In [ ]:
```
##### Author : Amir Shokri
##### github link : https://github.com/amirshnll/Abalone
##### dataset link : http://archive.ics.uci.edu/ml/datasets/Abalone
##### email : amirsh.nll@gmail.com
```

In [9]:
```
import sklearn
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn import preprocessing
from sklearn.preprocessing import StandardScaler
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report, confusion_matri
```

In [10]:
```
#read file
df = pd.read_csv("D:\\abalone.txt", header=None)
for char in df:
    df = df.replace('M','1')
    df = df.replace('F','-1')
    df = df.replace('I','0')
df

#separate the feature columns from the target column.
features = [0,1,2,3,4,5,6,7]
X = df[features]
y = df[8]
print(X)
print(y)
```

```
       0      1      2      3       4       5       6       7
0      1  0.455  0.365  0.095  0.5140  0.2245  0.1010  0.1500
1      1  0.350  0.265  0.090  0.2255  0.0995  0.0485  0.0700
2     -1  0.530  0.420  0.135  0.6770  0.2565  0.1415  0.2100
3      1  0.440  0.365  0.125  0.5160  0.2155  0.1140  0.1550
4      0  0.330  0.255  0.080  0.2050  0.0895  0.0395  0.0550
...   ..    ...    ...    ...     ...     ...     ...     ...
4172  -1  0.565  0.450  0.165  0.8870  0.3700  0.2390  0.2490
4173   1  0.590  0.440  0.135  0.9660  0.4390  0.2145  0.2605
4174   1  0.600  0.475  0.205  1.1760  0.5255  0.2875  0.3080
4175  -1  0.625  0.485  0.150  1.0945  0.5310  0.2610  0.2960
4176   1  0.710  0.555  0.195  1.9485  0.9455  0.3765  0.4950

[4177 rows x 8 columns]
0       15
1        7
2        9
3       10
4        7
        ..
4172    11
4173    10
4174     9
4175    10
4176    12
Name: 8, Length: 4177, dtype: int64
```

In [11]:
```
#separate the Training data and Test data
X_train, X_test, y_train, y_test = train_test_split(X,y,random_state=1,test_si
ze=0.2)
# Feature scaling
scaler = StandardScaler()
scaler.fit(X_train)
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)
```

