APPLY KMEANS , AGGLOMERATIVE & DBSCAN CLUSTERING ALGORITHM on Fine Food Reviews

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:

Label the review as Positive or negative

Loading,Cleaning & Preprocessing 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 ignc 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
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 sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer

import 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

warnings.filterwarnings("ignore")
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is c
  import pandas.util.testing as tm
```

```
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=947318989803-6bn6qk8qdgf4n4g3pf

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

```
con = sqlite3.connect("/content/drive/My Drive/Colab Notebooks/database.sqlite")

filtered_data=pd.read_sql_query("""SELECT * FROM Reviews WHERE Score != 3""",con);
filtered_data.head(3)
```

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

```
filtered_data.shape

def partition(x):
  if x < 3 :
    return 'negative'
  return 'positive'

actualScore=filtered_data['Score']
positive_negative=actualScore.map(partition)
filtered_data['Score']=positive_negative
print("Number of datapoints",filtered_data.shape)
filtered_data.head(3)
```

```
Number of datapoints (525814, 10)
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	1

```
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(3)
```

```
(80668, 7)
```

	UserId	ProductId	ProfileName	Time	Score	
0	#oc-R115TNMSPFT9I7	B007Y59HVM	Breyton	1331510400	2	Overall its just OK when considering t
1	#oc-R11D9D7SHXIJB9	B005HG9ET0	Louis E. Emory "hoppy"	1342396800	5	My wife has recurring extreme muscle sp
2	#oc-R11DNU2NBKQ23Z	B007Y59HVM	Kim Cieszykowski	1348531200	1	This coffee is horrible and unfortuna

```
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	
0	78445	B000HDL1RQ	AR5J8UI46CURR	Geetha Krishnan	2	2	5	119
1	138317	B000HDOPYC	AR5J8UI46CURR	Geetha Krishnan	2	2	5	119
2	138277	B000HDOPYM	AR5J8UI46CURR	Geetha Krishnan	2	2	5	119
3	73791	B000HDOPZG	AR5J8UI46CURR	Geetha Krishnan	2	2	5	119
4	155049	B000PAQ75C	AR5J8UI46CURR	Geetha Krishnan	2	2	5	119

```
sorted_data=filtered_data.sort_values('ProductId',axis=0,ascending=True,inplace=False,kind='quicksort',na_position

final_data=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"},keep='first',inplace=False)
final_data.shape
```

```
(364173, 10)
```

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

```
69.25890143662969
```

```
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	Scor
0	64422	B000MIDROQ	A161DK06JJMCYF	J. E. Stephens "Jeanne"	3	1	5
1	44737	B001EQ55RW	A2V0I904FH7ABY	Ram	3	2	4

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

```
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
True
```

```
stopping_words = set(stopwords.words('english'))
print(stopping_words)
```

```
{'mightn', 'wouldn', 'i', 'because', 'shan', 'ours', 'few', 'about', "that'll", 'now', 'myself', 'all', 'such',
```

```
def clean_html(text):
    clean_r = re.compile('<,*?>')
    clean_text = re.sub(clean_r,'',text)
    return clean_text

def Clean_punc(text):
    clean_sentence = re.sub(r'[?|!|\'|"|#]',r' ',text)
    clean_data = re.sub(r'[.|,|)|(|\|/)]',r' ',clean_sentence)
    return clean_data
```

```
from tqdm import tqdm
import os
import pdb
import pickle

from tqdm import tqdm
import os
import pdb
import pickle

stem_no = nltk.stem.SnowballStemmer('english')

if not os.path.isfile('final_data.sqlite'):
    final_string=[]
    all_positive_words=[]
    all_negative_words=[]
    for i,sentence in enumerate(tqdm(final_data['Text'].values)):
        filtered_sentence=[]
        sent_without_html_tags=clean_html(sentence)
        #pdb.set_trace()
        for w in sent_without_html_tags.split():
            for cleaned_words in Clean_punc(w).split():
                if ((cleaned_words.isalpha()) & (len(cleaned_words) > 2)):
                    if(cleaned_words.lower() not in stopping_words) :
                        stemming=(stem_no.stem(cleaned_words.lower())).encode('utf8')
                        filtered_sentence.append(stemming)
                        if(final_data['Score'].values)[i]=='positive':
                            all_positive_words.append(stemming)
                        if(final_data['Score'].values)[i]=='negative':
                            all_negative_words.append(stemming)
        str1 = b" ".join(filtered_sentence)
        final_string.append(str1)

    final_data['Cleaned_text']=final_string
    final_data['Cleaned_text']=final_data['Cleaned_text'].str.decode("utf-8")

    conn = sqlite3.connect('final_data.sqlite')
    cursor=conn.cursor
    conn.text_factory = str
    final_data.to_sql('Reviews',conn,schema=None,if_exists='replace',index=True,index_label=None,chunksize=None,dt
    conn.close()


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

```
100%|██████████| 364171/364171 [06:11<00:00, 980.74it/s]
```

```
final_data['total_words'] = [len(x.split()) for x in final_data['Cleaned_text'].tolist()]
```

```
final_data.sort_values(by=['Time'], inplace=True, ascending=True)
```

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

```
positive    307061
negative     57110
Name: Score, dtype: int64
```

```
final_data=final_data[0:50000]
final_data.head(2)
```

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score
138706	150524	0006641040	ACITT7DI6IDDL	shari zychinski	0	0	positive
138683	150501	0006641040	AJ46FKXOVC7NR	Nicholas A Mesiano	2	2	positive

KMEAN CLUSTERING ALGORITHM

KMEANS ON AMAZON FINE FOOD REVIEW TO FIND THE CLUSTER AND PLOT OF CLUSTERS WITH INERTIA(INTRA CLUSTER DISTANCE) -----> BAG OF WORD VECTORIZATION TECHNIQUE

```
final_data_bow=[]
print(final_data.shape)


print("="*100)

count_vector=CountVectorizer(min_df=100)
final_data_bow=(count_vector.fit_transform(final_data['Cleaned_text'].values))

print("After vectorizations")
print(final_data_bow.shape)

print("="*100)
```

```
(50000, 12)
====================================================================================================
After vectorizations
(50000, 1750)
====================================================================================================
```

```
pd.DataFrame(final_data_bow.toarray(),columns=count_vector.get_feature_names())
```

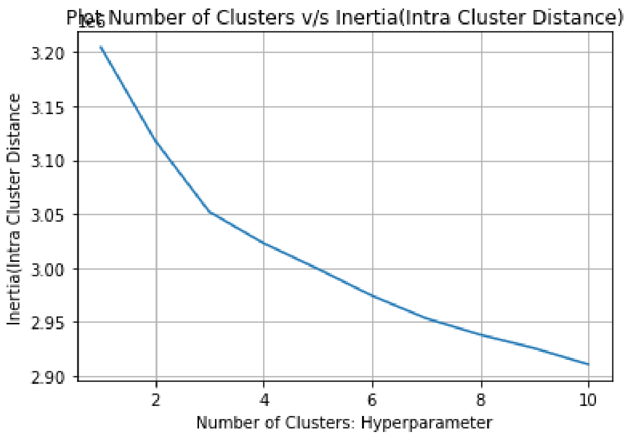
	abl	absolut	absorb	accept	accord	acid	acquir	across	act	activ	actual	ad	add	addict	addit	a
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
49995	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
49996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
49997	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	
49998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
49999	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	

50000 rows × 1750 columns

Apply KMeans to Find the Hyperparameter i.e Best No of Cluster (K)

```
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import cross_val_score
from sklearn.cluster import KMeans

n_clusters = [1,2,3,4,5,6,7,8,9,10]
plot_inertia=[]
def K_Means_Clustering(x_training_data):
  for i  in n_clusters:
    KMeans_Clustering = KMeans(init='k-means++',max_iter=300,n_clusters=i)
    KMeans_Clustering.fit(x_training_data)
    plot_inertia.append(KMeans_Clustering.inertia_)
  plt.plot(n_clusters, plot_inertia)
  plt.xlabel("Number of Clusters: Hyperparameter")
  plt.ylabel("Inertia(Intra Cluster Distance")
  plt.title("Plot Number of Clusters v/s Inertia(Intra Cluster Distance)")
  plt.grid()
  plt.show()
```

```
K_Means_Clustering(final_data_bow)
```



By looking at the above Plot. Looks like the BEST K is 3. At K=3 , there is an inflexion

```
from sklearn.cluster import KMeans
K_Mean_Model=KMeans(init='k-means++',max_iter=300,n_clusters=3)
K_Mean_Model.fit(final_data_bow)
```

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=None, tol=0.0001, verbose=0)
```

Find the Top 10 Words for each Cluster

