Amazon Fine Food Reviews Analysis

Data Source: https://www.kaggle.com/snap/amazon-fine-food-reviews

EDA: https://nycdatascience.com/blog/student-works/amazon-fine-foods-visualization/

The Amazon Fine Food Reviews dataset consists of reviews of fine foods from Amazon.

Number of reviews: 568,454
Number of users: 256,059
Number of products: 74,258
Timespan: Oct 1999 - Oct 2012
Number of Attributes/Columns in data: 10

Attribute Information:

1. Id
2. ProductId - unique identifier for the product
3. UserId - unqiue identifier for the user
4. ProfileName
5. HelpfulnessNumerator - number of users who found the review helpful
6. HelpfulnessDenominator - number of users who indicated whether they found the review helpful or not
7. Score - rating between 1 and 5
8. Time - timestamp for the review
9. Summary - brief summary of the review
10. Text - text of the review

Objective:

Given a review, determine whether the review is positive (Rating of 4 or 5) or negative (rating of 1 or 2).

[Q] How to determine if a review is positive or negative?

[Ans] We could use the Score/Rating. A rating of 4 or 5 could be cosnidered a positive review. A review of 1 or 2 could be considered negative. A review of 3 is nuetral and ignored. This is an approximate and proxy way of determining the polarity (positivity/negativity) of a review.

```
from scipy.sparse import csr_matrix

lst = [1, 2, 3, 4, 5, 6, 7]

ans = sparse.csr_matrix(lst)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-2-51e1a92f6585> in <module>()
      3 lst = [1, 2, 3, 4, 5, 6, 7]
      4 
----> 5 ans = sparse.csr_matrix(lst)

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

SEARCH STACK OVERFLOW

```
from google.colab import drive
drive.mount('/content/drive/')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.a

Enter your authorization code:
··········
Mounted at /content/drive/
```

Loading the data

The dataset is available in two forms

1. .csv file

2. SQLite Database

In order to load the data, We have used the SQLITE dataset as it easier to query the data and visualise the data efficiently.

Here as we only want to get the global sentiment of the recommendations (positive or negative), we will purposefully ignore all Scores equal to 3. If the score id above 3, then the recommendation wil be set to "positive". Otherwise, it will be set to "negative".

```
%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
```

[1]. Reading Data

```
# using the SQLite Table to read data.
con = sqlite3.connect("/content/drive/My Drive/colab folder/Datasets/amazon-fine-food-reviews/database.sqlite")
#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 points
# you can change the number to any other number based on your computing power

# filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3 LIMIT 500000""", con)
# for tsne assignment you can take 5k data points

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)
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	S
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1	1	1303862400	D
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	0	0	1346976000	Ac
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	1	1	1219017600	" s

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

```
print(display.shape)
display.head()
```

```
(80668, 7)
```

	UserId	ProductId	ProfileName	Time	Score	Text	COUNT(
0	#oc-R115TNMSPFT9I7	B007Y59HVM	Breyton	1331510400	2	Overall its just OK when considering the price...	
1	#oc-R11D9D7SHXIJB9	B005HG9ET0	Louis E. Emory "hoppy"	1342396800	5	My wife has recurring extreme muscle spasms, u...	
2	#oc-R11DNU2NBKQ23Z	B007Y59HVM	Kim Cieszykowski	1348531200	1	This coffee is horrible and unfortunately not ...	
3	#oc-R11O5J5ZVQE25C	B005HG9ET0	Penguin Chick	1346889600	5	This will be the bottle that you grab from the...	
4	#oc-R12KPBODL2B5ZD	B007OSBE1U	Christopher P. Presta	1348617600	1	I didnt like this coffee. Instead of telling y...	

```
display[display['UserId']=='AZY10LLTJ71NX']
```

	UserId	ProductId	ProfileName	Time	Score	Text	COUN
80638	AZY10LLTJ71NX	B006P7E5ZI	undertheshrine "undertheshrine"	1334707200	5	I was recommended to try green tea extract to ...	

```
display['COUNT(*)'].sum()
```

```
393063
```

Exploratory Data Analysis

[2] Data Cleaning: Deduplication

It is observed (as shown in the table below) that the reviews data had many duplicate entries. Hence it was necessary to remove duplicates in order to get unbiased results for the analysis of the data. Following is an example:

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

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Su
0	78445	B000HDL1RQ	AR5J8UI46CURR	Geetha Krishnan	2	2	5	1199577600	LOA QUADI VA WA
1	138317	B000HDOPYC	AR5J8UI46CURR	Geetha Krishnan	2	2	5	1199577600	LOA QUADI VA WA
2	138277	B000HDOPYM	AR5J8UI46CURR	Geetha Krishnan	2	2	5	1199577600	LOA QUADI VA WA
3	73791	B000HDOPZG	AR5J8UI46CURR	Geetha Krishnan	2	2	5	1199577600	LOA QUADI VA WA
4	155049	B000PAQ75C	AR5J8UI46CURR	Geetha Krishnan	2	2	5	1199577600	LOA QUADI VA WA

As can be seen above the same user has multiple reviews of the with the same values for HelpfulnessNumerator, HelpfulnessDenominator, Score, Time, Summary and Text and on doing analysis it was found that

ProductId=B000HDOPZG was Loacker Quadratini Vanilla Wafer Cookies, 8.82-Ounce Packages (Pack of 8)

ProductId=B000HDL1RQ was Loacker Quadratini Lemon Wafer Cookies, 8.82-Ounce Packages (Pack of 8) and so on

It was inferred after analysis that reviews with same parameters other than ProductId belonged to the same product just having different flavour or quantity. Hence in order to reduce redundancy it was decided to eliminate the rows having same parameters.

The method used for the same was that we first sort the data according to ProductId and then just keep the first similar product review and delelte the others. for eg. in the above just the review for ProductId=B000HDL1RQ remains. This method ensures that there is only one representative for each product and deduplication without sorting would lead to possibility of different representatives still existing for the same product.

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


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

```
(4986, 10)
```

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

```
99.72
```

Observation:- It was also seen that in two rows given below the value of HelpfulnessNumerator is greater than HelpfulnessDenominator which is not practically possible hence these two rows too are removed from calcualtions

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

display.head()
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	
0	64422	B000MIDROQ	A161DK06JJMCYF	J. E. Stephens "Jeanne"	3	1	5	1224892800	Bou My Sor
1	44737	B001EQ55RW	A2V0I904FH7ABY	Ram	3	2	4	1212883200	Pure w alm

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

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

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

```
(4986, 10)
1    4178
0     808
Name: Score, dtype: int64
```

[3]. Text Preprocessing.

