PreProcessing Steps :

In [1]:
```
#!pip3 install gensim
import time
start = time.time()

#Importing libraries:
import sqlite3 as sql
import seaborn as sns
import datetime
import gensim
import random
import warnings
warnings.filterwarnings("ignore")

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
#it helps the output of plotting commands is displayed inline in Jupyte
r notebook directly below the cell on which op was run.
import re
import pickle
end = time.time()
print('execution time is {:.3f} Minutes'.format(((end - start) / 60)))
```

```
execution time is 0.053 Minutes
```

Loading data

In [2]:
```
#Using sqlite3 to retrieve data from sqlite file
start = time.time()
con = sql.connect("database.sqlite")#Connection object that represents
 the database
```

```
#Using pandas functions to query from sql table
df = pd.read_sql_query("""SELECT * FROM Reviews  where "Score" !=3 """,
con)

#Reviews is the name of the table given
#Taking only the data where score != 3 as score 3 will be neutral and i
t won't help us much
df.head(2)
end = time.time()
print('execution time is {:.3f} Minutes'.format(((end - start) / 60)))
```

```
execution time is 0.065 Minutes
```

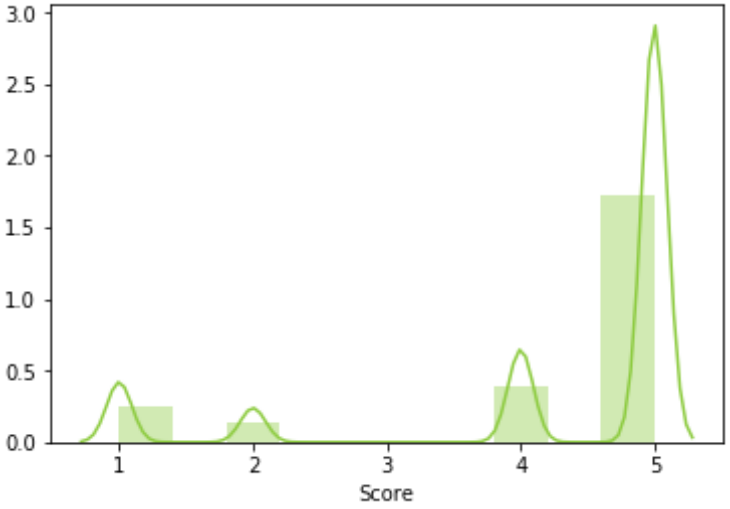
In [3]:
```
df['Score'].value_counts()
```

Out[3]:
```
5    363122
4     80655
1     52268
2     29769
Name: Score, dtype: int64
```

In [4]:
```
%%time
#to check the distibutions of the column 'Score'
sns.distplot(df['Score'], bins=10, color="#8ecc41")
```

```
CPU times: user 1.94 s, sys: 56 ms, total: 2 s
Wall time: 2 s
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b325438d0>
```



DataCleaning Steps

In [5]:
```
print(df.duplicated(subset={"UserId","ProfileName","Time","Text"}).head
(5))
print()
print('total no of duplicate rows based on columns are:\n{}'.format(df.
duplicated(subset={"UserId","ProfileName","Time","Text"}).value_counts
()))
```

```
0    False
1    False
2    False
3    False
4    False
dtype: bool

total no of duplicate rows based on columns are:
False    364173
True     161641
dtype: int64
```

In [6]:
```
#removing duplicates:
df = df.drop_duplicates(subset={"UserId","ProfileName","Time","Text"},
keep='first')
print(len(df))
```

```
364173
```

In [7]:
```
df = df[df['HelpfulnessNumerator'] <= df.HelpfulnessDenominator]
print(len(df))
```

```
364171
```

In [8]:
```
df['Score'] = df['Score'].apply(lambda x: 'Positive' if x >3 else 'Nega
tive')
df['Score'].value_counts()
```

Out[8]:
```
Positive    307061
Negative     57110
Name: Score, dtype: int64
```

In [9]:
```
#cerating a copy of deduplicated data to 'final' dataframe:
final = df.copy()
```

Texual Data Preprocessing:

