Pattern Recognition Laboratory – Exercises #5 & #6
Recognition of handwritten digits with artificial neural networks

Due date: **25.05.2018 (is it possible?)**

In the current assignment, we remain at the problem of recognizing digits, changing only the type of classifier used for this task. Since all the information about the data set were given in the materials for the previous assignment, I will not repeat them here.

MNIST database is available on the Galera server:

http://galera.ii.pw.edu.pl/~rkz/epart/mnist.zip

or on the Yann LeCun page:

http://yann.lecun.com/exdb/mnist/

Below you can find results of reference implementation of the neural network with one hidden layer trained with simple incremental backpropagation with fixed learning ratio.
I used directly pixel values without normalization (I removed pixels with constant values in all samples in the training set).

	MNIST training set			MNIST testing set		
	OK.	Error	Rejection	OK.	Error	Rejection
Classification coefficients	99.47%	0.53%	0.00%	98.04%	1.96%	0.00%

Parameters of network and training are omitted because part of this task is configuration of the network itself and tuning of the training parameters.

The results show clearly overfitting of my network.

Your task is preparation of neural network classifier trained with the backpropagation algorithm without serious overfitting and error coefficient on the test set below 2%. This last point really is only a postulate because as in previous assignment you should measure classification quality on the test set only once.

The suggested procedure is following:

Split the training set into two parts: training proper and validation. The training subset should be used in backpropagation to modify net weights and the validation subset should work as the testing set proxy to detect overfitting and break the learning early.

Here the question is how big should be the validation subset (10% seems to be good starting point). You should check if class frequencies are more or less the same in both the training and validation subsets.

Your report should include:

1. Short description of the basic learning method.
2. Short description of the experiments performed.
3. Network learning times, classification quality data.

Do not include MNIST data! It will cost you 2 points!