In [25]:
```
%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 [40]:

```
# using the SQLite Table to read data.
con = sqlite3.connect(r'C:\Sandy\privy\AI\Data Sets\Amazon Food rev dataset\datab

#filtering only positive and negative reviews i.e.
# not taking into consideration those reviews with Score=3
# SELECT * FROM Reviews WHERE Score != 3 LIMIT 500000, will give top 500000 data
# you can change the number to any other number based on your computing power

#Took 3000 points from each Category i.e from Positive reviews and Negative Revie
#Negative Data
Neg_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score < 3 LIMIT 3000
#Positive Data
Pos_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score > 3 LIMIT 3000

Neg_data.head()
filtered_data =pd.concat([Neg_data,Pos_data])
print("Total Sample Points : ",filtered_data.shape)
#filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3 ""
print("\n Sample Points : ")
filtered_data.head()
```

```
Total Sample Points :  (6000, 10)

 Sample Points :
```

Out[40]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenomi
0	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	
1	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	
2	13	B0009XLVG0	A327PCT23YH90	LT	1	
3	17	B001GVISJM	A3KLWF6WQ5BNYO	Erica Neathery	0	

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenomi
4	27	B001GVISJM	A3RXAU2N8KV45G	lady21	0	

In [41]:

```
# Give reviews with Score>3 a positive rating, and reviews with a score<3 a negat
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 dataset", filtered_data.shape)
filtered_data.head(3)
```

```
Number of data points in our data (6000, 10)
```

Out[41]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominato
0	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	
1	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	
2	13	B0009XLVG0	A327PCT23YH90	LT	1	

In [44]:

```
display = pd.read_sql_query("""
SELECT UserId, ProductId, ProfileName, Time, Score, Text, COUNT(*)
FROM Reviews
GROUP BY UserId
HAVING COUNT(*)>1
""", con)
```

In [45]:
```
print(display.shape)
display.head()
```

```
(80668, 7)
```

Out[45]:

	UserId	ProductId	ProfileName	Time	Score	Text	COUNT(*)
0	#oc-R115TNMSPFT9I7	B005ZBZLT4	Breyton	1331510400	2	Overall its just OK when considering the price...	2
1	#oc-R11D9D7SHXIJB9	B005HG9ESG	Louis E. Emory "hoppy"	1342396800	5	My wife has recurring extreme muscle spasms, u...	3
2	#oc-R11DNU2NBKQ23Z	B005ZBZLT4	Kim Cieszykowski	1348531200	1	This coffee is horrible and unfortunately not ...	2
3	#oc-R11O5J5ZVQE25C	B005HG9ESG	Penguin Chick	1346889600	5	This will be the bottle that you grab from the...	3
4	#oc-R12KPBODL2B5ZD	B007OSBEV0	Christopher P. Presta	1348617600	1	I didnt like this coffee. Instead of telling y...	2

In [46]:
```
display[display['UserId']=='AZY10LLTJ71NX']
```

Out[46]:

	UserId	ProductId	ProfileName	Time	Score	Text	COUNT(*)
80638	AZY10LLTJ71NX	B001ATMQK2	undertheshrine "undertheshrine"	1296691200	5	I bought this 6 pack because for the price tha...	5

In [47]:
```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND UserId="AR5J8UI46CURR"
ORDER BY ProductID
""", con)
display.head()
```

Out[47]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenomi
0	78445	B000HDL1RQ	AR5J8UI46CURR	Geetha Krishnan	2	
1	138317	B000HDOPYC	AR5J8UI46CURR	Geetha Krishnan	2	
2	138277	B000HDOPYM	AR5J8UI46CURR	Geetha Krishnan	2	
3	73791	B000HDOPZG	AR5J8UI46CURR	Geetha Krishnan	2	
4	155049	B000PAQ75C	AR5J8UI46CURR	Geetha Krishnan	2	

In [49]:
```
#Sorting data according to ProductId in ascending order
sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inpla
```

In [50]:
```
#Deduplication of entries
final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"},
final.shape
```

Out[50]: (5873, 10)

In [51]:
```
#Checking to see how much % of data still remains

