TSNE_Visualization (2)

June 2, 2018

In [0]:
```
import sqlite3
import pandas as pd
import numpy as np
import nltk
import matplotlib.pyplot as plt
import seaborn as sns
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.preprocessing import StandardScaler
```

1 Loading the data

In [0]:
```
# using the SQLite Table to read data.
con = sqlite3.connect('./amazon-fine-food-reviews/database.sqlite')



#filtering only positive and negative reviews i.e.
# not taking into consideration those reviews with Score=3
filtered_data = pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3
""", con)



# Give reviews with Score>3 a positive rating, and reviews with a score<3 a negative r
def partition(x):
    if x < 3:
```

```
            return 'negative'
        return 'positive'

    #changing reviews with score less than 3 to be positive and vice-versa
    actualScore = filtered_data['Score']
    positiveNegative = actualScore.map(partition)
    filtered_data['Score'] = positiveNegative
```

In [0]:
```
    #Data cleaning and deduplication
    display= pd.read_sql_query("""
    SELECT *
    FROM Reviews
    WHERE Score != 3 AND UserId="AR5J8UI46CURR"
    ORDER BY ProductID
    """, con)

    #Sorting data according to ProductId in ascending order
    sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inplace=Fals

    #Deduplication of entries
    final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"}, keep=

    final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenominator]
```

2 Text Preprocessing: Stemming, stop-word removal and Lemmatization.

In [0]:
```
    #Code for implementing the pre-processing phase
    # this code takes a while to run as it needs to run on 500k sentences.
    i=0
    str1=' '
    final_string=[]
    all_positive_words=[] # store words from +ve reviews here
    all_negative_words=[] # store words from -ve reviews here.
    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 used to descri
```

```
                        if(final['Score'].values)[i] == 'negative':
                            all_negative_words.append(s) #list of all words used to descri
                    else:
                        continue
                else:
                    continue
            #print(filtered_sentence)
            str1 = b" ".join(filtered_sentence) #final string of cleaned words
            #print("*****************************************************************")

            final_string.append(str1)
            i+=1
```

In [0]:
```
# store final table into an SQlLite table for future.
conn = sqlite3.connect('final.sqlite')
c=conn.cursor()
conn.text_factory = str
final.to_sql('Reviews', conn, flavor=None, schema=None, if_exists='replace', index=Tru
```

In [22]:
```
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 ch
    cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
    cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
    return  cleaned
print(stop)
print('************************************')
print(sno.stem('tasty'))
```

```
{'i', 'out', 'them', 'will', 'it', 'was', 'her', 'where', "shan't", 'me', 'not', 'more', 'won'
**********************************
tasti
```

In [0]:
```
# Sampling the data
### "final.csv" containing saved "CleanedText" column
```

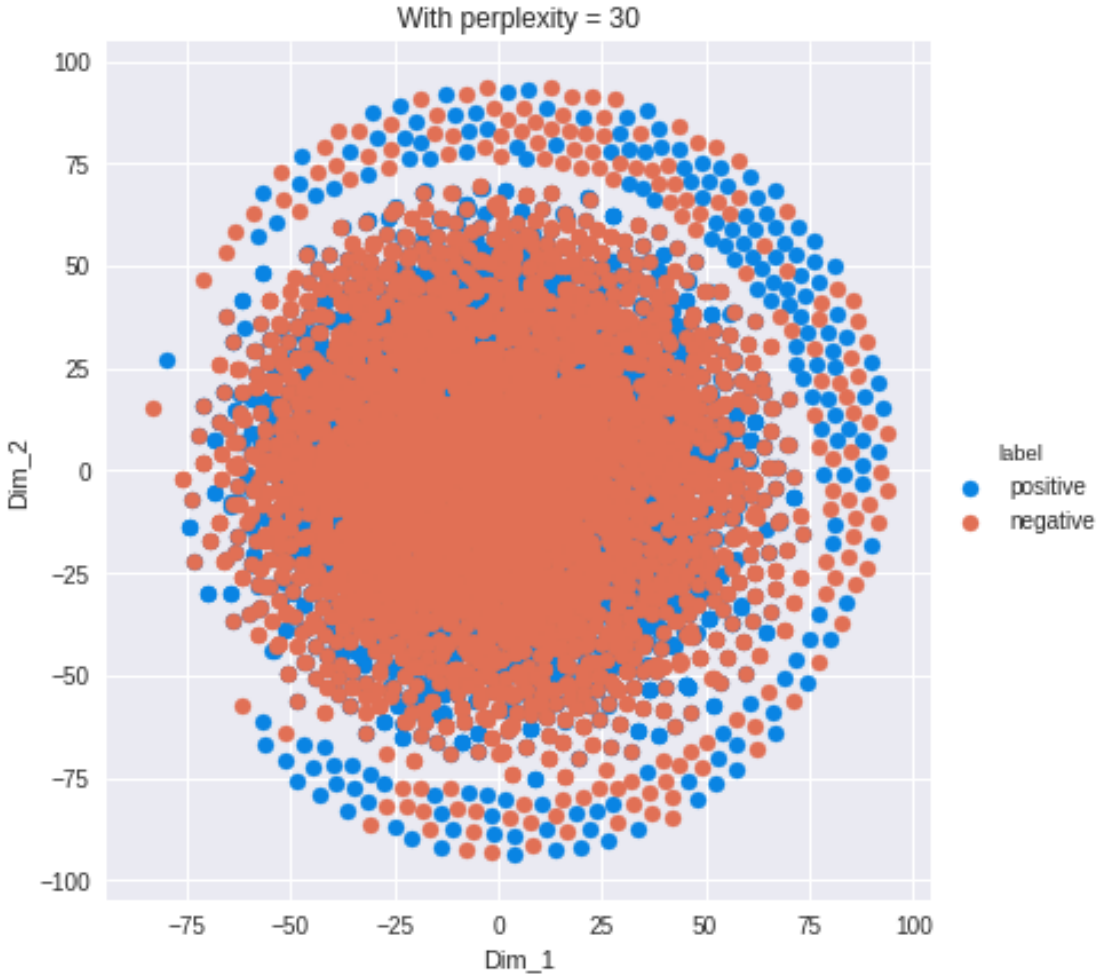
```
In [0]: #"final.csv contains the final data with the 'CleanedText' column ."
        final = pd.read_csv("final.csv")

        positive_reviews = final.loc[final["Score"] == "positive"]
        negative_reviews = final.loc[final["Score"] == "negative"]

        positive_reviews = positive_reviews.sample(n = 5000)
        negative_reviews = negative_reviews.sample(n = 5000)

        f1 = [positive_reviews, negative_reviews]
        final_data = pd.concat(f1)
        labels_10k = final_data["Score"]

In [8]: final_data.shape

Out[8]: (10000, 12)
```

