COM-512

Networks out of control

Cursus	Sem.	Type
Computer science	MA2, MA4	Opt.
Cybersecurity	MA2, MA4	Opt.
Data Science	MA2, MA4	Opt.
Data science minor	E	Opt.
Electrical Engineering		Opt.
SC master EPFL	MA2, MA4	Opt.
Systems Engineering minor	E	Opt.

Language of teaching	English
Credits	6
Session	Summer
Semester	Spring
Exam	Written
Workload	180h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Remark

Pas donné en 2026-27 - Cours biennal

Summary

The goal of this class is to acquire mathematical tools and engineering insight about networks whose structure is random, as well as learning and control techniques applicable to such network data.

Content

- Random graph models: Erdös-Renyi graphs, random regular graphs, random geometric graphs, small worlds, stochastic block model, power-laws and scale-free graphs.
- Learning graphs from data: centrality metrics, embeddings, network alignment, network motifs.
- Processes on graphs: bond/site percolation, bootstrap percolation, epidemics, navigation.

Keywords

Random graphs, network data, machine learning, graph processes.

Learning Prerequisites

Required courses

COM-300 Modèles stochastiques pour les communications, or equivalent

Important concepts to start the course

Basic probability and statistics; Markov chains; basic combinatorics.

Learning Outcomes

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

- Develop models of networks driven by data or applications
- Analyze properties of random graphs
- Design algorithms dealing with random networks

Teaching methods

Ex cathedra lectures, exercises, mini-project

Expected student activities

Attending lectures, bi-weekly homeworks, mini-project incl. student presentation at the end of semester, final exam.

Assessment methods

- Homeworks
- Mini-project
- Final exam

Supervision

Office hours	Yes
Assistant.e.s	Yes
Forum	No

Resources

Bibliography

- A. D. Barbour, L. Holst and S. Janson, Poisson Approximation, Oxford Science Publications, 1992.
- B. Bollobas, Random Graphs (2nd edition), Cambridge University Press, 2001.
- R. Durrett, Random Graph Dynamics, Cambridge University Press, 2006 (electronic version).
- D. Easley, J. Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World, Cambridge University Press, 2010 (electronic version).
- G. Grimmett, Percolation (2nd edition), Springer, 1999.
- S. Janson, T. Luczak, A. Rucinski, Random Graphs, Wiley, 2000.
- R. Meester and R. Roy, Continuum Percolation, Cambridge University Press, 1996.

Ressources en bibliothèque

- Find the references at the Library

Notes/Handbook

Class notes will be available on the course website.

Moodle Link

- https://go.epfl.ch/COM-512