1. Removing HTML tags
2. Removing puncuation marks/special characters
3. Conversion of all reviews to lower characters

In [10]:
```
%%time
# removeing HTML TAG
final['Text'] = final['Text'].apply(lambda x : re.sub('<.*?>',' ', x))
#No characters to be substitited in place of HTML tag

#removing punctuation marks:
final['Text'] = final['Text'].apply(lambda x: re.sub(r'[?|!|\'|"|#|.|,
|)|(|\|/|~|%|*]', ' ', x))
```

```
#converting it to lower case:
final['Text'] = final['Text'].apply(lambda x: x.lower())
```

```
CPU times: user 4.33 s, sys: 88 ms, total: 4.42 s
Wall time: 4.43 s
```

StopWords creation:

In [11]:

```
%%time

#supporting libraries for creating stopwords:
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer


#creating stopwords list:

stop = set(stopwords.words('english')) #set of stopwords
stop = list(stop)
temp = []
list_of_excluded_words = ['against','not','don', "don't",'ain', 'aren',
 "aren't", 'couldn', "couldn't", 'didn', "didn't",
             'doesn', "doesn't", 'hadn', "hadn't", 'hasn', "hasn't", 'h
aven', "haven't", 'isn', "isn't",
             'mightn', "mightn't", 'mustn', "mustn't", 'needn', "need
n't",'shouldn', "shouldn't", 'wasn',
             "wasn't", 'weren', "weren't", 'won', "won't", 'wouldn', "w
ouldn't"]


for i in range(len(stop)):
    if stop[i] in list_of_excluded_words:
        continue
    else:
        temp.append(stop[i])
```

```
stop = set(temp)
print(stop)
```

```
{'other', 'll', 'more', 'between', 'was', 'm', 'each', 'just', "sha
n't", 'once', 'while', 'myself', 'too', 'same', 'such', 'o', 'ma', "sho
uld've", 'below', 'have', 'very', 'to', 'again', 'through', 'be', 'ove
r', 'i', 'them', 'its', 'down', 'few', 'off', 'with', 'why', 'only', 'o
urselves', 'who', 'out', 'no', 'we', 'than', 'their', 'itself', 'thes
e', 'up', 'here', 'at', "that'll", "it's", 'by', 'for', "you'll", 'a',
'they', 't', 'theirs', 'd', 'doing', 'from', 'herself', 'if', 'or', 'no
r', 'it', 'will', 'whom', 'ours', 'yours', 'of', 'own', 'hers', 'when',
'about', 'most', 'is', "you're", 'and', 'the', 'which', 'did', 'our',
'because', 'into', 'y', 'before', "she's", 'do', 'your', 'during', 'i
n', 'this', 'all', 'those', 'she', 'on', 'you', 'been', 'my', 'themselv
es', 'can', 'both', 'where', 'an', 'so', 'he', 'are', 'me', 'does', 'yo
urselves', 'him', 'were', 'should', 's', 'further', 'as', 'some', 'afte
r', "you'd", 'having', "you've", 'then', 'himself', 'there', 'any', 'he
r', 'had', 'what', 'that', 'until', 'under', 're', 'am', 'now', 'abov
e', 'but', 'shan', 've', 'his', 'yourself', 'how', 'has', 'being'}
CPU times: user 568 ms, sys: 24 ms, total: 592 ms
Wall time: 594 ms
```

In [12]:
```
#nltk.download()
```

Stemming:

Porter Stemmer: Most commonly used stemmer. But it is also the most computationally intensive algorithms. It is also the oldest stemming algorithm.

SnowBall Stemmer: it is regarded as an improvement over porter. Slightly faster computation time than Porter stemmer.

