AFFR-TSNE

September 7, 2018

```
In [2]: import sqlite3
        import pandas as pd
        import numpy as np
        import nltk
        import string
        import matplotlib.pyplot as plt
        import seaborn as sns
        from sklearn.preprocessing import StandardScaler #standardizing data
        from sklearn.manifold import TSNE #TSNE
        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
        import gensim
        from gensim.models import Word2Vec
        from gensim.models import KeyedVectors
        import pickle
        import warnings
        warnings.filterwarnings("ignore")
```

```
C:\Users\Aravindh\Anaconda3\lib\site-packages\gensim\utils.py:1209: UserWarning: detected Windo
  warnings.warn("detected Windows; aliasing chunkize to chunkize_serial")
```

Objective

1. To do vectorization of words using BOW, TFIDF, AVGW2V, TFIDFW2V.
2. To do dimensionality reduction and visulase plots for +ve and -ve points and see if they're linearly seperable.

```
In [3]: #connect the Database
        con = sqlite3.connect('final.sqlite')
```

```
In [4]: #read sql data using pandas
        data = pd.read_sql('SELECT * FROM REVIEWS', con)
```

```
In [5]: data.head() #visualise first five rows in data
```

```
Out[5]:     index      Id   ProductId          UserId                  ProfileName  \
        0  138706  150524  0006641040   ACITT7DI6IDDL              shari zychinski
        1  138688  150506  0006641040  A2IW4PEEKO2R0U                        Tracy
        2  138689  150507  0006641040  A1S4A3IQ2MU7V4        sally sue "sally sue"
        3  138690  150508  0006641040     AZGXZ2UUK6X  Catherine Hallberg "(Kate)"
        4  138691  150509  0006641040  A3CMRKGE0P909G                       Teresa

           HelpfulnessNumerator  HelpfulnessDenominator     Score        Time  \
        0                     0                       0  positive   939340800
        1                     1                       1  positive  1194739200
        2                     1                       1  positive  1191456000
        3                     1                       1  positive  1076025600
        4                     3                       4  positive  1018396800

                                              Summary  \
        0                       EVERY book is educational
        1  Love the book, miss the hard cover version
        2                    chicken soup with rice months
        3          a good swingy rhythm for reading aloud
        4                  A great way to learn the months

                                                        Text  \
        0  this witty little book makes my son laugh at l...
        1  I grew up reading these Sendak books, and watc...
        2  This is a fun way for children to learn their ...
        3  This is a great little book to read aloud- it ...
        4  This is a book of poetry about the months of t...

                                                 CleanedText
        0  witti littl book make son laugh loud recit car...
        1  grew read sendak book watch realli rosi movi i...
        2  fun way children learn month year learn poem t...
        3  great littl book read nice rhythm well good re...
        4  book poetri month year goe month cute littl po...
```

```
In [6]: # create database using only cleaned text and score of each reviews

        df = pd.DataFrame(data, columns=['CleanedText', 'Score'])
        df.describe()
```

```
Out[6]:                                               CleanedText     Score
        count                                              364171    364171
        unique                                             363249         2
        top     sever year ago went tour celesti season tea fa...  positive
        freq                                                   13    307061
```

```
In [7]: #about negative reviews
        df[df['Score'] == 'negative'].describe()
```

```
Out[7]:                                         CleanedText     Score
        count                                         57110     57110
        unique                                        56943         1
        top     fed dog iam proactiv health five year realiz u...  negative
        freq                                              4     57110
```

```
In [8]: #about positive reviews
        df[df['Score'] == 'positive'].describe()
```

```
Out[8]:                                         CleanedText     Score
        count                                        307061    307061
        unique                                       306313         1
        top     sever year ago went tour celesti season tea fa...  positive
        freq                                             13    307061
```

```
In [9]: #see first 5 rows of data
        df.head()
```

```
Out[9]:                                        CleanedText     Score
        0  witti littl book make son laugh loud recit car...  positive
        1  grew read sendak book watch realli rosi movi i...  positive
        2  fun way children learn month year learn poem t...  positive
        3  great littl book read nice rhythm well good re...  positive
        4  book poetri month year goe month cute littl po...  positive
```

```
In [10]: #create two databases with equal number (2000) of +ve and -ve reviews and concatenate
         df_1 = df[df['Score']=='positive'].head(2000)
         df_2 = df[df['Score']=='negative'].head(2000)
```

```
In [11]: #new dataset
         df = pd.concat([df_1, df_2], ignore_index=True)
         df.head()
         df.shape
```

```
Out[11]: (4000, 2)
```

```
In [12]: #seperate labels from text
         label = df['Score']
         df = df.drop('Score', axis=1)
```

```
In [13]: label.shape
```

```
Out[13]: (4000,)
```

```
In [14]: # new database with only text for word vectorisation
         text = df['CleanedText']
```

```
In [15]: text.shape
```

```
Out[15]: (4000,)
```

0.1 Final

1. text = CleanedText (4000 reviews)
2. labels = positive or negative (2000 each)

Now Need to do TSNE Plot for: 1. BOW 2. TFIDF 3. AVG-W2V 4. TFIDF-W2V each T-sne plot is tried on different iterations and perplexity values

1 BOW

```
In [16]: bow = CountVectorizer().fit_transform(text.values)
```

```
In [19]: import pickle
         from sklearn.externals import joblib
         joblib.dump(bow, 'bow.pkl')
```

```
Out[19]: ['bow.pkl']
```