(final['Id'].size*1.0)/(filtered_data['Id'].size*1.0)*100
```

Out[51]: 97.88333333333334

In [52]:
```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND Id=44737 OR Id=64422
ORDER BY ProductID
""", con)

display.head()
```

Out[52]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenomir
0	64422	B000MIDROQ	A161DK06JJMCYF	J. E. Stephens "Jeanne"	3	
1	44737	B001EQ55RW	A2V0I904FH7ABY	Ram	3	

In [53]:
```
final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenominator]
```

In [54]:
```
#Before starting the next phase of preprocessing lets see the number of entries l
print(final.shape)

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

```
(5873, 10)
```

Out[54]:
```
1    2994
0    2879
Name: Score, dtype: int64
```

In [55]:
```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'not'
# <br /><br /> ==> after the above steps, we are getting "br br"
# we are including them into stop words list
# instead of <br /> if we have <br/> these tags would have revmoved in the 1st st

stopwords= set(['br', 'the', 'i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ou
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he',
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itse
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'tha
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'ha
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 't
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'of
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than'
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "di
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma',
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn
            'won', "won't", 'wouldn', "wouldn't"])
```

In [56]:
```
import re

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase
```

In [58]:
```
# Combining all the above stundents
from tqdm import tqdm
import re
from bs4 import BeautifulSoup
preprocessed_reviews = []
# tqdm is for printing the status bar
for sentance in tqdm(final['Text'].values):
    sentance = re.sub(r"http\S+", "", sentance)
    sentance = BeautifulSoup(sentance, 'html.parser').get_text()
    sentance = decontracted(sentance)
    sentance = re.sub("\S*\d\S*", "", sentance).strip()
    sentance = re.sub('[^A-Za-z]+', ' ', sentance)
    # https://gist.github.com/sebleier/554280
    sentance = ' '.join(e.lower() for e in sentance.split() if e.lower() not in s
    preprocessed_reviews.append(sentance.strip())
```

```
100%|██████████| 5873/5873 [00:03<00:00, 1917.23it/s]
```

In [59]:
```
print(preprocessed_reviews[1])
```

```
used victor fly bait seasons ca not beat great product
```

BOW with 20 sample Points

In [65]:
```
#BoW
count_vect = CountVectorizer() #in scikit-learn
count_vect.fit(preprocessed_reviews)
print("some feature names ", count_vect.get_feature_names()[:10])
print('='*50)

final_counts = count_vect.transform(preprocessed_reviews)
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])
```

```
some feature names  ['aa', 'aahhhs', 'aback', 'abandoned', 'abates', 'abby', 'a
bc', 'abdomen', 'abdominal', 'abide']
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (5873, 14923)
the number of unique words  14923
```

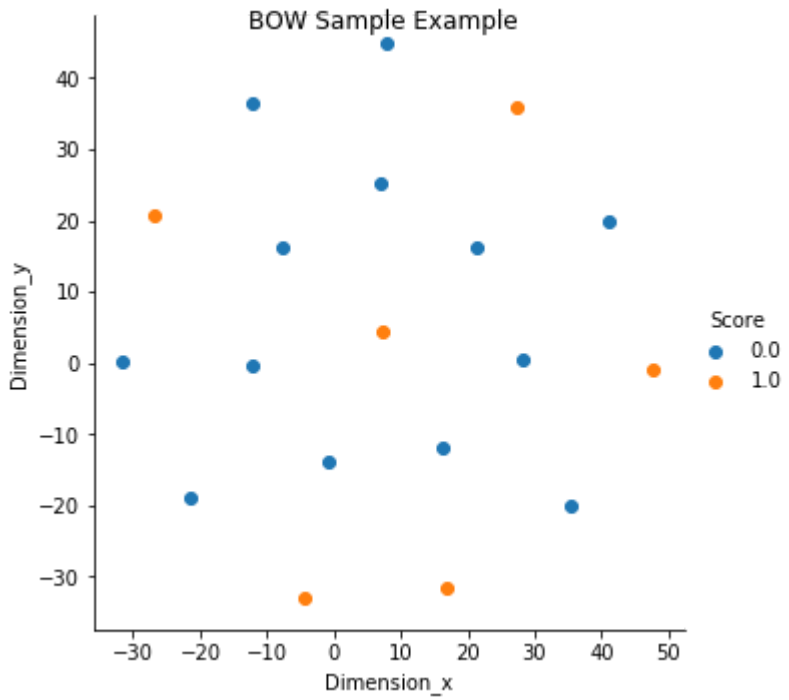
In [68]:
```
print("first vector is ",final_counts[0])
```

```
first vector is    (0, 849)     1
  (0, 2989)     1
  (0, 5123)     1
  (0, 5497)     1
  (0, 8637)     1
  (0, 10131)    1
  (0, 10217)    1
  (0, 11128)    1
  (0, 12598)    1
  (0, 13557)    1
  (0, 13641)    1
  (0, 14007)    1
  (0, 14261)    1
```

