T-SNE on Amazon food reviews

May 2, 2018

0.1 T-SNE on Amazon food reviews

In [1]:
```
%matplotlib inline
import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer
from sklearn.decomposition import TruncatedSVD
from sklearn.preprocessing import StandardScaler
```

In [2]:
```
#getting Cleaned data from Reviews table
conn = sqlite3.connect('final.sqlite')
final_amazon = pd.read_sql_query("""
SELECT *
FROM Reviews
""", conn)
```

In [3]:
```
#importing TSNE
from sklearn.manifold import TSNE
from MulticoreTSNE import MulticoreTSNE as MTSNE
```

In [4]:
```
#stacking with score
def Stacking_df(x,y):
    '''
    return dataframe after concatinating  and y
    '''
    out_2d5 = np.hstack((x,y))
    return pd.DataFrame(out_2d5,columns=['one','two','score'])
```

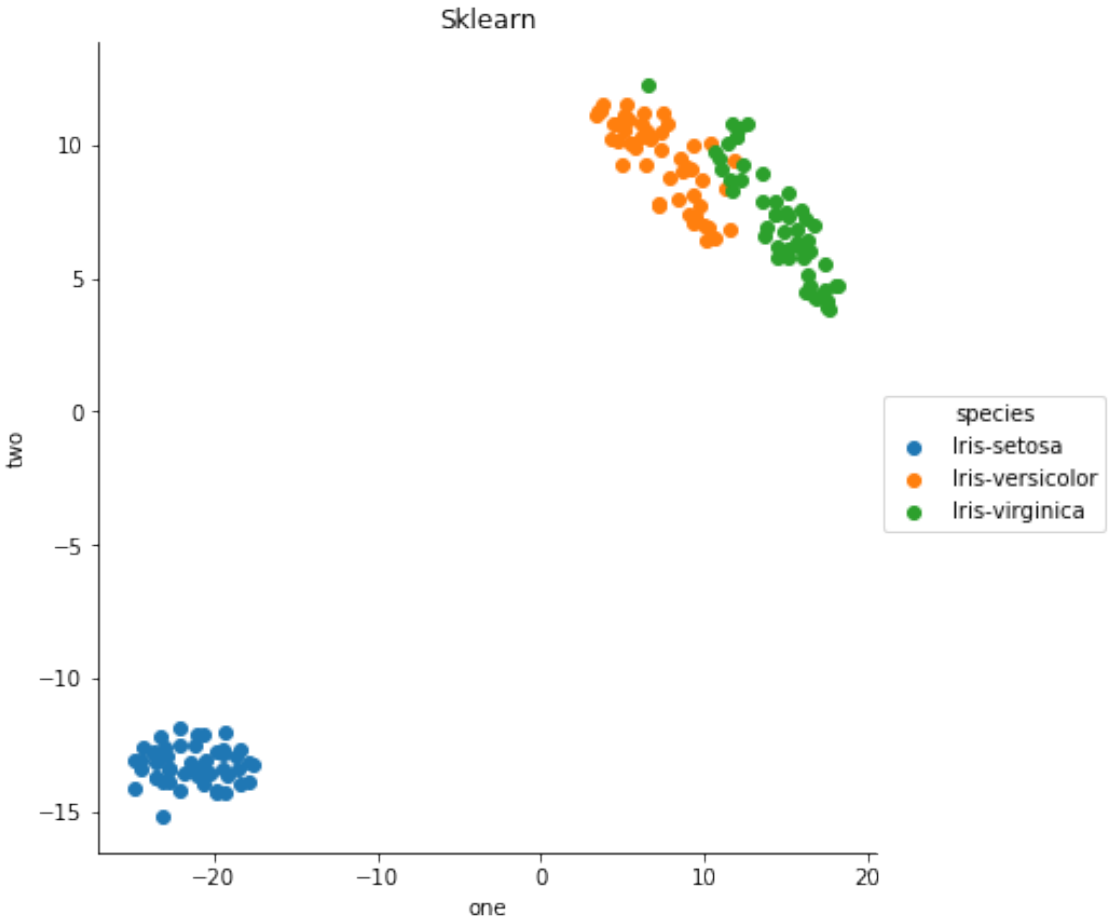
While searching for optimization of tsne issues for Sklean i found intersting post https://github.com/scikit-learn/scikit-learn/issues/10044 , https://gist.github.com/lmcinnes/023443d7e249689cb968f36570447950 after that i checked with iris data with both `Sklearn` and `Multicore-TSNE` and results are much similar and and found resutls as below.

```
In [4]: col = ['sepal_length', 'sepal_width', 'petal_length', 'petal_width','species']

In [5]: #Reading iris data
        dta = pd.read_csv(
        'https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data',
            header=None,names=col)

In [6]: dta.head()
```

Out[6]:

	sepal_length	sepal_width	petal_length	petal_width	species
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

```
In [7]: %%timeit
        X = TSNE(n_components=2,perplexity=30,n_iter=1000).\
        fit_transform(dta[['sepal_length', 'sepal_width',
                           'petal_length', 'petal_width']])

1.88 s ś 167 ms per loop (mean ś std. dev. of 7 runs, 1 loop each)


In [8]: X = TSNE(n_components=2,perplexity=30,n_iter=1000).\
        fit_transform(dta[['sepal_length', 'sepal_width',
                           'petal_length', 'petal_width']])

In [9]: out = np.hstack((X,dta['species'].values.reshape(-1,1)))
        df = pd.DataFrame(out,columns=['one','two','species'])

In [10]: sns.FacetGrid(df, hue="species", size=6).\
         map(plt.scatter,'one','two').add_legend()
         plt.title('Sklearn')

Out[10]: Text(0.5,1,'Sklearn')
```




```
In [11]: %%timeit
         Y = MTSNE(n_components=2,perplexity=30,n_iter=1000).\
         fit_transform(dta[['sepal_length', 'sepal_width',
                            'petal_length', 'petal_width']])
```

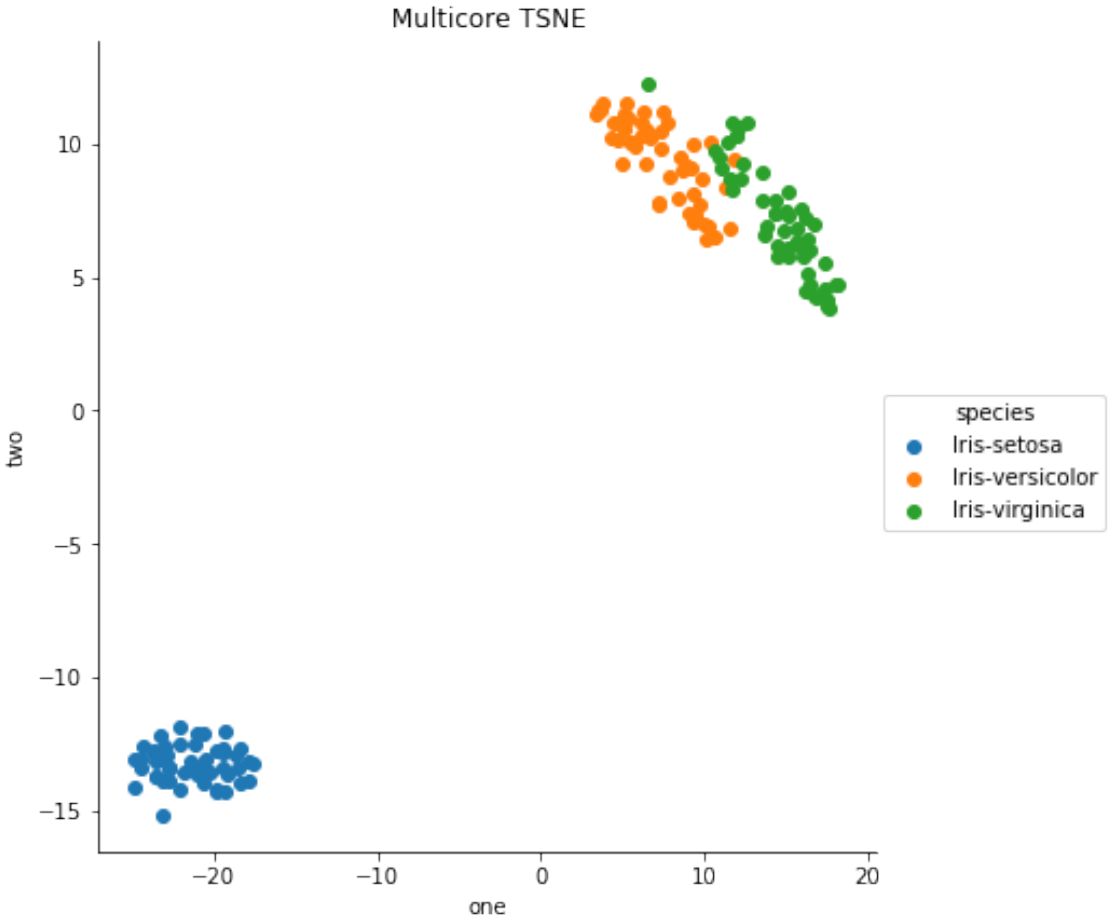
```
232 ms ś 21.6 ms per loop (mean ś std. dev. of 7 runs, 1 loop each)
```

```
In [12]: Y = MTSNE(n_components=2,perplexity=30,n_iter=1000).\
         fit_transform(dta[['sepal_length', 'sepal_width',
                            'petal_length', 'petal_width']])
```

```
In [13]: out1 = np.hstack((Y,dta['species'].values.reshape(-1,1)))
         df1 = pd.DataFrame(out,columns=['one','two','species'])
```

```
In [14]: sns.FacetGrid(df1, hue="species", size=6).\
         map(plt.scatter,'one','two').add_legend()
         plt.title('Multicore TSNE')
```

Out[14]: Text(0.5,1,'Multicore TSNE')



0.1.1 Bag of Words:

Cleaned data is in CleanedTextBow column of final_amazon data frame. for Bag of Words doing count vectorizer from scikit learn.

```
In [4]: #for BoW
        count_vect = CountVectorizer(dtype=np.int8) #in scikit-learn
        final_counts = count_vect.fit_transform(
            final_amazon['CleanedTextBow'].values)
```

```
In [5]: #Shape of sparse matrix
        final_counts.get_shape()
```

```
Out[5]: (364171, 108358)
```

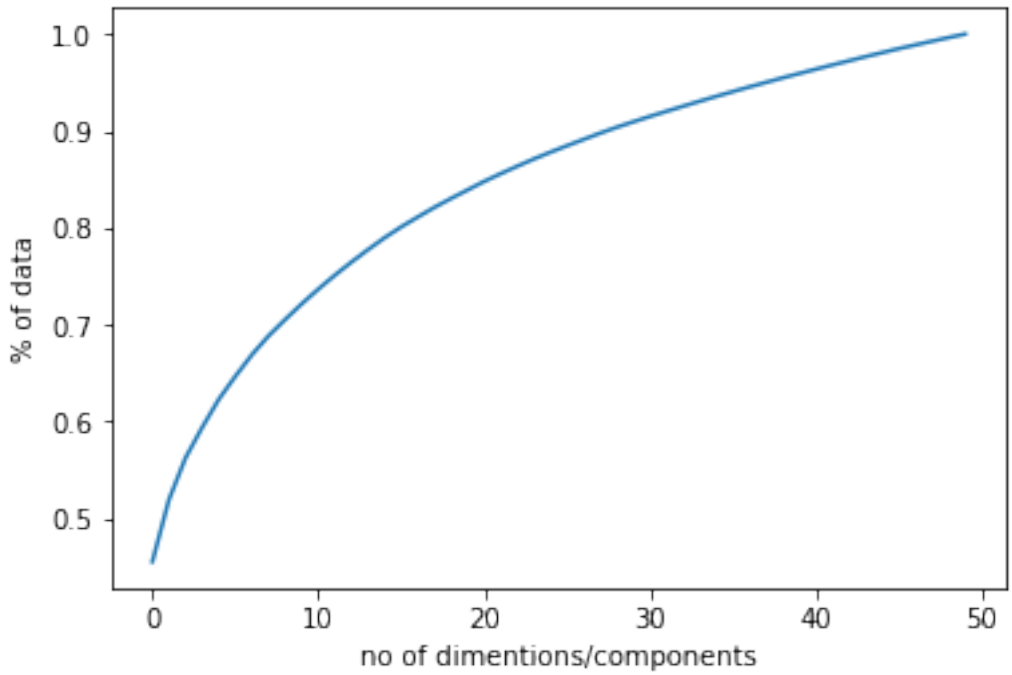
Because of large dataset and lack of powerful processor addressed issues with below two methods * Did TruncatedSVD ,got dimentions to 50 and then used that data to plot T-SNE. * Sampled data from original data and then used sampled data to plot T-SNE

1. SVD for Total data then TSNE

```
In [6]: #Trucated SVD for dimentonality reduction
        svd = TruncatedSVD(n_components=50, n_iter=7,
                           random_state=42).fit(final_counts)
        X_svd = svd.transform(final_counts)
```

```
In [8]: plt.plot(np.cumsum(svd.explained_variance_/np.sum(
                                    svd.explained_variance_)))
        plt.xlabel('no of dimentions/components')
        plt.ylabel('% of data')
```

```
Out[8]: Text(0,0.5,'% of data')
```



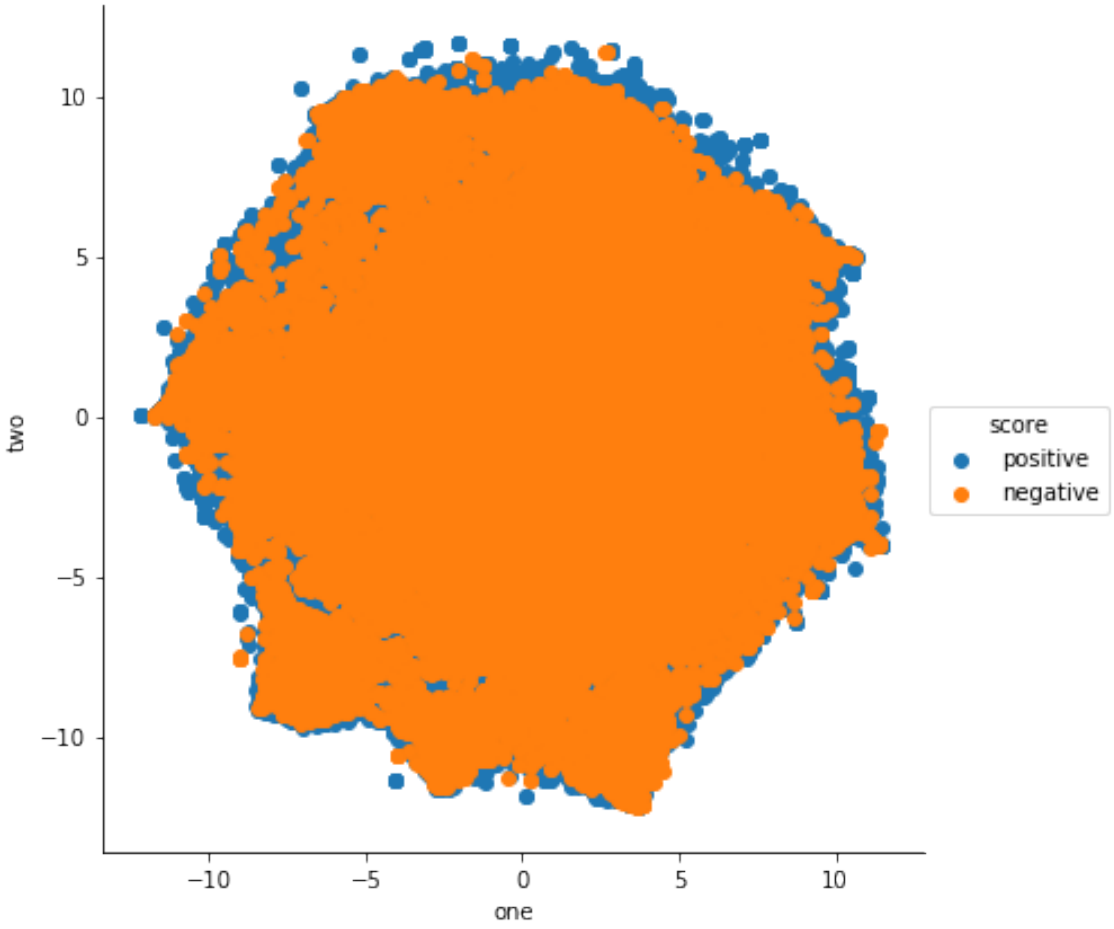

```
In [7]: scaler = StandardScaler()
        X_svd_scale=scaler.fit_transform(X_svd)
```

```
In [24]: #TSNE for SVD data
         final_2d = MTSNE(n_components=2,perplexity=30,n_iter=1000,
                          n_jobs=8).fit_transform(X_svd_scale)
```

```
In [26]: #stacking wit score for visualization
         out_2d = np.hstack((final_2d,final_amazon.Score.values.reshape(-1,1)))
         #creating dataframe
         df_2d = pd.DataFrame(out_2d,columns=['one','two','score'])
```

In [27]:
```
#Scatter plot for TSNE in 2d
sns.FacetGrid(df_2d, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[27]: <seaborn.axisgrid.FacetGrid at 0x1470ed4c4400>

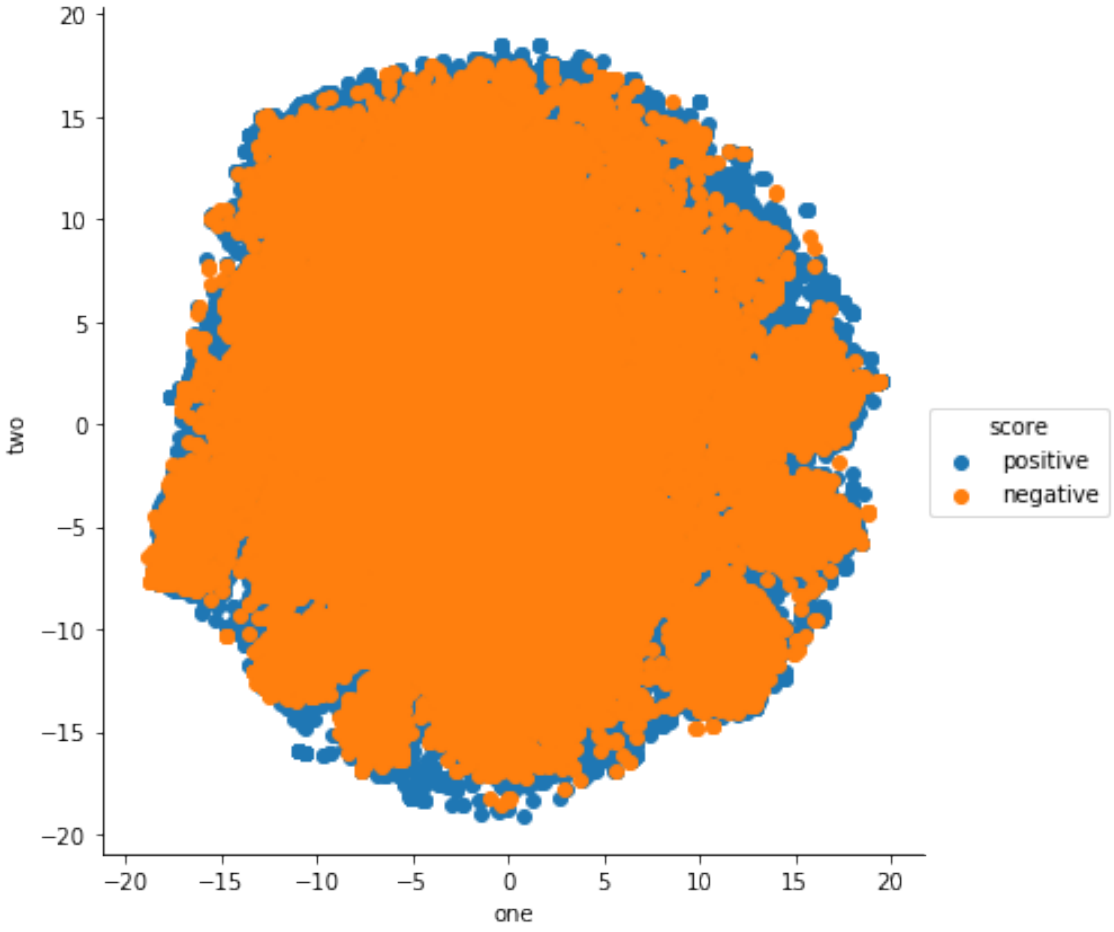


In [28]:
```
#TSNE with diierent n_iter
final_2d2 = MTSNE(n_components=2,perplexity=35,n_iter=1700,
                  n_jobs=8).fit_transform(X_svd_scale)
```

In [29]:
```
#stacking with score for visualization
out_2d2 = np.hstack((final_2d2,final_amazon.Score.values.reshape(-1,1)))
#Creating DataFrame
df_2d2 = pd.DataFrame(out_2d2,columns=['one','two','score'])
```

In [30]:
```
#scatter plot
sns.FacetGrid(df_2d2, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[30]: <seaborn.axisgrid.FacetGrid at 0x1470ed4c4cc0>