In [13]:
```
from nltk.stem import SnowballStemmer
snow = SnowballStemmer('english') #initialising the snowball stemmer
print("Stem/Root words of the some of the words using SnowBall Stemmer:
\n")
print(snow.stem('tasty'))
```

```
print(snow.stem('tasteful'))
print(snow.stem('tastiest'))
print(snow.stem('New Delhi'))
```

```
Stem/Root words of the some of the words using SnowBall Stemmer:

tasti
tast
tastiest
new delhi
```

BoW - Preprocessing - single review

In [14]:
```
%%time

#creating list of cleaned words and two seperate lists of pos & neg rev
iews
str1=''
final_string=[]
all_positive_words=[] # store words from +ve reviews here
all_negative_words=[] # store words from -ve reviews here.
s=''
for sentence in final['Text'][2:3].values:
    filtered_sentence=[]
    print(sentence)
    for word in sentence.split():
        print('.....................................................>> {}'
.format(word))
        if((word not in stop) & (len(word)>2) & (word.isalpha())):
            s = snow.stem(word).encode('utf8')
            print('word after stemming is .........>> {}'.format(s))
            filtered_sentence.append(s)
        else:
            print('{} eliminated' .format(word))
            continue

#print(filtered_sentence)
    str1 = b" ".join(filtered_sentence) #final string of cleaned words
```

```
    #print("*" * 40)

    final_string.append(str1)
```

```
this is a confection that has been around a few centuries   it is a lig
ht  pillowy citrus gelatin with nuts - in this case filberts  and it is
cut into tiny squares and then liberally coated with powdered sugar   a
nd it is a tiny mouthful of heaven   not too chewy  and very flavorful
  i highly recommend this yummy treat   if you are familiar with the st
ory of c s  lewis   the lion  the witch  and the wardrobe  - this is th
e treat that seduces edmund into selling out his brother and sisters to
the witch
.................................................>> this
this eliminated
.................................................>> is
is eliminated
.................................................>> a
a eliminated
.................................................>> confection
word after stemming is .........>> b'confect'
.................................................>> that
that eliminated
.................................................>> has
has eliminated
.................................................>> been
been eliminated
.................................................>> around
word after stemming is .........>> b'around'
.................................................>> a
a eliminated
.................................................>> few
few eliminated
.................................................>> centuries
word after stemming is .........>> b'centuri'
.................................................>> it
it eliminated
.................................................>> is
is eliminated
.................................................>> a
a eliminated
```

```
.................................................>> light
word after stemming is .........>> b'light'
.................................................>> pillowy
word after stemming is .........>> b'pillowi'
.................................................>> citrus
word after stemming is .........>> b'citrus'
.................................................>> gelatin
word after stemming is .........>> b'gelatin'
.................................................>> with
with eliminated
.................................................>> nuts
word after stemming is .........>> b'nut'
.................................................>> -
- eliminated
.................................................>> in
in eliminated
.................................................>> this
this eliminated
.................................................>> case
word after stemming is .........>> b'case'
.................................................>> filberts
word after stemming is .........>> b'filbert'
.................................................>> and
and eliminated
.................................................>> it
it eliminated
.................................................>> is
is eliminated
.................................................>> cut
word after stemming is .........>> b'cut'
.................................................>> into
into eliminated
.................................................>> tiny
word after stemming is .........>> b'tini'
.................................................>> squares
word after stemming is .........>> b'squar'
.................................................>> and
and eliminated
.................................................>> then
then eliminated
```

```
.................................................>> liberally
word after stemming is .........>> b'liber'

.................................................>> coated
word after stemming is .........>> b'coat'
.................................................>> with
with eliminated
.................................................>> powdered
word after stemming is .........>> b'powder'
.................................................>> sugar
word after stemming is .........>> b'sugar'
.................................................>> and
and eliminated
.................................................>> it
it eliminated
.................................................>> is
is eliminated
.................................................>> a
a eliminated
.................................................>> tiny
word after stemming is .........>> b'tini'
.................................................>> mouthful
word after stemming is .........>> b'mouth'
.................................................>> of
of eliminated
.................................................>> heaven
word after stemming is .........>> b'heaven'
.................................................>> not
word after stemming is .........>> b'not'
.................................................>> too
too eliminated
.................................................>> chewy
word after stemming is .........>> b'chewi'
.................................................>> and
and eliminated
.................................................>> very
very eliminated
.................................................>> flavorful
word after stemming is .........>> b'flavor'
.................................................>> i
```

```
i eliminated
.................................................>> highly

word after stemming is .........>> b'high'
.................................................>> recommend
word after stemming is .........>> b'recommend'
.................................................>> this
this eliminated
.................................................>> yummy
word after stemming is .........>> b'yummi'
.................................................>> treat
word after stemming is .........>> b'treat'
.................................................>> if
if eliminated
.................................................>> you
you eliminated
.................................................>> are
are eliminated
.................................................>> familiar
word after stemming is .........>> b'familiar'
.................................................>> with
with eliminated
.................................................>> the
the eliminated
.................................................>> story
word after stemming is .........>> b'stori'
.................................................>> of
of eliminated
.................................................>> c
c eliminated
.................................................>> s
s eliminated
.................................................>> lewis
word after stemming is .........>> b'lewi'
.................................................>> the
the eliminated
.................................................>> lion
word after stemming is .........>> b'lion'
.................................................>> the
the eliminated
```

```
.................................................>> witch
word after stemming is .........>> b'witch'

.................................................>> and
and eliminated
.................................................>> the
the eliminated
.................................................>> wardrobe
word after stemming is .........>> b'wardrob'
.................................................>> -
- eliminated
.................................................>> this
this eliminated
.................................................>> is
is eliminated
.................................................>> the
the eliminated
.................................................>> treat
word after stemming is .........>> b'treat'
.................................................>> that
that eliminated
.................................................>> seduces
word after stemming is .........>> b'seduc'
.................................................>> edmund
word after stemming is .........>> b'edmund'
.................................................>> into
into eliminated
.................................................>> selling
word after stemming is .........>> b'sell'
.................................................>> out
out eliminated
.................................................>> his
his eliminated
.................................................>> brother
word after stemming is .........>> b'brother'
.................................................>> and
and eliminated
.................................................>> sisters
word after stemming is .........>> b'sister'
.................................................>> to
```

```
to eliminated
.................................................>> the

the eliminated
.................................................>> witch
word after stemming is .........>> b'witch'
CPU times: user 20 ms, sys: 0 ns, total: 20 ms
Wall time: 22.1 ms
```