TSNE Implementation(BOW) with 20 sample Points

In [72]:
```
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(final_counts[1:20].toarray())
#APPlied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'][1:20])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['Dimension_x','Dimension_y',
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'Dimension_x',
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('BOW Sample Example')
print(for_tsne_df[1:20])
```

```
    Dimension_x  Dimension_y  Score
1     47.533840    -1.048463    1.0
2     16.947844   -31.575644    1.0
3    -26.929747    20.732336    1.0
4     -4.395844   -32.922810    1.0
5     27.327641    35.805267    1.0
6     21.456394    16.117622    0.0
7    -21.427845   -19.114166    0.0
8     41.190418    19.893555    0.0
9      6.972011    25.294550    0.0
10    -0.793375   -13.779734    0.0
11   -12.198659    -0.359586    0.0
12    28.322632     0.344556    0.0
13    16.103151   -11.880673    0.0
14     7.838866    44.811310    0.0
15   -31.785879     0.133858    0.0
16    35.416283   -20.160290    0.0
17    -7.743803    16.121630    0.0
18   -12.220153    36.350624    0.0
```



By above plot we can visualize that data is randomly distrubuted and cannot differentiate the space over positive and negative points

BOW with bi-gram

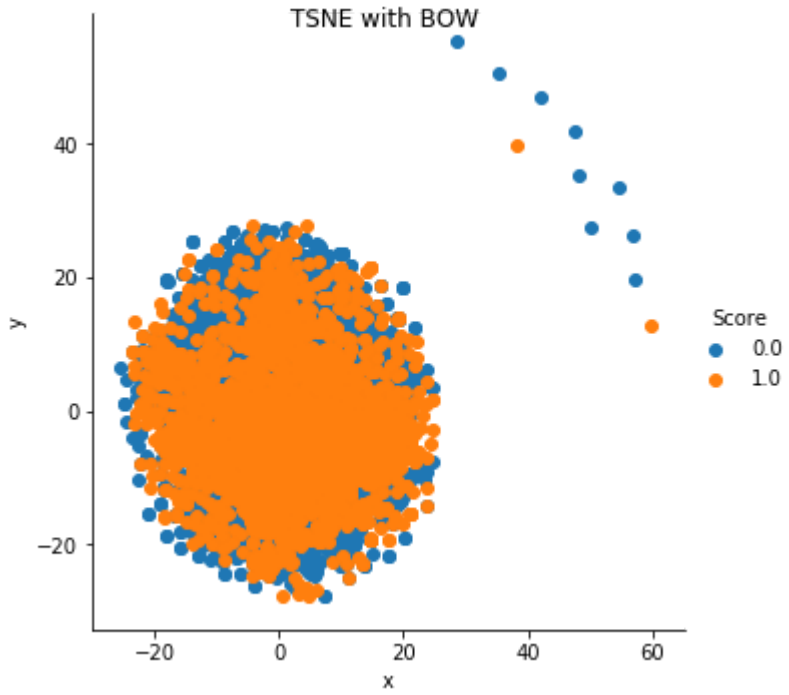
In [70]:
```
#bi-gram, tri-gram and n-gram

#removing stop words like "not" should be avoided before building n-grams
# count_vect = CountVectorizer(ngram_range=(1,2))
# please do read the CountVectorizer documentation http://scikit-learn.org/stable
# you can choose these numebrs min_df=10, max_features=5000, of your choice
count_vect = CountVectorizer(ngram_range=(1,2), min_df=10, max_features=5000)
#min-df ignore terms that have a document frequency strictly lower than the given
#max_features build a vocabulary that only consider the top max_features ordered
final_bigram_counts = count_vect.fit_transform(preprocessed_reviews)
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_bi
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (5873, 3877)
the number of unique words including both unigrams and bigrams  3877
```