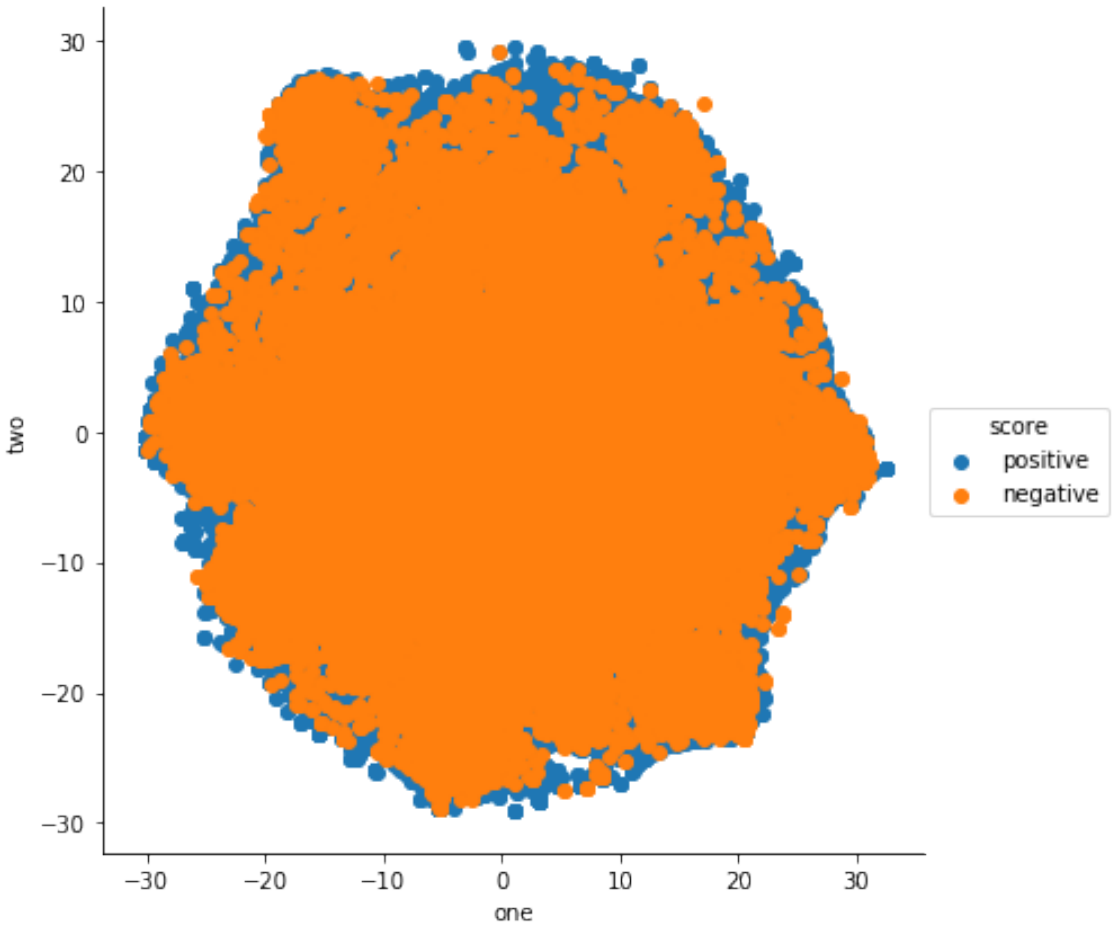


In [31]:
```
#Checking with higher iterations
final_2d3 = MTSNE(n_components=2,perplexity=35,n_iter=2800,
                  n_jobs=8).fit_transform(X_svd_scale)
```

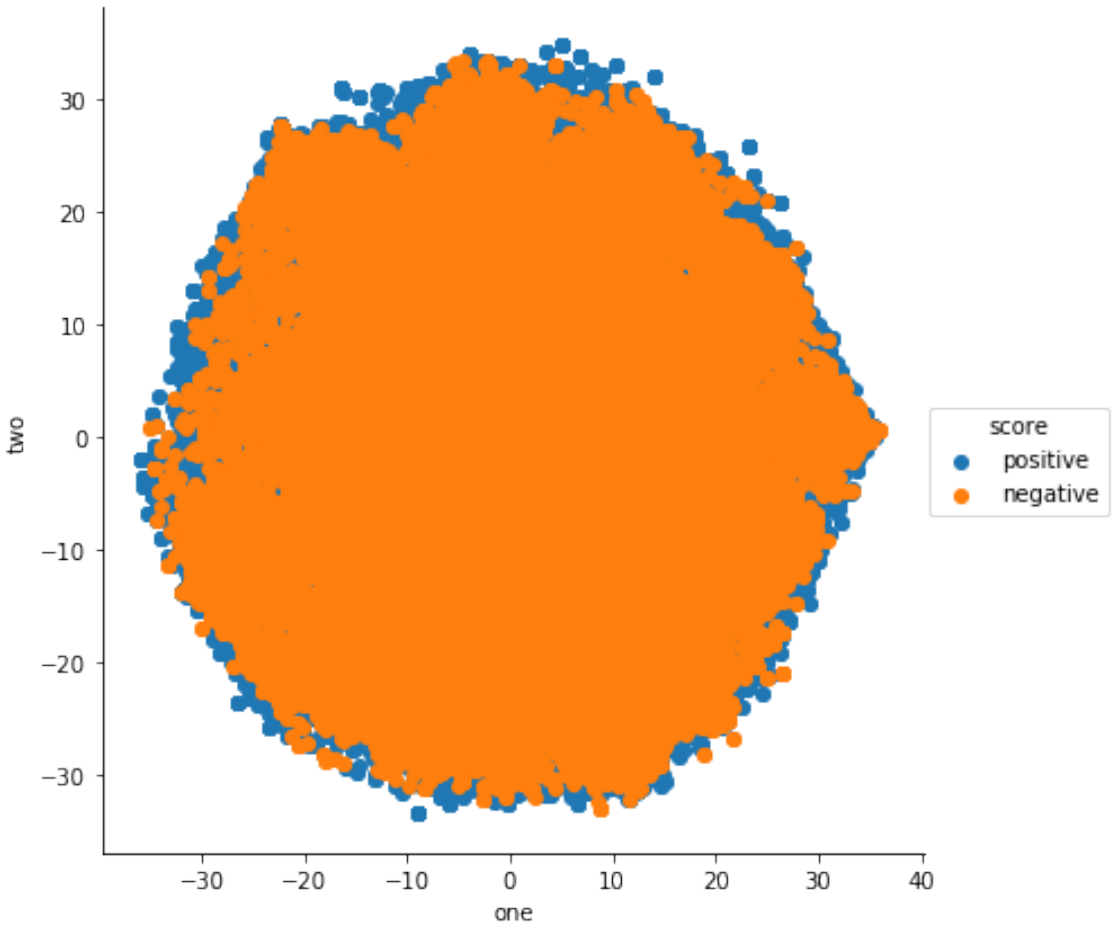
In [32]:
```
#stacking score for visualization
out_2d3 = np.hstack((final_2d3,final_amazon.Score.values.reshape(-1,1)))
#Creating DataFrame
df_2d3 = pd.DataFrame(out_2d3,columns=['one','two','score'])
```

In [33]:
```
#Plot for TSNE
sns.FacetGrid(df_2d3, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[33]: <seaborn.axisgrid.FacetGrid at 0x1470e75dce80>




```
In [8]: #TSNE with different perpleity
        final_2d4 = MTSNE(n_components=2,perplexity=15,
                          n_iter=2800,n_jobs=8).fit_transform(X_svd_scale)

In [9]: #Stacking wit Score
        out_2d4 = np.hstack((final_2d4,final_amazon.Score.values.reshape(-1,1)))
        #creating DataFrame
        df_2d4 = pd.DataFrame(out_2d4,columns=['one','two','score'])

In [10]: #plot for TSNE
         sns.FacetGrid(df_2d4, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[10]: <seaborn.axisgrid.FacetGrid at 0x150a1b2fa3c8>
```



2. Sampled data then TSNE

```
In [4]: #getting sample of Data
        s = final_amazon.sample(n=25000)

In [5]: #converting to BOW
        count_vect = CountVectorizer(dtype=np.int8) #in scikit-learn
        final_counts = count_vect.fit_transform(s['CleanedTextBow'].values)

In [6]: #shape of BOW data
        final_counts.get_shape()

Out[6]: (25000, 31257)

In [7]: #converting to dense array
        x = final_counts.toarray()

In [8]: #scaling data
        scaler = StandardScaler()
        X_svd_scale=scaler.fit_transform(x)
```

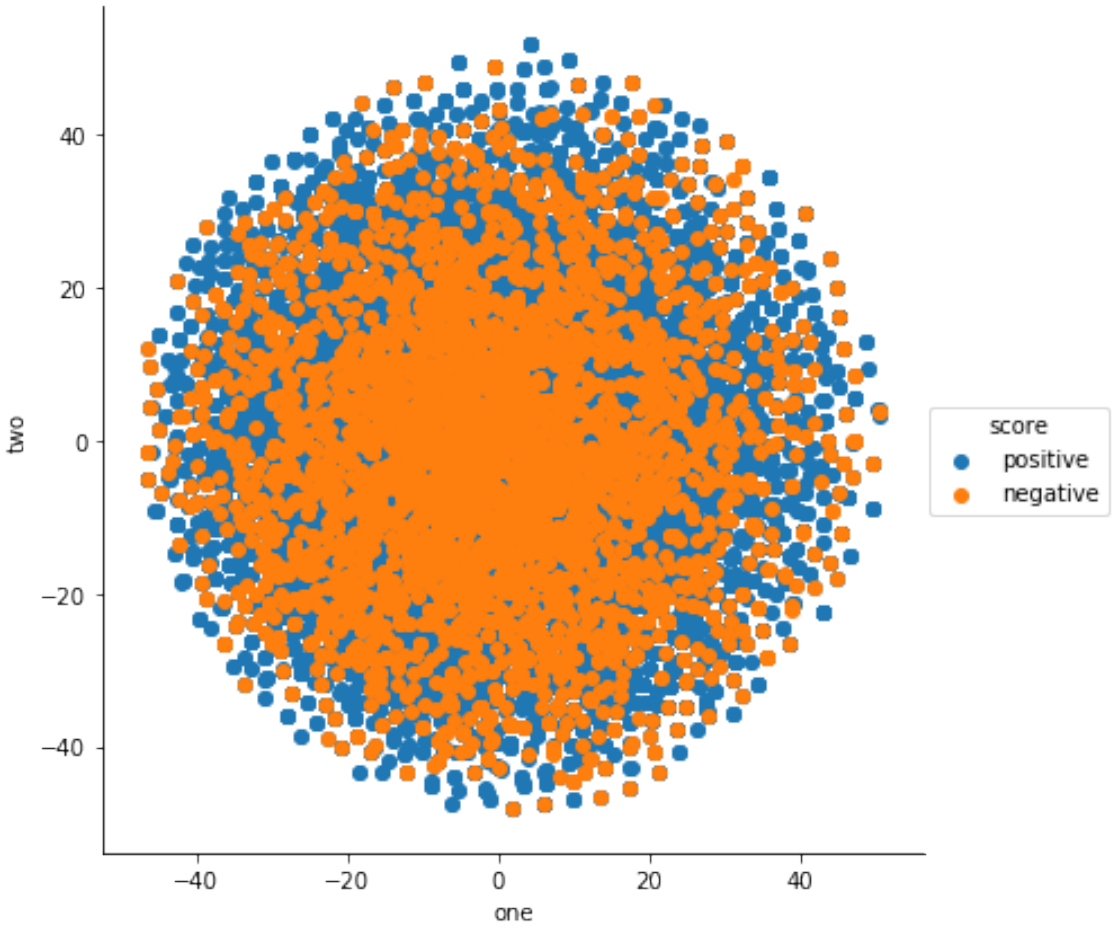
```
/glob/intel-python/versions/2018u2/intelpython3/lib/python3.6/site-packages/sklearn/utils/valid
  warnings.warn(msg, DataConversionWarning)
```

```
In [16]: #TSNE wit sampled data
         final_2d4 = MTSNE(n_components=2,perplexity=30,n_iter=2800,
                           n_jobs=8).fit_transform(X_svd_scale)
```

```
In [18]: #stacking with score
         out_2d4 = np.hstack((final_2d4,s.Score.values.reshape(-1,1)))
         #Creating DataFrame
         df_2d4 = pd.DataFrame(out_2d4,columns=['one','two','score'])
```

```
In [19]: #Scatter plot
         sns.FacetGrid(df_2d4, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()
```

```
Out[19]: <seaborn.axisgrid.FacetGrid at 0x150a1995dba8>
```

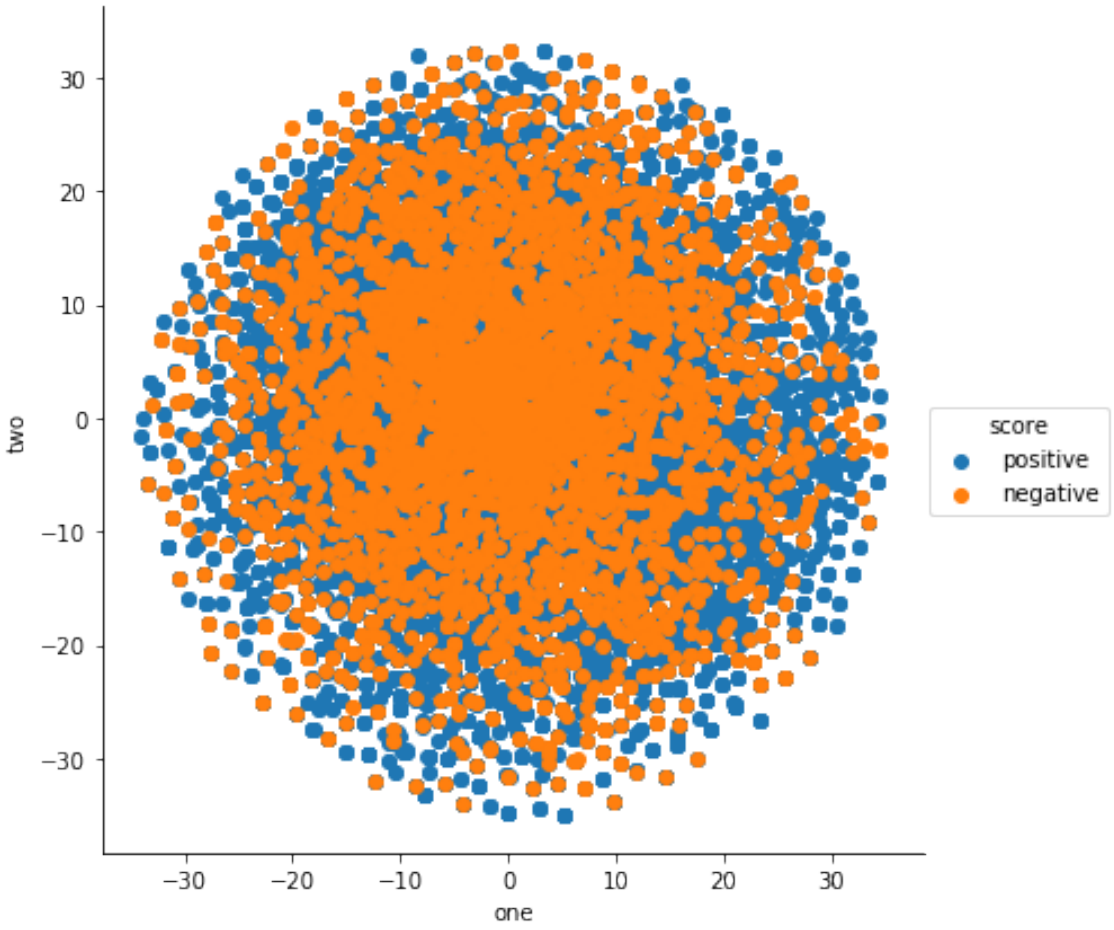


In [20]:
```
#TSNE with different params
final_2d5 = MTSNE(n_components=2,perplexity=50,n_iter=3200,
                  n_jobs=8).fit_transform(X_svd_scale)
```

In [21]:
```
#Stacking with score
out_2d5 = np.hstack((final_2d5,s.Score.values.reshape(-1,1)))
#Creating DataFrame
df_2d5 = pd.DataFrame(out_2d5,columns=['one','two','score'])
```

In [22]:
```
#Scatter Plot
sns.FacetGrid(df_2d5, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[22]: <seaborn.axisgrid.FacetGrid at 0x150a1a2e2748>

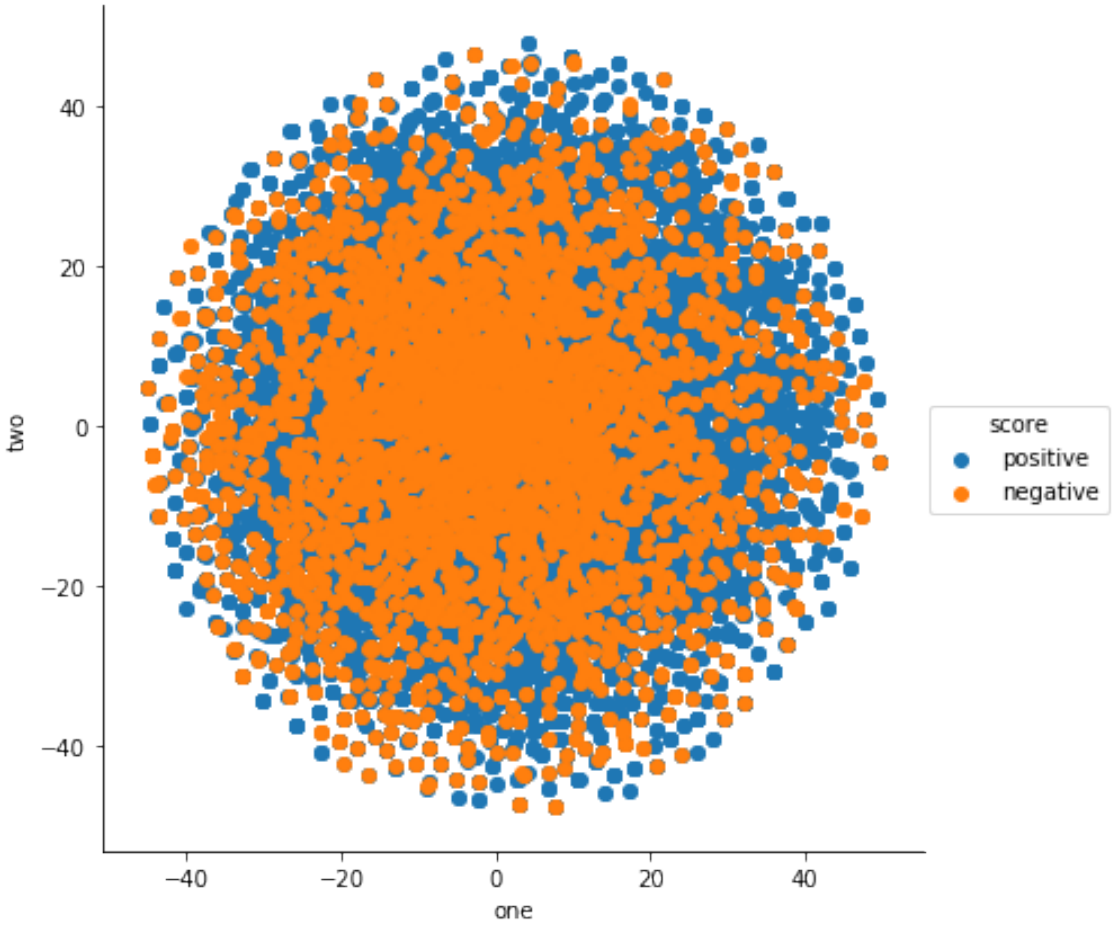


In [9]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=42,n_iter=4500,
                  n_jobs=8).fit_transform(X_svd_scale)
```

In [10]:
```
#stacking with score
out_2d5 = np.hstack((final_2d5,s.Score.values.reshape(-1,1)))
#Creating DataFrame
df_2d5 = pd.DataFrame(out_2d5,columns=['one','two','score'])
```

In [11]:
```
#Scatter Plot
sns.FacetGrid(df_2d5, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[11]: <seaborn.axisgrid.FacetGrid at 0x14f3f278cd68>

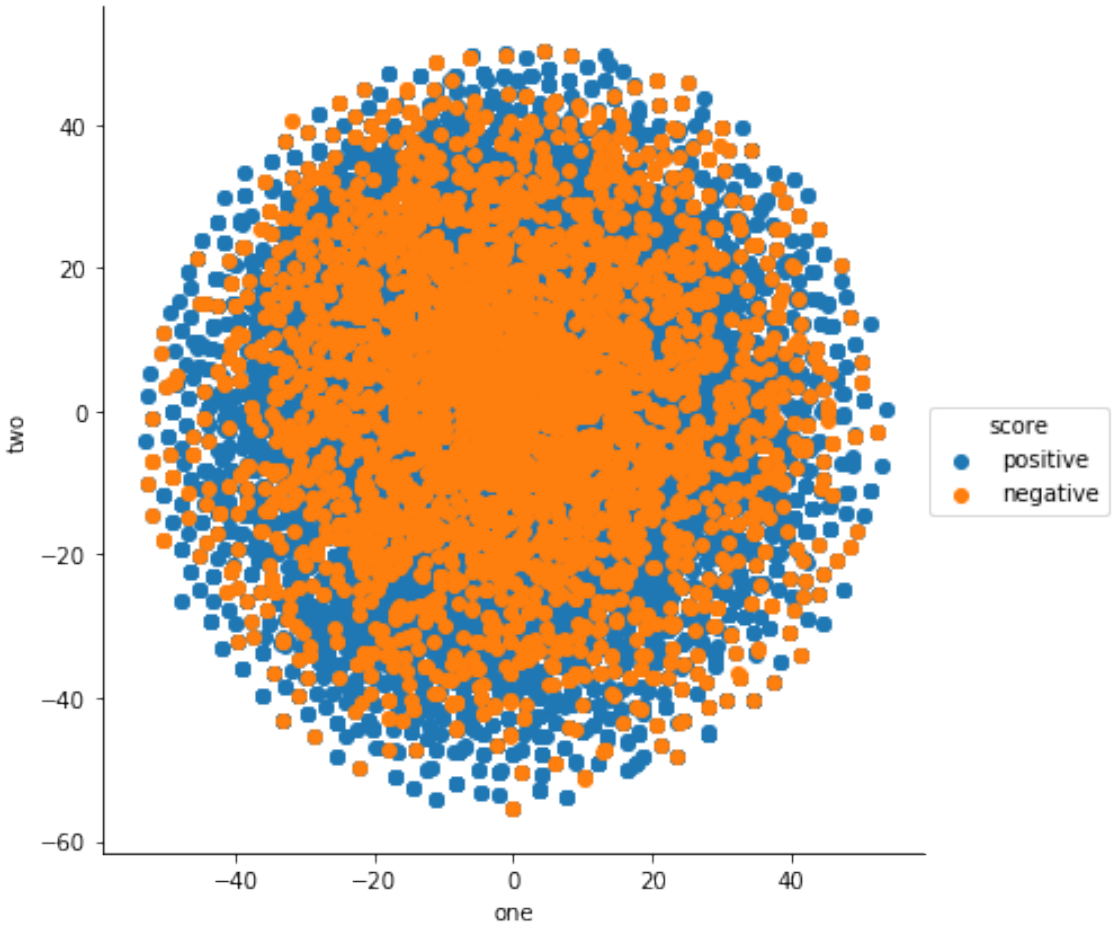


In [12]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=42,n_iter=6500,
                  n_jobs=8).fit_transform(X_svd_scale)
```

In [13]:
```
#Stacking with Score
out_2d5 = np.hstack((final_2d5,s.Score.values.reshape(-1,1)))
df_2d5 = pd.DataFrame(out_2d5,columns=['one','two','score'])
```

In [14]:
```
#Scatterplot
sns.FacetGrid(df_2d5, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[14]: <seaborn.axisgrid.FacetGrid at 0x14f3f12a42b0>