Now that we have finished deduplication our data requires some preprocessing before we go on further with analysis and making the prediction model.

Hence in the Preprocessing phase we do the following in the order below:-

1. Begin by removing the html tags
2. Remove any punctuations or limited set of special characters like , or . or # etc.
3. Check if the word is made up of english letters and is not alpha-numeric
4. Check to see if the length of the word is greater than 2 (as it was researched that there is no adjective in 2-letters)

5. Convert the word to lowercase
6. Remove Stopwords
7. Finally Snowball Stemming the word (it was obsereved to be better than Porter Stemming)

After which we collect the words used to describe positive and negative reviews

```
# printing some random reviews
sent_0 = final['Text'].values[0]
print(sent_0)
print("="*50)

sent_1000 = final['Text'].values[1000]
print(sent_1000)
print("="*50)

sent_1500 = final['Text'].values[1500]
print(sent_1500)
print("="*50)

sent_4900 = final['Text'].values[4900]
print(sent_4900)
print("="*50)
```

```
Why is this $[...] when the same product is available for $[...] here?<br />http://www.amazon.com/VICTOR-FLY-MAGNET-BAIT-REFILL/
==================================================
I recently tried this flavor/brand and was surprised at how delicious these chips are.  The best thing was that there were a lot
==================================================
Wow.  So far, two two-star reviews.  One obviously had no idea what they were ordering; the other wants crispy cookies.  Hey, I
==================================================
love to order my coffee on amazon.  easy and shows up quickly.<br />This k cup is great coffee.  dcaf is very good as well
==================================================
```

```
# remove urls from text python: https://stackoverflow.com/a/40823105/4084039
sent_0 = re.sub(r"http\S+", "", sent_0)
sent_1000 = re.sub(r"http\S+", "", sent_1000)
```

```
sent_150 = re.sub(r"http\S+", "", sent_1500)
sent_4900 = re.sub(r"http\S+", "", sent_4900)

print(sent_0)
```

```
Why is this $[...] when the same product is available for $[...] here?<br /> /><br />The Victor M380 and M502 traps are unreal,
```

```
# https://stackoverflow.com/questions/16206380/python-beautifulsoup-how-to-remove-all-tags-from-an-element
from bs4 import BeautifulSoup

soup = BeautifulSoup(sent_0, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1000, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1500, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_4900, 'lxml')
text = soup.get_text()
print(text)
```

```
# https://stackoverflow.com/a/47091490/4084039
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


sent_1500 = decontracted(sent_1500)
print(sent_1500)
print("="*50)
```

```
Wow.  So far, two two-star reviews.  One obviously had no idea what they were ordering; the other wants crispy cookies.  Hey, I
==================================================
```

```
#remove words with numbers python: https://stackoverflow.com/a/18082370/4084039
sent_0 = re.sub("\S*\d\S*", "", sent_0).strip()
print(sent_0)
```

```
Why is this $[...] when the same product is available for $[...] here?<br /> /><br />The Victor  and  traps are unreal, of cours
```

```
#remove spacial character: https://stackoverflow.com/a/5843547/4084039
```

```
sent_1500 = re.sub('[^A-Za-z0-9]+', ' ', sent_1500)
print(sent_1500)
```

```
Wow So far two two star reviews One obviously had no idea what they were ordering the other wants crispy cookies Hey I am sorry
```

```
# 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 step

stopwords= set(['br', 'the', 'i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them', 'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll", 'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having', 'do', 'does', \
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', 'while', 'of', \
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during', 'before', 'after',\
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'further',\
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'each', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll', 'm', 'o', 're', \
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't", 'mustn',\
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn', "wasn't", 'weren', "weren't", \
            'won', "won't", 'wouldn', "wouldn't"])

# Combining all the above stundents
from tqdm import tqdm
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, 'lxml').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 stopwords)
    preprocessed_reviews.append(sentance.strip())
```

```
100%|██████████| 4986/4986 [00:01<00:00, 3253.39it/s]
```

```
preprocessed_reviews[1500]
```

```
'wow far two two star reviews one obviously no idea ordering wants crispy cookies hey sorry reviews nobody good beyond reminding
```

[3.2] Preprocess Summary

```
## Similartly you can do preprocessing for review summary also.
```

[4] Featurization

[4.1] BAG OF WORDS

```
#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', 'abandon', 'abates', 'abbott', 'abby', 'abdominal', 'abiding', 'ability']
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 12997)
the number of unique words  12997
```

[4.2] Bi-Grams and n-Grams.

```
#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/modules/generated/sklearn.feature_extraction.text.C
# 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)
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_bigram_counts.get_shape()[1])
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 3144)
the number of unique words including both unigrams and bigrams  3144
```

[4.3] TF-IDF

```
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_names()[0:10])
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_tf_idf.get_shape()[1])
```

```
some sample features(unique words in the corpus) ['ability', 'able', 'able find', 'able get', 'absolute', 'absolutely', 'absolut
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (4986, 3144)
the number of unique words including both unigrams and bigrams  3144
```

[4.4] Word2Vec

```
# Train your own Word2Vec model using your own text corpus
i=0
list_of_sentance=[]
for sentance in preprocessed_reviews:
    list_of_sentance.append(sentance.split())


# Using Google News Word2Vectors

# in this project we are using a pretrained model by google
# its 3.3G file, once you load this into your memory
# it occupies ~9Gb, so please do this step only if you have >12G of ram
# we will provide a pickle file wich contains a dict ,
# and it contains all our courpus words as keys and  model[word] as values
# To use this code-snippet, download "GoogleNews-vectors-negative300.bin"
# from https://drive.google.com/file/d/0B7XkCwpI5KDYNlNUTTlSS21pQmM/edit
# it's 1.9GB in size.


# http://kavita-ganesan.com/gensim-word2vec-tutorial-starter-code/#.W17SRFAzZPY
# you can comment this whole cell
# or change these varible according to your need

is_your_ram_gt_16g=False
want_to_use_google_w2v = False
```

```
want_to_use_google_w2v = False
want_to_train_w2v = True

if want_to_train_w2v:
    # min_count = 5 considers only words that occured atleast 5 times
    w2v_model=Word2Vec(list_of_sentance,min_count=5,size=50, workers=4)
    print(w2v_model.wv.most_similar('great'))
    print('='*50)
    print(w2v_model.wv.most_similar('worst'))

elif want_to_use_google_w2v and is_your_ram_gt_16g:
    if os.path.isfile('GoogleNews-vectors-negative300.bin'):
        w2v_model=KeyedVectors.load_word2vec_format('GoogleNews-vectors-negative300.bin', binary=True)
        print(w2v_model.wv.most_similar('great'))
        print(w2v_model.wv.most_similar('worst'))
    else:
        print("you don't have gogole's word2vec file, keep want_to_train_w2v = True, to train your own w2v ")
```

```
[('alternative', 0.9954606294631958), ('though', 0.9953978061676025), ('especially', 0.9953963756561279), ('overall', 0.99482387
==================================================
[('awful', 0.9995988607406616), ('gold', 0.9995235204696655), ('wow', 0.9995198845863342), ('yes', 0.999491810798645), ('normal
```

```
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  3817
sample words  ['product', 'available', 'course', 'total', 'pretty', 'stinky', 'right', 'nearby', 'used', 'ca', 'not', 'beat', 'g
```

