In [2]:

```
Objective: To visualize the positive and negative reviews using TSNE with the preprocessing techniques
BoW, bigram, avgw2v,
            tfidfw2v.

Note: Due to memory constraints, I chose 5000 data points from the database.
Steps Followed:
1. Using the SQLite Table to read data.
2. Give reviews with Score>3 a positive rating, and reviews with a score<3 a negative rating.
3. Changing reviews with score less than 3 to be positive and vice-versa
4. Sorting data according to ProductId in ascending order
5. Deduplication of entries
6. Checking to see how much % of data still remains
7. How many positive and negative reviews are present in our dataset?
8. Find sentences containing HTML tags
9. Removing alphanumeric,stopwords
10. Calculating positive and negative words
11. BoW technique
12. Plotted TSNE by both suggested methods:
#TSNE using
1)By converting Sparse to dense matrix using toarray
2)Truncated SVD(chose number of components(600) based on explained variance ratio(85% data is widesprea
d)
13.Preprocessing technique without removing stopwords
14.Bigram technique
15.Truncated SVD to reduce dimensions
16.TSNE for Bigram
17.Average W2V
18.TF-IDF weighted Word2Vec
#TSNE plot for Average W2V and TFIDF weighted Word2Vec
```

```
  File "<ipython-input-2-04df3263001a>", line 1
    Objective: To visualize the positive and negative reviews using TSNE with the preprocessing techniq
ues BoW, bigram, avgw2v,
                           ^
SyntaxError: invalid syntax
```

In [3]:

```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")

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.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 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

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
```

```
import pickle

from tqdm import tqdm
import os
```

In [ ]:

```
#5000 data points chosen from the database
```

In [4]:

```
# using the SQLite Table to read data.
con = sqlite3.connect('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 LIMIT 5000""", con)


# Give reviews with Score>3 a positive rating, and reviews with a score<3 a negative rating.
def partition(x):
    if x < 3:
        return 0
    return 1

#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
print("Number of data points in our data", filtered_data.shape)
filtered_data.head(3)
```

```
Number of data points in our data (5000, 10)
```

Out[4]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Ti
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	1	1303862
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	0	1346976
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	1	1219017

In [5]:

```
#Sorting data according to ProductId in ascending order
sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inplace=False, kind='quickso
rt', na_position='last')
```

In [6]:

```
print(sorted_data.shape)
```

```
(5000, 10)
```

In [7]:

```
#Deduplication of entries
final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"}, keep='first', inplace=
False)
final.shape
```

Out[7]:

```
(4986, 10)
```

In [8]:

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

Out[8]:

```
99.72
```

In [9]:

```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND Id=44737 OR Id=64422
ORDER BY ProductID
""", con)

display.head()
```

Out[9]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	
0	64422	B000MIDROQ	A161DK06JJMCYF	J. E. Stephens "Jeanne"	3	1	5	12248
1	44737	B001EQ55RW	A2V0I904FH7ABY	Ram	3	2	4	12128

In [10]:

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

In [11]:

```
#Before starting the next phase of preprocessing lets see the number of entries left
print(final.shape)
#print(final['Text'].head)

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

```
(4986, 10)
```

Out[11]:

```
1    4178
0     808
Name: Score, dtype: int64
```

In [ ]:

```
From above, we can conclude that there are 4178 positive reviews and 808 negative reviews.
```

In [12]:

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

```
0
Why is this $[...] when the same product is available for $[...] here?<br />http://www.amazon.com/VICTO
R-FLY-MAGNET-BAIT-REFILL/dp/B00004RBDY<br /><br />The Victor M380 and M502 traps are unreal, of course
-- total fly genocide. Pretty stinky, but only right nearby.
```

In [13]:

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

```
{'been', 'being', "weren't", "wouldn't", 'you', 'of', 'wasn', 'weren', 'ourselves', 'during', 'when', '
yours', 'mustn', 'don', 'are', 'was', 'were', "wasn't", 'against', 'after', 'on', 'over', 'should', 'th
ese', 'have', 'which', 'and', "doesn't", 'this', 'off', 'same', 'then', "shan't", 'it', 'yourselves', '
too', 'than', "haven't", 'she', 'won', "mustn't", 'about', 'now', 'me', 'them', "didn't", 'yourself', '
very', "you'd", "hasn't", 'in', 'only', 'down', 'isn', 'do', 'again', 'there', 'if', 'your', 'as', "it'
s", 'ours', 'him', 'll', 'how', 'where', 'couldn', 'that', 'few', 'themselves', 'having', 'below', 'not
', 'hadn', 'his', 'between', 'is', 'their', 'theirs', 'a', 'will', "that'll", 'here', 'to', 'why', 'had
', 'through', 'didn', 'my', 'under', 'other', 'aren', 'can', 'am', "should've", 'm', 'before', 'those',
'doing', 'mightn', 'such', 've', 'does', 'myself', 'any', 'all', 'both', 'own', 'whom', 'what', "hadn't
", "needn't", "won't", 's', "mightn't", 'doesn', 'until', 'more', 'her', 're', 'we', 'needn', 'herself'
, 'itself', 'haven', 'himself', 'its', 'shouldn', 'most', 'hers', 'some', 'nor', 'into', 'or', 'they',
'once', "you're", 'for', 'because', 'no', 't', "don't", 'did', 'be', 'from', "couldn't", 'hasn', "aren'
t", 'i', "isn't", 'ma', 'with', "shouldn't", 'but', 'while', 'ain', 'wouldn', 'by', 'above', "she's", '
y', 'further', 'so', 'he', "you'll", 'an', 'the', 'each', 'who', 'our', 'at', 'just', 'd', 'out', 'up',
"you've", 'has', 'shan', 'o'}
************************************
beauti
```

In [14]:

```
if not os.path.isfile('final.sqlite'):
    i=0
    str1=' '
    final_string=[]
    all_positive_words=[] # store words from +ve reviews here
    all_negative_words=[] # store words from -ve reviews here.
    s=''
    print(final['Text'].head)
    print(final['Text'].shape)
    for sent in tqdm(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)):
                    #print("First If condition Passed")
                    if(cleaned_words.lower() not in stop):
                        #print("Word is not a stopword")
                        s=(sno.stem(cleaned_words.lower())).encode('utf8')
                        #print(s)
                        filtered_sentence.append(s)
                        # (final['Score'].values)[i] == 'positive':
                        if (final['Score'].values)[i] == 1:
                            #print("Positive word found")
                            all_positive_words.append(s) #list of all words used to describe positive r
eviews
                        #if(final['Score'].values)[i] == 'negative':
                        if(final['Score'].values)[i] == 0:
                            #print("Negative word found")
                            all_negative_words.append(s) #list of all words used to describe negative r
eviews reviews
                    else:
                        continue
                else:
                    continue
        #print(filtered_sentence)
        str1 = b" ".join(filtered_sentence) #final string of cleaned words
        #str1
        #print("***********************************************************************")

        final_string.append(str1)
        i+=1

    ############---- storing the data into .sqlite file ------######################
    final['CleanedText']=final_string #adding a column of CleanedText which displays the data after pre
-processing of the review
    final['CleanedText']=final['CleanedText'].str.decode("utf-8")
    #print(final['CleanedText'])
    #print(final.shape)
    print(final.columns.values)


        # 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,  schema=None, if_exists='replace', \
                 index=True, index_label=None, chunksize=None, dtype=None)
    conn.close()



    with open('positive_words.pkl', 'wb') as f:
        pickle.dump(all_positive_words, f)
    with open('negitive_words.pkl', 'wb') as f:
        pickle.dump(all_negative_words, f)

#print(all_positive_words)
#print(all_negative_words)
```

```
<bound method NDFrame.head of 2546    Why is this $[...] when the same product is av...
2547    We have used the Victor fly bait for 3 seasons...
1145    I just received my shipment and could hardly w...
1146    This was a really good idea and the final prod...
2942    I'm glad my 45lb cocker/standard poodle puppy ...
2941    We have been using this food for about 6 month...
1071    I have nine cats and they are crazy about thes...
2187    These were shipped out the day after I ordered...
4695    This mix is probably not something you would w...
2068    The description of this product is disceptive....
2069    I bought this same brand from an online Indian...
2806    I use these to keep my finicky toddler's prote
```

```
2806    I use these to keep my finicky toddler's prote...
2805    When we get very busy in our home, I like this...
4099    This company is an American Classic been in bu...
4096    I love Pico Pica.  It adds some flavor, and it...
4097    Thank goodness for MexGrocer. We love this Pic...
4098    This is a very different sauce - nothing like ...
1332    i found this product doing a search for "edibl...
1330    i purchased this item for a cake that called f...
1329    I have used this product multiple times.  In f...
1328    I used Super Gold Luster Dust to create the mo...
1331    This product allows me to make some really big...
4320    This was a cute, affordable set for my 2 y/o s...
4321    I only used one green with it's ball, etc. wit...
4322    <a href="http://www.amazon.com/gp/product/B000...
4323    The Golf "set" arrived quickly and was just as...
4054    With all natural ingredients and no preservati...
2477    Adzuki ( or Azuki) beans are ment to be used i...
2476    Good beans.  I can't find these in the grocery...
2478    their not only good for you but their yummy.th...
                              ...
2214    Carabou Mahogony is the worst tasting cup of c...
2215    I ordered the Mahogany Caribou Coffee K-Cups a...
2212    my wife and I are avid Keurig coffee fans (wit...
2216    This is a serious cup of joe. Yummyness!<br />...
2217    this is maybe the greatest coffee ever made.  ...
677     So surprised to find the Taiwan-shaped pineapp...
678     I really like the pineapple shortcakes sold he...
3663    I started using <a href="http://www.amazon.com...
3662    I've been using Lourdes Chimichurri for years ...
3664    I absolutely love this product!  I use it on c...
3580    I've never had Sunchy Malta before (I drank a ...
1110    My item got to my house on time and I was surp...
1109    Since being gluten free I've tried all types o...
1108    These are not as good at Houston's Samba Grill...
1107    I made these recently for a holiday party.  I ...
1106    I spent the first five years of my life in Bra...
1232    Love this, dont use too much because it is str...
4714    This is the best olive oil not for cooking as ...
2013    A nearby Fresh and Easy Neighborhood Market st...
3567    I can get it at Walmart for $1.78 each or the ...
3271    This coffee is really rich, perfect in the mor...
220     Fresh,a great way to get a little chocolate in...
4117    THIS TASTE IS BETWEEN SOMETHING LIKE FLAX BREA...
4118    I just had a wonderful dinner: Fresh fluke fri...
712     I have tried about 75% of the available T-Disc...
711     This is one of the best choices, in my opinion...
710     We've tried many Tassimo flavors.  This is by ...
709     This is a bold blend that has a great taste. T...
713     Of all the coffee's available for Tassimo this...
1362    This coffee supposedly is premium, it tastes w...
Name: Text, Length: 4986, dtype: object>
(4986,)
```