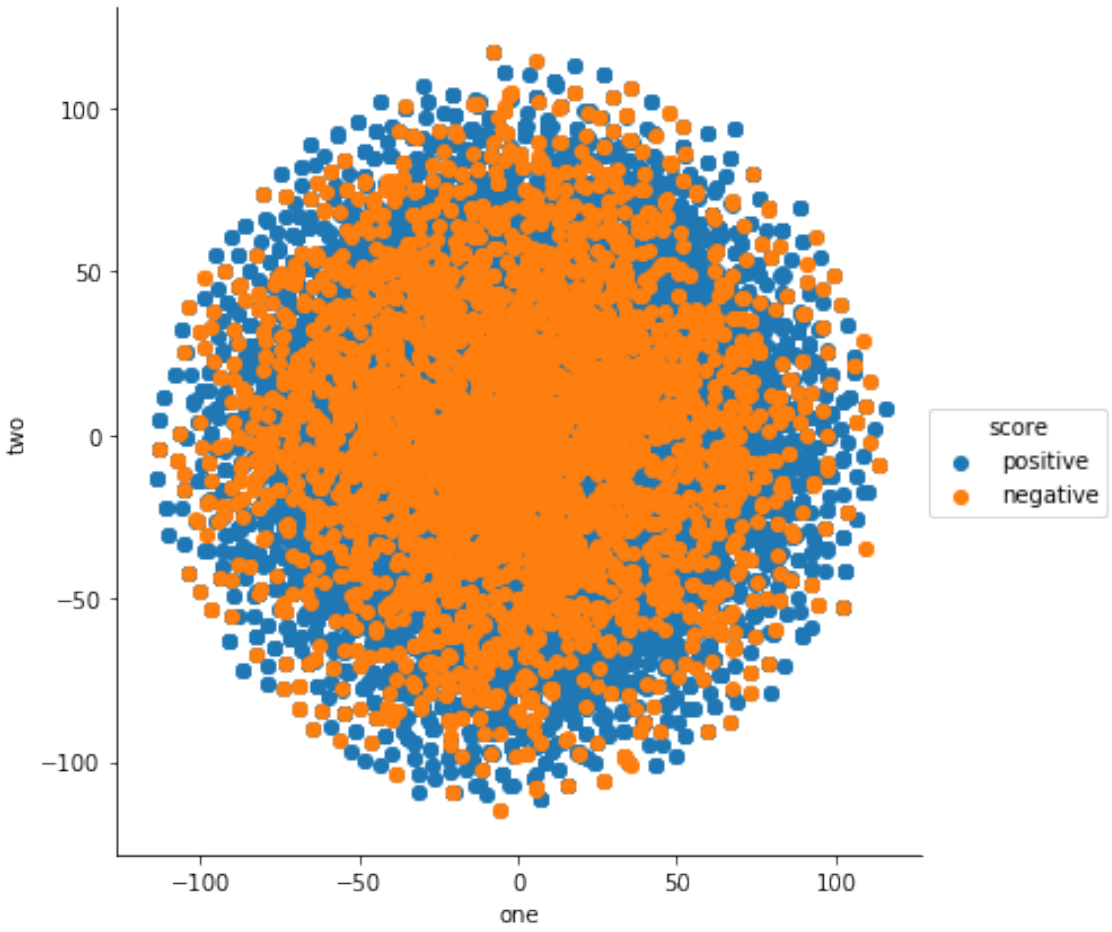


In [15]:
```
#TSNE wit less perpleity
final_2d5 = MTSNE(n_components=2,perplexity=8,n_iter=5000,
                  n_jobs=8).fit_transform(X_svd_scale)
```

In [16]:
```
#stacking with score
out_2d5 = np.hstack((final_2d5,s.Score.values.reshape(-1,1)))
df_2d5 = pd.DataFrame(out_2d5,columns=['one','two','score'])
```

In [17]:
```
#Scatter plot
sns.FacetGrid(df_2d5, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[17]: <seaborn.axisgrid.FacetGrid at 0x14f3f09a9828>



Observations-BOW:

1. We can infer from above TSNE plots that data for both positive and negative reviews are so much overlapped.
2. Plot from first section after doing SVD for whole data is so much similar to sample data plots and checked wit different perflity and no of iterations.

0.1.2 TF-IDF:

```
In [4]: #tf-idf
        tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
        final_tf_idf = tf_idf_vect.fit_transform(
                       final_amazon['CleanedTextBow'].values)

In [5]: #shape of tfidf
        final_tf_idf.get_shape()

Out[5]: (364171, 2923705)
```

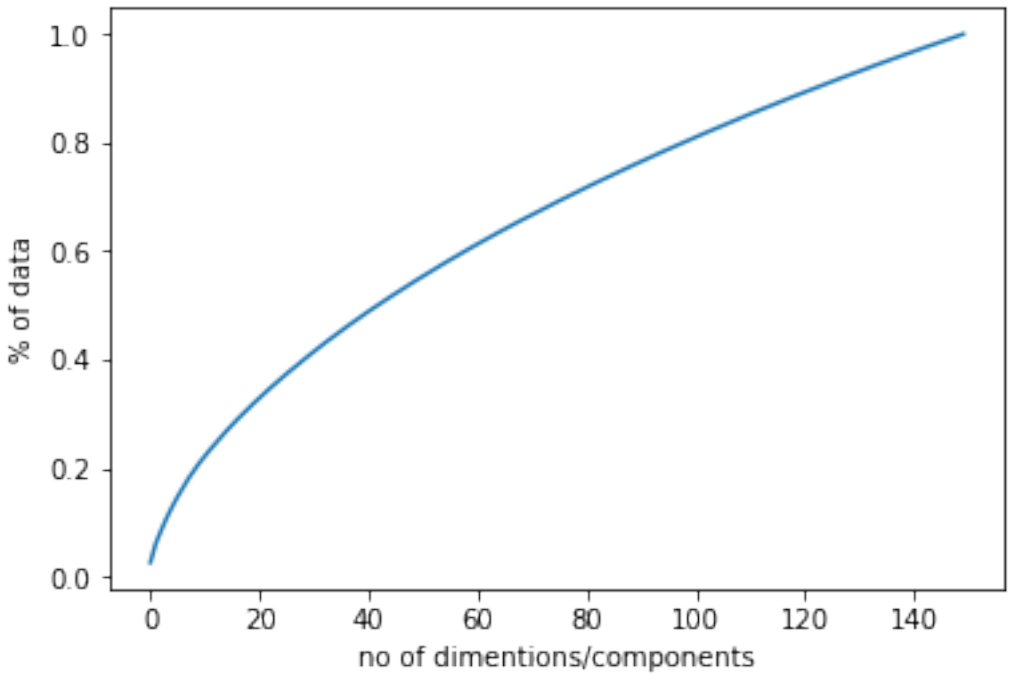
Because of large dataset and lack of powerful processor addressed issues with below two methods * Did TruncatedSVD ,got dimentions to 50 and then used that data to plot T-SNE. * Sampled data from original data and then used sampled data to plot T-SNE

1. using SVD and then TSNE for TFIDF vectors

```
In [5]: #Trucated SVD for dimentonality reduction
        svd = TruncatedSVD(n_components=150, n_iter=7, random_state=42).fit(final_tf_idf)
        X_svd = svd.transform(final_tf_idf)
```

```
In [11]: plt.plot(np.cumsum(svd.explained_variance_/np.sum(svd.explained_variance_)))
         plt.xlabel('no of dimentions/components')
         plt.ylabel('% of data')
```

```
Out[11]: Text(0,0.5,'% of data')
```




```
In [6]: scaler = StandardScaler()
        X_svd_scale=scaler.fit_transform(X_svd)
```

```
In [13]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=32,n_iter=3200,
                           n_jobs=12).fit_transform(X_svd_scale)
```

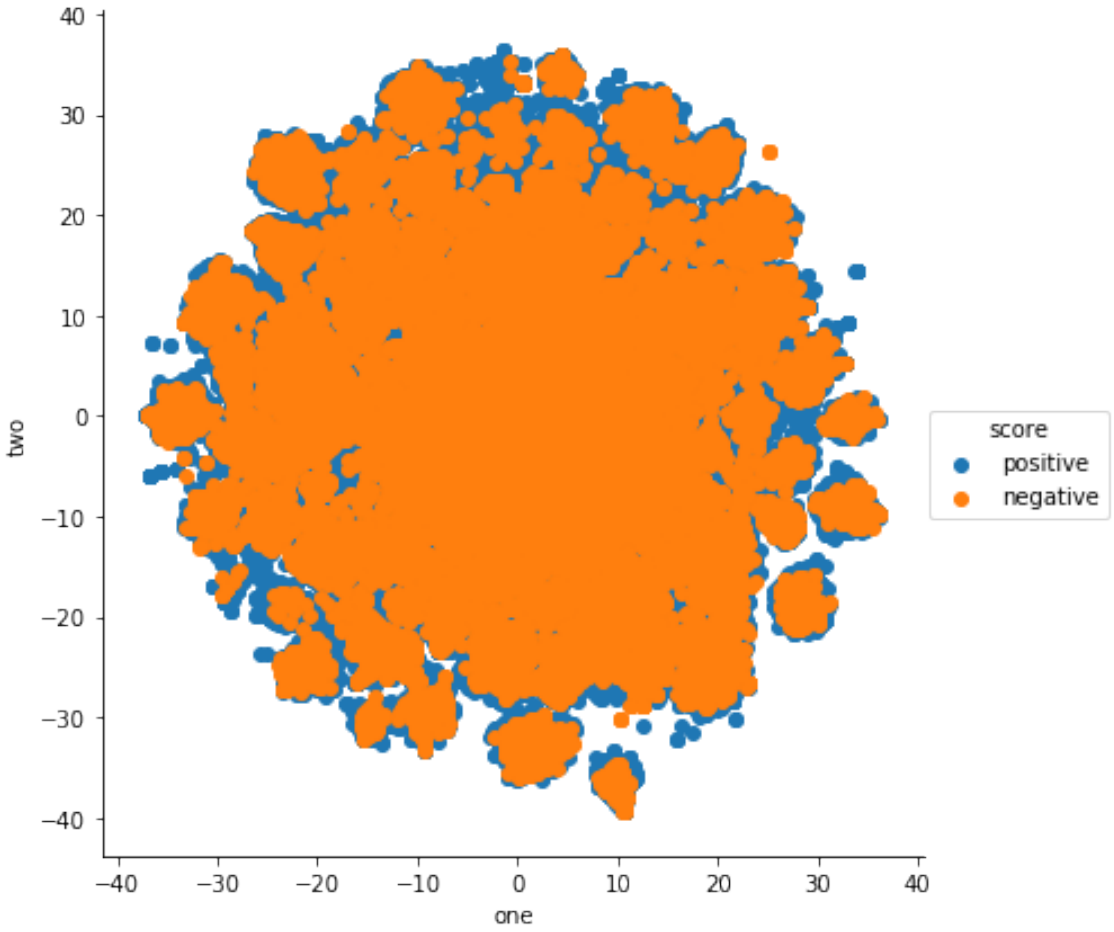
```
In [4]: #stacking with score
        def Stacking_df(x,y):
```

```
    '''
    return dataframe after concatinating  and y
    '''
    out_2d5 = np.hstack((x,y))
    return pd.DataFrame(out_2d5,columns=['one','two','score'])
```

In [22]:
```
df = Stacking_df(final_2d5,final_amazon.Score.values.reshape(-1,1))
```

In [21]:
```
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[21]: <seaborn.axisgrid.FacetGrid at 0x1497df5516a0>

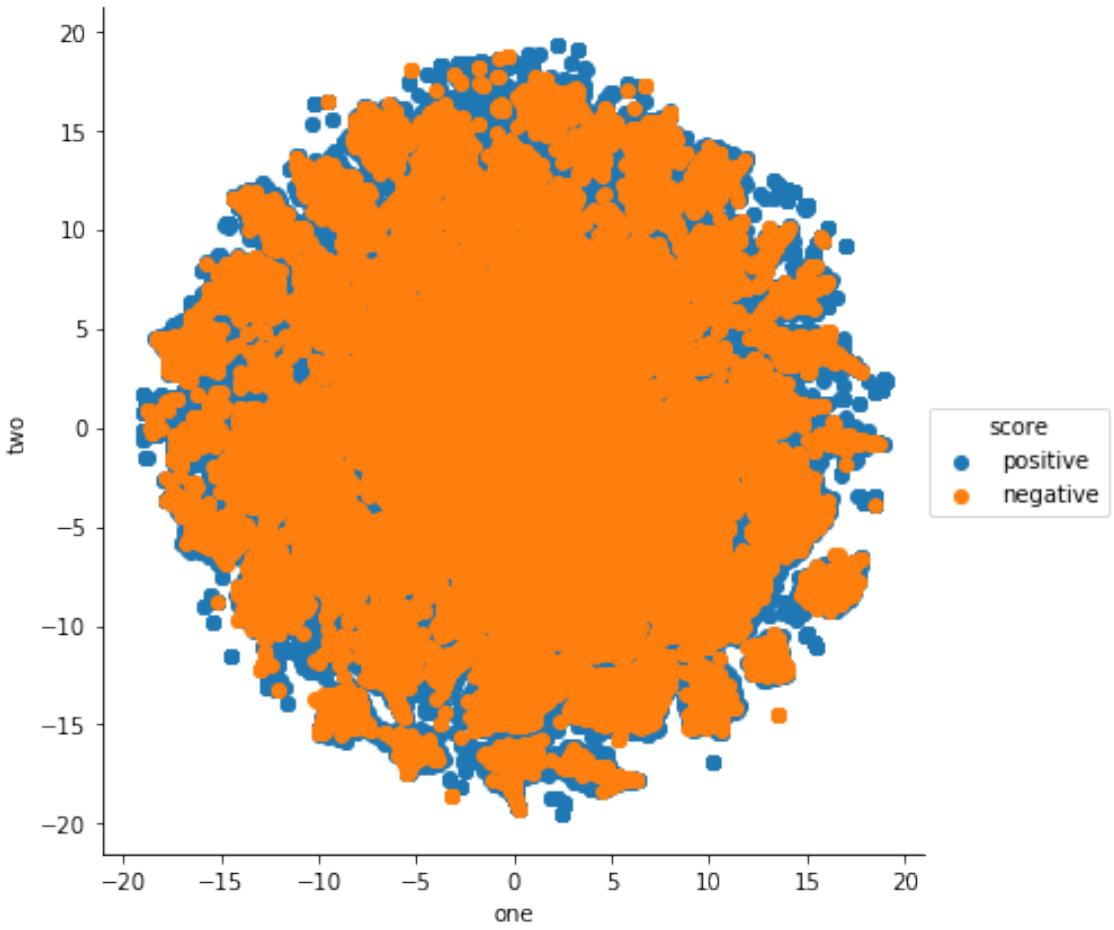


In [10]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=6,n_iter=1200,
                  n_jobs=12).fit_transform(X_svd_scale)
```

In [13]:
```
#Stacking df
df = Stacking_df(final_2d5,final_amazon.Score.values.reshape(-1,1))
```

In [14]:
```
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[14]: <seaborn.axisgrid.FacetGrid at 0x14a03c5985c0>

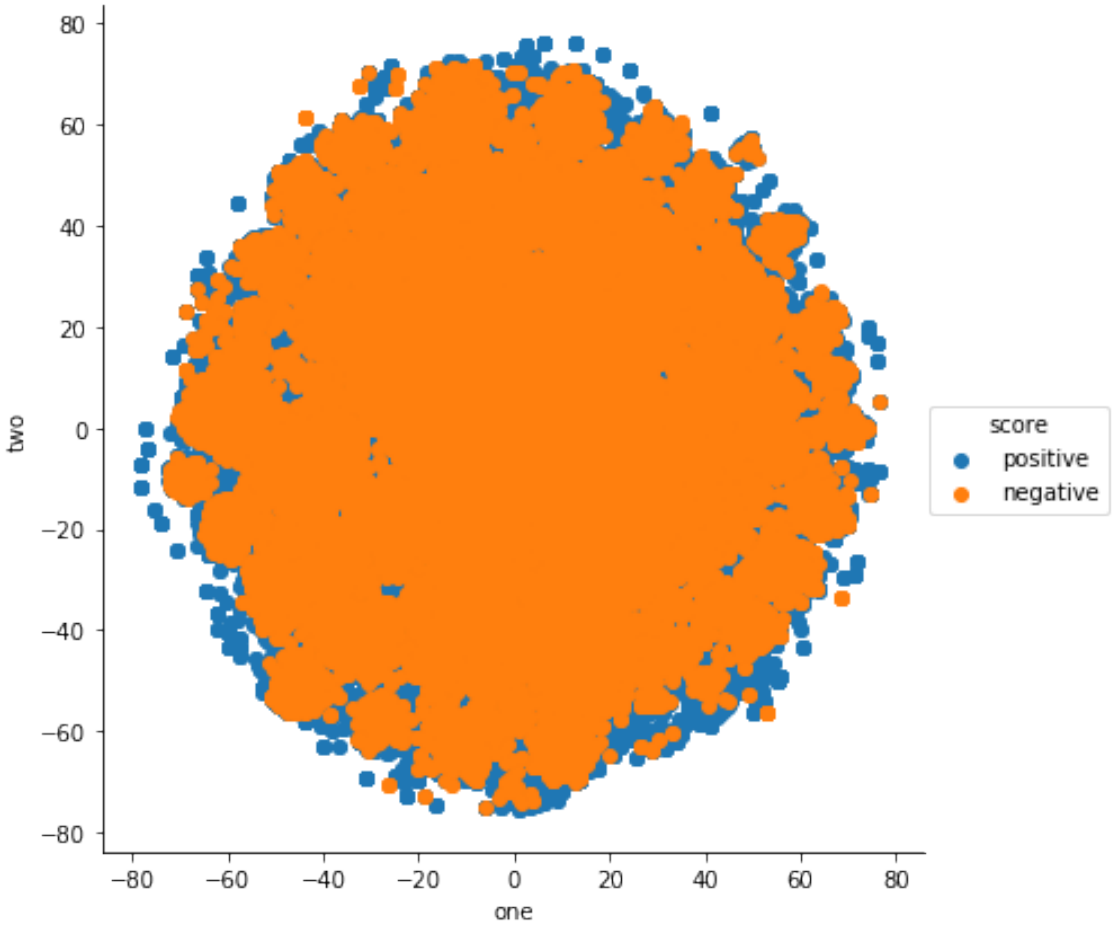


In [15]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=6,n_iter=5000,
                  n_jobs=12).fit_transform(X_svd_scale)
```

In [16]:
```
#Stacking df
df = Stacking_df(final_2d5,final_amazon.Score.values.reshape(-1,1))
```

In [17]:
```
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[17]: <seaborn.axisgrid.FacetGrid at 0x14a03c598320>

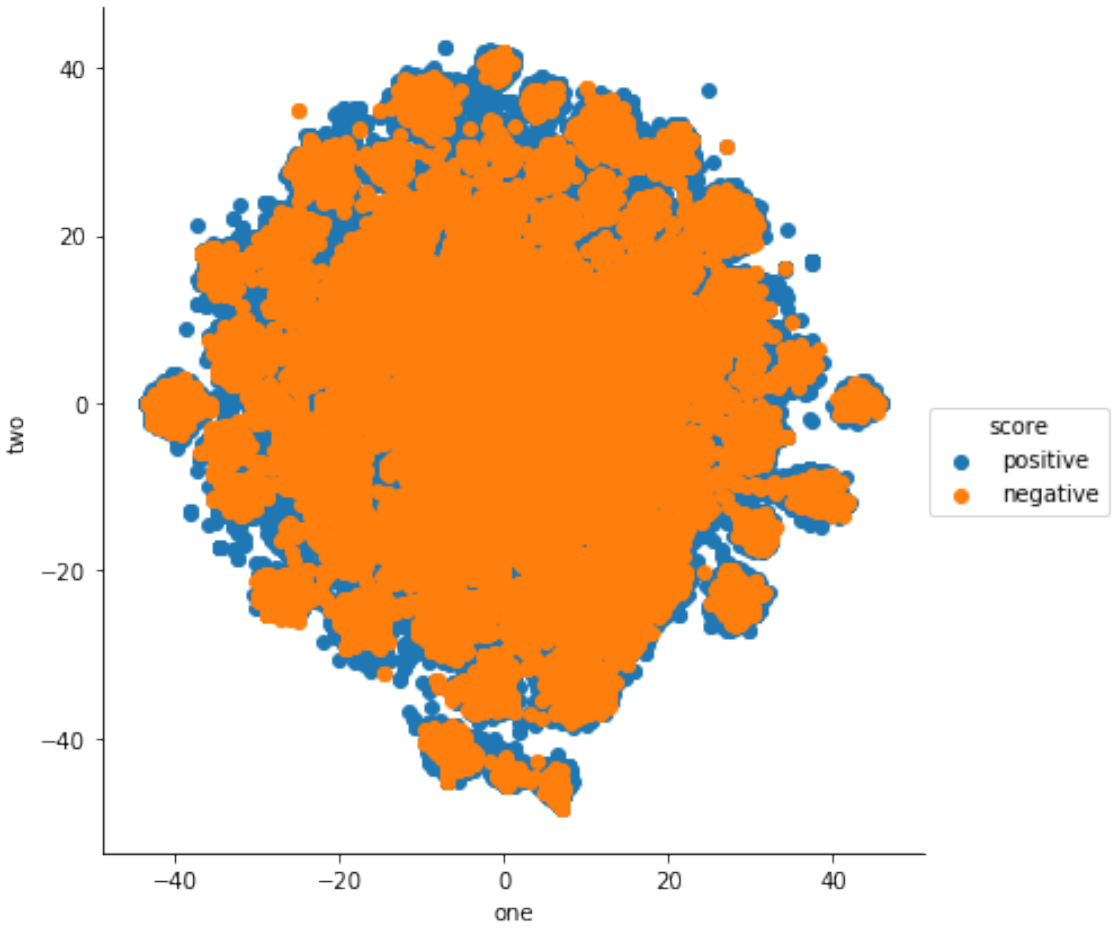


In [7]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=75,n_iter=5000,n_jobs=12).fit_transform(X_s
```

In [10]:
```
#Stacking df
df = Stacking_df(final_2d5,final_amazon.Score.values.reshape(-1,1))
```

In [11]:
```
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