TSNE(BOW) implementation

In [71]:
```
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(final_counts.toarray())
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
#APPlied AI Bi-variate analysys
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with BOW')
#print(for_tsne_df[1:20])
```

Out[71]: Text(0.5, 0.98, 'TSNE with BOW')

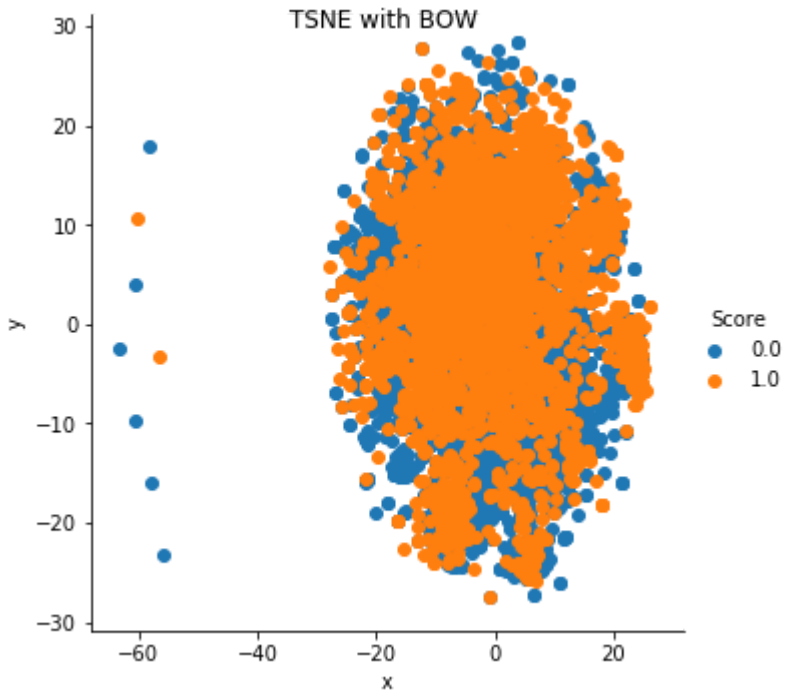


Here we cannot predict or visualie a a line which segrgates the Scores(i.e positive or negative)

TSNE(BOW with bigram) Implementation

In [73]:
```
import time
start = time. time()
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(final_bigram_counts.toarray())
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with BOW')
#print(for_tsne_df[1:20])
end = time. time()
print(end - start)
```

```
388.993488073349
```



