ABSTRACTS FOR WEEKS 5 AND 6

Apprentice Program: Laci Babai

Continuing, week 5 only: We will cover a variety of topics in algebra, geometry and combinatorics. The Apprentice problem session continues on the same schedule (MWF 12:30 - 3:00) as before, but it will be in Ry 365 since the barn is now reserved for the YSP.

Probability and Analysis, continuing: from Greg Lawler:

WEEK 5 in Probability and Analysis: Convergence of measures and invariance principles

We will be doing a combination of analysis and probability in the two lecture series. At this point I am not sure what I will do where. We will build off our work on Fourier series and Fourier transformation to discuss two big "invariance principles" in probability: the central limit theorem and the semicircle law for random matrices. As part of this, we will need to discuss what it means for a sequence of measures to converge and this will lead us to discuss Banach spaces and "dual spaces".

Week 6 I will be gone most if not all of the week. At this point I have Jinwoo Sung (advanced grad student) who will give some lectures plus I am getting back to Rina Foygel Barbour about her giving a lecture. More details later.

WEEK 6 in Probability and Analysis: TBA guest lecturers

Continuing: Algebraic Topology: Peter May

Two topic series, one more elementary than the other.

Title: Finite spaces and larger contexts

Abstract: A finite space is a topological space with finitely many points. Finite spaces are "isomorphic" to finite posets and "equivalent" to finite simplicial complexes. They relate well to categories, simplicial sets, and general topological spaces. They are entering the applied world through data analysis and discrete Morse theory, and they are intrinsically related to many areas of current mathematical interest. We will start slow and go as far as we can. As an easy miracle, we will see a space with six points and infinitely many non-zero homotopy groups.'

Title: Operads and iterated loop spaces

Abstract: This is an area a half century old that is undergoing current reinvestigation on a more abstract and yet quite concrete level. We will explain the interest of higher homotopical structure and show how simply it can be incorporated into elementary structures which hide the homotopies conceptually. Spectra and stable homotopy theory will be introduced. The focus will be on the process of constructing iterated loop spaces and spectra from structured spaces and categories, getting into equivariant and multiplicative contexts as and if time permits.

Algebraic Topology: T, Th Week 6 Mark Behrens

Tuesday TITLE: K-theory

Thursday TITLE: The Adams ss and the stable homotopy groups of spheres

Continuing: Geometry-Topology: T, Th Week 5 Carmen Rovi

First ABSTRACT last week: Historically, there has been a strong connection between geometry, topology, and physics. Topology provides a good framework to formalize certain quantum phenomena mathematically. In these lectures I will focus on the mathematical side of this story and will give an introduction to 2-dimensional Topological Quantum Field Theories (TQFTs). The main ingredients of the lecture will be manifolds, cobordisms and some category theory. I will attempt to make the lecture accessible and students of all levels are welcome.

Second ABSTRACT last week: Topology is sometimes referred to as "rubber-sheet geometry", and like geometry, it is concerned with the study of spaces. Among the most interesting spaces are "manifolds". Manifolds are sets of points locally modeled on Euclidean space. In this talk, we will explore the notion of cutting and pasting of manifolds. It turns out that these cut-and-paste operations determine interesting algebraic structures, which have strong connections to Topological Quantum Field Theories.

Hilbert's third problem: Week 5 MTThF Daniil Rudenko

Title: Hilbert's third problem

ABSTRACT: We will discuss the notion of scissors congruence of polytopes in Euclidean and hyperbolic geometry. Here is an approximate plan.

1. Hilbert's Third Problem. Dehn invariant.
2. Sydler's theorem.
3. Scissors congruence in hyperbolic geometry. Connection to algebraic K-theory.
4. Goncharov's conjectures on scissors congruence of polytopes.