BoW Preprocessing - All Reviews:

In [15]:
```
start = time.time()

#creating list of cleaned words and two seperate lists of pos & neg rev
iews
i = 0
str1 = ''
final_string = []
all_positive_words = [] # store words from +ve reviews here
all_negative_words = [] # store words from -ve reviews here.
s = ''
for sentence in final['Text'].values:
    filtered_sentence = []
    for word in sentence.split():
        if((word not in stop) & (len(word)>2) & (word.isalpha())):
            s = snow.stem(word).encode('utf8')
            filtered_sentence.append(s)
            if (final['Score'].values)[i] == 'Positive':
                all_positive_words.append(s) #list of all words used to
 describe positive reviews
            elif(final['Score'].values)[i] == 'Negative':
                all_negative_words.append(s) #list of all words used to
 describe negative reviews reviews
        else:
            continue
 #print(filtered_sentence)
    str1 = b" ".join(filtered_sentence) #final string of cleaned words
    #print("*" * 40)
```

```
    final_string.append(str1)
    i+=1
end = time.time()
print('time elapsed is {:<.3f} minutes'.format((end - start) / 60))
```

```
time elapsed is 5.292 minutes
```

In [16]:
```
final.columns
```

Out[16]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerato
r',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text'],
      dtype='object')
```

W2V and TFidf Preprocessing

In [17]:
```
%%time
final = df
# removeing HTML TAG
final['Text'] = final['Text'].apply(lambda x : re.sub('<.*?>',' ', x))
#No characters to be substitited in place of HTML tag

#removing punctuation marks:
final['Text'] = final['Text'].apply(lambda x: re.sub(r'[?|!|\'|"|#|.|,
|)|(|\|/|~|%|*]', ' ', x))

#converting it to lower case:
final['Text'] = final['Text'].apply(lambda x: x.lower())

#creating the list of cleaned words(without stemming and lemmatization
 for W2V):

i = 0
str_w2v = ' '
final_string_w2v = []
s = ''
for sentence in final['Text'].values:
```

```
    filtered_sentence=[]
    for word in sentence.split():
        if((len(word) > 2) & (word.isalpha()) & (word not in stop)):

            s = word.encode('utf8')
            filtered_sentence.append(s)
        else:
            continue
 #print(filtered_sentence)
    str_w2v = b" ".join(filtered_sentence) #final string of cleaned wor
ds
    final_string_w2v.append(str_w2v)
    i+=1
```

