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Pattern Recognition and Neural Networks (521497S, 5 cp / 3 cu)
Examination 23.8.2014

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

1. *Principles of Statistical Pattern Recognition*

   Explain briefly but precisely the following terms:
   - *a)* feature vector (½ p),
   - *b)* feature space (½ p),
   - *c)* classifier (½ p),
   - *d)* decision boundary (½ p),
   - *e)* class-conditional probability density function (½ p),
   - *f)* risk (½ p),
   - *g)* sensitivity (½ p),
   - *h)* specificity (½ p),
   - *i)* predictive value of positive test (½ p),
   - *j)* predictive value of negative test (½ p),
   - *k)* N-fold cross-validation (½ p), and
   - *l)* confusion matrix (½ p)!

2. *kNN-classifier*

   Describe the principle of operation of a kNN-classifier and its relation to the Bayes decision rule! What can you say about the classification error rate and the effects the choice of the metric has? (6p)

3. *Perceptrons*

   You have three samples from a two-class scenario with one real-valued feature X. For the class 1, the samples are $x_1 = -1$ and $x_2 = 1$. For the class 2, the sample is $x_3 = 0$. Design a multilayer Perceptron that can correctly classify the samples! Justify your choices and show the validity of you solution! (6p)

4. *Maximum Likelihood Estimation*

   When constructing a classifier, you need information on the probability mass function of a discrete feature. In your studies, you have found out that the feature can only have two possible values. The other value occurs with the probability p, and the other one is observed with the probability $1 - \mathrm{p}$. Your task is now to derive an estimate of the parameter p using the maximum likelihood estimation technique! (6p)