3 Visualizing 'Bag of words'

```
In [0]: #BoW
        count_vect = CountVectorizer() #in scikit-learn
        final_counts = count_vect.fit_transform(final_data['CleanedText'].values)

In [14]: #Standardization
         sc= StandardScaler(with_mean=False)
         final_bow = sc.fit_transform(final_counts)

/usr/local/lib/python3.6/dist-packages/sklearn/utils/validation.py:475: DataConversionWarning:
  warnings.warn(msg, DataConversionWarning)


In [0]: #T-SVD
        svd = TruncatedSVD(n_components=4000)
        X = svd.fit_transform(final_bow)

In [18]: # List of explained variances
         var_explained = svd.explained_variance_ratio_.sum()
         var_explained

Out[18]: 0.8913821999598844

In [0]: # TSNE

        from sklearn.manifold import TSNE

        model = TSNE(n_components=2, random_state=0, perplexity = 30)


        tsne_data = model.fit_transform(X)
```

```
# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, labels_10k)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

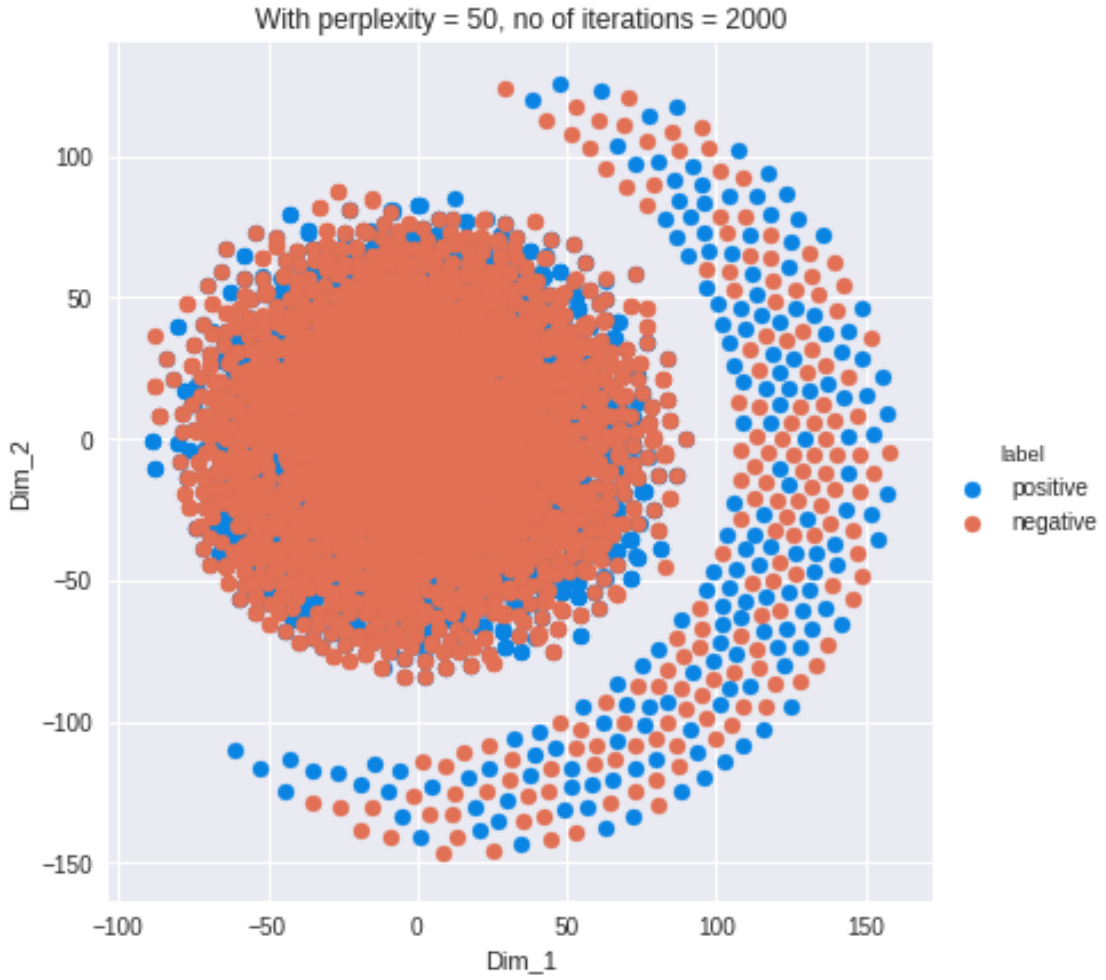
In [20]:
```
#Plotting
pal = dict(positive = "#0984e3", negative = "#e17055")
sns.FacetGrid(tsne_df, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
plt.title('With perplexity = 30')
plt.show()
```



In [0]:
```
# TSNE
model2 = TSNE(n_components=2, random_state=0, perplexity = 50, n_iter = 2000)


