KNN (k-nearest neighbour) Amazon reviews

In [210]:

```
import sqlite3
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn import neighbors
from matplotlib.colors import ListedColormap
from sklearn import cross_validation
from sklearn.metrics import accuracy_score
from sklearn.cross_validation import cross_val_score
from sklearn.model_selection import cross_val_predict
from sklearn.metrics import confusion_matrix
import scikitplot as skplt
from sklearn.metrics import f1_score
```

Load data

In [211]:

```
#Data here used is preprocessed(deduplication,removal of html tags,punctuation,stop words,stemming)
con =sqlite3.connect(r'C:\Users\Friend\AI\AI_datasets\Amazon\cleaned_database.sqlite')
filtered_data  = pd.read_sql_query('SELECT * FROM Reviews WHERE Score != 3',con)
filtered_data = filtered_data.drop('index',axis = 1)

filtered_data = filtered_data.sort_values('Time')
```

Sampling data

In [212]:

```
data = filtered_data.head(30000)
data.columns
```

Out[212]:

```
Index(['Id', 'ProductId', 'UserId', 'ProfileName', 'HelpfulnessNumerator',
       'HelpfulnessDenominator', 'Score', 'Time', 'Summary', 'Text',
       'CleanedText'],
      dtype='object')
```

In [213]:

```
X_train, X_test, y_train, y_test = cross_validation.train_test_split(data['CleanedText'], data['Score']
, test_size=0.3, random_state=0)
print(X_train.shape,y_train.shape,X_test.shape,y_test.shape)
```

```
(21000,) (21000,) (9000,) (9000,)
```

BOW

In [214]:

```
# Performing BOW on review
from sklearn.feature_extraction.text import CountVectorizer
count_vect = CountVectorizer()
vocabulary = count_vect.fit(X_train)
```

In [215]:

```
bag_of_words_train = count_vect.transform(X_train)
print(bag_of_words_train.shape)
```

```
(21000, 18506)
```

4-fold Cross Validation

In [216]:

```
#4 fold cross validation using kd-tree algorithm
myList = list(range(5,15))
k_values = list(filter(lambda x: x % 2 != 0, myList))

#claculate CV scores
f1_scores_bow = []
for k in k_values:
    knn = neighbors.KNeighborsClassifier(n_neighbors=k,algorithm = 'kd_tree')
    pred = cross_val_predict(knn, bag_of_words_train, y_train, cv=4)
    tn, fp, fn, tp = confusion_matrix(y_train, pred).ravel()
    pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
    score=(2*pr*re)/(pr+re)
    f1_scores_bow.append(score)
```

```
C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree with sparse input: using brute force
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```

```
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C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree
with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
```
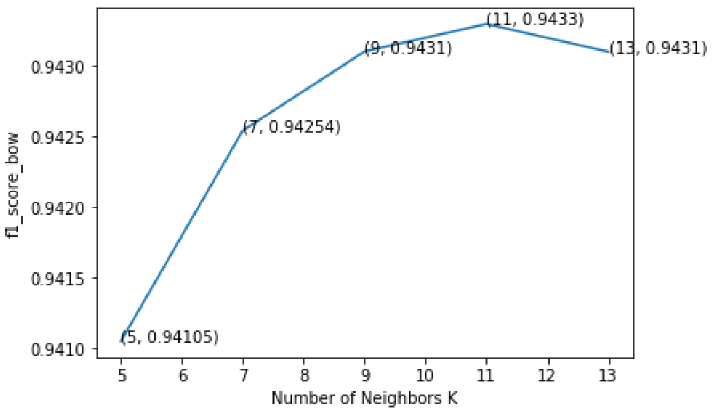

In [217]:

```
plt.plot(k_values,f1_scores_bow)
for xy in zip(k_values, np.round(f1_scores_bow,5)):
    plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')
plt.xlabel('Number of Neighbors K')
plt.ylabel('f1_score_bow')
plt.show()
```



In [218]:

```
#sELECTING K VALUE WITH MINIMUM ERROR
f1_score_bow_train = max(f1_scores_bow)
optimal_k_BOW = k_values[f1_scores_bow.index(max(f1_scores_bow))]
optimal_k_BOW
```

Out[218]:

```
11
```

In [219]:

```
bag_of_words_test = count_vect.transform(X_test)
print(bag_of_words_test.shape)
```

```
(9000, 18506)
```

In [220]:

```
#Performing K-NN for optimal k-value using test data
knn_optimal = neighbors.KNeighborsClassifier(n_neighbors=optimal_k_BOW,algorithm = 'kd_tree')
knn_optimal.fit(bag_of_words_train, y_train)

#predicting using test data
pred = knn_optimal.predict(bag_of_words_test)
tn, fp, fn, tp = confusion_matrix(y_test, pred).ravel()
pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
f1_score_bow_test = (2*pr*re)/(pr+re)
print('f1 score is',f1_score_bow_test)
```

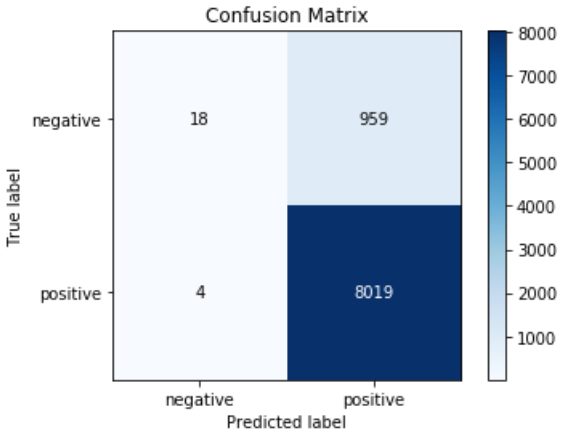
```
#plot confusion matrix
skplt.metrics.plot_confusion_matrix(y_test, pred, normalize=False)
```

```
C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree
with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
```

```
f1 score is 0.9433562731604023
```

Out[220]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x24ed3e80d30>
```



tfidf

In [221]:

```
from sklearn.feature_extraction.text import TfidfVectorizer

tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
vocabulary = tf_idf_vect.fit(X_train)
```

In [222]:

```
tf_idf_train = tf_idf_vect.transform(X_train)
print(tf_idf_train.shape)
```

```
(21000, 379449)
```

4-fold Cross Validation

In [223]:

```
#4 fold cross validation using kd-tree algorithm
myList = list(range(5,15))
k_values = list(filter(lambda x: x % 2 != 0, myList))

f1_scores_tfidf_train = []
for k in k_values:
    knn = neighbors.KNeighborsClassifier(n_neighbors=k,algorithm = 'kd_tree')
    pred = cross_val_predict(knn, tf_idf_train, y_train, cv=4)
    tn, fp, fn, tp = confusion_matrix(y_train, pred).ravel()
    pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
    score=(2*pr*re)/(pr+re)
    f1_scores_tfidf_train.append(score)
```

```
C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree
with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
```

```
  warnings.warn("cannot use tree with sparse input: "
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C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree
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C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree
with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
```
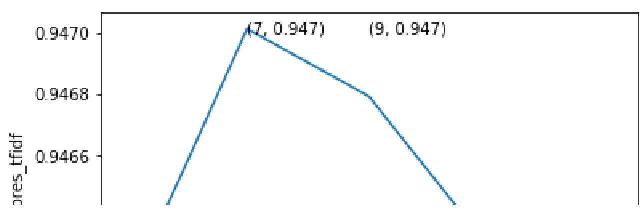
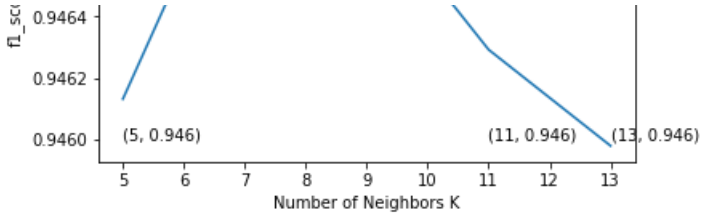