```
100%|██████████| 4986/4986 [00:09<00:00, 529.16it/s]
```

```
['Id' 'ProductId' 'UserId' 'ProfileName' 'HelpfulnessNumerator'
 'HelpfulnessDenominator' 'Score' 'Time' 'Summary' 'Text' 'CleanedText']
```

In [15]:

```
if os.path.isfile('final.sqlite'):
    conn = sqlite3.connect('final.sqlite')
    final = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3 """, conn)
    conn.close()
else:
    print("Please the above cell")
```

In [16]:

```
#BoW
count_vect = CountVectorizer() #in scikit-learn
final_counts = count_vect.fit_transform(final['CleanedText'].values)
#print(final['CleanedText'].head)
#print(final_counts[0:2:])
```

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

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 8574)
the number of unique words  8574
```

In [17]:

```
with open('positive_words.pkl', 'rb') as f:
    all_positive_words = pickle.load(f)
with open('negitive_words.pkl', 'rb') as f:
    all_negative_words = pickle.load(f)

freq_dist_positive=nltk.FreqDist(all_positive_words)
freq_dist_negative=nltk.FreqDist(all_negative_words)
print("Most Common Positive Words : ",freq_dist_positive.most_common(20))
print("Most Common Negative Words : ",freq_dist_negative.most_common(20))
```

```
Most Common Positive Words :  [(b'like', 1812), (b'tast', 1636), (b'good', 1571), (b'flavor', 1549), (b
'love', 1468), (b'great', 1442), (b'use', 1269), (b'product', 1204), (b'one', 1193), (b'tri', 1161), (b
'coffe', 1027), (b'food', 1017), (b'chip', 997), (b'make', 982), (b'get', 830), (b'tea', 801), (b'bag',
761), (b'buy', 728), (b'best', 710), (b'eat', 709)]
Most Common Negative Words :  [(b'like', 444), (b'tast', 432), (b'product', 399), (b'tri', 282), (b'one
', 281), (b'flavor', 271), (b'would', 247), (b'food', 241), (b'use', 231), (b'good', 207), (b'buy', 187
), (b'order', 185), (b'tea', 182), (b'chip', 180), (b'bag', 179), (b'get', 179), (b'even', 169), (b'mak
e', 162), (b'box', 161), (b'mix', 155)]
```

In [18]:

```
#converting sparse matrix to dense matrix
final_counts_dense = final_counts.todense()
print(final_counts_dense.shape)
```