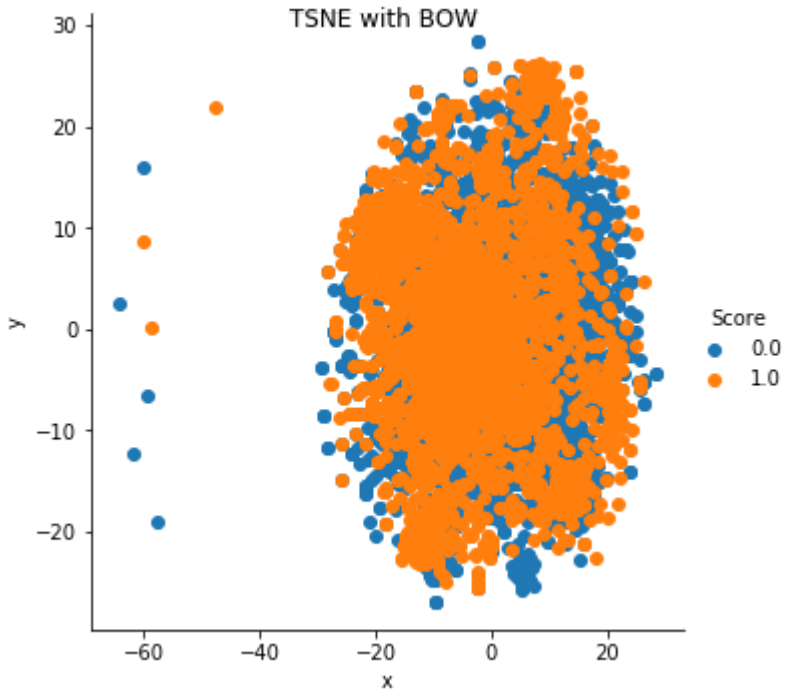
TSNE(BOW with Trigram) Implementation

In [74]:
```
#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))
# please do read the CountVectorizer documentation http://scikit-learn.org/stable
# you can choose these numebrs min_df=10, max_features=5000, of your choice
count_vect = CountVectorizer(ngram_range=(1,3), min_df=10, max_features=5000)
final_bigram_counts3 = count_vect.fit_transform(preprocessed_reviews)
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_bi
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (5873, 3877)
the number of unique words including both unigrams and bigrams  3877
```

In [75]:
```
import time
start = time.time()
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(final_bigram_counts3.toarray())
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with BOW')
#print(for_tsne_df[1:20])
end = time.time()
print(end - start)
```

```
362.6028325557709
```



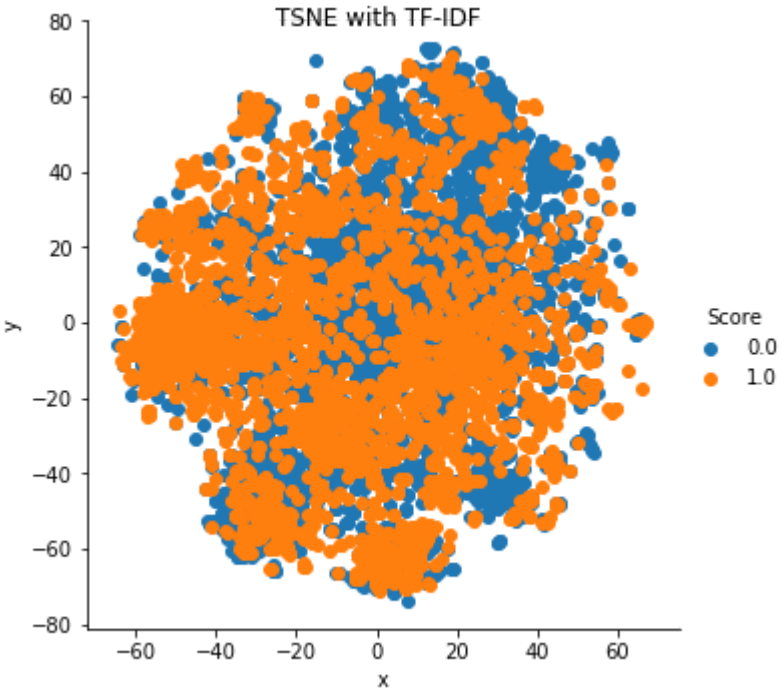
T-SNE with TF-IDF

In [76]:
```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10)
tf_idf_vect.fit(preprocessed_reviews)
print("some sample features(unique words in the corpus)",tf_idf_vect.get_feature_
print('='*50)

final_tf_idf = tf_idf_vect.transform(preprocessed_reviews)
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_t
```

```
some sample features(unique words in the corpus) ['ability', 'able', 'able fin
d', 'able get', 'absolute', 'absolutely', 'absolutely delicious', 'absolutely l
ove', 'absolutely no', 'accept']
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (5873, 3877)
the number of unique words including both unigrams and bigrams  3877
```

