EE 381M, 16780
Probability & Stochastic Processes II

Random Graphs and Communication Networks

Spring 2017

Instructor: François Baccelli, francois.baccelli@austin.utexas.edu

Objectives

The course is focused on the random graphs and their applications to network science and communications science.

Prerequisites

EE 381J Probability and Stochastic Processes I is a pre-requisite. The course will provide self contained material on infinite random graphs and on point processes.

Contents

The course is structured in two blocks.

I. Random Graphs

This block will discuss both random graphs in the Erdős–Renyi sense and infinite random sparse graphs in the Aldous and Lyons sense. The following notions will be covered:

- Branching processes;
- The Erdős–Renyi model;
- Sparse infinite random graphs and networks;
- Mass transport, unimodularity.

The following applications will be discussed: epidemic diffusion, viral processes, connectivity in communication networks, navigation on random networks, random walks on random graphs and trees.

II. Random Geometric Graphs

This block will discuss random graphs defined on Poisson point processes of the Euclidean space. The following notions will be covered:

- Poisson point processes;
- The Boolean model;
- Random geometric graphs;

- The random connection model;
- Discrete and continuum percolation;
- Shortest path routing in random networks;
- Random tessellations (Voronoi, Delaunay) of Poisson point processes;
- Poisson line processes.

The following applications will be discussed: Voronoi clustering; distribution network architectures; coverage in wireless networks; shadowing in wireless networks; SINR graphs and SINR navigation. The high dimensional Euclidean space case will also be discussed with applications to information theory (capacity and error exponents).

References

The following material will be used in the course:

[BB] F. Baccelli and B. Blaszczyszyn, *Stochastic Geometry and Wireless Networks*, Vol. 1, 2, NOW Publishers, 2009.
pdf available at http://hal.inria.fr/inria-00403039 and http://hal.inria.fr/inria-00403040

[Bol] B. Bollobas, *Random Graphs*, Cambridge University Press, 2001.

[DVJ] D. Daley & D. Vere-Jones, *Introduction to the Theory of Point Processes* Springer Verlag, second edition, 2008.

[DM] M. Draief and L. Massoulié, *Epidemics and Rumors in Complex Networks*, London Mathematical Society Lecture Note Series, 2010.

[Gri] G. Grimmett, *Random Processes on Graphs and Lattices*, Cambridge University Press, 2010.

[MF] M. Franceschetti and R. Meester, *Random Networks for Communications*, Cambridge University Press, 2007.

Grading

- Assignments: 1/3;
- 2 midterm exams: 1/3;
- One research paper to read and present (from a list of proposed papers): 1/3.

Practical Information

Class Hours: TBA

Office Hours: TBA

Place and Time: TBA