[4.4.1] Converting text into vectors using wAvg W2V, TFIDF-W2V

[4.4.1.1] Avg W2v

```
# 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 length 50, you might need to change this to 300 if you use google's w2v
    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 [00:03<00:00, 1467.74it/s]4986
50
```

[4.4.1.2] TFIDF weighted W2v

```
# 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_)))
```

```
# 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_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%|██████████| 4986/4986 [00:22<00:00, 222.68it/s]
```

[5] Applying TSNE

1. you need to plot 4 tsne plots with each of these feature set
    1. Review text, preprocessed one converted into vectors using (BOW)
    2. Review text, preprocessed one converted into vectors using (TFIDF)
    3. Review text, preprocessed one converted into vectors using (AVG W2v)
    4. Review text, preprocessed one converted into vectors using (TFIDF W2v)
2. Note 1: The TSNE accepts only dense matrices
3. Note 2: Consider only 5k to 6k data points

```
https://github.com/pavlin-policar/fastTSNE you can try this also, this version is little faster than sklearn
port numpy as np
om sklearn.manifold import TSNE
om sklearn import datasets
```

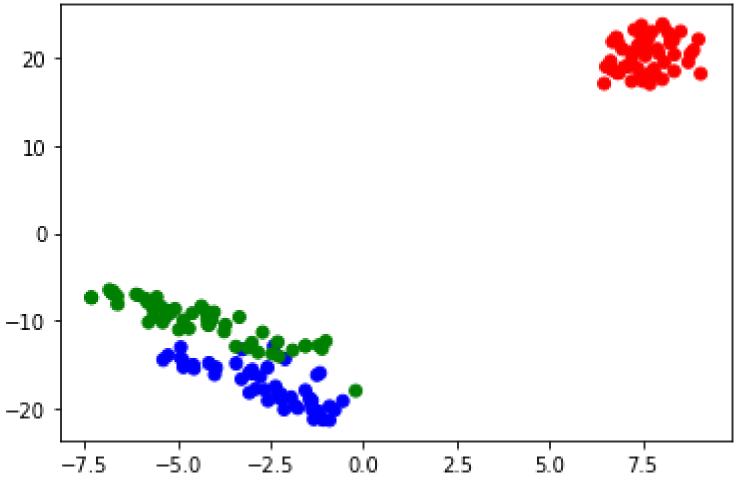
```
port pandas as pd
port matplotlib.pyplot as plt

is = datasets.load_iris()
= iris['data']
= iris['target']

ne = TSNE(n_components=2, perplexity=30, learning_rate=200)

embedding = tsne.fit_transform(x)
if x is a sparse matrix you need to pass it as X_embedding = tsne.fit_transform(x.toarray()) , .toarray() will convert the sparse mat

r_tsne = np.hstack((X_embedding, y.reshape(-1,1)))
r_tsne_df = pd.DataFrame(data=for_tsne, columns=['Dimension_x','Dimension_y','Score'])
lors = {0:'red', 1:'blue', 2:'green'}
t.scatter(for_tsne_df['Dimension_x'], for_tsne_df['Dimension_y'], c=for_tsne_df['Score'].apply(lambda x: colors[x]))
t.show()
```




```
print(y.shape)
print(y.ndim)
print(x.ndim)
z=y.reshape(-1,1)
z.shape
```

```
(150,)
1
2
(150, 1)
```

```
print(y.shape)
print(type(y))
print(x.shape)
k=np.vstack((x.T,y.T)).T
k_df=pd.DataFrame(k,columns=["col1","col2","col3","col4","col5"])
k_df.head()
```

```
(150,)
<class 'numpy.ndarray'>
(150, 4)
```

	col1	col2	col3	col4	col5
0	5.1	3.5	1.4	0.2	0.0
1	4.9	3.0	1.4	0.2	0.0
2	4.7	3.2	1.3	0.2	0.0
3	4.6	3.1	1.5	0.2	0.0
4	5.0	3.6	1.4	0.2	0.0

[5.1] Applying TNSE on Text BOW vectors

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
count_bow=CountVectorizer().fit(preprocessed_reviews)
```

```
count_bow=CountVectorizer().fit(preprocessed_reviews)
print(type(count_bow.get_feature_names()))
label_col=count_bow.get_feature_names()
print(len(label_col))
value=count_bow.transform(preprocessed_reviews)
print(type(value))
print(value.shape)
```

```
<class 'list'>
12997
<class 'scipy.sparse.csr.csr_matrix'>
(4986, 12997)
```

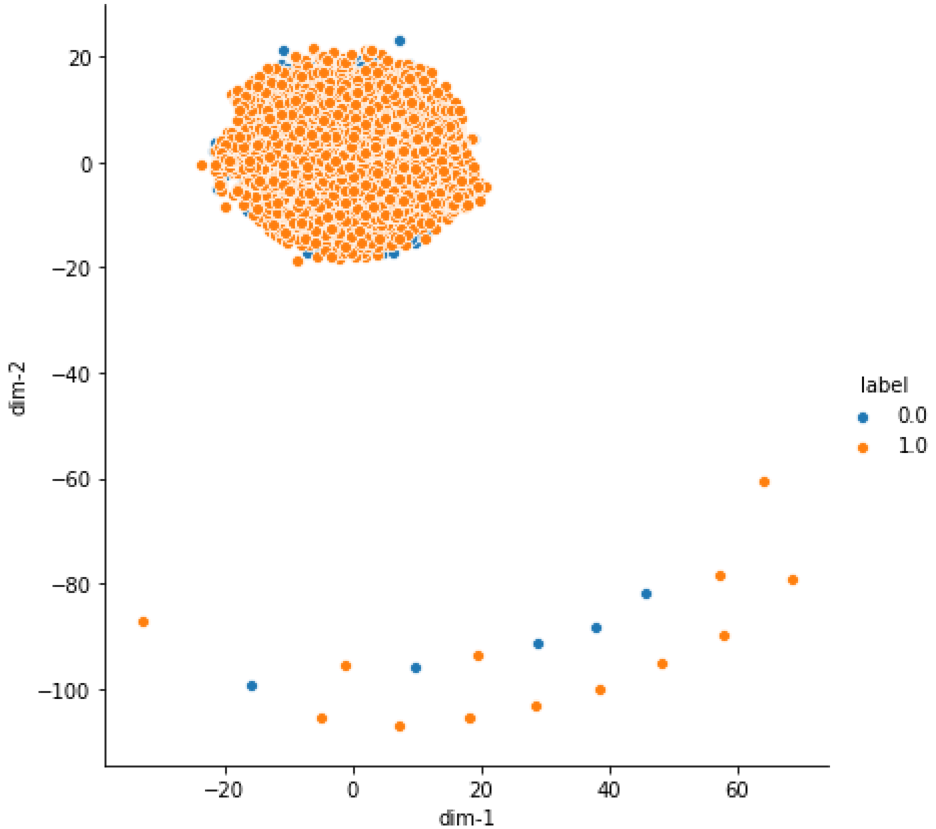
```
  tsne=TSNE(n_components=2,perplexity=30.0,learning_rate=200,n_iter=1500)
  x_emb=tsne.fit_transform(value.toarray())
  #x_data=np.vstack((x_emb.T,label)).T
```