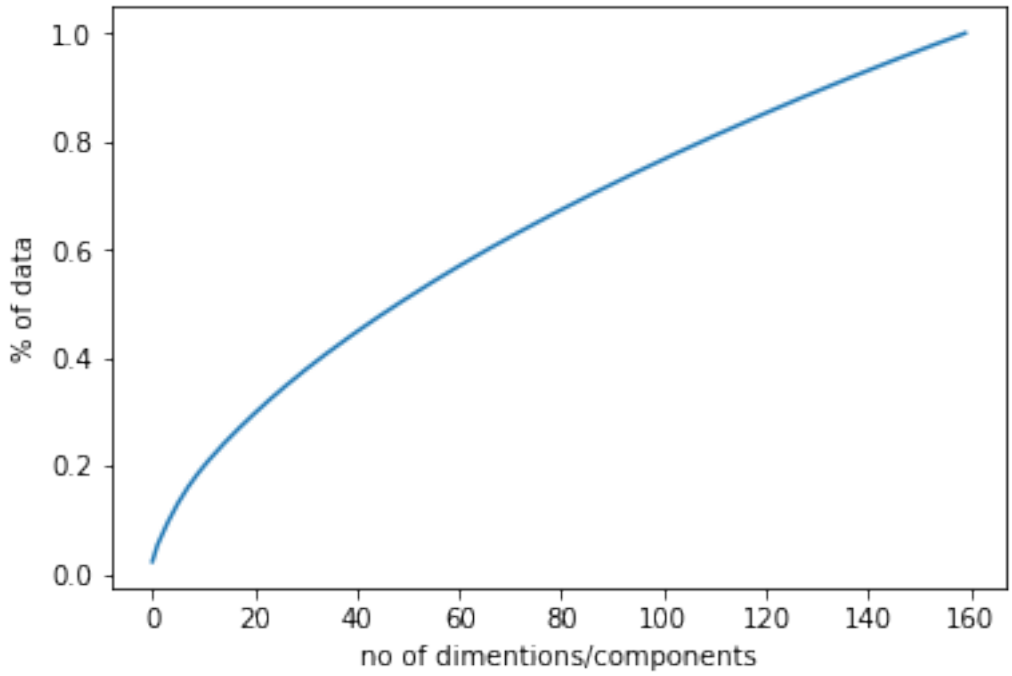
Out[11]: <seaborn.axisgrid.FacetGrid at 0x14f7db899b38>



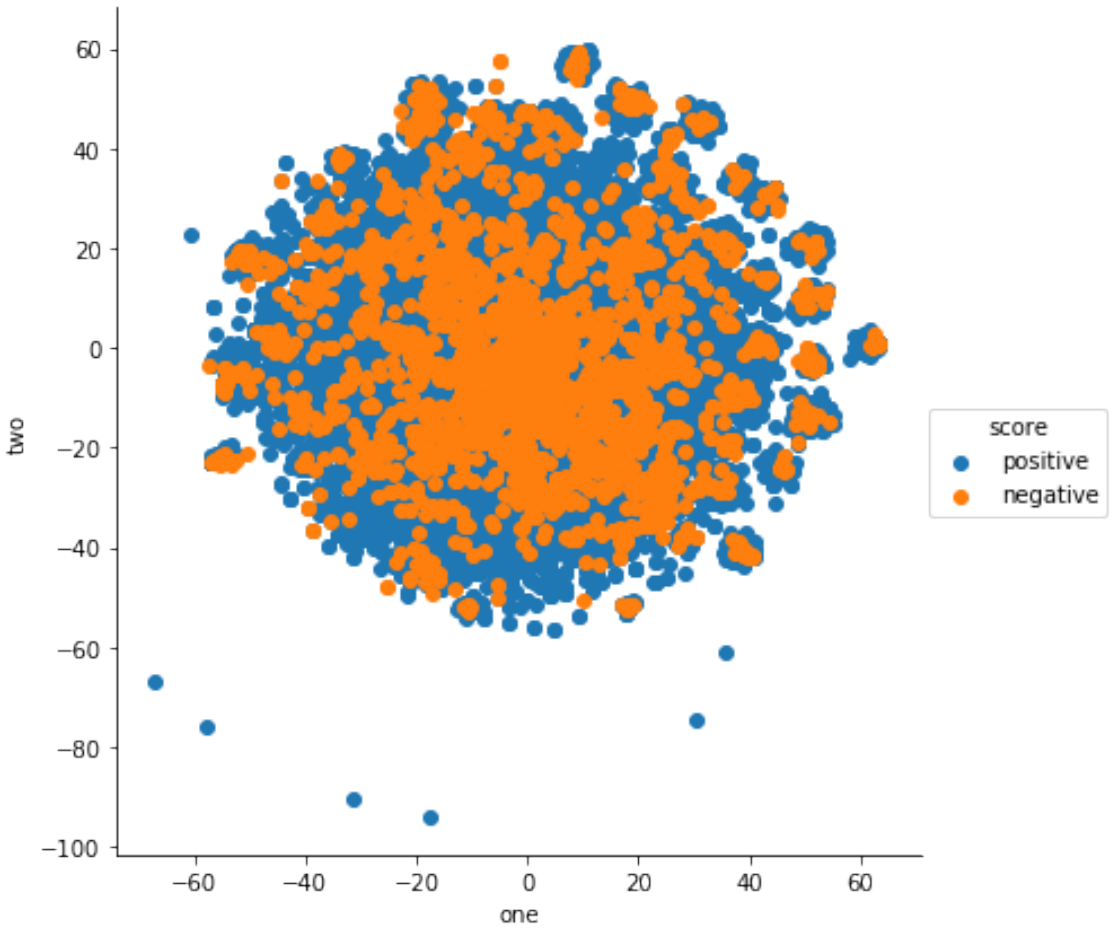
2. Sapmpled and then T-SNE for TFIDF

```
In [5]: #sampled df
        s = final_amazon.sample(n=15000)

In [6]: #tf-idf
        tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
        final_tf_idf = tf_idf_vect.fit_transform(
                       s['CleanedTextBow'].values)

In [7]: #shape
        final_tf_idf.get_shape()

Out[7]: (15000, 359426)

In [10]: #Trucated SVD for dimentonality reduction
         svd = TruncatedSVD(n_components=160, n_iter=7, random_state=42).fit(final_tf_idf)
         X_svd = svd.transform(final_tf_idf)
```

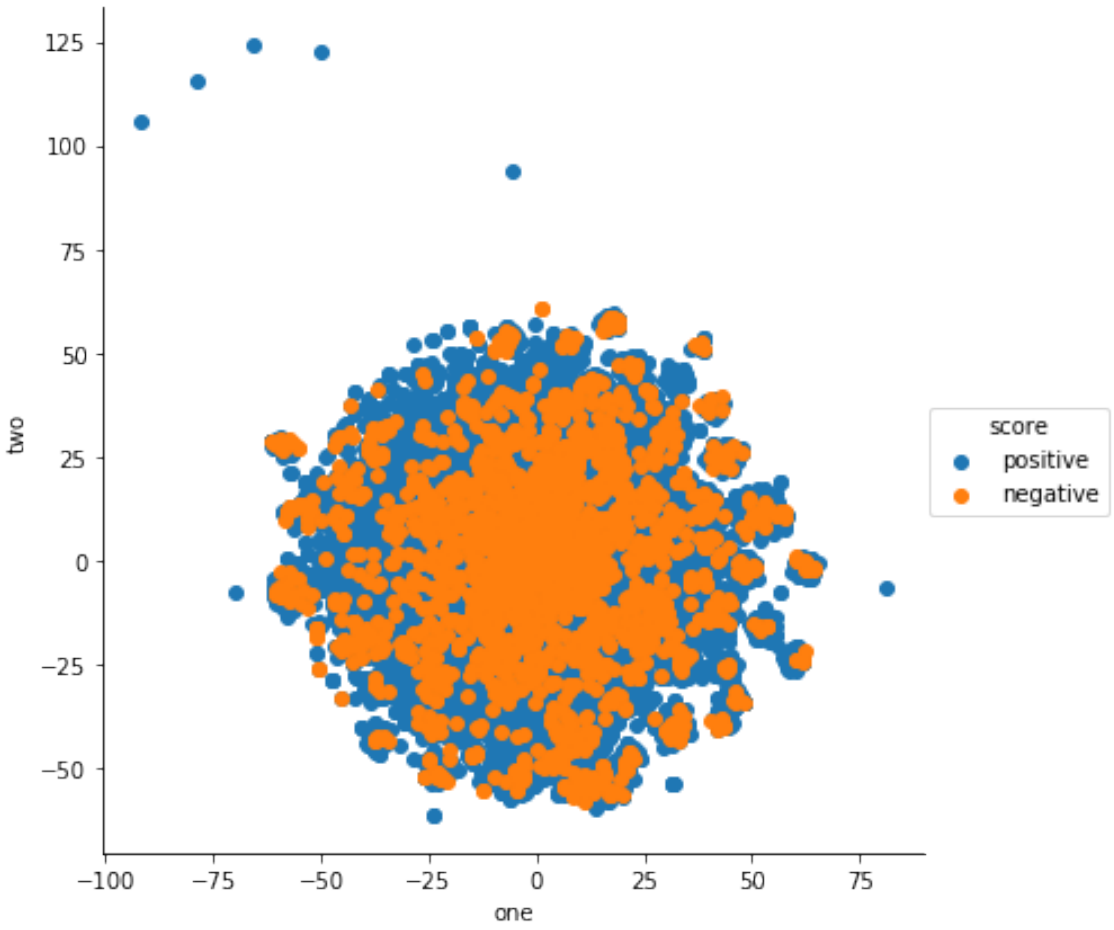
```
In [11]: plt.plot(np.cumsum(svd.explained_variance_/np.sum(svd.explained_variance_)))
         plt.xlabel('no of dimentions/components')
         plt.ylabel('% of data')

Out[11]: Text(0,0.5,'% of data')
```




```
In [12]: scaler = StandardScaler()
         X_svd_scale=scaler.fit_transform(X_svd)

In [13]: #TSNE
         final_2d5 = TSNE(n_components=2,perplexity=35,
                          n_iter=1800).fit_transform(X_svd_scale)

In [15]: #Stacking df
         df = Stacking_df(final_2d5,s.Score.values.reshape(-1,1))

In [16]: #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[16]: <seaborn.axisgrid.FacetGrid at 0x14a6b30f8a58>
```

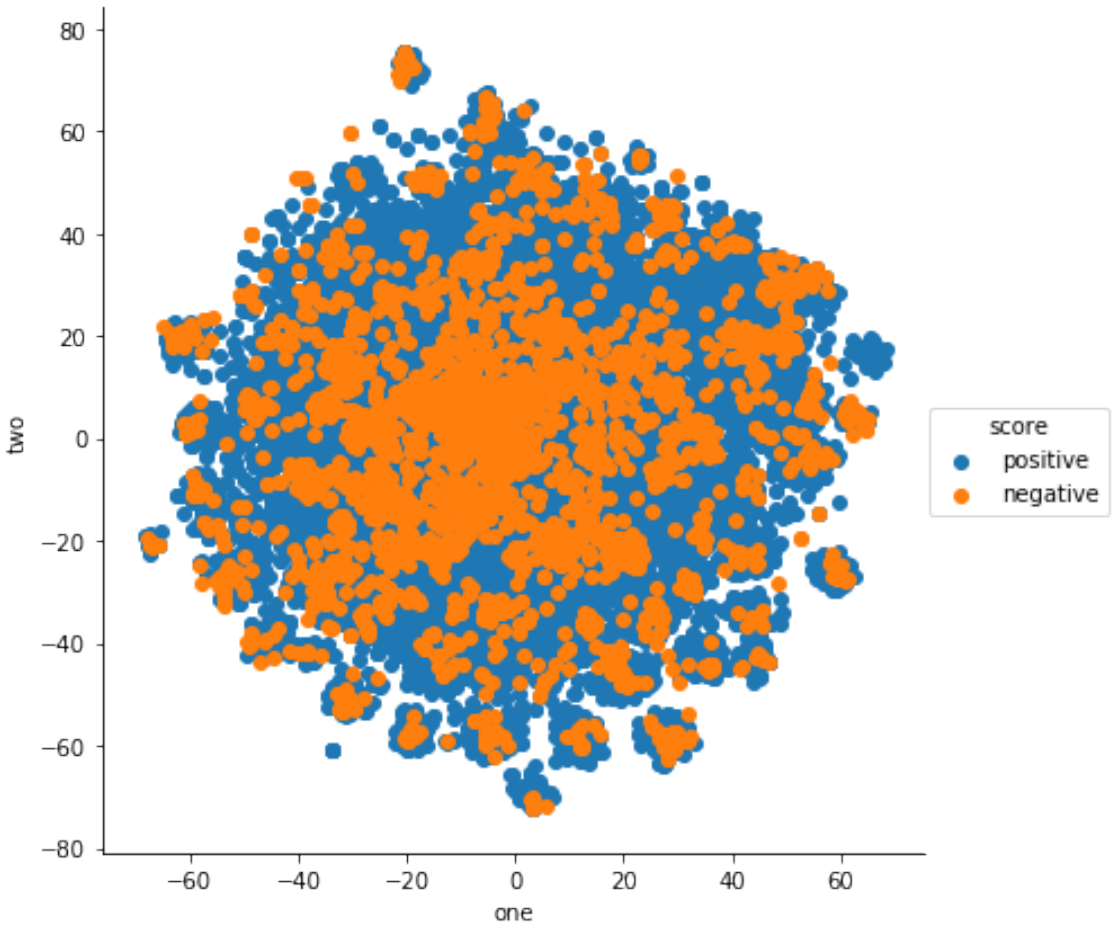



```
In [17]: #TSNE
         final_2d5 = TSNE(n_components=2,perplexity=35,
                          n_iter=3500).fit_transform(X_svd_scale)

In [18]: #Stacking df
         df = Stacking_df(final_2d5,s.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[18]: <seaborn.axisgrid.FacetGrid at 0x14a6b4051630>
```



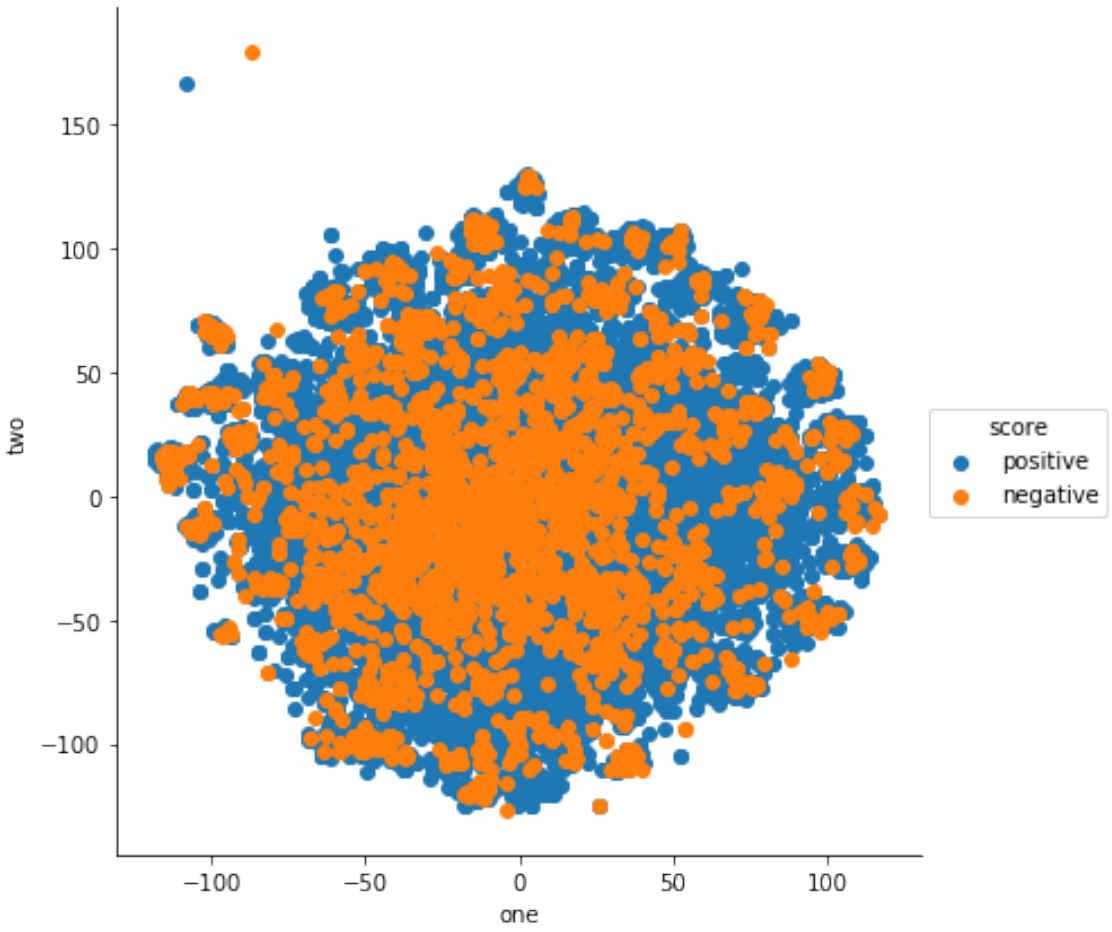
In [21]:
```
#TSNE
final_2d5 = TSNE(n_components=2,perplexity=35,
                 n_iter=6500).fit_transform(X_svd_scale)
#Stacking df
df = Stacking_df(final_2d5,s.Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[21]: <seaborn.axisgrid.FacetGrid at 0x14a6b1aa6630>



In [22]:
```
#TSNE
final_2d5 = TSNE(n_components=2,perplexity=10,
                 n_iter=3500).fit_transform(X_svd_scale)
#Stacking df
df = Stacking_df(final_2d5,s.Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[22]: <seaborn.axisgrid.FacetGrid at 0x14a6b2d070f0>



- For TFIDF also there is so much overlap and data looks like random

0.1.3 Word2Vec

```
In [19]: #importing
         from gensim.models import Word2Vec
         from gensim.models import KeyedVectors
         import pickle
         import re

In [20]: def cleanpunc(sentence):
             '''
             function to clean the word of any punctuation or special characters
             '''
             cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
             cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
             return  cleaned
```

```
In [7]: import gensim
        i=0
        list_of_sent=[]
        for sent in final_amazon.CleanedTextBow.values:
            filtered_sentence=[]
            #sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            list_of_sent.append(filtered_sentence)
```

```
In [8]: #word2vec
        w2v_model=gensim.models.Word2Vec(list_of_sent,min_count=5,size=50, workers=8)
```

Avg W2V

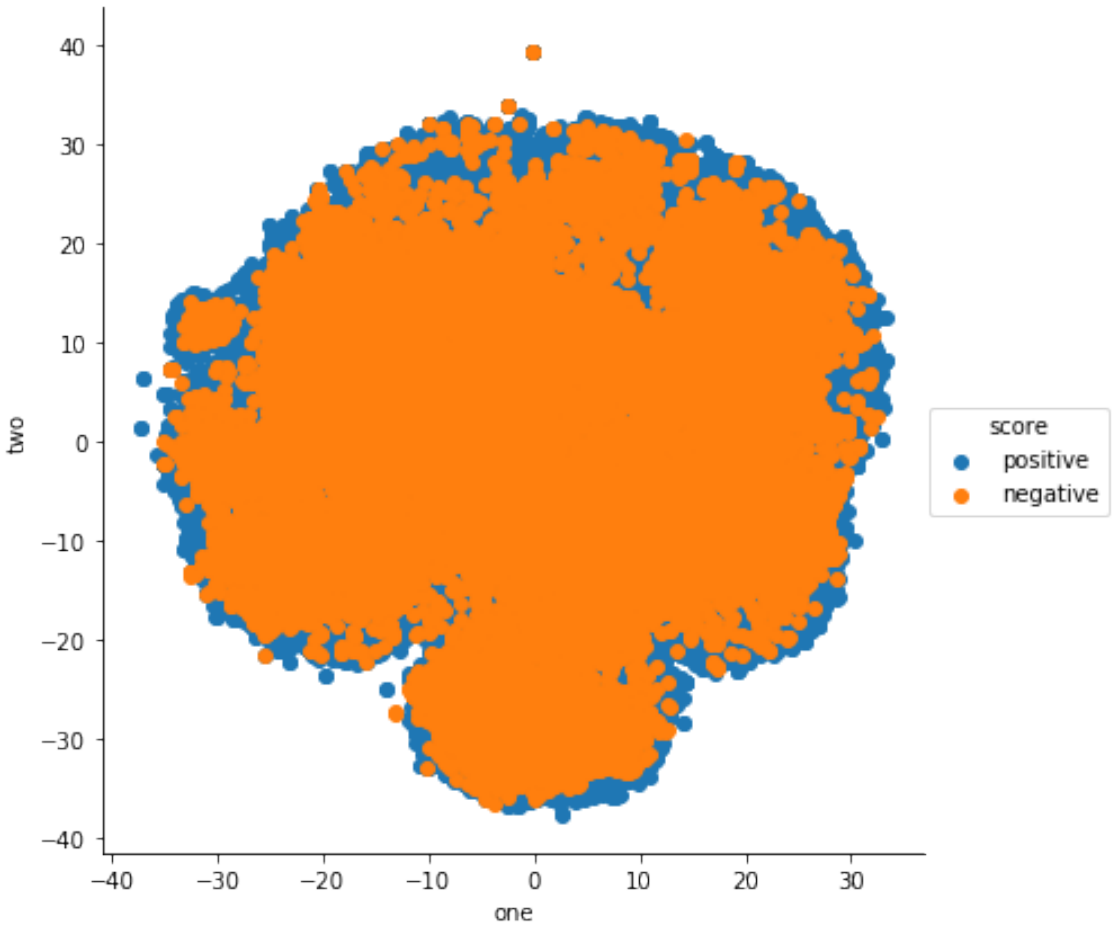
```
In [13]: # average Word2Vec
         # compute average word2vec for each review.
         sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
         for sent in list_of_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             cnt_words =0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     pass
             sent_vec /= cnt_words
             sent_vectors.append(sent_vec)
         print(len(sent_vectors))
         print(len(sent_vectors[0]))
```

```
/glob/intel-python/versions/2018u2/intelpython3/lib/python3.6/site-packages/ipykernel_launcher
```

```
364171
50
```

