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Statistical Methods and Learning in Computer Vision
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Homework Assignment 8 — January 24th, 2013

Exercise 1. (Neural Networks)

Solve the logical ¨AND¨ and ¨XOR¨ problems by means of a multilayer perceptron.

a) Define the value table for AND and XOR.

b) Draw the general structure of the network with input and output layer.

c) Draw the problems graphically and find the necessary separating planes.

d) Show that the AND problem can be solved without hidden layer whereas the XOR problem requires one hidden layer.

e) Conclude the activation and output function of each of the neurons.

Exercise 2. (Convexity)

A functional $E : \mathscr{C}^1(\mathbb{R}^2, \mathbb{R}) \to \mathbb{R}$ is convex, if for any two points $u_1, u_2 \in \mathscr{C}^1(\mathbb{R}^2, \mathbb{R})$ ($u_1, u_2 \in \mathscr{C}^1(\mathbb{R}^2, [0, 1])$) and any $\lambda \in [0, 1]$ it holds

$$E(\lambda u_1 + (1 - \lambda)u_2) \leq \lambda E(u_1) + (1 - \lambda)E(u_2)$$

Prove for the denoising functional

$$E(u) = \int_\Omega ||I(x) - u(x)||^2 dx + \lambda \int_\Omega ||\nabla u(x)||dx, \quad u : \mathbb{R}^2 \to \mathbb{R}$$

and for the *relaxed* segmentation functional

$$E(u) = \int_\Omega f(x)u(x)dx + \lambda \int_\Omega ||\nabla u(x)||dx, \quad u : \mathbb{R}^2 \to [0, 1]$$

from the lecture that they are convex.

For downloads of slides and of homework assignments and for further information on the course see

`http://vision.in.tum.de`