```
print("Top terms per cluster")
centroids=K_Mean_Model.cluster_centers_.argsort()[:,::-1]

features=count_vector.get_feature_names()
top_words=[]
for i in range(3):
  top_ten_words = [features[ind] for ind in centroids[i,:10]]
  top_words.append(top_ten_words)
  print("Clusters {} : {} ".format(i,' '.join(top_ten_words)))
```

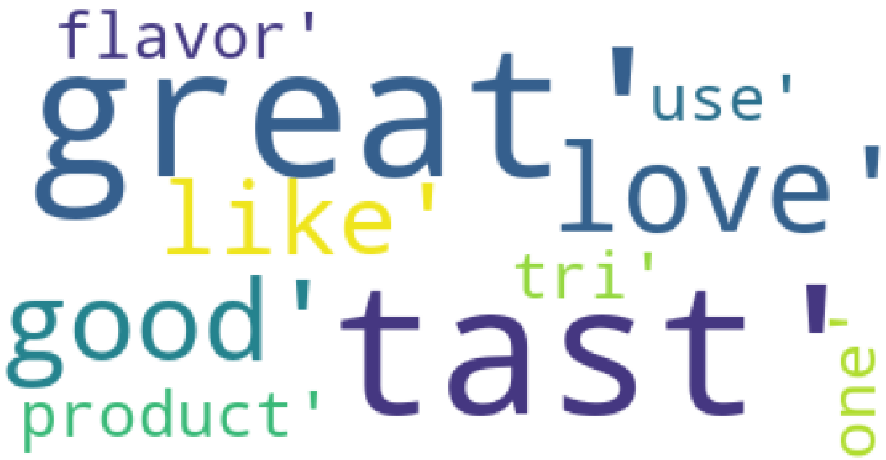
```
Top terms per cluster
Clusters 0 : tast great love good like product flavor use one tri
Clusters 1 : tea flavor green like tast bag drink use make one
Clusters 2 : like tast flavor one use product good tri food make
```

```
top_words[0]
```

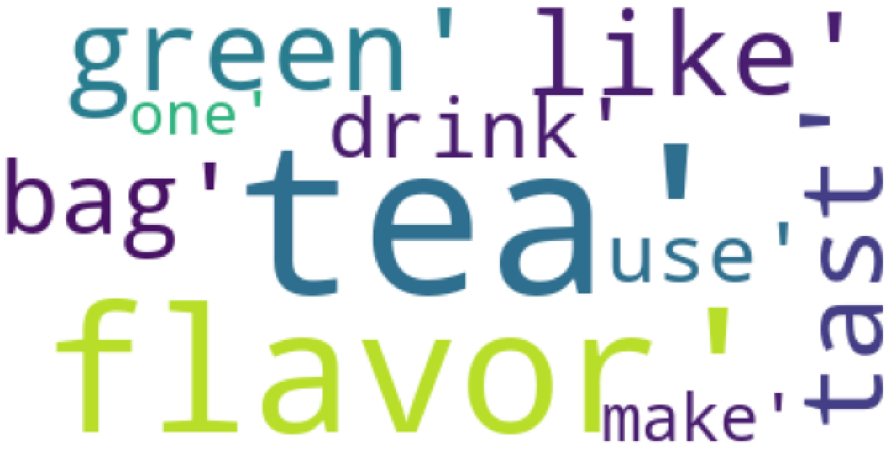
```
['tast',
 'great',
 'love',
 'good',
 'like',
 'product',
 'flavor',
 'use',
 'one',
 'tri']
```

GENERATE THE TOP 10 WORDS FROM EACH CLUSTER USING WORD CLOUD

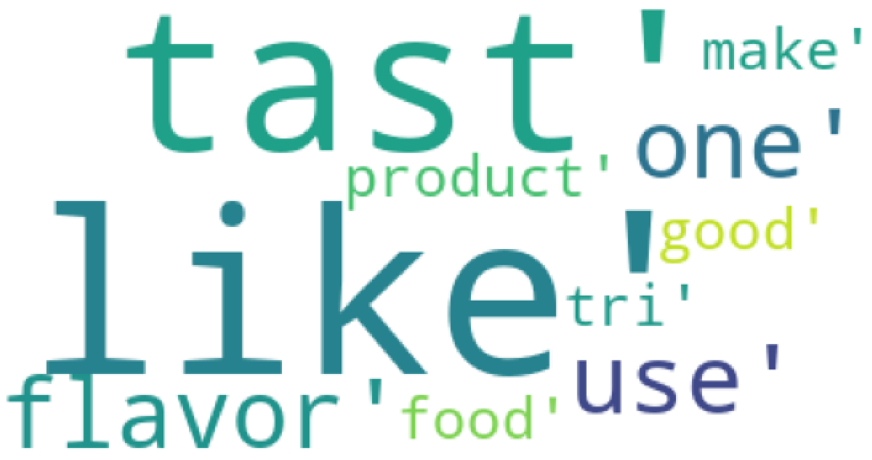
```
from wordcloud import WordCloud
from wordcloud import WordCloud
import matplotlib.pyplot as plt
%matplotlib inline

for i in range(3) :
  wordcloud = WordCloud(background_color='white').generate(str(top_words[i]))
  plt.figure(figsize=(8,8),facecolor=None)
  plt.imshow(wordcloud)
  plt.axis("off")
  plt.tight_layout(pad = 0)
  plt.show()
  print('---------------------------------------------------------------------------')
```



```
---------------------------------------------------------------------------
```



```
---------------------------------------------------------------------------
```



```
---------------------------------------------------------------------------
```

KMEANS ON AMAZON FINE FOOD REVIEW TO FIND THE CLUSTER AND PLOT OF CLUSTERS WITH INERTIA(SUM OF ALL INTRA CLUSTER DISTANCE) ----> tf VECTORIZATION TECHNIQUE

```
from sklearn.feature_extraction.text import TfidfVectorizer
final_data_tfidf=[]
print(final_data.shape)


print("="*100)

tfidf_vector=TfidfVectorizer(min_df=100)
final_data_tfidf=(tfidf_vector.fit_transform(final_data['Cleaned_text'].values))

print("After vectorizations")
print(final_data_tfidf.shape)

print("="*100)
```

```
(50000, 12)
====================================================================================================
After vectorizations
(50000, 1750)
====================================================================================================
```

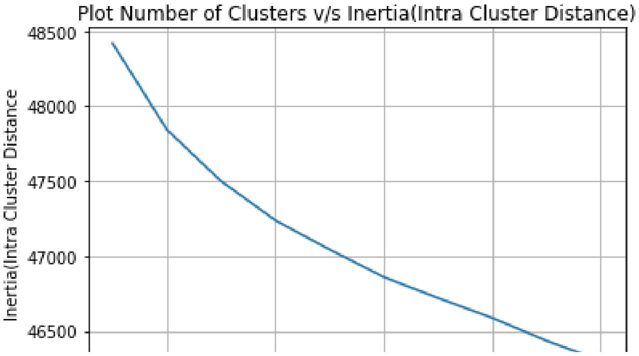
```
pd.DataFrame(final_data_tfidf.toarray(),columns=tfidf_vector.get_feature_names())
```

	abl	absolut	absorb	accept	accord	acid	acquir	across	act	activ	actual	ad	a
0	0.144869	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
1	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
2	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.35954	0.0	0.000000	0.000000	0.0000
3	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
4	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
...	...	...	...	...	...	...	...	...	...	...	...	...	
49995	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.109359	0.0000
49996	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
49997	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.2861
49998	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.000000	0.000000	0.0000
49999	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00000	0.0	0.194975	0.000000	0.0000

50000 rows × 1750 columns

Apply KMeans to find the Hyperparameter i.e Best No of Cluster(K)

```
K_Means_Clustering(final_data_tfidf)
```



BY LOOKING AT THE ABOVE PLOT , LOOKS IKE THE BEST K IS 5.