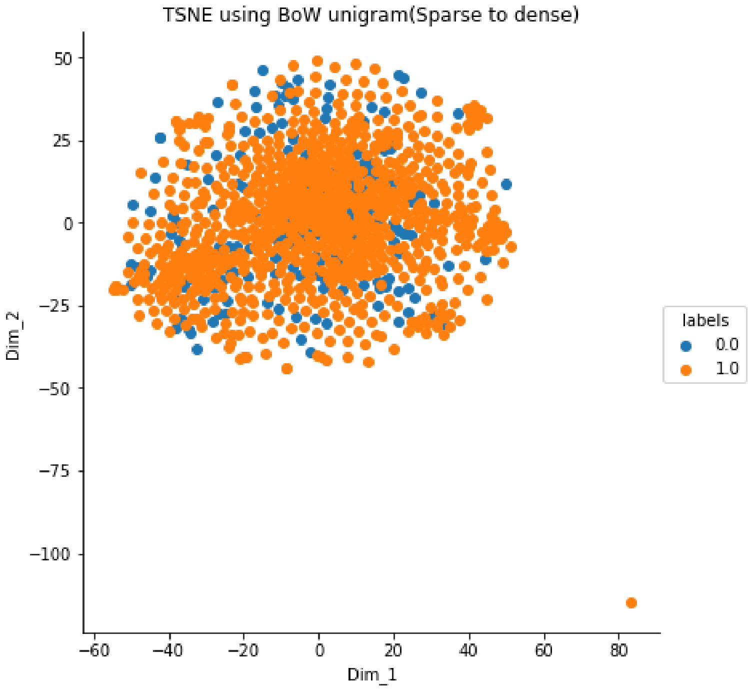
```
(4986, 8574)
```

In [19]:

```
# Plotting TSNE by converting sparse BoW matrix to dense:
import seaborn as sn
from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
data_1000 = final_counts_dense[0:1000:]
#data_1000 = final_counts_svd[0:1000:]
#print (standardized_data.head)
label = final['Score']
labels = label[0:1000]

model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(data_1000)
#print("passed")

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

# Ploting the result of tsne
sn.FacetGrid(tsne_df,hue = "labels", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.title("TSNE using BoW unigram(Sparse to dense)")
#plt.show()
```

Out[19]:

```
Text(0.5,1,'TSNE using BoW unigram(Sparse to dense)')
```



In [ ]:

```
Applying Truncated SVD using 300/500/600 features and calculated explained variance ratio. Based upon h
igh variance,
concluded to use 600 features.
```

In [20]:

```
#Applying Truncated SVD:
#choosing 300 features and calculating explained variance ration sum
from sklearn.decomposition import TruncatedSVD
from sklearn.random_projection import sparse_random_matrix
svd = TruncatedSVD(n_components=300)
svd.fit(final_counts)
TruncatedSVD(algorithm='randomized', n_components=300, n_iter=7,
        random_state=42, tol=0.0)
final_counts_svd = svd.fit(final_counts).transform(final_counts)
print(final_counts_svd.shape)
print(svd.explained_variance_ratio_.sum())
```

```
(4986, 300)
0.7266108383048321
```

In [ ]:

```
Observation:
    1.Explained variance ration sum is 0.72 for 300 features. Basically, we prefer data with high varia
nce/huge spread.
```

In [21]:

```
#Applying Truncated SVD:
#choosing 500 features and calculating explained variance ration sum
from sklearn.decomposition import TruncatedSVD
from sklearn.random_projection import sparse_random_matrix
svd = TruncatedSVD(n_components=500)
svd.fit(final_counts)
TruncatedSVD(algorithm='randomized', n_components=500, n_iter=7,
        random_state=42, tol=0.0)
final_counts_svd = svd.fit(final_counts).transform(final_counts)
print(final_counts_svd.shape)
print(svd.explained_variance_ratio_.sum())
```

```
(4986, 500)
0.8239251309463383
```

In [ ]:

```
Observation:
    By choosing 500 features, Variance ration sum is 0.82, which means, 82% of my data is widely spread
.
```

In [22]:

```
#Applying Truncated SVD:
#choosing 600 features and calculating explained variance ration sum
from sklearn.decomposition import TruncatedSVD
from sklearn.random_projection import sparse_random_matrix
svd = TruncatedSVD(n_components=600)
svd.fit(final_counts)
TruncatedSVD(algorithm='randomized', n_components=600, n_iter=7, tol=0.0)
final_counts_svd = svd.fit(final_counts).transform(final_counts)
print(final_counts_svd.shape)
print(svd.explained_variance_ratio_.sum())
##print(final_counts_svd[0:1:])
```

```
(4986, 600)
0.8547926187037
```

In [ ]:

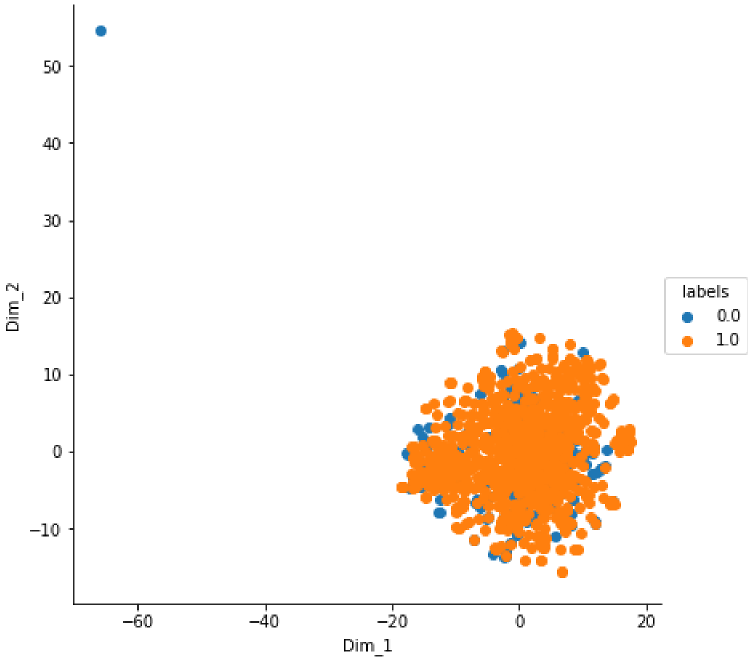
```
Observation:
    From the above results, it can be said that 85% data is wide spread. Hence, finalizing 600 as numbe
r of components.
```