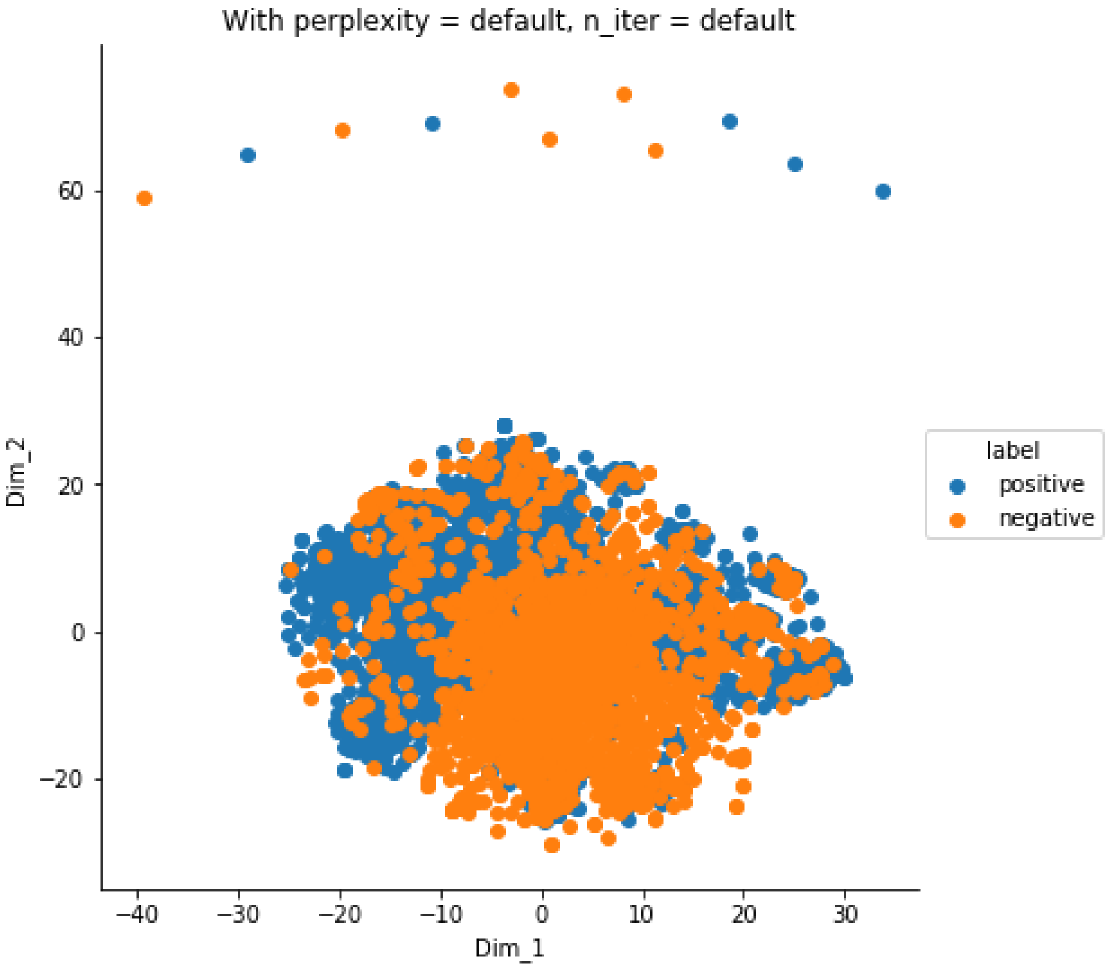
```
In [20]: bow = joblib.load('bow.pkl')
```

```
In [21]: print("the type of count vectorizer ",type(bow))
         print("the shape of out text BOW vectorizer ",bow.get_shape())
         print("the number of unique words ", bow.get_shape()[1])
```

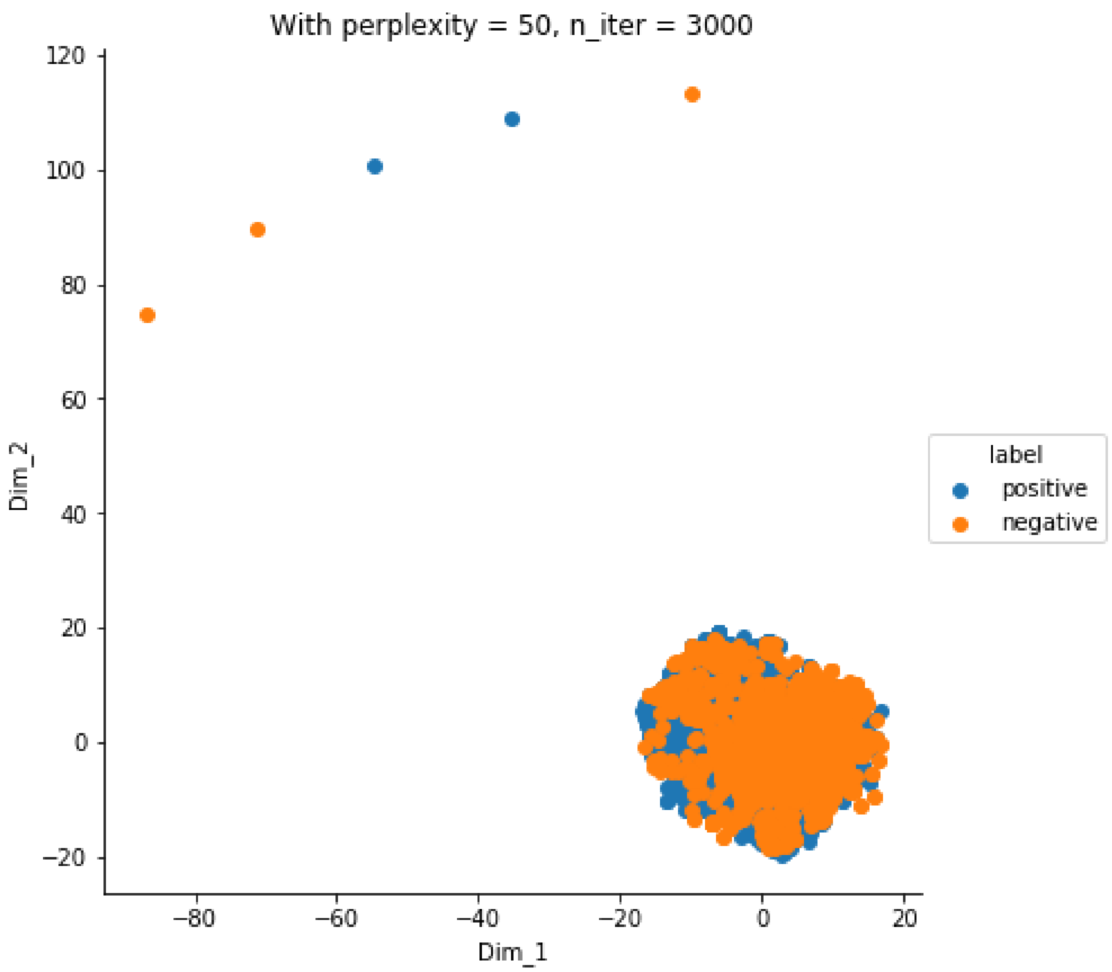
```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4000, 9592)
the number of unique words  9592
```

2 TSNE ON BOW

```
In [135]: model = TSNE(n_components = 2, random_state=0)
          t_data = bow.toarray() #to convert sparse matrix to dense matrix
          tsne_data = model.fit_transform(t_data) #gives word vocabulary as matrix as[n_sample

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T #vstack = arrange in row format.
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = default, n_iter = default')
          plt.show()
```



```
In [136]: model = TSNE(n_components = 2, random_state=0, perplexity=50, n_iter=3000)
          t_data = bow.toarray()
          tsne_data = model.fit_transform(t_data)

          #stacking bow and labels in columnwise
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))

          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 50, n_iter = 3000')
          plt.show()
```



2.0.1 Observations

1. Positive and Negative datas are overlapped and increase in number of iterations didnt produce any significant changes.