```
from sklearn.cluster import KMeans
K_Mean_Model=KMeans(init='k-means++',max_iter=300,n_clusters=5)
K_Mean_Model.fit(final_data_tfidf)
```

```
KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
       n_clusters=5, n_init=10, n_jobs=None, precompute_distances='auto',
       random_state=None, tol=0.0001, verbose=0)
```

FIND TOP 10 WORDS FOR EACH CLUSTER

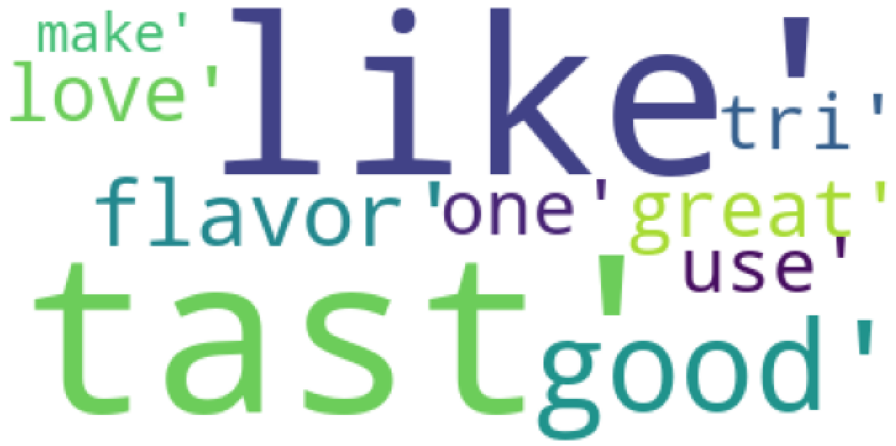
```
print("Top terms per cluster")
centroids=K_Mean_Model.cluster_centers_.argsort()[:,::-1]

features=tfidf_vector.get_feature_names()
top_words=[]
for i in range(5):
  top_ten_words = [features[ind] for ind in centroids[i,:10]]
  top_words.append(top_ten_words)
  print("Clusters {} : {} ".format(i,' '.join(top_ten_words)))
```

```
Top terms per cluster
Clusters 0 : tast like good flavor great love use tri one make
Clusters 1 : product order amazon store price find ship great buy love
Clusters 2 : tea green flavor drink tast like bag cup love good
Clusters 3 : coffe cup flavor pod tast like roast strong good tri
Clusters 4 : dog cat treat food love chew one eat like get
```

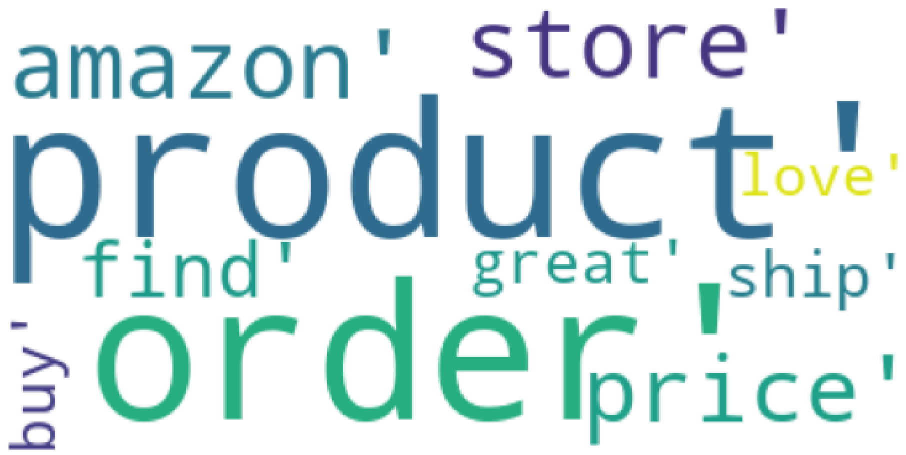
GENERATE THE TOP 10 WORDS FROM EACH CLUSTER USING WORD CLOUD

```
from wordcloud import WordCloud
import matplotlib.pyplot as plt
%matplotlib inline

for i in range(5) :
  wordcloud = WordCloud(background_color='white').generate(str(top_words[i]))
  print("="*100)
  plt.figure(figsize=(8,8),facecolor=None)
  plt.imshow(wordcloud)
  plt.axis("off")
  plt.tight_layout(pad = 0)
  plt.show()
  print("="*100)
```

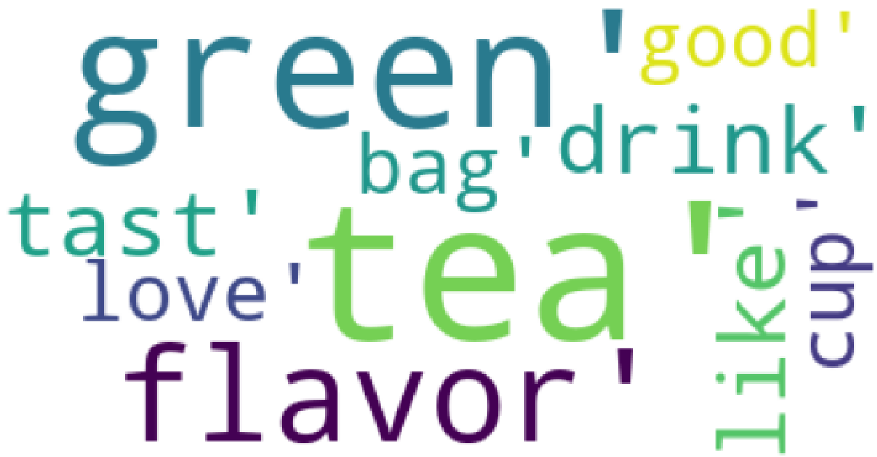
```
====================================================================================================
```


like'
tast'
good'
flavor'
one'
great'
love'
make'
tri'
use'

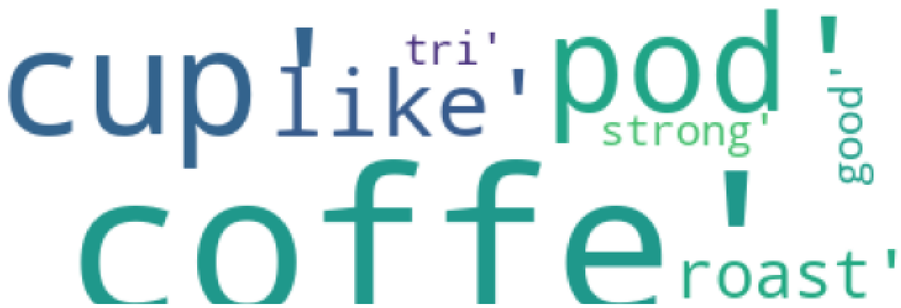
```
====================================================================================================
====================================================================================================
```


product'
order'
amazon'
store'
love'
find'
great'
ship'
buy'
price'

```
====================================================================================================
====================================================================================================
```


green'
good'
drink'
bag'
tast'
tea'
love'
flavor'
like'
cup'

```
====================================================================================================
====================================================================================================
```


cup'
tri'
like'
pod'
strong'
good'
coffe'
roast'

```
====================================================================================================
====================================================================================================
```

chew'
love'
like'
one'
eat'
dog'
get'
food'
cat'
treat'

KMEANS ON AMAZON FINE FOOD REVIEW TO FIND THE CLUSTER AND PLOT OF CLUSTERS WITH INERTIA(SUM OF ALL INTRA CLUSTER DISTANCE) --> AV WORD2VEC

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

list_of_sent_train_avgw2v=[]

for sent_train_avgw2v in tqdm(final_data['Cleaned_text'].values):
    list_of_sent_train_avgw2v.append(sent_train_avgw2v.split())
```

```
100%|██████████| 50000/50000 [00:00<00:00, 83276.96it/s]
```

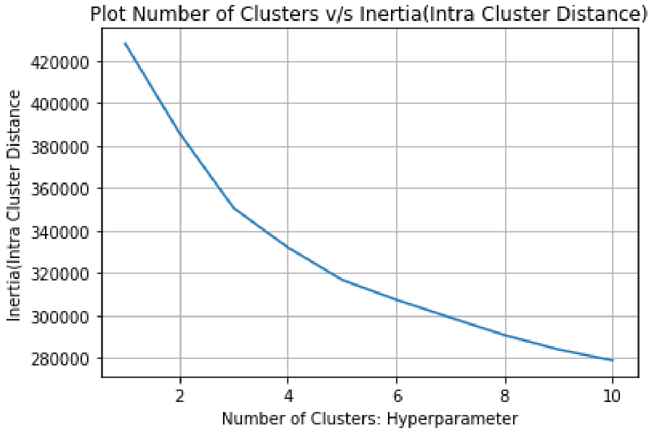
```python
w2v_model_train = Word2Vec(list_of_sent_train_avgw2v,min_count=5,size=50,workers=4)
w2v_words_svm_train=list(w2v_model_train.wv.vocab)
```

```python
train_vectors=[];
for sent in tqdm(list_of_sent_train_avgw2v):
    sent_vec=np.zeros(50)
    cnt_words=0;
    for word in sent:
        if word in w2v_words_svm_train:
            vec=w2v_model_train.wv[word]
            sent_vec+=vec
            cnt_words+=1
    if cnt_words !=0:
        sent_vec/=cnt_words
    train_vectors.append(sent_vec)
print(len(train_vectors))
print(len(train_vectors[0]))
```

```
100%|██████████| 50000/50000 [00:54<00:00, 911.49it/s]50000
50
```

