Objective :

applying TSNE on :

1.BOW
2.TF_IDF
3.Average WORD2VEC
4.TF_IDF WORD2VEC

In [48]:

```
import sqlite3 as s
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.manifold import TSNE
```

Establishing connection and selecting all the data from reviews

In [4]:

```
con=s.connect("database.sqlite")

data=pd.read_sql_query("select * from Reviews",con)
```

In [5]:

```
data.shape
```

Out[5]:

```
(568454, 10)
```

In [6]:

```
#function to change the score to positive/negative
def change(x):
    if x<3:
        return 'negative'
    else:
        return 'positive'
```

In [7]:
```
#changing the score(calling the change function)
a_s=data.Score
a_s=a_s.map(change)
data.Score=a_s
data.Score.head(10)
```

Out[7]:
```
0    positive
1    negative
2    positive
3    negative
4    positive
5    positive
6    positive
7    positive
8    positive
9    positive
Name: Score, dtype: object
```

Data cleaning

It is needed to remove some unwanted things in the dataset,such as duplicates.

In [8]:
```
#sorting the values by product ids
data=data.sort_values("ProductId")
```

In [9]:
```
f=data[data.HelpfulnessNumerator<=data.HelpfulnessDenominator]
f.shape
```

Out[9]:
```
(568452, 10)
```

In [10]:
```
#removing the duplicates from the data
final_data=f.drop_duplicates(subset={"UserId","Text","ProfileName","Time"},keep="
```

In [11]:
```
#selecting positive and negative review data
p_data=final_data[final_data.Score=="positive"]
n_data=final_data[final_data.Score=="negative"]
```

In [12]:
```
print(p_data.shape)
print(n_data.shape)
```

```
(336824, 10)
(57107, 10)
```

In [13]:
```
#selecting 2000 points each
p_data=p_data.head(2000)
n_data=n_data.head(2000)
```

In [14]:
```
#concatenating the positive and negative data
d=pd.concat((p_data,n_data))
print(d.shape)
```

```
(4000, 10)
```

In [15]:
```
d.Score.value_counts()
```

Out[15]:
```
positive    2000
negative    2000
Name: Score, dtype: int64
```

Data preprocessing

Here the data is made ready to work on it.
removing html tags and puctuations

In [16]:
```
#finding html tags
import re
i=0
for s in d.Text.values:
    if (len(re.findall("<.*?>",s))):
        print(i)
        print(s)
    i+=1
```

```
the funny little stories with accompanying pictures make for an ideal bedtime
read. This isn't nearly as good as some of Sendak's other books (like Where t
he Wild Things are or Pierre: The Boy Who Didn't Care), but it still carries
his unique brand of charm.
9
This is a wonderful little book. I loved it 40 years ago and my twins love it
now. They enjoy helping me finish each month by singing "... chicken soup wit
h rice!"<br /><br />The cute drawings add to the fun -- but be warned, one of
them is very un-PC! We're not in 1962 any more, Toto.
10
One of my earliest memories is of this book.  My mother, who read to us const
antly, read this one to us, and we quoted it non-stop.  In fact, that was a t
ypical sort of soup we would beg for at the grocery because of this book!<br
/><br />Since then, I have used the book in every class/teaching situation I
have been in.  I have never met a child who did not LOVE it, and ask to be re
ad it again and again.  It sure beats all those stupid songs you sing in pres
chool about the months of the year! :)  Even if you are not a Maurice Sendak
fan, you will enjoy this one, because it is so original and poetic.
13
These days, when a person says, "chicken soup" they're probably going to foll
```

In [17]:
```
import string
from nltk.corpus import stopwords
from nltk.stem import SnowballStemmer
```

In [18]:

```
#stopwords
stop_words=set(stopwords.words("english"))
#initializing snowball stemmer
sno=SnowballStemmer("english")
```

In [19]:

```
#function to remove html tags
def cleanhtml(s):
    cleanr=re.compile("<.*?>")
    cleant=re.sub(cleanr," ",s)
    return cleant
```

In [20]:

```
#funtion to remove punctuation and special character
def cleanpunc(s):
    cleaned = re.sub(r'[?|!|\'|"|#]',r'',s)
    cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
    return  cleaned
```