3 TFIDF

```
In [139]: tfidf = TfidfVectorizer().fit_transform(text.values)
```

```
In [178]: import pickle
          from sklearn.externals import joblib
          joblib.dump(tfidf, 'tfidf.pkl')
```

```
Out[178]: ['tfidf.pkl']
```

```
In [140]: print("the type of count vectorizer ",type(tfidf))
          print("the shape of out text TFIDF vectorizer ",tfidf.get_shape())
          print("the number of unique words including both unigrams and bigrams ", tfidf.get_s
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (4000, 9592)
the number of unique words including both unigrams and bigrams  9592
```

```
In [141]: tfidf.shape
```

```
Out[141]: (4000, 9592)
```

```
In [175]: features = tf_idf_vect.get_feature_names()
          print("some sample features(unique words in the corpus)",features[1995:2016])
```

```
some sample features(unique words in the corpus) ['custard', 'custodian', 'custom', 'cut', 'cu
```

```
In [165]: # source: https://buhrmann.github.io/tfidf-analysis.html
          def top_tfidf_feats(row, features, top_n=25):
              ''' Get top n tfidf values in row and return them with their corresponding featu
              topn_ids = np.argsort(row)[::-1][:top_n]
              top_feats = [(features[i], row[i]) for i in topn_ids]
              df = pd.DataFrame(top_feats)
              df.columns = ['feature', 'tfidf']
              return df

          top_tfidf = top_tfidf_feats(final_tf_idf[1,:].toarray()[0],features,25)
```

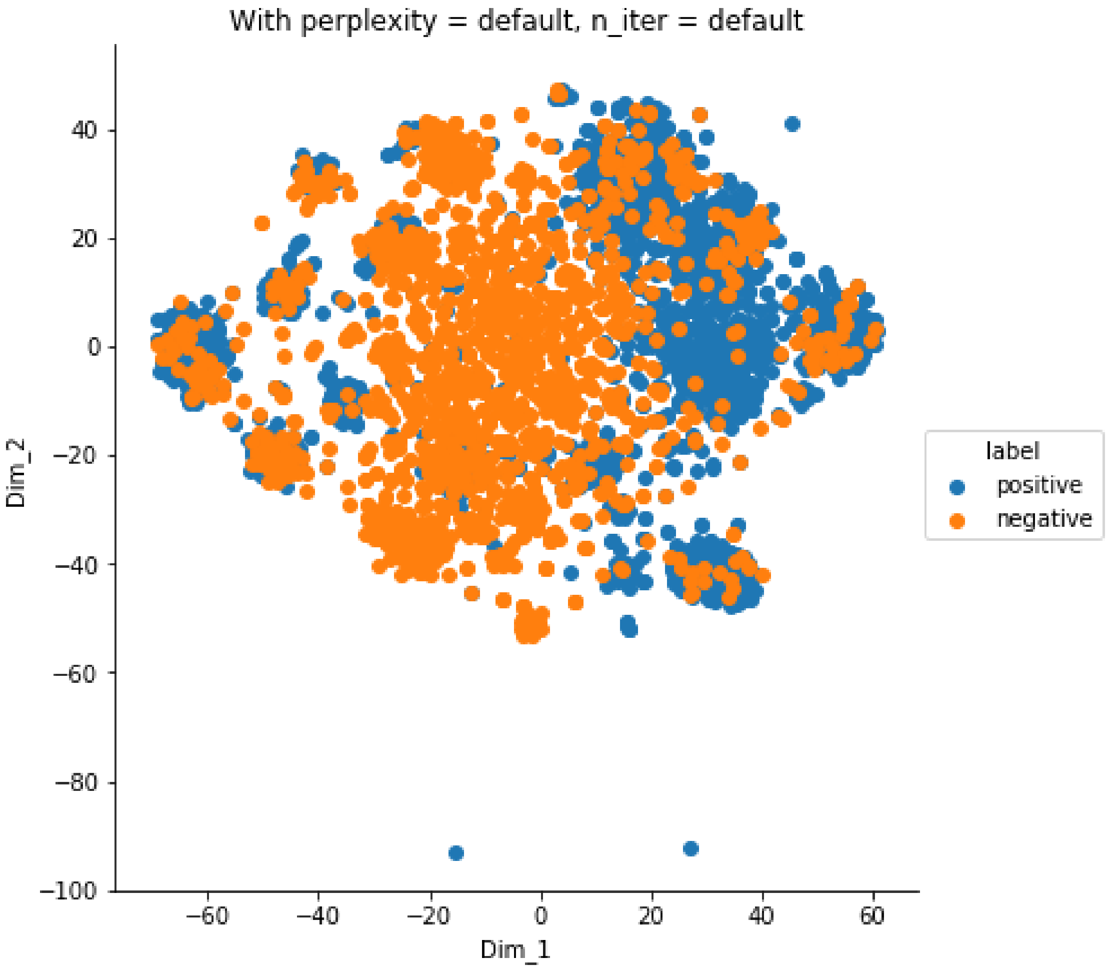
```
In [166]: top_tfidf
```

```
Out[166]:       feature     tfidf
          0   paperback  0.303202
          1        rosi  0.303202
          2    incorpor  0.292559
          3      flimsi  0.258661
          4      sendak  0.251916
          5        page  0.227847
          6        grew  0.220570
          7         son  0.215629
          8        book  0.197668
          9        miss  0.192996
          10      cover  0.185629
          11       love  0.184542
          12    version  0.183629
          13       hand  0.180369
          14      watch  0.166424
          15       kind  0.161028
          16       movi  0.158230
          17       open  0.144644
          18       hard  0.144644
          19       read  0.141088
```

