews using gensim module.

```
In [24]: # traing word2vec model for amazon reviews using gensim
         import gensim
         i=0
         list_of_sent=[]
         for sent in final['Text'].values:
             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
             list_of_sent.append(filtered_sentence)
```

```
C:\ProgramData\Anaconda3\lib\site-packages\gensim\utils.py:1197: UserWarning: detec
  warnings.warn("detected Windows; aliasing chunkize to chunkize_serial")
```

```
In [25]: print(len(list_of_sent))
         #print(final['Text'].values[0])
         #print("*****************************************************************'
         #print(list_of_sent[56])
```

```
9515
```

```
In [26]: #Creating word2vec on cleaned text
         import gensim
         w=[]
         for text in final['CleanedText'].values:
             filter_text=[]
             for i in text.split():
                 if(i.isalpha()):
                     filter_text.append(i.lower())
                 else:
                     continue
             w.append(filter_text)
         print(len(w))
         # w word2vec of cleaned text
```

```
9515
```

```
In [27]: w2v_model=gensim.models.Word2Vec(list_of_sent,min_count=5,size=100, worker
         #this model is used in avg word2vec
```

```
In [28]: words = list(w2v_model.wv.vocab)
         print(len(words))
```

```
5804
```

Avg Word2Vec

```
In [29]: # average Word2Vec

         sent_vectors = [];
         for sent in R_data: # for each review/sentence
             sent_vec = np.zeros(100)
             cnt_words =0; # num of words with a valid vector in the sentence/revie
             for word in sent:
                 try:
                     vec = w2v_model.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     pass
             sent_vec /= cnt_words
             sent_vectors.append(sent_vec)


         print(len(sent_vectors))

         #print(sent_vectors[0:4])
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:14: RuntimeWarning



9515
```

```
In [30]: # to check the formator of data vector
         print(sent_vectors[7890])
         # convert the nan value into zero for further processing
         b = np.where(np.isnan(sent_vectors), 0, sent_vectors)
         print(b[7890])
```

```
[nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan]
[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0.]
```

```
In [31]: # converting list to nd array

         data2_avg = np.asarray(b)
         print(type(data2_avg))
         #data2 is used for further processing
```

```
<class 'numpy.ndarray'>
```

4 3. tf-idf

```
In [32]: # tf-idf
         tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
         final_tf_idf = tf_idf_vect.fit_transform(R_data.values)
         final_tf_idf.get_shape()
```

```
Out[32]: (9515, 212248)
```

```
In [33]: features = tf_idf_vect.get_feature_names()
         len(features)
```

```
Out[33]: 212248
```

```
In [34]: data3 =final_tf_idf[:,:]
         #print(data3)
         print(type(data3))
```

```
<class 'scipy.sparse.csr.csr_matrix'>
```

5 4.TF-IDF weighted Word2Vec

```
In [35]: # TF-IDF weighted Word2Vec
         tfidf_feat = tf_idf_vect.get_feature_names()

         tfidf_sent_vectors = [];
         row=0;
         for sent in R_data:
             sent_vec = np.zeros(100) # 100 dimension
             weight_sum =0;
             for word in sent:
                 try:
                     vec = w2v_model.wv[word]

                     tfidf = final_tf_idf[row, tfidf_feat.index(word)]
                     sent_vec += (vec * tf_idf)
                     weight_sum += tf_idf
                 except:
                     pass
             sent_vec /= weight_sum
             tfidf_sent_vectors.append(sent_vec)
             row += 1
```

```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:18: RuntimeWarning
```

```
In [36]: print(len(tfidf_sent_vectors))
```

```
9515
```

```
In [37]: data41 = np.asarray(tfidf_sent_vectors)
         print(type(data41))
```

```
<class 'numpy.ndarray'>
```

```
In [38]: print(tfidf_sent_vectors[786])
         bcd = np.where(np.isnan(tfidf_sent_vectors), 0, tfidf_sent_vectors)
         print(bcd[786])
```

```
[nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan nan
 nan nan nan nan nan nan nan nan nan nan]
[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0.]
```

tfidf_sent_vectors contains nan value. In above program is replacing nan value to ‘o’.

```
In [39]: #check the type od data
         data2_tf = np.asarray(bcd)
         print(type(data2_tf))
```

```
<class 'numpy.ndarray'>
```

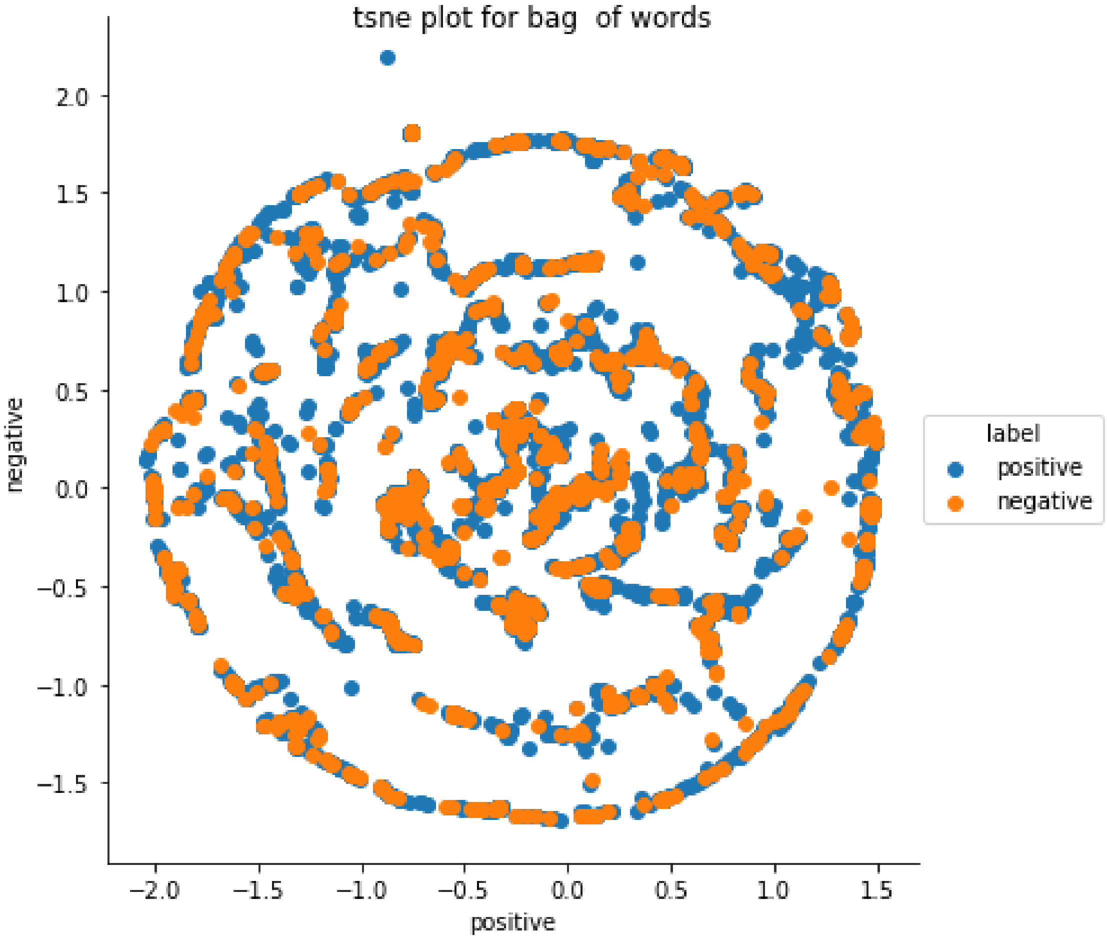
```
In [40]: #print(myarray2[4])
         data4=data41[0:10000,:]
```

As there is computational limit , 10k data is processed for t-sne plots.

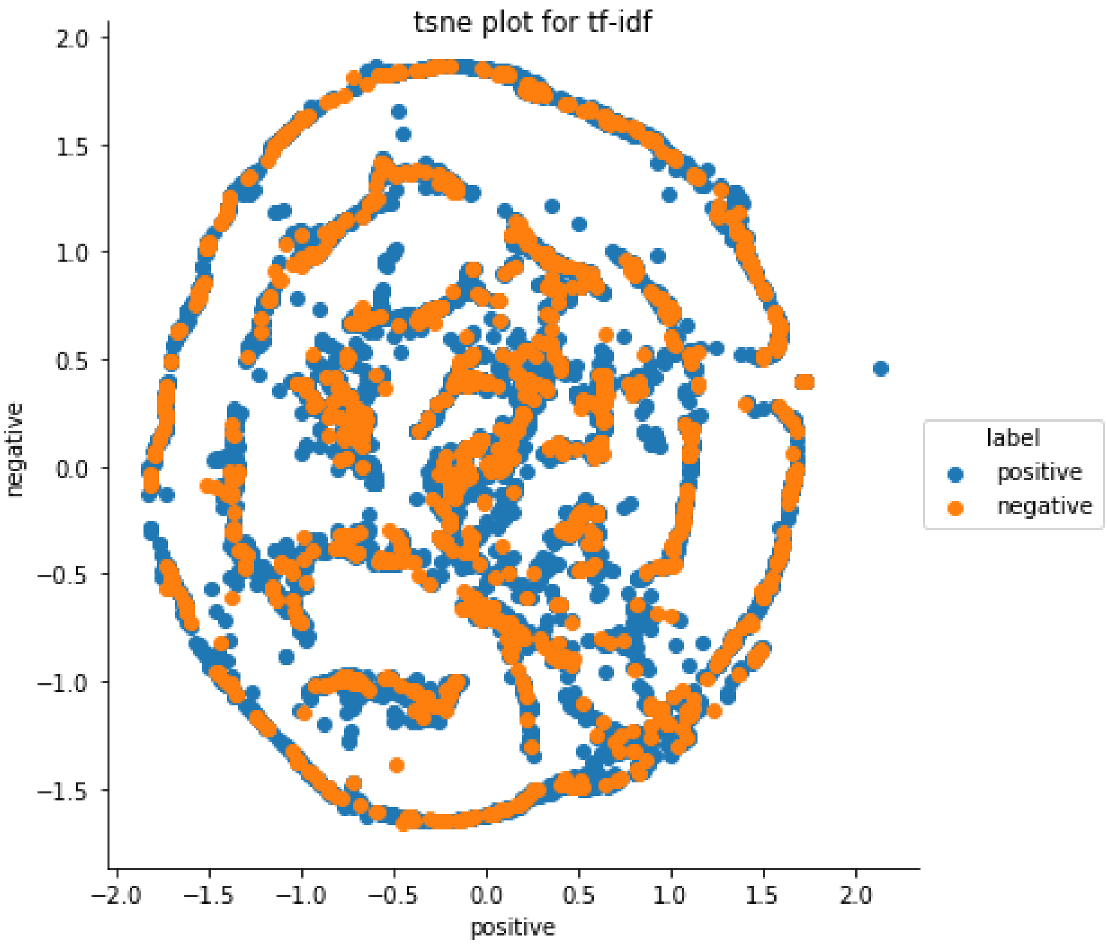
```
In [41]: from sklearn.manifold import TSNE
         import seaborn as sn
         print("a")
         R=['bag  of words','tf-idf']
         X =[data,data3] # for large datavalues

         Y=[data[0:10000,10000],data3[0:10000,10000]] # for small datavalues to ru


         #data_1000 = data[0:1000,:].toarray()
         #print(data_1000.shape)
         #print("b")
         labels_1000 = pn_score[0:10000]
         #print(labels_1000.shape)
         #print("c")
         for i in range(len(X)):
             Y_data=Y[i].toarray()
             print('vectorization technique is ',R[i])
         #print(data_1000)
             model = TSNE(n_components=2, random_state=0)
             print("d")
             tsne_data = model.fit_transform(Y_data)
             print(type(tsne_data))
             print("e")
             tsne_data = np.vstack((tsne_data.T, labels_1000)).T
             print(tsne_data.shape)
             print("f")
             tsne_df = pd.DataFrame(data=tsne_data, columns=("positive", "negative'
             print("g")

             # Ploting the result of tsne
             aa=sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'positi
             print("h")
             aa.fig.suptitle('tsne plot for '+str(R[i]))
             plt.show()

         #print(labels_1000)
```

```
a
vectorization technique is  bag  of words
d
```

```
<class 'numpy.ndarray'>
e
(9515, 3)
f
g
h
```



```
vectorization technique is  tf-idf
d
<class 'numpy.ndarray'>
e
(9515, 3)
f
g
h
```

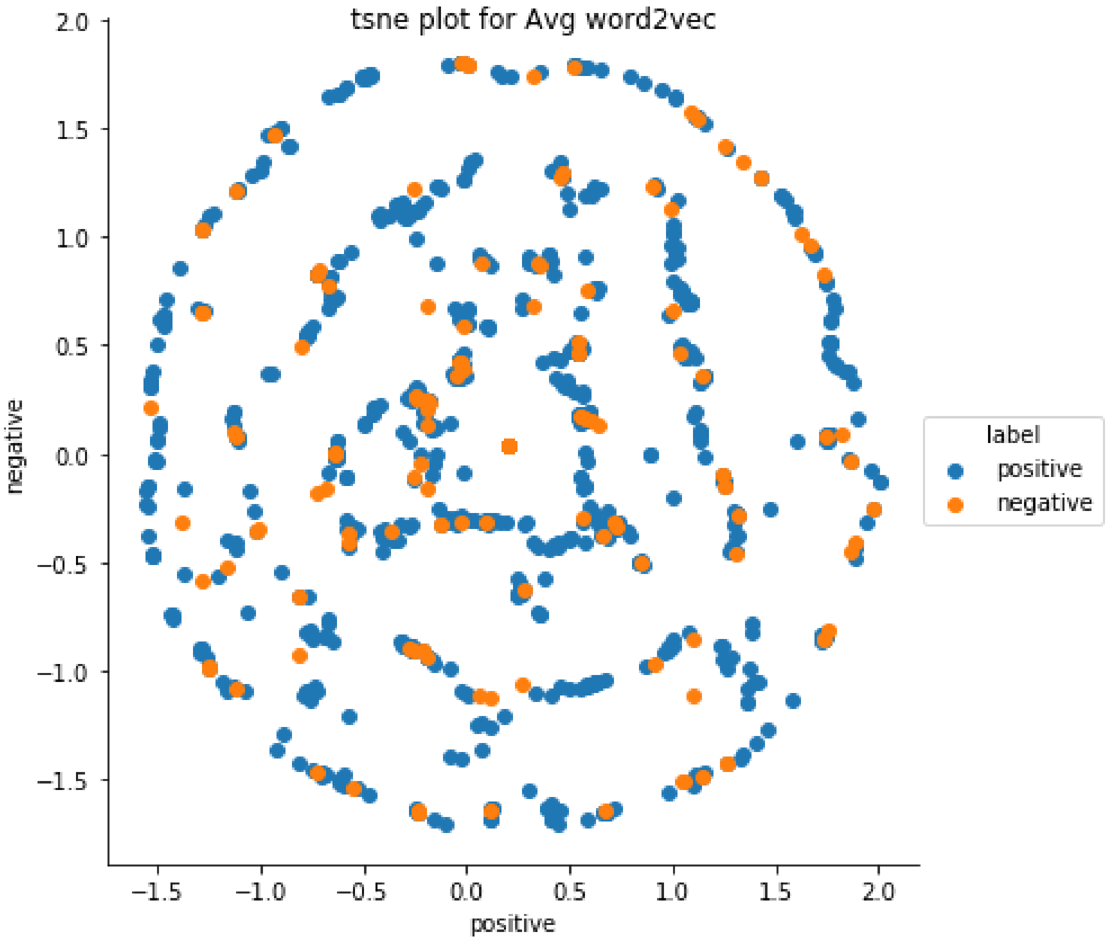


Observations t-sne plot for Bag of words and tf-idf is shown above.After Text preprocessing the data and featurization, t-sne is plotted to visualize the polarity based on reviews. * here, only 10k is used out of 393931 values of datasets. * here,10000 dimensional is used for converting into low dimensional(i.e. 2D).All positive and negative reviews are visualized as shown in above figure. * For Bag of words,In t-sne plot ,postive and negative polarity reviews are visualized in the form of circles. Negative points and postive points are overlapping each others in 2D views.It is observed that positive and negative points are nearly equal in quantity. * For tf-idf,t-sne plot is also visualized in forms circle here and positive and negative polarity reviews are wonderfully visualized on t-sne plot.

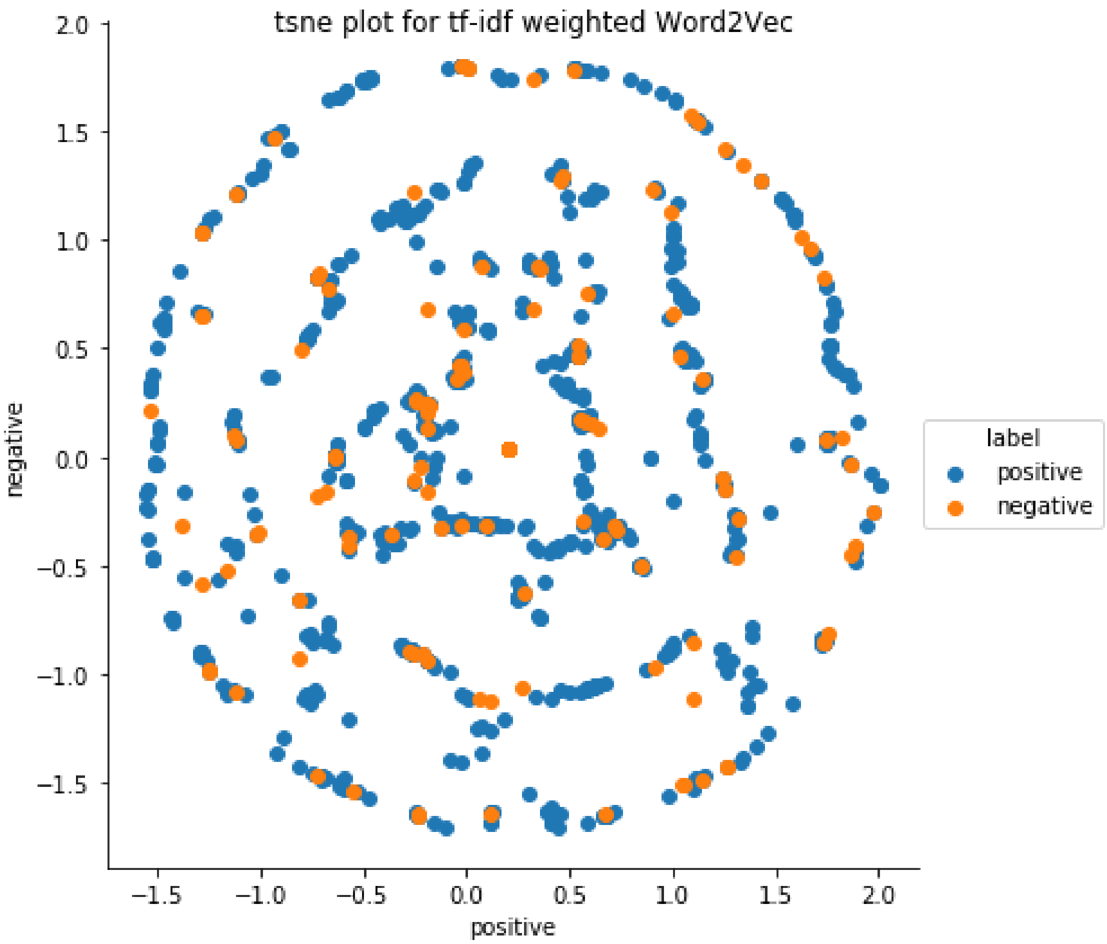
```
In [82]: w2v_list=[data2_avg,data2_tf] # for large dataset
         w2v_small_list=[data2_avg[0:1000,:],data2_tf[0:1000,:]] # for small datase
         #data_1000 = data2_tf[0:1000,:]
         #print(data_1000.shape)
         #print("b")
         R1=['Avg word2vec','tf-idf weighted Word2Vec']
         labels_1000 = pn_score[0:1000]
```

```
print(labels_1000.shape)
print("c")
for j in range(len(w2v_small_list)):
    w2v_data=w2v_small_list[j]
    print('vectorization technique is ',R1[j])
    model = TSNE(n_components=2, random_state=0)
    print("d")
    tsne_data = model.fit_transform(w2v_data)
    print("e")
    tsne_data = np.vstack((tsne_data.T, labels_1000)).T
    print(tsne_data.shape)
    print("f")
    tsne_df = pd.DataFrame(data=tsne_data, columns=("positive", "negative"
    print("g")

    # Ploting the result of tsne
    aa1=sn.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'posit
    print("h")
    aa1.fig.suptitle('tsne plot for '+str(R1[j]))
    plt.show()
```

```
(1000,)
c
vectorization technique is  Avg word2vec
d
e
(1000, 3)
f
g
h
```



```
vectorization technique is  tf-idf weighted Word2Vec
d
e
(1000, 3)
f
g
h
```



Observation

- In Average word2vec and tf-idf weighted Word2Vec, only 100 dimensions are plotted on t-sne because of computational limit.
- t-sne plot for Average word2vec and tf-idf weighted Word2Vec are visualized as above. As data points are taken less here(nearly 1000) for 100 dimensions ,the structure may seems different than actual t-sne plot of them.
- It is observed from Average word2vec and tf-idf weighted Word2Vec plots negative points are centered and postive points are going away from center.It means if dimesions is large and datapoints is high, all negative points will concentrated on the center and positive points will try to go away from center.
- the structure of t-sne plot varies accouding to dimensions and feturizations data.
- Here, we are plotting bag of words and tf-idf t-sne seperatly and Average word2vec and tf-idf weighted Word2Vec seperately.Because while Average word2vec and tf-idf weighted Word2Vec featurization vector is already in the form of nd.array while bag of words and tf-idf was not and it is converted into nd.array by using x.toarray().

From t-sne plots,high dimensional data can be visualized in low dimension(2D).The objective to visualize the postive and negative reviews using t-sne is done.

```
In [43]: print(336824-57107)

279717
```

```
In [ ]:
```