<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>Monday, Sept 13, 2021</td>
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<tr>
<td>3:00pm-4:00pm</td>
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<td>Integrable Systems and Random Matrix Theory -- Mateusz Piorkowski (MSRI) Long-time asymptotics of KdV dispersive shock wave via Riemann-Hilbert problems -- ZOOM ID: 922 9373 3366  Passcode: 651935 Virtual</td>
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<td>4:00pm-5:00pm</td>
<td>Student Combinatorics -- Katie Waddle (UM) Schubert Calculus Part I: Grassmanians and Schubert Classes</td>
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<td>Student Analysis -- Elizabeth Collins-Woodfin (University of Michigan) Tridiagonal random matrices (Part 1)</td>
<td>3866 East Hall</td>
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<td>Colloquium Series -- reserved ()</td>
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<td>MCAIM Colloquium -- Gérard Ben Arous (Courant Institute) Topological Complexity and Optimization of High Dimensional Random Functions</td>
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RTG Seminar on Number Theory
Monday, September 13, 2021, 3:00pm-4:00pm
4088 East Hall
Charlotte Chan (University of Michigan)
Flag varieties and representations of p-adic groups

Algebraic geometry has had a huge influence on representation theory for (nearly) the last century. I'll talk about some historical instances of this relationship and recent progress in translating our algebraic understanding of representations of p-adic groups to geometric contexts. I'll talk about how this fits into the picture of the Langlands program.

Integrable Systems and Random Matrix Theory
Monday, September 13, 2021, 3:30pm-4:30pm
ZOOM ID: 922 9373 3366   Passcode: 651935 Virtual
Mateusz Piorkowski (MSRI)
Long-time asymptotics of KdV dispersive shock wave via Riemann-Hilbert problems

In this talk we will summarize a recent paper on the KdV equation with steplike initial data. The focus lies on the Deift-Zhou nonlinear steepest descent analysis in the transition region, where solutions converge to a modulated elliptic (Its-Matveev) solution. We state the corresponding Riemann-Hilbert problem, as well as the global parametrix (model) problem. Surprisingly, the global parametrix problem has in general no matrix valued solution. We thus have to rely on a vector-valued model solution and compare it directly to the exact solution. For this we rely on the work of Zhou on Fredholm index theory for singular integral operators.

Student Combinatorics
Monday, September 13, 2021, 4:00pm-5:00pm
3866 East Hall
Katie Waddle (UM)
Schubert Calculus Part I: Grassmanians and Schubert Classes

This talk will be the first in a two part series giving a broad overview of Schubert Calculus, an area of study that uses the combinatorics of symmetric polynomials to get results about enumerative algebraic geometry questions with finite answers. In this part we will discuss the translation of such questions into the study of Grassmanians, in particular their decomposition into Schubert varieties.
One of the most famous results in random matrix theory is the eigenvalue distribution of the Gaussian Unitary Ensemble (GUE). In this talk, I will briefly introduce GUE matrices and then present a tridiagonal matrix ensemble that shares the same eigenvalue distribution as GUE. These tridiagonal matrices are very handy because they provide a more computationally efficient way to model the eigenvalues of GUE. This expository talk aims to be accessible to graduate students without prior knowledge of random matrix theory. There will be a related talk next week by Han Le, who will present a more detailed application of tridiagonal random matrices.

Student Commutative Algebra
Tuesday, September 14, 2021, 3:00pm-4:00pm
2866 East Hall
Swaraj Pande (UM)
Tight Closure and Briançon-Skoda Theorem

The Briançon-Skoda theorem relates the powers on an ideal with their integral closures. In this talk, we'll discuss this theorem in the simplest, yet interesting case of a polynomial ring over a field. For example, it implies the following non-trivial fact about polynomials in two variables: for any three polynomials f, g and h in two variables, the product f^2*g^2*h^2 is in the ideal generated by f^3, g^3 and h^3. We'll see a proof of this theorem in positive characteristics using the operation of tight closure. Time permitting, we'll discuss how to use this to deduce the theorem in characteristic zero. We'll introduce the relevant definitions including that of integral closure, tight closure, regular rings etc. This talk will be accessible to anyone taking Math 614.
Learning Seminar in Algebraic Combinatorics
Wednesday, September 15, 2021, 2:30pm-4:00pm
4088 East Hall
Melissa Sherman-Bennett (UM)

Introduction

I'll give a taste of the topics we'll discuss during the rest of the semester, focusing on the example of the torus knot \( T(n,n+1) \). The combinatorics that appears includes the q-Catalan numbers, point counts of the open positroid variety in \( \text{Gr}(n,2n+1) \), and the diagonal coinvariant ring.

