MultiLayerPerceptron_15_test_15_train

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```
In [26]: from sklearn.neural_network import MLPClassifier
         from sklearn.preprocessing import StandardScaler
         from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
         from sklearn.model_selection import train_test_split
         import pandas as pd
         from pandas import DataFrame,Series
         from matplotlib.colors import ListedColormap
         import numpy as np
         from sklearn.metrics import accuracy_score,confusion_matrix,classification_report
         import matplotlib.pyplot as plt
         from pandas.plotting import scatter_matrix
         from random import sample
```

```
In [27]: dup_train = pd.read_csv('../FeaturesCsvFile/featuresfile.csv')
         dup_test = pd.read_csv('../FeaturesCsvFile/featuresfile_10.csv')
         df1 = dup_test.drop_duplicates(subset=['User', 'Timestamp'])
         df2 = dup_train.drop_duplicates(subset=['User', 'Timestamp'])
         frames = [df1, df2]
         df= pd.concat(frames)
         df.shape
```

```
Out[27]: (821, 46)
```

```
In [30]: X = df.values[:, 2:45]
         y = df.values[:, 45] #label : walking/runing
         y_plot = np.where(y == 'walking', -1, 1)
         X_train, X_test, y_train, y_test = train_test_split(X, y_plot, test_size=0.3)
         scaler = StandardScaler()
         scaler.fit(X_train)
         StandardScaler(copy=True, with_mean=True, with_std=True)
         X_train = scaler.transform(X_train)
         X_test = scaler.transform(X_test)
         mlp = MLPClassifier(hidden_layer_sizes=(15,),max_iter=60)
         mlp.fit(X_train,y_train)
         y_pred = mlp.predict(X_test)
         print('Accuracy of Accuracy Score : %.2f' % accuracy_score(y_test,y_pred))
         print('Accuracy of Multi-Layer Perceptron Score: %.2f' % mlp.score(X_test,y_test))
         print(confusion_matrix(y_test,y_pred))
         print(classification_report(y_test,y_pred))
```

```
Accuracy of Accuracy Score : 0.95
Accuracy of Multi-Layer Perceptron Score: 0.95
[[132   5]
 [  7 103]]
             precision    recall  f1-score   support

         -1       0.95      0.96      0.96       137
          1       0.95      0.94      0.94       110

avg / total       0.95      0.95      0.95       247
```

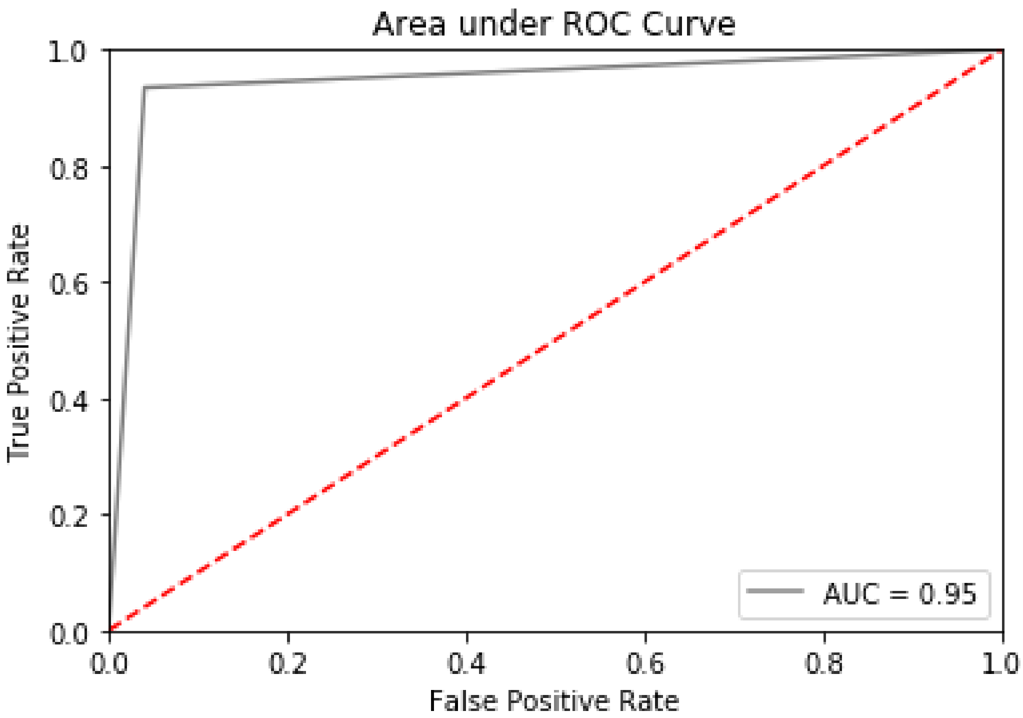
```
In [15]: avg_weight = []
         for i in range(0,len(mlp.coefs_[0])):
             avg_weight.append(np.mean(mlp.coefs_[0][i]))
         print ('Important features (featureName, weigh of important, #column)')
         header = list(df.head(1))
         important_feature = []
         for i in range(0,len(avg_weight)):
              important_feature.append((header[i+2],avg_weight[i],i+2))
         sorted_list = sorted(important_feature,key=lambda important_feature: important_featur
         for j in range(0,len(sorted_list)):
                 first_imp_fea = sorted_list[0]
                 second_imp_fea = sorted_list[1]
                 print sorted_list[j]
```

```
Important features (featureName, weigh of important, #column)
('Bin3,z', 0.10825592994061183, 24)
('Bin6,x', 0.099050904501434653, 7)
('AvgAcc-y', 0.072431320057493101, 39)
('Bin5,x', 0.070197353658616207, 6)
('StdDev-y', 0.059787564913883734, 42)
('Bin7,z', 0.059601690509690934, 28)
('Bin9,y', 0.044901323984415702, 20)
('AvgAbsDiff-z', 0.030665486239005578, 37)
('Bin3,y', 0.028917213562429201, 14)
('AvgAcc-x', 0.027602009597943528, 38)
('TimeDiffPeaks-y', 0.024406273141934252, 33)
('Bin1,z', 0.022291450883107876, 22)
('Bin8,y', 0.013387262576128274, 19)
('Bin6,y', 0.012826037878942664, 17)
('Bin8,x', 0.0092786045093103797, 9)
('Bin2,z', 0.0088359802466105204, 23)
('Bin7,x', 0.0084503892418165989, 8)
```

```
('Bin3,x', 0.0061114596853632094, 4)
('Bin5,y', 0.005510641749506O771, 16)
('Bin6,z', 0.0029566149246515582, 27)
('Bin10,y', 0.0019471520057938692, 21)
('Bin9,z', 0.0013783328195343596, 30)
('AvgAbsDiff-y', -0.0013050781765424346, 36)
('Bin2,y', -0.0017919156902444012, 13)
('Bin2,x', -0.003927755930684073, 3)
('Bin4,y', -0.012892902034440549, 15)
('AvgAbsDiff-x', -0.017511543702004303, 35)
('Bin1,y', -0.01783316444767534, 12)
('AvgAcc-z', -0.02037735095122958, 40)
('StdDev-z', -0.022119987856093683, 43)
('Bin7,y', -0.025977987046485441, 18)
('Bin1,x', -0.033222958956476277, 2)
('AvgResAcc', -0.034471345586067653, 44)
('StdDev-x', -0.03807143267292027, 41)
('Bin8,z', -0.044565909675076086, 29)
('Bin10,z', -0.045433237271096466, 31)
('TimeDiffPeaks-z', -0.048707633118018692, 34)
('Bin5,z', -0.050599779731201909, 26)
('Bin9,x', -0.051573141481606181, 10)
('TimeDiffPeaks-x', -0.073463131772347243, 32)
('Bin4,z', -0.092496139247622011, 25)
('Bin10,x', -0.096060475320505878, 11)
('Bin4,x', -0.11269002628339721, 5)
```

```
In [5]: from sklearn import metrics
        def plot_roc_curve(Y_predict,Y_test,name_graph):
            num_predns = []
            for i in range(0,len(Y_predict)):
                if Y_predict[i] == "walking":
                    num_predns.append(0)
                else:
                    num_predns.append(1)
            num_labels = []
            for i in range(0,len(Y_test)):
                if Y_test[i] == "walking":
                    num_labels.append(0)
                else:
                    num_labels.append(1)

            predns = np.array(num_predns)
            labels = np.array(num_labels)
            fpr, tpr, thresholds = metrics.roc_curve(y_test, y_pred)
            roc_auc = metrics.auc(fpr, tpr)
            plt.title('Area under ROC Curve')
```

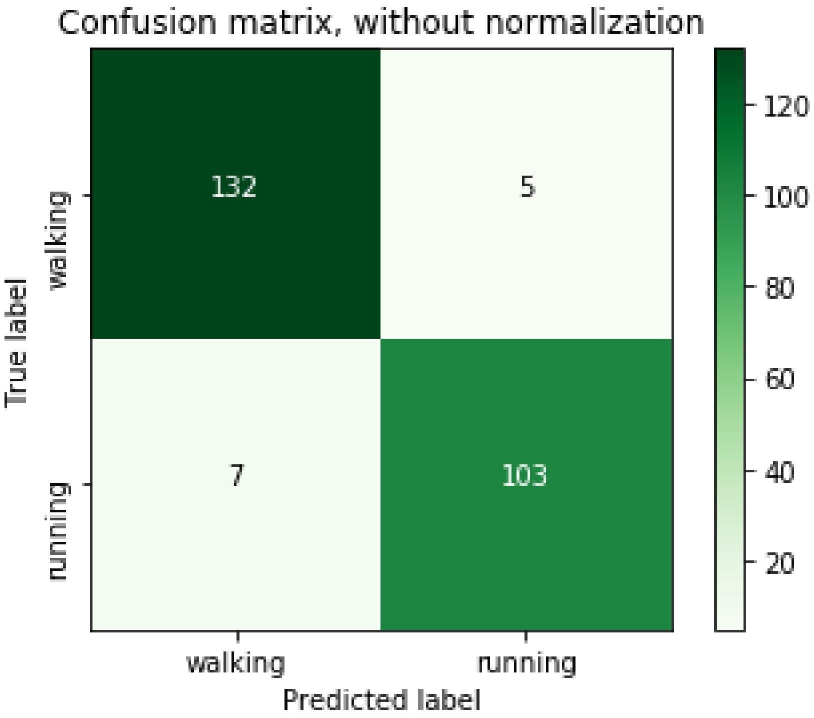
```
    plt.plot(fpr, tpr, 'grey', label = 'AUC = %0.2f' % roc_auc)
    plt.legend(loc = 'lower right')
    plt.plot([0, 1], [0, 1],'r--')
    plt.xlim([0, 1])
    plt.ylim([0, 1])
    plt.ylabel('True Positive Rate')
    plt.xlabel('False Positive Rate')
    plt.show()
#     plt.savefig('./image/Area_under_roc_pc.png', dpi=1000)

plot_roc_curve(y_pred,y_test,"Area_under_roc_pc")
```

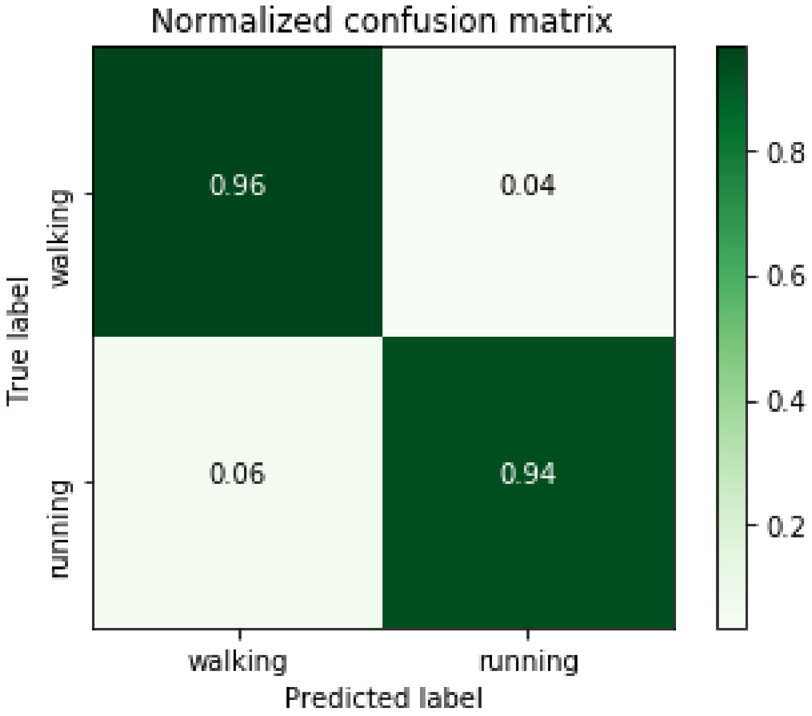


```
In [31]: import itertools
         import numpy as np
         import matplotlib.pyplot as plt

         def plot_confusion_matrix(cm, classes,
                                   normalize=False,
                                   title='Confusion matrix',
                                   cmap=plt.cm.Greens):
             """
             This function prints and plots the confusion matrix.
             Normalization can be applied by setting `normalize=True`.
             """
```

```
    if normalize:
        cm = cm.astype('float') / cm.sum(axis=1)[:, np.newaxis]
        print("Normalized confusion matrix")
    else:
        print('Confusion matrix, without normalization')

    print(cm)

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
    plt.xticks(tick_marks, classes)
    plt.yticks(tick_marks, classes, rotation=90)

    fmt = '.2f' if normalize else 'd'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, format(cm[i, j], fmt),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.ylabel('True label')
    plt.xlabel('Predicted label')

cnf_matrix = confusion_matrix(y_test, y_pred)
np.set_printoptions(precision=2)

# Plot non-normalized confusion matrix
plt.figure()
class_names = ["walking", "running"]
plot_confusion_matrix(cnf_matrix, classes=["walking", "running"],
                      title='Confusion matrix, without normalization')
plt.figure()
plot_confusion_matrix(cnf_matrix, classes=class_names, normalize=True,
                      title='Normalized confusion matrix')
plt.show()
```

```
Confusion matrix, without normalization
[[132   5]
 [  7 103]]
Normalized confusion matrix
[[ 0.96  0.04]
 [ 0.06  0.94]]
```


Confusion matrix, without normalization
True label
walking
running
132
5
7
103
walking
running
Predicted label
120
100
80
60
40
20


Normalized confusion matrix
True label
walking
running
0.96
0.04
0.06
0.94
walking
running
Predicted label
0.8
0.6
0.4
0.2