

COM-621

**Advanced Topics in Information Theory**

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Cursus	Sem.	Type
Computer and Communication Sciences		Opt.

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

**Frequency**

Only this year

**Remark**

Next time : Spring 2021

**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](#)