tsne_data2 = model2.fit_transform(X)
```

```
        # creating a new data frame which help us in ploting the result data
        tsne_data2 = np.vstack((tsne_data2.T, labels_10k)).T
        tsne_df2 = pd.DataFrame(data=tsne_data2, columns=("Dim_1", "Dim_2", "label"))
```

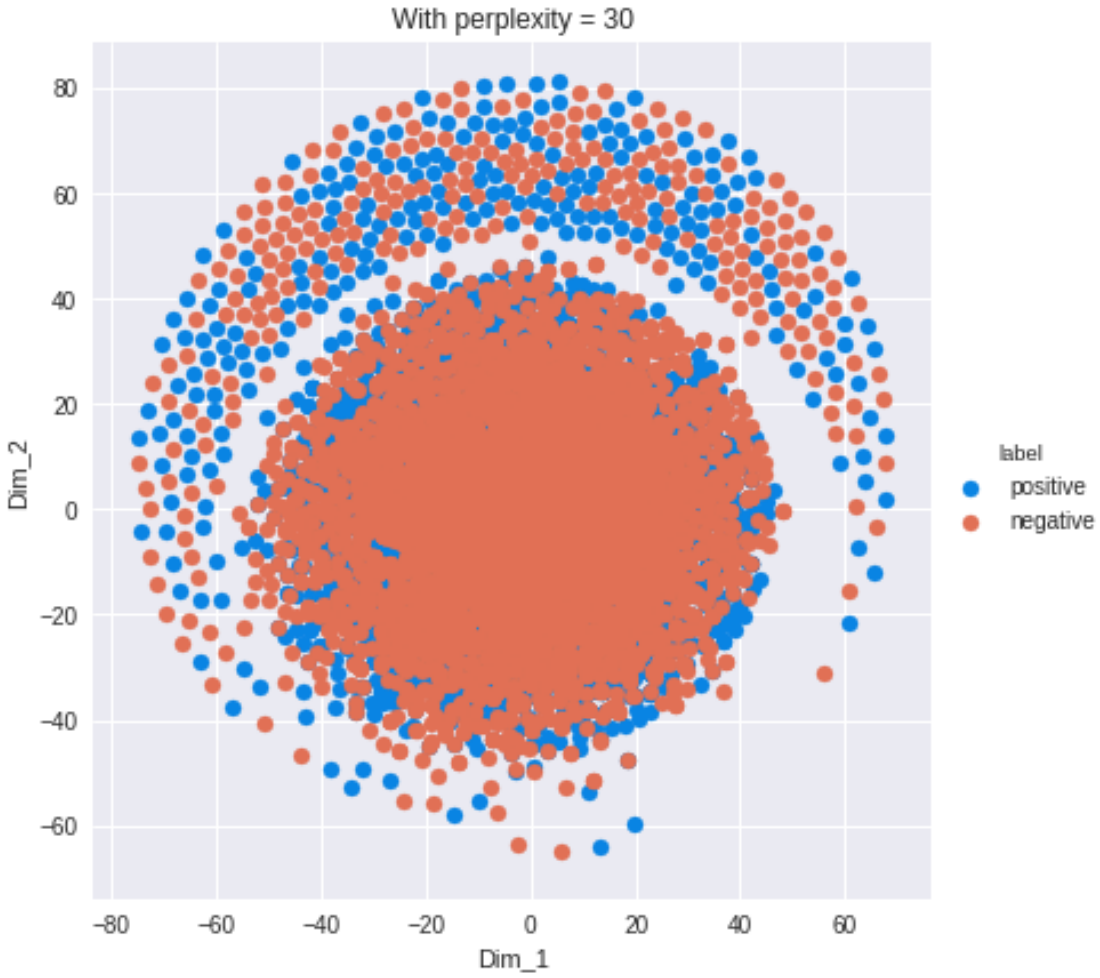
```
In [22]: pal = dict(positive = "#0984e3", negative = "#e17055")
         sns.FacetGrid(tsne_df2, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
         plt.title('With perplexity = 50, no of iterations = 2000')
         plt.show()
```



4 Visualizing 'TF-IDF'

