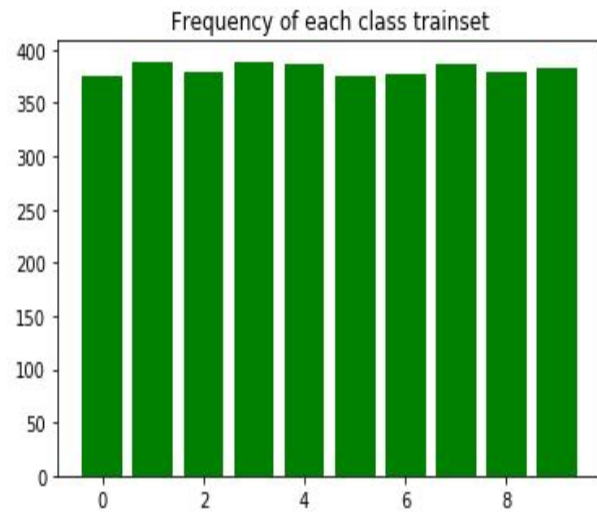
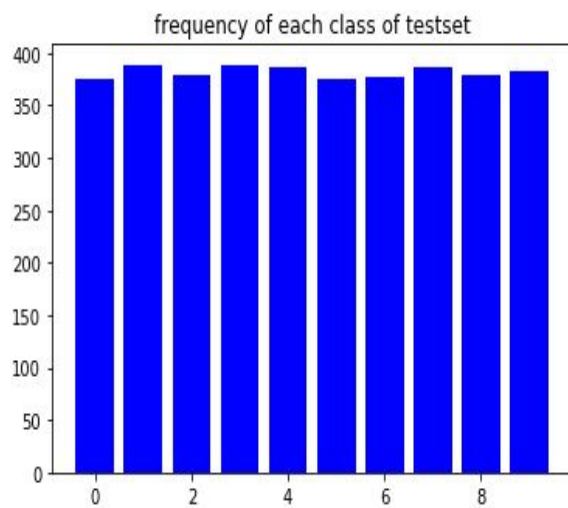


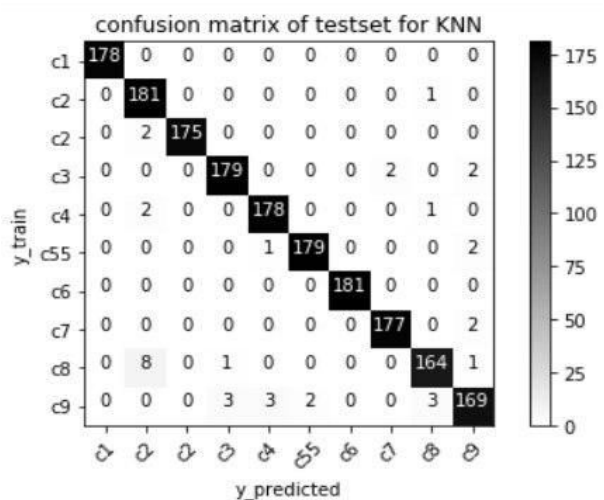
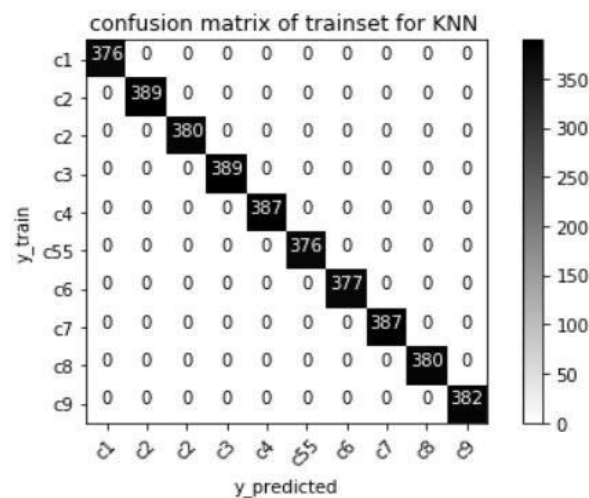
Istanbul Technical University- Fall2017
BLG527E Machine Learning
HomeWork3

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Q1) we split the training set and validation set to the whole of dataset with the ratio of 9/10 and 1/10, and this selection is chosen randomly(i use the train_test split function of scikit-learn). Therefore, 10 percent of data is prepared for validation set and 90 percent of them also allocated to training set.



KNN(K-nearest neighbors): for implementing the this method i use the scikit-learn package.for beautiful visualization of confusion matrix i used the additional function that i put the references of that in references section.



We have the **best accuracy of k for KNN: 1** ,**worst accuracy of k for KNN: 19** . As you see in fig1. This methods elapse time in trainset and test set is 0.9896 and 0.6230s respectively. We choose the best hyper parameter based on the validation accuracy.

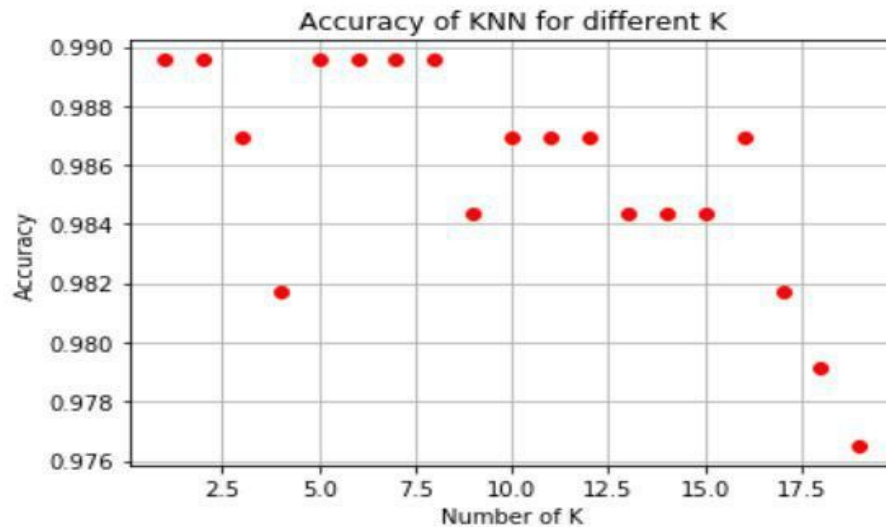


Fig1. plot of the accuracy of the KNN in accuracy with different K

Linear discrimination hyper-parameters:

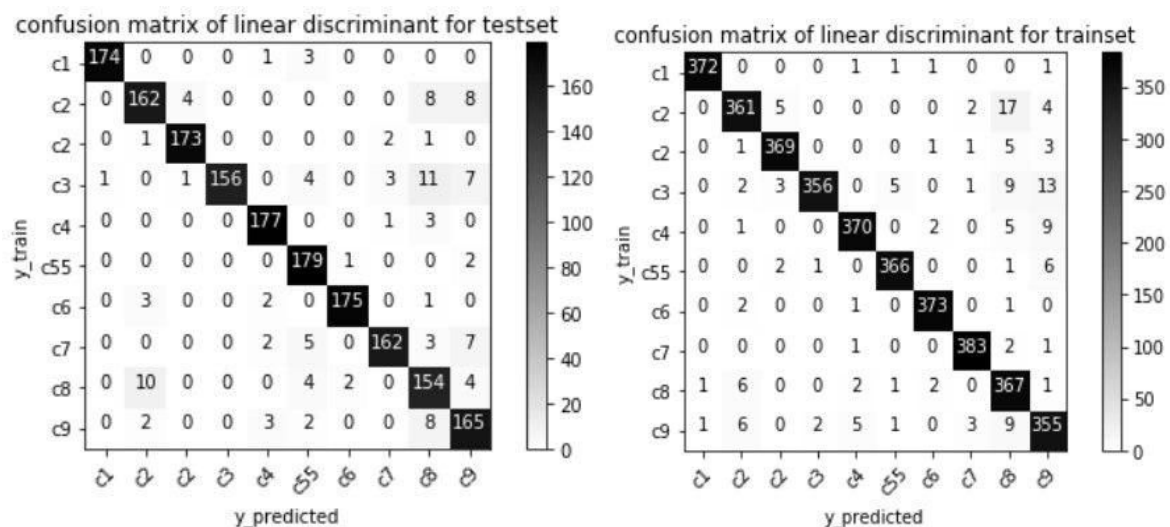


Fig2. confusion matrix of the accuracy of the linear discriminant .

We have the best variable in 0.5 and the elapsed time for linear discriminant in train and test set is 0.03202 s and 0.0010 respectively. We train the the trainset and predict the test set and show the performance of that with confusion matrix for train set and test set. We use the regularization penalty for linear discriminant method.

Multi-layer perceptron hyper-parameters tuning:

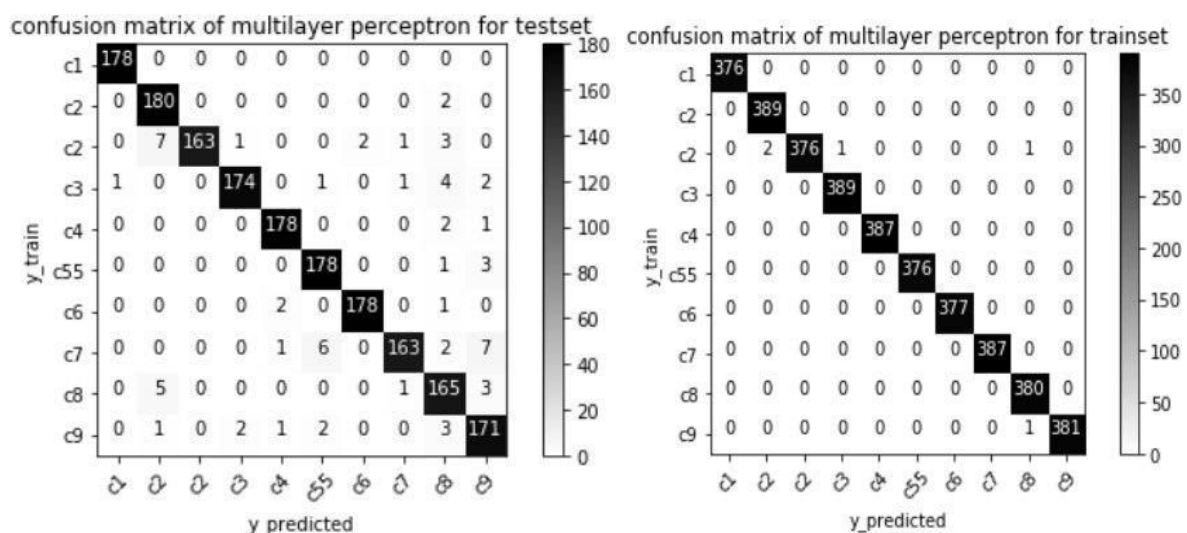


Fig3. confusion matrix of the accuracy of the Multi layer perceptron .

Actually, MLP is one of the most powerful method among the machine learning techniques, we should choose the best hyper-parameter for our neural network such as number of hidden layer and size of the layer and also regularization strength to have high performance based on the validation accuracy, we put the confusion matrix of trainset and test set for mlp in fig3.

Q2) the training rate in KNN and MLP is 100 percent , conversely the story about the linear discriminant is different. Furthermore, when we look at MLP accuracies, 100, 0.9948, 0.9627 percent accuracy for training validation and test respectively. validation accuracy in KNN and linear discriminant is 0.98956 and 0.9277 percent respectively and also in testset we have 0.9293, 0.97997 for the test set (a little low performance in linear discriminant), In addition. In terms of training time, the fastest classifier is knn, number of hidden layers and other related parameters can make the algorithm more complicated and it is cause of overfitting in training data, so cross validation reduce the effect of overfitting in training set. furthermore, among this KNN and linear discriminant have the very low elapsed time rather than multi-layer perceptron

in computational time. because , MLP has a lots of multiplication in among the matrices in forward and backward propagation. because it does not have any operation in training time and simply store the data, and the slowest model is neural network, because it has many matrix multiplication during forward back-propagation. But the elapse time for test set have different story MLP's elapse time is the lowest one among other methods it just take 0.0055 second and KNN due to the its comparison operation in test set has the highest elapsed time with 0.64499second. As conclusion linear discriminant have the logical computational time in training and test set.

Q3a) here, we should find the determined data point's class among the classes so we have to traverse among the conditions to find the related class.

(I put the question fig to have better visualization.)

[25,23]T $x_1 = 25$, $x_2 = 23$

$x_1 > w_{10}$? $\Rightarrow 25 > 10$ -----> Yes or no?----->yes

$x_2 > w_{20}$? $\Rightarrow 23 > 20$ -----> Yes or no? ---->yes

This point is in the C2

