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Examination in Statistical Image Analysis, March 12, 2002

Written examination March 12, 2002, 8.45-12.45 in room VV41.

Literature and notes may be brought for this written examination.

In the written examination there are two problems. You are supposed to answer both of them, and in the judgement they have the same weight. Answers may be given in English or Swedish.

Problem 1.

Figure 1 below shows an image from an experiment with baker's yeast. Each spot in the image corresponds to a protein with a specific isoelectric point (pI) determined by isoelectric focusing in the horizontal direction as a first step and a specific molecular weight determined by vertical separation in a second step.
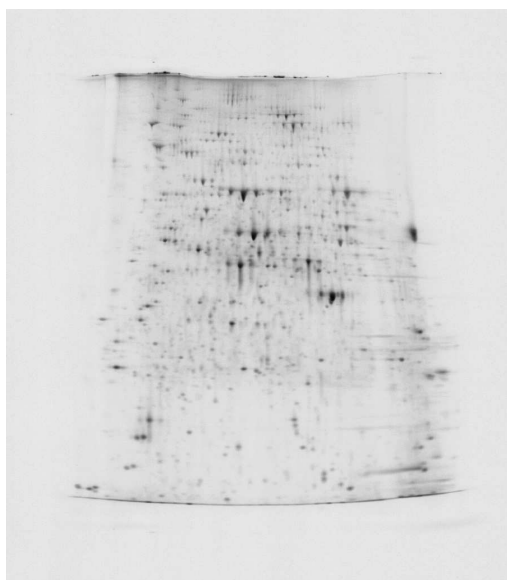

Figure 1: Image from 2D gel electrophoresis of baker's yeast.

a) Suggest a method for estimating the positions of the spots in Figure 1. Choose for simplicity to regard only a rectangular part of the image excluding the curves at the top and at the bottom and also the areas to the left and right without spots.

b) Suggest one method (or several methods) to test if the spots are placed in a purely random manner in the rectangle regarded. Looking at the image, do you expect deviations from a purely random placement of the spots?

c) One is also interested in estimating the size and shape of the spots. Suggest some method for doing this.

Problem 2. Suppose you get strips like the one shown in Figure 2 below with noisy binary digits.

Figure 2: Image with noisy binary digits.

a) Suggest an image analysis method that finds the consecutive digits with a reasonable accuracy — to begin with without finding out wether they are zeros or ones.

b) Suppose now that you have obtained isolated image parts with one noisy binary digit in each part. Suggest a method for identifying whether the digit in one such part is a "zero" or a "one". Describe a suitable experiment where you use strips with manually identified digits to optimize the performance of the identification method.