```
In [0]: #TF-IDF
        tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
        final_tf_idf = tf_idf_vect.fit_transform(final_data['CleanedText'].values)
        tfidf_feat = tf_idf_vect.get_feature_names()
```

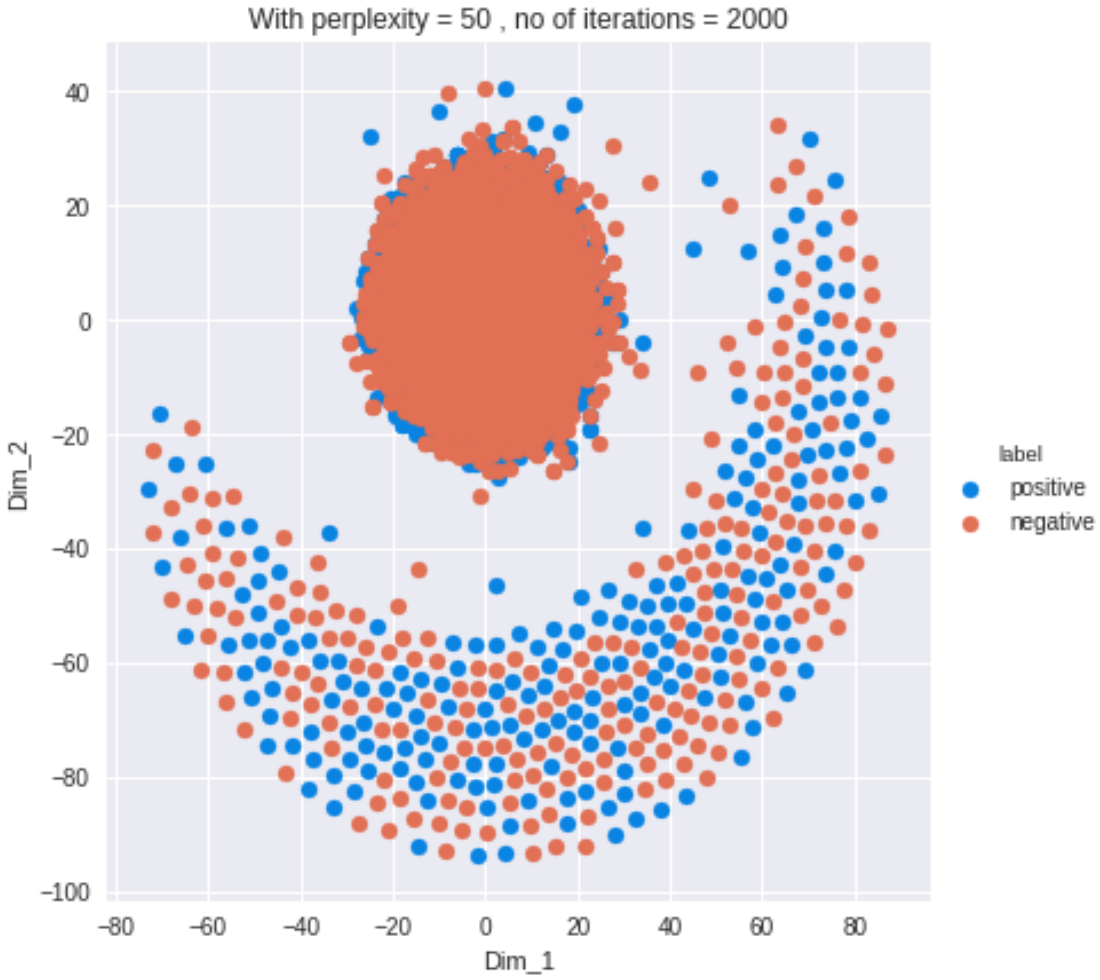
```
In [0]: sc= StandardScaler(with_mean=False)
        final_tf_idf = sc.fit_transform(final_tf_idf)

In [8]: final_tf_idf.shape

Out[8]: (10000, 245526)

In [0]: #T-SVD
        svd = TruncatedSVD(n_components=1000)
        X = svd.fit_transform(final_tf_idf)

In [0]: from sklearn.manifold import TSNE

        model3 = TSNE(n_components=2, random_state=0, perplexity = 30)
        tsne_data3 = model3.fit_transform(X)