In [21]:

```
i=0
final=[]
p=[]
n=[]
for s in d.Text.values:
    f=[]
    c=cleanhtml(s)
    for w in cleanpunc(c).split():
        if w.isalpha() and len(w)>2:
            if w not in stop_words:
                sne=(sno.stem(w.lower())).encode('utf-8')
                f.append(sne)
                if (d.Score.values)[i]=="positive":
                    p.append(sne)
                if (d.Score.values)[i]=="negative":
                    n.append(sne)
            else:
                continue
        else:
            continue
    te=b" ".join(f)
    final.append(te)
    i+=1
```

In [22]:

```
#adding the preprocessed data into another column
d["cleaned"]=final
```

In [23]:
```
#checking if column was added
d
```

7	150508	0006641040	AZGXZ2UUK6X	Catherine Hallberg "(Kate)"	1	1	pc
8	150509	0006641040	A3CMRKGE0P909G	Teresa	3	4	pc
9	150500	0006641040	A1IJKK6Q1GTEAY	A Customer	2	2	pc

In [24]:
```
import sqlite3
conn=sqlite3.connect("assignment2.sqlite")
c=conn.cursor()
conn.text_factory=str
d.to_sql('Reviews',conn,if_exists='replace',index=True)
```

we just saved the dataframe into file for any further use.

Bag of words

In [25]:
```
from sklearn.feature_extraction.text import CountVectorizer
#considering both unigram and bigram
count_vect=CountVectorizer(ngram_range=(1,2))
```

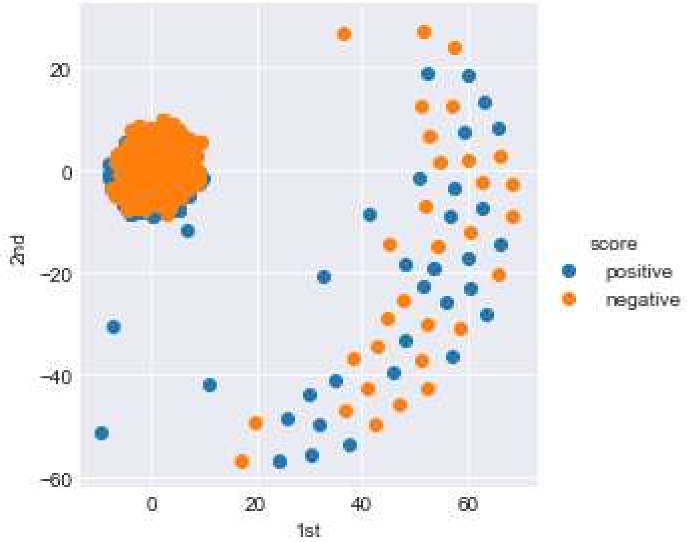
In [26]:
```
bag=count_vect.fit_transform(d.cleaned)
print(bag.shape)
```

```
(4000, 136218)
```

In [64]:
```
model=TSNE(n_components=2,random_state=0)
tbag=model.fit_transform(bag.todense())
```

In [66]:
```
#vertical stacking of score
score=d.Score
new=np.vstack((tbag.T,score)).T
```

In [67]:
```
#coverting new to dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,"1st","2nd").add_legend()
plt.show()
```

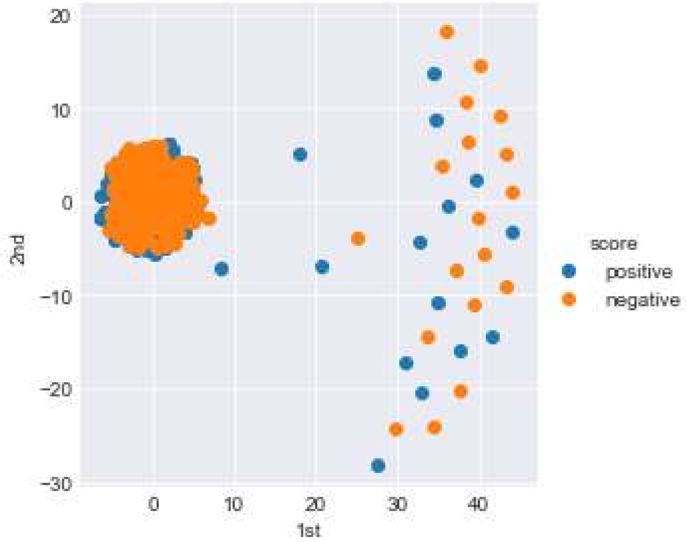


This plot was with default perplexity and iterations.This plot looks overlapped but this can happen if they overlap in 3D.lets check TSNE with different values of perplexity and iterations.

