Stanford Math Directed Reading Program Colloquium
Session I, Winter 2019

Wednesday April 3, 2019, 6:30pm–8:30pm
Sloan Mathematics Center, room 380-384H (fourth floor)
Dinner available at 6:15pm

Solving Inhomogeneous Boundary Conditions with Fourier Series

Zarah Tesfai
Mentor: Evangelie Zachos

Fourier series are used to expand period functions on an interval. In this talk, I will discuss the importance of convergence and introduce techniques to solve boundary value problems with Fourier series. Then, I will work through a problem with inhomogeneous boundary condition involving finding the temperature of a rod with one-dimensional heat flow.

Stochastic Differential Equations

Elyssa Hofgard
Mentor: Alexander Dunlap

Stochastic differential equations have a comprehensive range of applications from finance to neuroscience. In this talk, I will introduce and define the concept of a standard Wiener process. I will then discuss the properties of Wiener processes that are necessary to understand stochastic differential equations. I will give an example of a linear stochastic differential equation and present an informal derivation of Ito's lemma to solve this equation. Finally, I will discuss one application of stochastic differential equations to the Hodgkin-Huxley model of action potentials in neurons.

Preferential Attachment: Modeling Real-World Networks

Isaac Scheinfeld
Mentor: Yuval Wigderson

Many real-world networks share a number of interesting properties, such as sparsity, small diameter, and power-law degree distributions. I will motivate and describe the preferential attachment model, which generates graphs sharing many of these real-world properties.

Application of the Probabilistic Method to Prefix Codes

Aamnah Khalid
Mentor: Xiaoyu He

In prefix codes, such as variable-length Huffman codes and UTF-8, there is a tradeoff between shorter and longer length strings. Kraft's inequality establishes a bound on the sum of the number of valid strings of each possible length, weighted according to the exponential of that particular length. I will give an outline of the probabilistic method and use it to prove Kraft's inequality. Then I will discuss the more general Kraft-Macmillan inequality that extends this concept to all uniquely decipherable codes.

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