In [224]:

```python
plt.plot(k_values,f1_scores_tfidf_train)
for xy in zip(k_values, np.round(f1_scores_tfidf_train,3)):
    plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')
plt.xlabel('Number of Neighbors K')
plt.ylabel('f1_scores_tfidf')
plt.show()
```





In [225]:

```
#sELECTING K VALUE WITH MINIMUM ERROR
f1_score_tfidf_train = max(f1_scores_tfidf_train)
optimal_k_tfidf = k_values[f1_scores_tfidf_train.index(max(f1_scores_tfidf_train))]
optimal_k_tfidf
```

Out[225]:

7

In [226]:

```
tf_idf_test = tf_idf_vect.transform(X_test)
print(tf_idf_test.shape)
```

(9000, 379449)

In [227]:

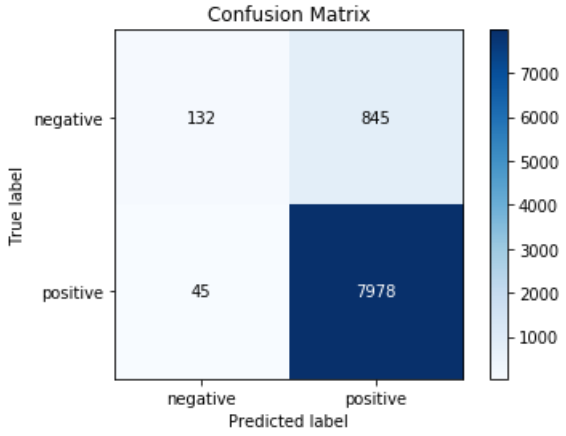
```
#Performing K-NN for optimal k-value using test data
knn_optimal = neighbors.KNeighborsClassifier(n_neighbors=optimal_k_tfidf,algorithm = 'kd_tree')
knn_optimal.fit(tf_idf_train, y_train)

#predicting using test data
pred = knn_optimal.predict(tf_idf_test)
tn, fp, fn, tp = confusion_matrix(y_test, pred).ravel()
pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
f1_score_tfidf_test = (2*pr*re)/(pr+re)
print('f1 score is',f1_score_tfidf_test)

#plot confusion matrix
skplt.metrics.plot_confusion_matrix(y_test, pred, normalize=False)
```

```
C:\Users\Friend\Anaconda3\lib\site-packages\sklearn\neighbors\base.py:212: UserWarning: cannot use tree with sparse input: using brute force
  warnings.warn("cannot use tree with sparse input: "
```

f1 score is 0.9471684672919388

Out[227]:

<matplotlib.axes._subplots.AxesSubplot at 0x24e9373b710>



KNN - Avgword2vec

In [228]:

```
from gensim.models import Word2Vec

i=0
list_of_sent=[]
for sent in X_train:
    list_of_sent.append(sent.split())

#word2vec
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
w2v_words = list(w2v_model.wv.vocab)

#Average word2vec
sent_vectors_train = [];
for sent in list_of_sent:
    sent_vec = np.zeros(50)
    cnt_words =0;
    for word in sent:
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors_train.append(sent_vec)
```