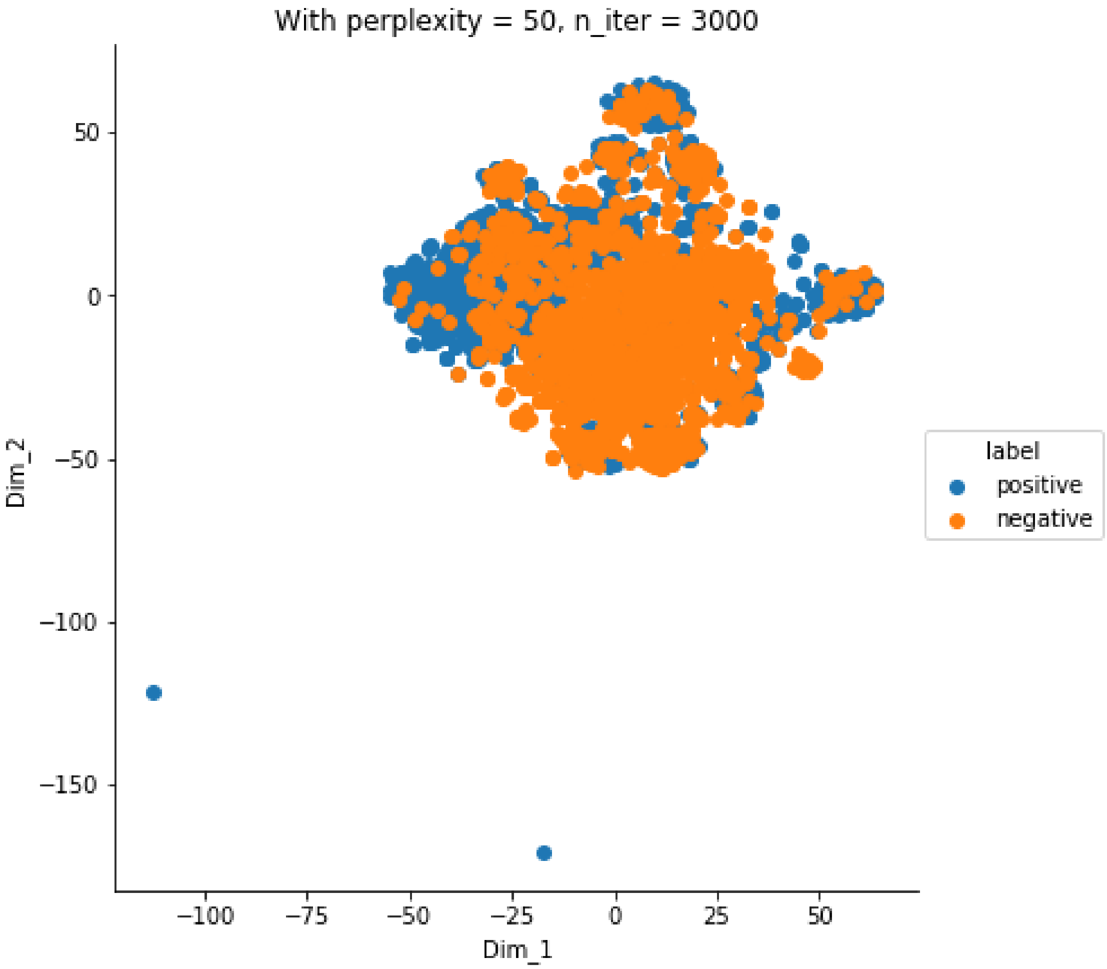
```
20      howev  0.139874
21       take  0.137984
22       keep  0.135650
23       seem  0.133204
24        two  0.119171
```

4 TSNE on TFIDF

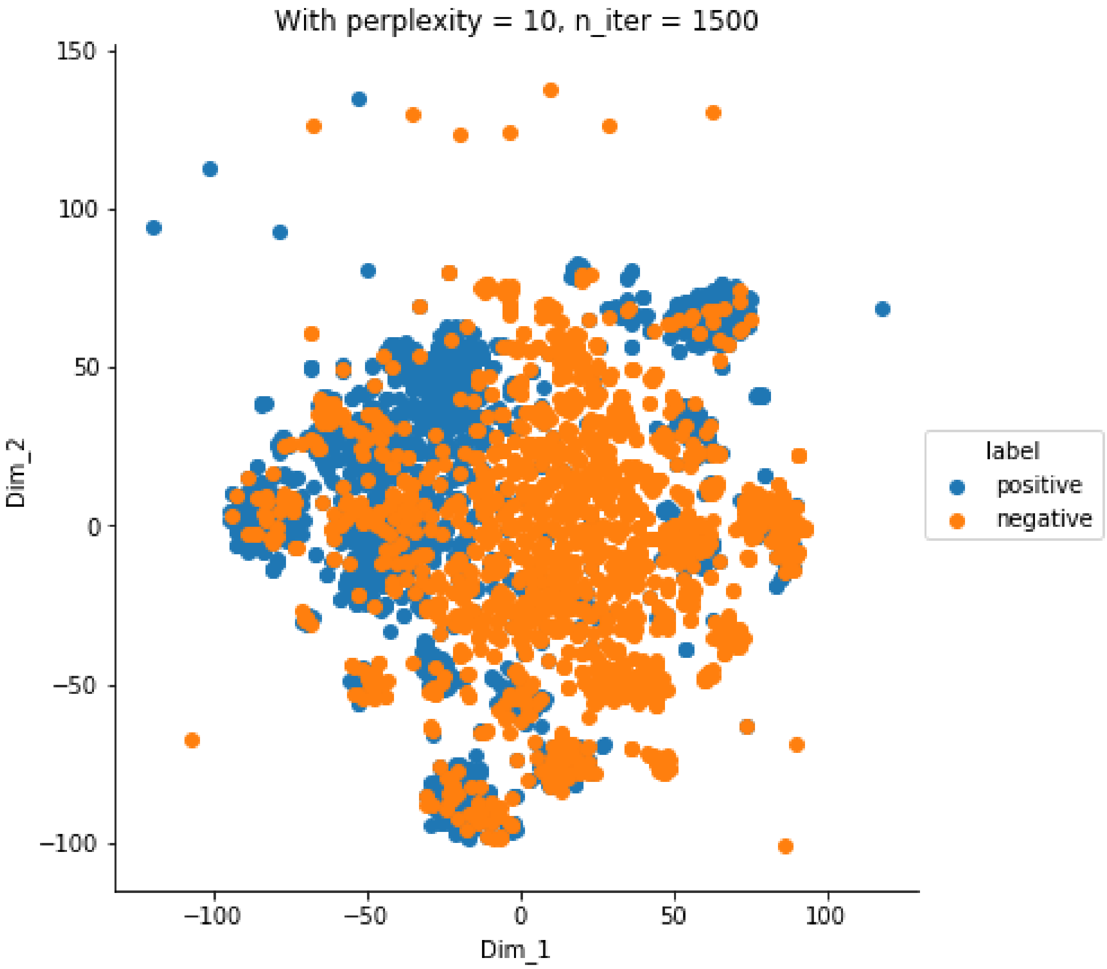
```
In [114]: #TSNE PLOT
          model = TSNE(n_components = 2, random_state=0)
          t_data = tfidf.toarray()
          tsne_data = model.fit_transform(t_data)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = default, n_iter = default')
          plt.show()
```



```
In [115]: model = TSNE(n_components = 2, random_state=0, perplexity=50, n_iter=3000)
          t_data = tfidf.toarray()
          tsne_data = model.fit_transform(t_data)

          #stacking bow and labels in columnwise
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))

          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 50, n_iter = 3000')
          plt.show()
```



```
In [117]: model = TSNE(n_components = 2, random_state=0, perplexity=10, n_iter=1500)
          t_data = tfidf.toarray()
          tsne_data = model.fit_transform(t_data)

          #stacking bow and labels in columnwise
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))

          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 10, n_iter = 1500')
          plt.show()
```