```
print(x_emb.shape)
print(final.Score.shape)
x_data=np.vstack((x_emb.T,final.Score))
y_data=np.vstack((x_emb.T,final.Score.T))
print(x_data.shape)
y_data.shape
```

```
(4986, 2)
(4986,)
(3, 4986)
(3, 4986)
```

```
def use_tsne(data,label):
  tsne=TSNE(n_components=2,perplexity=30.0,learning_rate=200,n_iter=1500)
  x_emb=tsne.fit_transform(data.toarray())
  x_data=np.vstack((x_emb.T,label)).T
  tsne_df=pd.DataFrame(data=x_data,columns=["dim-1","dim-2","label"])
  sns.FacetGrid(tsne_df,hue="label",size=6).map(sns.scatterplot,"dim-1","dim-2").add_legend()
  plt.show()
```

```
%%time
use_tsne(value,final.Score)
```




```
CPU times: user 13min 37s, sys: 882 ms, total: 13min 38s
Wall time: 12min 21s
```

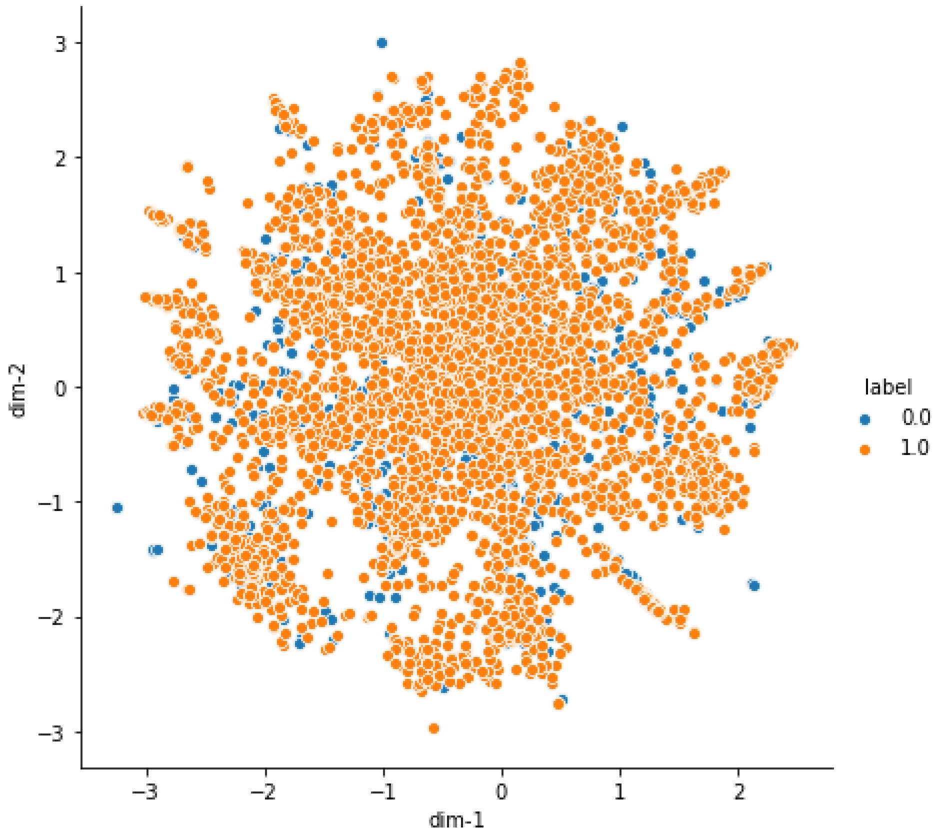
[5.2] Applying TNSE on Text TFIDF vectors

```
%%time
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label

tfidf=TfidfVectorizer().fit_transform(preprocessed_reviews)
```

```
CPU times: user 164 ms, sys: 1.99 ms, total: 166 ms
Wall time: 170 ms
```

```
%%time
use_tsne(tfidf,final.Score)
```

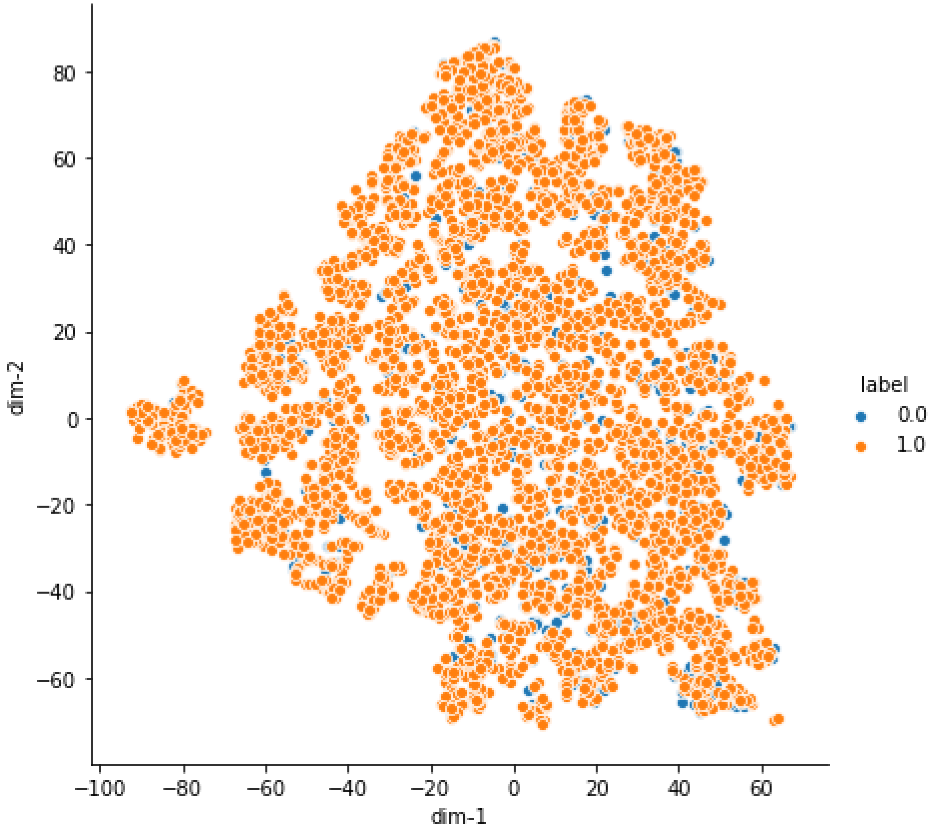



```
CPU times: user 12min 41s, sys: 291 ms, total: 12min 41s
Wall time: 11min 54s
```

[5.3] Applying TNSE on Text Avg W2V vectors

```
%%time
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
    # d. Y-axis label
```

```
tsne=TSNE(n_components=2,perplexity=30.0,learning_rate=200,n_iter=1500)
x_emb=tsne.fit_transform(sent_vectors)
x_data=np.vstack((x_emb.T,final.Score)).T
tsne_df=pd.DataFrame(data=x_data,columns=["dim-1","dim-2","label"])
sns.FacetGrid(tsne_df,hue="label",size=6).map(sns.scatterplot,"dim-1","dim-2").add_legend()
plt.show()
```




```
CPU times: user 1min 33s, sys: 273 ms, total: 1min 33s
Wall time: 47.9 s
```

```
%%time
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
```

```
        # c. X-axis label
        # d. Y-axis label
    def display_closestwords_tsnescatterplot(model, word):

        arr = np.empty((0,300), dtype='f')
        word_labels = [word]

        # get close words
        close_words = model.similar_by_word(word)

        # add the vector for each of the closest words to the array
        arr = np.append(arr, np.array([model[word]]), axis=0)
        for wrd_score in close_words:
            wrd_vector = model[wrd_score[0]]
            word_labels.append(wrd_score[0])
            arr = np.append(arr, np.array([wrd_vector]), axis=0)

        # find tsne coords for 2 dimensions
        tsne = TSNE(n_components=2, random_state=0)
        np.set_printoptions(suppress=True)
        Y = tsne.fit_transform(arr)

        x_coords = Y[:, 0]
        y_coords = Y[:, 1]
        # display scatter plot
        plt.scatter(x_coords, y_coords)

        for label, x, y in zip(word_labels, x_coords, y_coords):
            plt.annotate(label, xy=(x, y), xytext=(0, 0), textcoords='offset points')
        plt.xlim(x_coords.min()+0.00005, x_coords.max()+0.00005)
        plt.ylim(y_coords.min()+0.00005, y_coords.max()+0.00005)
        plt.show()
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-130-a260b3373fd5> in <module>()
----> 1 get_ipython().run_cell_magic('time', '', '# please write all the code with proper documentation, and proper titles for e

6 frames
</usr/local/lib/python3.6/dist-packages/decorator.py:decorator-gen-60> in time(self, line, cell, local_ns)

<timed exec> in <module>()

/usr/local/lib/python3.6/dist-packages/numpy/core/_asarray.py in asarray(a, dtype, order)
     83
     84     """
---> 85     return array(a, dtype, copy=False, order=order)
     86
     87

ValueError: could not convert string to float: 'product'
```

SEARCH STACK OVERFLOW

```
print(type(w2v_model))
w2v_model
```

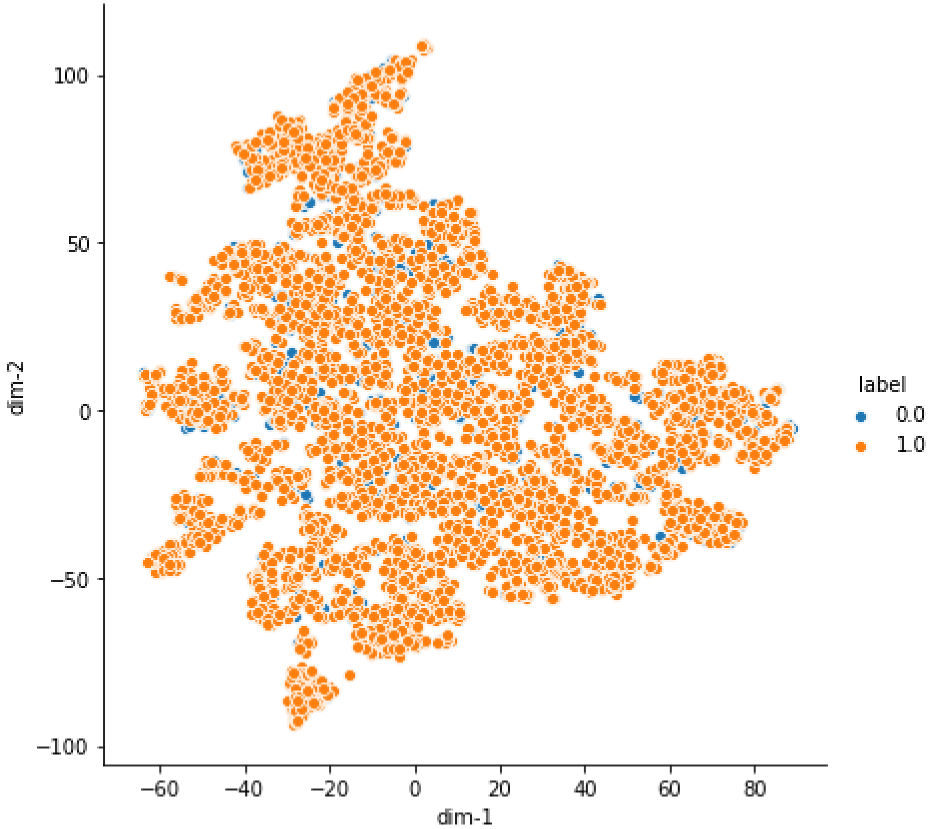
```
<class 'gensim.models.word2vec.Word2Vec'>
<gensim.models.word2vec.Word2Vec at 0x7f6723cc52e8>
```

[5.4] Applying TNSE on Text TFIDF weighted W2V vectors

```
# please write all the code with proper documentation, and proper titles for each subsection
# when you plot any graph make sure you use
    # a. Title, that describes your plot, this will be very helpful to the reader
    # b. Legends if needed
    # c. X-axis label
```

```
    # d. Y-axis label


tsne=TSNE(n_components=2,perplexity=30.0,learning_rate=200,n_iter=1500)
x_emb=tsne.fit_transform(tfidf_sent_vectors)
x_data=np.vstack((x_emb.T,final.Score)).T
tsne_df=pd.DataFrame(data=x_data,columns=["dim-1","dim-2","label"])
sns.FacetGrid(tsne_df,hue="label",size=6).map(sns.scatterplot,"dim-1","dim-2").add_legend()
plt.show()
```



[6] Conclusions

```
# Write few sentance about the results that you got and observation that you did from the analysis
```

```
sent_vectors1 = []; # the avg-w2v for each sentence/review is stored in this list
for sent in tqdm(list_of_sentance[0]): # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero length 50, you might need to change this to 300 if you use google's w2v
    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
            print(vec)
            print("="*50)
            print(sent_vec)
            print("="*50)
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors1.append(sent_vec)
```

```
100%|██████████| 13/13 [00:00<00:00, 145.32it/s][ 0.5113875   0.21962492  0.25483125  0.28397003 -0.13375011  0.05241313
 -0.45161933  0.2490815  -0.08682666 -0.14726564  0.09088904  0.6001517
  0.16238351 -0.26628125  0.44204584  0.4672331  -0.75576997 -0.36757976
 -0.01192469  0.0090513   0.3628863  -0.15826896 -0.04699279 -0.38199356
 -0.06076064  0.30613673  0.2130475  -0.75518423  0.05343331  0.22212219
  0.21384604 -0.1071032   0.28020394 -0.37541714 -0.16795602 -0.09425914
  0.0194863   0.16074978 -0.05816254 -0.03478634 -0.05703788 -0.15409091
 -0.21484493 -0.10515776  0.3346977  -0.26045436  0.07533501 -0.13279277
  0.0699793  -0.29880124]
==================================================
[ 0.51138753  0.21962492  0.25483125  0.28397003 -0.13375011  0.05241313
 -0.45161933  0.24908151 -0.08682666 -0.14726564  0.09088904  0.60015172
  0.16238351 -0.26628125  0.44204584  0.46723309 -0.75576997 -0.36757976
 -0.01192469  0.0090513   0.36288631 -0.15826896 -0.04699279 -0.38199356
 -0.06076064  0.30613673  0.2130475  -0.75518423  0.05343331  0.22212219
  0.21384604 -0.1071032   0.28020394 -0.37541714 -0.16795602 -0.09425914
  0.0194863   0.16074978 -0.05816254 -0.03478634 -0.05703788 -0.15409091
 -0.21484493 -0.10515776  0.33469769 -0.26045436  0.07533501 -0.13279277
  0.0699793  -0.29880124]
==================================================
[ 0.35505906  0.14429046  0.16819087  0.16904601 -0.09998723  0.03177129
 -0.3017963   0.17688072 -0.07448635 -0.09547119  0.06579737  0.39585605
  0.11994118 -0.18887135  0.29492623  0.3156937  -0.51739645 -0.25231472
 -0.0126832  -0.01003616  0.24637613 -0.1030957  -0.03979191 -0.26860073
 -0.04445962  0.19511545  0.15609726 -0.520052    0.02856261  0.1638592
  0.16282114 -0.07718397  0.17535917 -0.24904743 -0.10258224 -0.06118405
  0.00344139  0.10859454 -0.04392405 -0.0211028  -0.04574285 -0.10774794
 -0.14830989 -0.07921112  0.23475486 -0.17713717  0.04542988 -0.08229213
  0.04712066 -0.19913916]
==================================================
[ 8.66446584e-01  3.63915384e-01  4.23022121e-01  4.53016043e-01
 -2.33737342e-01  8.41844231e-02 -7.53415614e-01  4.25962225e-01
 -1.61313005e-01 -2.42736831e-01  1.56686403e-01  9.96007770e-01
  2.82324694e-01 -4.55152601e-01  7.36972064e-01  7.82926798e-01
 -1.27316642e+00 -6.19894475e-01 -2.46078875e-02 -9.84861515e-04
  6.09262437e-01 -2.61364654e-01 -8.67846981e-02 -6.50594294e-01
 -1.05220255e-01  5.01252174e-01  3.69144768e-01 -1.27523625e+00
  8.19959249e-02  3.85981396e-01  3.76667187e-01 -1.84287168e-01
  4.55563113e-01 -6.24464571e-01 -2.70538263e-01 -1.55443195e-01
  2.29276926e-02  2.69344322e-01 -1.02086596e-01 -5.58891408e-02
 -1.02780730e-01 -2.61838853e-01 -3.63154814e-01 -1.84368879e-01
  5.69452554e-01 -4.37591523e-01  1.20764893e-01 -2.15084903e-01
```

