4/28/2020

Zack Garza

Title: Higher Homotopy Groups of Spheres

Abstract: Higher homotopy groups are invariants that generalize the fundamental group, and are notoriously difficult to calculate. In this talk, I'll describe a central problem in algebraic topology: computation of the higher homotopy groups of spheres. This problem is often described as "hopelessly open", and has driven much of the development in the theory since the 1950s. I'll describe why these might be useful to understand, what is currently known, and highlight some computational techniques developed by Serre in his dissertation.

4/21/2020

Nolan Schock

Title: Moduli of hyperplane arrangements

Abstract: I will introduce the moduli space of hyperplane arrangements, which is the first example of a moduli space of higher-dimensional varieties. I will describe the compactification of this moduli space and explain its structure in the first few cases. This talk is intended to be very accessible and no knowledge of algebraic geometry or moduli spaces should be necessary.

4/14/2020

Tyler Genao

Title: Constructible numbers, division points and class field theory

Abstract: We'll take a look at global class field theory from a historical perspective. We'll start with straightedge and compass constructions, and see how they relate to roots of unity on the circle and torsion points on an elliptic curve. Then we'll describe some of the main results of a class field theory on finite extensions of $\mathbb{Q}$.

4/7/2020

Freddy Saia

Title: Sporadic CM Points on Modular Curves

Abstract : The set E(K) of K-rational points of an elliptic curve E over a number field K has the structure of a finitely generated abelian group. Fixing a positive integer d, which groups can arise as the torsion subgroup of E(K) for E an elliptic curve over a number field K of degree d? A reframing of this question leads

to the study of degrees of points on modular curves. In particular, based on joint work with Pete Clark, Tyler Genao, and Paul Pollack, we will discuss the pursuit of points of small degree on certain modular curves.

3/31/2020

David Galban

Title: Lie algebras and cohomology

Abstract: Today we'll go over basic concepts of Lie algebras, define their cohomology, and work out calculations in low degrees.

3/24/2020

Ben Tighe

Title: o-Minimal Structures in Algebraic Geometry

Abstract: We will look at generalizations of algebraic varieties which come from model-theoretic descriptions.

3/3/2020

Peter Woolfitt

Title: Counting Lattice Points on Spheres

Abstract: The question of counting the number of lattice points on a sphere is classical. There are even nice exact formulas in dimensions 2, 4, and 8. In this talk we will discuss how to get estimates in dimensions greater than 4 using the circle method.

2/25/2020

Erik Shreyer

Title: My Experience in Searching a Job Outside Academia

Abstract: This will be an informal talk discussing the various steps and aspects of searching a job, specifically outside of academia. I will share the experiences I had and my thoughts on the steps from deciding whether or not to pursue a job in the industry to the application and interview process as well as resources along the way. There will be xkcd comics throughout the talk.

2/18/2020

Daniel Hartman

Title : Basics of Smooth Manifolds

Abstract : In the realm of smooth manifolds, there are three ideas which are fundamental to one's understanding. They are the inverse function theorem, Sard's theorem, and the transversality theorem. To illustrate their importance, if the three theorems did not exist, neither would Morse theory, and more generally, singularity/catastrophe theory. Further, the three theorems are the foundation from which smooth intersection theory can built from. As they are so fundamental to several advanced topics, I plan to talk about these ideas and explore some of the relationships that exist between them.

2/11/2020

Arvind Suresh

Title- New point and curves of high rank

Abstract- I will present a method of Liu-Lorenzini (and others) which, given a field L, constructs curves X with points P having coordinates that generate L (eg: if L is the field of definition of the curve, these are called rational points). Such a P is called a new point of X over L. I will show how an idea of Matsuno can be used to improve their construction for some classes of field, and as an application, for cyclic degree 16 extensions L/K, construct elliptic curves whose ranks grow over L. It turns out that the above method is a "twist" of a classical method of constructing curves of high rank, used by Mestre and Shioda and others. I will describe a way to improve on this general construction to produce hyperelliptic curves of genus g (2 mod 3) whose Jacobians have rank 4g + 15. The latter process will involve a detour into the fascinating Prouhet-Tarry-Escott problem of finding groups of integers whose kˆth power sums are all equal for some values of k. The talk will be elementary and accessible to anyone who's taken algebra.