5 Word2Vec

```
In [142]: # Train your own Word2Vec model using your own text corpus
          i=0
          list_of_sent=[]
          for sent in text.values:
              list_of_sent.append(sent.split())
```

```
In [143]: print(text.values[0])
          print("*****************************************************************")
          print(list_of_sent[0])
```

```
witti littl book make son laugh loud recit car drive along alway sing refrain hes learn whale
*****************************************************************
['witti', 'littl', 'book', 'make', 'son', 'laugh', 'loud', 'recit', 'car', 'drive', 'along', '
```

```
In [145]: # min_count = 5 considers only words that occured atleast 5 times
          w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
```

```
In [146]: w2v_words = list(w2v_model.wv.vocab)
          print("number of words that occured minimum 5 times ",len(w2v_words))
          print("sample words ", w2v_words[0:50])
```

```
number of words that occured minimum 5 times  3259
sample words  ['littl', 'book', 'make', 'son', 'laugh', 'loud', 'car', 'drive', 'along', 'alwa
```

6 AVGW2V

```
In [151]: # average Word2Vec
          # compute average word2vec for each review.
          sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list

          for sent in list_of_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
                  if word in w2v_words:
                      vec = w2v_model.wv[word]
                      sent_vec += vec
                      cnt_words += 1
              if cnt_words != 0:
                  sent_vec /= cnt_words
              sent_vectors.append(sent_vec)
          print(len(sent_vectors))
          print(len(sent_vectors[0]))
```

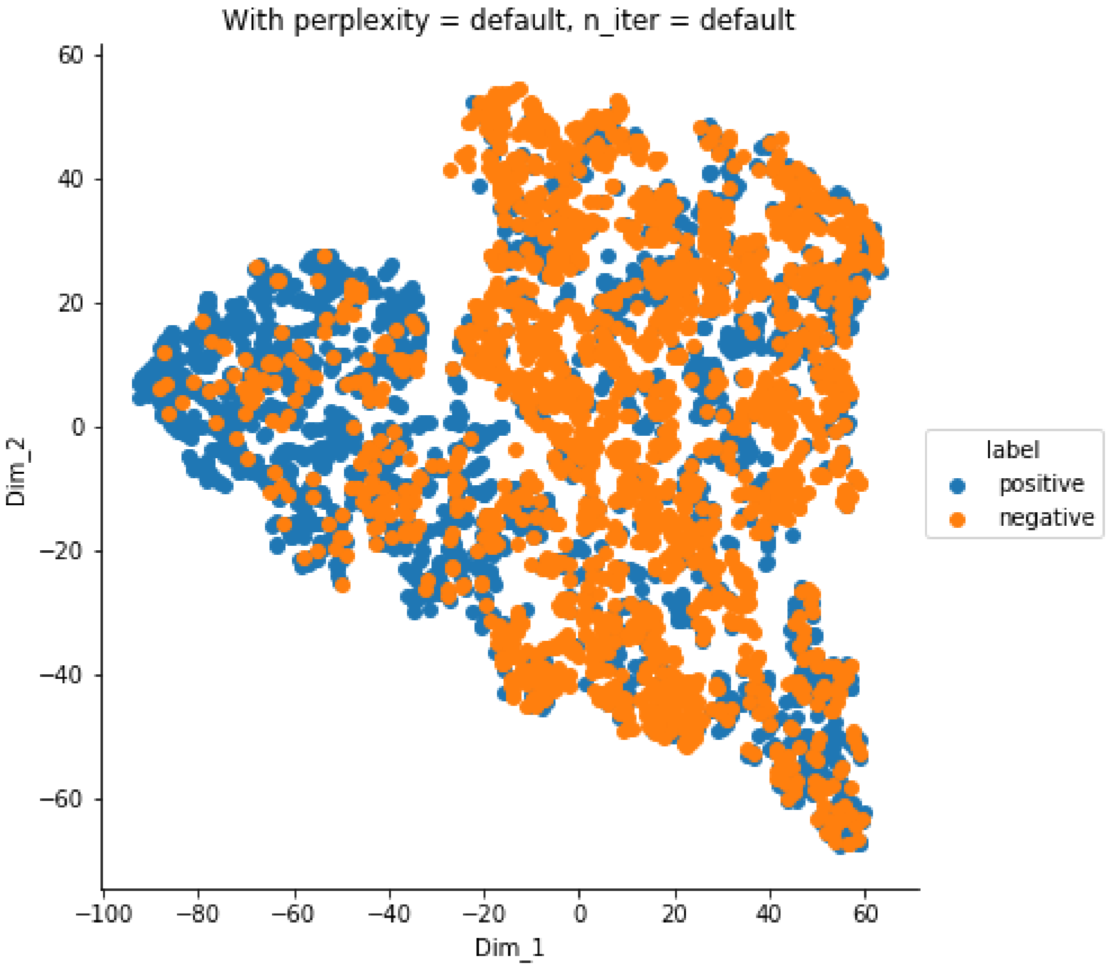
```
4000
50
```

```
In [182]: import pickle
          from sklearn.externals import joblib
          joblib.dump(sent_vectors, 'avgw2v.pkl')
```

