THIS IS AN EXAMPLE VERSION OF AN EXAM OF SGN-41006 IN SPRING 2014

SGN-41006 Signal Interpretation Methods, Spring 2014
Exam X on X X, 2014 / Jari Niemi and Katariina Mahkonen

No literature. Use of your own calculator allowed. Use either English of Finnish in your answers. You can keep this paper also after the exam.

Choose freely <u>two (2)</u> of the three (3) essay topics E1 – E3 and answer to them using approx. 200-500 words per each essay topic. You do not need to cover everything what is said in the course textbook(s) about the topic (especially you can omit mathematical derivations) but you need to give a summary (essay) which <u>shows that you have understood</u> the meaning and diversity of the topic from the point of view of pattern classification and/or regression.

In addition, answer to <u>both</u> of the calculation problems C1 – C2.

Altogether you need to give <u>four (4)</u> answers, each worth of 6 points.

ESSAY TOPICS

E1: Non-Parametric Density Estimation.
E2: Support Vector Machines.
E3: Performance Assessment.

CALCULATION PROBLEMS

C1: Explain the meaning and purpose of use of the formulas below. Especially, describe the meaning of each term ($\lambda, n_j, n, \gamma, c_j(\lambda)$, $\widehat{\mathbf{\Sigma}}_j$, $\mathbf{S}_W, \widehat{\mathbf{\Sigma}}_j^{\lambda}, \widehat{\mathbf{\Sigma}}_j^{\lambda,\gamma}, \mathbf{I}$) occurring in them.

$$\widehat{\mathbf{\Sigma}}_j^{\lambda} = \frac{(1-\lambda)n_j\widehat{\mathbf{\Sigma}}_j + \lambda n \mathbf{S}_W}{(1-\lambda)n_j + \lambda n}, \quad \widehat{\mathbf{\Sigma}}_j^{\lambda,\gamma} = (1-\gamma)\widehat{\mathbf{\Sigma}}_j^{\lambda} + \gamma c_j(\lambda)\mathbf{I}$$

C2: Recall the classifier combination method *product rule*: assign an object to class ω_j if

$$(p(\omega_j))^{-(L-1)} \prod_{i=1}^{L} p(\omega_j|\mathbf{x}_i) > (p(\omega_k))^{-(L-1)} \prod_{i=1}^{L} p(\omega_k|\mathbf{x}_i), \quad k = 1, \dots, c; k \neq j.$$

Using the product rule derive the *sum rule*: assign an object to class ω_j if

$$(1-L)p(\omega_j) + \sum_{i=1}^{L} p(\omega_j|\mathbf{x}_i) > (1-L)p(\omega_k) + \sum_{i=1}^{L} p(\omega_k|\mathbf{x}_i), \quad k = 1, \dots, c; k \neq j.$$

Instruction: Assume $p(\omega_k|\mathbf{x}_i) = p(\omega_k)(1+\delta_{ki})$, where $|\delta_{ki}| \ll 1$. Use this expression in the product rule and neglect the second order and higher terms in δ_{ki}.