In [69]:
```
model=TSNE(n_components=2,random_state=0,perplexity=100,n_iter=1000)
tbag=model.fit_transform(bag.todense())
```

In [70]:
```
#vertical stacking of score
score=d.Score
new=np.vstack((tbag.T,score)).T
```

In [71]:
```
#coverting new to dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,"1st","2nd").add_legend()
plt.show()
```



This plot is with perplexity=100 and iterations =1000

We are not able to differentiate it.May be in 3D it can be differentiated with plane.

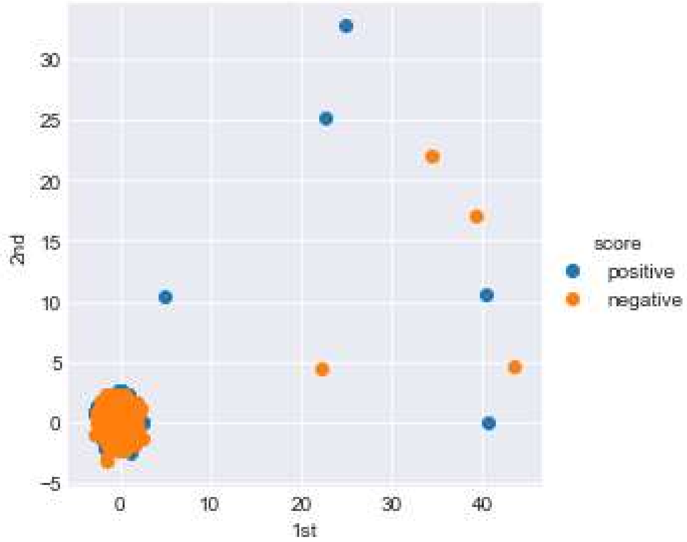
In [73]:
```
model=TSNE(n_components=2,random_state=0,perplexity=1000,n_iter=3000)
tbag=model.fit_transform(bag.todense())
```

```
C:\Users\himateja\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:371: Ru
ntimeWarning: invalid value encountered in sqrt
  result = np.sqrt(dist[sample_range, neigh_ind]), neigh_ind
```

In [74]:
```
#vertical stacking of score
score=d.Score
new=np.vstack((tbag.T,score)).T
```

In [75]:

```
#coverting new to dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,"1st","2nd").add_legend()
plt.show()
```



This plot is with perplexity=1000 and iterations=3000.
here the outliers got reduced ,but still the plot is overlapped.

In [76]:

```
model=TSNE(n_components=2,random_state=0,perplexity=4000,n_iter=1000)
tbag=model.fit_transform(bag.todense())
```

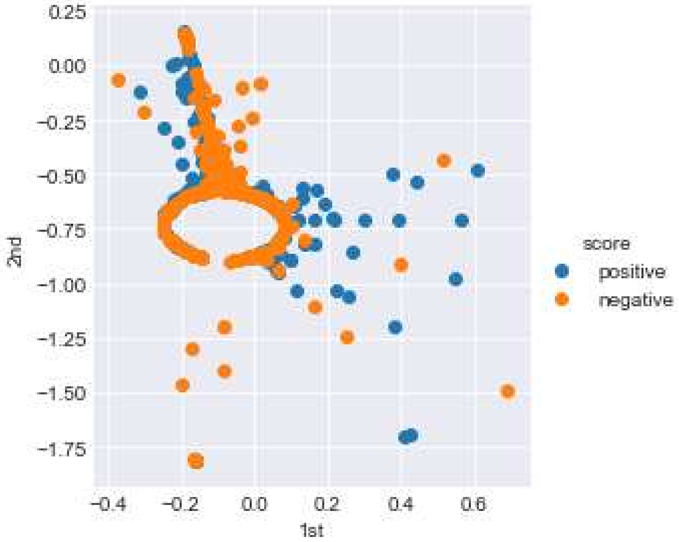
```
C:\Users\himateja\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:371: Ru
ntimeWarning: invalid value encountered in sqrt
  result = np.sqrt(dist[sample_range, neigh_ind]), neigh_ind
```