In [23]:

```
# Plotting TSNE after Truncated SVD dimensionality reduction
import seaborn as sn
from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
#data_1000 = final_counts_dense[0:1000:]
data_1000 = final_counts_svd[0:1000:]
#print (standardized_data.head)
label = final['Score']
labels = label[0:1000]

model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(data_1000)
#print("passed")

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

# Ploting the result of tsne
sn.FacetGrid(tsne_df,hue = "labels", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.title("TSNE using BoW unigram(Truncated SVD)")
#plt.show()
```

Out[23]:

```
Text(0.5,1,'TSNE using BoW unigram(Truncated SVD)')
```



In [24]:

```
if not os.path.isfile('final.sqlite'):
    i=0
    str1=' '
    final_string=[]
    all_positive_words=[] # store words from +ve reviews here
    all_negative_words=[] # store words from -ve reviews here.
    s=''
    print(final['Text'].head)
    print(final['Text'].shape)
    for sent in tqdm(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)):
                    #print("First If condition Passed")
                    #if(cleaned_words.lower() not in stop):
                        #print("Word is not a stopword")
                        s=(sno.stem(cleaned_words.lower())).encode('utf8')
                        #print(s)
                        filtered_sentence.append(s)
                        # (final['Score'].values)[i] == 'positive':
                        if (final['Score'].values)[i] == 1:
                            #print("Positive word found")
                            all_positive_words.append(s) #list of all words used to describe positive r
eviews
                        #if(final['Score'].values)[i] == 'negative':
                        if(final['Score'].values)[i] == 0:
                            #print("Negative word found")
                            all_negative_words.append(s) #list of all words used to describe negative r
eviews reviews
                    #else:
                        #continue
                else:
                    continue
        #print(filtered_sentence)
        str1 = b" ".join(filtered_sentence) #final string of cleaned words
        #str1
        #print("************************************************************************")

        final_string.append(str1)
        i+=1

    ############---- storing the data into .sqlite file ------#######################
    final['CleanedText']=final_string #adding a column of CleanedText which displays the data after pre
-processing of the review
    final['CleanedText']=final['CleanedText'].str.decode("utf-8")
    #print(final['CleanedText'])
    #print(final.shape)
    #print(final.columns.values)


        # 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,  schema=None, if_exists='replace',
                 index=True, index_label=None, chunksize=None, dtype=None)
    conn.close()



    with open('positive_words.pkl', 'wb') as f:
        pickle.dump(all_positive_words, f)
    with open('negitive_words.pkl', 'wb') as f:
        pickle.dump(all_negative_words, f)

#print(all_positive_words)
#print(all_negative_words)
```

```
<bound method NDFrame.head of 0       Why is this $[...] when the same product is av...
1       We have used the Victor fly bait for 3 seasons...
2       I just received my shipment and could hardly w...
3       This was a really good idea and the final prod...
4       I'm glad my 45lb cocker/standard poodle puppy ...
5       We have been using this food for about 6 month...
6       I have nine cats and they are crazy about thes...
7       These were shipped out the day after I ordered...
8       This mix is probably not something you would w...
9       The description of this product is disceptive....
10      I bought this same brand from an online Indian...
11      I use these to keep my finicky toddler's prote...
12      When we get very busy in our home, I like this...
13      This company is an American Classic been in bu...
14      I love Pico Pica.  It adds some flavor, and it...
15      Thank goodness for MexGrocer. We love this Pic...
16      This is a very different sauce - nothing like ...
17      i found this product doing a search for "edibl...
18      i purchased this item for a cake that called f...
19      I have used this product multiple times.  In f...
20      I used Super Gold Luster Dust to create the mo...
21      This product allows me to make some really big...
22      This was a cute, affordable set for my 2 y/o s...
23      I only used one green with it's ball, etc. wit...
24      <a href="http://www.amazon.com/gp/product/B000...
25      The Golf "set" arrived quickly and was just as...
26      With all natural ingredients and no preservati...
27      Adzuki ( or Azuki) beans are ment to be used i...
28      Good beans.  I can't find these in the grocery...
29      their not only good for you but their yummy.th...
                              ...
4956    Carabou Mahogony is the worst tasting cup of c...
4957    I ordered the Mahogany Caribou Coffee K-Cups a...
4958    my wife and I are avid Keurig coffee fans (wit...
4959    This is a serious cup of joe. Yummyness!<br />...
4960    this is maybe the greatest coffee ever made.  ...
4961    So surprised to find the Taiwan-shaped pineapp...
4962    I really like the pineapple shortcakes sold he...
4963    I started using <a href="http://www.amazon.com...
4964    I've been using Lourdes Chimichurri for years ...
4965    I absolutely love this product!  I use it on c...
4966    I've never had Sunchy Malta before (I drank a ...
4967    My item got to my house on time and I was surp...
4968    Since being gluten free I've tried all types o...
4969    These are not as good at Houston's Samba Grill...
4970    I made these recently for a holiday party.  I ...
4971    I spent the first five years of my life in Bra...
4972    Love this, dont use too much because it is str...
4973    This is the best olive oil not for cooking as ...
4974    A nearby Fresh and Easy Neighborhood Market st...
4975    I can get it at Walmart for $1.78 each or the ...
4976    This coffee is really rich, perfect in the mor...
4977    Fresh,a great way to get a little chocolate in...
4978    THIS TASTE IS BETWEEN SOMETHING LIKE FLAX BREA...
```

```
4979    I just had a wonderful dinner: Fresh fluke fri...
4980    I have tried about 75% of the available T-Disc...
4981    This is one of the best choices, in my opinion...
4982    We've tried many Tassimo flavors.  This is by ...
4983    This is a bold blend that has a great taste. T...
4984    Of all the coffee's available for Tassimo this...
4985    This coffee supposedly is premium, it tastes w...
Name: Text, Length: 4986, dtype: object>
(4986,)
```

```
100%|██████████| 4986/4986 [00:12<00:00, 405.57it/s]
```

