EPFL

COM-406   **Information theory and signal processing**

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Cursus	Sem.	Type
Computational science and Engineering	MA1, MA3	Opt.
Computer and Communication Sciences		Obl.
Cybersecurity	MA1, MA3	Opt.
Data Science	MA1, MA3	Obl.
Data science minor	H	Opt.
Digital Humanities	MA1, MA3	Opt.

Language of teaching	English
Credits	6
Session	Winter
Semester	Fall
Exam	Written
Workload	180h
Weeks	14
Hours	**6 weekly**
Courses	4 weekly
Exercises	2 weekly
Number of positions	

Summary

Information Theory and Signal Processing are key underpinnings of Data Science. They provide frameworks for signal representation and for fundamental performance bounds.

Content

This class presents basic concepts of Information Theory and Signal Processing and their relevance to emerging problems in Data Science and Machine Learning.
A tentative list of topics covered is:
1. Signal Representations
2. Measures of Information
3. Compression and Quantization
4. Sparsity
5. Exponential Families, Maximum Entropy
6. Detection and Estimation Theory

Keywords

Information Theory, Signal Processing, Statistical Signal Processing, Machine Learning, Data Science.

Learning Prerequisites

Required courses

COM-300 Modèles stochastiques pour les communications

Recommended courses

Statistics

Important concepts to start the course

Solid understanding of linear algebra and probability as well as real and complex analysis.

Learning Outcomes

By the end of the course, the student must be able to:

• Formulate the fundamental concepts of signal processing such as basis representations and sampling

• Formulate the fundamental concepts of information theory such as entropy and mutual information

• Analyze problems in statistical settings using fundamental bounds from information theory

• Formulate problems using robust and universal techniques

Teaching methods
Ex cathedra lectures, exercises, and small projects.

Expected student activities
Follow lectures; independent work on problems (homework and small projects).

Assessment methods
Written final exam during the exam session.
Homework Problem Sets during the semester.
10% homework, 90% final exam.

Supervision
Assistants   Yes

Resources

Bibliography
Cover and Thomas, Elements of Information Theory (Second Edition), Wiley, 2006.

Ressources en bibliothèque
• Elements of Information Theory / Cover

Notes/Handbook
Lectures notes

Websites
• https://ipg.epfl.ch/cms/lang/en/pid/147664