[1]. Loading the Data

In [2]:

```
import sqlite3
import pandas as pd

con = sqlite3.connect('database.sqlite')
filtered_data = pd.read_sql_query("""Select * from Reviews where Score !=3""",con)
print(filtered_data['Score'].value_counts())
```

```
5    363122
4     80655
1     52268
2     29769
Name: Score, dtype: int64
```

[1.1]. Display first 5 rows

In [3]:

```
filtered_data.head(5)
```

Out[3]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	5	130386240(
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	1	134697600(
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	4	121901760(
3	4	B000UA0QIQ	A395BORC6FGVXV	Karl	3	3	2	130792320(
4	5	B006K2ZZ7K	A1UQRSCLF8GW1T	Michael D. Bigham "M. Wassir"	0	0	5	135077760(

2. Exploratory Data Analysis

[2.1]. Deduplication

In [4]:

```
sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inplace=False, kind='quicksort', na_position='last')
final_data = sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"}, keep='first', inplace=False)
print(final_data.shape)
```

```
(364173, 10)
```

[2.2]. Remove HelpfulnessNumerator > HelpfulnessDenominator rows

In [5]:

```
final_data=final_data[final_data.HelpfulnessNumerator<=final_data.HelpfulnessDenominator]
print(final_data.shape)
```

```
(364171, 10)
```

In [6]:

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

Out[6]:

```
69.25852107399194
```

[2.3] Partition Score as +ve and -ve classes

In [7]:

```
def partition(x):
    if x > 3:
        return 1
    return 0

score = final_data['Score']
converted_scores = score.map(partition)
final_data['Score'] = converted_scores
print(final_data['Score'].value_counts())
```

```
1    307061
0     57110
Name: Score, dtype: int64
```

3. Text Preprocessing

In [8]:

```
# source : Amazon Fine Food Reviews Analysis.ipynb
import nltk
from nltk.corpus import stopwords
import os
from tqdm import tqdm
import re

stop = set(stopwords.words('english'))
snowballstemmer = nltk.stem.SnowballStemmer('english')
```

```
def cleanhtml(sentence):
    cleanr = re.compile('<.*?>')
    cleantext = re.sub(cleanr, ' ', sentence)
    return cleantext
def cleanpunc(sentence):
    cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
    cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
    return  cleaned


if not os.path.isfile('final_data.sqlite'):
    final_string=[]
    for i, sent in enumerate(tqdm(final_data['Text'].values)):
        filtered_sentence=[]
        sent=cleanhtml(sent)
        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=(snowballstemmer.stem(cleaned_words.lower())).encode('utf8')
                        filtered_sentence.append(s)
        str1 = b" ".join(filtered_sentence)
        final_string.append(str1)
    final_data['CleanedText']=final_string
    final_data['CleanedText']=final_data['CleanedText'].str.decode("utf-8")
```

```
100%|██████████████████████████████████████████████████████████████████████████| 364171/364171
[07:40<00:00, 790.36it/s]
```

In [10]:

```
final_data['Score'].value_counts()
```

Out[10]:

```
1    307061
0     57110
Name: Score, dtype: int64
```

4. Text to Vector

[4.1] Bag Of Words

In [11]:

```
# source : Amazon Fine Food Reviews Analysis.ipynb
# BOW
from sklearn.feature_extraction.text import CountVectorizer
count_vect = CountVectorizer()
bow = count_vect.fit_transform(final_data['CleanedText'].values)
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  (364171, 71624)
the number of unique words  71624
```

[4.2] TF-IDF

In [12]:

```
# source : Amazon Fine Food Reviews Analysis.ipynb
# TF-IDF
```

```
from sklearn.feature_extraction.text import TfidfVectorizer

tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
final_tf_idf = tf_idf_vect.fit_transform(final_data['CleanedText'].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  (364171, 2923725)
the number of unique words including both unigrams and bigrams  2923725
```

In [13]:

```
i=0
list_of_sent=[]
for sent in final_data['CleanedText'].values:
    list_of_sent.append(sent.split())

print(final_data['CleanedText'].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
india droop love new word book introduc silli classic book will bet son still abl recit memori col
leg
**********************************************************************
['witti', 'littl', 'book', 'make', 'son', 'laugh', 'loud', 'recit', 'car', 'drive', 'along', 'alwa
y', 'sing', 'refrain', 'hes', 'learn', 'whale', 'india', 'droop', 'love', 'new', 'word', 'book', '
introduc', 'silli', 'classic', 'book', 'will', 'bet', 'son', 'still', 'abl', 'recit', 'memori', 'c
olleg']
```