In [0]: # creating a new data fram which help us in ploting the result data
        tsne_data3 = np.vstack((tsne_data3.T, labels_10k)).T
        tsne_df3 = pd.DataFrame(data=tsne_data3, columns=("Dim_1", "Dim_2", "label"))

In [13]: # Ploting the result of tsne
         pal = dict(positive = "#0984e3", negative = "#e17055")
         sns.FacetGrid(tsne_df3, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
         plt.title('With perplexity = 30')
         plt.show()
```




```
In [0]: model4 = TSNE(n_components=2, random_state=0, perplexity = 50, n_iter = 2000)
        tsne_data4 = model4.fit_transform(X)
```

```
In [0]: # creating a new data fram which help us in ploting the result data
        tsne_data4 = np.vstack((tsne_data4.T, labels_10k)).T
        tsne_df4 = pd.DataFrame(data=tsne_data4, columns=("Dim_1", "Dim_2", "label"))
```

```
In [17]: # Ploting the result of tsne
         pal = dict(positive = "#0984e3", negative = "#e17055")
         sns.FacetGrid(tsne_df4, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
         plt.title('With perplexity = 50 , no of iterations = 2000' )
         plt.show()
```



Training Word2Vec model

```
In [0]: # Train your own Word2Vec model using your own text corpus
        import gensim
        i=0
        list_of_sent=[]
        for sent in final_data['CleanedText'].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)
```

```
In [27]: print(final_data['CleanedText'].values[0])
         print("**********************************************************************")
         print(list_of_sent[0])
```

```
b'new favorit littl pricey way less youd pay coffe shop creami sweet chai tea sugar count low c
**********************************************************************
['bnew', 'favorit', 'littl', 'pricey', 'way', 'less', 'youd', 'pay', 'coffe', 'shop', 'creami'
```

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

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

```
In [29]: w2v_model.wv.most_similar('nice')
```

```
Out[29]: [('pleasant', 0.9217043519020081),
          ('fresh', 0.9125576019287109),
          ('aroma', 0.9033433198928833),
          ('perfect', 0.9001665115356445),
          ('amber', 0.8909069299697876),
          ('smooth', 0.8902672529220581),
          ('mild', 0.8886803984642029),
          ('odd', 0.8864750266075134),
          ('burnt', 0.8864576816558838),
          ('rich', 0.8859496116638184)]
```

5 Visualizing Average Word2Vec

```
In [30]: #AVG-W2V
         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
                 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(len(sent_vectors[0]))
```

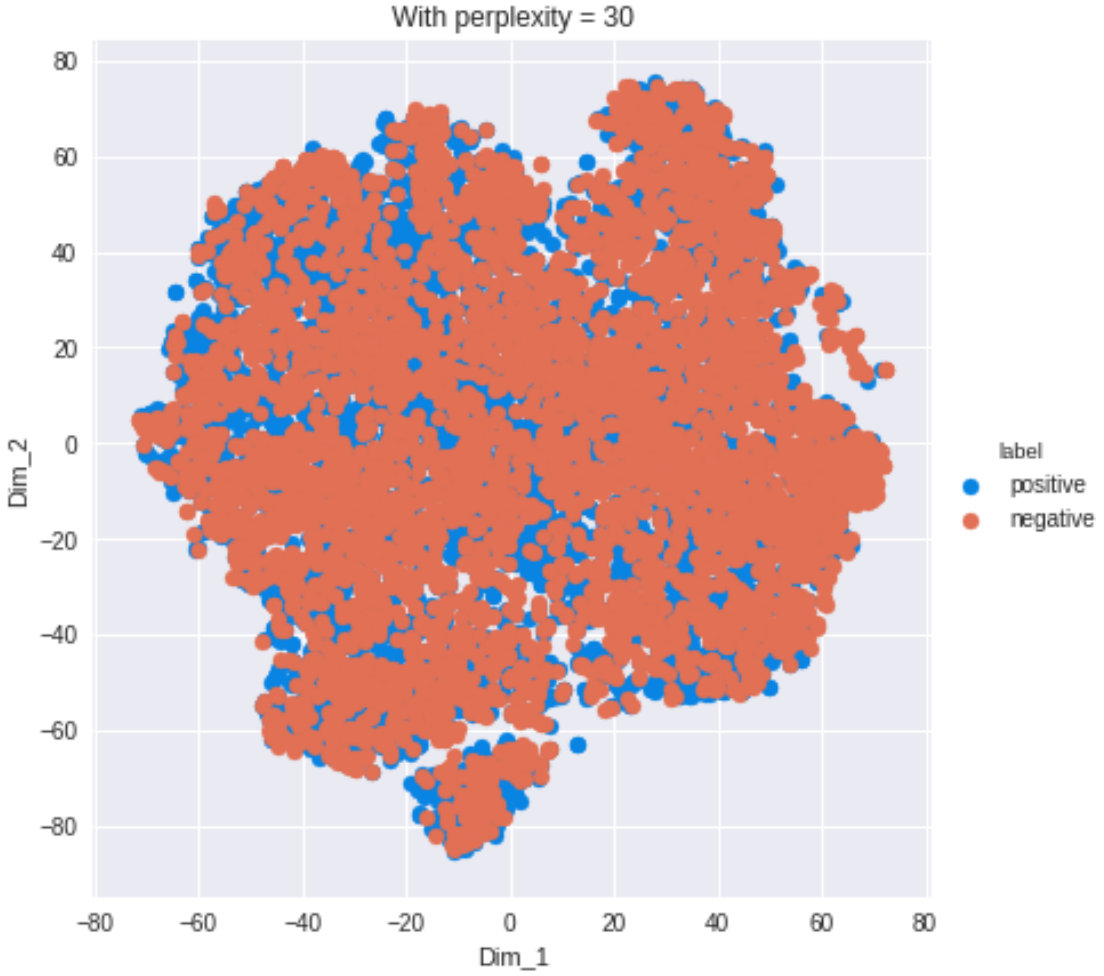
```
10000
50
```

In [0]:
```
#Standardization
from sklearn.preprocessing import StandardScaler
sc= StandardScaler()
final_sent = sc.fit_transform(sent_vectors)
```

In [0]:
```
from sklearn.manifold import TSNE