In [12]:

```
# Finally for the knn-k nearest neighbor(k=1,3,5,7,9)
test=[]
train=[]
knn=[]
for i in range(1, 10, 2):

    # Finally for the KNN
    classifier = KNeighborsClassifier(n_neighbors=i)
    classifier.fit(X_train, y_train)

    #In the prediction step, the model is used to predict the response for giv
en data.
    predictions =classifier.predict(X_test)
    print(predictions)

    # Last thing: evaluation of algorithm performance in classifying
    print(confusion_matrix(y_test,predictions))
    print(classification_report(y_test,predictions))

    # mean accuracy on the given test data and labels.
    knn.append(i)
    test.append(classifier.score(X_test,y_test))
    train.append(classifier.score(X_train,y_train))
    print("Accuracy Test  k[",i,"]",classifier.score(X_test,y_test))
    print("Accuracy Train k[",i,"]",classifier.score(X_train,y_train))
```

```
[11  8  8  8 13  5 10 12 14 12 11  5  9 11  7 10  9 19 10  9  8  9  6 13
 12 10 13 17  9 10 10  9 10  9 13 11  9  9  9 11  9 11 14  9  6  9  8 10
 10 11 10 11 10  5 15 11 10  8  8  9 16  9 11 10  8  8  9 10  9  8  9 10
  7  8  8  6 14  9 10 13  9  9 12  8 11  7  9  9 11  7 14 10 11 11  7  9
  9 17  6 23  8 10  6  8 20  6 14 12  9  9  7 12 10  7  6  8  7  6  9  9
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  7  8 10 11  9 10 10  7  9 10  7  8 10  9 11 11 11 14  9  5 10  7 11 10
  9 13  6 19 10  9  7 20 15 11  6  8  9  8  9 10  6 10 12  8 12 13  5  8
  6 12 12 12  8  4 10  8  5  8 10  9  7  8 12  7  8  6  9  8  9  8  8 12
 10 10 10 10 15  9 11  9 11 15  9  8 10 13  8  8 12 10  7  5 13 11 11 10
 13 12  8 10  5 10 19 11  9 15 14  9 11 11  5 14  9 13  7  9 10 19  7 13
  9  8 10 14  8 11  8 12 11  9 12 13  9 12 10 12 12  8 10  6  8  7  4  5
  6  9  6  8 10 10  9  9  8 10 11  8 18  8  7 11 20 11 13  7  9  7 16 11
 11  9  6 20 13 11 10  5 11  8 16 11  8 10  7 11  9  9 12 10 13  9  9  7
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  8  6  8 11  8 18  8  7 13  5 17 13  9 10 11 10  6  9  9  3 14  7  6 10
 11  6  8 10  6 14  6 11  9  7  9  5 13 14 10 12 10  7 10 15 11  8  8 17
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 14  5 10 10 15  7  6 12 10  7 12  9 11  8 10 10  7  8 11  9  5 11 10 11
 10  8 11 13 11  6  8 10  7 11  9  9 16  9 16  8  9  7  9  9 15 21 11  4
  7  7 17 11  7 12  7  9 15  9  8  8 14  6  6  5  7 10 10  9 10  5 11  9
  8  8  8  7  9 11 19  9 19  8  5  7  7 13  9  9 10 15  9 22  7  9 10  4
 13 14  9 11  8 10 10 11 11 10  8  5 11 11  8  9  7 11  7 10  8 10 12 10
  9 11 11  9  8 10  9  7  9  8  8  7 11 11 17  9 10 12  9  6 11 13 12  9
  9 10  8  9 12  8  9  4  9 17  7  9  4  9 10 18  8 10  8  9 14 17  3 14
 10 21 11  9  6 11  9  9  9 11 11 12  9  6 11  7  8  9 14  7 10 13  5 15
  8 10  8 10 10 12  6  8  9 11 10  8 15  6 15 10  8  6  9  9  9 10 11 11
  8  5 16  9  9 10  9 10  7 10 12  6 10 11  7  9  9 10 10  6  4  5 10 12
  5  6 10 12  7 11  8 12  6 10 10  6 10  8  9  7  7 10 10 13 13 17  9 11
  7  9  9  4  8  8  6 10 19 10 12 10  6 12  7  9 10 14  9 11  7 13 10  9
 16 19 11 10 10  8 12 14 11 10  9 10  8  7 10 13 17 10 12  8 17  8  9  8
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  7 10 11  6  9 10 10  6 11  9  8  8 13 10 16 11 10 11 11 10 14 13  8 12
  9 10  8  8 10  6  5 13 11 10 13 10  8  6  7 11 12  7 11  8  9  7  9  7
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 [ 0  0  0  0  0  0  0  0  1  0  0  0  0  0  1  0  0  0  0  0  0  0]]
```