In [77]:
```
import time
start = time.time()
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(final_tf_idf.toarray())
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with TF-IDF')
end = time.time()
print(end - start)
```

```
335.3896152973175
```



TSNE with word to vec

In [101]:
```
i=0
list_of_sentance=[]
for sentance in preprocessed_reviews:
    list_of_sentance.append(sentance.split())
print(list_of_sentance[1:10])
print('\n')
print(type(preprocessed_reviews))
```

```
[['used', 'victor', 'fly', 'bait', 'seasons', 'ca', 'not', 'beat', 'great', 'pr
oduct'], ['really', 'good', 'idea', 'final', 'product', 'outstanding', 'use',
'decals', 'car', 'window', 'everybody', 'asks', 'bought', 'decals', 'made', 'tw
o', 'thumbs'], ['received', 'shipment', 'could', 'hardly', 'wait', 'try', 'prod
uct', 'love', 'slickers', 'call', 'instead', 'stickers', 'removed', 'easily',
'daughter', 'designed', 'signs', 'printed', 'reverse', 'use', 'car', 'windows',
'printed', 'beautifully', 'print', 'shop', 'program', 'going', 'lot', 'fun', 'p
roduct', 'windows', 'everywhere', 'surfaces', 'like', 'tv', 'screens', 'compute
r', 'monitors'], ['glad', 'cocker', 'standard', 'poodle', 'puppy', 'loves', 'st
uff', 'trust', 'brand', 'superior', 'nutrition', 'compare', 'labels', 'previou
s', 'feed', 'pedigree', 'mostly', 'corn', 'little', 'dude', 'healthy', 'happy',
'high', 'energy', 'glossy', 'coat', 'also', 'superior', 'nutrition', 'produce
s', 'smaller', 'compact', 'stools'], ['using', 'food', 'months', 'find', 'excel
lent', 'fact', 'two', 'dogs', 'coton', 'de', 'tulear', 'standard', 'poodle', 'p
uppy', 'love', 'food', 'thriving', 'coats', 'excellent', 'condition', 'overal
l', 'structure', 'perfect', 'good', 'tasting', 'dog', 'good', 'good', 'deal',
'owner', 'around', 'best', 'food', 'ever', 'used', 'excellent'], ['nine', 'cat
s', 'crazy', 'kibbles', 'last', 'thing', 'want', 'cat', 'food', 'cats', 'hate',
'buying'], ['honestly', 'say', 'not', 'buy', 'variety', 'looks', 'bad', 'smell
s', 'bad', 'sure', 'tastes', 'bad', 'cat', 'not', 'touch', 'no', 'way', 'no',
'not', 'even', 'look', 'cat', 'way', 'one', 'looks', 'like', 'huge', 'ground',
'mess', 'leftovers', 'fish', 'market', 'sure', 'cats', 'must', 'like', 'still',
'made', 'things', 'much', 'much', 'better', 'one'], ['not', 'cat', 'yet', 'like
d', 'one', 'little', 'interesting', 'think', 'smells', 'nasty', 'think', 'tast
e', 'really', 'gets', 'current', 'cat', 'not', 'touch', 'might', 'eat', 'coupl
e', 'bites', 'really', 'hungry', 'always', 'wind', 'throwing', 'one', 'ground',
'cat', 'likes', 'pieces', 'not', 'try', 'one'], ['feeding', 'dog', 'months', 'r
ealized', 'stool', 'pretty', 'runny', 'whole', 'time', 'today', 'diarrhea', 'pr
obably', 'second', 'third', 'time', 'period', 'came', 'online', 'see', 'other
s', 'problem', 'sure', 'enough', 'answer', 'yes', 'done', 'dog', 'food', 'woul
d', 'suggest', 'not', 'right']]


<class 'list'>
```

In [81]:
```
w2v_model=Word2Vec(list_of_sentance,min_count=5,size=50, workers=4)
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])
```