model = TSNE(n_components=2, random_state=0, perplexity = 30)
tsne_data = model.fit_transform(final_sent)
```

In [0]:
```
# creating a new data frame which help us in ploting the result data
tsne_data = np.vstack((tsne_data.T, labels_10k)).T
tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

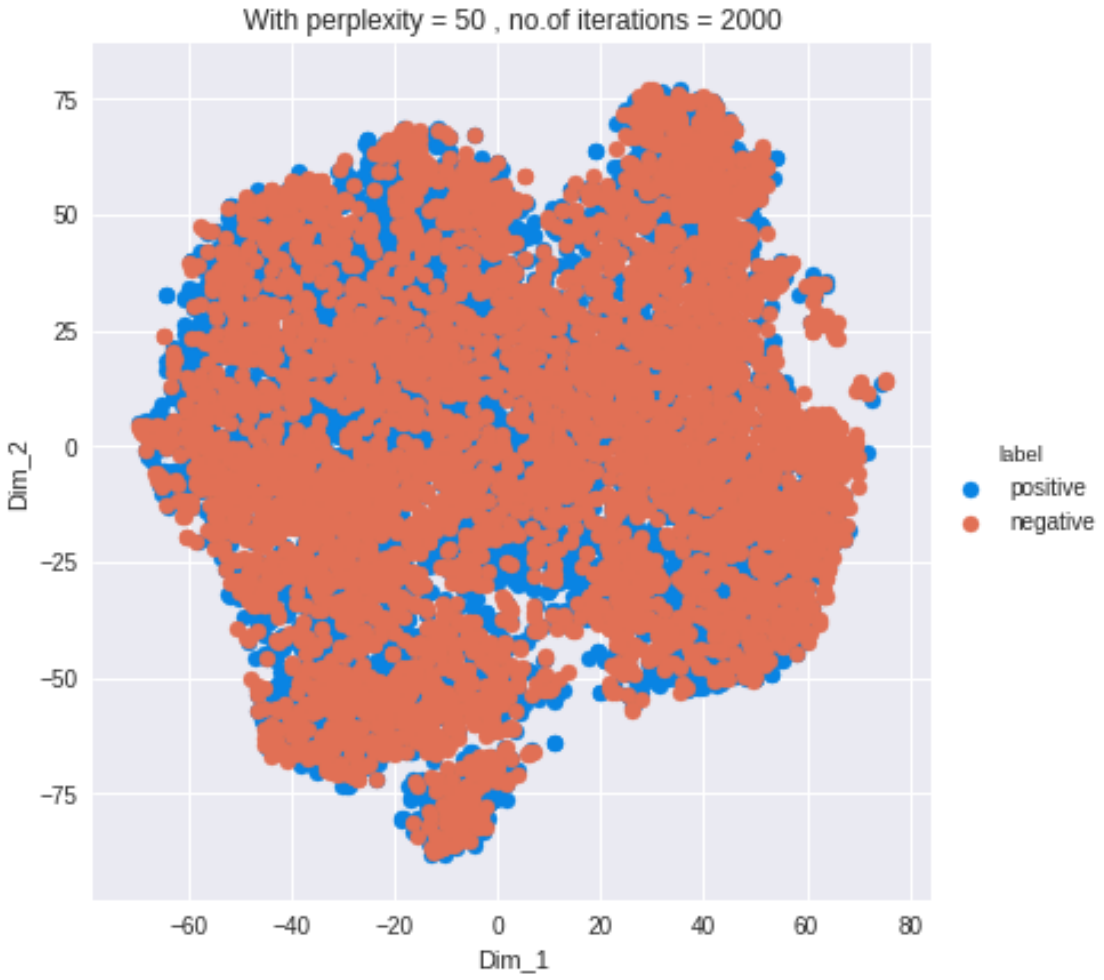
In [36]:
```
pal = dict(positive = "#0984e3", negative = "#e17055")
sns.FacetGrid(tsne_df, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
plt.title('With perplexity = 30')
plt.show()
```



