

Information Networks

MS&E 337, ICME 337

Course description

Information networks such as the Internet, World Wide Web, or social networks can be characterized by heterogeneity and independence of their building blocks (nodes) and the complex underlying link structure between them. This course tries to survey the mathematical results developed in the last few years on algorithms for analyzing such networks, and models that capture their basic properties.

The course pre-requisites include some background in graphs and algorithms as well as familiarity with probability and linear algebra.

Administrative Information

- **Instructor:** Amin Saberi.
(email: saberi@stanford.edu, cell: 650 704 7857)
- **Course load:** two homeworks, one response paper and a project. The project could be theoretical or network analysis (several datasets will be available)
- **Text book:** Random Graph Dynamics by Rick Durrett; research and survey papers will be given in the class.

Topics

Random graph models

Erdos-Renyi random graphs: cluster growth, formation of the giant connected component, diameter and distance distribution

Scale-free graphs: random graphs with a fixed degree distribution, preferential attachment model and Polya urns

Algorithmic aspects

Expansion, eigenvalue gap and their algorithmic implications; spectrum of random and scale-free graphs; random walks and propagation of viruses; spectral clustering and applications in data mining.

Decentralized search and small-world properties. Small-world effects in online datasets; decentralized search in structured and unstructured networks.

Case studies

WWW: graph structure in the WWW; searching the web; PageRank, HITS etc.

Internet: the Internet at the router and autonomous systems level.

Social Networks: online social networks; contagion and cascading behavior in a social network