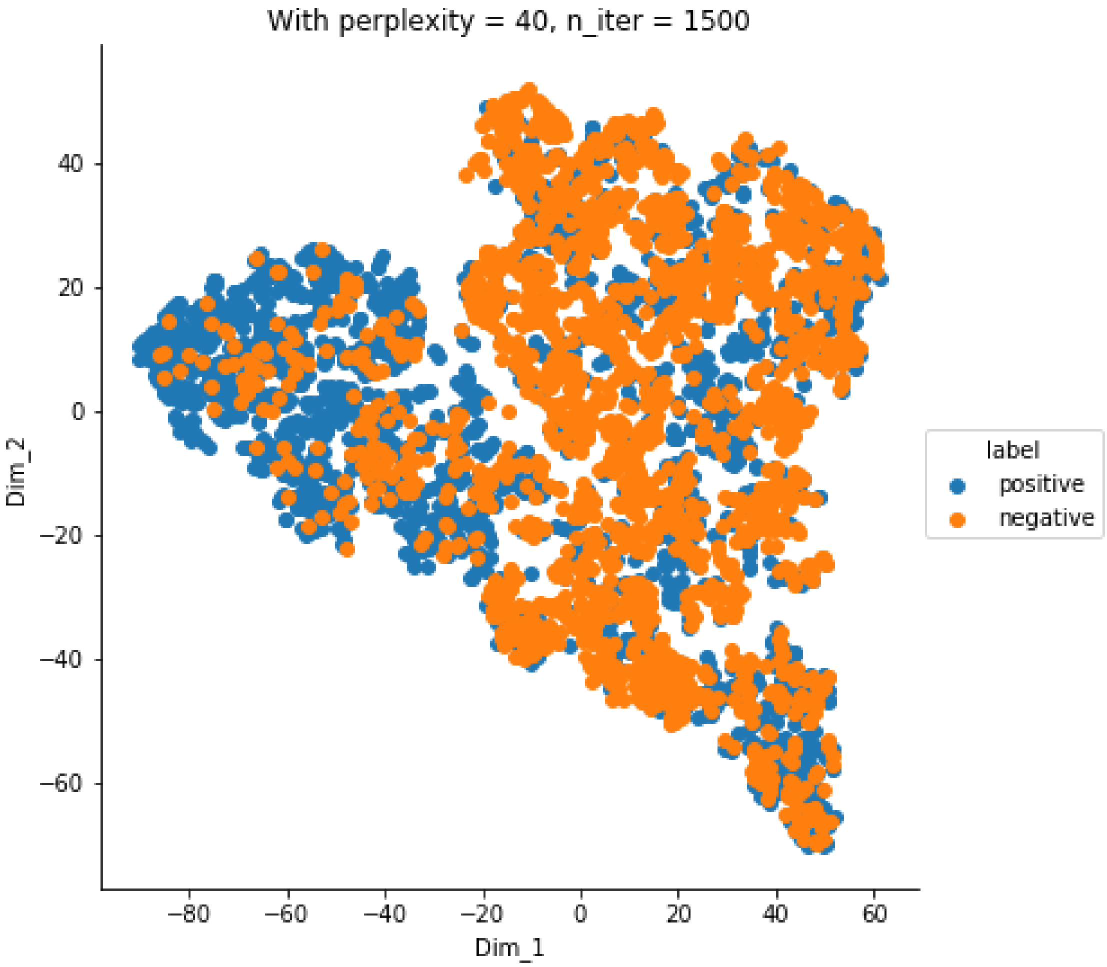
```
Out[182]: ['avgw2v.pkl']
```

```
In [152]: model = TSNE(n_components = 2, random_state=0)
          #t_data = tfidf.toarray()
          tsne_data = model.fit_transform(sent_vectors)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
```

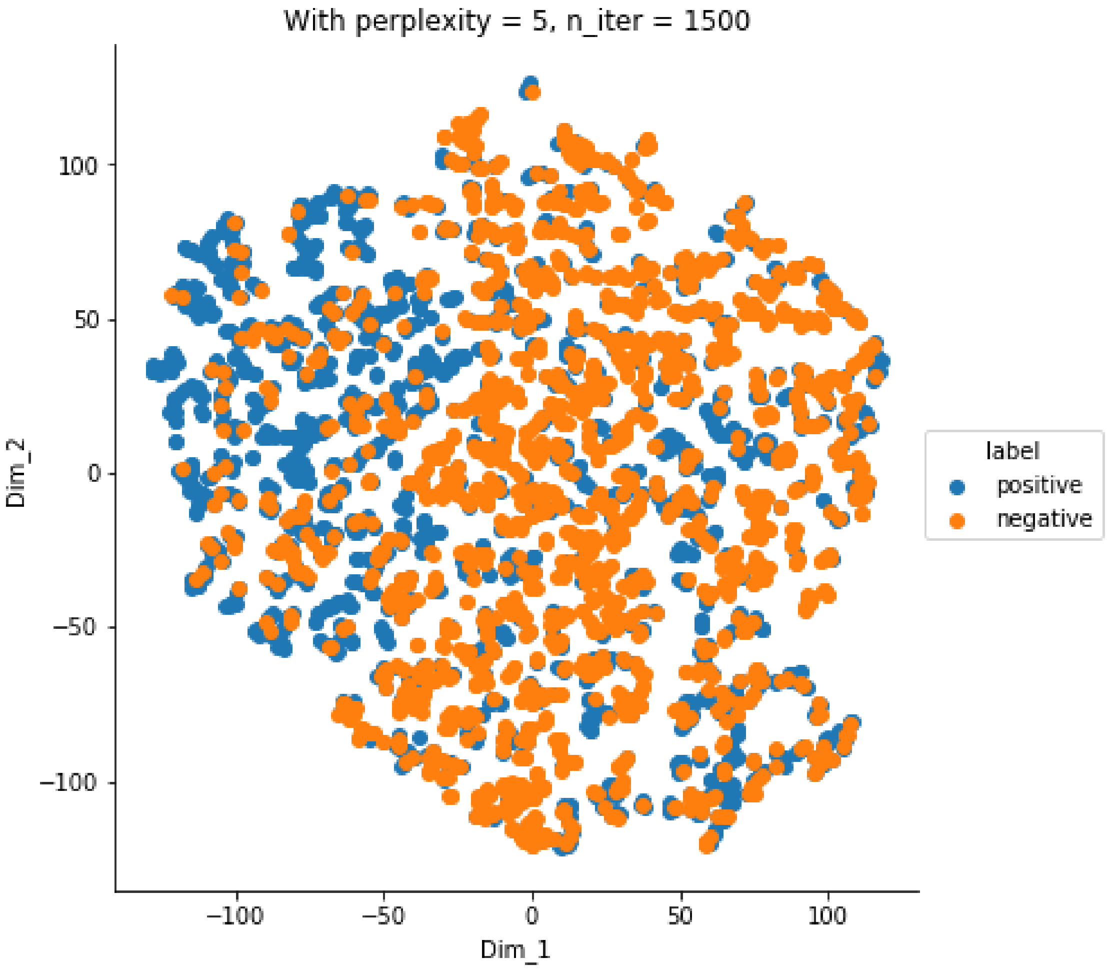
```
         #plot
         sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
         plt.title('With perplexity = default, n_iter = default')
         plt.show()
```



```
In [153]: model = TSNE(n_components = 2, random_state=0, perplexity=40, n_iter=1500)
         #t_data = tfidf.toarray()
         tsne_data = model.fit_transform(sent_vectors)

         #stacking bow and labels
         tsne_data = np.vstack((tsne_data.T, label)).T
         tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
         #plot
         sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
         plt.title('With perplexity = 40, n_iter = 1500')
         plt.show()
```



```
In [154]: model = TSNE(n_components = 2, random_state=0, perplexity=5, n_iter=1500)
          #t_data = tfidf.toarray()
          tsne_data = model.fit_transform(sent_vectors)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 5, n_iter = 1500')
          plt.show()
```