In [0]:
```
from sklearn.manifold import TSNE

        model = TSNE(n_components=2, random_state=0, perplexity = 50,n_iter = 2000)
        tsne_data = model.fit_transform(final_sent)
```

In [0]:
```
# creating a new data frame which help us in ploting the result data
        tsne_data = np.vstack((tsne_data.T, labels_10k)).T
        tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

In [39]:
```
pal = dict(positive = "#0984e3", negative = "#e17055")
        sns.FacetGrid(tsne_df, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1',
        plt.title('With perplexity = 50 , no.of iterations = 2000')
        plt.show()
```



6 Visualizing Word2Vec-Tfidf

In [0]:
```
#TF-IDF
```

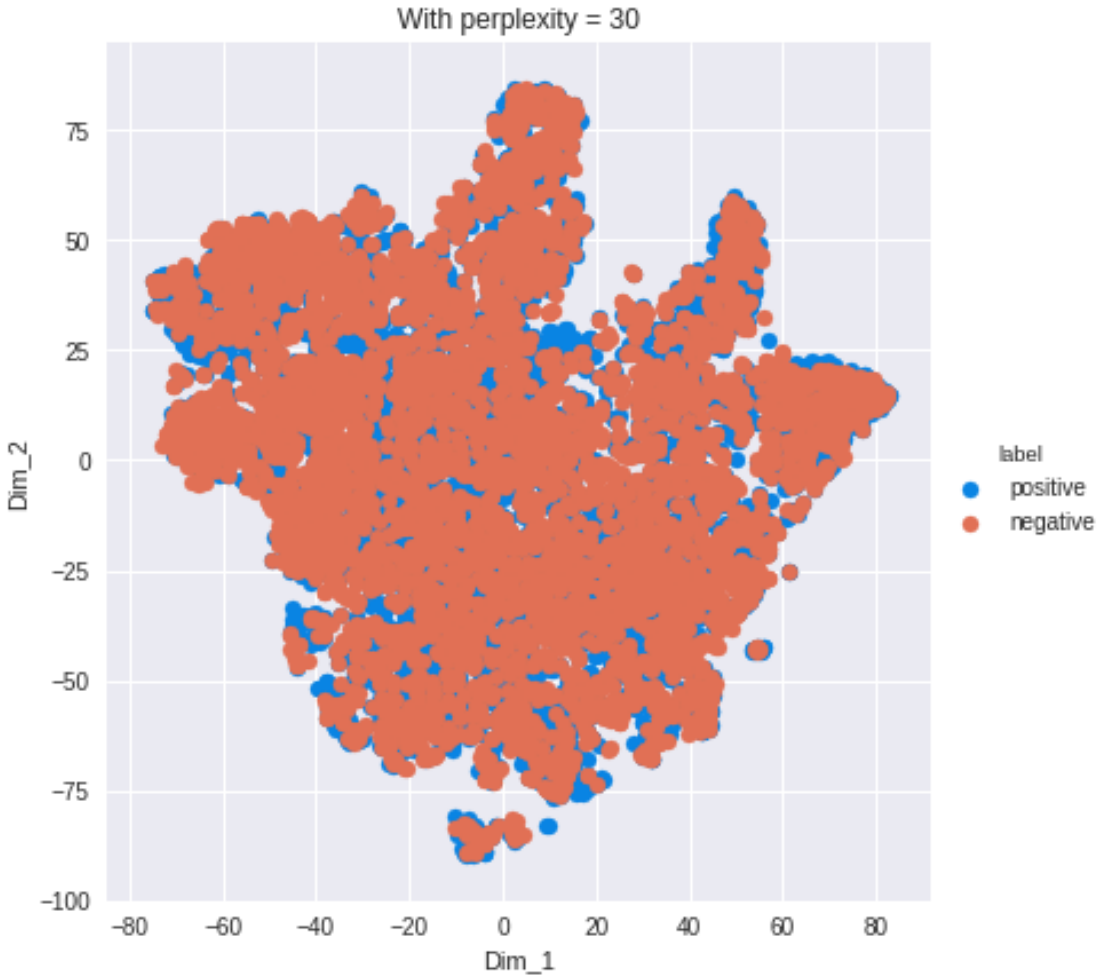
```
        tf_idf_vect = TfidfVectorizer()
        final_tf_idf = tf_idf_vect.fit_transform(final_data["CleanedText"].values)
        tfidf_feat = tf_idf_vect.get_feature_names()
         # tfidf words/col-names
        # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

        tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in this li
        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_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:
                    pass

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

            tfidf_sent_vectors.append(sent_vec)
            row += 1
```

In [0]:
```
        #Standardization
        from sklearn.preprocessing import StandardScaler
        sc = StandardScaler()
        final_tf_sent = sc.fit_transform(tfidf_sent_vectors)
```

In [0]:
```
        from sklearn.manifold import TSNE

        model = TSNE(n_components=2, random_state=0, perplexity = 30)
        tsne_data = model.fit_transform(final_tf_sent)
```

In [0]:
```
        # creating a new data frame which help us in ploting the result data
        tsne_data = np.vstack((tsne_data.T, labels_10k)).T
        tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