In [25]:

```
#bi-gram, tri-gram and n-gram

#removing stop words like "not" should be avoided before building n-grams
count_vect = CountVectorizer(ngram_range=(1,2) ) #in scikit-learn
final_bigram_counts = count_vect.fit_transform(final['CleanedText'].values)
print("the type of count vectorizer ",type(final_bigram_counts))
print("the shape of out text BOW vectorizer ",final_bigram_counts.get_shape())
print("the number of unique words including both unigrams and bigrams ", final_bigram_counts.get_shape(
)[1])
#print(final['CleanedText'].head)
#print(final_bigram_counts.values)
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 127714)
the number of unique words including both unigrams and bigrams  127714
```

In [26]:

```
#Applying Truncated SVD:
#choosing 600 features and calculating explained variance ration sum
from sklearn.decomposition import TruncatedSVD
from sklearn.random_projection import sparse_random_matrix
final_bigram_counts_svd = TruncatedSVD(n_components=600)
svd.fit(final_bigram_counts)
TruncatedSVD(algorithm='randomized', n_components=600, n_iter=7, tol=0.0)
final_bigram_counts_svd = svd.fit(final_bigram_counts).transform(final_bigram_counts)
print(final_bigram_counts_svd.shape)
print(svd.explained_variance_ratio_.sum())
##print(final_counts_svd[0:1:])
```

```
(4986, 600)
0.7056597312311603
```

In [ ]:

```
By choosing 600 features, 70% data is wide spread.
```

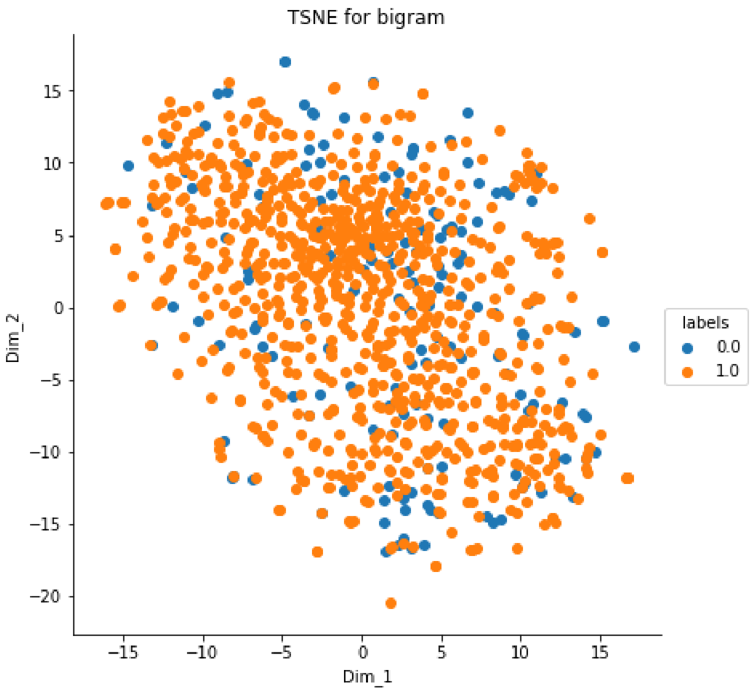
In [27]:

```
# TSNE for bigram
import seaborn as sn
from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
#data_1000 = final_counts_dense[0:1000:]
data_1000 = final_bigram_counts_svd[0:1000:]
#print (standardized_data.head)s
label = final['Score']
labels = label[0:1000]

model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000
```

```
tsne_data = model.fit_transform(data_1000)
#print("passed")

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

# Ploting the result of tsne
sn.FacetGrid(tsne_df,hue = "labels", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.title("TSNE for bigram")
#plt.show()
```

Out[27]:

```
Text(0.5,1,'TSNE for bigram')
```



In [28]:

```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
final_tf_idf = tf_idf_vect.fit_transform(final['Text'].values)
print("the type of count vectorizer ",type(final_tf_idf))
print("the shape of out text TFIDF vectorizer ",final_tf_idf.get_shape())
print("the number of unique words including both unigrams and bigrams ", final_tf_idf.get_shape()[1])
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (4986, 148211)
the number of unique words including both unigrams and bigrams  148211
```

