SCHEDULE WEEK 5

All times are CDT

JULY 19 – JULY 23

http://math.uchicago.edu/ may/REU2021/FIFTH.pdf

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Talks take place Monday through Friday afternoons (and/or mornings, at the discretion of speakers and hosts) Talks and group meetings are open to all participants or aimed at focus groups; for focus group events, those interested in joining and are not on the list of people in the relevant group should email the host in advance. All talks are 45 minutes to an hour, with at least a half hour break between talks. Open program talks are live on Zoom; with the speaker's permission, talks will be recorded and made available on Zoom.

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For those in the full program who are focusing on number theory, we have permission for you to attend:

MTWThF 10:00 Park City Undergraduate Summer School talks

(see https://www.ias.edu/pcmi/programs/pcmi-2021-undergraduate-summer-school)

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MTWThF 2:30: The probability subprogram, new talk series

MWF 2:30: Xuan Wu

Title: Card shuffling

Abstract: How many shuffles is enough when playing poker games? In these lectures, I will first talk about how to formulate such questions through Markov chains mathematically. A key concept here is called the cutoff phenomenon. To illustrate the idea, we begin with a simple shuffling model. In the end, a more realistic shuffling method that models the riffle shuffle will be introduced.

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Special number theory talk, on a surprising result about sequences of numbers,

Tuesday 1:00: Daniel Litt

Title: Linear recursions and the Mahler-Skolem-Lech theorem

Abstract: Consider a sequence of integers (a_n) defined by a linear recurrence relation, like the Fibonacci numbers. What does the set of n such that $a_n = 0$ look like? I'll discuss a famous result about the behavior of these sets, discovered independently by Mahler, Skolem, and Lech, and the underlying p-adic analysis that goes into the proof. I'll also discuss several related open questions.

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Thursday 1:00: Shmuel Weinberger (bonus continuation)

Title: Reduction from geometric to algebraic topology

Abstract: First I will explain a key paradigm in geometric topology - reduction to algebraic topology. This will lead to the problem of understanding how complicated homotopies look like. In some cases one can see connections to isoperimetric problems or spectral geometry (none of which will be assumed). My focus will be on maps to very concrete spaces, like spheres.

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Geometry/Analysis/Dynamics seminar

Tuesday 2:30:

Feng Gui (MIT)

Title: Liouville Properties

Abstract: The classical Liouville's theorem states that any positive or bounded harmonic functions on R^n is a constant. In 1970s, S.T. Yau generalized this theorem to the setting of manifolds with non-negative Ricci curvature. A stronger Liouville property concerning harmonic functions with certain growth conditions was proved by Colding and Minicozzi. In this talk, we will revisit the classical theorems and discuss some of the recent progress on this topic.
https://uchicago.zoom.us/j/96027580738?pwd=SnNVM0ZrMmlsTmk4NkdjYkIzMHpPQT09

Thursday 2:30 pm CDT

Zhenkun Li (Stanford)

Title: Knot invariants and knot detection Abstract: Knot theory is a very important branch of low dimensional topology. In this talk, we will introduce different types of popular knot invariants and discuss their effectiveness in the detection of unknot and other simple knots and links.

Different zoom link, to be announced.

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MW 1:00: Ao Sun (continuing)

Title: Heat Equations and Geometric Flows

Abstract: This will be a series of survey talks and all are welcome. The heat equation is a partial differential equation that describes how a quantity such as heat diffuses through a given region. The heat equation is connected to Fourier analysis in harmonic analysis, the study of random walks and Brownian motions in probability, the Atiyah-Singer's index theorem in geometry, and many applications in applied math. Later people found that a class of nonlinear heat equations called geometric flows are very powerful to the study of geometry and topology. One of the famous results is the solution to Poincare's conjecture using Ricci flow, by the theory of Hamilton and Perelman.

I will start with the classical linear heat equation: how to solve it and how to read geometric information of the ambient space. Then I will discuss the geometric flows, including Ricci flow and mean curvature flow. In particular, we will describe some key ideas in Perelman's proof of Poincare's conjecture.

Algebra subprogram talk

Fri 1:00: Wei Yao

Title: Elliptic Curves

Abstract: In this talk I will introduce elliptic curves and present several introductory but fascinating properties that make elliptic curves central objects of study in number theory and algebraic geometry. We will discuss how to view elliptic curves as complex tori, abelian varieties, and Diophantine equations, and some tools to study them from these perspectives. Finally, we will talk about applications and important open/closed conjectures, such as the Birch-Swinnerton-Dyer conjecture and the use of elliptic curves in Wiles's proof of Fermat's Last theorem.

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MTWF 4:00: Peter May

Title: NEW TOPIC: an introduction to equivariant homotopy and cohomology theory

Abstract: I will begin a new sequence of talks, largely based on "Equivariant homotopy and cohomology theory", number [82] on my web page. Much of it will be independent of the previous topics, although there will be correlation. Equivariance is concerns symmatries given by group actions, which are ubiquitous in mathematc. Equivariant algebraic topology starts with spaces (and spectra) with group actions. Large parts of the foundations work the sameway as nonequivariantly. Many of the most interesting parts do not. Again, statements and motivation will have priority over detailed proofs.

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Thursday 4:00 Simion Filip

Title: Riemann's nondifferentiable function

Abstract: I will discuss a function introduced by Riemann (less famous than his zeta function) defined as $f(x) =?sin(n^2x)/n^2$. It is continuous, but not differentiable at most points. After giving some background in Fourier analysis, discrete subgroups of 2×2 matrices, and the hyperbolic plane, I will explain how these notions are related to Riemann's function and shed light on its behavior.