Title: Integrable models, statistical physics and combinatorics

Instructor: Philippe Di Francesco

Course description:

This topics course aims at introducing various integrable structures arising from physical problems. These involve combinatorial objects such as: triangulations, trees, tilings, alternating sign matrices, plane partitions and networks. Integrability arises both as a consequence of the symmetries of the problem and the possibility of introducing parametric deformations that preserve them. It provides powerful algebraic and analytic tools for exact enumeration and more.

Plan of the course:

0. Introduction to statistical physics
1. Introduction to the combinatorics of paths and matchings
2. Integrable models I: Lorentzian Triangulations
3. Integrable models II: Lozenge tilings and Plane partitions
4. Discrete integrable systems and Cluster algebras
5. Integrable models III: Tilings of the Aztec diamond
6. Integrable models IV: General theory-example of the six vertex model and connection to Alternating Sign Matrices
7. Continuum limits and elements of Conformal Field Theory

The course is largely self-contained. No prerequisites. We include a quick introduction to all the necessary concepts and basic tools of statistical physics. Combinatorial methods will be developed when needed (generating functions, infinite matrices, determinants, decorated trees, lattice paths, networks, cluster algebras, etc.).

Reading material:

Lecture at the International Congress of Mathematical Physics 2012:
http://arxiv.org/abs/1210.4514

Slides by D. Bressoud:
www.macalester.edu/~bressoud/talks/2009/asm-ASU.pdf

Method of assessment:

Class participation, and response to open homework problems.

Days-Time-Place:

Tue - Thu 9:30-10:50 445 Altgeld Hall