	precision	recall	f1-score	support
2	0.00	0.00	0.00	1
3	0.00	0.00	0.00	2
4	0.40	0.36	0.38	11
5	0.29	0.40	0.33	20
6	0.25	0.25	0.25	53
7	0.24	0.21	0.23	80
8	0.25	0.26	0.26	107
9	0.21	0.23	0.22	132
10	0.28	0.28	0.28	143
11	0.20	0.22	0.21	91
12	0.19	0.16	0.17	63
13	0.06	0.05	0.05	39
14	0.00	0.00	0.00	24
15	0.00	0.00	0.00	21
16	0.08	0.10	0.09	10
17	0.25	0.25	0.25	12
18	0.33	0.10	0.15	10
19	0.00	0.00	0.00	7
20	0.00	0.00	0.00	4
21	0.00	0.00	0.00	3
22	0.00	0.00	0.00	1
23	0.00	0.00	0.00	2
accuracy			0.21	836
macro avg	0.14	0.13	0.13	836
weighted avg	0.21	0.21	0.21	836

```
C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.p
y:1221: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parame
ter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
Accuracy Test  k[ 1 ] 0.2117224880382775
Accuracy Train k[ 1 ] 1.0
[ 9  9  8  9  9  5  9 12 12 12  8  5  9  9  7 10  9  9 10  9  7  9  6 13
  8  9 13 11  9 10 10  8  9  9  6  7 10  9  9 10  9 10 14  9  8  9  8 10
  9  9 10 11 10  5 11 10  8  7  8  6  7  9 11 10  8  7 10  9  9  8  8 10
  5  8  8  6 13  8  9  8  7  8  9 10  9  6  9  6 11  7 12  7  8  9  7  8
  9 11  6 11  7 10  7  7 15  6 10 10  8  8  7 10  8  7  7  8  7  6  9  9
  9  9  7 12  9 10  9  9  7  9  7  7  9  6  9  7  9 10  7  9  8  9  8 10
  9  8 10 11  9  8 10  7  9 10  7  9 10  9  9 11  8 13  9  5  8  7 10 10
  8 12  6  9 10  9  7 13 10 10  6  8  9  8  9  6  6  9 10  8  9 10  5  8
  6 12  7  9  6  4 10 11  3  8 10  7  7  8  7  7  8  6  9  7  9  7  7  8
  9  9  9 10  9  9  8  9  9 11  9  6 10 10  8  7 12 11  6  5 13  9 11  8
 13 12  8  9  5 10  9  8  7  9 11  9 11  9  4 14  9  9  7  9 11 13  7  9
  9 10 10  8  8 12  8  9  9  8 10 10  9 12  9 12  8  8  9  6  5  8  4  6
  6  9  6  8 10  9  9  8  7 10 11  8  9  5  6 10 11  7 10  7  7  9  7 12
  9  7  6 10 11  8  9  5  8  6 10 10  8 10  5 11 11  9 10  7 10  9  8  7
  9  4 11 16  7  6 12  9 10 11 16 10 10  6  9  4 11  9  4 12  6 11 10  9
  8  6  8 10  8  8  4  7  9  5  9 13  9 10  9 10  6  9  8  5 13  7  5 10
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  8 13 10 10  9  9 15  6  8  8  7  6  9 10 10  9 10  5  5 10  9  8  9  7
  9  5  8 10 10  8  6 12  9  8  6  9 13  8 10 10  7  8  9  8  3  6 10 10
 10  8 11  8 11  6 10 12  7 10  9  9 10  9 16  8  5  7  9  9  8 11 11  5
  7  7 10  9  7  7  6  9  8  9  7  8  7  6  4  6  6  9  7  8 10  9  8  7
  8  8  8  8  9 11 13  7 13 10  5  7  7 10  8  9 10 15 10 13  8  8 10  4
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  8 10  6  9 10  8  8  3  6 11  7 11  3  9  9 15  8 10  7  6 10  9  4 11
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  9  5  9 11  9 10  7 10  8 10 10  6  8  9  7 10  8  8  9  6  3  5 10 12
  5  6  9 12  7 11  6 10  6  9  6  6  7  8  9  9  7  8  8 11 11 14  8 10
  7  9  9  4  8  6  6 10 10 10  8 10  6  7  7 11  6 11  9 11  7 13  8  8
  7 19 11 10  9 11 10 10 10 10  9 10  7  7 10 10 14  8  9  8 10  8  9  9
 11 11  7 10  6  7  6  9 10  6  9  8  8  5  8  3  9  5  7  7  9  7  9  7
  7 10 11  6  9 10 10  7  6  6  6  8  8 10  9  8 10 11 10 10 14  8  8 12
  9  9  8  8  9  4  7 10 11 10 13 10  8  6  7 11 12  7  9  8  7  6  9  7
 12  9  9 10 15 16  6 12 11  5 10 10  8  8 14  9  9 10 10 10]
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```

```
 [ 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  0  0  0  0  1  1  0  0  0  0  0  0  0  0  0  0  0  0  0]]
              precision    recall  f1-score   support