```
  1.17099956e-01 -4.97940406e-01]
==================================================
[ 0.2911156   0.11246883  0.14646187  0.13116232 -0.06976372  0.02984622
 -0.23662001  0.1384388  -0.04814423 -0.08377227  0.04103362  0.31818083
  0.08860375 -0.15192753  0.2475151   0.24517277 -0.4004577  -0.19220045
  0.00061261 -0.00346836  0.17714891 -0.08460841 -0.02562886 -0.20917568
 -0.03257331  0.15691483  0.12130345 -0.41197106  0.02820649  0.11980164
  0.14214559 -0.05080703  0.153363   -0.21089025 -0.06936701 -0.04883989
  0.01863909  0.07838025 -0.02491062 -0.01148924 -0.04124724 -0.08792179
 -0.12144051 -0.0593836   0.18956988 -0.13733315  0.02724039 -0.07022369
  0.02819588 -0.16788551]
==================================================
[ 1.1575622   0.47638422  0.569484    0.58417836 -0.30350106  0.11403064
 -0.99003562  0.56440103 -0.20945724 -0.3265091   0.19772002  1.3141886
  0.37092844 -0.60708013  0.98448716  1.02809957 -1.67362413 -0.81209493
 -0.02399528 -0.00445322  0.78641135 -0.34597307 -0.11241356 -0.85976997
 -0.13779357  0.658167    0.49044821 -1.68720731  0.11020242  0.50578304
  0.51881278 -0.2350942   0.60892612 -0.83535482 -0.33990528 -0.20428308
  0.04156678  0.34772457 -0.12699721 -0.06737838 -0.14402797 -0.34976064
 -0.48459533 -0.24375248  0.75902243 -0.57492468  0.14800528 -0.28530859
  0.14529583 -0.66582592]
==================================================
[ 0.58179504  0.24987297  0.29376101  0.28800455 -0.170667    0.04308232
 -0.47815102  0.2779568  -0.10984819 -0.15692447  0.08374476  0.6440242
  0.18035041 -0.30362207  0.49615633  0.525116   -0.83364105 -0.427482
 -0.03089411 -0.00210119  0.37860328 -0.16242193 -0.05964168 -0.43783435
 -0.0684787   0.3191337   0.25991234 -0.8284738   0.03349289  0.26238647
  0.24026643 -0.11124834  0.30024847 -0.41051558 -0.16746105 -0.08280775
  0.03560934  0.17313786 -0.07605702 -0.01789914 -0.08370811 -0.17636284
 -0.22442353 -0.12816313  0.3937543  -0.29951778  0.07452779 -0.12904757
  0.08313794 -0.3290181 ]
==================================================
[ 1.73935723  0.72625718  0.86324501  0.87218291 -0.47416805  0.15711295
 -1.46818665  0.84235784 -0.31930542 -0.48343357  0.28146478  1.95821279
  0.55127885 -0.9107022   1.4806435   1.55321559 -2.50726518 -1.23957694
 -0.05488939 -0.00655442  1.16501462 -0.50839499 -0.17205524 -1.29760432
 -0.20627227  0.9773007   0.75036056 -2.51568112  0.14369531  0.76816951
  0.7590792  -0.34634254  0.90917459 -1.2458704  -0.50736633 -0.28709083
  0.07717612  0.52086243 -0.20305423 -0.08527752 -0.22773607 -0.52612349
 -0.70901886 -0.3719156   1.15277673 -0.87444246  0.22253307 -0.41435616
  0.22843378 -0.994844  ]
==================================================
```

```
[ 0.14376841  0.05630118  0.07030809  0.08088391 -0.04640127  0.0091702
 -0.13430758  0.06604942 -0.02080611 -0.03893454  0.03169848  0.16943565
  0.03943319 -0.07101445  0.12917     0.12749654 -0.22829    -0.1014028
 -0.0006351  -0.00712784  0.10818113 -0.03675319 -0.00670781 -0.1297079
 -0.02532213  0.08378681  0.07988192 -0.2196489   0.01204755  0.06793343
  0.0671849  -0.0341668   0.07573926 -0.11872472 -0.0403228  -0.03162996
  0.01484627  0.03828776 -0.00847563  0.00194174 -0.02806497 -0.04309398
 -0.06974398 -0.03595784  0.11650266 -0.07693788  0.01923865 -0.03236245
  0.01125344 -0.09201427]
==================================================
[ 0.14376841  0.05630118  0.07030809  0.08088391 -0.04640127  0.0091702
 -0.13430758  0.06604942 -0.02080611 -0.03893454  0.03169848  0.16943565
  0.03943319 -0.07101445  0.12917     0.12749654 -0.22829001 -0.1014028
 -0.0006351  -0.00712784  0.10818113 -0.03675319 -0.00670781 -0.1297079
 -0.02532213  0.08378681  0.07988192 -0.2196489   0.01204755  0.06793343
  0.0671849  -0.0341668   0.07573926 -0.11872472 -0.0403228  -0.03162996
  0.01484627  0.03828776 -0.00847563  0.00194174 -0.02806497 -0.04309398
 -0.06974398 -0.03595784  0.11650266 -0.07693788  0.01923865 -0.03236245
  0.01125344 -0.09201427]
==================================================
[ 0.12629154  0.04715073  0.06635998  0.07409875 -0.0421212   0.00572717
 -0.11573782  0.06076309 -0.01520692 -0.03404859  0.02843848  0.1534839
  0.04009578 -0.07306424  0.11246528  0.12144715 -0.19709705 -0.10452886
 -0.00884326  0.00076997  0.10050111 -0.05378756 -0.01988903 -0.09584261
 -0.00499937  0.08464099  0.06592596 -0.19720533  0.00503775  0.06506669
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[ 0.35505906  0.14429046  0.16819087  0.16904601 -0.09998723  0.03177129
 -0.3017963   0.17688072 -0.07448635 -0.09547119  0.06579737  0.39585605
  0.11994118 -0.18887135  0.29492623  0.3156937  -0.51739645 -0.25231472
 -0.0126832  -0.01003616  0.24637613 -0.1030957  -0.03979191 -0.26860073
 -0.04445962  0.19511545  0.15609726 -0.520052    0.02856261  0.1638592
  0.16282114 -0.07718397  0.17535917 -0.24904743 -0.10258224 -0.06118405
  0.00344139  0.10859454 -0.04392405 -0.0211028  -0.04574285 -0.10774794
 -0.14830989 -0.07921112  0.23475486 -0.17713717  0.04542988 -0.08229213
  0.04712066 -0.19913916]
==================================================
[ 1.73354921  0.66964793  0.78176793  0.76131707 -0.49091103  0.16476956
 -1.42008498  0.80004364 -0.28480421 -0.40153933  0.23968431  1.83547613
  0.53869305 -0.88278851  1.42675686  1.48774317 -2.3124947  -1.14592013
 -0.04710845 -0.02999943  1.06251687 -0.43784776 -0.13112257 -1.25714302
 -0.21561766  0.97124767  0.7410835  -2.31064326  0.04940433  0.79139148
  0.74644417 -0.28318468  0.84718035 -1.12147114 -0.47057167 -0.26333006
  0.09406172  0.44027763 -0.20121935 -0.06633806 -0.28705522 -0.52131748
 -0.68690622 -0.40336054  1.09860617 -0.84541589  0.14626287 -0.3332822
  0.25373354 -0.92615111]
==================================================
[ 0.5165949   0.21273902  0.25266507  0.25407985 -0.15527184  0.05131547
 -0.42628092  0.24698192 -0.0870693  -0.13098173  0.07504939  0.5635415
  0.15771973 -0.26266024  0.44033033  0.45212805 -0.743594   -0.35512143
 -0.00630256 -0.01178221  0.34629354 -0.15236391 -0.03358667 -0.37443635
 -0.0569629   0.2838159   0.22475061 -0.73747253  0.03578156  0.22655506
  0.21845275 -0.09065808  0.25414017 -0.35614327 -0.14387205 -0.09003589
  0.01437193  0.15373024 -0.06188129 -0.01833266 -0.06693303 -0.14615357
 -0.20927173 -0.12531142  0.35553217 -0.2658183   0.07100596 -0.11973804
  0.07362718 -0.2862137 ]
==================================================
```