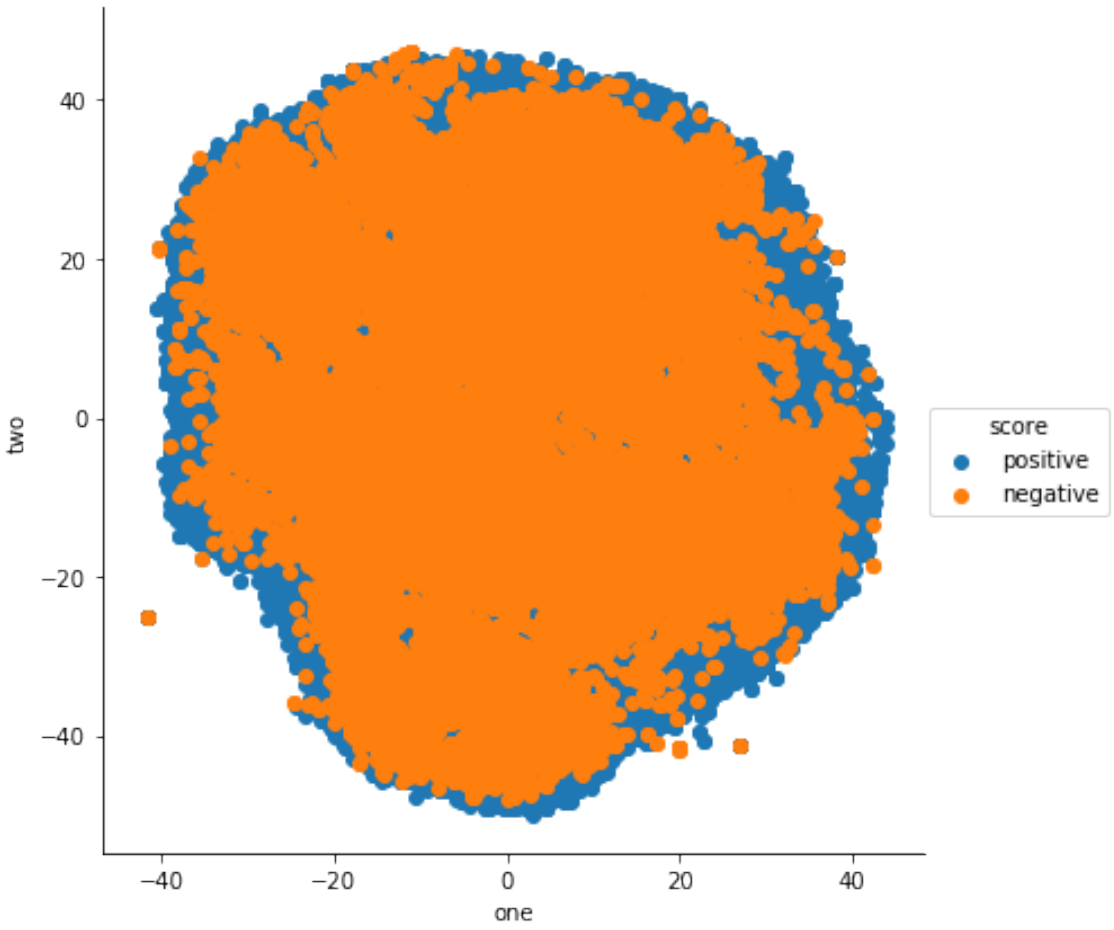
```
In [18]: #saving into disk for later use
         import pickle
         pickle.dump(sent_vectors,open('word2vec.p','wb'))
```

```
In [8]: w2v_array = pickle.load(open('word2vec.p','rb'))

In [9]: wdf = pd.DataFrame(w2v_array)

In [10]: #Found one null value row in w2v
         wdf[wdf.isnull().any(axis=1)][wdf.columns]

Out[10]:         0   1   2   3   4   5   6   7   8   9  ...  40  41  42  43  44  45  \
         270507 NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN ... NaN NaN NaN NaN NaN NaN

                 46  47  48  49
         270507 NaN NaN NaN NaN

         [1 rows x 50 columns]

In [48]: #row contains total numeric only so we are not considering
         cleanpunc(final_amazon.loc[270507].CleanedTextBow)

Out[48]: '&1056;&1077;&1096;&1080;&1083;&1072; &1079;&1072;&1082;&1072;&1079;&1072;&1090;&1100

In [50]: list_of_sent[270507]

Out[50]: []

In [11]: #removing from df
         final = final_amazon.drop(final_amazon.index[270507],axis=0)

In [12]: #droping null
         wdf = wdf.dropna()

In [13]: #Scaling
         scaler = StandardScaler()
         X_scale=scaler.fit_transform(wdf.values)

In [58]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=3500,
                           n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[58]: <seaborn.axisgrid.FacetGrid at 0x1507b4762630>
```

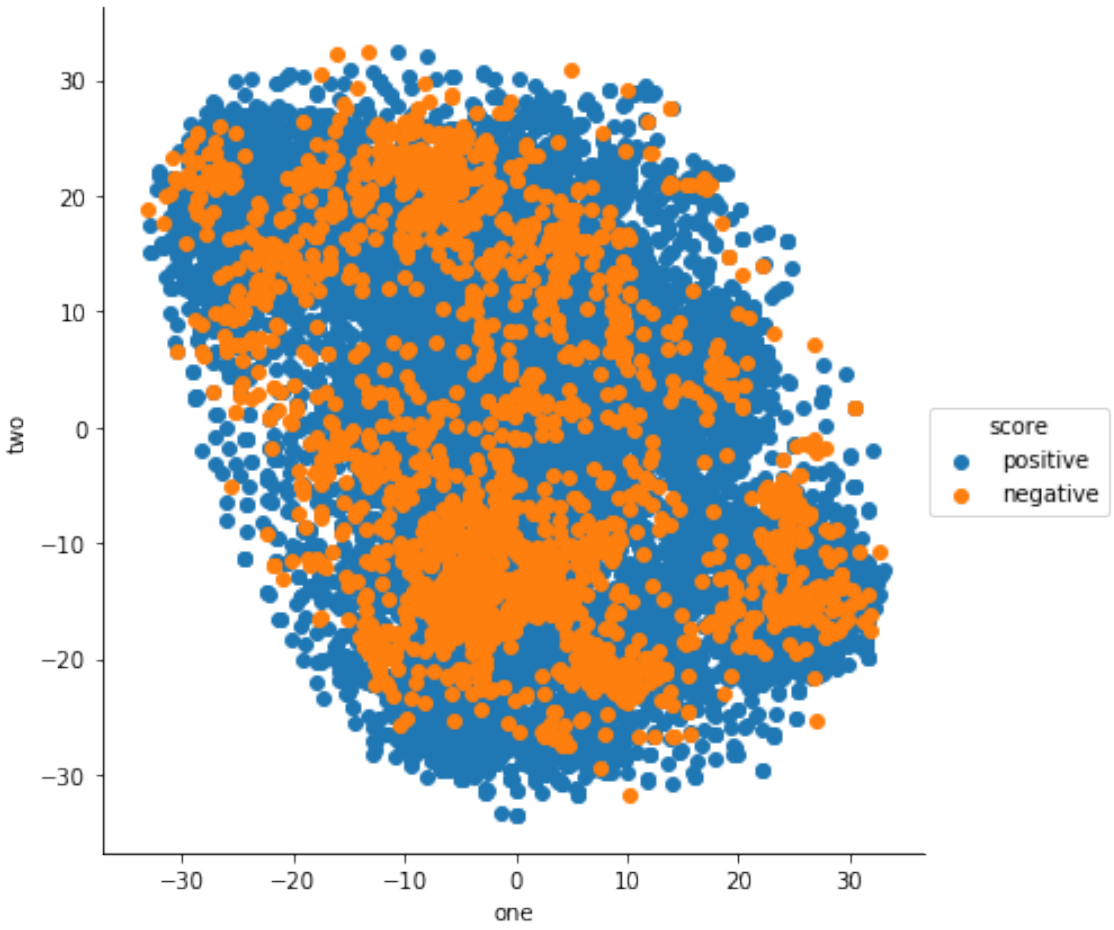


In [18]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=5000,random_state=0,n_jobs=12).
#Stacking df
df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[18]: <seaborn.axisgrid.FacetGrid at 0x145da5262080>

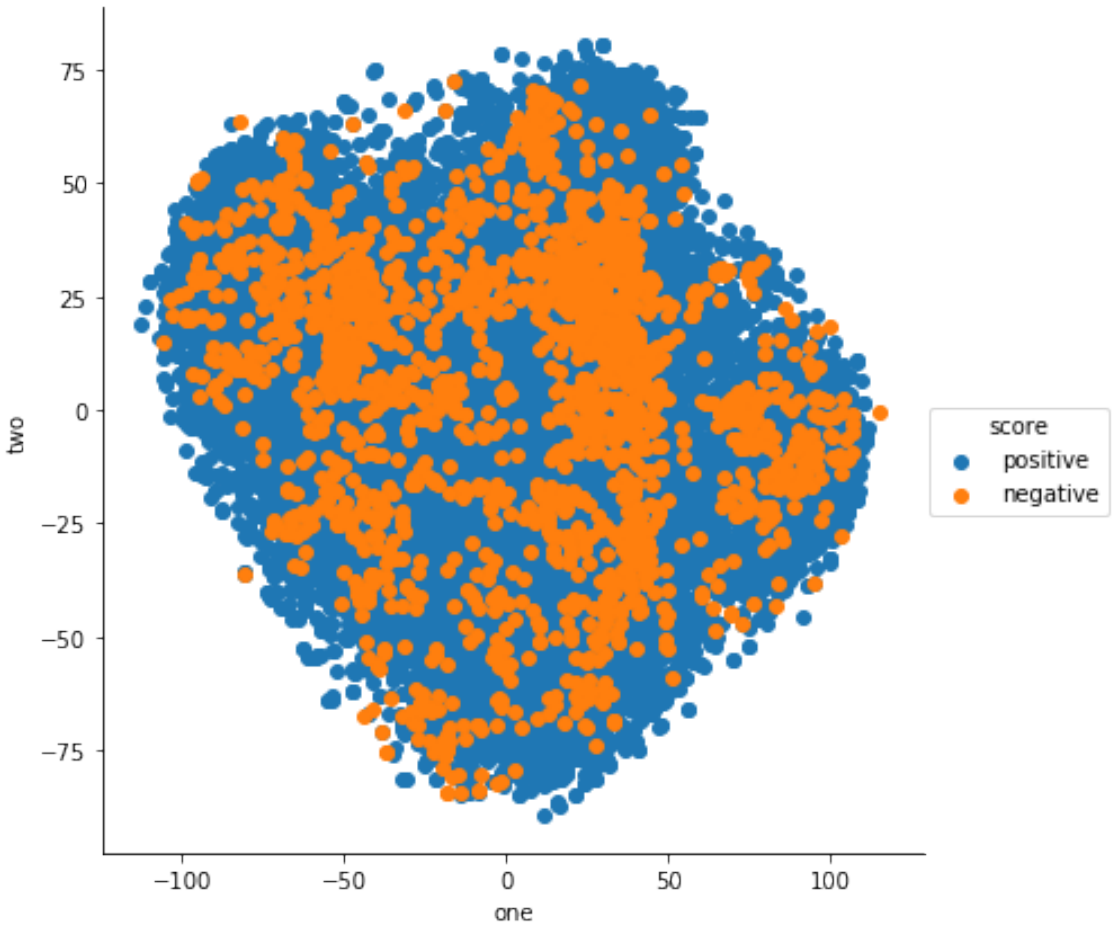



```
In [14]: #sampled some data from above
         s = wdf.sample(n=13000)

In [15]: #Scaling
         scaler = StandardScaler()
         X_scale=scaler.fit_transform(s.values)

In [29]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=5000,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[29]: <seaborn.axisgrid.FacetGrid at 0x145d9a7df978>
```



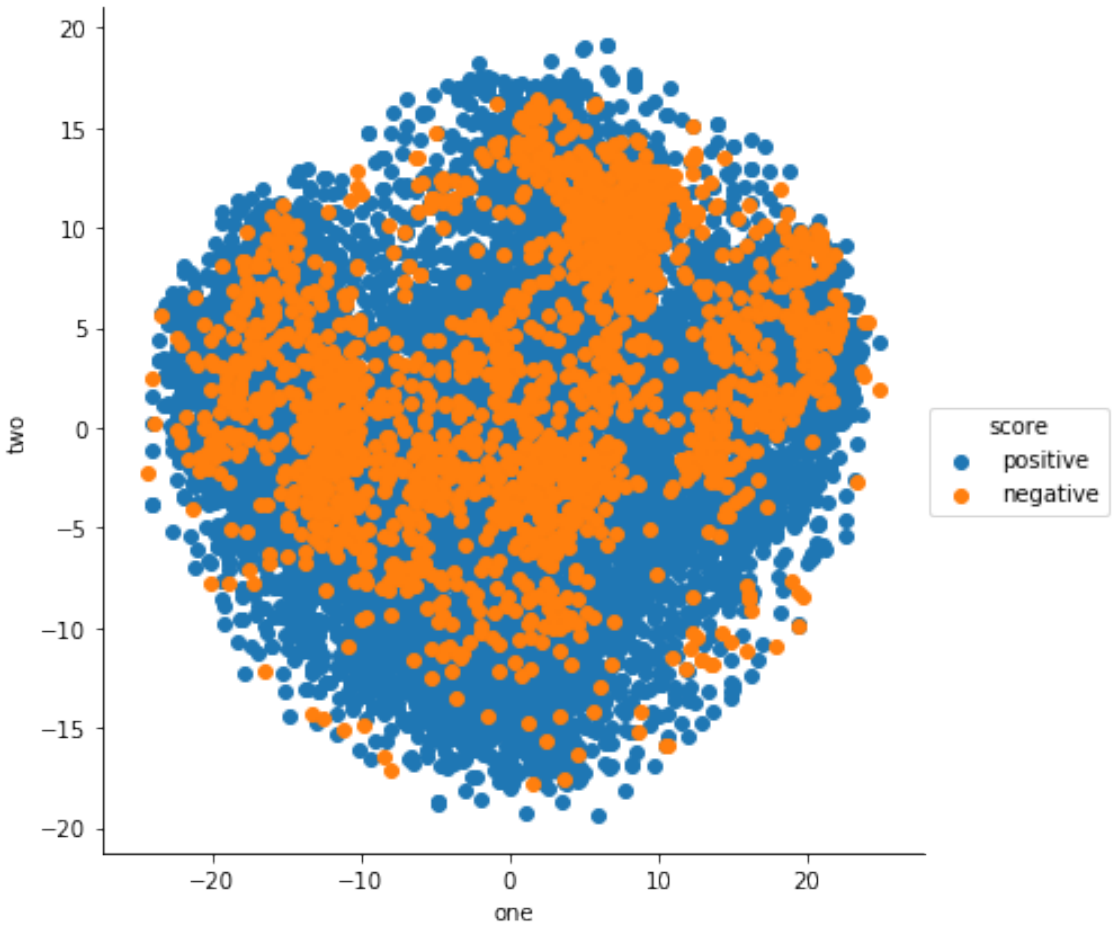
In [31]:
```
#TSNE
final_2d5 = TSNE(n_components=2,perplexity=35,n_iter=5000,
                 random_state=0).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[31]: <seaborn.axisgrid.FacetGrid at 0x145d50df15f8>



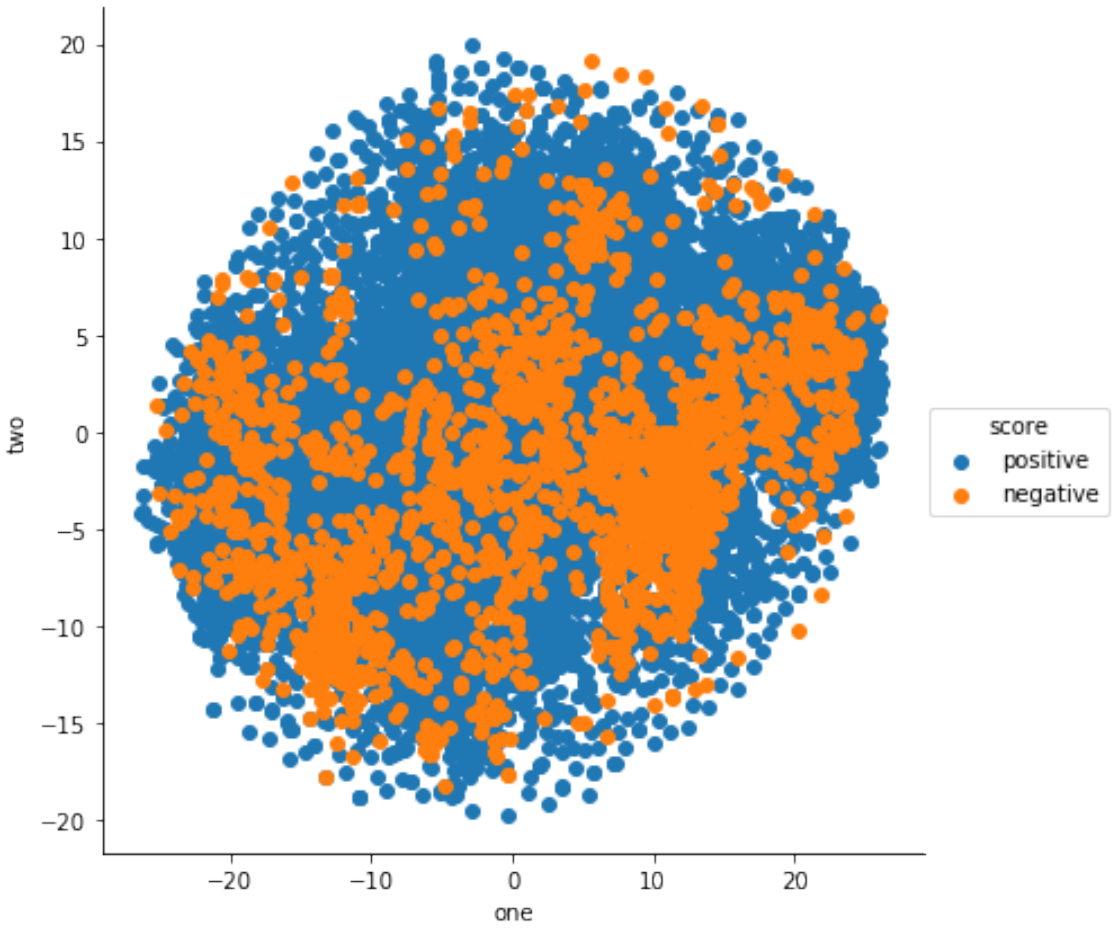
In [16]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=80,n_iter=3800,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[16]:
```
<seaborn.axisgrid.FacetGrid at 0x145cd75aa358>
```

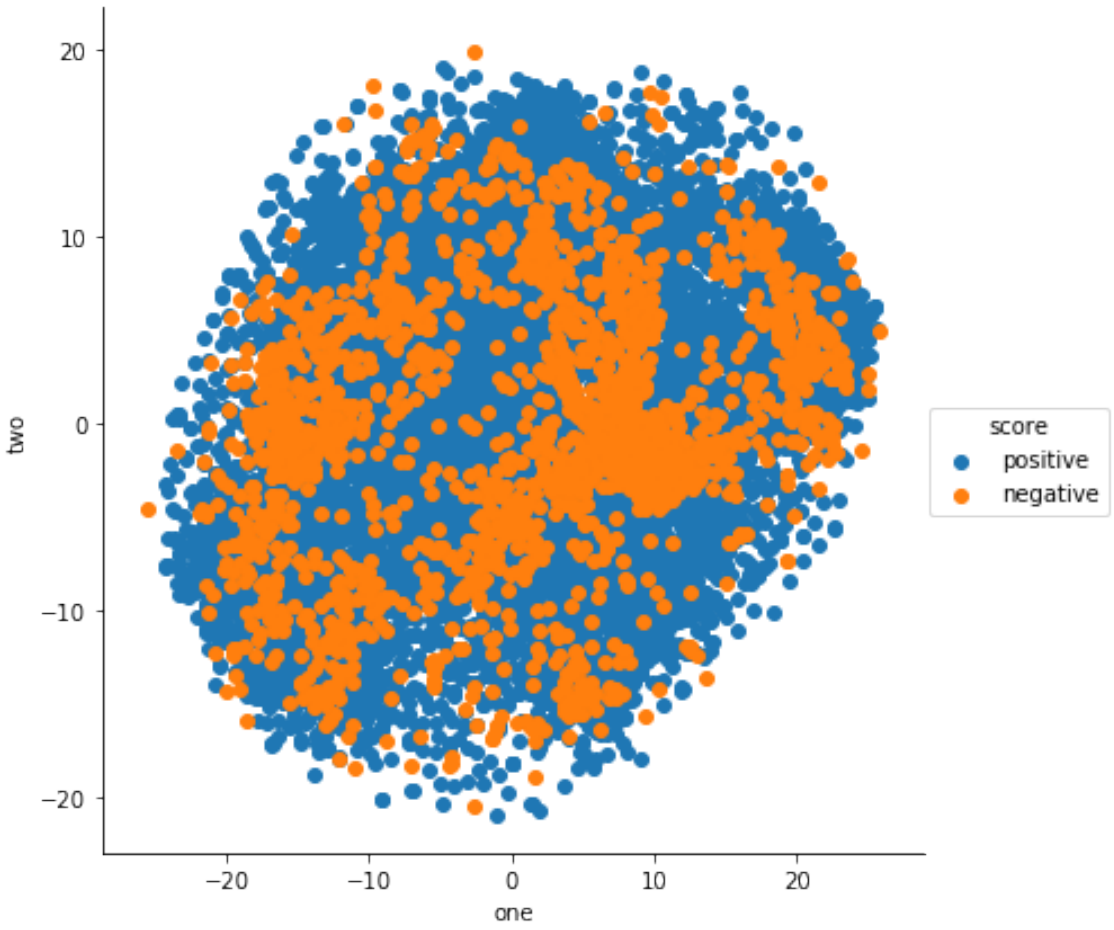


In [17]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=80,n_iter=5800,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[17]:
```
<seaborn.axisgrid.FacetGrid at 0x145cd75aac50>
```

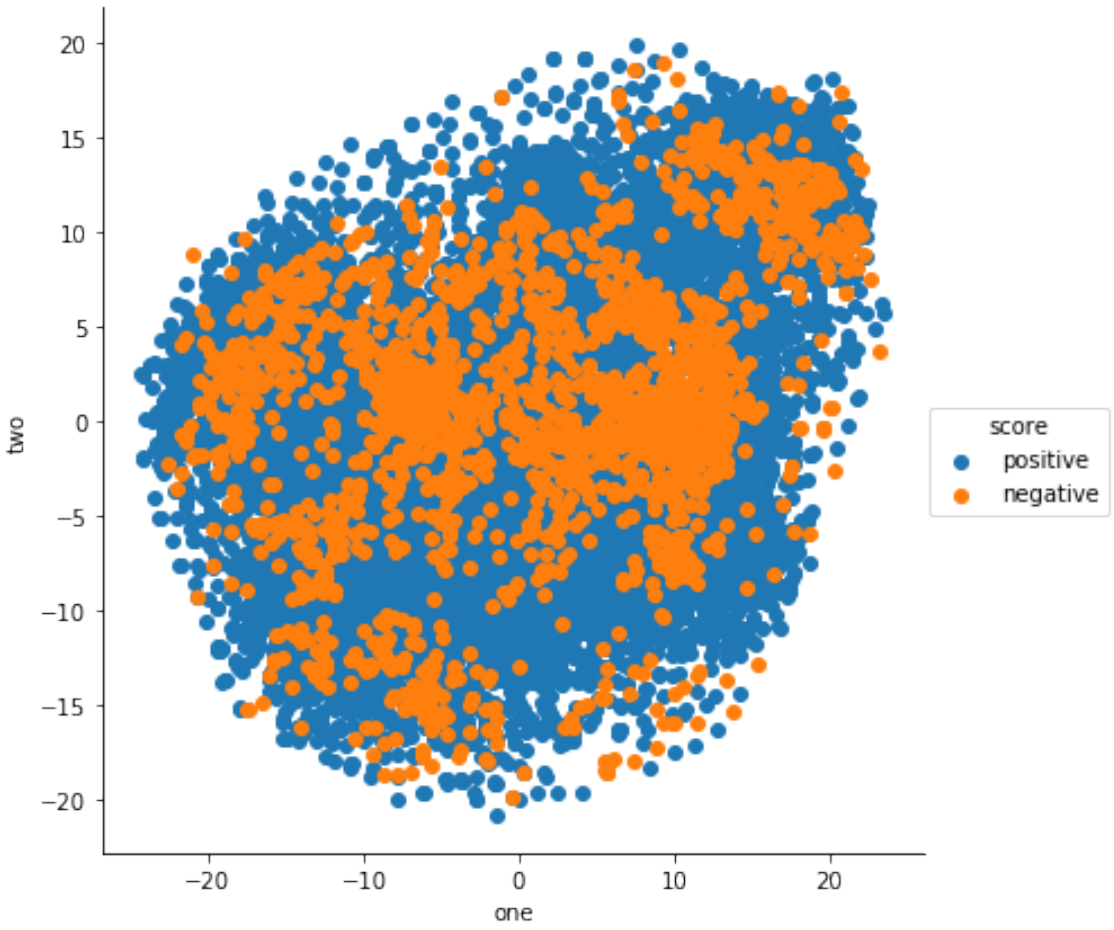