Apply KMeans to find the Hyperparameter i.e Best No of Clusters(K)

```
K_Means_Clustering(train_vectors)
```



By Looking at the Plot. Looks like No Of Cluster is 5 i.e K=5

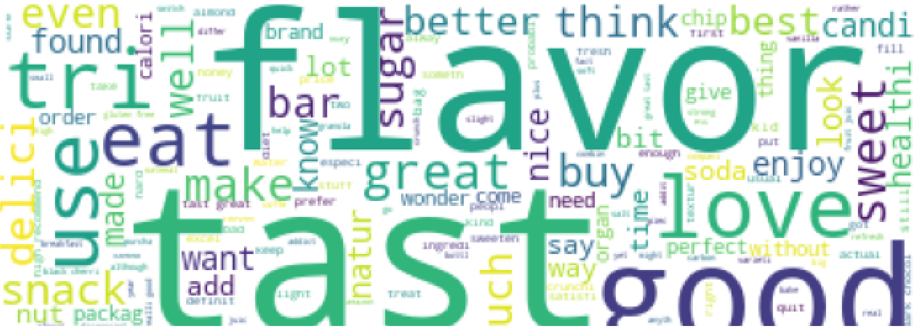
```
K_Mean_Model=KMeans(init='k-means++',max_iter=300,n_clusters=5)
predict_cluster_index=K_Mean_Model.fit_predict(train_vectors)
```

```
cluster_index =[]

for i in range(len(predict_cluster_index)):
  if predict_cluster_index[i] == 2:
    cluster_index.append(i)
```

```
text_features=[]

for i in range(len(cluster_index)) :
  text_features.append(list_of_sent_train_avgw2v[cluster_index[i]])
```

```
from wordcloud import WordCloud
import matplotlib.pyplot as plt
%matplotlib inline

text_var = ''
for j in range(len(text_features)):
    for i in range(len(text_features[j])):
        text_var = text_var + text_features[j][i] + ' '
wordcloud = WordCloud(background_color='white').generate(str(text_var))
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

```
====================================================================================================
```



KMEANS ON AMAZON FINE FOOD REVIEW TO FIND THE CLUSTER AND PLOT OF CLUSTERS WITH INERTIA(SUM OF ALL INTRA CLUSTER DISTANCE) ----> TI WORD 2VEC VECTORIZATION TECHNIQUE

```python
model_Avgw2v = TfidfVectorizer()
X_Train_Avgw2v=model_Avgw2v.fit_transform(final_data['Cleaned_text'].values)
```

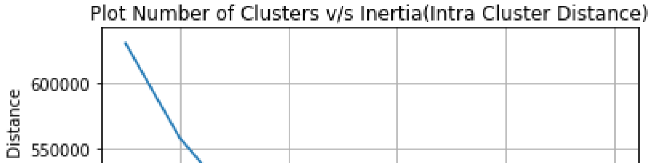
```python
dictionary = dict(zip(model_Avgw2v.get_feature_names(), list(model_Avgw2v.idf_)))
```

```python
tfidf_feature=model_Avgw2v.get_feature_names()

tfidf_sent_vectors_train=[];
row=0;

for sent in tqdm(list_of_sent_train_avgw2v):
    sent_vec=np.zeros(50)
    weight_sum=0;
    for word in sent :
        if word in w2v_words_svm_train and word in tfidf_feature :
            vec=w2v_model_train.wv[word]
            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_train.append(sent_vec)
    row+=1
```

```
100%|██████████| 50000/50000 [10:50<00:00, 76.90it/s]
```

Apply KMeans to find the Best Hyperparameter i.e Best No of Clusters K

```python
K_Means_Clustering(tfidf_sent_vectors_train)
```



By looking at the plot. It looks like the Best K will be 3 i.e K=3

No of Clusters = 3

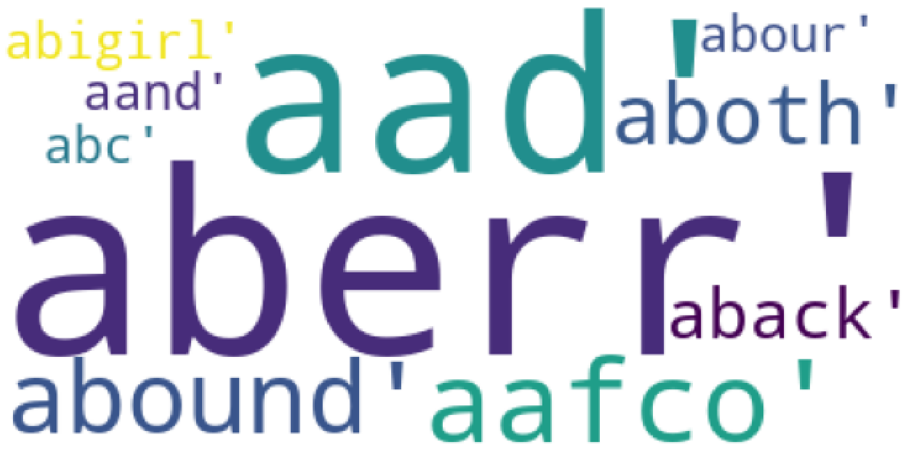
```
K_Mean_Model=KMeans(init='k-means++',max_iter=300,n_clusters=3)
fit_model=K_Mean_Model.fit(tfidf_sent_vectors_train)
```

```
print("Top terms per cluster")
centroids=fit_model.cluster_centers_.argsort()[:,::-1]

tfidf_feature=model_Avgw2v.get_feature_names()

top_words=[]
for i in range(3):
  top_ten_words = [tfidf_feature[ind] for ind in centroids[i,:10]]
  top_words.append(top_ten_words)
  print("Clusters {} : {} ".format(i,' '.join(top_ten_words)))
```

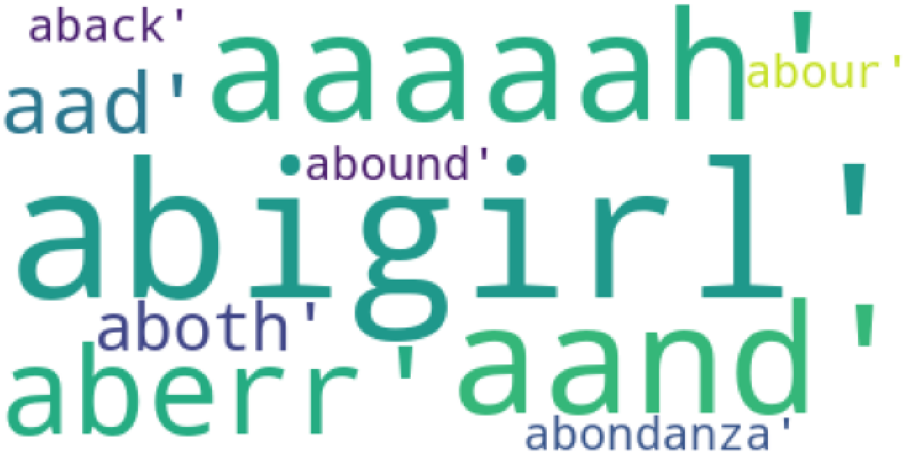
```
Top terms per cluster
Clusters 0 : aberr aad aafco abound aboth aback abigirl abc abour aand
Clusters 1 : abigirl aaaaah aand aberr aad aboth abondanza abour abound aback
Clusters 2 : aboard aah abj aardvark abi abigirl aaa aad aand aberr
```

```
from wordcloud import WordCloud
import matplotlib.pyplot as plt
%matplotlib inline

for i in range(3) :
  wordcloud = WordCloud(background_color='white').generate(str(top_words[i]))
  print("="*100)
  plt.figure(figsize=(8,8),facecolor=None)
  plt.imshow(wordcloud)
  plt.axis("off")
  plt.tight_layout(pad = 0)
  plt.show()
  print("="*100)
```

```
====================================================================================================
```



```
====================================================================================================
====================================================================================================
```



AGGLOMERATIVE CLUSTERING ALGORITHM

USING AVGWORD2VEC FEATURIZATION TECHNIQUE