2/4/2020

Dino Lorenzini

Title: Public Key Cryptography Abstract: A gentle introduction

1/28/2020

Thomas Melistas

Title: Smale's 10th Problem

Abstract: In 2016 Asaoka and Irie provided the answer to this problem for Hamiltonian diffeomorphisms of surfaces. This is based on ECH and work done by Irie using the asymptotics of ECH capacities. In this talk we'll talk about the historic background/motivation, ECH and Irie's work on density of Reeb orbits. If time permits I will sketch the idea of the proof of their theorem using the density result for Reeb orbits on 3-dim contact manifolds.

1/21/2020

Jack Wagner

Title: A quick introduction to perverse sheaves

Abstract: Perverse sheaves are a tool used in several areas of modern mathematics. In particular they help to understand the geometry of singular spaces. In this talk we will quickly construct the category of perverse sheaves and look at some examples and properties. Along the way we will introduce other tools necessary in modern mathematics such as derived categories and t-structures. The talk will mostly be example driven and my goal is for the first half to be accessible to anyone familiar with basic point set topology definitions, and for the second half to be accessible to people familiar with the basics of (co)chain complexes, their maps, and their (co)homology. It will all be safe for work.

11/26/2020

Arvind Suresh

Title: New points on curves

Abstract: This talk will be concerned with the phenomenon of varieties, specifically curves, acquiring new rational points over extensions of the ground field. I will discuss results of Liu–Lorenzini and Matsuno, which are of the form "if you fix an extension of fields L/K, then we can construct infinitely many distinct (hyperelliptic) curves X/K of a certain genus g with a new point over L," and state a generalization of these results in some directions (for ex: "if L/K is a cyclic degree 16 extension, then there are infinitely many elliptic curves over K whose rank grows over L"). On the other hand, I will discuss a construction of Shioda of hyperelliptic curves with high rank Jacobians, and discuss how this construction is related to the construction of Liu–Lorenzini (it is essentially identical). Finally, I'll discuss some other generalizations and open questions that have come up over the course of this project. The talk will be colloquium style and not assume anything beyond graduate algebra (at least for the first 40 mins.)

11/5/2019

Terrin Warren

Title: Slice Knots and Related Topics

Abstract: A knot is said to be slice if it bounds a nicely embedded disk in the 4-ball. I will give an introduction to slice knots, their motivation, and related topics. Additionally, I will give a sketch of the proof that the Conway knot is not slice. You're knot going to want to miss this!

10/29/2019

Zack Garza

Title: A Primer on Spectral Sequences

Abstract: Spectral sequences are algebraic gadgets that generalize the notion of a long exact sequence in homological algebra. When working with objects that admit filtrations, they provide a way of "approximating" homology at each step and taking a suitable limit to recover information about the total homology. They are most often employed to compute ring/algebra structures in cohomology, or compare cohomology theories, so this talk will focus on how to work with known/existing spectral sequences and will include examples from Algebra, Topology, and Algebraic Geometry as time permits.

10/22/2019

David Galban

Title: Results independent from ZFC

Abstract: Since Paul Cohen's 1963 proof of the independence of the continuum hypothesis in 1963, there has been a flurry of results showing the independence of a variety of statements from the standard axioms of ZFC. While most of these are purely set-theoretic, there are more than a few that show up in everyday mathematics. In today's talk, we will discuss several interesting examples of the latter.

10/15/2019

Erik Shreyer

Title: Constant curvature approximation in $\mathbb{R}^n$

Abstract: In 2007 Mohammad Ghomi proved that it is possible to approximate any C^2 curve in $\mathbb{R}^n$ by curves of constant curvature. In particular, closed curves can be approximated by closed curves of constant curvature proving for example,

that there exists constant curvature knots of any knot type. We will analyze Ghomi's result and the general idea of the proof and time permitting discuss a 2-dimensional analog using entirely different methods.

10/8/2019

Swapnanil Banerjee

Title: Morse 2-functions and its application

Abstract: I will start with an intuitive discussion about generic functions from n-dimensional manifolds to one-dimensional manifolds, followed by a discussion of generic functions from n-dimensional manifolds to 2-dimensional manifolds. I'll mainly give descriptions of those functions using local coordinates & low-dimensional pictures and I'll try to avoid technical details in this talk. Then if time permits I may outline the proof of the existence of trisections of 4-manifolds using generic functions to plane following David Gay and Rob Kirby's paper. I may also discuss the geometric description of 4-manifolds arising from generic functions to surfaces, which is known as Broken Lefschetz Fibrations.

10/1/2019

Melissa Zhang

Title: TQFTs and Bar Natan's cobordism category

Abstract: A "topological quantum field theory" (TQFT) is a functor that translates topological objects into algebraic ones. In this talk, I'll first give an overview of the axioms for TQFTs and give a few classical examples. Then, I'll focus on a particular example – Bar Natan's cobordism category for Khovanov homologies – to illustrate how TQFTs allow us to take advantage of both our topological intuition and our algebraic machinery.

9/17/2019

Daniel Litt

Title: Fundamental groups in arithmetic and geometry

Abstract: Which complex manifolds, and which maps between them, can be defined with polynomial equations? It turns out this (a priori complex-analytic) question is closely related to questions in number theory – and approaches to it require deep input from across mathematics, including arithmetic dynamics, the Langlands program, and algebraic topology. I'll give an intro to this topic, and to my own work on the arithmetic of fundamental groups. The talk will assume very little.

9/10/2019

Sasha Shmakov

Title: ?

Abstract: The special values $\zeta(n)$ of the Riemann zeta function are important objects of study in number theory. What if we multiply these zeta values to form an algebra? In general, a polynomial in zeta values is a linear combination of so called multiple zeta values, and these multiple zeta values form an algebra with two combinatorially rich multiplicative structures: the shuffle product of infinite sums, and the shuffle product of iterated integrals. The algebra of multiple zeta values carries two filtrations, the weight and length filtrations, and the Zagier and Broadhurst-Kreimer conjectures describing the dimensions of these weight and length spaces provides a far-reaching generalization of the transcendence conjectures for the odd zeta values $\zeta(2n+1)$. In this talk I will give a survey of definitions, theorems, and conjectures about multiple zeta values, and explain why these are of interest to number theorists, arithmetic geometers, and mathematical physicists.

9/3/2019

Makoto Suwama

Title: Balanced Centrifuge Problem

Abstract: A centrifuge is a device used to separate fluids by spinning a collection of test tubes at high speed. Since it spins very fast, it is important that the center of the mass of the test tube is at the center of the machine to avoid extra stress on the machine. In this talk, we will discuss if it is possible to balance k identical test tubes in an n-holed centrifuge, and related math problems.

8/27/2019

Richard Vradenburgh

Title : An elementary approach to computing special zeta values

Abstract : In 1650, Pietro Mengoli posed the famous Basel Problem, the task of which was to compute precisely the sum of the square-reciprocal of the natural numbers. Today, this amounts to evaluation the Riemann zeta function at s=2. The problem was solved by Euler, but his original methods were not fully justified. In years since, many solutions, "elementary" in the sense that they do not require the use of analytic function theory, have been found. I will present one such solution, most likely due to Johan Wästlund, which inspired a beautiful video on the popular YouTube channel 3Blue1Brown. An elementary argument of Estermann (1927) then gives a recursive identity for the value of the zeta function at all positive even integers.