In [14]:

```
from gensim.models import Word2Vec
# min_count = 5 considers only words that occured atleast 5 times
w2v_model=Word2Vec(list_of_sent,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])
```

```
C:\Users\sanjeev\Anaconda3\lib\site-packages\gensim\utils.py:1212: UserWarning: detected Windows;
aliasing chunkize to chunkize_serial
  warnings.warn("detected Windows; aliasing chunkize to chunkize_serial")
```

```
number of words that occured minimum 5 times  21938
sample words  ['witti', 'littl', 'book', 'make', 'son', 'laugh', 'loud', 'recit', 'car', 'drive',
'along', 'alway', 'sing', 'refrain', 'hes', 'learn', 'whale', 'india', 'droop', 'love', 'new', 'wo
rd', 'introduc', 'silli', 'classic', 'will', 'bet', 'still', 'abl', 'memori', 'colleg', 'grew', 'r
ead', 'sendak', 'watch', 'realli', 'rosi', 'movi', 'incorpor', 'howev', 'miss', 'hard', 'cover', '
version', 'paperback', 'seem', 'kind', 'flimsi', 'take', 'two']
```

[4.3] Average Word2Vec

In [15]:

```
# source : Amazon Fine Food Reviews Analysis.ipynb
# average Word2Vec
# compute average word2vec for each review.
import numpy as np
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%|████████████████████████████████████████████████████████████| 364171/364171
[16:08<00:00, 376.17it/s]
```

```
364171
50
```

In [16]:

```
model = TfidfVectorizer()
tf_idf_matrix = model.fit_transform(final_data['CleanedText'].values)
dictionary = dict(zip(model.get_feature_names(), list(model.idf_)))
```

In [36]:

```
tf_idf_matrix.shape
type(tf_idf_matrix)
```

Out[36]:

```
scipy.sparse.csr.csr_matrix
```

[4.4] TF-IDF weighted Word2Vec

In [17]:

```
# source : Amazon Fine Food Reviews Analysis.ipynb
# 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 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%|████████████████████████████████████████████████████████████| 364171/364171
[17:30<00:00, 346.79it/s]
```

Taking 3000 data points from each W2V technique

In [37]:

```
bow_data = bow[:3000].todense()
print(bow_data.shape)

tf_idf_data = tf_idf_matrix[:3000].todense()
print(tf_idf_data.shape)
```

```
avg_w2v = np.array(sent_vectors[:3000])
print(avg_w2v.shape)

tfidf_wv = np.array(tfidf_sent_vectors[:3000])
print(tfidf_wv.shape)
```

```
(3000, 71624)
(3000, 71624)
(3000, 50)
(3000, 50)
```

In [23]:

```
scores = final_data['Score']
scores.shape

scores_3000 = scores[:3000]
```

5. Apply t-SNE

[5.1] Apply t-SNE on BoW

In [24]:

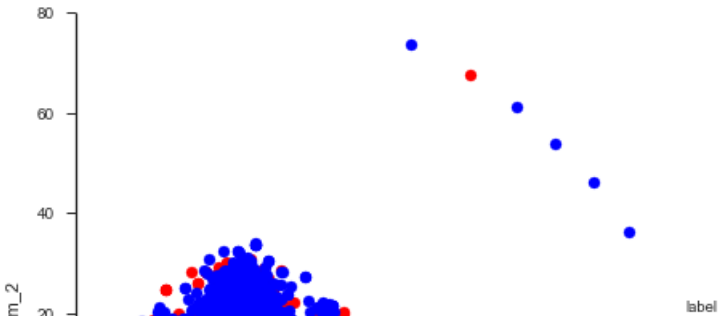
```
from sklearn.manifold import TSNE

model = TSNE(n_components=2, random_state=0)
bow_tsne_data = model.fit_transform(bow_data)
print(bow_tsne_data.shape)

bow_tsne_label_data = np.vstack((bow_tsne_data.T,scores_3000)).T
```