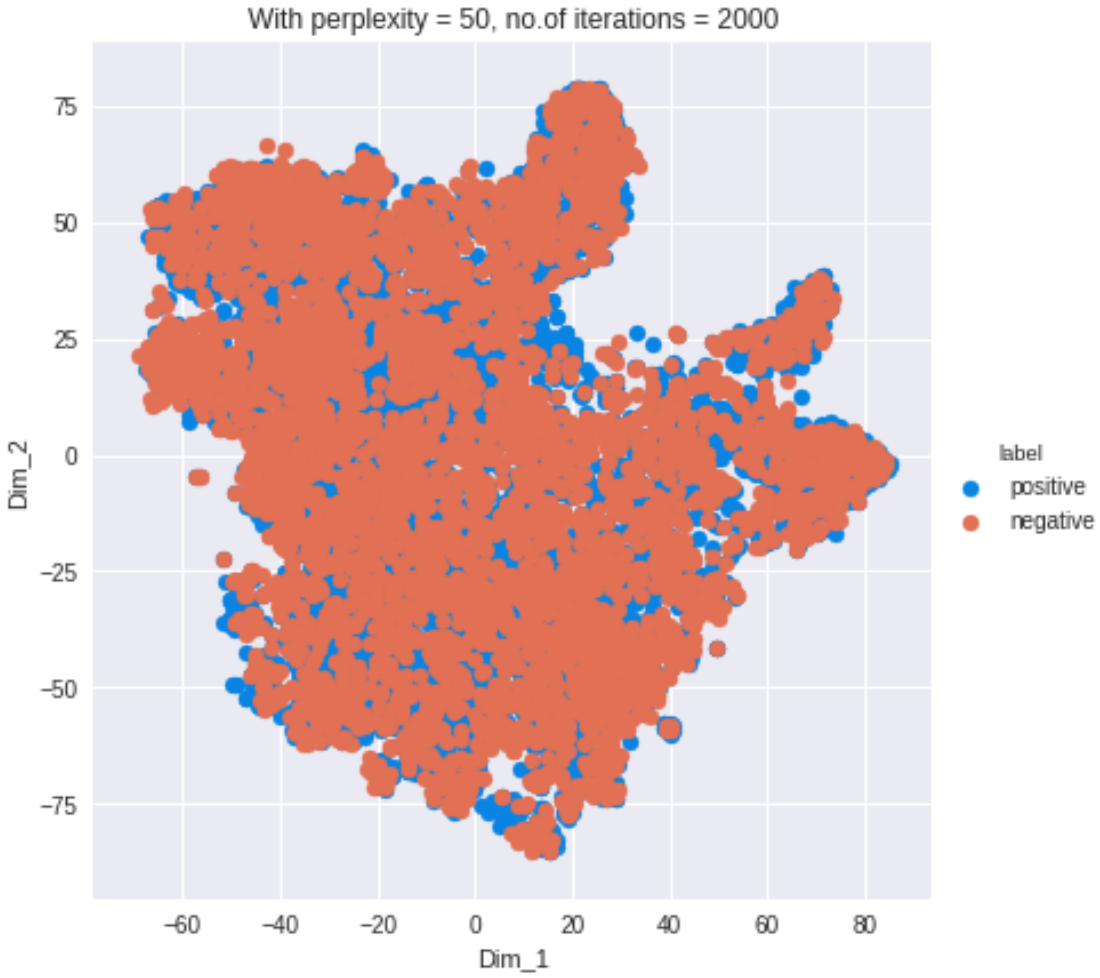
In [0]:
```
        pal = dict(positive = "#0984e3", negative = "#e17055")
        sns.FacetGrid(tsne_df, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1', '
        plt.title('With perplexity = 30')
        plt.show()
```




```
In [0]: from sklearn.manifold import TSNE

        model = TSNE(n_components=2, random_state=0, perplexity = 50, n_iter = 2000)
        tsne_data = model.fit_transform(final_tf_sent)
```

```
In [0]: # creating a new data frame which help us in ploting the result data
        tsne_data = np.vstack((tsne_data.T, labels_10k)).T
        tsne_df = pd.DataFrame(data=tsne_data, columns=("Dim_1", "Dim_2", "label"))
```

```
In [0]: pal = dict(positive = "#0984e3", negative = "#e17055")
        sns.FacetGrid(tsne_df, hue="label", size=6, palette = pal).map(plt.scatter, 'Dim_1', '
        plt.title('With perplexity = 50, no.of iterations = 2000')
        plt.show()
```



7 Conclusion

7.0.1 Since number of data points are considerably low(10k out of 364k),the points are not that separated but still 'tf-idf' and 'bag of words' vectorization techniques give the best results with perplexity of '50'.