PROGRAM NOTES AND ABSTRACTS FOR WEEKS 7 AND 8

Probability: Greg Lawler

TITLE: Random Walk and the Heat Equation

ABSTRACT: I will give a long series of lectures (at least three weeks) focusing on the closely related topics of random walk, harmonic functions, and diffusion of heat. I will start with the discrete case where understanding long range behavior boils down to a question in linear algebra. Along the way I will prove some important facts: Stirling?s formula and the (local) central limit theorem.

Next I will do the continuous time analogue which brings in Brownian motion, the usual heat equation from PDE, and show how the construction in the discrete case leads to Fourier series. I expect these ideas will be enough for the first two weeks and I will decide later (with possible participant input) about what to do later.

The only (unofficial!) prerequisites for these lecture are linear algebra and "undergraduate analysis" which is sometimes called "advanced calculus". At Chicago, this means Math 20250 and 20300. Much of the material that I will discuss appears in a small book of the same title published by AMS Press. For copyright reasons, I am not able to hand out copies but a near finished draft of the book is still available on the Web and can probably be found with a Google search.

Special talk: Mona Merling

TITLE: Social choice and topology

ABSTRACT: To avoid misleading anyone, this talk will not be about the sociology of topologists! "Social choice" is a model for decision making in economic, social, political contexts. For example: suppose that each person gets to vote on their favorite location where they would like to place a statue on an island. Is there a fair way based on these votes to choose the location? This will turn out to be a topological, even a homotopical problem, depending on the topology of the island. In this talk we will explore social choice models and fully answer the question about when they exist using algebraic topology.

The talk will serve as an advertisement for algebraic topology and basic category theory.

Special talk: Angelica Osorno

TITLE: 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.

Special talk: Hana Kong

TITLE: An introduction to motivic stable homotopy theory

ABSTRACT: I will introduce the motivic stable homotopy category and talk about some computational tools in this category. I will also talk about some applications to classical stable homotopy theory and to C_2-equivariant stable homotopy theory.

Special talk: Agnes Beaudry

TITLE: In this talk, I will give an introduction to the concept of cobordism between manifolds.

ABSTRACT: Manifolds are fundamental objects that appear throughout mathematics. They are topological spaces that, locally, look like Euclidean space $\mathbb{R}^n$. An interesting and difficult question is that of classifying manifolds. A raw classification in arbitrary dimensions is impossible, and for this reason, mathematicians often settle for less precise answers. For example, one can classify manifolds up to an equivalence called "cobordism". The goal of this talk will be to give an introduction to this concept and to give an idea of the kind of classifications that arise from it.

Algebraic Topology: Peter May and others

Excerpt from the original first week Abstract.

Possible topics to be explored in more depth later on:
Topic 1: Finite spaces and larger contexts (book in progress)
Topic 2: An introduction to stable homotopy theory and spectra
Slide talk: `https://www.youtube.com/watch?v=vRsrCNLkSA0`
Topic 3: An introduction to equivariant homotopy and cohomology theory
Slide talk: `https://www.cornell.edu/video/peter-may-equivariant-cohomology`
Topic 4: Operads and their algebras
Old new example: n-connective spaces are homotopically equivalent to "monadically coequalized" n-fold suspensions of E_n-spaces.
Old new example: Connective spectra are homotopically equivalent to "monadically coequalized" suspensions of E_∞-spaces.

Since I have already talked, way too fast, about Topics 1 and 4, I think I will return to 2 and 3, in opposite order. I will introduce the Adams spectral sequence towards the end.