```
In [18]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=80,n_iter=7800,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[18]: <seaborn.axisgrid.FacetGrid at 0x145d293eac50>
```



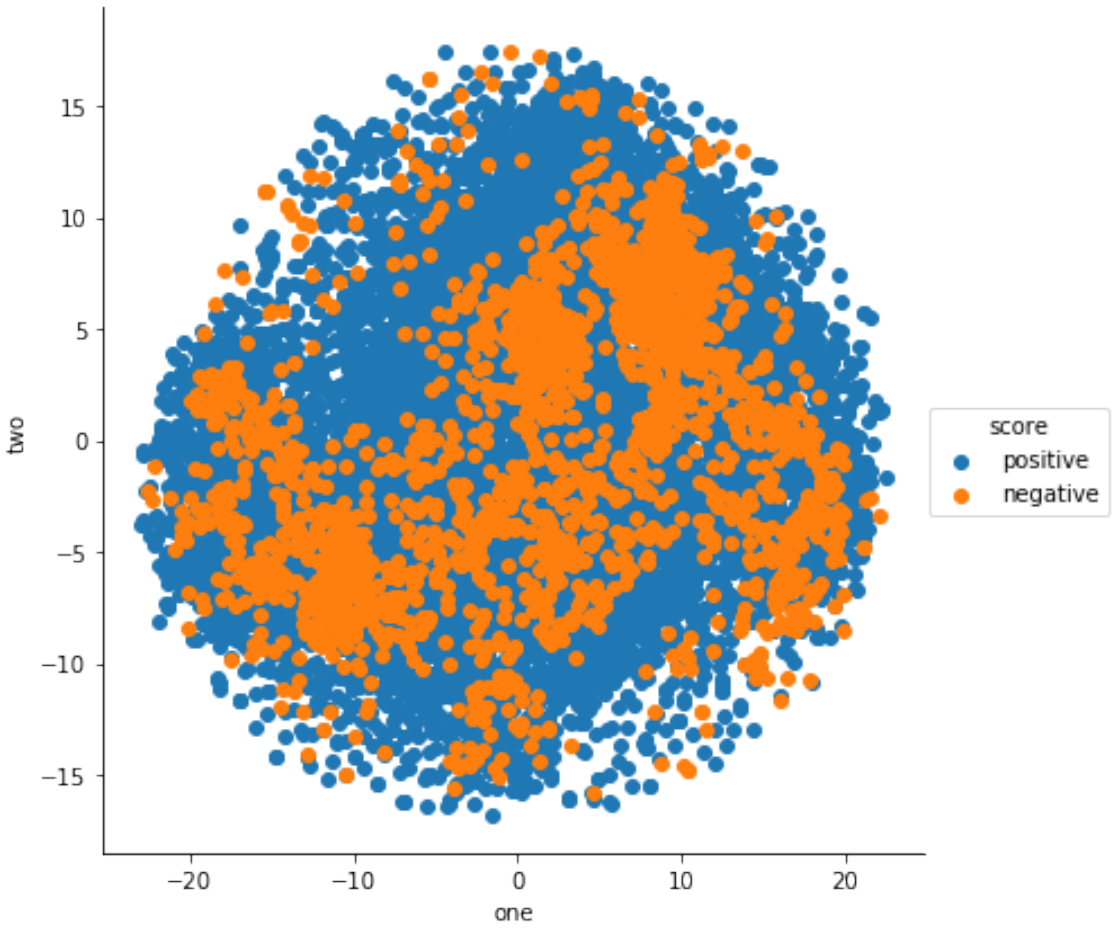
In [19]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=80,n_iter=8800,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[19]: <seaborn.axisgrid.FacetGrid at 0x145cd74f22e8>



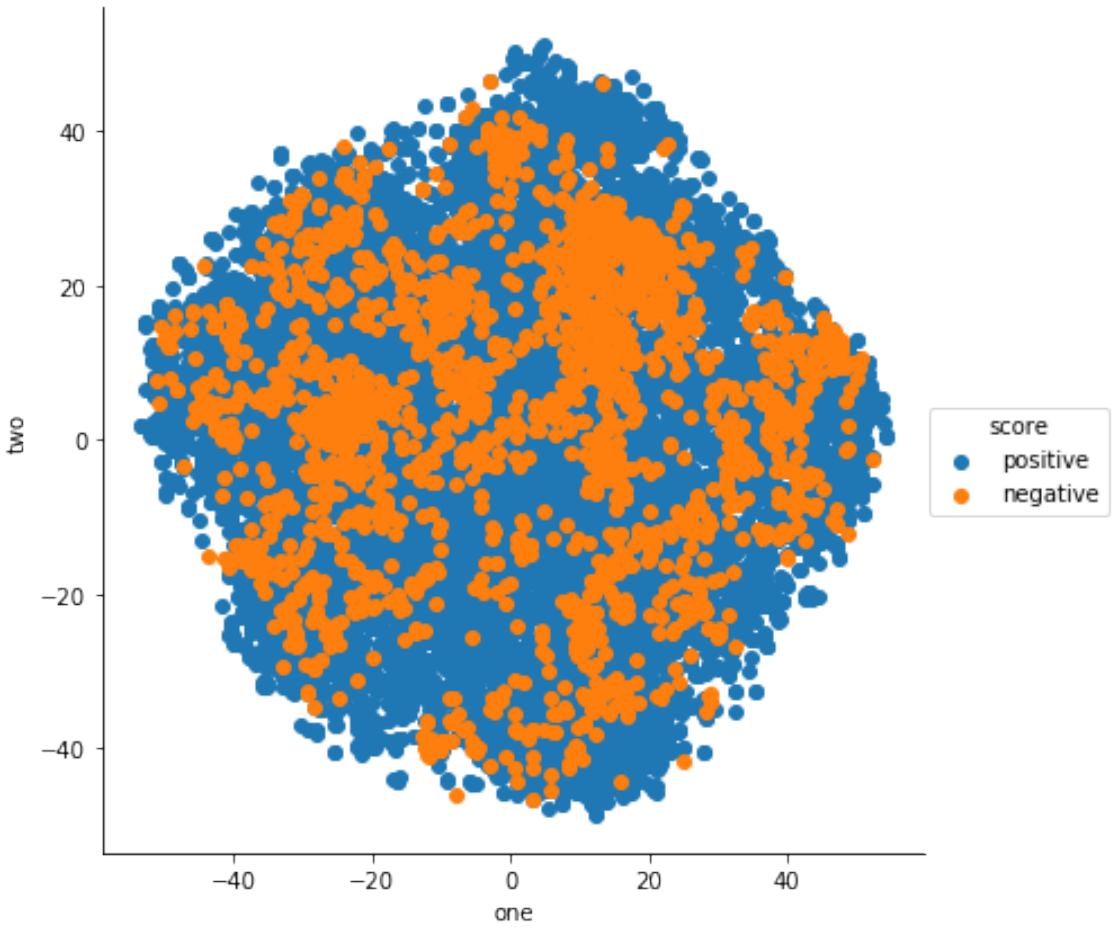
In [20]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=100,n_iter=8800,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[20]: <seaborn.axisgrid.FacetGrid at 0x145d29d2b3c8>



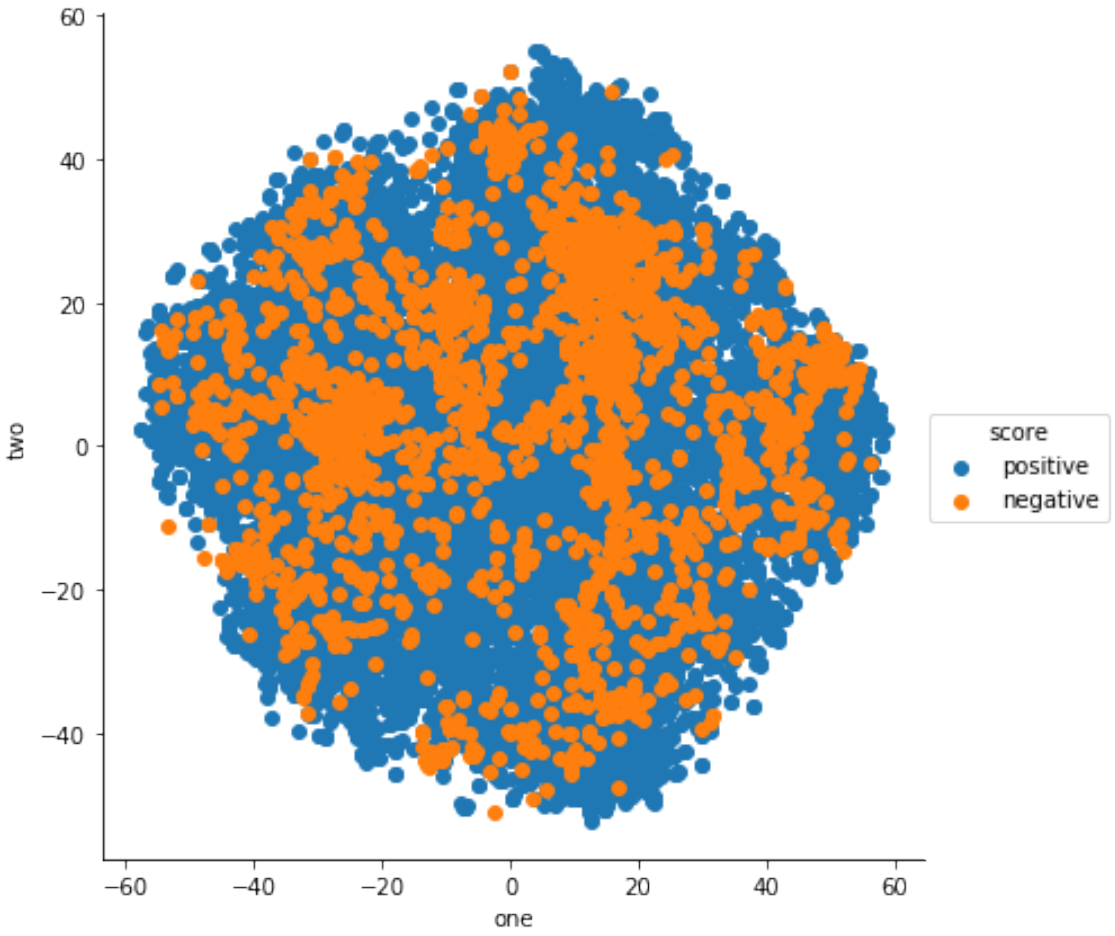
In [21]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=20,n_iter=5000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[21]: <seaborn.axisgrid.FacetGrid at 0x145d1d3b6630>

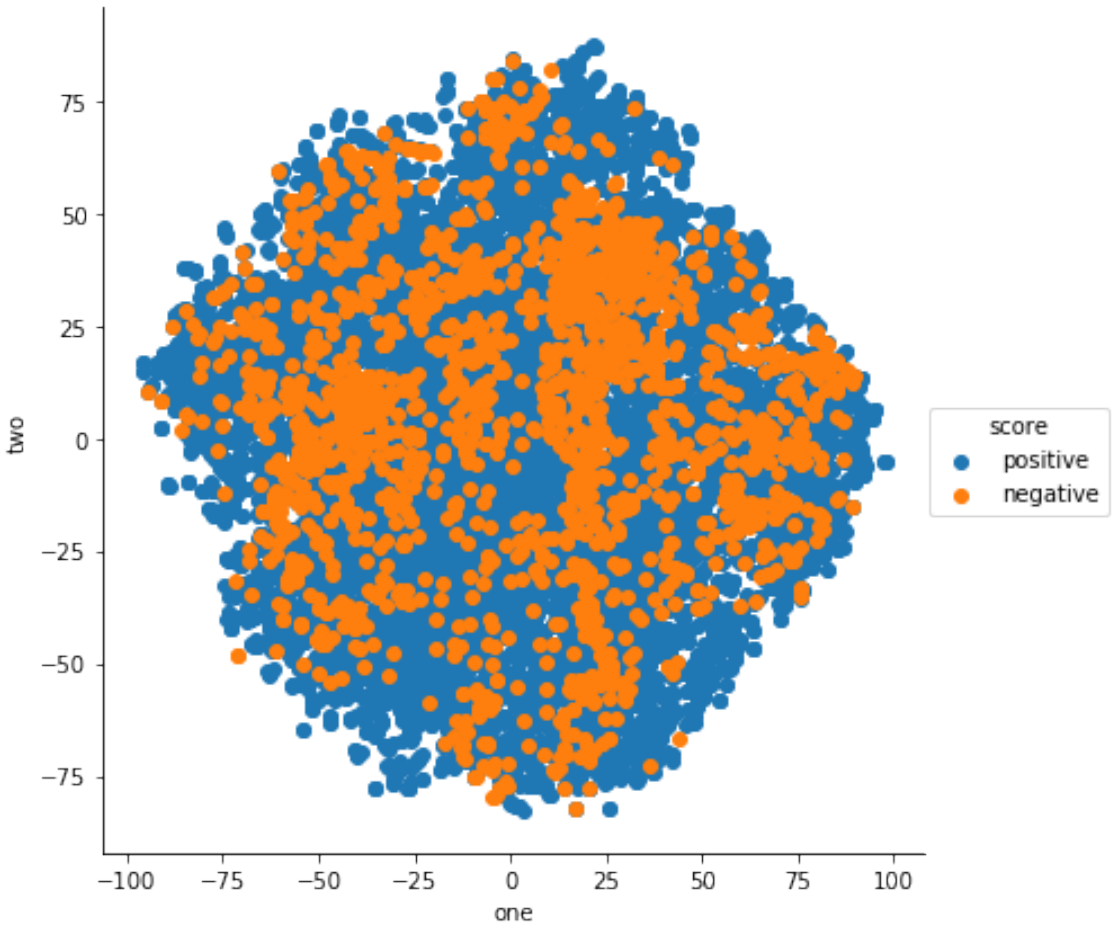


In [22]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=20,n_iter=7000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[22]: <seaborn.axisgrid.FacetGrid at 0x145d2e24e080>




```
In [23]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=8,
                           n_iter=7000,random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[23]: <seaborn.axisgrid.FacetGrid at 0x145d2d68ef98>
```



- Avg Word2Vec also having so much overlap on data for positive and negative instances

TF-IDF Weighted Word2Vec

```
In [9]: #Cleaning sent
        import gensim
        i=0
        list_of_sent_clean=[]
        for sent in final_amazon.CleanedTextBow.values:
            filtered_sentence=[]
            #sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            list_of_sent_clean.append(' '.join(filtered_sentence))
```

```
In [10]: len(list_of_sent_clean)

Out[10]: 364171

In [11]: #tf-idf
         tf_idf_vect = TfidfVectorizer(ngram_range=(1,1))
         final_tf_idf = tf_idf_vect.fit_transform(list_of_sent_clean)

In [12]: #convering featues names of tfidf to dict as value = index
         #for using in below TFIDF weighted Word2Vec for time efficiency
         dict_tfidf = {k: v for v, k in enumerate(tf_idf_vect.get_feature_names())}

In [36]: # TF-IDF weighted Word2Vec
         tfidf_feat = tf_idf_vect.get_feature_names() # tfidf words/col-names
         tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in this l
         row=0;
         for sent in list_of_sent: # for each review/sentence
             sent_vec = np.zeros(50,dtype=np.float64) # as word vectors are of zero length
             weight_sum =0.0; # num of words with a valid vector in the sentence/review
             for word in sent : # for each word in a review/sentence
                 try:
                     vec = w2v_model.wv[word]
                     #print(final_tf_idf[row, dict_tfidf[word]])
                     # obtain the tf_idfidf of a word in a sentence/review
                     #tfidf = final_tf_idf[row, tfidf_feat.index(word)]
                     tfidf = final_tf_idf[row, dict_tfidf[word]]
                     #print(tfidf)
                     #print(np.dot(vec,tf_idf))
                     sent_vec = sent_vec + vec*tfidf
                     #print(sent_vec)
                     weight_sum = weight_sum + tfidf
                 except:
                     pass
             sent_vec = sent_vec/weight_sum
             tfidf_sent_vectors.append(sent_vec)
             row += 1

/glob/intel-python/versions/2018u2/intelpython3/lib/python3.6/site-packages/ipykernel_launcher


In [38]: len(tfidf_sent_vectors)

Out[38]: 364171

In [39]: #Saving to local file
         pickle.dump(tfidf_sent_vectors,open('tfidf_w2v.p','wb'))

In [7]: #loading
        tfidf_sent_vectors = pickle.load(open('tfidf_w2v.p','rb'))
```

```
In [8]: wdf = pd.DataFrame(tfidf_sent_vectors)
        #Found one null value row in w2v
        wdf[wdf.isnull().any(axis=1)][wdf.columns]
```

```
Out[8]:         0   1   2   3   4   5   6   7   8   9  ...  40  41  42  43  44  45  \
        138708 NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN ... NaN NaN NaN NaN NaN NaN
        194901 NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN ... NaN NaN NaN NaN NaN NaN
        270507 NaN NaN NaN NaN NaN NaN NaN NaN NaN NaN ... NaN NaN NaN NaN NaN NaN

                46  47  48  49
        138708 NaN NaN NaN NaN
        194901 NaN NaN NaN NaN
        270507 NaN NaN NaN NaN

        [3 rows x 50 columns]
```

```
In [9]: #row contains total numeric only so we are not considering
        cleanpunc(final_amazon.loc[270507].CleanedTextBow)
```

```
Out[9]: '&1056;&1077;&1096;&1080;&1083;&1072; &1079;&1072;&1082;&1072;&1079;&1072;&1090;&1100;
```

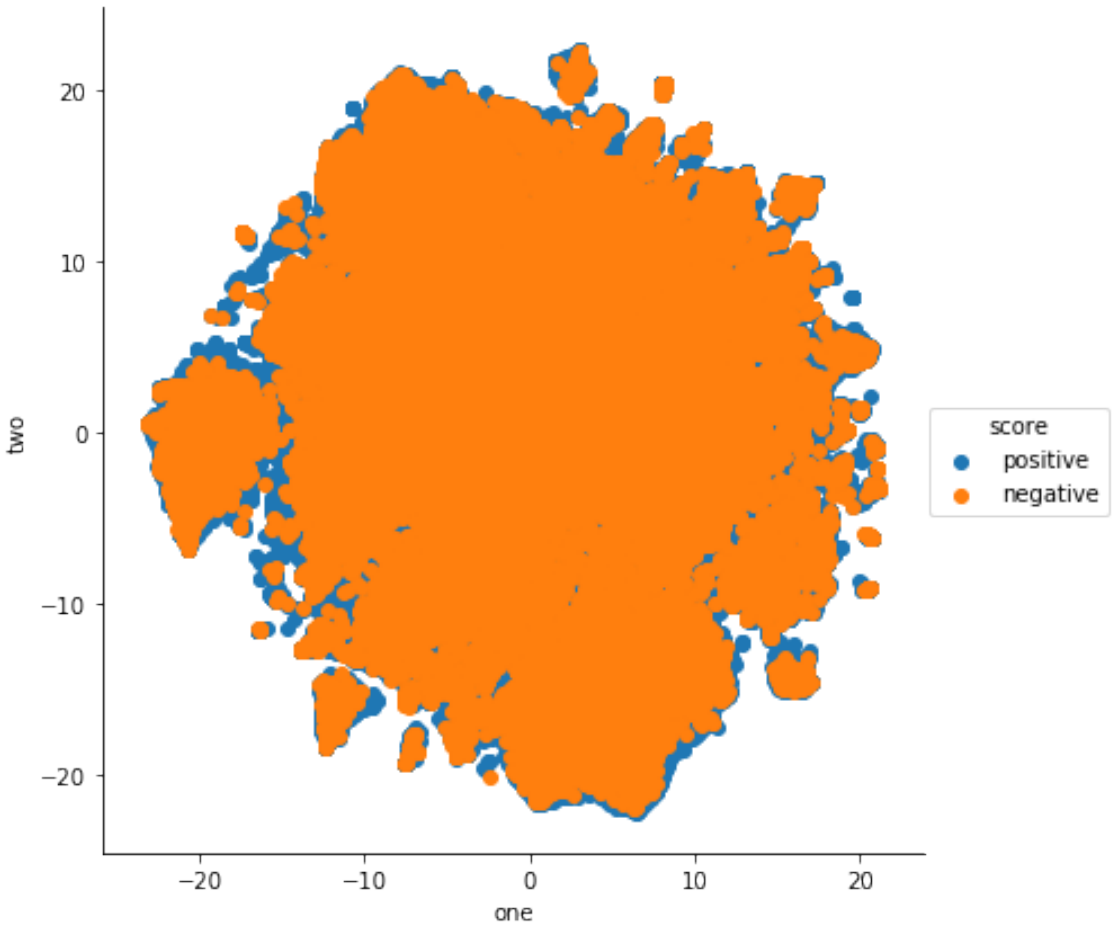
```
In [9]: #Deletting null entries
        final = final_amazon.drop([138708,194901,270507],axis=0)
```

```
In [10]: #deleting nan values
         wdf = wdf.dropna()
```

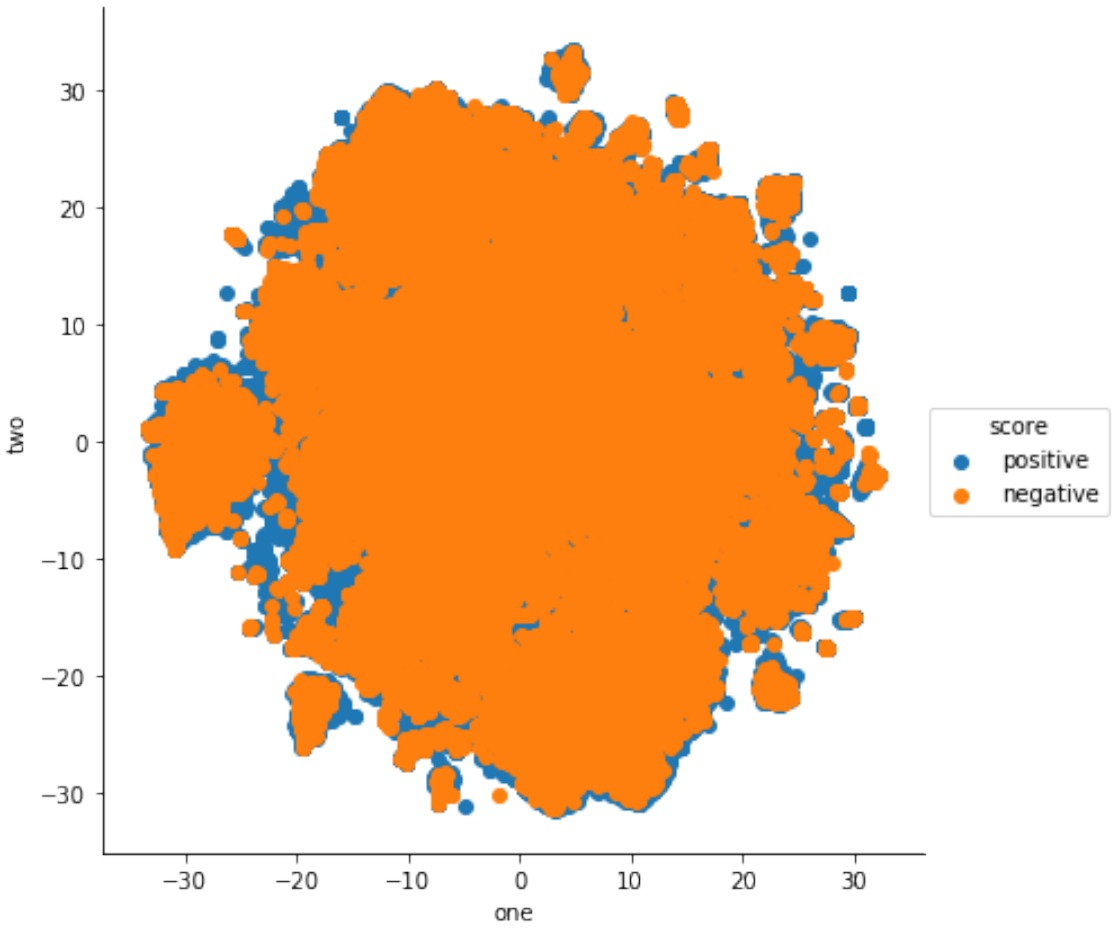
```
In [11]: #Scaling
         scaler = StandardScaler()
         X_scale=scaler.fit_transform(wdf.values)
```

```
In [50]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=1600,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()
```

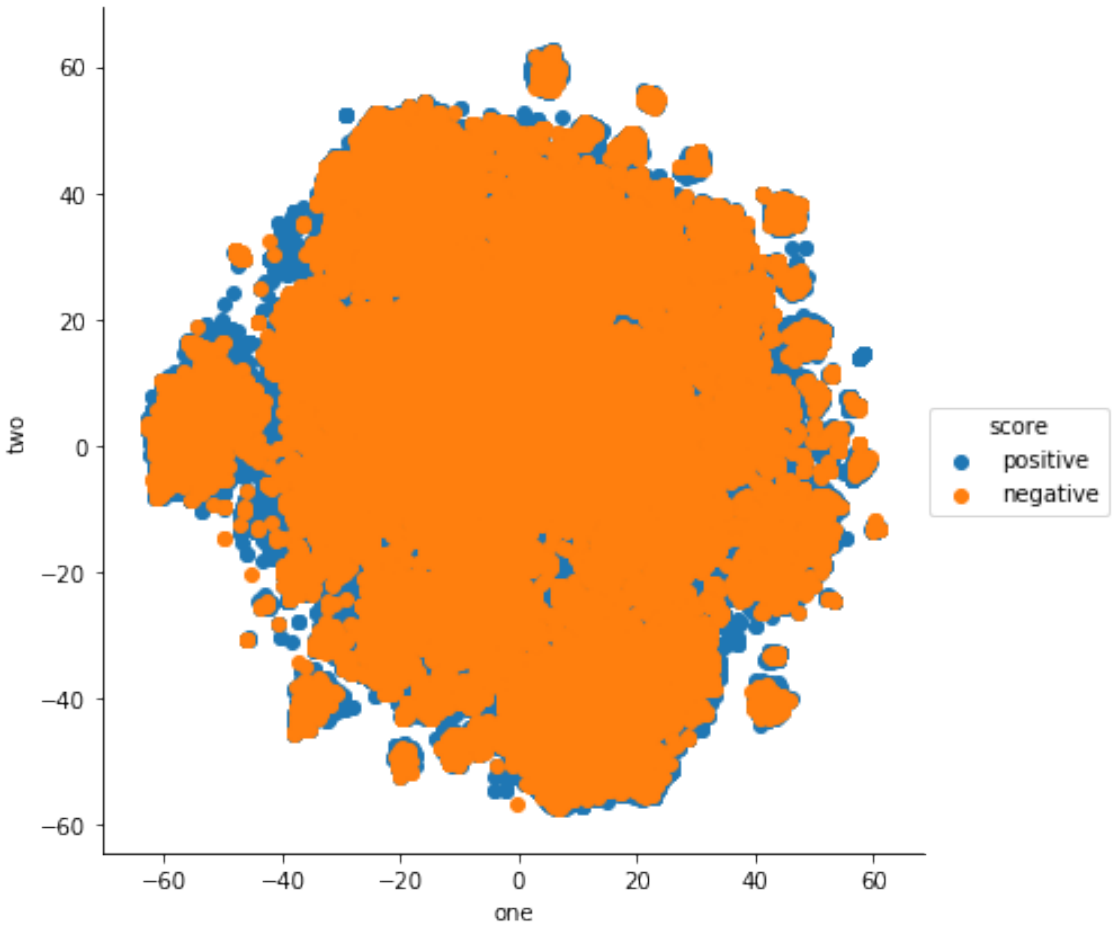
```
Out[50]: <seaborn.axisgrid.FacetGrid at 0x1515a84fc390>
```



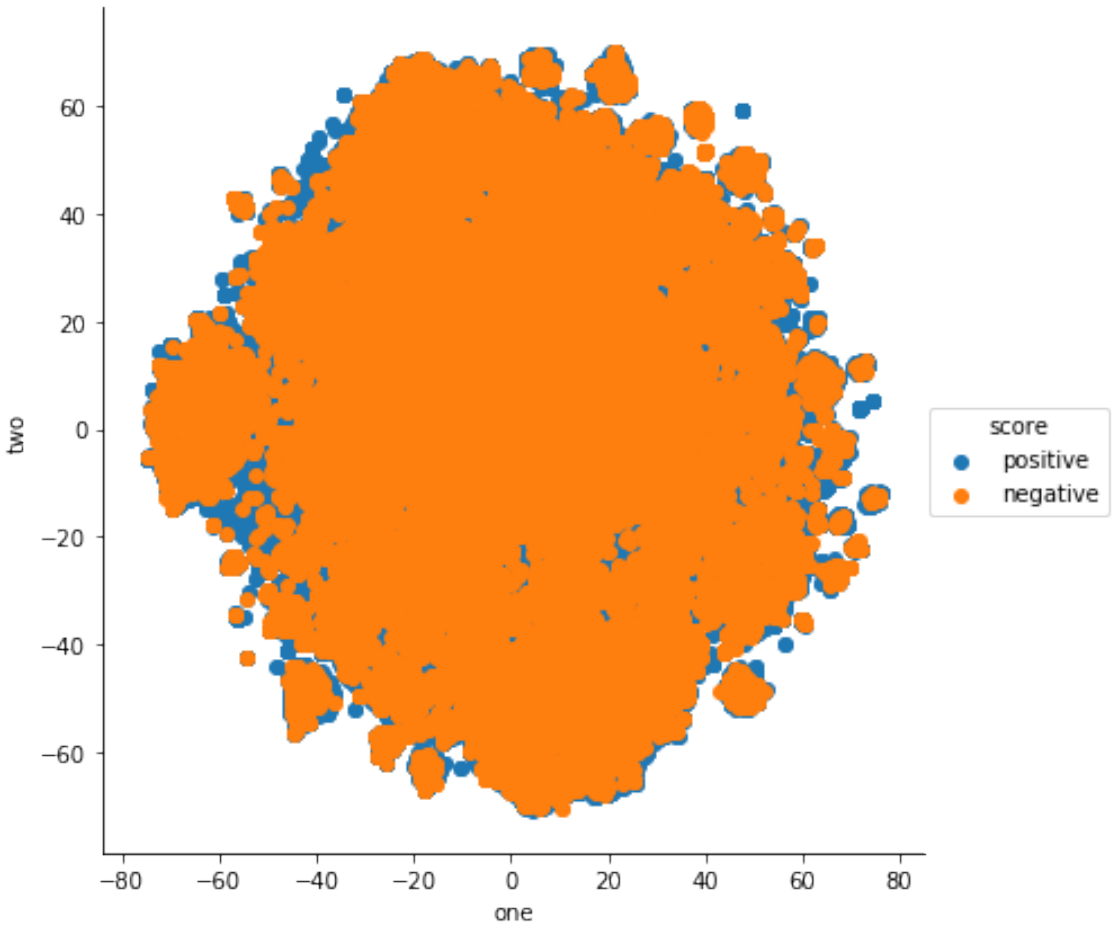

```
In [51]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=2500,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[51]: <seaborn.axisgrid.FacetGrid at 0x151596058438>
```




```
In [14]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=5500,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[14]: <seaborn.axisgrid.FacetGrid at 0x14c2b1eb1fd0>
```



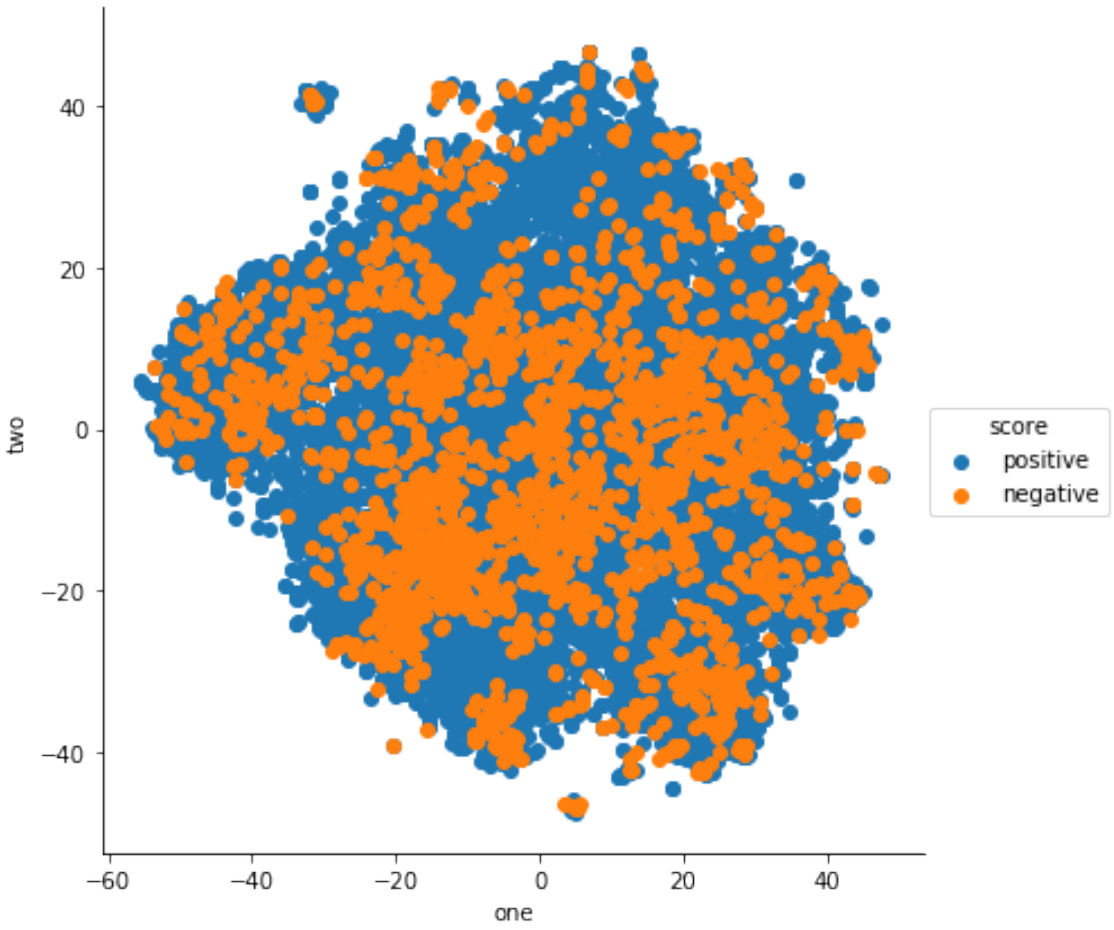