```python
final_data_new=final_data[:5000]
```

```python
final_data_new=final_data_new['Cleaned_text']
```

```python
final_data_new_array=final_data_new.to_numpy()
```

```python
final_data_new_array[66]
```

```
'tim burton start take serious michael keaton unleash unus restrain alec baldwin support cast known looni danc p
```

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

list_of_sent_avgw2v_agglo=[]

for sent_train_avgw2v in tqdm(final_data_new):
    list_of_sent_avgw2v_agglo.append(sent_train_avgw2v.split())
```

```
100%|██████████| 5000/5000 [00:00<00:00, 134248.66it/s]
```

```
w2v_model_train = Word2Vec(list_of_sent_avgw2v_agglo,min_count=5,size=50,workers=4)
w2v_words_svm_train=list(w2v_model_train.wv.vocab)
```

```
train_vectors=[];
for sent in tqdm(list_of_sent_avgw2v_agglo):
    sent_vec=np.zeros(50)
    cnt_words=0;
    for word in sent:
        if word in w2v_words_svm_train:
            vec=w2v_model_train.wv[word]
            sent_vec+=vec
            cnt_words+=1
    if cnt_words !=0:
        sent_vec/=cnt_words
    train_vectors.append(sent_vec)
print(len(train_vectors))
print(len(train_vectors[0]))
```

```
100%|██████████| 5000/5000 [00:05<00:00, 999.47it/s] 5000
50
```

APPLY AGGLOMERATIVE CLUSTERING TO FIND THE BEST HYPERPARAMETER I.E BEST NO OF CLUS

For K = 2

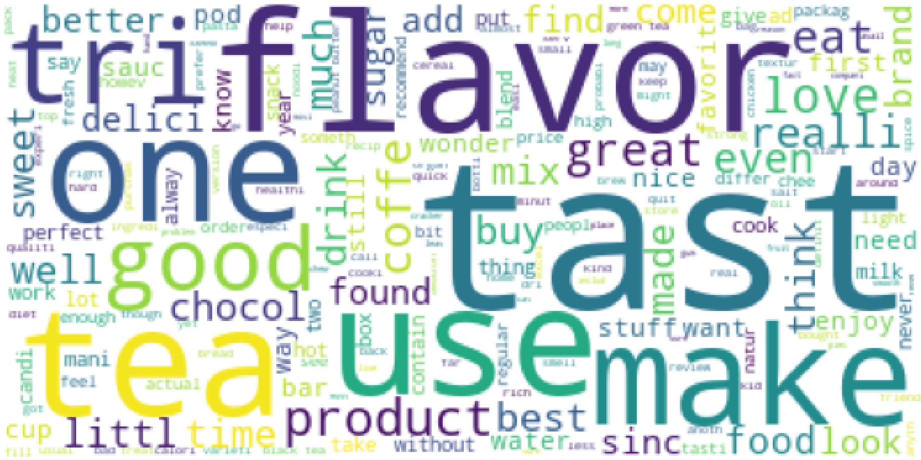
```
from sklearn.cluster import AgglomerativeClustering

k = 2
cluster_label=[]
Agglo_Clustering = AgglomerativeClustering(n_clusters=k)
cluster_label=Agglo_Clustering.fit_predict(train_vectors)
```

```
C1,C2 =[],[]

for i in range(Agglo_Clustering.labels_.shape[0]):
  if Agglo_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  else:
    C2.append(final_data_new_array[i])
```

CLUSTER 1 FEATURES

```
display_data=''

for i in C1:
  display_data+=str(i)

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wordcloud = WordCloud(background_color='white').generate(display_data)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

```
====================================================================================================
```

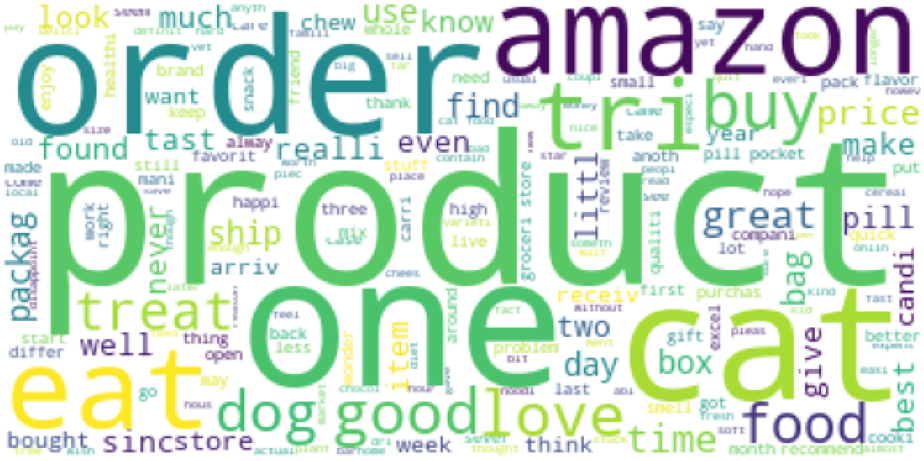


```
====================================================================================================
```

CLUSTER 2 FEATURES

```
display_data_C2=''

for i in C2:
  display_data_C2+=str(i)
wordcloud = WordCloud(background_color='white').generate(display_data_C2)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

```
====================================================================================================
```



```
====================================================================================================
```

For K=5

```
from sklearn.cluster import AgglomerativeClustering
k = 5
cluster_label=[]
```

```
cluster_label=[]
Agglo_Clustering = AgglomerativeClustering(n_clusters=k)
cluster_label=Agglo_Clustering.fit_predict(train_vectors)
```

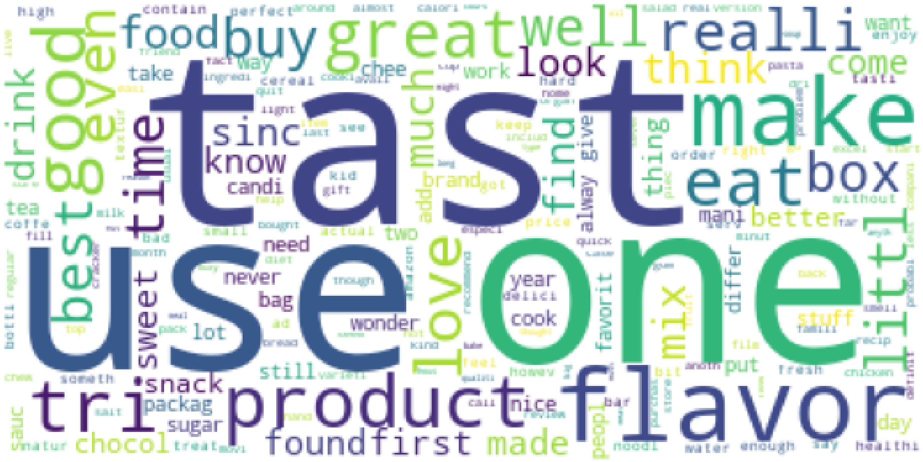
```
def display_data_agglo(cluster):
  display_data=''
  for i in cluster:
    display_data+=str(i)
  wordcloud = WordCloud(background_color='white').generate(display_data)
  print("="*100)
  plt.figure(figsize=(8,8),facecolor=None)
  plt.imshow(wordcloud)
  plt.axis("off")
  plt.tight_layout(pad = 0)
  plt.show()
  print("="*100)
```

```
C1,C2,C3,C4,C5 =[],[],[],[],[]

for i in range(Agglo_Clustering.labels_.shape[0]):
  if Agglo_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==1 :
    C2.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==2 :
    C3.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==3 :
    C4.append(final_data_new_array[i])
  else:
    C5.append(final_data_new_array[i])
```

CLUSTER 1 FEATURES

```
from wordcloud import WordCloud
import matplotlib.pyplot as plt
display_data_agglo(C1)
```

```
====================================================================================================
```

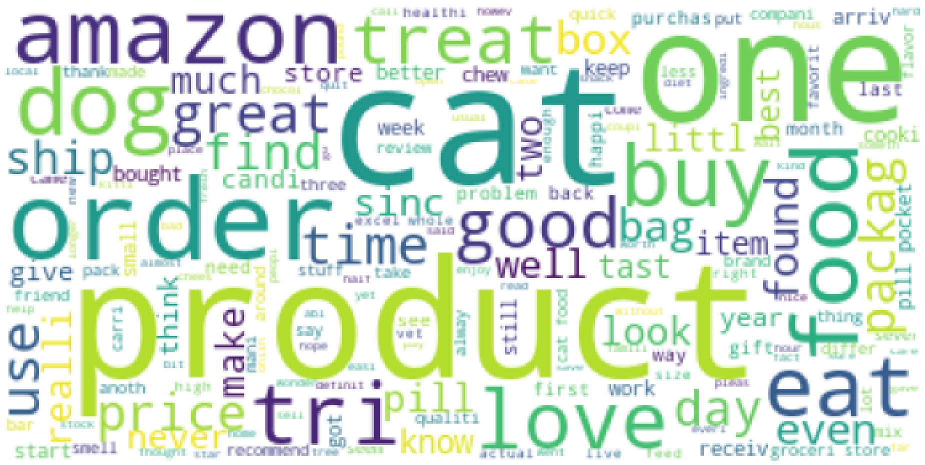


```
====================================================================================================
```

