

Exercises 2 - in english

(Solutions are given in english in the other pdf file.)

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8.1

A one-dimensional classification problem for three classes, A , B and C and pdf-s $f_A(x)$, $f_B(x)$, $f_C(x)$ is defined as:

$$p_A = 1/2, f_A(x) = 1/8 \text{ for } x \in [-4, 4]$$

$$p_B = 1/3, f_B(x) = 3(1 - x^2)/4 \text{ for } x \in [-1, 1]$$

$$p_C = 1/6, f_C(x) = x/8 \text{ for } x \in [0, 4]$$

Estimate optimal classification boundaries and decision rules for the system. Explain the general estimation steps and draw a figure that describes the estimation process and the results.

8.2

For a classification problem with two classes C_A and C_B , are the a priori probabilities $p_A = 3/4$ and $p_B = 1/4$. Assume the following pdf-s

$$p(\bar{z}|C_k) = \frac{1}{2\pi|\det\Sigma_k|^{1/2}} e^{-(\bar{z}-m_k)^T \Sigma_k^{-1} (\bar{z}-m_k)/2}$$

with

$$m_A = m_B = 0,$$

and

$$\Sigma_A = \begin{pmatrix} 4 & 0 \\ 0 & 1 \end{pmatrix}, \Sigma_B = \begin{pmatrix} 1 & 0 \\ 0 & 4 \end{pmatrix}.$$

Estimate decision boundaries for the problem!

10.5

Describe how to estimate the equation of a line that minimizes the sum of orthogonal distances for a set of points. Apply it on a following set of points:

$$p_1 = (-4, -2), p_2 = (-2, -1), p_3 = (0, 0), p_4 = (1, 1), p_5 = (3, 2)$$

Excercise 3 (a), Exam 11/03/2003

An image has been smoothed with the following kernel:

$$h = k \cdot [1, 5, 10, 10, 5, 1]$$

Can repeated convolutions of an image with the kernel

$$g = \frac{1}{2}[1, 1]$$

be used to obtain the same result as with the first kernel? If yes, how many convolutions are needed? If no, explain the reasons why.

What should the constant k be so that the filter gain is equal to 1?

Preparation for lab 3

(a) Derive a mask that approximates the first partial derivative in the x -direction when convolved with an image.

(b) Derive a mask, d_{xxx} for generating the third order derivative using the masks $d_x = 1/2(1, 0, -1)$, and $d_{xx} = (1, -2, 1)$ corresponding to the first and second order derivatives.