Graduate Algebra Symposium

Fall 2021

University of North Texas (virtual)

- Meet & Greet begins at 9:00 am
- Talks begin at 9:30 am
- Zoom link: *click here* **Passcode**: GAS2021
  (or use **Meeting ID**: 691 514 9232)

Schedule of talks

	Saturday, November 13
9:00	Meet & Greet
9:30	**Parabolic Category $\mathcal{O}$** Khoa Nguyen (UTA)
10:00	**When are quotients of affine semigroup rings by monomial ideals Cohen-Macaulay?** BYeongsu YU (TAMU)
10:30	**A quick look to the valuative tree** Chih-Kuang Lee (OU)
11:00	Short break
11:15	**Decompositions of modules over subalgebras of truncated polynomial rings** Kevin Harris (UTA)
11:45	**A Family Tree of Categories** Hannah Solomon (TAMU)
12:15	Lunch break
13:30	**A Brief Introduction to Jets and Arcs** Steven Lin (OU)
14:00	**Using Macaulay2 to Count Real Roots of Polynomials** Jordy Lopez Garcia (TAMU)
14:30	Short break
14:45	**Counting Link Components Algebraically** Clayton Allred (OU)
15:15	**Duality: An In-Schur-ance Policy for the Working Mathematician** Joey Randich (OU)
15:45	Happy hour

Abstracts

Khoa Nguyen

University of Texas at Arlington

Parabolic Category $\mathcal{O}$

Highest weight modules were first studied by Verma in his thesis in 1966. Among all categories of highest weight modules, the most important is the category $\mathcal{O}$ defined as the full subcategory of $\mathcal{U}(\mathfrak{g})$–module, where the objects are finitely generated weight modules on which the action of $\mathcal{U}(\mathfrak{n}_+)$ is locally finite. The category $\mathcal{O}$ was introduced in the celebrated paper by J. Bernstein, I. Gelfand, and S. Gelfand that initiated the categorical and homological approach of the categories of highest weight modules. Rocha-Caridi defined and studied the parabolic category $\mathcal{O}^{\mathfrak{p}}$ in his thesis in1980. In this talk, I will introduce the category $\mathcal{O}$, the parabolic category $\mathcal{O}^{\mathfrak{p}}$, and their properties.

BYeongsu Yu

Texas A&M University

When are quotients of affine semigroup rings by monomial ideals Cohen-Macaulay?

We give a new combinatorial criterion for quotients of affine semigroup rings by monomial ideals to be Cohen-Macaulay, by computing the homology of finitely many polyhedral complexes. This provides a common generalization of well-known criteria for affine semigroup rings and monomial ideals in polynomial rings. This is joint work with Laura Matusevich.

Chih-Kuang Lee

University of Oklahoma

A quick look to the valuative tree

Let R be the ring of formal power series in two variables, and let m be the maximal ideal. Considering the set of centered (semi)valuation normalized with respect to m, we can see that it is a tree. In this brief talk, I will illustrate how it looks like.

Kevin Harris

University of Texas at Arlington

Decompositions of modules over subalgebras of truncated polynomial rings

We investigate how modules decompose over principal subalgebras of certain truncated polynomial rings. In particular, we will investigate how a module decomposition may (or may not) change when we decompose over different principal subalgebras. Varying decompositions are related to the notion of rank varieties. Finally, we will examine how one might extend the notion of rank varieties to more general truncated polynomial rings.

Hannah Solomon

Texas A&M University

A Family Tree of Categories

Categories are a useful tool in the sciences, from allowing us to bridge different areas of mathematics to translating problems in physics, such as those related to topological phases of matter, to mathematical ones. In category theory, we seek to study mathematical structure in an abstract way. In this talk, our goal will be to explore what a super modular tensor category is, why we study them, and some avenues for understanding them. To do this, we will traverse the "Family Tree of Categories," adding layers of properties and structure until we bring everything together in the definition of a super modular tensor category.

Steven Lin

University of Oklahoma

A Brief Introduction to Jets and Arcs

In this talk, I will introduce the concepts about jets and arcs of an algebraic variety. Then I will list some of their applications in algebraic geometry without technical details.

Jordy Lopez Garcia

Texas A&M University

Using Macaulay2 to Count Real Roots of Polynomials

Since the 19th century, understanding the number of real roots of a polynomial has become ubiquitous in the study of real algebraic geometry. In particular, three theorems by Budan-Fourier, Sylvester and Sturm give us powerful methods to bound and count the number of real solutions of univariate polynomials. I will present a Macaulay2 package that implements algorithms for studying real roots of univariate polynomials based on such theorems. This is a joint project with Frank Sottile, Thomas Yahl and Kelly Maluccio.

Clayton Allred

University of Oklahoma

Counting Link Components Algebraically

Since 1923 when James Alexander proved that every knot or link can be represented as a closed braid, braid groups have been used in knot theory to provide algebraic tools for understanding knots and links. This talk will introduce braid groups, a nested family of finitely presented, torsion-free groups, and one application to knot theory wherein a surjective homomorphism of the braid group onto the symmetric group provides a convenient method for calculating the component number of a link.

Joey Randich

University of Oklahoma

Duality: An In-Schur-ance Policy for the Working Mathematician

There are many different notions of 'duality' throughout mathematics. In this talk, we will briefly introduce and discuss Schur-Weyl duality which yields a strong correspondence between the representation theory of the general linear group and the symmetric group.