7 TFIDF-W2V

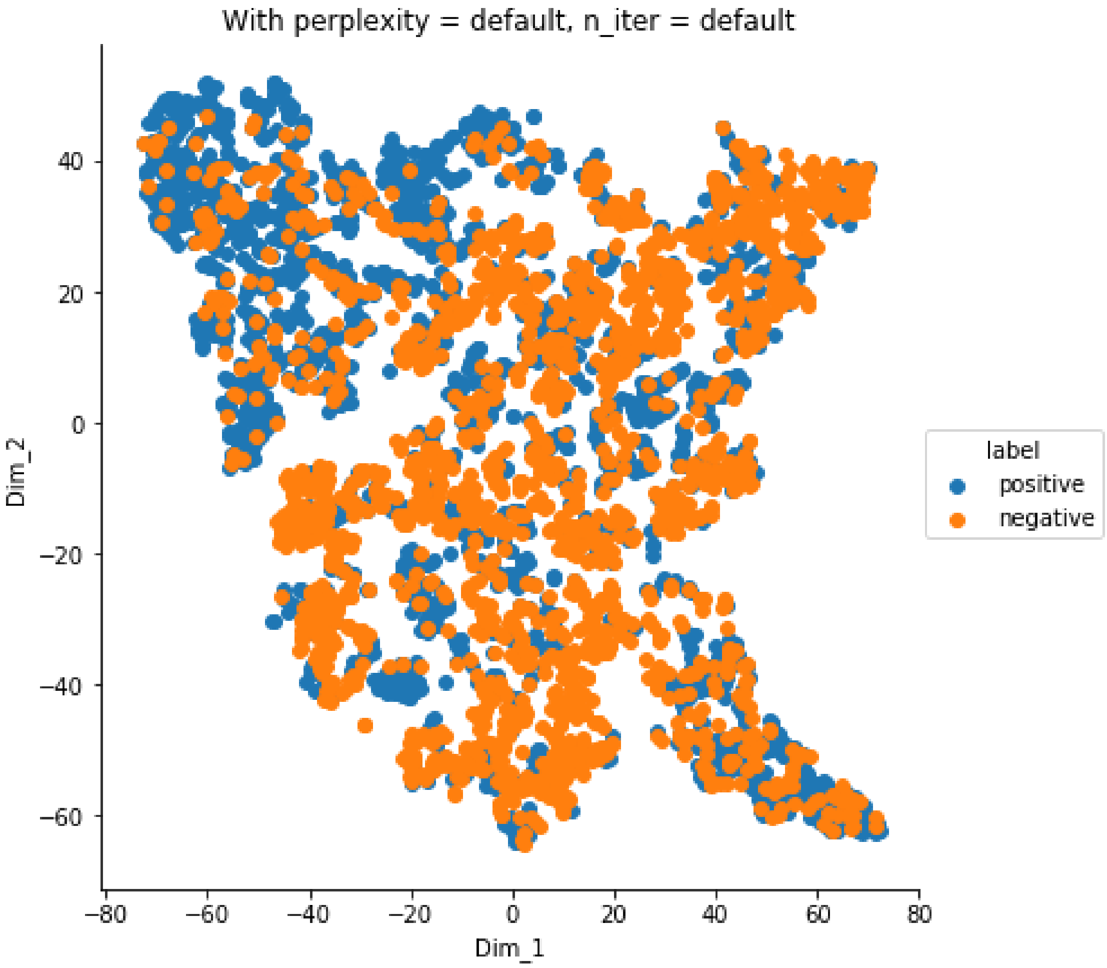
```
In [159]: tf_idf_vect = TfidfVectorizer()
          final_tf_idf = tf_idf_vect.fit_transform(text.values)

          # TF-IDF weighted Word2Vec
          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 = tfid
          np.seterr(divide='ignore', invalid='ignore')
          tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in this
          row=0;
          for sent in list_of_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_idfidf of a word in a sentence/review
                tf_idf = 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
```

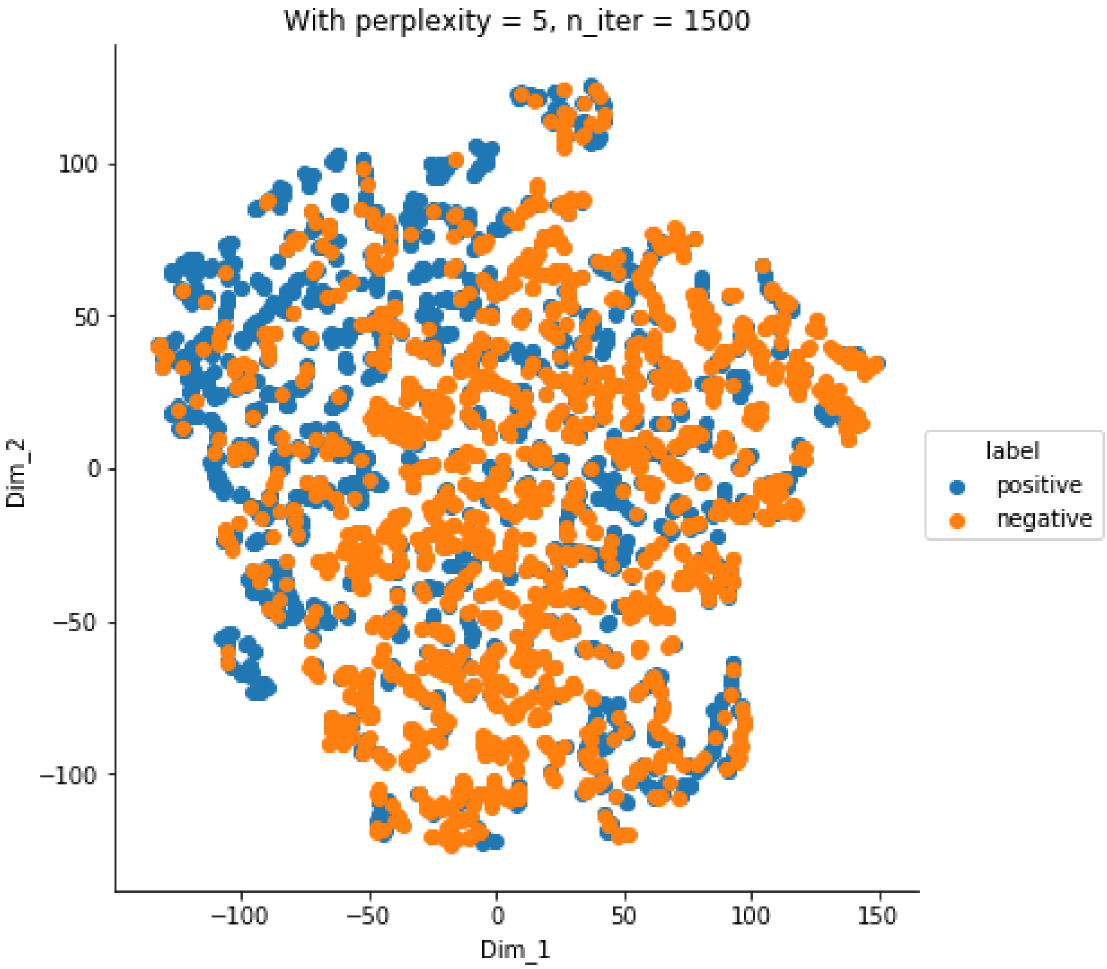
```
In [184]: import pickle
          from sklearn.externals import joblib
          joblib.dump(tfidf_sent_vectors, 'tfidfw2v.pkl')
```

```
Out[184]: ['tfidfw2v.pkl']
```