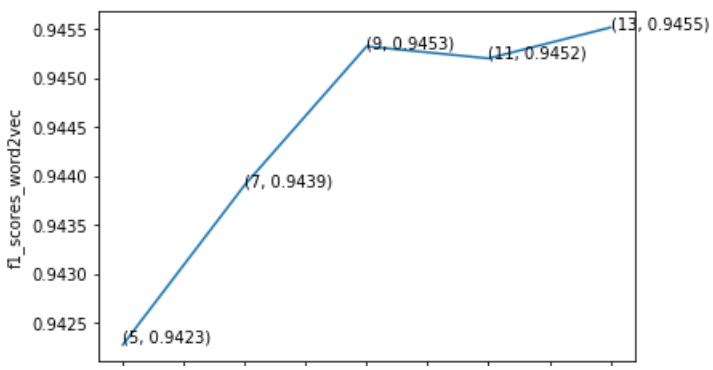
4-fold Cross Validation

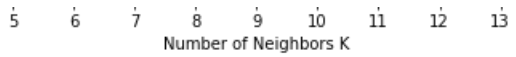
In [229]:

```
#4 fold cross validation using kd-tree algorithm
myList = list(range(5,15))
k_values = list(filter(lambda x: x % 2 != 0, myList))

#claculate CV scores
f1_scores_word2vec_train = []
for k in k_values:
    knn = neighbors.KNeighborsClassifier(n_neighbors=k,algorithm = 'kd_tree')
    pred = cross_val_predict(knn, sent_vectors_train, y_train, cv=4)
    tn, fp, fn, tp = confusion_matrix(y_train, pred).ravel()
    pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
    score=(2*pr*re)/(pr+re)
    f1_scores_word2vec_train.append(score)
```

In [230]:

```
plt.plot(k_values,f1_scores_word2vec_train)
for xy in zip(k_values, np.round(f1_scores_word2vec_train,4)):
    plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')
plt.xlabel('Number of Neighbors K')
plt.ylabel('f1_scores_word2vec')
plt.show()
```





In [231]:

```
#Considering k value with maximum f1-score
f1_score_word2vec_train = max(f1_scores_word2vec_train)
optimal_k_Word2Vec = k_values[f1_scores_word2vec_train.index(max(f1_scores_word2vec_train))]
optimal_k_Word2Vec
```

Out[231]:

13

In [232]:

```
from gensim.models import Word2Vec

i=0
list_of_sent=[]
for sent in X_test:
    list_of_sent.append(sent.split())

#Average word2vec
sent_vectors_test = [];
for sent in list_of_sent:
    sent_vec = np.zeros(50)
    cnt_words =0;
    for word in sent:
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors_test.append(sent_vec)
```

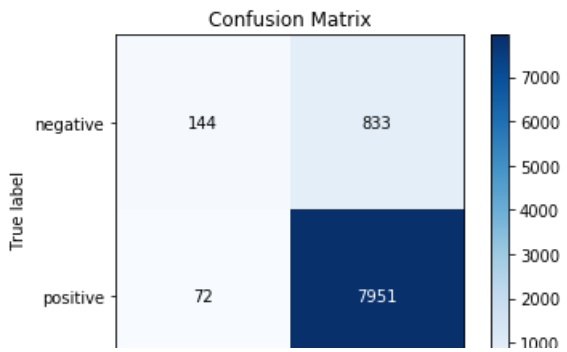
In [233]:

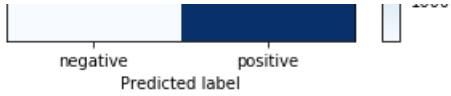
```
#Performing K-NN for optimal k-value using test data
knn_optimal = neighbors.KNeighborsClassifier(n_neighbors=optimal_k_Word2Vec,algorithm = 'kd_tree')
knn_optimal.fit(sent_vectors_train, y_train)

#predicting using test data
pred = knn_optimal.predict(sent_vectors_test)
tn, fp, fn, tp = confusion_matrix(y_test, pred).ravel()
pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
f1_score_word2vec_test = (2*pr*re)/(pr+re)
print('f1 score is',f1_score_word2vec_test)

#plot confusion matrix
skplt.metrics.plot_confusion_matrix(y_test, pred, normalize=False)
```

f1 score is 0.9461533884690903

Out[233]:

<matplotlib.axes._subplots.AxesSubplot at 0x24ed2482be0>





KNN - tfidf weighted word2vec

In [236]:

```
from sklearn.feature_extraction.text import TfidfVectorizer

tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
vocabulary = tf_idf_vect.fit(X_train)
tf_idf_train = tf_idf_vect.transform(X_train)
```

In [240]:

```
print(tf_idf_train.shape)
```

```
(21000, 379449)
```

In [ ]:

```
import gensim

i=0
list_of_sent=[]
for sent in X_train:
    list_of_sent.append(sent.split())

#get tf_idf
tfidf_feat = tf_idf_vect.get_feature_names()
tfidf_sent_vectors_train = [];

#word2vec
w2v_model =Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
w2v_words = list(w2v_model.wv.vocab)

#tfidf wieghted vector
row=0;
for sent in list_of_sent:
    sent_vec = np.zeros(50)
    weight_sum =0;
    for word in sent:
        if word in w2v_words:
            vec = w2v_model.wv[word]
            tf_idf = tf_idf_train[row, tfidf_feat.index(word)]
            sent_vec += (vec * tf_idf)
            weight_sum += tf_idf
        else:
            continue
    if weight_sum != 0:
        sent_vec /= weight_sum
    tfidf_sent_vectors_train.append(sent_vec)
    row += 1
```

4-fold Cross Validation

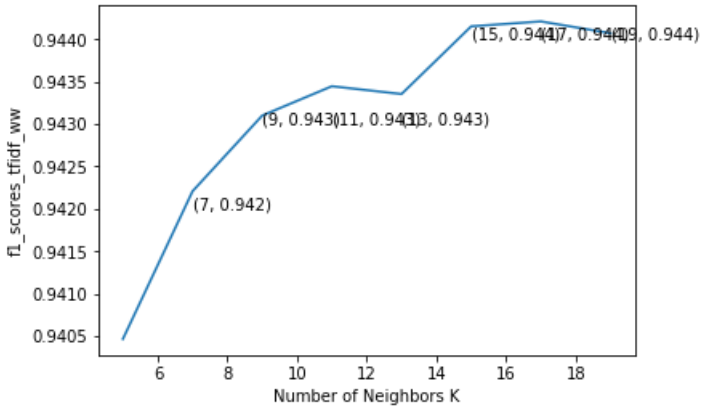
In [242]:

```
#4 fold cross validation using kd-tree algorithm
myList = list(range(5,20))
k_values = list(filter(lambda x: x % 2 != 0, myList))

#claculate CV scores
f1_scores_tfidf_ww_train = []
for k in k_values:
    knn = neighbors.KNeighborsClassifier(n_neighbors=k,algorithm = 'kd_tree')
```

```
    pred = cross_val_predict(knn, tfidf_sent_vectors_train, y_train, cv=4)
    tn, fp, fn, tp = confusion_matrix(y_train, pred).ravel()
    pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
    score=(2*pr*re)/(pr+re)
    f1_scores_tfidf_ww_train.append(score)
```

In [244]:

```
plt.plot(k_values,f1_scores_tfidf_ww_train)
for xy in zip(k_values, np.round(f1_scores_tfidf_ww_train,3)):
    plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')
plt.xlabel('Number of Neighbors K')
plt.ylabel('f1_scores_tfidf_ww')
plt.show()
```



In [245]:

```
#Considering k value with maximum f1-score
f1_score_tfidf_ww_train = max(f1_scores_tfidf_ww_train)
optimal_k_tfidfww = k_values[f1_scores_tfidf_ww_train.index(max(f1_scores_tfidf_ww_train))]
optimal_k_tfidfww
```

Out[245]:

17

In [246]:

```
tf_idf_test = tf_idf_vect.transform(X_test)
print(tf_idf_test.shape)
```

(9000, 379449)

