Lectures on Probability and Stochastic Processes XII

Indian Statistical Institute, Kolkata

December 15 - 19, 2017

The twelfth meeting of the **Lectures on Probability and Stochastic Processes**, colloquially known as "LPS", will be held at the Indian Statistical Institute (http://www.isical.ac.in/), Kolkata during December 15 - 19, 2017. There will be two minicourses on the following topics.

- **Exclusion processes with drift** by Arvind Ayyer (http://www.math.iisc.ernet.in/~arvind/), Indian Institute of Science.

  In these lectures, we will discuss a natural generalisation of the random walk with drift, known as the asymmetric simple exclusion process (ASEP). The ASEP on a finite one-dimensional lattice was first studied by statistical physicists in the mid 1990s interested in understanding a toy model of nonequilibrium phenomena. Since then, they have emerged in different areas of mathematics, such as combinatorics, queueing theory, special functions and representation theory.

  There are two natural variants of the ASEP, one in which the number of particles is fixed, and one in which this number is allowed to vary. In the first two lectures, we will derive the basic properties of these variants. In the remaining part, we will motivate and discuss ASEPs with multiple species of particles. Only the basics of the theory of Markov processes on finite state spaces will be assumed.

- **An introduction to the Gaussian free field and Liouville quantum gravity** by Nathanaël Berestycki (http://www.statslab.cam.ac.uk/~beresty/), University of Cambridge.

  I will give an introduction to the Gaussian free field, an object which has been at the heart of some recent groundbreaking developments in probability. I will then discuss a few applications to the emerging theory of Liouville quantum gravity, which can be thought of as trying to define and describing the properties of a canonical notion of random surface. Mathematically, this is related to the problem of giving a meaning to the exponential of the Gaussian free field. I will then discuss how this can be used to prove a rigourous version of the Khnizhnik-Polyakov-Zamolodchikov (KPZ) relation from quantum gravity.

  The course will be kept at a basic level and should in particular be accessible at a masters level, assuming only basic notions of measure-theoretic probability (essentially, Gaussian vectors and Brownian motion).