UNIVERSITY OF OULU
Department of Computer Science and Engineering
Dr. Tapio Seppänen

Pattern Recognition and Neural Networks (521497S, 5 cp / 3 cu)
Examination 4.10.2013

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

1. *Testing Classifiers*

   Describe briefly but precisely what the following terms relating to classifier validation mean:
   - *a)* sensitivity, (½p)
   - *b)* specificity, (½p)
   - *c)* predictive value of positive test, (½p)
   - *d)* predictive value of negative test, (½p)
   - *e)* N-fold cross-validation, (2p)
   - *f)* confusion matrix. (2p)

2. *Linear Discriminant Functions*

   Write a short (max. 2 pages) essay on Linear Discriminant Functions in Pattern Recognition! You can address topics such as what are these functions, how and where they are used, and what are their pros and cons? You may use illustrations and/or formulas to clarify the text. (6p)

3. *Maximum Likelihood Estimation*

   You have N samples x_i of a real-valued random variable X at your disposal. The random variable X attains values in the range $]0, \infty[$, and you know that it has the distribution $p(x|\lambda) = \lambda e^{-\lambda x}$ with a parameter λ. Use the Maximum Likelihood Estimation method to derive an estimate for the parameter λ using the samples x_i! (6p)

4. *Perceptrons and Artificial Neural Networks*

   Describe the so-called *XOR*-problem and construct a multilayer Perceptron capable of solving it! Justify the choices you make and validate the resulting network! (6p)