```
CPU times: user 22 s, sys: 4 ms, total: 22 s
Wall time: 22 s
```

BoW & TFidf - cleaned data columns creation

In [18]:
```
final['CleanedText_Bow'] = final_string
final['ClenedText_W2Vtfdf'] = final_string_w2v
final['CleanedText_Bow'] = final['CleanedText_Bow'].apply(lambda x: x.d
ecode("utf-8"))
final['ClenedText_W2Vtfdf'] = final['ClenedText_W2Vtfdf'].apply(lambda
x: x.decode("utf-8"))
final.iloc[:, -2:].head(4)
```

Out[18]:

	CleanedText_Bow	ClenedText_W2Vtfdf
0	bought sever vital can dog food product found ...	bought several vitality canned dog food produc...
1	product arriv label jumbo salt peanut peanut a...	product arrived labeled jumbo salted peanuts p...
2	confect around centuri light pillowi citrus ge...	confection around centuries light pillowy citr...
3	look secret ingredi robitussin believ found go...	looking secret ingredient robitussin believe f...

In [19]:
```
final.columns
```

Out[19]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerato
r',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text',
       'CleanedText_Bow', 'ClenedText_W2Vtfdf'],
      dtype='object')
```

In [20]:
```
final['Score'].value_counts()
```

Out[20]:
```
Positive    307061
Negative     57110
Name: Score, dtype: int64
```

In [21]:
```
final['Score'] = final['Score'].apply(lambda x: 1 if x == 'Positive' el
se 0)
final['Score'].value_counts()
```

Out[21]:
```
1    307061
0     57110
Name: Score, dtype: int64
```

sorting dataframe on 'Time' column,sample 1L sorted datapoints & saving dataFrame onto disc

In [22]:
```
final = final.sort_values('Time')
final_1L = final.iloc[0:100000, ]
final_1L.to_csv('final_1L.csv', index=False)
```

In [23]:
```
final_1L.columns
```

Out[23]:
```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerato
r',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text',
       'CleanedText_Bow', 'ClenedText_W2Vtfdf'],
      dtype='object')
```

BoW - Train, Test & CV splits:

In [24]:
```
%%time

#train-test split:
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.preprocessing import normalize

X_train, X_test, y_train, y_test = train_test_split(final_1L['CleanedText_Bow'].values, final_1L['Score'].values,
                                                    test_size = 0.2, shuffle=False)
# split the train data set into cross validation train and cross validation test
X_tr, X_cv, y_tr, y_cv = train_test_split(X_train, y_train, test_size=0.2, shuffle=False)
```

```
CPU times: user 16 ms, sys: 0 ns, total: 16 ms
Wall time: 14 ms
```

In [25]:
```
print('length of X_tr is {} y_tr is {}'.format(len(X_tr), len(y_tr)))
print('length of X_cv is {} y_cv is {}'.format(len(X_cv), len(y_cv)))
print('length of X_test is {} y_test is {}'.format(len(X_test), len(y_test)))
```

```
length of X_tr is 64000 y_tr is 64000
length of X_cv is 16000 y_cv is 16000
length of X_test is 20000 y_test is 20000
```

BoW - splitted datapoints into pickled file and saving onto disc:

In [26]:
```
#pickeling splitted data points to disk:

bow_list = [X_tr, X_cv, X_test]
file1 = open('bow_splitted_dataPoints.pickle','wb')

# dump information to that file
pickle.dump(bow_list, file1)
```

```
# close the file
file1.close()

class_label = [y_tr, y_cv, y_test]
file1 = open('class_label.pickle', 'wb')

# dump information to that file
pickle.dump(class_label, file1)

# close the file
file1.close()
```

W2V, TFidf - Train, Test, CV splits:

In [27]:
```
#train-test split:
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(final_1L['ClenedTex
t_W2Vtfdf'].values, final_1L['Score'].values,
                                                    test_size = 0.2, sh
uffle=False)
# split the train data set into cross validation train and cross valida
tion test
X_tr, X_cv, y_tr, y_cv = train_test_split(X_train, y_train, test_size=
0.2, shuffle=False)
```