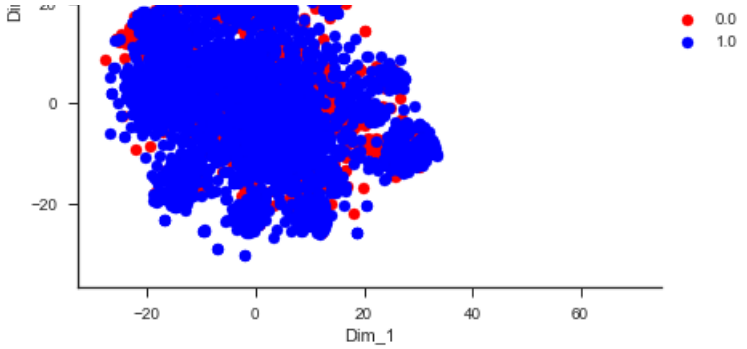
```
(3000, 2)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-24-ceb4473612f7> in <module>()
      6
      7 bow_tsne_label_data = np.vstack((bow_tsne_data.T,scores_3000)).T
----> 8 print(tsne_label_data.shape)

NameError: name 'tsne_label_data' is not defined
```

In [35]:

```
import seaborn as sn
import matplotlib.pyplot as plt

dataFrame = pd.DataFrame(data=bow_tsne_label_data, columns=("Dim_1", "Dim_2", "label"))
sn.set_style('ticks')
d = {'color': ['r', 'b']}
sn.FacetGrid(dataFrame,hue_kws = d,hue="label",size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_legen
d()
plt.show()
```



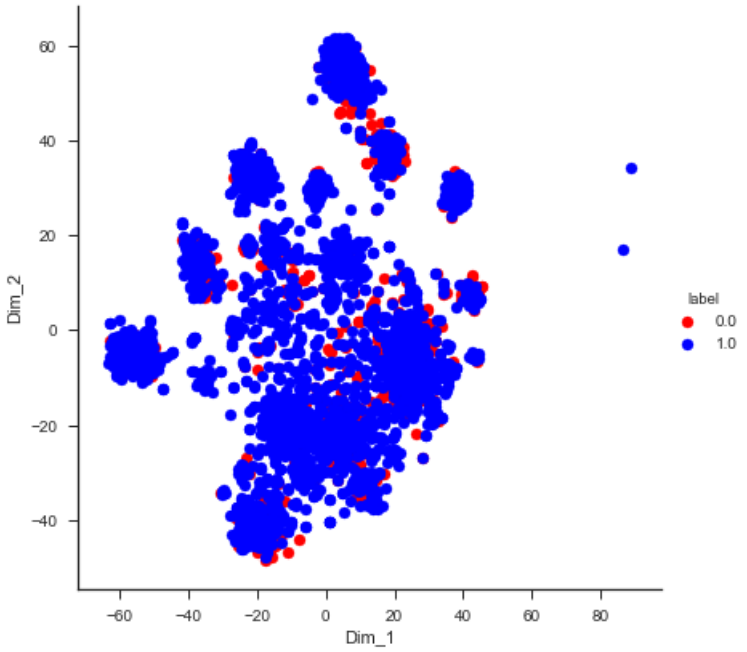


[5.2] Apply t-SNE on TF-IDF

In [36]:

```
tf_idf_tsne_data = model.fit_transform(tf_idf_data)
print(tf_idf_tsne_data.shape)

tf_idf_tsne_label_data = np.vstack((tf_idf_tsne_data.T,scores_3000)).T
print(tf_idf_tsne_label_data.shape)

dataFrame = pd.DataFrame(data=tf_idf_tsne_label_data, columns=("Dim_1", "Dim_2", "label"))
sn.set_style('ticks')
sn.FacetGrid(dataFrame,hue_kws = d, hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_leg
end()
plt.show()
```

```
(3000, 2)
(3000, 3)
```



