Math 593 Special Topics in Mathematics: Graphs and Markov Chains Summer 2012

Course

Math 593 - 01 meets MTTh 9:30-11:35 in RH 121
Course web page `http://mathcs.slu.edu/~clair/markov`

This is a course in combinatorics and graph theory, with the unifying concept of Markov chains. We will treat questions of counting, mixing, and random sampling from discrete distributions.

Instructor

Dr. Bryan Clair
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Ritter Hall 110, 977-3043

Office Hours

Summer office hours by appointment.

Textbook

Markov Chains and Mixing Times, Levin, Peres, Wilmer. This is available in book form, or online at `http://pages.uoregon.edu/dlevin/MARKOV`.

We will also use other literature as appropriate.

Grading

Grades in this class will be determined by in-class participation and occasional homework.

Honesty

Students are expected to be honest in their academic work, as per the Honesty Policy of the College of Arts & Sciences. Plagiarism, cheating and dishonesty will be reported to the dean and may result in probation, expulsion, or worse.

Objective

The main objective of the course is to give students the necessary background to understand current research in the areas of graph theory and combinatorics related to Markov chains, particularly questions related to expander graphs and to statistical mechanical models such as dimers and the Ising model.

Topical Outline

- Random walks on graphs.
- Markov chain basics: Irreducible, aperiodic chains. Stationary distributions. Reversibility.
- More classical examples: Gambler's ruin, perfect matchings, the Ising model.
- Markov Chain Monte Carlo: Convergence to the stationary distribution. Mixing times. Coupling.
- Spectral graph theory: The adjacency matrix, and the matrix-tree theorem. Eigenvalues and mixing times. Bottlenecks. Expander graphs and applications.
- Sampling from large combinatorical sets: Path coupling, approximate counting. Coupling from the past. Applications to matchings and the Ising model.