SGN-13000/SGN-13006 Introduction to Pattern Recognition and Machine Learning
Department of Signal Processing, Tampere University of Technology
Exercise 4
CIFAR-10 Black Box classifiers

Be prepared for the exercise sessions. You may ask TA questions regarding your solutions, but don't expect them to show you how to start from the scratch. Before the end of the session, demonstrate your solution to TA to receive exercise points.

1. **CIFAR-10 – Neural Networks** (80 points)

   Data: We will use the CIFAR-10 dataset.

   The MLP neural Network works best so that there is one output for each class. Each output estimates the likelihood of one class. To do that, the class labels should be changed in following way:

   $$0 \rightarrow (1\ 0\ 0\ 0\ 0)$$
   $$1 \rightarrow (0\ 1\ 0\ 0\ 0)$$
   $$2 \rightarrow (0\ 0\ 1\ 0\ 0)$$
   $$\ldots$$

   MLP training: There exists the Graphical User Interface of Matlabs Neural Networks Toolbox (run "nnstart") which you can use to find good network parameters. However, note that there are also Matlab functions that can be directly used. You can learn these from the Matlab documentation - just type "doc patternnet". Look at the net structure and find the neuron weight and bias values before and after training. Check also, what kind of transfer functions are used at each layer. Try different setups (number of layers and number of neurons at each layer) to search for the best performance.

   Note: Matlabs Neural Networks Toolbox expects both input and output data to be column vectors.

   Write a function *net=cifar_10_MLP_train(trdata,trlabels)* that trains an MLP classifier for the CIFAR data. Write also *estlabel=cifar_10_MLP_test(x,net)* that estimates the label for the given input x.

   Make a script that inputs all CIFAR-10 test samples to this function and evaluate its classification accuracy using your evaluation function.

   Compare your best MLP results with the random and k-NN implemented during the previous exercises.