```
[ 2.25014409  0.88238695  1.03443301  1.01539692 -0.64618287  0.21608504
 -1.8463659   1.04702556 -0.37187351 -0.53252105  0.31473369  2.3990176
  0.69641278 -1.14544874  1.86708719  1.93987122 -3.05608869 -1.50104156
 -0.05341101 -0.04178164  1.40881041 -0.59021167 -0.16470924 -1.63157937
 -0.27258057  1.25506356  0.96583411 -3.04811579  0.08518589  1.01794654
  0.96489692 -0.37384277  1.10132052 -1.4776144  -0.61444373 -0.35336595
  0.10843364  0.59400787 -0.26310064 -0.08467072 -0.35398825 -0.66747105
 -0.89617795 -0.52867196  1.45413834 -1.11123419  0.21726883 -0.45302024
  0.32736072 -1.21236481]
==================================================
```

```
a=np.zeros(10)
for i in range(10):
  a=np.append(a,i)
print(a)
```

```
[0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 2. 3. 4. 5. 6. 7. 8. 9.]
```

```
b=np.zeros(10)
for i in range(10):
  b=b+i
  print(b)
```

```
[0. 0. 0. 0. 0. 0. 0. 0. 0. 0.]
[1. 1. 1. 1. 1. 1. 1. 1. 1. 1.]
[3. 3. 3. 3. 3. 3. 3. 3. 3. 3.]
[6. 6. 6. 6. 6. 6. 6. 6. 6. 6.]
[10. 10. 10. 10. 10. 10. 10. 10. 10. 10.]
[15. 15. 15. 15. 15. 15. 15. 15. 15. 15.]
[21. 21. 21. 21. 21. 21. 21. 21. 21. 21.]
[28. 28. 28. 28. 28. 28. 28. 28. 28. 28.]
[36. 36. 36. 36. 36. 36. 36. 36. 36. 36.]
[45. 45. 45. 45. 45. 45. 45. 45. 45. 45.]
```

```
sent_vectors1 = []; # the avg-w2v for each sentence/review is stored in this list
for sent in tqdm(list_of_sentance[0]): # for each review/sentence
```

```
    sent_vec = np.zeros(50) # as word vectors are of zero length 50, you might need to change this to 300 if you use google's w2v
    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
            print(vec)
            print("="*50)
            print(sent_vec)
            print("="*50)
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors1.append(sent_vec)
```

what i want is to is op: [0,1,2,3,4,5,6,7,8,9]

```
g=w2v_model["tasty"]
g
```

```
array([ 8.43227625e-01,  2.84313202e-01,  3.47350925e-01,  3.19551021e-01,
       -2.19206497e-01,  1.31001145e-01, -7.17353404e-01,  3.57540637e-01,
       -1.87308162e-01, -1.72162369e-01,  2.15414781e-02,  8.30916524e-01,
        3.25760692e-01, -4.77827132e-01,  6.75754428e-01,  6.84670985e-01,
       -1.02446103e+00, -5.38067937e-01, -2.32033320e-02, -2.30905861e-02,
        4.65304136e-01, -1.39601156e-01, -4.83925790e-02, -6.31824732e-01,
       -1.24218263e-01,  4.55041647e-01,  4.18998003e-01, -1.04717159e+00,
        2.98232324e-02,  4.00741607e-01,  4.62189108e-01, -1.76488087e-01,
        4.05584782e-01, -5.01690745e-01, -1.50732949e-01, -1.02516197e-01,
        6.75313547e-02,  2.10180238e-01, -1.08296692e-01, -9.72020626e-02,
       -1.30780563e-01, -2.69870251e-01, -3.50871474e-01, -2.04379052e-01,
        5.12117684e-01, -4.25456971e-01, -3.17809987e-04, -1.27427593e-01,
        1.07258596e-01, -4.87505108e-01], dtype=float32)
```

```
c=np.zeros(50)
c
```

```
array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
       0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
       0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.])
```

```
c=c+g
c
```

```
array([ 8.43227625e-01,  2.84313202e-01,  3.47350925e-01,  3.19551021e-01,
       -2.19206497e-01,  1.31001145e-01, -7.17353404e-01,  3.57540637e-01,
       -1.87308162e-01, -1.72162369e-01,  2.15414781e-02,  8.30916524e-01,
        3.25760692e-01, -4.77827132e-01,  6.75754428e-01,  6.84670985e-01,
       -1.02446103e+00, -5.38067937e-01, -2.32033320e-02, -2.30905861e-02,
        4.65304136e-01, -1.39601156e-01, -4.83925790e-02, -6.31824732e-01,
       -1.24218263e-01,  4.55041647e-01,  4.18998003e-01, -1.04717159e+00,
        2.98232324e-02,  4.00741607e-01,  4.62189108e-01, -1.76488087e-01,
        4.05584782e-01, -5.01690745e-01, -1.50732949e-01, -1.02516197e-01,
        6.75313547e-02,  2.10180238e-01, -1.08296692e-01, -9.72020626e-02,
       -1.30780563e-01, -2.69870251e-01, -3.50871474e-01, -2.04379052e-01,
        5.12117684e-01, -4.25456971e-01, -3.17809987e-04, -1.27427593e-01,
        1.07258596e-01, -4.87505108e-01])
```

```
d=np.zeros(50)
d+=g
d
```

```
array([ 8.43227625e-01,  2.84313202e-01,  3.47350925e-01,  3.19551021e-01,
       -2.19206497e-01,  1.31001145e-01, -7.17353404e-01,  3.57540637e-01,
       -1.87308162e-01, -1.72162369e-01,  2.15414781e-02,  8.30916524e-01,
        3.25760692e-01, -4.77827132e-01,  6.75754428e-01,  6.84670985e-01,
       -1.02446103e+00, -5.38067937e-01, -2.32033320e-02, -2.30905861e-02,
        4.65304136e-01, -1.39601156e-01, -4.83925790e-02, -6.31824732e-01,
       -1.24218263e-01,  4.55041647e-01,  4.18998003e-01, -1.04717159e+00,
        2.98232324e-02,  4.00741607e-01,  4.62189108e-01, -1.76488087e-01,
        4.05584782e-01, -5.01690745e-01, -1.50732949e-01, -1.02516197e-01,
        6.75313547e-02,  2.10180238e-01, -1.08296692e-01, -9.72020626e-02,
       -1.30780563e-01, -2.69870251e-01, -3.50871474e-01, -2.04379052e-01,
        5.12117684e-01, -4.25456971e-01, -3.17809987e-04, -1.27427593e-01,
        1.07258596e-01, -4.87505108e-01])
```