In [29]:

```
features = tf_idf_vect.get_feature_names()
print("some sample features(unique words in the corpus)",features[40000:40010])
```

```
some sample features(unique words in the corpus) ['each dried', 'each drink', 'each eat', 'each evening
', 'each feeding', 'each fell', 'each five', 'each flavor', 'each for', 'each fortune']
```

In [30]:

```
# 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 feature names.'''
    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)
top_tfidf
```

Out[30]:

	feature	tfidf
0	fly bait	0.274736
1	seasons can	0.274736
2	for seasons	0.274736
3	victor	0.262108
4	bait for	0.262108
5	the victor	0.262108
6	victor fly	0.262108
7	fly	0.246199
8	seasons	0.246199
9	bait	0.240521
10	beat it	0.235720
11	can beat	0.201504
12	used the	0.192545
13	have used	0.186498
14	beat	0.173265
15	it great	0.169864
16	great product	0.154497
17	we have	0.142644
18	used	0.109802
19	we	0.092118
20	product	0.080693
21	can	0.077881
22	great	0.074089
23	have	0.061395
24	for	0.051863

In [31]:

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

In [32]:

```
print(final['CleanedText'].values[0])
print("*****************************************************************")
print(list_of_sent[0])
```

```
whi this when the same product avail for here www amazon com the victor and trap are unreal cours total
fli genocid pretti stinki but onli right nearbi
*****************************************************************
['whi', 'this', 'when', 'the', 'same', 'product', 'avail', 'for', 'here', 'www', 'amazon', 'com', 'the'
, 'victor', 'and', 'trap', 'are', 'unreal', 'cours', 'total', 'fli', 'genocid', 'pretti', 'stinki', 'bu
t', 'onli', 'right', 'nearbi']
```

In [33]:

```
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=5)
```

In [34]:

```
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  3037
sample words  ['whi', 'this', 'when', 'the', 'same', 'product', 'avail', 'for', 'here', 'www', 'amazon'
, 'com', 'and', 'trap', 'are', 'cours', 'total', 'fli', 'pretti', 'stinki', 'but', 'onli', 'right', 'ne
arbi', 'have', 'use', 'season', 'cant', 'beat', 'great', 'just', 'receiv', 'shipment', 'could', 'hard',
'wait', 'tri', 'love', 'which', 'what', 'call', 'them', 'instead', 'sticker', 'becaus', 'they', 'can',
'remov', 'easili', 'daughter']
```

In [35]:

```
w2v_model.wv.most_similar('tasti')
```

Out[35]:

```
[('delici', 0.9748965501785278),
 ('crunchi', 0.9655242562294006),
 ('textur', 0.955356240272522),
 ('crisp', 0.9509963393211365),
 ('light', 0.9495143294334412),
 ('salti', 0.9347854256629944),
 ('soft', 0.9323551654815674),
 ('low', 0.9311342239379883),
 ('chewi', 0.9231307506561279),
 ('crunch', 0.9196618795394897)]
```

In [36]:

```
w2v_model.wv.most_similar('like')
```

Out[36]:

```
[('spici', 0.8856682777404785),
 ('realli', 0.8799726963043213),
 ('strong', 0.877139687538147),
 ('bitter', 0.871982216835022),
 ('tast', 0.8707834482192993),
 ('doe', 0.8631897568702698),
 ('not', 0.8614490032196045),
 ('doesnt', 0.8605141043663025),
 ('smell', 0.8525605201721191),
 ('real', 0.8513809442520142)]
```

In [ ]:

```
Above result shows few dissimilar words for like, which may be due to less number of data points chosen
as an input
```

In [37]:

```
# 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 tqdm(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]))
```

```
100%|██████████| 4986/4986 [00:05<00:00, 834.50it/s]
```

```
4986
50
```

In [38]:

```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
model = TfidfVectorizer()
tf_idf_matrix = model.fit_transform(final['CleanedText'].values)
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(model.get_feature_names(), list(model.idf_)))
```

In [39]:

```
# TF-IDF weighted Word2Vec
tfidf_feat = model.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 list
row=0;
for sent in tqdm(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
        if word in w2v_words:
            vec = w2v_model.wv[word]
#             tf_idf = tf_idf_matrix[row, tfidf_feat.index(word)]
            # to reduce the computation we are
            # dictionary[word] = idf value of word in whole corpus
            # sent.count(word) = tf valeus of word in this review
            tf_idf = dictionary[word]*(sent.count(word)/len(sent))
            sent_vec += (vec * tf_idf)
            weight_sum += tf_idf
    if weight_sum != 0:
        sent_vec /= weight_sum
    tfidf_sent_vectors.append(sent_vec)
    row += 1
```

