EN2500 Information Theory and Source Coding 7.5 credits

Informationsteori och källkodning

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for EN2500 valid from Autumn 2007

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Specific prerequisites

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

To obtain an understanding of the theoretical principles of source coding.

Course contents

Information theory of discrete and continuous variables: entropy, Kraft inequality, relative entropy, entropy rate, redundancy rate, mutual information, asymptotic equipartition. Estimation of probability density and probability mass functions. Expectation-Maximization algorithm. Maximum entropy principle.

Lossless coding: nonadaptive codes: Shannon, Huffmann, arithmetic codes. Universal and adaptive codes. Ziv-Lempel codes.

Rate-distortion theory: the rate-distortion function, Shannon lower bound, rate distribution over independent variables, reverse waterfilling, Blahut algorithm.

High-rate quantization: constrained-resolution and constrained-entropy quantization. Vector versus scalar quantization. Practical high-rate-theory-based quantizers: mixture and lattice quantizers, companding.

Low-rate quantization: Lloyd training algorithm for constrained-resolution and constrained-entropy cases. Structured vector quantization (tree-structured, multi-stage, gain-shape, lattice). Fast search methods.

Transforms and filter banks: bases and frames. Transforms and filter banks. Fixed transforms: DFT, DCT, MLT, Gabor frames, Balian-Low theorem. A-priori adaptation: Karhunen-Loeve, a-priori energy concentration. A-posteriori adaptation: a-posteriori energy concentration, best-basis search, matching pursuit.

Linear prediction: closed-loop prediction, noise-shaping, analysis-by-synthesis, spectral flatness, Kolmogorov's Formula, spectral flatness, redundancy, forward and backward prediction.

Course literature

W.B. Kleijn, A basis for source coding, KTH-S3 (2004).

Examination

- HEM1 - Assignment, 1.5 credits, grading scale: P, F
- TEN1 - Examination, 6.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

Written examination (4 credits).
Homework (1 cr).

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.