           2       0.00      0.00      0.00         1
           3       0.17      0.50      0.25         2
           4       0.17      0.18      0.17        11
           5       0.19      0.30      0.24        20
           6       0.25      0.36      0.30        53
           7       0.16      0.23      0.19        80
           8       0.22      0.30      0.25       107
           9       0.22      0.30      0.25       132
          10       0.27      0.28      0.27       143
          11       0.19      0.13      0.15        91
          12       0.36      0.14      0.20        63
          13       0.00      0.00      0.00        39
          14       0.00      0.00      0.00        24
          15       0.17      0.05      0.07        21
          16       0.25      0.10      0.14        10
          17       0.00      0.00      0.00        12
          18       0.00      0.00      0.00        10
          19       0.00      0.00      0.00         7
          20       0.00      0.00      0.00         4
          21       0.00      0.00      0.00         3
          22       0.00      0.00      0.00         1
          23       0.00      0.00      0.00         2

    accuracy                           0.22       836
   macro avg       0.12      0.13      0.11       836
weighted avg       0.20      0.22      0.20       836


C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.p
y:1221: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parame
ter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
Accuracy Test  k[ 3 ] 0.21650717703349281
Accuracy Train k[ 3 ] 0.5151152349595929
[ 9  9  8  9 13  5  8 12 12  9 10  4  9 10  6 10  9  9 10  9  7  9  6 13
  9  9 10 10 14 11 10  8  9  9  5  7 10 10  9 11  9 11 10  9  7  9  8  9
 11 10 10  9 10  4 11 10 10  6  8  6  7  9 10 10  8  8 10  9 10  8  8 10
  5  8  8  6 11  9  9  8  7  8  9 10  9  7 10  6 11 10 12  7  9 10  7  9
 10 11  5 13  7 10  7  8 17  6  8 10  9  8  7  8  8  7  6  9  7  6  9  9
  9  9  7  9  8 10 12  9  7  9  7  7  8  7  9  7  9  8  9  9  8  9  8 12
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 13 12  5  9 10  9  7 11 11 10  6  6 10  8  9  6  6  8 10  8  9 12  6  8
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  9  4 11 16  7  6 12  9 12 11 12 13  9  8 10  5 11  8  4  8  6 11 10  9
  9  4  8 10  8  8  4  7 11  5 11 13 12 10 11  8  6  9  7  4  9  7  6 10
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 10  8 11  8 10  7  8 12  8  9 12  9 10  9 16  8  5  7  9  9  8 11 11  4
  7  7 10 11  7  7  6  9  8  9  8  7  7  6  5  6  6  9  8  8 12  5  9  6
  8  9  9  8  9 10 13  9 10 10  5  7  7 10  8  9  7 16 10 10  8  9  9  4
 10 11  9 11  8  9 11 10 11 10  7  7  9 11  8 10  5 11  9  8  9 10  8 10
  8 10 10  7  8 10  8  7  9  6  7 13  8 10  9 12 10  6  9  7 11  8 11  9
  8 11  7  9 11  8 10  3  6 11  9 11  4 10  9 18  8 10  8  8 10  9  4  9
 10  8  9  7  6  9  9  9  9 11  8 10  9  6 11  7  7  8  9  7  8 10  6 11
  8 10  7 12  7  7  6  9  9 11  9  8 14  5  7 10  8  6  9  8  9  9 11 10
  8  5  9 11 11 10  7 13  8 11 10  6  9  9 10  9  9  8  9  6  3  5 10 12
  5  6  9 12  7 11  6 10  6  9 10  6  7  8  9  9 10  9  8 11 11 11  8 11
  7  9 10  7 11  7  6 10 11 10  9 10  7  7  7  9  7 11  9  9  7 11  8  8
  7 19  9 10  9 11 10 10 10  8  9 10  7  7  9 10 14  8  9  8 10  8 10  9
 11 11  7 10  6  7  6 11 10  6  9  8  8  7  6  3  9  8  7  7  9  7  8  7
  7 10  9  6  9 12 10  7  6  6  6  8  8 10 13  8 10 11 10  9 14  8 10 12
 12  9  8  8  9  5  6 10 11 10 13 10  7  6 12 11 10  9  9  7  7  6 10 10
  9  9  9 10 17 11  6 12 11  5  9 10  8  8 10  9 10 10 10 10]
[[ 0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  4  4  2  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  5  6  4  4  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  3 11 18 13  7  0  0  1  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  1  1 23 26 18  7  4  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  9 23 36 24 11  2  1  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  2  5 16 26 46 21 11  2  1  1  0  0  1  0  0  0  0  0  0]
 [ 0  0  0  1  2 11 22 40 37 17  7  3  2  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  3 13 25 27 18  4  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  6  8 13 13 12  8  2  0  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  2  2  6  6  8 12  3  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  9  6  4  1  1  1  0  0  1  1  0  0  0  0  0]
 [ 0  0  0  0  0  0  3  4 10  1  0  1  0  1  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  2  1  2  1  2  0  0  1  0  1  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  3  4  2  0  1  1  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  2  2  2  2  0  0  0  0  0  0  1  0  0  0  0]
 [ 0  0  0  0  1  0  0  0  2  2  0  2  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  1  1  0  0  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  2  0  1  0  0  0  0  0  0  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  0  0  0  0  1  0  0  0  1  0  0  0  0  0  0  0  0  0  0]]
              precision    recall  f1-score   support