W2V, TFIDF - splitted datapoints into pickled file and saving onto disc:

In [28]:
```
#pickeling splitted data points to disk:

w2v_list = [X_tr, X_cv, X_test]

# open a file object, to store the data
file1 = open('w2v_splitted_datapoints.pickle', 'wb')

# dump information to that file
pickle.dump(w2v_list, file1)
```

```
# close the file
file1.close()
```

W2V - creating document corpus of reviews for X_train ,X_cv, X_test

In [29]:
```
%%time
file1 = open('w2v_splitted_datapoints.pickle','rb')
w2v_list = pickle.load(file1)
X_tr, X_cv, X_test = w2v_list[0], w2v_list[1], w2v_list[2]
file1.close()

#creating list of lists(list of words in sentence of sentences) for X_t
r
w_train = []
s = ''
for sentence in X_tr:
    sentence_list = []
    for words in sentence.split():
        s = words
        sentence_list.append(s)
    w_train.append(sentence_list)

cnt = 0
for i in w_train:
    print(i)
    cnt = cnt + 1
    if cnt == 1:
        break
print(len(w_train))
```

```
['witty', 'little', 'book', 'makes', 'son', 'laugh', 'loud', 'recite',
'car', 'driving', 'along', 'always', 'sing', 'refrain', 'learned', 'wha
les', 'india', 'drooping', 'love', 'new', 'words', 'book', 'introduce
s', 'silliness', 'classic', 'book', 'willing', 'bet', 'son', 'still',
'able', 'recite', 'memory', 'college']
64000
CPU times: user 1.18 s, sys: 72 ms, total: 1.26 s
Wall time: 1.31 s
```

In [30]:
```
%%time

#creating list of lists(list of words in sentence of sentences) for X_cv:
w_cv = []
s = ''
for sentence in X_cv:
    sentence_list = []
    for words in sentence.split():
        s = words
        sentence_list.append(s)
    w_cv.append(sentence_list)


#to check first review
cnt = 0
for j in w_cv:
    print(j)
    cnt = cnt + 1
    if cnt == 1:
        break
print(len(X_cv))
```

```
['need', 'find', 'good', 'egg', 'substitute', 'allergic', 'family', 'me
mbers', 'enjoy', 'cake', 'tried', 'powder', 'egg', 'replacer', 'didn',
'work', 'tried', 'extra', 'baking', 'powder', 'tried', 'applesauce', 'f
lax', 'seeds', 'etc', 'nothing', 'worked', 'help']
16000
CPU times: user 152 ms, sys: 28 ms, total: 180 ms
Wall time: 182 ms
```

In [31]:
```
%%time

#creating list of lists(list of words in sentence of sentences) for X_test:
w_test = []
s = ''
for sentence in X_test:
```

```
    sentence_list = []
    for words in sentence.split():
        s = words
        sentence_list.append(s)
    w_test.append(sentence_list)

#to check first review
cnt = 0
for j in w_test:
    print(j)
    cnt = cnt + 1
    if cnt == 1:
        break
print(len(w_test))
```

```
['product', 'great', 'taste', 'italy', 'wonderful', 'almost', 'cheese',
'slight', 'drizzle', 'brie', 'chedder', 'cheese', 'love']
20000
CPU times: user 200 ms, sys: 24 ms, total: 224 ms
Wall time: 223 ms
```

W2V - pickeling list of data points and saving onto disc

In [33]:
```
w2v_ListOfSentence = [w_train, w_cv, w_test]

file = open('w2v_ListOfSentence.pickle', '+wb')
pickle.dump(w2v_ListOfSentence, file)
file.close()
```

FeatureEngineering:

BoW - Feature Engineering

In [34]:
```
#checking for whether any column is haivng Null value?
final_1L.isna().sum()
```

Out[34]:
```
Id                          0
ProductId                   0
UserId                      0
ProfileName                 0
HelpfulnessNumerator        0
HelpfulnessDenominator      0
Score                       0
Time                        0
Summary                     0
Text                        0
CleanedText_Bow             0
ClenedText_W2Vtfdf          0
dtype: int64
```