In [ ]:

```
import gensim

i=0
list_of_sent=[]
for sent in X_test:
    list_of_sent.append(sent.split())

#get tf_idf
tfidf_feat = tf_idf_vect.get_feature_names()
tfidf_sent_vectors_test = [];

#tfidf wieghted vector
row=0;
for sent in list_of_sent:
    sent_vec = np.zeros(50)
    weight_sum =0;
    for word in sent:
        if word in w2v_words:
            vec = w2v_model.wv[word]
```

```
            tf_idf = tf_idf_test[row, tfidf_feat.index(word)]
            sent_vec += (vec * tf_idf)
            weight_sum += tf_idf
        else:
            continue
    if weight_sum != 0:
        sent_vec /= weight_sum
    tfidf_sent_vectors_test.append(sent_vec)
    row += 1
```

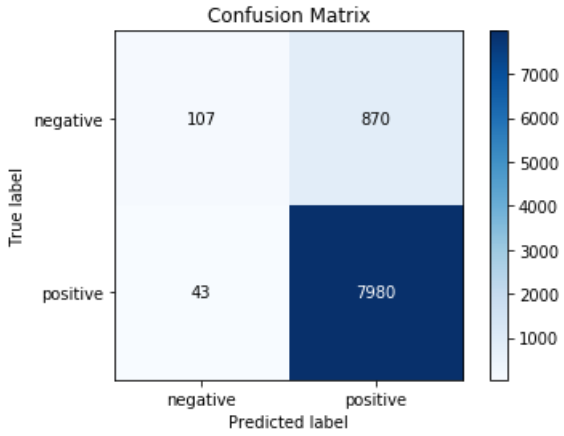
In [249]:

```
#Performing K-NN for optimal k-value using test data
knn_optimal = neighbors.KNeighborsClassifier(n_neighbors=optimal_k_tfidfww,algorithm = 'kd_tree')
knn_optimal.fit(tfidf_sent_vectors_train, y_train)

#predicting using test data
pred = knn_optimal.predict(tfidf_sent_vectors_test)
tn, fp, fn, tp = confusion_matrix(y_test, pred).ravel()
pr,re = (tp)/(tp+fp),(tp)/(tp+fn)
f1_score_tfidf_ww_test = (2*pr*re)/(pr+re)
print('f1 score is',f1_score_tfidf_ww_test)

#plot confusion matrix
skplt.metrics.plot_confusion_matrix(y_test, pred, normalize=False)
```

```
f1 score is 0.9458898832454218
```

Out[249]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x24ee738ecc0>
```



Conclusion

In [250]:

```
from prettytable import PrettyTable

Table = PrettyTable()

Table.field_names  = ["Model", "Hyper_parameter(K)", "Train f1-score", "Test f1-score"]

Table.add_row(["BOW", optimal_k_BOW, f1_score_bow_train,f1_score_bow_test])
Table.add_row(["TF_IDF", optimal_k_tfidf, f1_score_tfidf_train,f1_score_tfidf_test])
Table.add_row(["Avg Word2Vec", optimal_k_Word2Vec,f1_score_word2vec_train, f1_score_word2vec_test])
Table.add_row(["TF_IDF_wieghted_Word2Vec", optimal_k_tfidfww, f1_score_tfidf_ww_train,f1_score_tfidf_ww
_test])

print(Table)
```

```
+--------------------------+--------------------+--------------------+--------------------+
|          Model           | Hyper_parameter(K) |   Train f1-score   |   Test f1-score    |
+--------------------------+--------------------+--------------------+--------------------+
|           BOW            |         11         | 0.9432983198569234 | 0.9433562731604023 |
```

BOW	11	0.9452905196309234	0.9455502791004023
TF_IDF	7	0.9470129738238505	0.9471684672919388
Avg Word2Vec	13	0.9455183640248245	0.9461533884690903
TF_IDF_wieghted_Word2Vec	17	0.9442105797027945	0.9458898832454218