           2       0.00      0.00      0.00         1
           3       0.00      0.00      0.00         2
           4       0.25      0.36      0.30        11
           5       0.26      0.30      0.28        20
           6       0.28      0.34      0.31        53
           7       0.25      0.33      0.28        80
           8       0.25      0.34      0.29       107
           9       0.25      0.35      0.29       132
          10       0.25      0.26      0.25       143
          11       0.21      0.20      0.20        91
          12       0.27      0.13      0.17        63
          13       0.00      0.00      0.00        39
          14       0.20      0.04      0.07        24
          15       1.00      0.05      0.09        21
          16       0.33      0.10      0.15        10
          17       0.00      0.00      0.00        12
          18       0.00      0.00      0.00        10
          19       0.00      0.00      0.00         7
          20       0.00      0.00      0.00         4
          21       0.00      0.00      0.00         3
          22       0.00      0.00      0.00         1
          23       0.00      0.00      0.00         2

    accuracy                           0.24       836
   macro avg       0.17      0.13      0.12       836
weighted avg       0.24      0.24      0.22       836


C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.p
y:1221: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parame
ter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
Accuracy Test  k[ 5 ] 0.24162679425837322
Accuracy Train k[ 5 ] 0.4357976653696498
[ 9  9  8  9 13  5  8 12 12  8 10  5  9  9  6 10  9 11 10  9 11  9  7 13
  9  9 10 11 11 10 10  9  9  9  5 10 10 10  9 10  9 11 10  9  7  8 11  9
 11 10  9  9  9  4 11  9 10  8  8  6  7  9 11 10  8  8  9  9  9  8  8 10
  5  8  8  6 11 10  9  8  7  7 12  9  9  7 10  7 11 10 12 10  9 10  7  9
 10 11  5 13  7 11  7  8 17 10 10 10  9 10  7  9  8  7  6  9  7  6 11  9
  9  6  7 12 10 10 12  9  7 11  7  7  8  8  9  7  9 10  8  9  8  9  9 12
  8  8 10 11  9  8 10  7  8 11  9  9 10  9 10 11  8 11 10  6  8 10 10 10
 12 11  7  9 10  9  7 11 11 11  6 12 10  8  9  6  6  8 10  8 12 12  6  8
  6 11  8 11  5  4 10 10  4  8 10  7  7  7  9  6  9  6 10  8  9  7  8  9
  9  9 11 10 11  9 10  9  9 13  9  9  9 12  8  7 17 10  8  5 10  9 11  8
 13 12  8  9  8 10  8  9  8  9 10  9 11  9  5 13  9  8  7  9 11 15  7  9
  8  9 10 11  8 11  8  9 11 10 11 10  9  9 10 11  9  8  9  6  5  8  4  6
  7  9  6  8 11  9  8  9  7 10 10  9 10  6  8 10 11  9 13  7  9  8  7  9
 11  7  6 10 11 11  7  5  9 10 10  9  9 10  7 11  9  9 11  7 10  7  8  7
  9  4 11 16  7  6 12  9 12 10 16 11  9  8 11  3 11  8  5  9  6 11 10 10
  8  4  8 10  8  8  5  7 10  5 11  9 10 10  9  8  6  9  8  5  9  7  6 10
 10  7  8  9  6  9  6 10 11  7  8  9  9 10 10 18  8  7 10 11  9  5  8 17