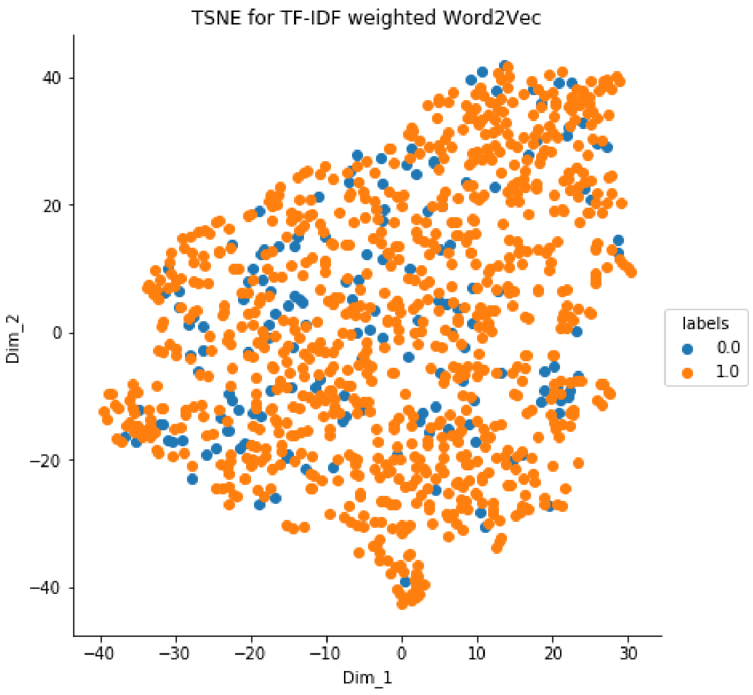
```
100%|██████████| 4986/4986 [00:08<00:00, 556.82it/s]
```

In [40]:

```
# TSNE for TF-IDF weighted Word2Vec
import seaborn as sn
from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
#data_1000 = final_counts_dense[0:1000:]
data_1000 = tfidf_sent_vectors[0:1000:]
#print (standardized_data.head)s
label = final['Score']
labels = label[0:1000]

model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(data_1000)
#print("passed")

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

# Ploting the result of tsne
sn.FacetGrid(tsne_df,hue = "labels", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.title("TSNE for TF-IDF weighted Word2Vec")
#plt.show()
```

Out[40]:

```
Text(0.5,1,'TSNE for TF-IDF weighted Word2Vec')
```

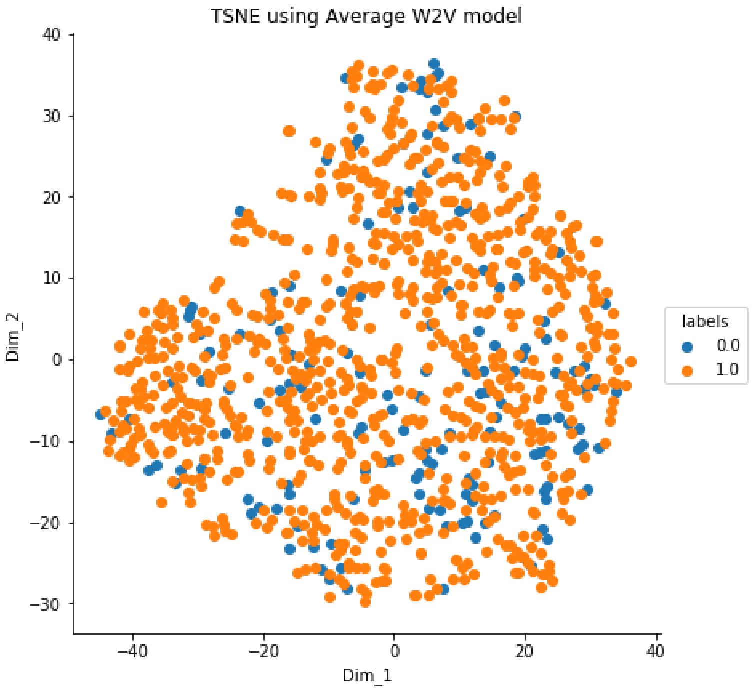


In [41]:

```
# TSNE for average W2V
import seaborn as sn
from sklearn.manifold import TSNE

# Picking the top 1000 points as TSNE takes a lot of time for 15K points
#data_1000 = final_counts_dense[0:1000:]
data_1000 = sent_vectors[0:1000:]
#print (standardized_data.head)s
label = final['Score']
labels = label[0:1000]

model = TSNE(n_components=2, random_state=0)
# configuring the parameteres
# the number of components = 2
# default perplexity = 30
# default learning rate = 200
# default Maximum number of iterations for the optimization = 1000

tsne_data = model.fit_transform(data_1000)
#print("passed")

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

# Ploting the result of tsne
sn.FacetGrid(tsne_df,hue = "labels", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legend()
plt.title("TSNE using Average W2V model")
#plt.show()
```

Out[41]:

```
Text(0.5,1,'TSNE using Average W2V model')
```



```
In [ ]:
```

```
Upon applying TSNE using BoW, bigram, Average W2V and TFIDG weighted W2V techniques, both positive and
negative reviews are
overlapping. The reviews cannot be visualized into two separate clusters.
```