AI1072: Machine learning, exercise sheet 2

MNIST can be obtained via the link given in our E-Learning page.

numpy& matplotlib with MNIST

Load the MNIST data as follows:
import gzip, pickle ;
with gzip.open("MNIST.pkl.gz") as f:
 data = pickle.load(f) ;
 traind = data["data_train"].reshape(-1,28,28)
 trainl = data["labels_train"]

'traind' contains the samples, 'trainl' the target values (labels) in one-hot format.
a) Create a scatter plot of the image-wise pixel mean for all samples!
b) Copy out all the samples whose mean over pixels is > 0.3 and display 3 of them
c) Compute the "average image" and display it! **d)** Compute the "average image" for samples of class 5 and display it!

1   Softmax theory

Show that the softmax function $\vec{S}(\vec{x})$ is normalized, i.e., that it satisfies $\sum_i S_i(\vec{x}) = 1$

2   Cross-entropy theory

Show that the cross-entropy is always positive!

3   Implementing softmax

Write a python function S(x) which takes an 1D numpy array and returns the softmax, also as a numpy array! Print out results for $\vec{x} = [-1, -1, 5]$ and $\vec{x} = [1, 1, 2]$!

4   Implementing cross-entropy

Write a python function CE(y,t) which takes an 1D numpy array and returns the its cross-entropy as a scalar! Print out results for $\vec{t} = [0, 0, 1]$ in the three cases of $\vec{y} = [0.1, 0.1, 0.8]$ and $\vec{y} = [0.3, 0.3, 0.4]$ and $\vec{y} = [0.8, 0.1, 0.1]$!