In [77]:

```
#vertical stacking of score
score=d.Score
new=np.vstack((tbag.T,score)).T
```

In [78]:

```
#coverting new to dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,"1st","2nd").add_legend()
plt.show()
```



This plot is with interesting perplexity of 4000 (we have 4000 datapoints),iterations=1000.
When we use all datapoints the graphs becomes unsensible ,so we should not use all the points.

tfidf

In [27]:

```
from sklearn.feature_extraction.text import TfidfVectorizer
```

In [28]:

```
tfidf=TfidfVectorizer(ngram_range=(1,2))
```

In [29]:

```
tfdata=tfidf.fit_transform(d.cleaned)
```

In [86]:

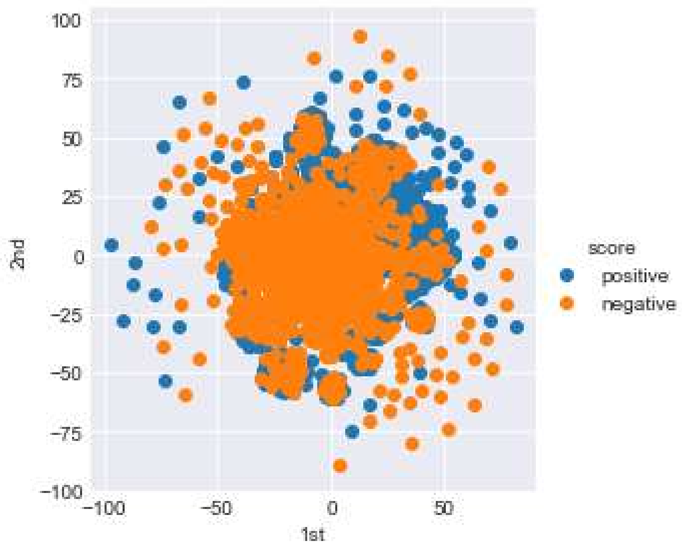
```
model=TSNE(n_components=2,random_state=0)
tf=model.fit_transform(tfdata.todense())
```

In [87]:

```
score=d.Score
new=np.vstack((tf.T,score)).T
```

In [89]:

```
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```



This plot is with default perplexity and iterations
The plot is overlapped , may be this can be separated by a plane in 3D

In [90]:

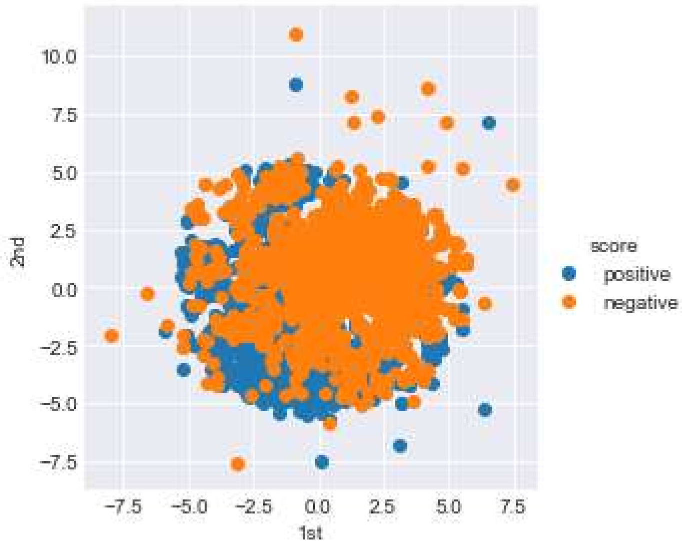
```
model=TSNE(n_components=2,random_state=0,perplexity=1000,n_iter=1000)
tf=model.fit_transform(tfdata.todense())
```

In [91]:

```
score=d.Score
new=np.vstack((tf.T,score)).T
```

In [92]:

```
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```

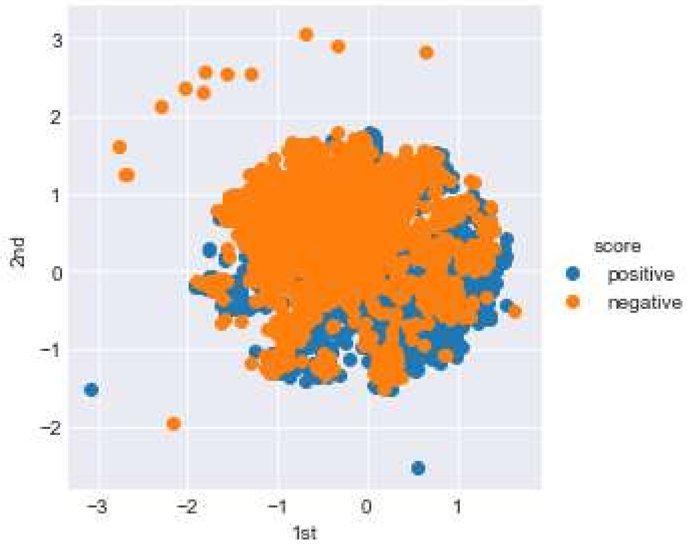


This plot is with perplexity =1000 and iterations =1000.
this plot is also overlapped,but this seems to be better than the above plot as it has less outliers.

In [94]:
```
model=TSNE(n_components=2,random_state=0,perplexity=2000,n_iter=500)
tf=model.fit_transform(tfdata.todense())
```

In [ ]:
```
score=d.Score
new=np.vstack((tf.T,score)).T
```

In [97]:
```
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```



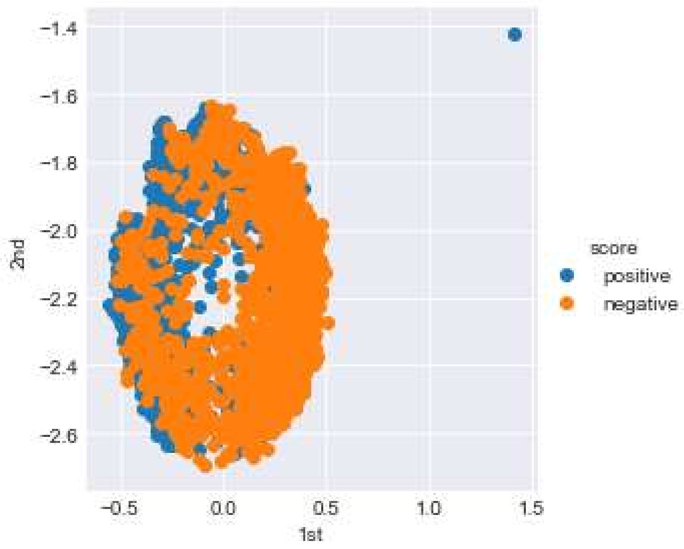
This plot is with perplexity=2000 and iterations=500
This plots seems to be better than previous as it has less outliers and mostly outliers are "negative".

In [101]:
```
model=TSNE(n_components=2,random_state=0,perplexity=3500,n_iter=2000)
tf=model.fit_transform(tfdata.todense())
```

In [102]:
```
score=d.Score
new=np.vstack((tf.T,score)).T
```

In [103]:

```
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```



This plot is with perplexity=3500 and iterations=2000
This one has only one outlier,this plot may be separated by plane in 3D

Word2Vec

In [32]:

```
from gensim.models import Word2Vec
import warnings
warnings.filterwarnings("ignore")
```

In [33]:

```
#making list of sentences
import string
i=0
list_s=[]
for s in d.Text.values:
    filtered=[]
    s=cleanhtml(s)
    for w in s.split():
        for c_w in cleanpunc(w).split():
            if c_w.isalpha():
                filtered.append(c_w.lower())
            else:
                continue
    list_s.append(filtered)
#training our own model
w2v_model=Word2Vec(list_s,min_count=5,size=50,workers=4)
```

In [34]:

```
print(w2v_model)

print(len(w2v_model.wv.vocab))
```

```
Word2Vec(vocab=4419, size=50, alpha=0.025)
4419
```

In [35]:

```
w2v_model.wv.most_similar("delicious")
```

Out[35]:

```
[('positive', 0.9945021867752075),
 ('durable', 0.9935411214828491),
 ('powerful', 0.990723729133606),
 ('safe', 0.990662693977356),
 ('perhaps', 0.9896670579910278),
 ('extremely', 0.9890426993370056),
 ('certain', 0.9881437420845032),
 ('vegan', 0.9876738786697388),
 ('sweetened', 0.9873123168945312),
 ('hazelnut', 0.9872627258300781)]
```