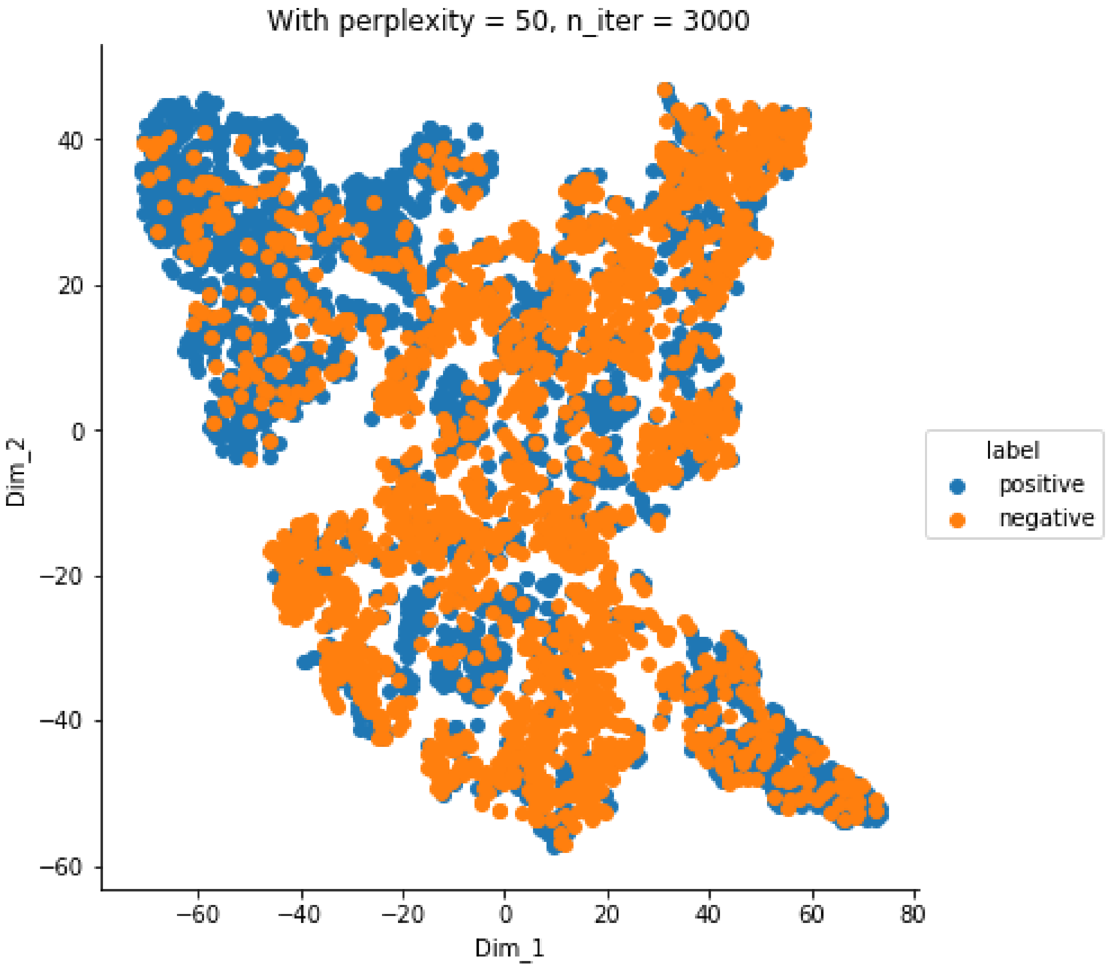
```
In [161]: model = TSNE(n_components = 2, random_state=0)
          tsne_data = model.fit_transform(tfidf_sent_vectors)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = default, n_iter = default')
          plt.show()
```



```
In [160]: model = TSNE(n_components = 2, random_state=0, perplexity=5, n_iter=1500)
          tsne_data = model.fit_transform(tfidf_sent_vectors)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 5, n_iter = 1500')
          plt.show()
```



```
In [162]: model = TSNE(n_components = 2, random_state=0, perplexity=50, n_iter=3000)
          tsne_data = model.fit_transform(tfidf_sent_vectors)

          #stacking bow and labels
          tsne_data = np.vstack((tsne_data.T, label)).T
          tsne_df = pd.DataFrame(data=tsne_data, columns=('Dim_1', 'Dim_2', 'label'))
          #plot
          sns.FacetGrid(tsne_df, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_le
          plt.title('With perplexity = 50, n_iter = 3000')
          plt.show()
```



8 observations

1. cleaned text is used
2. 2000 reviews from each positive and negative are used
3. from bow, tfidf, tfidfW2V, avgW2V TSNE plot we can see Positive and Negative datas are overlapped and increase in number of iterations didnt produce any significant changes.

*tsne plot can be tried for various higher iteration too or different perplexity number, but it is stopped because of limited computation power of this system.