Information Theory I

Signal and Information Processing Laboratory

Institut für Signal- und Informationsverarbeitung

Fall Semester 2025

Dr. S. Moser / Dr. L. Wang

Course Information

Lecturers	Dr. Stefan M. Moser ETF E 107 Tel: +41 44 632 51 92 E-mail: moser@isi.ee.ethz.ch	Dr. Ligong Wang ETF E 107 Tel: +41 44 632 51 92 E-mail: ligwang@isi.ee.ethz.ch

Assistant
Joel Neeser
ETF E 105
Tel: +41 44 632 28 99
E-mail: neeser@isi.ee.ethz.ch

Lectures   Wednesdays, 14:15–16:00 in ETF C 1

Tutorials   Wednesdays, 16:15–18:00 in ETF C 1

Course Structure   The lectures and tutorials are in English and held in person. In the tutorials, the assistant reviews recent material, offers hints on the current exercise sheet, and answers questions. Livestreams and recordings will not be provided; no recordings from previous years are available.

Prerequisites
- Solid foundation in probability and calculus.
- Pleasure with mathematics.

Exercises   Weekly exercise sheets complement the lecture material. You will have one week to complete each sheet; solutions will then be posted on the course website. We **strongly** recommend attempting the problems independently before consulting the solutions, as this is the best preparation for the exam. Submitting solutions is optional but encouraged; please follow the instructions on each sheet.

Exam   A 180-minute written exam (in English) will be held during the exam period 19 January – 13 February 2026. The exam covers all material from lectures and exercise sheets. You may bring printed lecture notes, course handouts, and your own notes; electronic devices are not permitted. No exam will be offered in the summer 2026 exam period; retakes are only possible after re-enrolling.

Course Website   https://isi.ee.ethz.ch/teaching/courses/it1.html

Content	Topics include information-theoretic quantities and their properties (entropy, conditional entropy, mutual information); data compression (efficient coding of a single random message, a memoryless source, and a stationary source with memory); typicality and the Asymptotic Equipartition Property (AEP); data transmission over noisy channels; joint source-channel coding; continuous random variables and differential entropy; Gaussian channels with the corresponding coding theorem.
Lecture Notes	• Stefan M. Moser: *Information Theory (Lecture Notes)*, 6th edition, Signal and Information Processing Laboratory, ETH Zürich, Switzerland, and Institute of Communications Engineering, National Yang Ming Chiao Tung University (NYCU), Hsinchu, Taiwan, 2018.
	• Thomas M. Cover and Joy A. Thomas, *Elements of Information Theory*, 2nd Edition, John Wiley & Sons, 2006.
Additional Reading	The following textbooks provide additional details for interested students. This material is optional and not required for the exam.
	• Stefan M. Moser: *Advanced Topics in Information Theory (Lecture Notes)*, 6th edition, Signal and Information Processing Laboratory, ETH Zürich, Switzerland, and Institute of Communications Engineering, National Yang Ming Chiao Tung University (NYCU), Hsinchu, Taiwan, 2025.
	• Robert G. Gallager, *Information Theory and Reliable Communication*, John Wiley & Sons, 1968.
	• Imre Csiszár and János Körner, *Information Theory: Coding Theorems for Discrete Memoryless Systems*, Academic Press, 1981.
	• Raymond W. Yeung, *A First Course in Information Theory*, Kluwer Academic Press, 2002.
	• Robert McEliece, *The Theory of Information and Coding*, Cambridge University Press, 2004.