In [36]:

```
w2v_model.wv.similarity("delicious","yummy")
```

Out[36]:

```
0.9849248
```

Average word2vec

In [130]:

```
#creating avg word2vec
sv=[]
for s in list_s:
    sum=np.zeros(50)
    i=0
    for w in s:
        try:

            x=w2v_model.wv[w]
            sum+=x
            i+=1
        except:
            pass
    sum/=i
    sv.append(sum)

#cheking the dimension
print(len(sv))
print(len(sv[0]))
```

```
4000
50
```

In [131]:

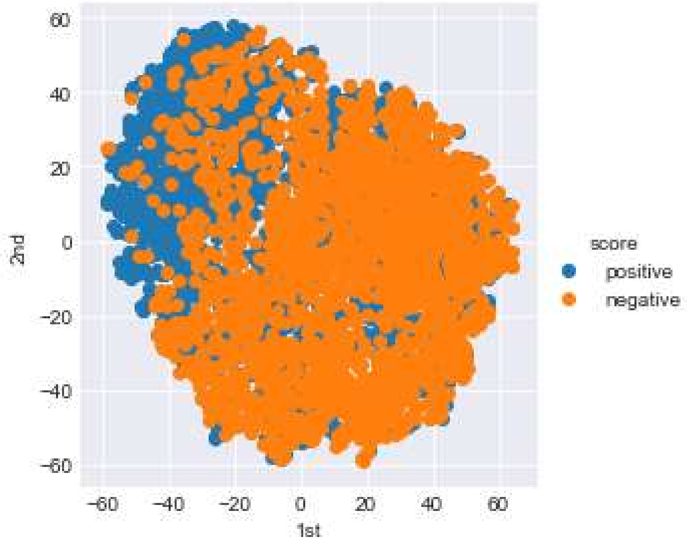
```
model=TSNE(n_components=2,random_state=0)
ww=model.fit_transform(np.asarray(sv))
```

In [132]:

```
score=d.Score
new=np.vstack((ww.T,score)).T
```

In [133]:

```
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```



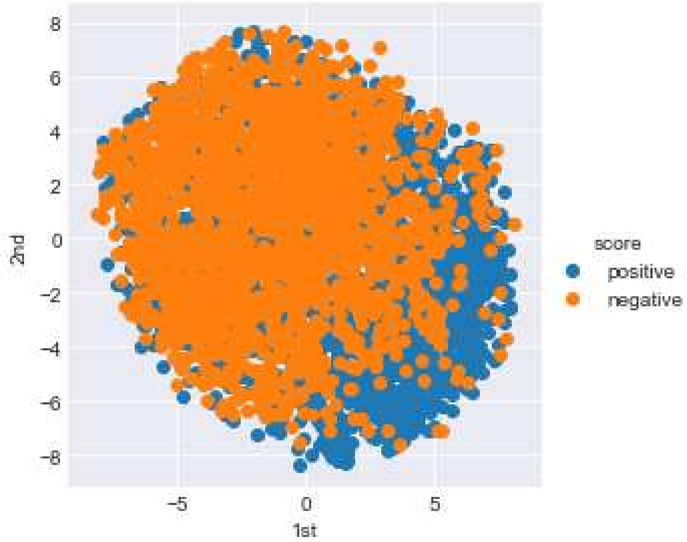
In [135]:

```
model=TSNE(n_components=2,random_state=0,perplexity=500,n_iter=500)
ww=model.fit_transform(np.asarray(sv))
```

In [136]:

```
#vertical stacking
score=d.Score
new=np.vstack((ww.T,score)).T
```

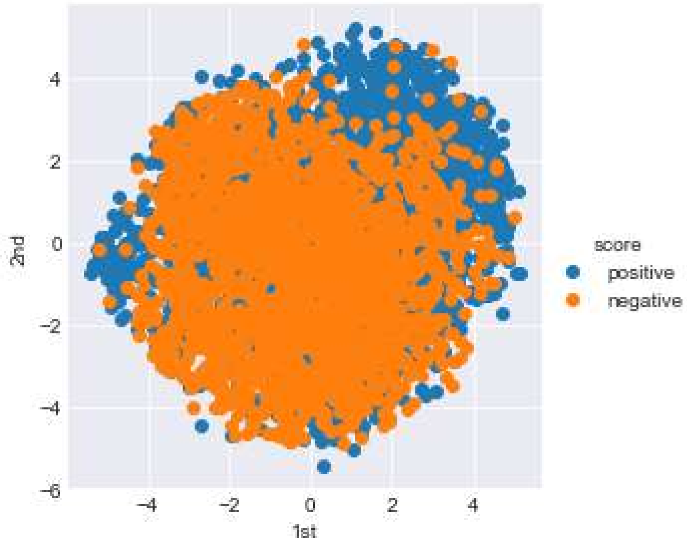
```
In [137]: #plotting dataframe with seaborn
          df=pd.DataFrame(new,columns=['1st','2nd','score'])
          sns.set_style("darkgrid")
          sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
          plt.show()
```



```
In [138]: model=TSNE(n_components=2,random_state=0,perplexity=1000,n_iter=2000)
          ww=model.fit_transform(np.asarray(sv))
```

```
In [139]: #vertical stacking
          score=d.Score
          new=np.vstack((ww.T,score)).T
```

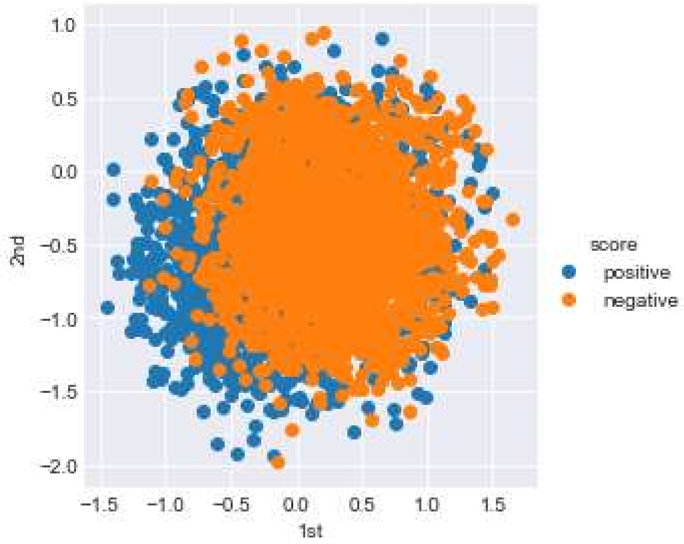
```
In [140]: #plotting dataframe with seaform
          df=pd.DataFrame(new,columns=['1st','2nd','score'])
          sns.set_style("darkgrid")
          sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
          plt.show()
```



```
In [141]: model=TSNE(n_components=2,random_state=0,perplexity=3500,n_iter=5000)
          ww=model.fit_transform(np.asarray(sv))
```

```
In [142]: #vertical stacking
          score=d.Score
          new=np.vstack((ww.T,score)).T
```

```
In [143]: #creating dataframe and plotting with seaborn
          df=pd.DataFrame(new,columns=['1st','2nd','score'])
          sns.set_style("darkgrid")
          sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
          plt.show()
```



All the plots in avg word2vec are similar,they are overlapped .
These plots may be differentiated by a plane in 3D.(probably)

Tf-idf Word2Vec

In [37]:

```
tfidf_feat = tfidf.get_feature_names()
tf=tfidf.fit_transform(d.Text.values)
tfidfsv = []
row=0;
for s in list_s:
    sum = np.zeros(50)
    i=0;
    for word in s:
        try:
            vec = w2v_model.wv[word]
            tf_idf = tfdata[row, tfidf_feat.index(word)]
            sum += (vec * tf_idf)
            i += tf_idf
        except:
            pass
    sum /= i
    tfidfsv.append(sum)
    row += 1
```

In [38]:

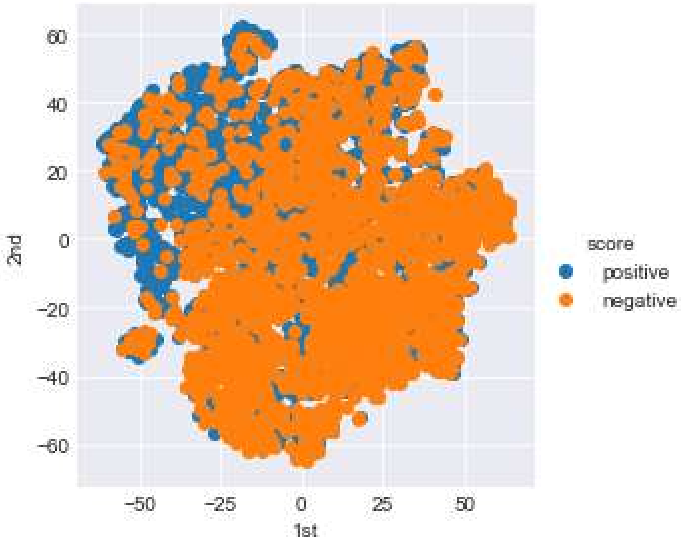
```
model=TSNE(n_components=2,random_state=0)
ww=model.fit_transform(np.asarray(tfidfsv))
```

In [39]:

```
#vertical stacking
score=d.Score
new=np.vstack((ww.T,score)).T
```

In [40]:

```
#creating dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```

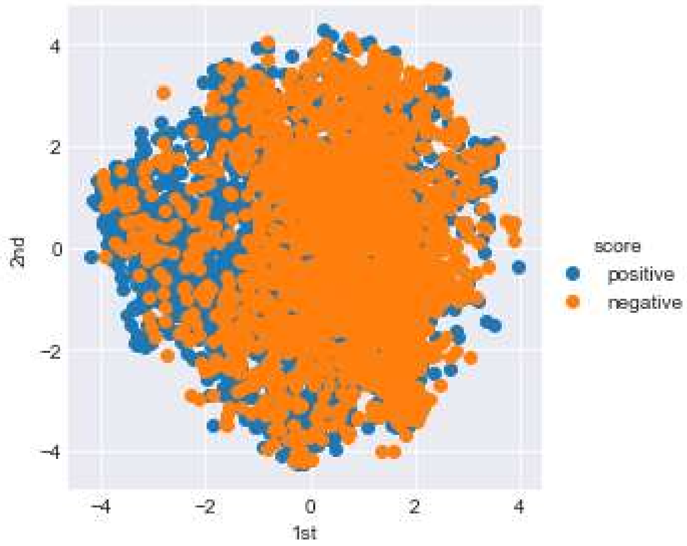


In [41]:

```
model=TSNE(n_components=2,random_state=0,perplexity=1500,n_iter=1000)
ww=model.fit_transform(np.asarray(tfidfsv))
```

In [42]:
```
#vertical stacking
score=d.Score
new=np.vstack((ww.T,score)).T
```

In [43]:
```
#creating dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```

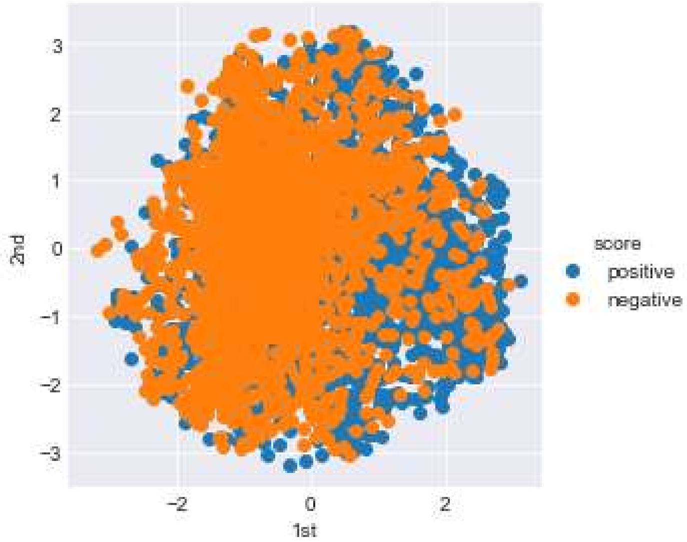


In [44]:
```
model=TSNE(n_components=2,random_state=0,perplexity=2000,n_iter=500)
ww=model.fit_transform(np.asarray(tfidfsv))
```

In [45]:
```
#vertical stacking
score=d.Score
new=np.vstack((ww.T,score)).T
```

In [46]:

```
#creating dataframe and plotting with seaborn
df=pd.DataFrame(new,columns=['1st','2nd','score'])
sns.set_style("darkgrid")
sns.FacetGrid(df,hue="score",size=4).map(plt.scatter,'1st','2nd').add_legend()
plt.show()
```



Tfidf word2vec also seems to similar they are overlapping. It is not possible to differentiate in 2D,we need to differentiate it in > 2D.

In [ ]: