Group Practical 1

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July 19, 2018

1 Problem overview

1. Using iris data to assess the classification performance by tuning the KNN classifiers:

- Splitting the data using different percentage
- Change cross validation folds
- Changing the value of K
- Normalise the data

1) Summarise the above classification performances of the above settings using tables/figures

2) Discuss the results.

2 Problem one

The data of the table 1 is from weka, we can see

1. When the percentage of traning is 0.4, the evaluate score is the highest, which means when we use half of the data to train and the other half to test, the model performs best.

2. When the percentage of traning is 0.1, the evaluate score is the lowest.

3. When the trainning part goes from 0.9 to 0.4, the evaluate score goes up.

4. when the trainning part goes from 0.4 to 0.1, the evaluate score goes down. We could find when the percentage is 0.4, the model has highest Correctly Classified Instances TP rate Precision Recall F-Measure MCC ROC Area, PRC Area and the lowest FP rate.

This data is from the software weka:

Table 1: Splitting the data using different percentage(weka)

Training proportion	Test Proportion	Evaluate Score
0.9	0.1	0.933333
0.8	0.2	0.966667
0.7	0.3	0.955556
0.6	0.4	0.950000
0.5	0.5	0.96000
0.4	0.6	0.966667
0.3	0.7	0.942857
0.2	0.8	0.958333
0.1	0.9	0.903704

Table 2: The Detailed Accuracy(From weka)

Percentage	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC	PRC
0.1	0.904	0.048	0.904	0.904	0.904	0.856	0.928	0.854
0.2	0.958	0.022	0.960	0.958	0.958	0.937	0.968	0.934
0.3	0.943	0.025	0.952	0.943	0.943	0.919	0.960	0.916
0.4	0.967	0.014	0.970	0.967	0.967	0.952	0.977	0.949
0.5	0.960	0.021	0.964	0.960	0.960	0.941	0.970	0.939
0.6	0.950	0.027	0.956	0.950	0.950	0.926	0.962	0.925
0.7	0.956	0.025	0.960	0.956	0.955	0.935	0.966	0.931
0.8	0.967	0.017	0.970	0.967	0.966	0.953	0.976	0.947
0.9	0.933	0.033	0.944	0.933	0.933	0.906	0.953	0.902

To compare we use the sklean to train the data:

The code:https://github.com/chanchann/Bio_Machine_Learning

By the table3 which is the result of codes, we can see

1.when the percentage of traning is 0.5, the evaluate score is the highest, which means when we use half of the data to train and the other half to test, the model performs best.

2.when the percentage of traning is 0.1, the evaluate score is the lowest.

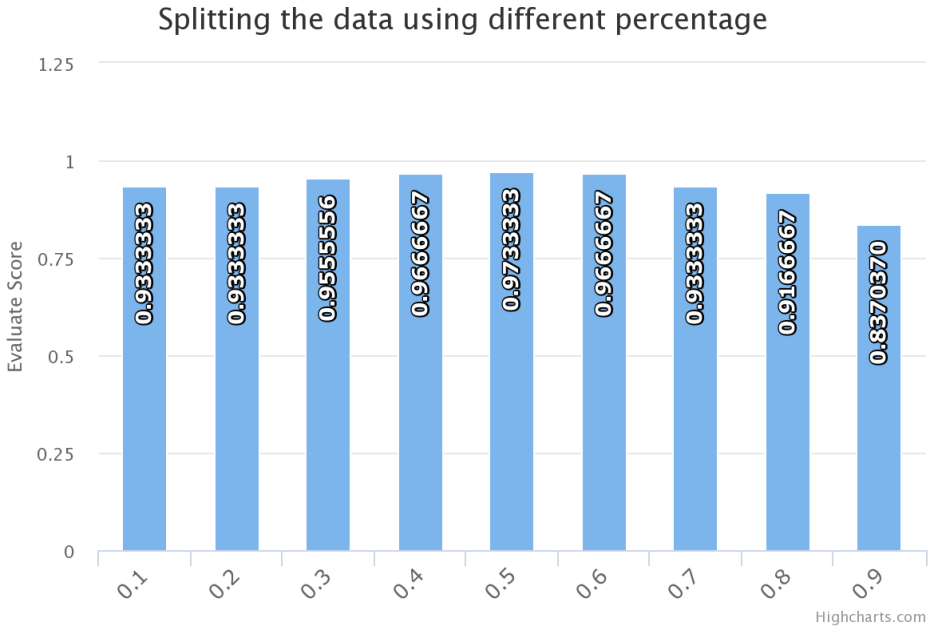
Table 3: Splitting the data using different percentage(sklearn)

Training proportion	Test Proportion	Evaluate Score
0.9	0.1	0.9333333333333333
0.8	0.2	0.9333333333333333
0.7	0.3	0.9555555555555556
0.6	0.4	0.9666666666666667
0.5	0.5	0.9733333333333334
0.4	0.6	0.9666666666666667
0.3	0.7	0.9333333333333333
0.2	0.8	0.9166666666666666
0.1	0.9	0.837037037037037

3.when the trainning part goes from 0.9 to 0.5, the evaluate score goes up.

4.when the trainning part goes from 0.5 to 0.1, the evaluate score goes down.

The difference may caused by many aspects such as parameters,evaluate methods and so on.



3 Problem two

Table 4: The cross validation folds Detailed Accuracy

Fold	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC	PRC
2	0.940	0.030	0.941	0.940	0.940	0.911	0.956	0.907
3	0.947	0.027	0.947	0.947	0.947	0.920	0.961	0.917
4	0.960	0.020	0.960	0.960	0.960	0.940	0.985	0.962
5	0.940	0.030	0.941	0.940	0.940	0.911	0.957	0.907
6	0.953	0.023	0.953	0.953	0.953	0.930	0.966	0.927
7	0.947	0.027	0.947	0.947	0.947	0.920	0.963	0.924
8	0.960	0.020	0.960	0.960	0.960	0.940	0.978	0.949
9	0.953	0.023	0.953	0.953	0.953	0.930	0.972	0.937

By the data from weka we can see that

1. when the fold is set as 4, it has the the model hashighest Correctly Classified Instances TP rate Precision Recall F-Measure MCC ROC Area, PRC Area and the lowest FP rate. If we take ROC area as the standard for judging accuracy,we would find

2. when the fold goes from 2 to 4, the ROC area is rising overall.

3. when the fold goes from 4 to 5, the ROC area is reduced .

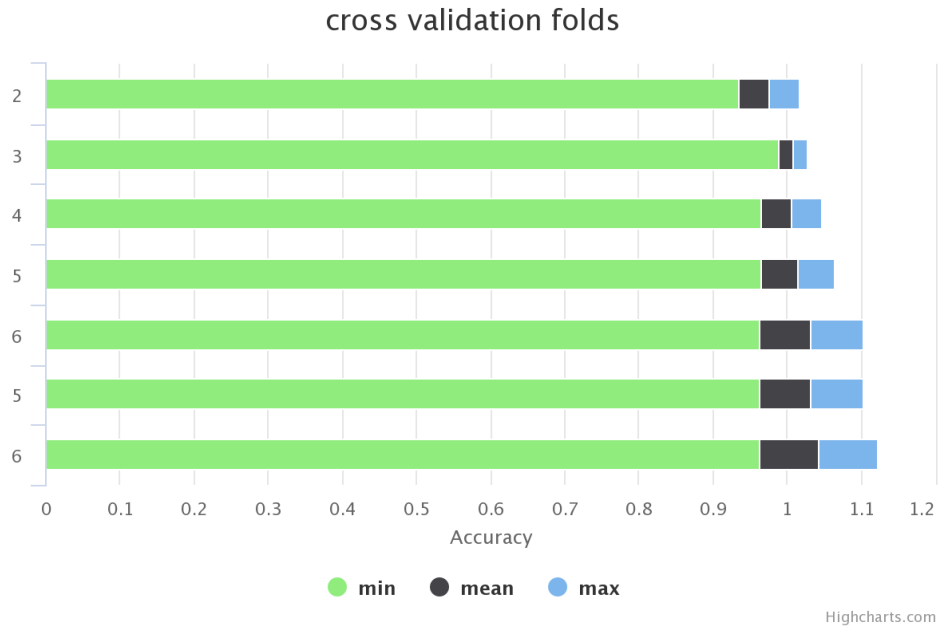
4. when the fold goes from 5 to 9, the ROC area is rising again but the peak has never reached as high as when fold is 4.

Table 5: cross validation folds(From Sklearn)

cv's folder	Accuracy
2	0.94(+/-0.04)
3	0.99(+/-0.02)
4	0.97(+/-0.04)
5	0.97(+/-0.05)
6	0.97(+/-0.07)
7	0.97(+/-0.07)
8	0.97(+/-0.08)

By the table5 we can see that

1. when the fold is set as 3, the model has the highest accuracy
2. when the fold goes up from 3 to 8, the accuracy goes down



4 Problem three

Table 6: The different K's Detailed Accuracy

K	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC	PRC
1	0.960	0.020	0.960	0.960	0.960	0.940	0.985	0.962
2	0.960	0.020	0.960	0.960	0.960	0.940	0.986	0.966
3	0.953	0.023	0.953	0.953	0.953	0.930	0.987	0.969
4	0.960	0.020	0.960	0.960	0.960	0.940	0.985	0.972
5	0.960	0.020	0.960	0.960	0.960	0.940	0.991	0.979
6	0.960	0.020	0.960	0.960	0.960	0.940	0.996	0.992
7	0.953	0.023	0.953	0.953	0.953	0.930	0.997	0.994
8	0.960	0.020	0.960	0.960	0.960	0.940	0.998	0.995
9	0.960	0.020	0.960	0.960	0.960	0.940	0.997	0.993

We choose ROC area as the criterion for judging the accuracy of the model. By the table we can see that,

1. when K =8, the model has the highest ROC Area.
2. when K goes from 1 to 8, and the ROC area is rising overall.

5 Problem Four

We use the different nomalization method to dicovery the effect:

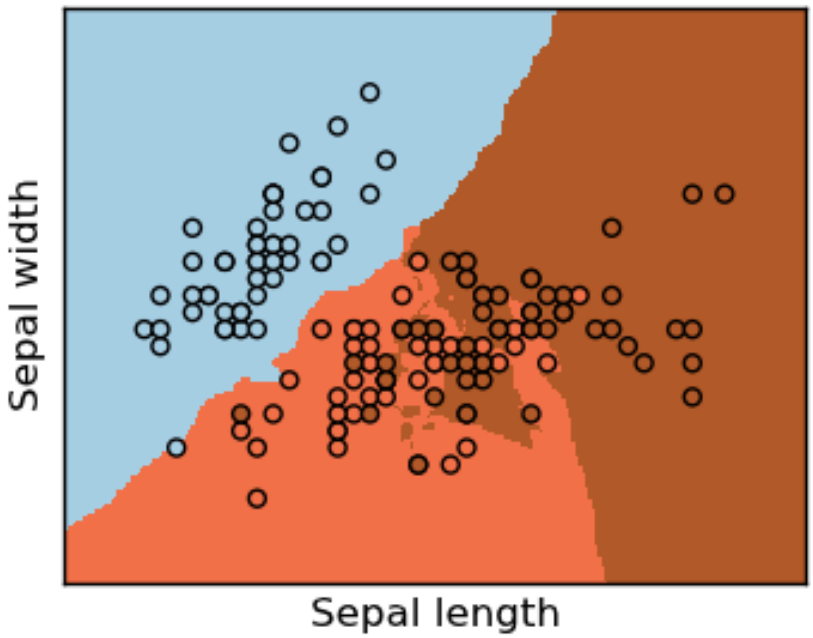
Table 7: Normalise the data(code)

Method	Accuracy
Min-Max scaling	0.97(+/-0.05)
Standardization	0.97(+/-0.02)
Normalizer	0.97(+/-0.04)

By the table7 we can see that, the Standardization has the minimum fluctuation interval.

6 Classification

We can plot the graph to see the Data distribution



7 Discussion

In our case, we chose the ROC area as a standard for judging models. ROC area is a curve, and the area covered under this curve on the coordinate axis is approximately close to 1, indicating that the prediction of the model is better.

We can find that if we set 0.4 as our percentage, 4 as our fold and 8 for the K value, the ROC area is more close to 1, so this model will have the highest accuracy.

Due to the random selection of seeds, the data obtained from each run would differ slightly, but the overall accuracy was not affected.

8 Code

split.py
To implement Splitting the data using different percentage

```
import numpy as np
import pandas as pd
from sklearn import datasets
from sklearn.neighbors import KNeighborsClassifier

iris=datasets.load_iris()
iris_x=iris.data
iris_y=iris.target

# Split iris data in train and test data
# A random permutation, to split the data randomly

np.random.seed(0)
indices=np.random.permutation(len(iris_x))
for i in np.arange(0.1,1,0.1):
test_size=-1*i*len(indices)
test_size=int(test_size)
iris_x_train=iris_x[indices[:test_size]]
iris_y_train=iris_y[indices[:test_size]]
iris_x_test=iris_x[indices[test_size:]]
iris_y_test=iris_y[indices[test_size:]]
#Create a nearest-neighbor classifier
knn=KNeighborsClassifier()
knn.fit(iris_x_train,iris_y_train)
#iris_x_predict=knn.predict(iris_x_test)
#print(iris_x_predict)
#print(iris_y_test)
score=knn.score(iris_x_test,iris_y_test)
#print(score)
```

```
print('test proprotion: {0},\nevaluate score:{1}'.format(i,score
                                ))
print('-------------------------------------------------')
```

crossVal.py

To use cross validation folds.

```
import numpy as np
import pandas as pd
from sklearn import datasets
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score

#Create the KNNClassifer
knn=KNeighborsClassifier()
# knn.fit(x_train,y_train)
for i in range(2,9):
scores=cross_val_score(knn,iris.data,iris.target,cv=i)
print(scores)
print("Accuracy:%0.2f(+/-%0.2f)"%(scores.mean(),scores.std()*2))
print("-------------------------------------------------")
```

normalize.py

To normalize the data to train.

```
import numpy as np
import pandas as pd
from sklearn import datasets
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
from sklearn.preprocessing import MinMaxScaler
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import Normalizer

iris=datasets.load_iris()
#Min-Max scaling
#MinMaxScaler().fit_transform(iris.data)

#Standardization
# StandardScaler().fit_transform(iris.data)

# Normalizer
Normalizer().fit_transform(iris.data)

# Here we split the data 0.6:0.4
```

```
x_train,x_test,y_train,y_test=train_test_split(
iris.data,iris.target,test_size=0.4,random_state=0)

#Create the KNNClassifer
knn=KNeighborsClassifier()
scores=cross_val_score(knn,iris.data,iris.target,cv=5)
print("Accuracy:%0.2f(+/-%0.2f)"%(scores.mean(),scores.std()*2))
```

plot.py

To plot the classification.

```
import numpy as np
import pylab as pl
from sklearn import neighbors, datasets

# import some data to play with
iris = datasets.load_iris()
X = iris.data[:, :2] # we only take the first two features.
Y = iris.target


h = .02 # step size in the mesh

knn=neighbors.KNeighborsClassifier()

# we create an instance of Neighbours Classifier and fit the
                                data.
knn.fit(X, Y)

# Plot the decision boundary. For that, we will asign a color to
                                each
# point in the mesh [x_min, m_max]x[y_min, y_max].
x_min, x_max = X[:,0].min() - .5, X[:,0].max() + .5
y_min, y_max = X[:,1].min() - .5, X[:,1].max() + .5
xx, yy = np.meshgrid(np.arange(x_min, x_max, h), np.arange(y_min
                                , y_max, h))
Z = knn.predict(np.c_[xx.ravel(), yy.ravel()])

# Put the result into a color plot
Z = Z.reshape(xx.shape)
pl.figure(1, figsize=(4, 3))
pl.set_cmap(pl.cm.Paired)
pl.pcolormesh(xx, yy, Z)

# Plot also the training points
pl.scatter(X[:,0], X[:,1],c=Y )
pl.xlabel('Sepal length')
pl.ylabel('Sepal width')
```

```
pl.xlim(xx.min(), xx.max())
pl.ylim(yy.min(), yy.max())
pl.xticks(())
pl.yticks(())

pl.show()
```