

COM-621

Advanced Topics in Information Theory

Gastpar Michael, Issa Ibrahim

Cursus	Sem.	Type
Computer and Communication Sciences		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Project report
Workload	60h
Hours	28
Courses	14
Exercises	14
Number of positions	

Frequency

Only this year

Remark

Not given this year, next time: Spring 2026

Summary

The class will focus on information-theoretic progress of the last decade. Topics include: Network Information Theory ; Information Measures: definitions, properties, and applications to probabilistic models.

Content

- 1) Information measures: Definitions, properties, applications, pitfalls.
 - Mutual information
 - Directed information
 - Wyner's common information
 - Entropy-power inequality
 - Renyi- and f-divergences
 - Extremization of information measures
- 2) Information measures in probabilistic systems
 - Generalization guarantees for learning algorithms
 - Compressed Sensing
- 3) Network Information Theory
 - Classical channel settings: Multiple-Access, Broadcast, Relay
 - Classical source settings: Slepian-Wolf, Lossy source coding, CEO problem
 - "Gaussian location" model and problem
 - Caching
 - Application to federated learning?

Learning Prerequisites**Recommended courses**

COM-404 Information Theory and Coding

Learning Outcomes

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

- Generalize information measures
- Formulate estimation, inference and decision problems via the lens of information measures

- Analyze communication networks via information measures
- Manipulate information measures

Assessment methods

Students will work on projects.

Resources

Bibliography

Cover and Thomas, Elements of Information Theory (2nd ed), Wiley, 2006.
El Gamal and Kim, Network Information Theory, Cambridge, 2011.

Ressources en bibliothèque

- [Elements of Information Theory](#)
- [Network Information Theory](#)

Moodle Link

- <https://go.epfl.ch/COM-621>