CLUSTER 2 FEATURES

```
display_data_agglo(C2)
```

```
====================================================================================================
```

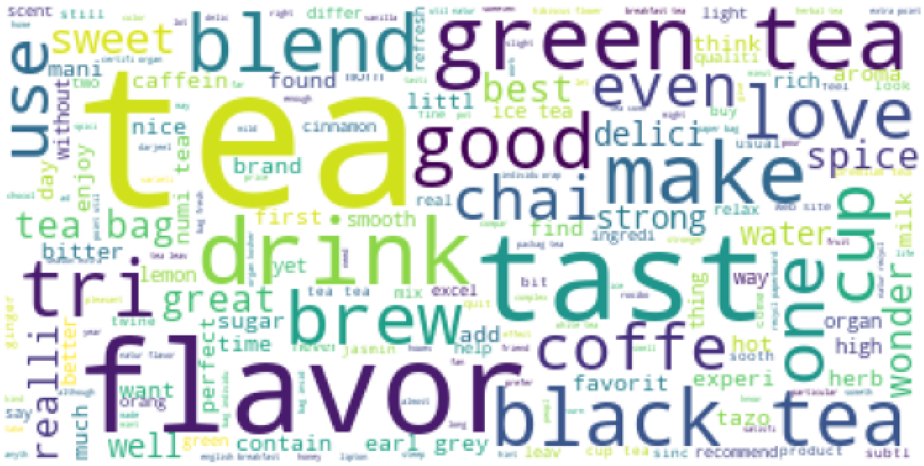


```
====================================================================================================
```

CLUSTER 3 FEATURES

```
display_data_agglo(C3)
```

```
====================================================================================================
```



```
====================================================================================================
```

CLUSTER 4 FEATURES

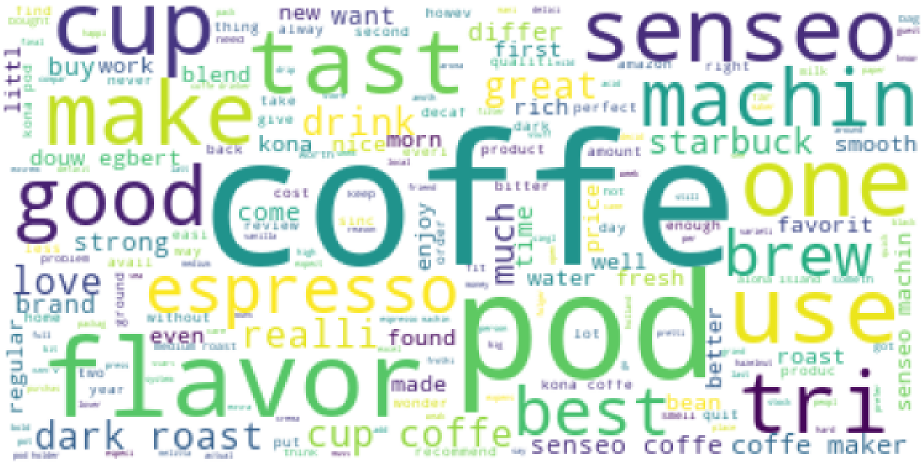
```
display_data_agglo(C4)
```

```
=========================================================================================================
```

CLUSTER 5 FEATURES

```
display_data_agglo(C5)
```

```
=========================================================================================================
```



```
=========================================================================================================
```

USING TF-IDF WORD2VEC FEATURIZATION TECHNIQUE

```
model_Avgw2v = TfidfVectorizer()
X_Train_Avgw2v=model_Avgw2v.fit_transform(final_data_new)
```

```
dictionary = dict(zip(model_Avgw2v.get_feature_names(), list(model_Avgw2v.idf_)))
```

```
tfidf_feature=model_Avgw2v.get_feature_names()

tfidf_sent_vectors_train=[];
row=0;

for sent in tqdm(list_of_sent_avgw2v_agglo):
    sent_vec=np.zeros(50)
    weight_sum=0;
    for word in sent :
        if word in w2v_words_svm_train and word in tfidf_feature :
            vec=w2v_model_train.wv[word]
            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_train.append(sent_vec)
    row+=1
```

```
100%|██████████| 5000/5000 [00:33<00:00, 150.70it/s]
```

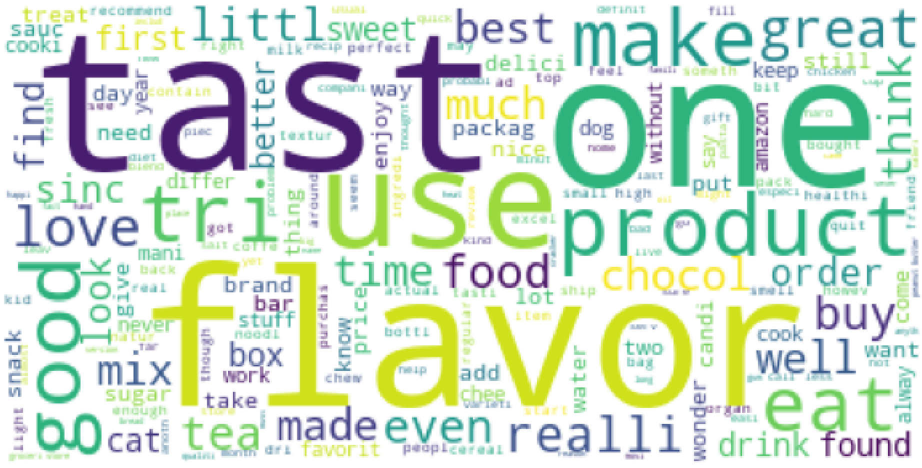
```
k = 2
cluster_label=[]
Agglo_Clustering = AgglomerativeClustering(n_clusters=k)
cluster_label=Agglo_Clustering.fit_predict(tfidf_sent_vectors_train)
```

```
C1,C2 =[],[]

for i in range(Agglo_Clustering.labels_.shape[0]):
  if Agglo_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  else:
    C2.append(final_data_new_array[i])
```

CLUSTER 1 FEATURES

```
display_data_agglo(C1)
```

```
=====================================================================================================
```

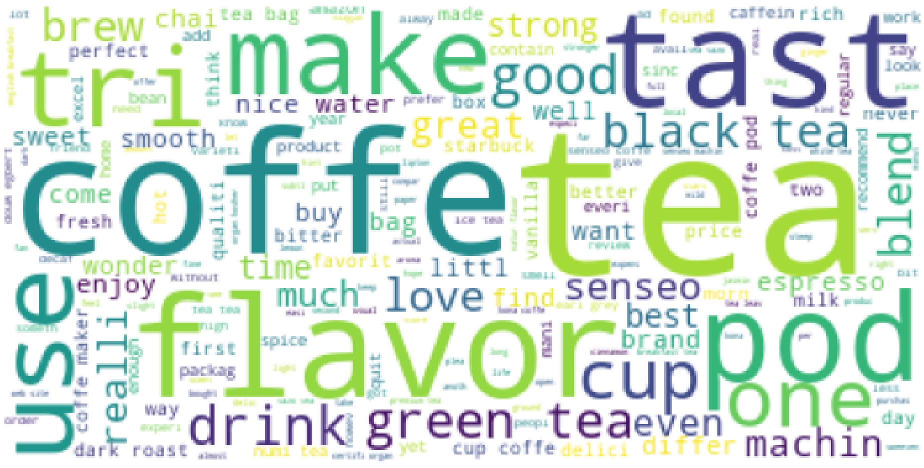


```
=====================================================================================================
```

CLUSTER 2 FEATURES

```
display_data_agglo(C2)
```

```
=====================================================================================================
```



```
=====================================================================================================
```

```
k = 5
cluster_label=[]
Agglo_Clustering = AgglomerativeClustering(n_clusters=k)
cluster_label=Agglo_Clustering.fit_predict(tfidf_sent_vectors_train)
```