  9  9 10 11  9  9 11  6  9  9  7  8  9  9 10  8  8  4  5 10  9  9  9  8
  9  7  8 10  9  7  8 12 10  8  7  9 10  8 10 10  8  7 12  9  4  7 10 11
 10  8 11 11 10  7  8 12  8 10 10  9 10  9 16  8  5  7  9 10  8  9 11  4
  7  7 16  9  7  7  7  9 15  9  8  8  7  6  4  6  6  9  7  8 12  5  9  6
  8  9  9  8  8 10 13  9 13 10  5  7  7 10  9  9  7 16 10 13  8  9  9  4
 10 12  9 11  8  9 11 11 11 10  7  7  9 10  8 10  5 11  9 10  9 10  8  9
  8 11 10  8  8 11  8  7  8  6  8 12  8 10  9 12 10  6  9  7 11  8 11  9
  9 11  7  9 11  8  9  3  9 11  9  9  4 10 10 18  8 10  7  6 10  9  4  9
 10  8 10  7  6  9 12  9  9 11  8 10  9  6 11  7  7  9  9  7 11 10  6  8
  8 10  7 12  7 12  6  9  9 11  9  8 14  6  8 10  9  4  9  8  7 10  7 11
  8  7  8  9 10 10  7 13  8 11 10  6  9  9 10  9  9  8  9  6  4  5 10 12
  5  6  9 12  7 11  7 13  6 10 10  6  7  8  9  7  8 11 11 11 11  8  8 11
  7  9 10  7 11  8  7 11 11 11  9 10  6  9  7  9  7 12  9  9  8 11  9  8
  7 19  9 10  9 11 10 10 10  8  9 20  9  7  9 10 14  8  9  8 10  8  9  9
 11 11  7 10  6  7  6 11 10  6  9  8  6  7  9  4  9  8  7  8  9  7  6  8
  8 10  9  6  9 12 16  8  6  9  7  8  9  9  8  8 10 11 10 10 14  8 10 19
 11  9  8  9 10  5  7 10 11 10 13 10  7  6  9 11 10 10  9  7  7  6 10 10
  9  9  9 10 17 11  6 12 11  6 12 10  7  6 10  9 10 10 10 10]
[[ 0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  2  6  2  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  5  7  4  4  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2 11 16 15  7  1  0  0  1  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  1 22 25 21  7  4  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  7 22 32 29 14  2  0  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  1  3 16 30 41 25 11  3  0  1  1  0  0  0  0  0  0  0  0]
 [ 0  0  0  1  1 11 17 46 37 20  7  0  1  0  1  1  0  0  0  0  0  0]
 [ 0  0  0  0  1  3  7 31 23 20  4  1  0  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  3  5 11 15 16  9  1  0  0  2  0  0  1  0  0  0  0]
 [ 0  0  0  0  1  1  6 10  6 11  3  0  0  0  0  0  0  0  1  0  0  0]
 [ 0  0  0  0  0  0  1  8  6  4  1  2  0  0  0  1  1  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  3 11  2  0  2  0  1  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  3  0  4  0  1  0  0  1  0  1  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  3  2  2  1  2  1  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  4  3  1  1  0  0  0  0  0  0  1  0  0  0  0]
 [ 0  0  0  0  0  0  0  1  2  2  0  1  0  0  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  1  1  0  0  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  2  0  0  0  0  0  1  0  0  0  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  0  0  1  0  0  0  0  1  0  0  0  0  0  0  0  0  0  0]]
              precision    recall  f1-score   support

           2       0.00      0.00      0.00         1
           3       0.00      0.00      0.00         2
           4       0.38      0.55      0.44        11
           5       0.30      0.35      0.33        20
           6       0.29      0.30      0.29        53
           7       0.25      0.31      0.28        80
           8       0.25      0.30      0.27       107
           9       0.21      0.31      0.25       132
          10       0.25      0.26      0.25       143
          11       0.21      0.22      0.22        91
          12       0.29      0.14      0.19        63
          13       0.00      0.00      0.00        39
          14       0.00      0.00      0.00        24
          15       0.50      0.05      0.09        21
          16       0.17      0.10      0.12        10
          17       0.00      0.00      0.00        12
          18       0.00      0.00      0.00        10
          19       0.00      0.00      0.00         7
          20       0.00      0.00      0.00         4
          21       0.00      0.00      0.00         3
          22       0.00      0.00      0.00         1
          23       0.00      0.00      0.00         2

    accuracy                           0.23       836
   macro avg       0.14      0.13      0.12       836
weighted avg       0.22      0.23      0.22       836


C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.p
y:1221: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parame
ter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

```
Accuracy Test  k[ 7 ] 0.2332535885167464
Accuracy Train k[ 7 ] 0.39748578269979046
[ 9  9  8  9 13  5  9 12 12  8 10  5  9  9  6 10  9 11 10  9 11  9  7 13
  9 11 10 11 14 11 10  9  9  9  7  9 10 10  9 10  9 11 10  9  8  8 10  9
 11  9  9  9  9  6 11  8 10  7  8 10  7  9 11 10  8  8 10  9  9  8  9 10
  5  8  8  6 11 10  9  8  7  8 12 10  9  7 10  7 11  7 12 10  9 10  7  9
  9 11  5 13  8 11  7  8 17 10 10 10  9  9  7 10  9  7  6  9  7  6 11  9
  9 10  7 12 10 10 12  9  7 11  7  7  8  7  9  9  9 10  8 10  8  9  8 12
  8  8 10 11 10  8 10  7  8 11  9  9 10  9  9 11  8 11 10  6  8 10 10 10
  7 13  5 12  9  8  8 10 11 11  6  8 10  8  9  6  6 11 10  8 11  9  6  8
  6 11  8 11  7  4 10 10  4  8 10  8  7  7 11  6  9  6 10  8 10  7  8  8
  9  9  9  8 11  8  9  9  9 13  9  9 10 13  9  7 17 10  7  5 10  9 11 10
 14 11  8  9  7 10  8  9  8  9 10 12 11 10  5 13  9  8  6  8 10 15  7  9
  8  9 10 11  8 11  8  9 11 10 10 10  9  9 10 11  9  8  9  6  5  8  4  6
  7  9  6  7  9  9  8  9  7 10 10  9  9  6  8 10 11  9 13  7  9  8  7  9
 11  7  7 10 11 11  9  5  9 10 10 11  9 10  8 11  9  9  9  8 10  9  8  7
  9  4 11 16  7  6 12 14 12 10 16 11 10  8 11  3 11  8  4  9  8  9 10 10
 10  4  8 10  8  8  6  7 10  7  9  9 11 10  9 10  6  9  9  5  9  7  6  9
 11  7  8  9  6  9  9 10 11  7  9  9  8 10 10 13  8  7 10 11  9  7  8 13
  9  9 10 10  9  9 11  6  9  9  7  8  8  9  9  9 10  4  6 10  9  9 13  8
  9  7  8 10 10  7  8  9  9  9  6  9 10  6 10 10  8  8 11  9  4  7 10 10
  9  8 11 11 10  7  8 12  8 10 10 11 10  9 16  8  8  8  9  9  8 10 11  4
  7  7 16 10  7  9  7  9 15 10  8  8  7  6  4  7  7  9  9  8 12  6  9 12
  8  9  9  8 10 10 13  8 13 10  5  7  7 10 12  9  7 16 10 10  7 10 10  4
  9 12  9 11  9  9 10  9 11 10  7  7 11 11  8  8  5 11  9 10  9  9  8  9
  8 11 10  8  8 11  8  7  8  7  8 13  8 10  9 12 10  8  9  7 11  8 11  9
  8 11  7  8 11  8  9  3  7 11  9 11  4 10 10 15  8  9  7  6 10  9  4  9
 10 10  9  9  6  9 12  9  9 11  8 11  9  6 11  7  7  9 10  7 11 10  7  8
  8  8  7 12  9 12  6  8  9 11 10  6 12  6  8 10  9  4  9  8  7 10  7 10
  8  7  8  9 11 11  7 16  8 11 10  7  9  9  7  9  9  8  9  6  4  5 10  9
  5  6  9 12  7 11  7  9  6  9 10  7  7  9  9 11  9 11 11 11 11 11  8 11