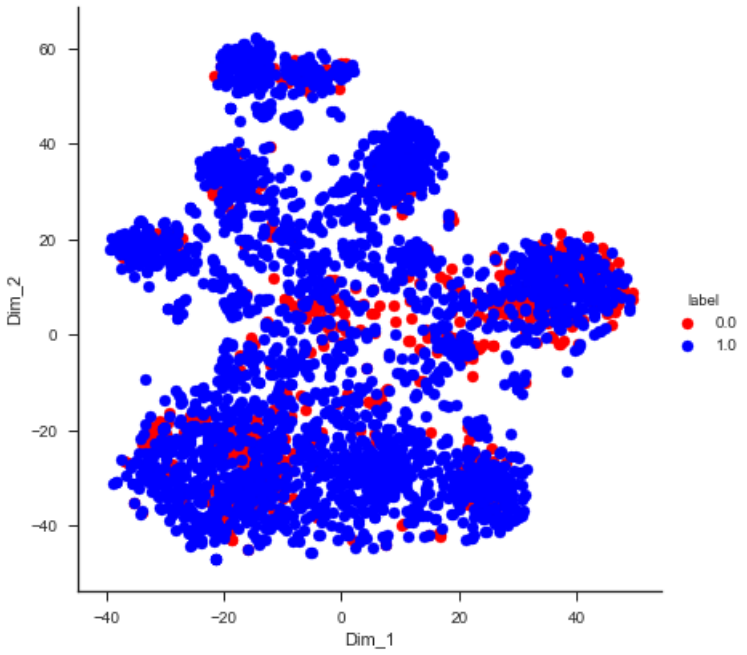
[5.3] Apply t-SNE on Avgearge W2V

In [39]:

```
avg_w2v_tsne_data = model.fit_transform(avg_w2v)
print(avg_w2v_tsne_data.shape)

avg_w2v_tsne_label_data = np.vstack((avg_w2v_tsne_data.T,scores_3000)).T
print(avg_w2v_tsne_label_data.shape)

dataFrame = pd.DataFrame(data=avg_w2v_tsne_label_data, columns=("Dim_1", "Dim_2", "label"))
sn.set_style('ticks')
```

```
sn.FacetGrid(dataFrame, hue_kws = d,hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_leg
end()
plt.show()
```

```
(3000, 2)
(3000, 3)
```

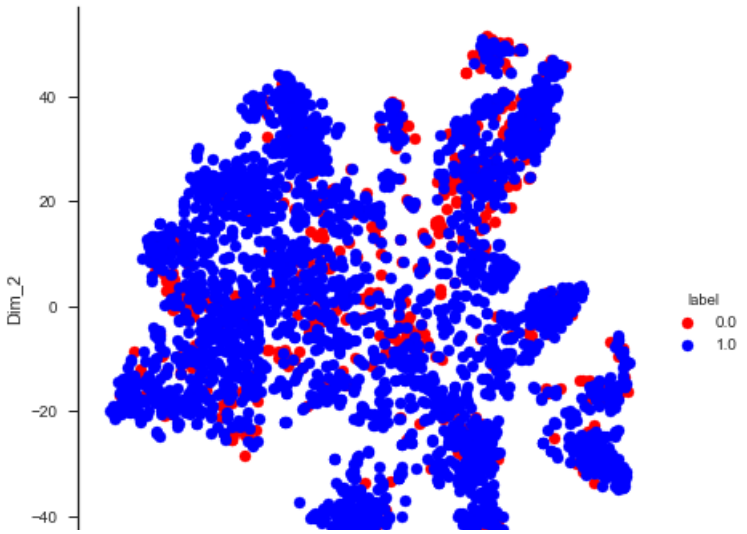


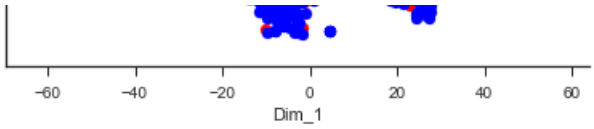
[5.4] Apply t-SNE on TF-IDF weighted Word2Vec

In [40]:

```
tfidf_wv_tsne_data = model.fit_transform(tfidf_wv)
print(tfidf_wv_tsne_data.shape)

tfidf_wv_tsne_label_data = np.vstack((tfidf_wv_tsne_data.T,scores_3000)).T
print(tfidf_wv_tsne_label_data.shape)

dataFrame = pd.DataFrame(data=tfidf_wv_tsne_label_data, columns=("Dim_1", "Dim_2", "label"))
sn.set_style('ticks')
sn.FacetGrid(dataFrame, hue_kws = d,hue="label", size=6).map(plt.scatter, 'Dim_1', 'Dim_2').add_leg
end()
plt.show()
```

```
(3000, 2)
(3000, 3)
```





6. Conclusion

1. With 3000 data points, most of the points are overlapped in BoW t-SNE plot.
2. With 3000 data points, most of the points are overlapped in TF-IDF t-SNE plot.
3. With 3000 data points, most of the points are overlapped in average Word2Vec t-SNE plot.
4. With 3000 data points, most of the points are overlapped in TF-IDF weighted Word2Vec t-SNE plot.

7. Reference

1. Most of the above code snippets are referred from AAIC 'Amazon Fine Food Reviews Analysis.ipynb'