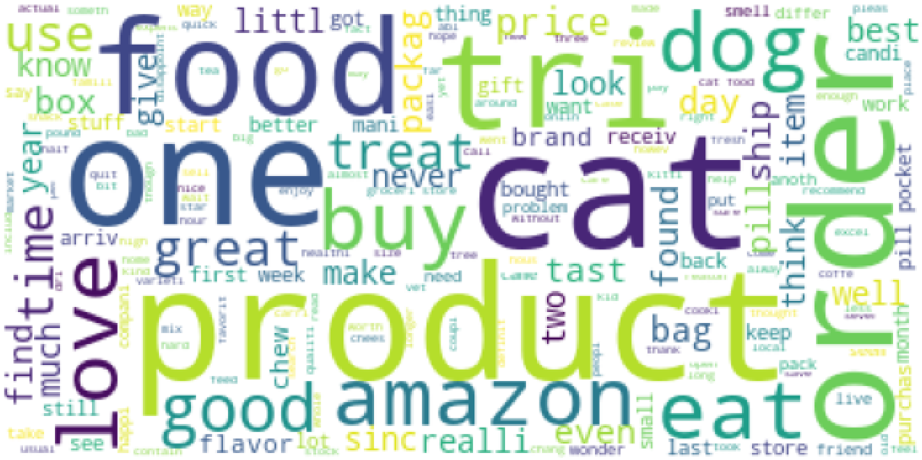
```
C1,C2,C3,C4,C5 =[],[],[],[],[]
```

```
C1,C2,C3,C4,C5 =[],[],[],[],[]

for i in range(Agglo_Clustering.labels_.shape[0]):
  if Agglo_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==1 :
    C2.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==2 :
    C3.append(final_data_new_array[i])
  elif Agglo_Clustering.labels_[i]==3 :
    C4.append(final_data_new_array[i])
  else:
    C5.append(final_data_new_array[i])
```

CLUSTER 1 FEATURES

```
display_data_agglo(C1)
```

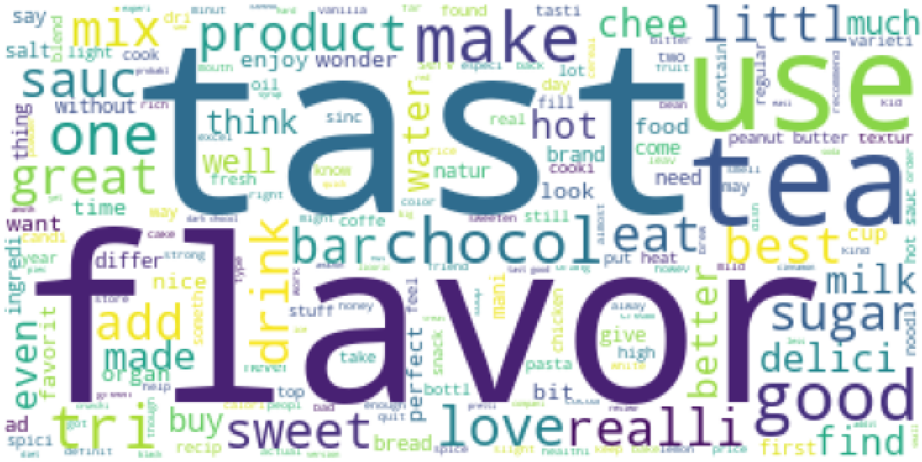
```
====================================================================================================
```



```
====================================================================================================
```

```
display_data_agglo(C2)
```

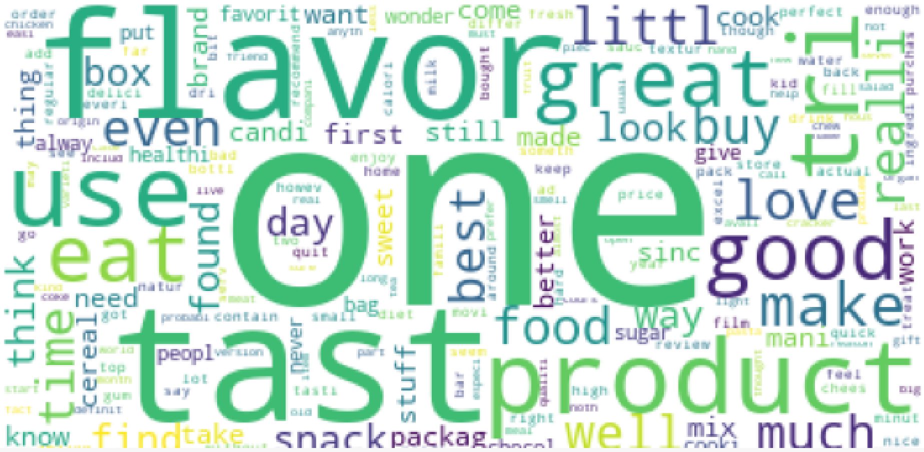
```
====================================================================================================
```



```
====================================================================================================
```

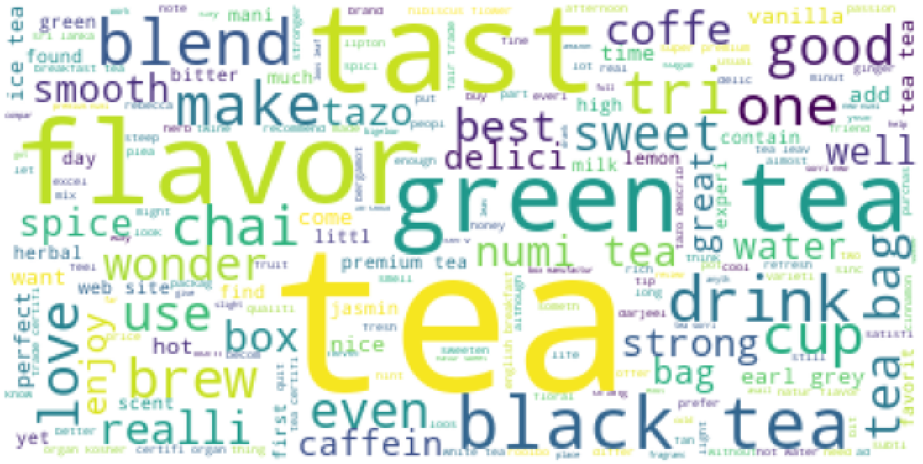
```
display_data_agglo(C3)
```

```
========================================================================================================================
```



```
display_data_agglo(C4)
```

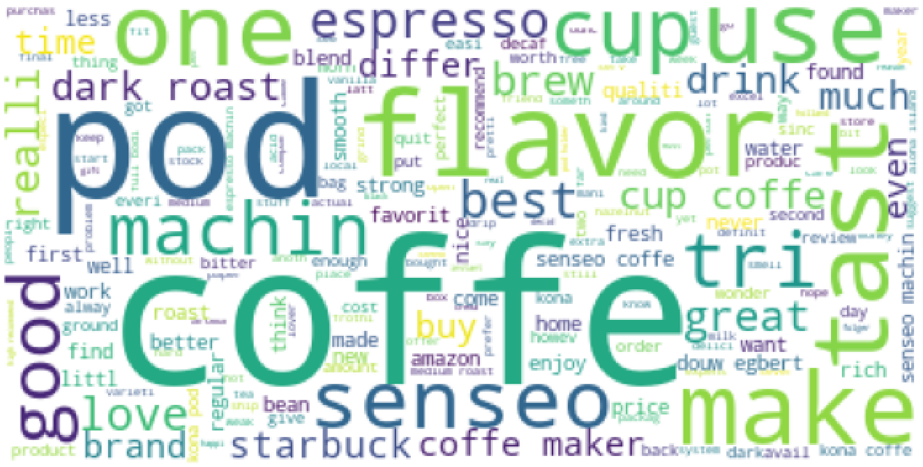
```
========================================================================================================================
```



```
========================================================================================================================
```

```
display_data_agglo(C5)
```

```
========================================================================================================================
```



```
========================================================================================================================
```

DBSCAN CLUSTERING ALGORITHM

USING AVGWORD2VEC FEATURIZATION TECHNIQUE APPLY DBSCAN CLUSTERING TECHNIQUE TO F BEST HYPERPARAMETER

```
from sklearn.cluster import DBSCAN


cluster_label=[]
dbscan_Clustering = DBSCAN(eps=0.5,n_jobs=-1,algorithm='kd_tree')
dbscan_Clustering.fit(train_vectors)
print('No Of Clusters' ,len(set(dbscan_Clustering.labels_)))
```

```
No Of Clusters 2
```

No of Cluster for eps = 0.5 is 2

```
print('Cluster are ignored',set(dbscan_Clustering.labels_))
```

```
Cluster are ignored {0, -1}
```

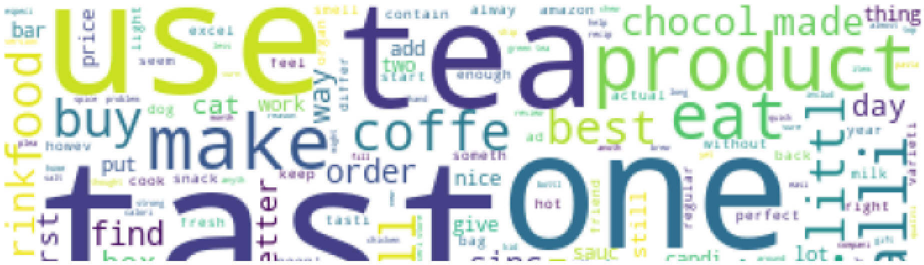
```
C1,C2 =[],[]

for i in range(dbscan_Clustering.labels_.shape[0]):
  if dbscan_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  else:
    C2.append(final_data_new_array[i])
```

