Undergraduate Seminar

Math 395, Spring 2024

Instructor: Prof. Ursula Porod

Random Walks on Graphs and Electric Networks

Random walks on graphs have a myriad of applications in areas such as physics, biology, economics, engineering, and computer science. The idea of studying random walks on graphs as electrical networks was first introduced by Kakutani in the 1940's and later popularized by Doyle and Snell. The analogy reveals interesting connections between certain laws of physics, discrete harmonic functions, and the study of reversible Markov chains. Quantities such as access times, commute times, and escape probabilities for random walks can be phrased and often very efficiently computed in the language of electrical networks. For infinite graphs, a highlight application of the electrical network approach will be an elegant proof of Pólya's famous *Recurrence Theorem* for random walks on lattices from 1921.

Prerequisites: Probability and Markov chain theory (such as Math 310-1,2 or Math 311-1,2).