

Homework 2 (issued March 13th, due on April 1st, 2025, 11 p.m)

Topic: neuronal network applied to handwritten digits from MNIST

Objective: Analysis of learning behavior in function of learning rate for various hidden-node sizes

Given are MNIST-datasets hand-written digits (60 000 and 10 000 training and testing pictures, respectively, in folder Day7:NN), and a python script ([part2_neural_network_mnist_data.py](#)) in folder Homework2: TaskDescription which uses an artificial neuronal network to recognize hand written digits (*class NeuralNetwork*); the script is from: Tariq Rashid "Make your own neuronal network".

SCRIPTING TASK

Rescript the driver from the python script provided so that you can train and test it in a more a compact way. That is, define reusable functions to be called as:

```
n=NeuralNetwork(...)
nn_fit(n,X_train, y_train, epochs=5)
# X_train: training pics with corresponding labels in y_train
# over 5 epochs (default)

y_pred = nn_predict(n,X_test)
conf = confusion_matrix(y_test,y_pred)

from sklearn.metrics import accuracy_score
scores = accuracy_score(y_pred, y_test)
```

This scoring function compares the predicted classifier with the actual classifier of the test data and returns the accuracy (1=perfect match, 0 = no match at all) in the recall problem.

Alternatively, define these functions as methods within the class `NeuralNetwork` to be called as:

```
n.fit(X_train, y_train, epochs=5)
y_pred = n.predict(X_test)
conf = n.confusion_matrix(y_pred, y_test)

scores = accuracy_score(y_pred, y_test)
```

DATA ANALYSIS TASK:

Study the learning behavior of the network as a function of the learning rate parameter LR in the definition range $0.001 < LR < 1$, for at least 2 different values of the parameter hiddennodes (say 50 and 200). Plot the scoring-accuracy vs LR graph for each hiddennode parameter. Don't forget to add plot legend showing which graph belongs to which hiddennode parameter. Save plot as PNG and upload as [Surname_ID_plot.png](#)

hint: It is a good idea to use logarithmically spaced values for the LR-array, such as,
`np.round(np.power(10,np.linspace(-3,0,15))*1000)/1000`

Please upload your python file and the plot.png output file into the Homework2:UploadFolder.
Please stick to the following naming convention

`Surname_nn_task.py`
`Surname_ID_plot.png`

or: `Team_Surname1_Surname2_task.py`
or: `Team_Surname1_Surname2_plot.py`

Do not upload the mnist files.