### 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**

**Ressources en bibliothèque**
- Elements of Information Theory / Cover

**Notes/Handbook**
Lectures notes

**Websites**