Lab 10 06-10-2022 k-NN cancer

October 6, 2022

0.1 Breast Cancer

[1]:
```
import numpy as np
import pandas as pd
!pip install scikit-learn
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: scikit-learn in
/opt/anaconda3/lib/python3.9/site-packages (1.0.2)
Requirement already satisfied: numpy>=1.14.6 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.21.5)
Requirement already satisfied: threadpoolctl>=2.0.0 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (2.2.0)
Requirement already satisfied: joblib>=0.11 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.1.0)
Requirement already satisfied: scipy>=1.1.0 in
/opt/anaconda3/lib/python3.9/site-packages (from scikit-learn) (1.7.3)
```

[3]:
```
ds = pd.read_csv('BreastCancer.csv')
print(ds)
```

```
           id diagnosis  radius_mean  texture_mean  perimeter_mean  area_mean  \
0      842302         M        17.99         10.38          122.80     1001.0
1      842517         M        20.57         17.77          132.90     1326.0
2    84300903         M        19.69         21.25          130.00     1203.0
3    84348301         M        11.42         20.38           77.58      386.1
4    84358402         M        20.29         14.34          135.10     1297.0
..        …       …          …           …             …        …
564    926424         M        21.56         22.39          142.00     1479.0
565    926682         M        20.13         28.25          131.20     1261.0
566    926954         M        16.60         28.08          108.30      858.1
567    927241         M        20.60         29.33          140.10     1265.0
568     92751         B         7.76         24.54           47.92      181.0

     smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
0            0.11840           0.27760         0.30010              0.14710
1            0.08474           0.07864         0.08690              0.07017
2            0.10960           0.15990         0.19740              0.12790
3            0.14250           0.28390         0.24140              0.10520
```

```
4            0.10030           0.13280         0.19800              0.10430
..               …               …             …                  …
564          0.11100           0.11590         0.24390              0.13890
565          0.09780           0.10340         0.14400              0.09791
566          0.08455           0.10230         0.09251              0.05302
567          0.11780           0.27700         0.35140              0.15200
568          0.05263           0.04362         0.00000              0.00000

     …  texture_worst  perimeter_worst  area_worst  smoothness_worst  \
0    …          17.33           184.60      2019.0           0.16220
1    …          23.41           158.80      1956.0           0.12380
2    …          25.53           152.50      1709.0           0.14440
3    …          26.50            98.87       567.7           0.20980
4    …          16.67           152.20      1575.0           0.13740
..   …            …               …         …               …
564  …          26.40           166.10      2027.0           0.14100
565  …          38.25           155.00      1731.0           0.11660
566  …          34.12           126.70      1124.0           0.11390
567  …          39.42           184.60      1821.0           0.16500
568  …          30.37            59.16       268.6           0.08996

     compactness_worst  concavity_worst  concave points_worst  symmetry_worst  \
0              0.66560           0.7119                0.2654          0.4601
1              0.18660           0.2416                0.1860          0.2750
2              0.42450           0.4504                0.2430          0.3613
3              0.86630           0.6869                0.2575          0.6638
4              0.20500           0.4000                0.1625          0.2364
..                 …               …                   …             …
564            0.21130           0.4107                0.2216          0.2060
565            0.19220           0.3215                0.1628          0.2572
566            0.30940           0.3403                0.1418          0.2218
567            0.86810           0.9387                0.2650          0.4087
568            0.06444           0.0000                0.0000          0.2871

     fractal_dimension_worst  Unnamed: 32
0                    0.11890          NaN
1                    0.08902          NaN
2                    0.08758          NaN
3                    0.17300          NaN
4                    0.07678          NaN
..                       …          …
564                  0.07115          NaN
565                  0.06637          NaN
566                  0.07820          NaN
567                  0.12400          NaN
568                  0.07039          NaN

[569 rows x 33 columns]
```

[5]:

```
ds.shape
cols=ds.columns
print(cols)
ds.value_counts("diagnosis")
```

```
Index(['id', 'diagnosis', 'radius_mean', 'texture_mean', 'perimeter_mean',
       'area_mean', 'smoothness_mean', 'compactness_mean', 'concavity_mean',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
       'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
       'fractal_dimension_se', 'radius_worst', 'texture_worst',
       'perimeter_worst', 'area_worst', 'smoothness_worst',
       'compactness_worst', 'concavity_worst', 'concave points_worst',
       'symmetry_worst', 'fractal_dimension_worst', 'Unnamed: 32'],
      dtype='object')
```

[5]:

```
diagnosis
B    357
M    212
dtype: int64
```

0.1.1 Data preprocessing

[8]:

```
y = ds['diagnosis']
ds.drop('diagnosis', axis = 1,inplace = True)
ds.drop('Unnamed: 32', axis = 1,inplace=True)
ds.drop('id', axis = 1,inplace=True)
cols=ds.columns
print(cols)
x = ds
```

```
Index(['radius_mean', 'texture_mean', 'perimeter_mean', 'area_mean',
       'smoothness_mean', 'compactness_mean', 'concavity_mean',
       'concave points_mean', 'symmetry_mean', 'fractal_dimension_mean',
       'radius_se', 'texture_se', 'perimeter_se', 'area_se', 'smoothness_se',
       'compactness_se', 'concavity_se', 'concave points_se', 'symmetry_se',
       'fractal_dimension_se', 'radius_worst', 'texture_worst',
       'perimeter_worst', 'area_worst', 'smoothness_worst',
       'compactness_worst', 'concavity_worst', 'concave points_worst',
       'symmetry_worst', 'fractal_dimension_worst'],
      dtype='object')
```

[10]:

```
ds.describe()
```

[10]:

```
       radius_mean  texture_mean  perimeter_mean    area_mean  \
count   569.000000    569.000000      569.000000   569.000000
mean     14.127292     19.289649       91.969033   654.889104
```

```
std       3.524049     4.301036       24.298981   351.914129
min       6.981000     9.710000       43.790000   143.500000
25%      11.700000    16.170000       75.170000   420.300000
50%      13.370000    18.840000       86.240000   551.100000
75%      15.780000    21.800000      104.100000   782.700000
max      28.110000    39.280000      188.500000  2501.000000

       smoothness_mean  compactness_mean  concavity_mean  concave points_mean  \
count       569.000000        569.000000      569.000000           569.000000
mean          0.096360          0.104341        0.088799             0.048919
std           0.014064          0.052813        0.079720             0.038803
min           0.052630          0.019380        0.000000             0.000000
25%           0.086370          0.064920        0.029560             0.020310
50%           0.095870          0.092630        0.061540             0.033500
75%           0.105300          0.130400        0.130700             0.074000
max           0.163400          0.345400        0.426800             0.201200

       symmetry_mean  fractal_dimension_mean  …  radius_worst  \
count     569.000000              569.000000  …    569.000000
mean        0.181162                0.062798  …     16.269190
std         0.027414                0.007060  …      4.833242
min         0.106000                0.049960  …      7.930000
25%         0.161900                0.057700  …     13.010000
50%         0.179200                0.061540  …     14.970000
75%         0.195700                0.066120  …     18.790000
max         0.304000                0.097440  …     36.040000

       texture_worst  perimeter_worst   area_worst  smoothness_worst  \
count     569.000000       569.000000   569.000000        569.000000
mean       25.677223       107.261213   880.583128          0.132369
std         6.146258        33.602542   569.356993          0.022832
min        12.020000        50.410000   185.200000          0.071170
25%        21.080000        84.110000   515.300000          0.116600
50%        25.410000        97.660000   686.500000          0.131300
75%        29.720000       125.400000  1084.000000          0.146000
max        49.540000       251.200000  4254.000000          0.222600

       compactness_worst  concavity_worst  concave points_worst  \
count         569.000000       569.000000            569.000000
mean            0.254265         0.272188              0.114606
std             0.157336         0.208624              0.065732
min             0.027290         0.000000              0.000000
25%             0.147200         0.114500              0.064930
50%             0.211900         0.226700              0.099930
75%             0.339100         0.382900              0.161400
max             1.058000         1.252000              0.291000
```

```
       symmetry_worst  fractal_dimension_worst
count      569.000000               569.000000
mean         0.290076                 0.083946
std          0.061867                 0.018061
min          0.156500                 0.055040
25%          0.250400                 0.071460
50%          0.282200                 0.080040
75%          0.317900                 0.092080
max          0.663800                 0.207500

[8 rows x 30 columns]
```

[11]:

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test= train_test_split(x, y, test_size= 0.25,␣
 ↪random_state=0)
```

0.1.2 Feature Scaling

[13]:

```
from sklearn.preprocessing import MinMaxScaler
st_x= MinMaxScaler()
x_train= st_x.fit_transform(x_train)
x_test=st_x.fit_transform(x_test)
print(x_train)
```

```
[[0.23044157 0.32157676 0.21940433 … 0.31484671 0.30277942 0.09858323]
 [0.20062473 0.42116183 0.19452699 … 0.06965208 0.34042973 0.06677161]
 [0.62232003 0.76929461 0.60403566 … 0.56079917 0.19850187 0.07431457]
 …
 [0.11619102 0.35726141 0.11077327 … 0.17402687 0.17524147 0.17263545]
 [0.12963226 0.35311203 0.11706171 … 0.         0.06780997 0.06919848]
 [0.21434995 0.59004149 0.21235575 … 0.33251808 0.10782574 0.21172767]]
```

0.1.3 Fitiing k-NN

[15]:

```
from sklearn.neighbors import KNeighborsClassifier
classifier = KNeighborsClassifier(n_neighbors = 5)
classifier.fit(x_train, y_train)
```

[15]:

```
KNeighborsClassifier()
```

[16]:

```
y_pred= classifier.predict(x_test)
print(y_pred)
```

```
['M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B' 'M'
 'M' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'B' 'M' 'B' 'M' 'B' 'M' 'B' 'M'
 'B' 'M' 'B' 'M' 'M' 'B' 'M' 'B' 'B' 'M' 'B' 'B' 'B' 'M' 'M' 'M' 'M' 'B'
 'B' 'B' 'B' 'B' 'B' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'M' 'M' 'M' 'B' 'M' 'M'
 'B' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B' 'M' 'B' 'B' 'B' 'M' 'M'
 'B' 'M' 'M' 'M' 'B' 'B' 'M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'M' 'B'
 'M' 'M' 'B' 'M' 'M' 'M' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'B' 'M' 'B' 'M' 'M'
 'M' 'B' 'B' 'B' 'M' 'B' 'B' 'M' 'B' 'B' 'M' 'M' 'M' 'B' 'B' 'B' 'M']
```

0.1.4 Creating confusion matrix

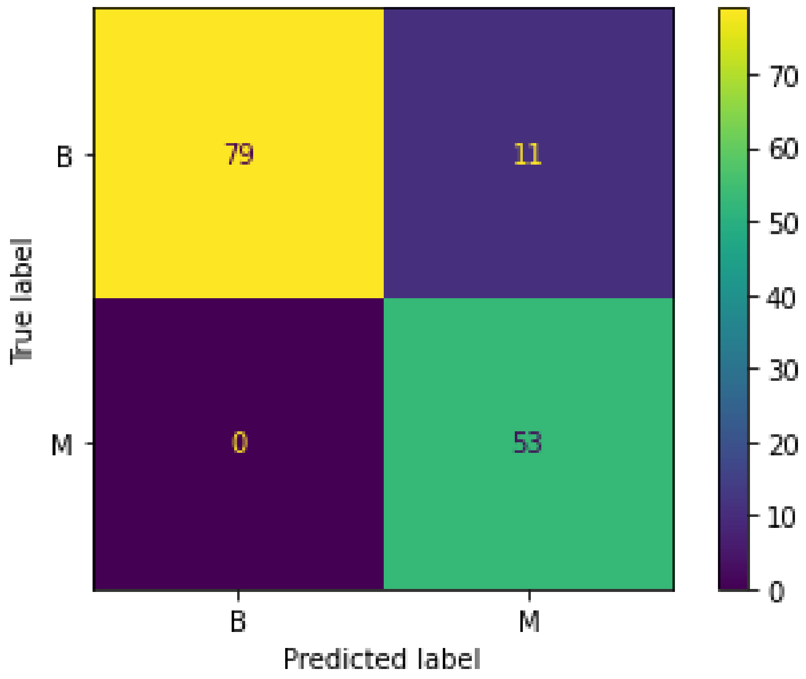
```
[17]: from sklearn.metrics import confusion_matrix
      cm= confusion_matrix (y_test, y_pred,labels=classifier.classes_)
      print(cm)
```

```
[[79 11]
 [ 0 53]]
```

```
[20]: from sklearn.metrics import ConfusionMatrixDisplay
      disp = ConfusionMatrixDisplay(confusion_matrix=cm,
      display_labels=classifier.classes_)

      disp.plot()
```

```
[20]: <sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
      0x7eff2c581f10>
```



Accuracy

[21]:

```
training_score = classifier.score(x_train, y_train)
test_score = classifier.score(x_test, y_test)
print(training_score)
print(test_score)
```

```
0.9765258215962441
0.9230769230769231
```

New set

[25]:

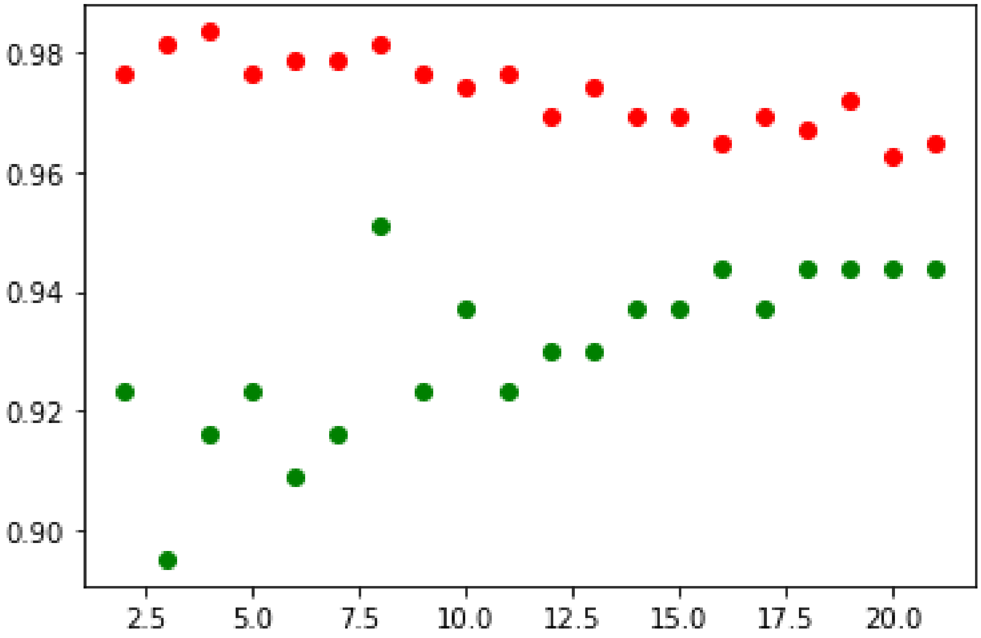
```
K = []
training = []
test = []
scores = {}
for k in range(2, 22):
    clf = KNeighborsClassifier(n_neighbors = k)
    clf.fit(x_train, y_train)
    training_score = clf.score(x_train, y_train)
    test_score = clf.score(x_test, y_test)
    K.append(k)
    training.append(training_score)
    test.append(test_score)
    scores[k] = [training_score, test_score]
for keys, values in scores.items():
    print(keys, ':', values)
```

```
2 : [0.9765258215962441, 0.9230769230769231]
3 : [0.9812206572769953, 0.8951048951048951]
4 : [0.9835680751173709, 0.916083916083916]
5 : [0.9765258215962441, 0.9230769230769231]
6 : [0.9788732394366197, 0.9090909090909091]
7 : [0.9788732394366197, 0.916083916083916]
8 : [0.9812206572769953, 0.951048951048951]
9 : [0.9765258215962441, 0.9230769230769231]
10 : [0.9741784037558685, 0.9370629370629371]
11 : [0.9765258215962441, 0.9230769230769231]
12 : [0.9694835680751174, 0.9300699300699301]
13 : [0.9741784037558685, 0.9300699300699301]
14 : [0.9694835680751174, 0.9370629370629371]
15 : [0.9694835680751174, 0.9370629370629371]
16 : [0.9647887323943662, 0.9440559440559441]
17 : [0.9694835680751174, 0.9370629370629371]
18 : [0.9671361502347418, 0.9440559440559441]
19 : [0.971830985915493, 0.9440559440559441]
20 : [0.9624413145539906, 0.9440559440559441]
21 : [0.9647887323943662, 0.9440559440559441]
```

Visualisation

[27]:

```
import matplotlib.pyplot as plt
plt.scatter(K, training, color ='r')
plt.scatter(K, test, color ='g')
plt.show()
```


0.98
0.96
0.94
0.92
0.90
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0