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Pattern Recognition and Neural Networks (521497S, 5 cp / 3 cu)
Examination 5.9.2012

NEITHER PROGRAMMABLE/GRAPHICAL CALCULATORS NOR COURSE MATERIAL ARE ALLOWED IN THE EXAM!

1. *Principles of Statistical Pattern Recognition*

   Write a short essay (max. 2 pages) on using the *Bayesian decision theory* in Pattern Recognition! In your answer, please include both the *Bayes' formula* and the *Bayes decision rule*, and shortly explain the notation used! (6 p).

2. *Distribution Estimation*

   You need to form an estimate of the probability distribution of a certain feature. The feature is a continuous real-valued random variable X with a density

   $$p(x|\mu) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}(x-\mu)^2}.$$

   Using the maximum likelihood method, derive the estimate for the unknown parameter μ when you have N independent samples x_i from the distribution! (6 p)

3. *AdaBoost.*

   Describe the operating principle of the AdaBoost (*Adaptive Boosting*) method when using a single weak classifier! (6 p)

4. *Multilayer Perceptrons and Artificial Neural Networks*

   Construct a neural network that solves the so-called XOR problem in which the output of the network must equal the *logical exclusive-OR function* applied to the two inputs (with values 0 or 1)! Justify your choices! (6 p)