In [35]:
```
final_1L['Score'] = final_1L['Score'].apply(lambda x: 'Positive' if int
(x) == 1 else 'Negative')
final_1L['Score'].value_counts()
```

Out[35]:
```
Positive    87729
Negative    12271
Name: Score, dtype: int64
```

In [36]:
```
%%time
# removeing HTML TAG
final_1L['Summary'] = final_1L['Summary'] .apply(lambda x : re.sub('<.
*?>',' ', x)) #No characters to be substitited in place of HTML tag

#removing punctuation marks:
final_1L['Summary']  = final_1L['Summary'] .apply(lambda x: re.sub(r'[?
|!|\'|"|#|.|,|)|(|\|/|~|%|*]', ' ', x))

#converting it to lower case:
final_1L['Summary']  = final_1L['Summary'] .apply(lambda x: x.lower())
```

```
CPU times: user 420 ms, sys: 0 ns, total: 420 ms
Wall time: 426 ms
```

In [37]:
```
start = time.time()
```

```
#creating list of cleaned words and two seperate lists of pos & neg rev
iews
i = 0
str1 = ''
final_string = []
all_positive_words = [] # store words from +ve reviews here
all_negative_words = [] # store words from -ve reviews here.
s = ''
for sentence in final_1L['Summary'].values:
    filtered_sentence = []
    for word in sentence.split():
        if((word not in stop) & (len(word)>2) & (word.isalpha())):
            s = snow.stem(word).encode('utf8')
            filtered_sentence.append(s)
            if (final_1L['Score'].values)[i] == 'Positive':
                all_positive_words.append(s) #list of all words used to
 describe positive reviews
            elif(final_1L['Score'].values)[i] == 'Negative':
                all_negative_words.append(s) #list of all words used to
 describe negative reviews reviews
        else:
            continue
 #print(filtered_sentence)
    str1 = b" ".join(filtered_sentence) #final string of cleaned words
    #print("*" * 40)

    final_string.append(str1)
    i+=1
end = time.time()
print('time elapsed is {:<.3f} minutes'.format((end - start) / 60))
```

```
time elapsed is 0.112 minutes
```

In [38]:
```
final_1L['Bow_feat'] = final_string
final_1L['Bow_feat'] = final_1L['Bow_feat'].apply(lambda x: x.decode("u
tf-8"))
```

In [39]:
```
final_1L['Bow_feat'].head(4)
```

Out[39]:
```
138706                          everi book educ
138683    whole seri great way spend time child
417839                      entertainingl funni
212472                    modern day fairi tale
Name: Bow_feat, dtype: object
```

BoW - creating new featured column

In [40]:
```
# replacing blank space of one of the cells of 'summary' which is havin
g NaN value:
#final_1L['Summary'] = final_1L['Summary'].replace(np.nan, '', regex=Tr
ue)

#creating new column of concatenation of two columns:
final_1L['Bow_new_feat'] = final_1L[['Bow_feat', 'CleanedText_Bow']].ap
ply(lambda x: ' '.join(x),axis=1)
final_1L['Bow_new_feat'].head(2)
```

Out[40]:
```
138706    everi book educ witti littl book make son laug...
138683    whole seri great way spend time child rememb s...
Name: Bow_new_feat, dtype: object
```

W2V, TFidf - Feature engineering

In [41]:
```
final_1L.isna().sum()
```

Out[41]:
```
Id                      0
ProductId               0
UserId                  0
ProfileName             0
HelpfulnessNumerator    0
HelpfulnessDenominator  0
Score                   0
Time                    0
Summary                 0
Text                    0
CleanedText_Bow         0
```

```
ClenedText_W2Vtfdf        0
Bow_feat                  0
Bow_new_feat              0
dtype: int64
```

In [42]:

```
%%time
# removeing HTML TAG
final_1L['Summary'] = final_1L['Summary'] .apply(lambda x : re.sub('<.
*?>',' ', x)) #No characters to be substitited in place of HTML tag

#removing punctuation marks:
final_1L['Summary']  = final_1L['Summary'] .apply(lambda x: re.sub(r'[?
|!|\'|"|#|.|,|)|(|\|/|~|%|*]', ' ', x))

#converting it to lower case:
final_1L['Summary']  = final_1L['Summary'] .apply(lambda x: x.lower())
```

```
CPU times: user 272 ms, sys: 4 ms, total: 276 ms
Wall time: 280 ms
```

