T-61.231 Principles of Pattern Recognition

Exercise 1: 1.10.2001

1. COURSE ASSIGNMENTS
   - Instructions at the course website, *http://www.cis.hut.fi/Opinnot/Tik-61.231/*
   - Fruit shape classification, texture classification or handwritten digit classification.
   - Assignments are to be done individually.
   - The deadline for the assignments is 1.12.2001. The experiments will take some time so start working before the last weekend.
   - Feel free to contact the course assistant, preferrably through e-mail (*matti.aksela@hut.fi*) or after exercises, if you have any questions or problems.

2. Describe a method of data preprocessing capable of transforming measured data into independent features and minimizing the error resulting from dimension reduction.

3. Let $\omega_i, i = 1, 2, \ldots, M$, be the classes for a classification task. Divide the interval of the possible values of a feature into subintervals $\Delta_j, j = 1, 2, \ldots, K$. If $P(\Delta_j)$ is the probability of having values in the respective subinterval and $P(\omega_i|\Delta_j)$ the probability of occurrence of ω_i in this interval, show tat the so-called *ambiguity function*

   $$A = -\sum_i \sum_j P(\Delta_j) P(\omega_i|\Delta_j) \log_M (P(\omega_i|\Delta_j))$$

   is equal to 1 for completely overlapped distributions and is equal to 0 for perfectly separated ones. For all other cases it takes intermediate values. Thus, it can be used as a distribution overlap criterion. *(Theodoridis, excercise 5.5, p.175)*

4. Let P be the probability that event A occurs. The probability that event A occurs k times in a sequence of N independent experiments is given by the binomial distribution

   $$\binom{N}{k} P^k (1-P)^{N-k}$$

   Show that $E[k] = NP$ and $\sigma_k^2 = NP(1-P)$. *(Theodoridis, excercise 10.1, p.348)*