MCAIM Colloquium
Wednesday, September 15, 2021, 4:00pm-5:00pm
Virtual

Gérard Ben Arous (Courant Institute)

Topological Complexity and Optimization of High Dimensional Random Functions

Smooth random functions of very many variables can be topologically very complex, and thus it can be terribly hard to find their minimum. One does not need to look very far for such an example: pick at random a homogeneous polynomial of degree \( p \) (with \( p \) larger than 3) of a large number of variables and restrict it to the (high-dimensional) unit sphere. Important examples of such functions include many Hamiltonians of statistical mechanics in disordered media (as Spin Glasses or Random Interfaces in high disorder). They can also include the loss functions of high dimensional inference problems, and naturally the landscapes defined by Machine Learning.

We will cover some of the recent progress in our understanding of both questions: the statics or geometric question about the topological complexity and the transition to simple landscapes (the so-called topological trivialization), as well as the dynamics and optimization questions.

https://umich.zoom.us/j/95889337803
Meeting ID: 95889337803
Meeting Password: 811977
Algebraic Geometry  
**Wednesday, September 15, 2021, 4:00pm-5:20pm**  
4096 East Hall  
**Lena Ji (University of Michigan)**  
*The Noether-Lefschetz theorem in arbitrary characteristic*

The classical Noether-Lefschetz theorem says that for a very general surface S of degree 4 in P^3 over the complex numbers, the restriction map from the divisor class group on P^3 to S is an isomorphism. In this talk, we will show a Noether-Lefschetz result for varieties over fields of arbitrary characteristic. The proof uses the relative Jacobian of a curve fibration, and it also works for singular varieties (for Weil divisors). We will not use any Hodge theory, cohomology, or monodromy.

RTG Seminar on Geometry, Dynamics and Topology  
**Wednesday, September 15, 2021, 4:00pm-5:30am**  
3866 East Hall  
**Sayantan Khan (U M)**  
*Introduction to Patterson-Sullivan theory (for hyperbolic surfaces) (part 2)*

Continuing from the previous talk, we recall the definition of shadows, and prove the Sullivan shadow lemma. We then get asymptotics (up to multiplicative constants) for the counting function for convex cocompact groups. Finally, we will define the Bowen-Margulis measure for the geodesic flow and talk about its mixing properties.

Arithmetic Geometry Learning  
**Thursday, September 16, 2021, 4:00pm-5:30pm**  
4096 East Hall  
**Sridhar Venkatesh (University of Michigan)**  
*Review of GIT. Construction and properties of the character variety*

Student Dynamics/Geometry Topology  
**Thursday, September 16, 2021, 5:30pm-6:30pm**  
3866 East Hall  
**Som Phene (University of Michigan)**  
*Black Hole Information and the Quantum Extremal Surface*

We explore how an understanding of Black Hole Information through the perspective of Ryu-Takayanagi prescription gives rise to a natural interpretation of quantum extremal surface. A comparison of quantum information-theoretic tools in the context of quantum entanglement entropy, with the classical setting (Shannon entropy), will be drawn.
Representation Stability
Friday, September 17, 2021, 1:00pm-2:00pm
Online
Nicholas Proudfoot (University of Oregon)
Equivariant log concavity and representation stability

June Huh proved in 2012 that the Betti numbers of the complement of a complex hyperplane arrangement form a log concave sequence. But what if the arrangement has symmetries, and we regard the cohomology as a representation of the symmetry group? The motivating example is the braid arrangement, where the complement is the configuration space of n points in the plane, and the symmetric group acts by permuting the points. I will present an equivariant log concavity conjecture, and show that one can use representation stability to prove infinitely many cases of this conjecture for configuration spaces.

This talk is based on joint work with Jacob Matherne, Dane Miyata, and Eric Ramos.

Applied Interdisciplinary Mathematics (AIM)
Friday, September 17, 2021, 3:00pm-4:00pm
ZOOM East Hall
Davoud Ataee Tarzanagh (University of Michigan)
Fair Structure Learning in Heterogeneous Graphical Models

Inference of community structure in probabilistic graphical models is not guaranteed to be fair when nodes have demographic attributes. Certain demographics may be over-represented in some detected communities and under-represented in others. This paper defines a novel $\ell_1$-regularized pseudo-likelihood approach for fair graphical model selection. In particular, we assume there is some community or clustering structure in the true underlying graph, and we seek to learn a sparse undirected graph and its communities from the data such that demographic groups are fairly represented within the communities. Our optimization approach uses the demographic parity definition of fairness, but the framework is easily extended to other definitions of fairness. We establish statistical consistency of the proposed method for both a Gaussian graphical model and an Ising model for, respectively, continuous and binary data, proving that our method can recover the graphs and their fair communities with high probability.

Learning Seminar in Representation Stability
Friday, September 17, 2021, 3:00pm-3:50pm
1866 East Hall
Nate Harman (UM)
A survey of representation stability in characteristic p
Combinatorics  
Friday, September 17, 2021, 3:00pm-4:00pm  
4088 East Hall  
Melissa Sherman-Bennet (University of Michigan)  
*The m=2 amplituhedron and the hypersimplex*

I'll discuss a surprising parallel between certain decompositions of the amplituhedron, a non-polytopal subset of a Grassmannian, and the hypersimplex, a polytope in $\mathbb{R}^n$. The amplituhedron was introduced by physicists Arkani-Hamed and Trnka to better understand scattering amplitudes in $\mathcal{N}=4$ super Yang-Mills theory. In particular, each "fine positroidal" decomposition of the amplituhedron conjecturally gives you a way to compute a scattering amplitude. The hypersimplex is a classical object in algebraic combinatorics; its decompositions correspond to tropical linear spaces (Speyer) and are parametrized by the Dressian. Despite the dissimilarities of the hypersimplex and the $m=2$ amplituhedron, Lukowski--Parisi--Williams conjectured a straightforward bijection between their fine positroidal decompositions. I'll discuss joint work with Matteo Parisi and Lauren Williams, in which we prove this bijection. Along the way, we prove an intrinsic description of the $m=2$ amplituhedron, originally conjectured by Arkani-Hamed--Thomas--Trnka; give a decomposition of the $m=2$ amplituhedron into chambers enumerated by the Eulerian numbers, in direct analogy with a triangulation of the hypersimplex; and find new cluster varieties in the Grassmannian.

Student Algebraic Geometry  
Friday, September 17, 2021, 3:00pm-4:00pm  
2866 East Hall  
Sridhar Venkatesh (UM)  
*Quotients in AG*

Geometric Invariant Theory (GIT) deals with the construction of quotients of group actions in algebraic geometry. In this talk, I will try to motivate why GIT is a satisfactory theory for taking quotients, and if time permits, I will demonstrate how certain moduli spaces are constructed as GIT quotients. Most of the talk should be accessible to anyone currently taking Math 631. Also, there will be plenty of examples!

Student AIM Seminar  
Friday, September 17, 2021, 4:00pm-5:00pm  
2866 East Hall  
Jessica Conrad (University of Michigan)  
*Lessons from Previous Epidemics: Understanding Space and Time*

Susceptible-Infected-Removed (SIR) modeling has been used extensively over the last century as a basic framework for predicting disease spread through populations. Techniques have been developed to calculate the average invasion speed (called the reproduction number), epidemic peak size, equilibria, and the impact of mitigation tactics. Here we will review some of this work, and present current extensions to this model using spatial spread and mitigations.