For K=2

CLUSTER 1 FEATURES

```
display_data=''

for i in C1:
  display_data+=str(i)

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wordcloud = WordCloud(background_color='white').generate(display_data)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

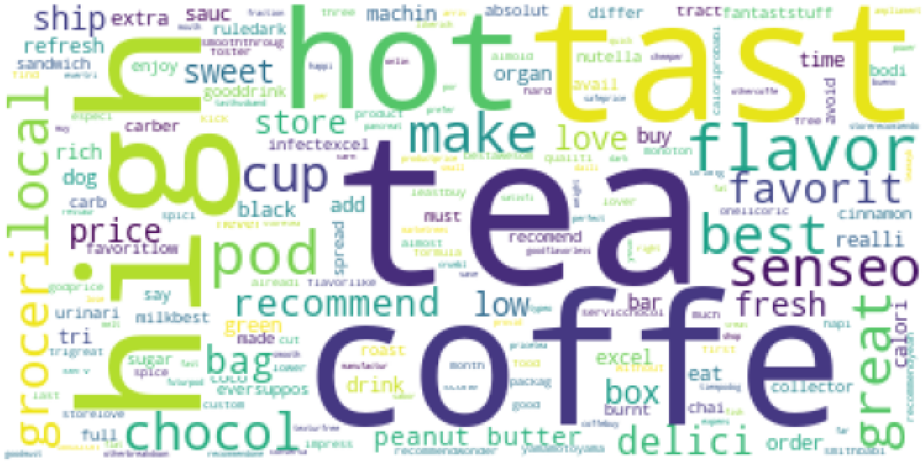
```
====================================================================================================
```



CLUSTER 2 FEATURES

```
display_data=''

for i in C2:
  display_data+=str(i)

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wordcloud = WordCloud(background_color='white').generate(display_data)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

```
====================================================================================================
```



```
====================================================================================================
```

USING TF-IDF FEATURIZATION TECHNIQUE APPLY DBSCAN CLUSTERING TECHNIQUE TO FIND THE HYPERPARAMETER

```
dbscan_Clustering = DBSCAN(eps=0.1,n_jobs=-1,algorithm='kd_tree')
dbscan_Clustering.fit(tfidf_sent_vectors_train)
print('No Of Clusters' ,len(set(dbscan_Clustering.labels_)))
```

```
No Of Clusters 10
```

```
dbscan_Clustering = DBSCAN(eps=0.5,n_jobs=-1,algorithm='kd_tree')
dbscan_Clustering.fit(tfidf_sent_vectors_train)
print('No Of Clusters' ,len(set(dbscan_Clustering.labels_)))
```

```
No Of Clusters 2
```

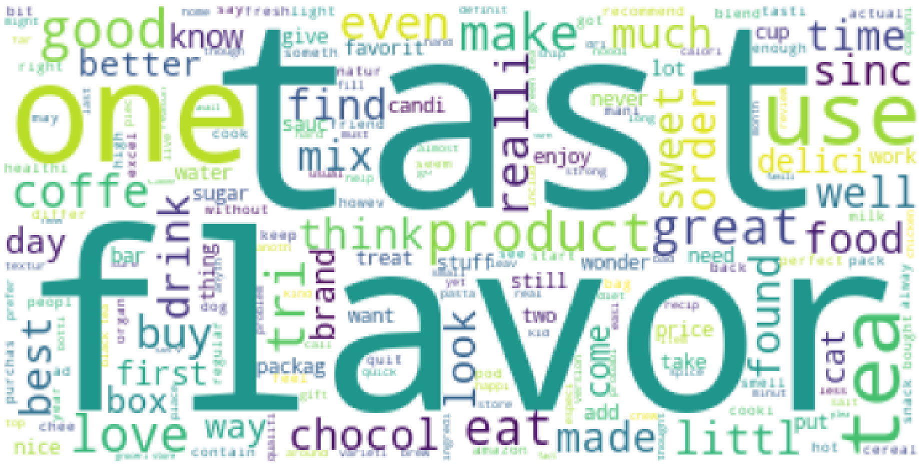
```
dbscan_Clustering = DBSCAN(eps=1,n_jobs=-1,algorithm='kd_tree')
dbscan_Clustering.fit(tfidf_sent_vectors_train)
print('No Of Clusters' ,len(set(dbscan_Clustering.labels_)))
```

```
No Of Clusters 2
```

```
C1,C2 =[],[]

for i in range(dbscan_Clustering.labels_.shape[0]):
  if dbscan_Clustering.labels_[i]==0 :
    C1.append(final_data_new_array[i])
  else:
    C2.append(final_data_new_array[i])
```

```
display_data=''

for i in C1:
  display_data+=str(i)

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wordcloud = WordCloud(background_color='white').generate(display_data)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

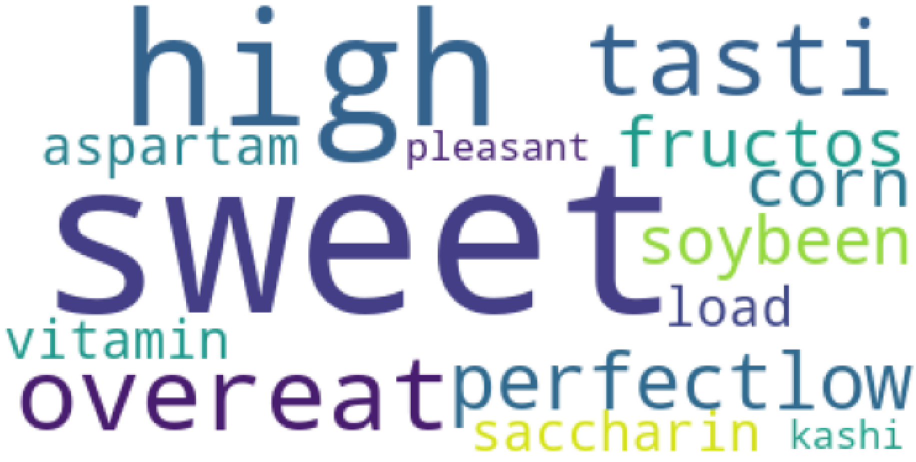
```
====================================================================================================
```



```
====================================================================================================
```

```
display_data=''

for i in C2:
  display_data+=str(i)

from wordcloud import WordCloud
import matplotlib.pyplot as plt
wordcloud = WordCloud(background_color='white').generate(display_data)
print("="*100)
plt.figure(figsize=(8,8),facecolor=None)
plt.imshow(wordcloud)
plt.axis("off")
plt.tight_layout(pad = 0)
plt.show()
print("="*100)
```

```
====================================================================================================
```



```
====================================================================================================
```

```
from prettytable import PrettyTable

x = PrettyTable()
x.field_names = ["Clustering Algorithm Technique","Vectorizer","Best k"]
x.add_row(['KMeans','BOW','3'])
x.add_row(['KMeans','TFIDF','5'])
x.add_row(['KMeans','AVG W2vec','5'])
x.add_row(['KMeans','TFIDF W2vec','3'])
x.add_row(['AGGLOMERATIVE','AVGWORD2VEC','(2,5)'])
x.add_row(['AGGLOMERATIVE','TFIDFW2vec','(2,5)'])
x.add_row(['DBSCAN','AVGW2vec(eps =0.5)','2'])
x.add_row(['DBSCAN','TFIDFW2vec(eps=0.1)','10'])
x.add_row(['DBSCAN','TFIDFW2vec(eps=0.5)','2'])
x.add_row(['DBSCAN','TFIDFW2vec(eps=1)','2'])
print(x)
```

```
+--------------------------------+---------------------+--------+
| Clustering Algorithm Technique |      Vectorizer     | Best k |
+--------------------------------+---------------------+--------+
|             KMeans             |         BOW         |   3    |
|             KMeans             |        TFIDF        |   5    |
|             KMeans             |      AVG W2vec      |   5    |
|             KMeans             |     TFIDF W2vec     |   3    |
|         AGGLOMERATIVE          |     AVGWORD2VEC     | (2,5)  |
|         AGGLOMERATIVE          |      TFIDFW2vec     | (2,5)  |
|             DBSCAN             |  AVGW2vec(eps =0.5) |   2    |
|             DBSCAN             | TFIDFW2vec(eps=0.1) |   10   |
|             DBSCAN             | TFIDFW2vec(eps=0.5) |   2    |
|             DBSCAN             |  TFIDFW2vec(eps=1)  |   2    |
+--------------------------------+---------------------+--------+
```