basque center for applied mathematics

Adventures in random graphs: Models, structures and algorithms

Lecturer: Armand Makowski[1]

Dates: 10–14 January 2011

Abstract:

In this short course, we provide an introduction to the theory of random graphs. We survey recent developments in the theory of random graphs as models of complex networks with applications to telecommunications, biology, economics and social networks. In the process, a number of important examples are introduced, namely Erdős-Rényi random graphs, scale-free networks, small worlds and geometric random graphs, among others. Dynamic processes and algorithms on some of these graphs are also discussed. The presentation will cover basic concepts, structural graph properties and methods of analysis.

Programme:

1. Random graphs as graph-valued rvs: Construction and examples.
2. Erdős-Rényi random graphs: Zero-one laws and the method of first and second moments; Small graph containment, absence of isolated nodes and connectivity.
3. Erdős-Rényi random graphs: The giant component and its emergence (via the branching process argument); diameter and degree distribution.
4. Random graphs with general degree distributions: Generalized Erdős-Rényi random graphs and the Fan-Lu model; the configuration model.
5. Scale-free networks: Preferential attachment, power-law degree distributions.
6. Epidemics and diffusion processes over scale-free networks.
7. Small world networks: Modeling Milgram's experiment; clustering and the impact of short cuts.
8. Algorithmic perspective on Milgram's experiment: Navigation and search over small worlds.
9. Geometric random graphs as models of wireless networks.
10. Random intersection graphs with applications to social networks and key predistribution schemes.

Bibliography:

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