W2V, TFidf : creating the list of cleaned words(without stemming and lemmatization) of 'Summary' column

In [43]:

```
%%time

i = 0
str_w2v = ' '
final_string_w2v = []
s = ''
for sentence in final_1L['Summary'].values:
    filtered_sentence=[]
    for word in sentence.split():
        if((len(word) > 2) & (word.isalpha()) & (word not in stop)):

            s = word.encode('utf8')
            filtered_sentence.append(s)
        else:
            continue
```

```
 #print(filtered_sentence)
    str_w2v = b" ".join(filtered_sentence) #final string of cleaned wor
ds
    final_string_w2v.append(str_w2v)
    i+=1
```

```
CPU times: user 360 ms, sys: 0 ns, total: 360 ms
Wall time: 362 ms
```

BoW, TFidf : New featured column creation:

In [44]:
```
%%time

final_1L['w2v_feat'] = final_string_w2v
final_1L['w2v_feat'] = final_1L['w2v_feat'].apply(lambda x: x.decode("u
tf-8"))

# replacing blank space of one of the cells of 'summary' which is havin
g NaN value:
#final_1L['Summary'] = final_1L['Summary'].replace(np.nan, '', regex=Tr
ue)

#creating new column of concatenation of two columns:
final_1L['w2v_new_feat'] = final_1L[['w2v_feat', 'ClenedText_W2Vtfdf']]
.apply(lambda x: ' '.join(x),axis=1)
final_1L['w2v_new_feat'].head(2)
```

```
CPU times: user 2.33 s, sys: 0 ns, total: 2.33 s
Wall time: 2.34 s
```

Out[44]:
```
138706    every book educational witty little book makes...
138683    whole series great way spend time child rememb...
Name: w2v_new_feat, dtype: object
```

In [45]:
```
final_1L['Score'].value_counts()
```

Out[45]:
```
Positive    87729
Negative    12271
Name: Score, dtype: int64
```

In [46]:
```
final_1L['Score'] = final_1L['Score'].apply(lambda x: 1 if x == 'Positi
ve' else 0)
final_1L['Score'].value_counts()
```

Out[46]:
```
1    87729
0    12271
Name: Score, dtype: int64
```

Storing dataframe in table and saving into disc

In [47]:
```
final_1L.to_csv('final_1L.csv', index=False)
import sqlite3
conn = sqlite3.connect('final_1L.sqlite')
final_1L.to_sql('reviews', conn,if_exists='replace') #dataframe is save
d under table 'reviews'
```

In [51]:
```
#!pip3 install wordcloud

from wordcloud import WordCloud, STOPWORDS
stopwords = set(STOPWORDS)
```

In [52]:
```
%%time

plt.rcParams['figure.figsize']=(8.0,6.0)
plt.Figure(figsize=(12, 10), dpi=80, facecolor='w', edgecolor='k')
plt.rcParams['font.size']=12                #10
plt.rcParams['savefig.dpi']=100             #72
plt.rcParams['figure.subplot.bottom']=.1

def show_wordcloud(data, title = None):
    wordcloud = WordCloud(
        background_color='white',
        stopwords=stopwords,
        max_words=200,
        max_font_size=40,
        scale=3,
```

```
        random_state=42
    ).generate(str(data))

    fig = plt.figure(1, figsize=(8, 8))
    plt.axis('off')
    if title:
        fig.suptitle(title, fontsize=20)
        fig.subplots_adjust(top=2.3)

    plt.imshow(wordcloud)
    plt.show()

show_wordcloud(final['CleanedText_Bow'])
final.loc[final['Score'] >3]['CleanedText_Bow']
```


```
CPU times: user 572 ms, sys: 48 ms, total: 620 ms
Wall time: 631 ms
```

Out[52]:
```
Series([], Name: CleanedText_Bow, dtype: object)
```

In [53]:
```
pwd
```

Out[53]:
```
'/home/reachjalesh/PreprocessingFolder'
```

In [ ]: