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<td><strong>Student Commutative Algebra</strong> -- Anna Brosowsky (University of Michigan, Ann Arbor) <em>An Introduction to Determinantal Rings</em> -- 3088 East Hall</td>
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<td><strong>Learning Seminar in Algebraic Combinatorics</strong> -- Zenan Fu (University of Michigan) <em>Cluster Varieties</em> -- 4096 East Hall</td>
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<td><strong>Combinatorics</strong> -- David Anderson (Ohio State University) Bumpless pipe dreams and coefficients of Schubert polynomials</td>
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<td>3:00pm-4:00pm</td>
<td><strong>Applied Interdisciplinary Mathematics (AIM)</strong> -- Rishi Sonthalia (UCLA) Metric representation learning</td>
<td>1084 East Hall</td>
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<td><strong>Student Algebraic Geometry</strong> -- Quang Dao (UM) Coding Theory from the lens of Algebraic Geometry</td>
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<td><strong>Preprint Algebraic Geometry</strong> -- Sridhar Venkatesh (UM) Fujita’s conjecture, part I</td>
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Abstracts for the week of February 13th, 2022 - February 19th, 2022

Complex Analysis, Dynamics and Geometry
Monday, February 14, 2022, 11:00am-12:00pm
https://umich.zoom.us/j/97288641488 Virtual
Baptiste Louf (Uppsala University)

Combinatorial maps and hyperbolic surfaces in large genus (SPECIAL TIME 11AM)

(joint work with Svante Janson)

Combinatorial maps are discrete surfaces built by gluing polygons along their sides. They have many deep connections to combinatorics, computer science, algebra or statistical physics, but in this talk we are going to consider them from a probabilistic viewpoint, by studying the geometry of large random maps in the regime where both the size and the genus go to infinity.

In this work, we consider a particular model of maps (unicellular maps), and we study the law of simple closed curves on our maps. Surprisingly, we obtain the exact same limit law as Mirzakhani and Petri who studied the same problem on random hyperbolic surfaces in large genus under the Weil-Petersson measure. This leads us to conjecture that these two models are somehow "the same" in the limit.

https://umich.zoom.us/j/97288641488

RTG Seminar on Number Theory
Monday, February 14, 2022, 3:00pm-4:00pm
4088 East Hall
Aleksander Horawa (University of Michigan)

Motivic action conjectures

A surprising property of the cohomology of locally symmetric spaces is that Hecke operators can act on multiple cohomological degrees with the same eigenvalues. A recent series of conjectures proposes an arithmetic explanation: a hidden degree-shifting action of a certain motivic cohomology group. We will give an overview of the conjectures of Venkatesh, Prasanna, and Harris, and discuss our own conjecture for Hilbert modular forms of parallel weight one.
Integrable Systems and Random Matrix Theory  
**Monday, February 14, 2022, 4:00pm-5:00pm**  
**ZOOM ID: 926 6491 9790 Virtual**  
**Benjamin Fahs (KTH)**  
*Hankel determinants with a multi-cut regular potential*  

We discuss recent results on the asymptotics of Hankel determinants with a multi-cut regular potential V. We will begin by considering an examples which is particularly simple (in particular V is given in terms of the Chebyshev polynomials), before continuing on to the general situation where the asymptotics are described in terms of Riemann's theta functions.

The motivation behind studying such determinants is to provide information about the asymptotic distribution of the eigenvalues of Hermitian random matrices with the potential V, and we will discuss the linear statistics of the eigenvalues under both smooth functions and jump functions.

The talk is based on joint work with Christophe Charlier, Christian Webb, and Mo Dick Wong.

**Donaldson-Thomas Theory**  
**Monday, February 14, 2022, 4:00pm-5:30pm**  
**4096 East Hall**  
**Nawaz Sultani ()**  
*Virtual fundamental classes on moduli spaces of complexes*

**RTG Representation Theory**  
**Monday, February 14, 2022, 4:00pm-5:15pm**  
**4088 East Hall**  
**Nate Harman (UM)**  
*Mod p representations of SL2Fp*

**Student Combinatorics**  
**Monday, February 14, 2022, 4:00pm-5:00pm**  
**3866 East Hall**  
**Katie Waddle (UM)**  
*Quivers and Plabic Graphs*

Cluster algebras have an associated combinatorial object called a quiver. We will experiment with quiver mutations, and think about some interesting questions that come up. Then we will introduce plabic graphs, which are a related tool, and get our hands dirty with moves on plabic graphs. Come ready to draw some arrows!
Student Dynamics/Geometry Topology  
Monday, February 14, 2022, 5:00pm-6:00pm  
3866 East Hall

Lightning Talks! (Part 2)

All younger graduate students in dynamics, geometry, and topology are invited to give ~5-10 minute "lightning talks" about one or more mathematical topics/questions/ideas they are interested in.

Student Commutative Algebra  
Tuesday, February 15, 2022, 3:00pm-4:00pm  
3088 East Hall

Anna Brosowsky (University of Michigan, Ann Arbor)

An Introduction to Determinantal Rings

The determinantal ring $R_t$ comes from considering a polynomial ring over a matrix of indeterminates and quotienting by the ideal generated by the minors of order $t$. Such ideals have a combinatorial structure which often leads them to also have nice algebraic structure. In this introductory talk, we will give an overview of some of these interesting properties.

This talk will be simultaneously livestreamed via Zoom.
Colloquium Series
Tuesday, February 15, 2022, 4:00pm-5:00pm
1360 East Hall
Isabel Vogt (Brown University)
*Brill--Noether theory over the Hurwitz space*

While in the 19th century an algebraic curve was synonymous with a one-dimensional subset of projective space specified by polynomial equations, the modern study of curves makes use of the definition of an abstract curve independent of a projective embedding. Brill--Noether theory is the bridge between these two perspectives. The fundamental question: given an abstract curve $C$, what is the geometry of the space of maps of $C$ to projective space with certain invariants?

As a crowning achievement of the modern study of linear series in the 1980s, this geometry is well-understood when the curve $C$ is sufficiently generic. However, in nature, curves are often encountered via a realization specified by polynomial equations of relatively small degree, which might force the curve to be too special for the classic Brill--Noether theorem to apply. In this talk, I will discuss joint work with Eric Larson and Hannah Larson which provides the first complete analogue of all of the main theorems of Brill--Noether theory when the curve is equipped with a low degree map to the line.

Variational Analysis and Optimization
Wednesday, February 16, 2022, 11:00am-12:00pm
Virtual
Tyrrell Rockafellar (University of Washington, Seattle)
*Virtual Convexity and its Role in Second-Order Conditions for Local Optimality*

Virtual convexity is a property that a function can have in localizing not only in a primal sense around a particular point but also in a dual sense relative to a subgradient at that point. In finite-dimensions it is tantamount to the subgradient mapping of the function being monotone locally around that primal-dual pair, which is indeed possible without local convexity.

This concept turns out to have fundamental implications in the understanding of sufficient conditions for local optimality that engender stability in support of numerical methodology. It is especially important for insights into augmented Lagrangians and their potential for producing a form of local duality that mimics the global duality enjoyed in convex optimization.

Time: 11:00 AM EST
Join Zoom Meeting
https://umich.zoom.us/j/95524251106?pwd=TUN5SnIvQzB5bGRtejZRU2NhVXpJUT09

Meeting ID: 955 2425 1106
Passcode: 491904

Here is the recording for anyone who missed it!
https://umich.zoom.us/rec/share/GLjhFpfQTXXKXBExeYGKNJCJ1AzcPHfWjXyNKssv9wmIWCmhoUp_3qwVQpnf90_2.LXdxW6_ZxYoVi_SC
Learning Seminar in Algebraic Combinatorics  
Wednesday, February 16, 2022, 2:30pm-4:00pm  
4096 East Hall  
Zenan Fu (University of Michigan)  
Cluster Varieties

Cluster algebras were introduced by Fomin and Zelevinsky in 2000. Since then, cluster algebras have been discovered in many contexts throughout mathematics. In this talk, we will focus on a subclass "locally acyclic cluster algebras" introduced by Muller. A "locally acyclic cluster algebra" is a cluster algebra which admits a finite cover by acyclic cluster algebras. Many nice properties of acyclic cluster algebras (such as finite generation, equaling their upper cluster algebra, smoothness) extend to locally acyclic cluster algebras. This subclass is pretty large in the sense that it includes the Grassmannian (more generally, all positroid varieties).

Financial/Actuarial Mathematics  
Wednesday, February 16, 2022, 4:00pm-5:00pm  
Zoom Virtual  
Christoph Belak (TU Berlin)  
Convergence of Deep Solvers for Semilinear PDEs

We derive convergence rates for a deep learning algorithm for semilinear partial differential equations which is based on a Feynman-Kac representation in terms of an uncoupled forward-backward stochastic differential equation and a discretization in time of the stochastic equation. We show that the error of the deep learning algorithm is bounded in terms of its loss functional, hence yielding a direct measure to judge the quality of the deep solver in numerical applications, and that the loss functional converges sufficiently fast to zero to guarantee that the error of the deep learning algorithm vanishes in the limit. As a consequence of these results, we argue that the deep solver has a strong convergence rate of order 1/2. The talk is based on joint work with Oliver Hager, Lotte Schnell, Charlotte Reimers (TU Berlin) and Maximilian Würschmidt (Trier University).
Algebraic Geometry  
Wednesday, February 16, 2022, 4:00pm-5:00pm  
Zoom  
Georg Oberdieck (University of Bonn)  
*Enumerative geometry of holomorphic-symplectic 4-folds*

I will discuss joint work with Yalong Cao and Yukinobu Toda where we use reduced Gromov-Witten theory to define new invariants of holomorphic-symplectic 4-folds. The invariants are (a) conjecturally integers, and (b) in an ideal geometry should be enumerative for the counts of curves in primitive curve classes. This leads to explicit predictions for the number of genus 2 curves of minimal degree on very general polarized HK 4-folds of K3[2]-type. For example there should be precisely 3465 genus 2 curves of degree 11 on a very general Debarre-Voisin 4-fold. For the case K3xK3 it motivates a closed evaluation of Fujiki constants of Chern classes of the tangent bundle of Hilb(K3) in terms of quasi-modular forms.

Student Analysis  
Wednesday, February 16, 2022, 5:15pm-6:15pm  
3096 East Hall  
Christopher Stith (University of Michigan)  
*Field equations on flat spacetime*

Field equations on manifolds are of interest in many areas of mathematics and physics. Equations for the curvature, a tensor field, are central to general relativity. Maxwell's equations govern the behavior of a different type of tensor field. The wave equation concerns a scalar field. We will discuss these three field equations, focusing on the case when the underlying manifold is flat (Minkowski) spacetime. We will discuss motivation in the larger context of the Bianchi equations on a more general spacetime and the stability problem of Minkowski spacetime.

Zoom Meeting ID: 961 6652 1871
Commutative Algebra  
Thursday, February 17, 2022, 4:00pm-5:00pm  
https://umich.zoom.us/j/96274532499 (password: algebra) Virtual East Hall  
Kyle Maddox (University of Kansas)  
*Homological properties of pinched Veronese rings*  

Pinched Veronese rings are an example of affine semigroup rings that are formed by removing a generator of a Veronese subring of a polynomial ring. One of the first examples of a non Cohen-Macaulay ring comes from this family, and so natural questions abound about the local cohomology modules of such rings. In joint work with Vaibhav Pandey, we study homological properties of these rings, including the Cohen-Macaulay, Gorenstein, and complete intersection properties. If the underlying field is of prime characteristic, we also find that nearly all pinched Veronese rings are F-nilpotent, a new singularity type of recent interest.  
https://arxiv.org/abs/2111.05810

Arithmetic Geometry Learning  
Thursday, February 17, 2022, 4:00pm-5:30pm  
4096 East Hall  
Andy Jiang ()  
*Consequences of* the Gersten conjecture for etale cohomology*  

Logic  
Thursday, February 17, 2022, 4:00pm-5:30pm  
2866 East Hall  
Iian Smythe (UM)  
*Equivalence of generic reals*  

Given a countable transitive model of set theory and a partial order contained in it, there is a natural countable Borel equivalence relation on generic filters over the model; two are equivalent if they yield the same generic extension. We examine the complexity of this equivalence relation for various partial orders, focusing on Cohen and random forcing.
In their work on back-stable Schubert calculus, Lam, Lee, and Shimozono gave combinatorial formulas which realize the back-stable Schubert polynomials as weighted enumerators of "bumpless pipe dreams". I will describe variants of these polynomials, called "enriched Schubert polynomials", which collect the symmetric part into Schur functions. In this (re-)formulation, one can ask for the coefficient of a given Schur function in such an enriched Schubert polynomial. Answering this question leads to new bumpless pipe dream formulas, along with other combinatorial identities.

This is joint work with William Fulton.
Applied Interdisciplinary Mathematics (AIM)
Friday, February 18, 2022, 3:00pm-4:00pm
1084 East Hall
Rishi Sonthalia (UCLA)

Metric representation learning

All data has some inherent mathematical structure. One of the many challenges in representation learning is determining ways to judge the quality of the representation learned. In many cases, the consensus is that if $d$ is the natural metric on the representation (such as $L_2$ distance for Euclidean embeddings), then this metric should provide meaningful information about the data. Many examples of this can be seen in areas such as metric learning, manifold learning, and graph embedding. However, most algorithms that solve these problems learn a representation in a metric space first and then extract a metric.

A large part of my research is exploring what happens if the order is switched, that is, learn the appropriate metric first and the embedding later. The philosophy behind this approach is that understanding the inherent geometry of the data is the most crucial part of representation learning. Often, studying the properties of the appropriate metric on the input data sets indicates the type of space, we should be seeking for the representation. Hence giving us more robust representations. Optimizing for the appropriate metric can also help overcome issues such as missing and noisy data.

For learning optimal metric, we are given a dissimilarity matrix $\hat{D}$, some function $f$ and some a subset $S$ of the space of all metrics and we want to find $D \in S$ that minimizes $f(D, \hat{D})$. In this talk, we consider the version of the problem when $S$ is the space of metrics defined on a fixed graph. That is, given a graph $G$, we let $S$ be the space of all metrics defined via $G$. For this $S$, we consider the sparse objective function as well as convex objective functions. We also looked at the problem where we want to learn a tree. We also show how the ideas behind learning the optimal metric can be applied to dimensionality reduction in the presence of missing data.

Student Algebraic Geometry
Friday, February 18, 2022, 3:00pm-4:00pm
2866 East Hall
Quang Dao (UM)

Coding Theory from the lens of Algebraic Geometry

Coding theory is the study of error-correction for communication over a noisy channel, with many applications ranging from satellite communication to QR codes. In this talk, I will explain error-correcting codes from a geometric perspective, and introduce Algebraic-Geometric (AG) codes, a family of codes enjoying structured algebraic properties and asymptotically optimal parameters. No prerequisite on coding theory is needed.
Learning Seminar in Representation Stability  
Friday, February 18, 2022, 4:00pm-4:50pm  
1866 East Hall  
Sophie Kriz (UM)  
On the structure of simple generic FI-modules in positive characteristic

In this talk, I will talk about FI-modules, meaning functors from the category of finite sets and injections into the category of vector spaces over a given field. I will explain my recent work describing a bijective correspondence between simple representations of finite symmetric groups and simple objects in the category of FI-modules in positive characteristic. In particular, I will show examples of simple generic FI-modules none of whose terms are simple symmetric group representations.

Geometry  
Friday, February 18, 2022, 4:00pm-5:00pm  
3866 East Hall  
Thang Nguyen (U Michigan)  
How easy/hard is it to perturb a nice action?

Given a group acting “nicely” on a compact manifold, are we able to slightly perturb the action to obtain a new one? In joint works with C. Connell, M. Islam, and R. Spatzier, we give some answers to this question. We consider groups that are lattices or fundamental groups of non-positively curved manifolds, and compact manifolds that are geometric boundaries or Furstenberg boundaries.

Preprint Algebraic Geometry  
Friday, February 18, 2022, 4:00pm-5:30pm  
4096 East Hall  
Sridhar Venkatesh (UM)  
Fujita’s conjecture, part I