  7  9  7  7 11  8  7 11 10 11  9  9  7 10  7  9  6 12  9  9  8 11  9  8
  9 10  8 10  9 11  9 10 10  8  8 20  7  7  9 13  9 10  9  8 10  8 10  9
 11 11  7 10  6  7  7  9 10  6  9  8  6  7  8  4  9  8  7  8  9  6  7  8
  8 10  9  6  9 12 10  8  6  8  7  8  9  9  8  8 10 11 10 10 14  8  9 12
 11 10  8  9 10  5  7 10 11 10 13 10  7  6  9 11 10 10  9  7  7  6 10 10
  9  9  9 10 17 13  6  9 11  5 12 10  7  6 10  9 10 10 10 10]
[[ 0  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  2  6  2  0  1  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  4  4  6  6  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  2  8 13 19  8  1  1  0  1  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  1  1 21 21 24  7  5  0  0  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  4 25 32 28 14  3  0  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  3 17 31 43 22 13  1  0  1  1  0  0  0  0  0  0  0  0]
 [ 0  0  0  1  2  7 17 47 40 18  7  1  1  0  1  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  3  8 31 24 21  2  1  0  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  2  6 18 15 13  6  2  0  0  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  1  4  7  7 13  3  2  1  0  0  0  0  0  1  0  0  0]
 [ 0  0  0  0  0  0  1  6  8  3  2  2  1  0  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  5 10  2  0  1  0  1  0  1  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  3  0  3  0  2  0  1  1  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  1  3  3  2  1  2  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  4  3  1  2  0  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  1  0  0  2  2  0  2  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  1  1  1  0  1  0  0  0  0  0  0  0  0  0  0]
 [ 0  0  0  0  0  0  0  0  2  0  0  0  0  0  1  0  0  0  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  0  0  1  0  0  0  0  0  0  0  1  0  0  0  0  0  0  0]]
              precision    recall  f1-score   support

           2       0.00      0.00      0.00         1
           3       0.00      0.00      0.00         2
           4       0.38      0.55      0.44        11
           5       0.25      0.20      0.22        20
           6       0.27      0.25      0.25        53
           7       0.20      0.26      0.23        80
           8       0.24      0.30      0.27       107
           9       0.21      0.33      0.26       132
          10       0.25      0.28      0.27       143
          11       0.22      0.23      0.23        91
          12       0.23      0.10      0.13        63
          13       0.12      0.05      0.07        39
          14       0.25      0.04      0.07        24
          15       0.33      0.05      0.08        21
          16       0.17      0.10      0.12        10
          17       0.00      0.00      0.00        12
          18       0.00      0.00      0.00        10
          19       0.00      0.00      0.00         7
          20       0.00      0.00      0.00         4
          21       0.00      0.00      0.00         3
          22       0.00      0.00      0.00         1
          23       0.00      0.00      0.00         2

    accuracy                           0.23       836
   macro avg       0.14      0.12      0.12       836
weighted avg       0.22      0.23      0.21       836


C:\ProgramData\Anaconda3\lib\site-packages\sklearn\metrics\_classification.p
y:1221: UndefinedMetricWarning: Precision and F-score are ill-defined and bei
ng set to 0.0 in labels with no predicted samples. Use `zero_division` parame
ter to control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))

Accuracy Test  k[ 9 ] 0.2284688995215311
Accuracy Train k[ 9 ] 0.3795270876982939
```

In [13]:
```
plt.plot(knn, test)
plt.plot(knn, train)
plt.show()
```