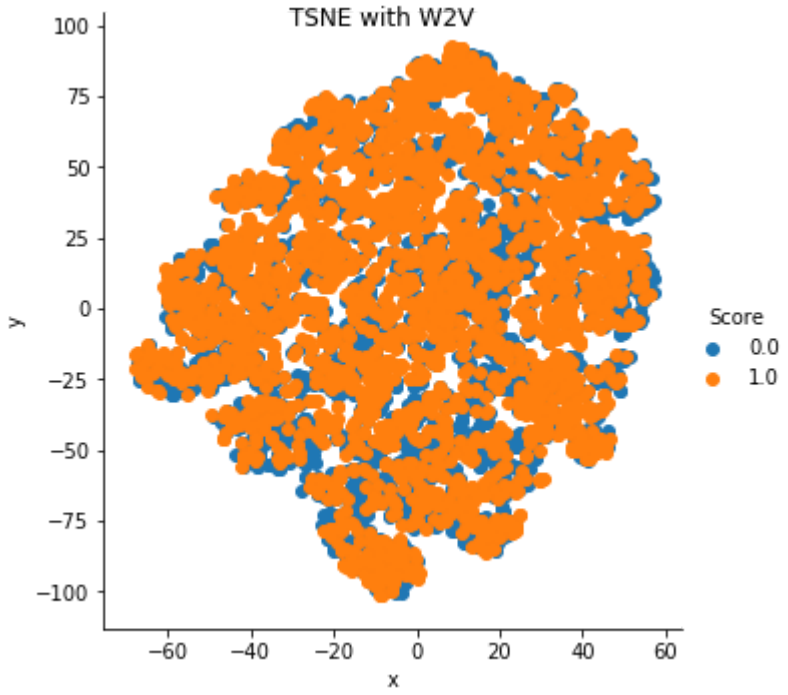
```
number of words that occured minimum 5 times  4506
sample words  ['product', 'available', 'course', 'total', 'fly', 'pretty', 'sti
nky', 'right', 'nearby', 'used', 'bait', 'ca', 'not', 'beat', 'great', 'reall
y', 'good', 'idea', 'final', 'outstanding', 'use', 'car', 'everybody', 'asks',
'bought', 'made', 'two', 'thumbs', 'received', 'shipment', 'could', 'hardly',
'wait', 'try', 'love', 'call', 'instead', 'stickers', 'removed', 'easily', 'dau
ghter', 'designed', 'signs', 'printed', 'windows', 'print', 'shop', 'program',
'going', 'lot']
```

In [85]:
```
# 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_sentance): # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero's with length 50, you m
    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]))
print(sent_vectors[0:1])
```

```
100%|██████████| 5873/5873 [00:08<00:00, 658.76it/s]

5873
50
[array([ 0.1525359 , -0.62744745,  0.52472873, -0.27241544,  0.14966254,
       -0.39644233,  0.48789565,  0.0015135 , -0.39131813,  0.01530557,
        0.35525566, -0.28522921, -0.05777501, -0.27065225,  0.03089993,
       -0.08066183,  0.38462851,  0.55563261,  0.08326235, -0.24288433,
       -0.00324191,  0.07570929,  0.17412864, -0.24991199, -0.36722103,
        0.0779019 ,  0.64432961,  0.27008459,  0.00591411, -0.05998786,
        0.11583283, -0.32985068,  0.52553442,  0.02068581, -0.41303387,
        0.36133172, -0.23856224,  0.27659468, -0.55712601,  0.52464679,
        0.03851868, -0.08190021,  0.26804303, -0.22408732,  0.40699712,
        0.38733752,  0.33414323, -0.0607787 ,  0.26856936,  0.41334341])]
```

In [87]:
```
import time
start = time.time()
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(sent_vectors)
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with W2V')
#print(for_tsne_df[1:20])
end = time.time()
print(end - start)
```

```
101.93248295783997
```



In [92]:
```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
model = TfidfVectorizer()
model.fit(preprocessed_reviews)
# 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 [94]:
```
# 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 = t

tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in tl
row=0;
for sent in tqdm(list_of_sentance): # 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 and word in tfidf_feat:
            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 courpus
            # 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
```

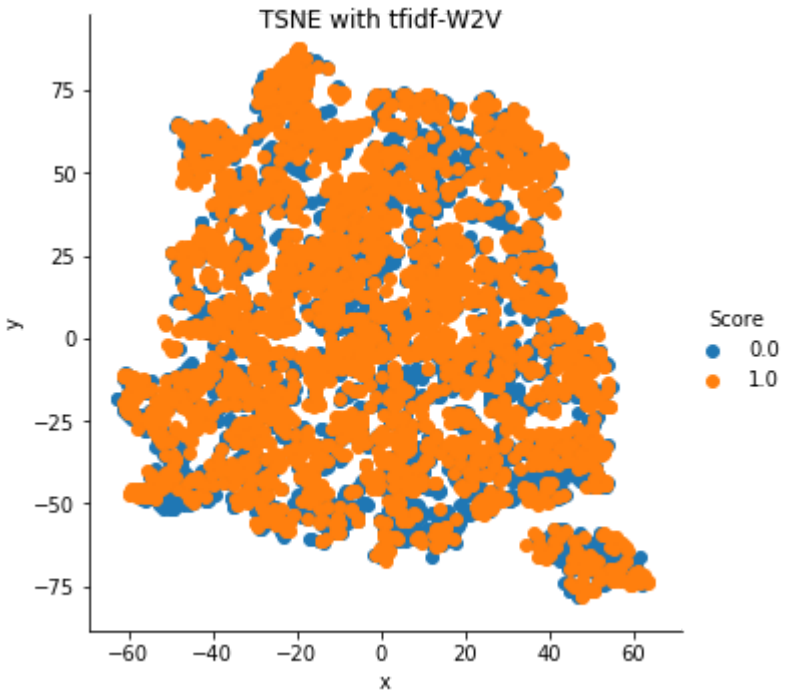
```
100%|██████████| 5873/5873 [00:59<00:00, 98.94it/s]
```

In [96]:
```
print(tfidf_sent_vectors[0:1])
```

```
[array([ 0.13974505, -0.55714064,  0.46484216, -0.22281855,  0.13737088,
       -0.34302053,  0.43661114,  0.00430282, -0.3376963 ,  0.03347259,
        0.29675686, -0.25173992, -0.05566038, -0.24536326,  0.02151735,
       -0.07293872,  0.34343102,  0.49180235,  0.07343349, -0.20915471,
       -0.00986948,  0.06860271,  0.14925795, -0.22424151, -0.33002456,
        0.0817408 ,  0.56608569,  0.23630838, -0.00252105, -0.05884005,
        0.10677823, -0.27940819,  0.46686405,  0.01556381, -0.37600343,
        0.31724785, -0.20182131,  0.23008624, -0.49810311,  0.4576221 ,
        0.0361226 , -0.07244837,  0.23355375, -0.1971585 ,  0.35185873,
        0.34700864,  0.30291627, -0.05453237,  0.23134542,  0.36313557])]
```

In [97]:
```
import time
start = time.time()
from sklearn.manifold import TSNE
model=TSNE(n_components=2,random_state=0)
X_embedding=model.fit_transform(tfidf_sent_vectors)
#Applied AI learning
tsne_data=np.vstack((X_embedding.T,final['Score'])).T
for_tsne_df = pd.DataFrame(data=tsne_data, columns=['x','y','Score'])
g=sns.FacetGrid(for_tsne_df,hue='Score',height=5).map(plt.scatter,'x','y').add_le
#https://stackoverflow.com/questions/29813694/how-to-add-a-title-to-seaborn-facet
g.fig.suptitle('TSNE with tfidf-W2V')
#print(for_tsne_df[1:20])
end = time.time()
print(end - start)
```

```
81.7252299785614
```



1)With BOW Implementation, we are not able to seperate the Positive and Negative points. 2)With

TF-IDF Implementation, we are not able to seperate the Positive and Negative points. 3)With Avg Weighted W2V Implementation we are not able to seperate the Positive and Negative points. 4)With TF-IDF weighted W2V Implementation we are not able to seperate the Positive and Negative points.

Conclusion:

By using TSNE we are not able to differentiate the positive and negative points and need to use other enhanced techniques for more understandings on the Data