```
In [15]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=15,n_iter=5500,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final.Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[15]: <seaborn.axisgrid.FacetGrid at 0x14c2abff7320>
```



In [12]:
```
#Sampling some data
s = wdf.sample(n=13000)
scaler = StandardScaler()
X_scale=scaler.fit_transform(s.values)
```

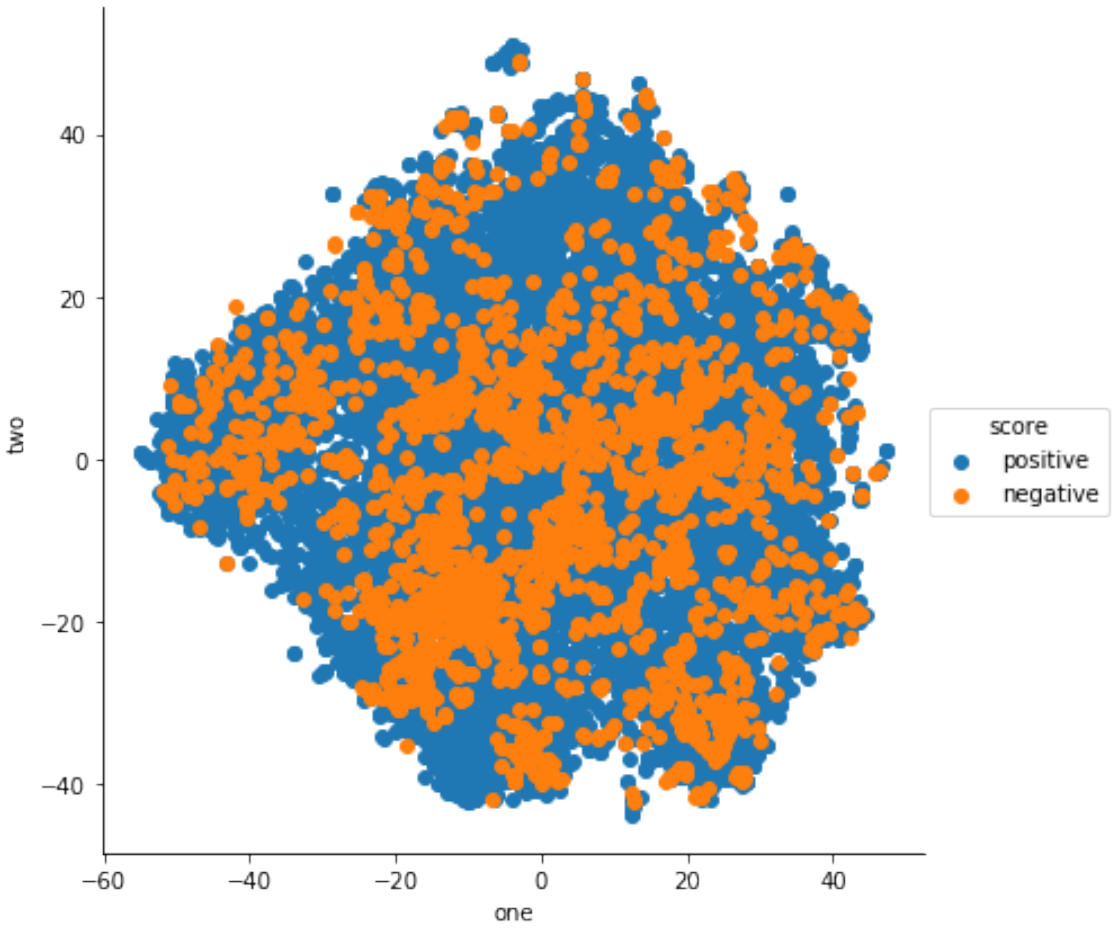
In [17]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=5000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[17]:
```
<seaborn.axisgrid.FacetGrid at 0x14c2a649c4e0>
```



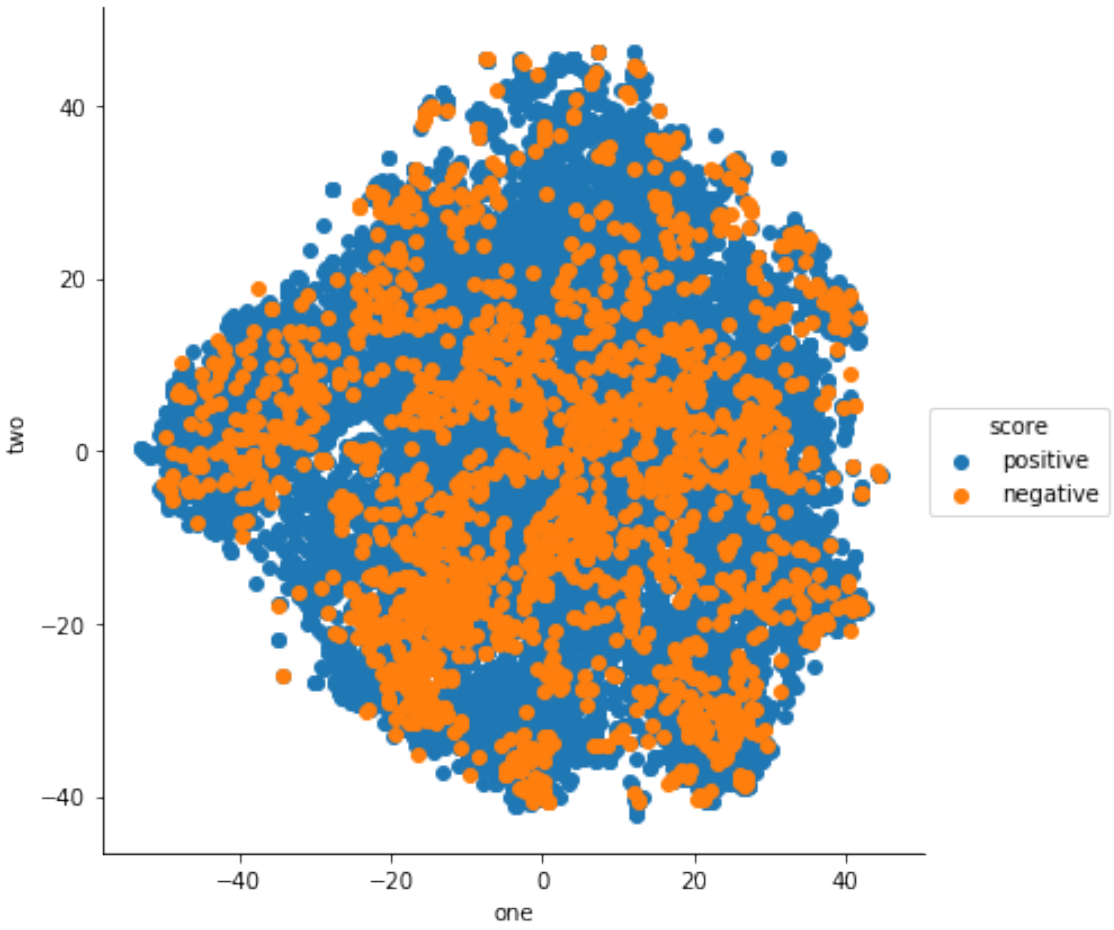
In [18]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=6000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[18]:
```
<seaborn.axisgrid.FacetGrid at 0x14c296e4e9e8>
```

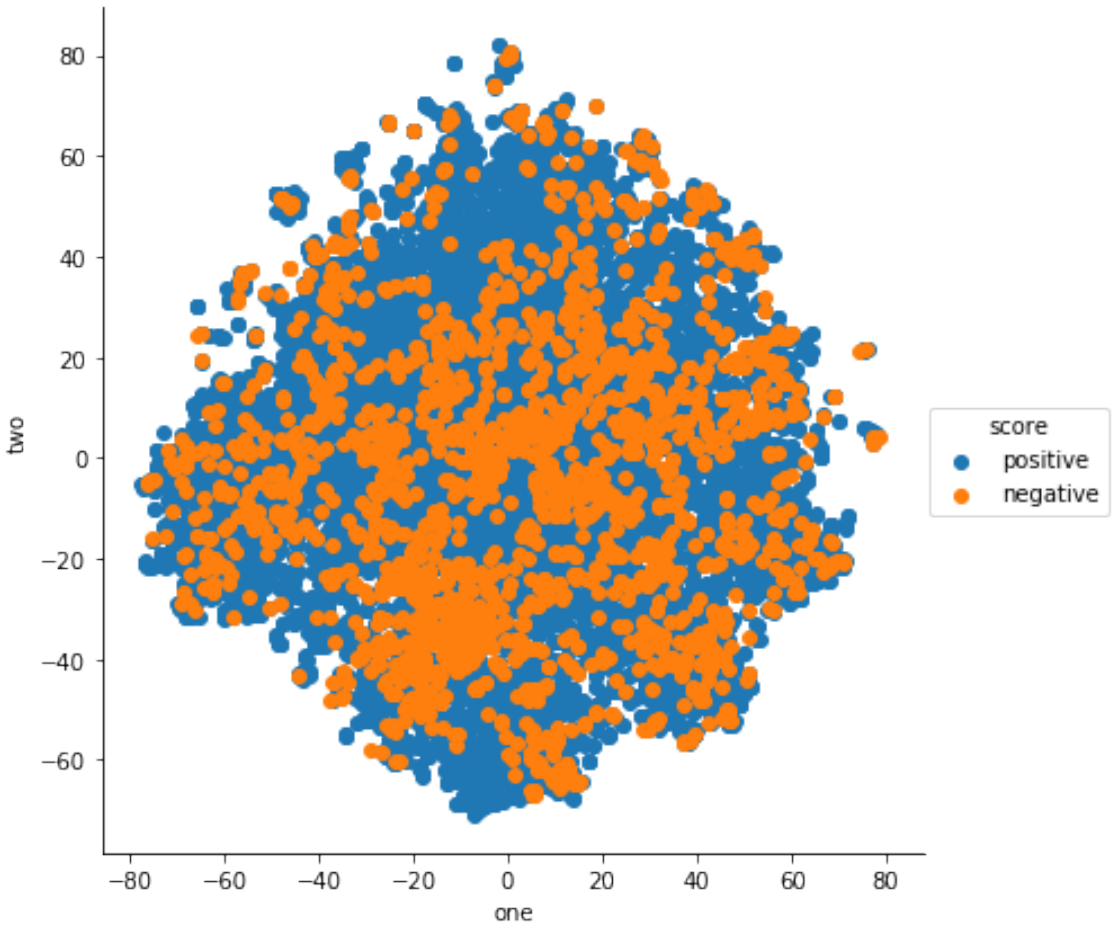


In [19]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=35,n_iter=4000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[19]:
```
<seaborn.axisgrid.FacetGrid at 0x14c296b34518>
```

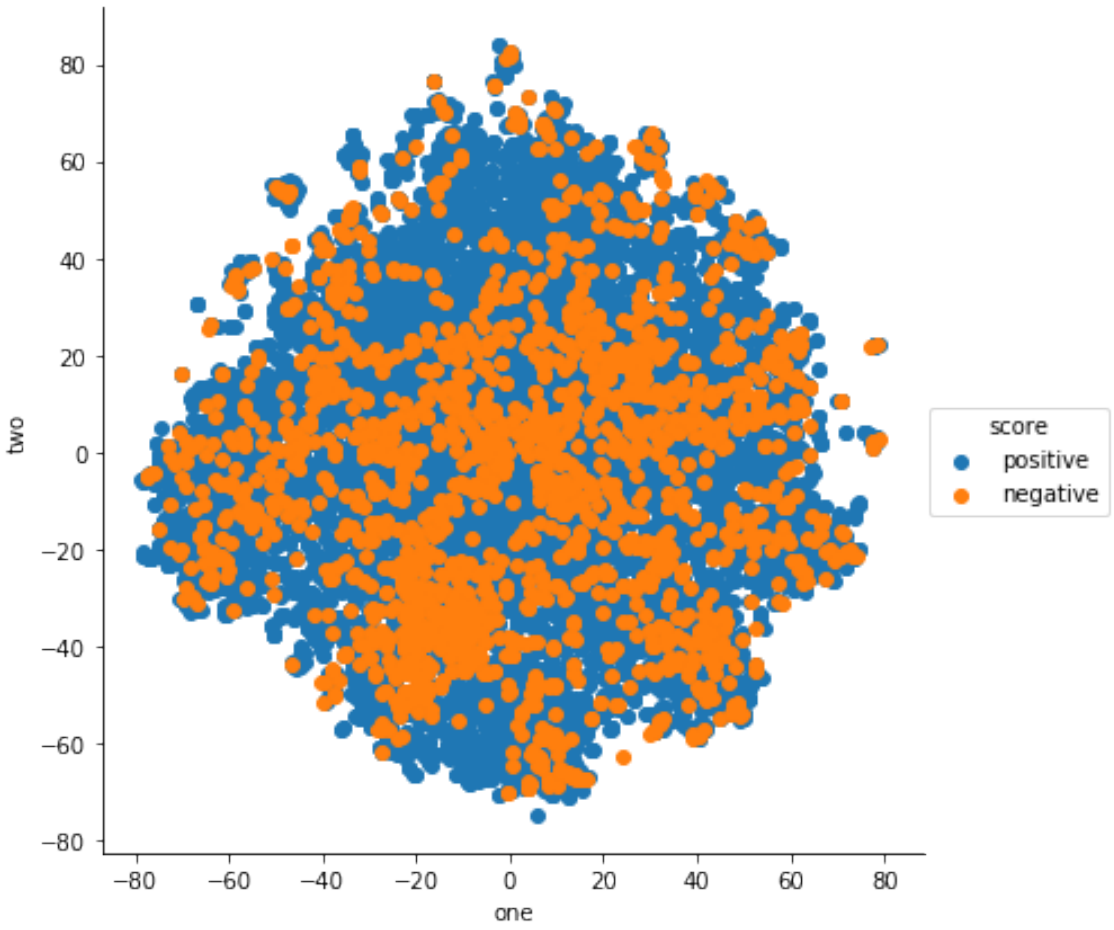



```
In [20]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=10,n_iter=4000,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[20]: <seaborn.axisgrid.FacetGrid at 0x14c2968565f8>
```

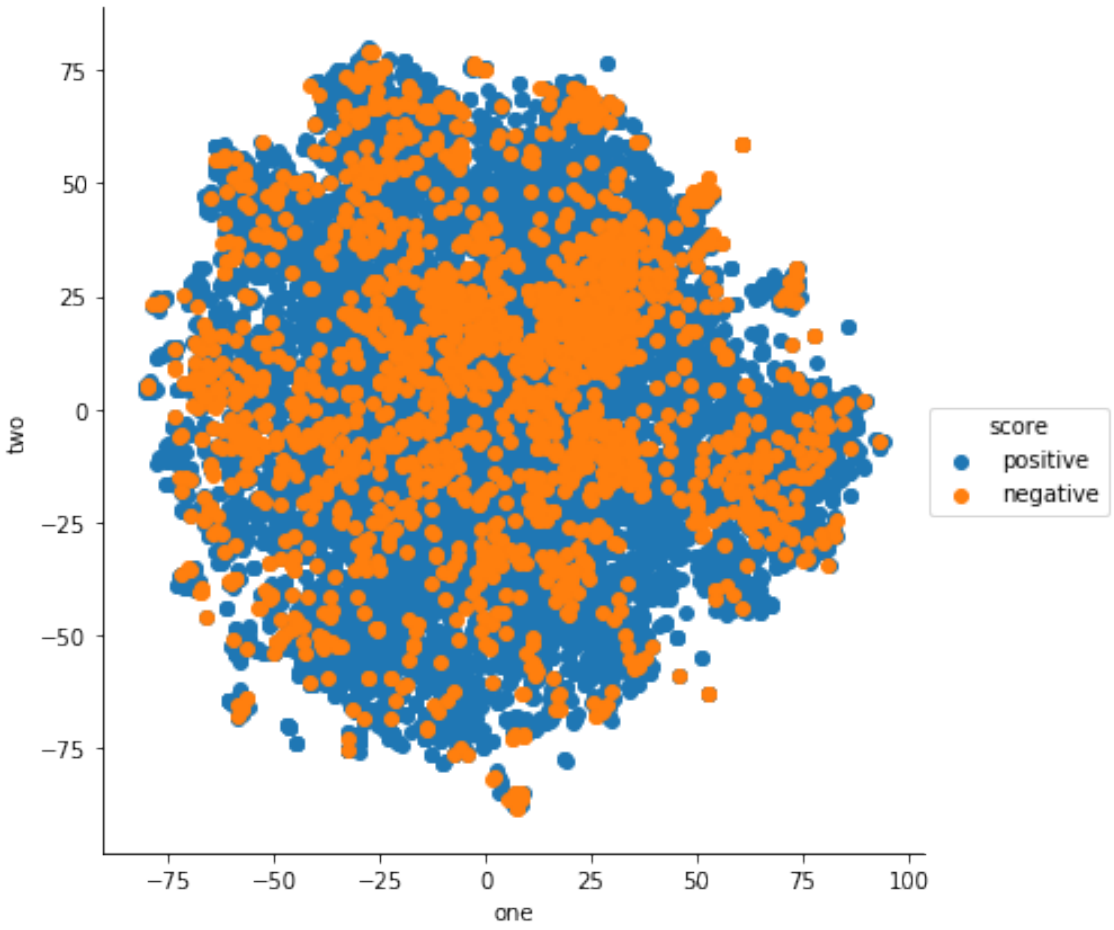


In [22]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=10,n_iter=5000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

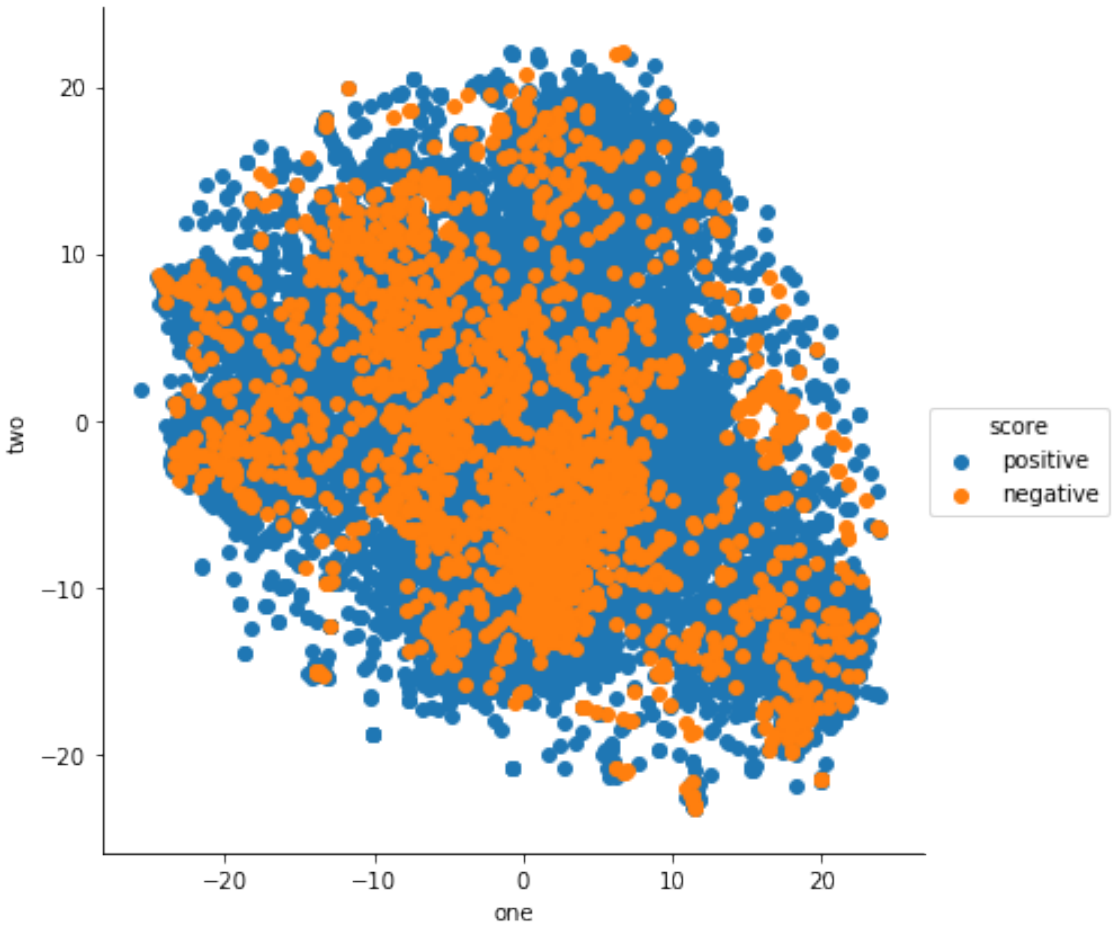
Out[22]: <seaborn.axisgrid.FacetGrid at 0x14c29657a320>




```
In [13]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=10,n_iter=7000,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[13]: <seaborn.axisgrid.FacetGrid at 0x14573a76c710>
```

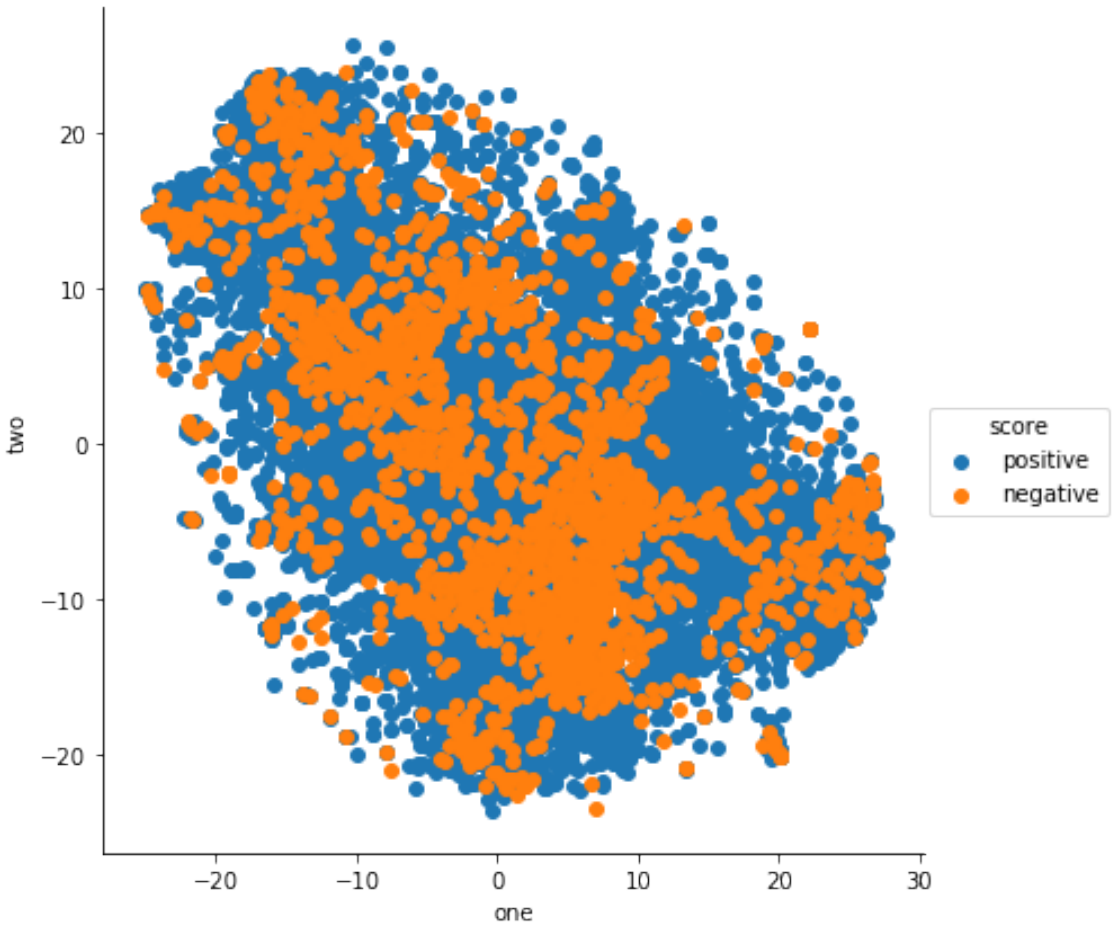



```
In [14]: #TSNE
         final_2d5 = MTSNE(n_components=2,perplexity=90,n_iter=3000,
                           random_state=0,n_jobs=12).fit_transform(X_scale)
         #Stacking df
         df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
         #Scatter plot
         sns.FacetGrid(df, hue="score", size=6).\
         map(plt.scatter,'one','two').add_legend()

Out[14]: <seaborn.axisgrid.FacetGrid at 0x14578be320f0>
```



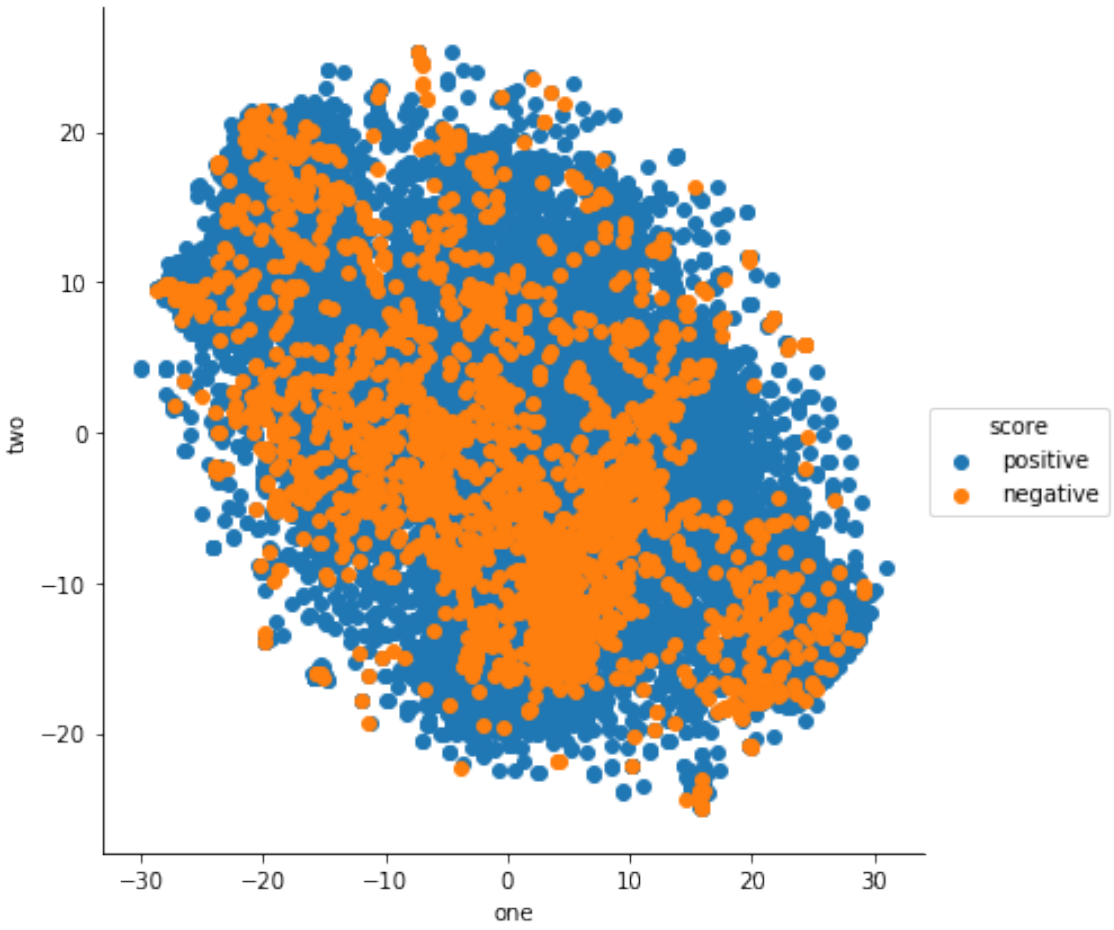
In [15]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=90,n_iter=4000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[15]:
```
<seaborn.axisgrid.FacetGrid at 0x1457884fa588>
```



In [16]:
```
#TSNE
final_2d5 = MTSNE(n_components=2,perplexity=90,n_iter=6000,
                  random_state=0,n_jobs=12).fit_transform(X_scale)
#Stacking df
df = Stacking_df(final_2d5,final_amazon.loc[s.index].Score.values.reshape(-1,1))
#Scatter plot
sns.FacetGrid(df, hue="score", size=6).\
map(plt.scatter,'one','two').add_legend()
```

Out[16]: <seaborn.axisgrid.FacetGrid at 0x145784d3b588>


20
10
0
−10
−20
two
−30
−20
−10
0
10
20
30
one
score
positive
negative