ABSTRACTS FOR SIXTH WEEK PROGRAM, JULY 27–JULY 31

1:00 CENTRAL STANDARD TIME, Monday, Wednesday, and Friday

GREGORY LAWLER

PROBABILITY, RANDOM FIELDS, AND GEOMETRY IN STATISTICAL PHYSICS, LAST WEEK OF TALKS

ABSTRACT (from first week): We will be looking at models that arise in critical phenomena in statistical physics. The general framework is that there is a collection of sites and there is a random "field" defined on the sites. This field can be either a collection of random variables indexed by the sites or a random path or subgraph.

The lectures will focus on two main examples: the loop-erased walk which is closely related to uniform spanning trees and the Gaussian field. The lectures discuss the relationship of these to Markov chains and usual random walks, "loop measures". and determinants of the Laplacian. There are other models that participants may consider such as Ising model, percolation, and Potts models.

Other participants may consider the continuous analogues of these fields and random curves, and, in particular, the Schramm-Loewner evolution and the definition of the determinant of the Laplacian in the continuum. Other possibilities are random geometry (quantum gravity) and physics approaches to conformal field theory.

We will use facts in undergraduate mathematics from the following areas: linear algebra, (post-calculus) probability, real variables, complex variables, combinatorics and graph theory. These should not be considered strict prerequisites but they give hints to outside reading that participants may have to do.

The mathematics in the discrete models will involve a lot of combinatorics and should be of interest for those who like this kind of mathematics. The continuous analogues involve a lot of analysis (real, complex, and stochastic) and some PDE. It is not required to have much background in this; indeed, many find learning the discrete theory to be a good start before attacking the mathematically more sophisticated continuous theories.

It is hoped that the lecture notes for this class will become a book.

1:00 CENTRAL STANDARD TIME, Tuesday and Thursday

FOCUS GROUPS

GREGORY LAWLER; lawler@math.uchicago.edu

PROBABILITY

PETER MAY; may@math.uchicago.edu

ALGEBRAIC TOPOLOGY (OPEN; on Peter's Zoom account)

2:30 CENTRAL STANDARD TIME

EUGENIA CHENG, Monday, July 27

DISTRIBUTIVE LAWS IN CATEGORY THEORY

ABSTRACT: One very fruitful way of expressing algebraic structure in category theory is using monads. Distributive laws are then a way of combining two or more types of algebraic structure by combining the corresponding monads in a coherent way. This can be used to build up more complicated algebraic structures from simple ones, or to break down more complicated ones into simpler components to analyse them. A key motivating example is rings, which are built form monoids and groups; a more advanced example is higher dimensional categories.

This talk will be introductory but I will assume some familiarity with basic category theory, including categories, functors and natural transformations. I will cover monads but prior familiarity with monads will help as this will not be a full introduction to monads. My aim is to cover the main ideas and results about distributive laws, and explain my favorite result about distributive laws from the beautiful classic paper of Street, The Formal Theory of Monads.

SPECIAL EVENT: GRADUATE STUDENT PANEL

CHANGED:
DANNY SHI, Friday, July 31

THE HOPF CONDITION FOR BILINEAR FORMS

ABSTRACT: I will first discuss how the classical Hopf condition arises from the study of "sums of squares formulas" over fields of characteristic 0. Then, I will talk about Dugger-Isaksen's proof, using motivic cohomology, of the Hopf condition for "sums of squares formulas" over arbitrary fields of characteristic not 2

4:00 CENTRAL STANDARD TIME

MIKE HOPKINS, Tuesday July 28

90 YEARS OF COBORDISM THEORY

ANGELICA OSORNO, Thursday July 30

OPERADS IN CAT

ABSTRACT: Operads are a good way of packaging certain algebraic structures. In this talk, we will explore those operads in Cat whose algebras are symmetric monoidal categories and other related structures. in these cases, recognizing the algebras over the operad involves two key ideas:

- finite presentation of the operad
- coherence theorems for the algebraic structures

I will not assume any prior knowledge of any of the topics mentioned above.

PETER MAY; Monday, Wednesday, and Friday,

(see also Tuesday, Thursday 1:00 focus groups)

TOPICS IN AND AROUND ALGEBRAIC TOPOLOGY

ABSTRACT: See Week 4. Some follow up on previous talks and some new topics. Possible topics include: How to compute the real cobordism ring. The historical road to algebraic K-theory and to localization and completion in algebraic topology. The J-homomorphism and the Adams conjecture. Quillen's solution (in the complex case that Adams had already solved!), the homology of $GL(\infty, \overline{\mathbb{F}}_q)$, the plus construction, the general definition and the algebraic K-theory of finite fields. The algebraic K-theory of the fields $\overline{\mathbb{F}}_q$.

Participants are strongly urged to ask for topics that they might like to see and to contact Peter about any and all other topics and questions `may@math.uchicago.edu`.