An Algebra So Nice It Will Make You Quiver! An Introduction to Cluster Algebras of Geometric Type
Joey Randich, University of Oklahoma

Abstract: Cluster algebras are a class of commutative algebras introduced in 2002 by Fomin and Zelevinsky which feature a (possibly infinite) distinguished set of generators called **cluster variables**. Every cluster algebra is also endowed with a combinatorial structure which involves distinguished sets of cluster variables called **clusters**. Every cluster may be obtained from any other cluster via a sequence of **mutations**. This talk will give a brief, nontechnical introduction to cluster algebras by focusing on a particular subclass: those obtained from a quiver. We will explore the necessary definitions and the interesting combinatorial properties by way of numerous examples.

Syzygies and Pieri Maps
John Miller, Baylor University

Abstract: The talk will include a brief overview of the fundamental problem of Classical Invariant Theory: finding generators and relations (syzygies) for rings of invariants and, more generally, for modules of covariants. For the general linear groups, this problem is partially answered by Weyl's First and Second Fundamental Theorems for the rings of invariants of several vectors and co-vectors. Furthermore, the higher sygygies of these rings of invariants are given by the Lascoux resolution of determinantal ideals.

Our work extends the results of Weyl and Lascoux to modules of covariants. Explicit descriptions of the minimal free resolutions that appear in this context and some interesting examples will be provided.

An Algebraic Representation Theory of a Semigroup
Ryan Reynolds, University of Oklahoma

Abstract: In this talk, we will discuss representations of a semigroup Γ over any field K and define what it means for a function $f : \Gamma \to K$ to be *finitary* in order to construct a space of coefficient functions. Let A be a subcoalgebra of the coalgebra of all finitary functions $F(K^{\Gamma})$. We consider the full subcategory of all A-rational $K\Gamma$ -modules, and call the study of such a category "A-representation theory".

Counting Polynomially Parameterized Interpolants via Necklaces
Taylor Brysiewicz, Texas A&M University

Abstract: We consider the problem of locally approximating an analytic curve in the complex plane by a polynomial parametrization $t \to (x_1(t), x_2(t))$ of bidegree (d_1, d_2). Contrary to Taylor approximations, these parametrizations can achieve a higher order of contact at the cost of losing uniqueness and possibly the reality of the solution. We study the extent to which uniqueness fails by counting the number of such curves as the number of aperiodic combinatorial necklaces on d_1 white beads and d_2 black beads. We analyze when this count is odd as an initial step in studying when real solutions exist.

Modular Representation Theory of Symmetric Groups

Gordon Brown, University of Oklahoma

Abstract: Over fields of characteristic zero, the representations of the symmetric group have been well understood for over half a century. On the other hand, there are fundamental questions about the modular representations -- those in positive characteristic -- that remain unanswered. In this talk, I will broadly outline what is known, what the open problems are, and how the methods of study have radically changed in the last two decades.

Partitioning Data Using Monomial Bases to Improve Network Inference in Systems Biology

Anyu Zhang, Southern Methodist University

Abstract: In systems biology, network inference is plagued by too few input data and too many candidate models which fit the data. Finite dynamical systems offer a viable solution as the model space can be described by a monomial basis. The problem of selecting a model can be reduced to selecting an appropriate basis.

Recently affine transformations were shown to partition input data into equivalence classes with the same bases, and data sets configured as a staircase are associated with a unique basis. We wrote a python package incorporating parallel computation to build the equivalence classes for small networks. We developed a metric to measure how far a data set is from being a staircase and propose that a data set configured as a staircase is in standard position. Using this metric, we defined the representative of an equivalence class in terms of its distance from a staircase and showed that representatives are unique. We are currently focusing on computing the number of equivalence classes and the size of each class based on the number of data points, variables, and network states.

The implication of this work is guidance for systems biologists in designing experiments to collect data that result in a unique model, meaning a unique set of predictions. This has the potential to reduce ambiguity in modeling and improving predictions.

Me Gusta Tu Module: An Exploration in the Highest “Ranked” and Most “Supportive” Varieties

Rebekah Aduddell, University of Texas at Arlington

Abstract: In classical Algebraic Geometry, there exists a dictionary that associates algebraic varieties to ideals in polynomial rings. It seems natural to also have an association between differing algebraic structures, such as modules, and algebraic varieties. Many moons ago, such an association developed when Jon F. Carlson defined the concepts of rank and support varieties for kG-modules, with k a field (characteristic $p > 0$) and G a finite group. This talk will cover some definitions of the rank variety (both in the original case and in a more generalized case), building intuition on the connection between varying definitions. Additionally, we will look at some examples of computing the rank variety of a specific type of module and some basic properties. If time permits, I will briefly discuss how support varieties are related.

Using Relative Homological Algebra in Hochschild Cohomology
Pablo S. Ocal, Texas A&M University

Abstract: First, we will define what Hochschild cohomology is and how can we construct it. Second, we will define what relative homological algebra is and see how the expected results hold. Finally, we will see how they relate to each other and some questions of interest that arise in this context.

Classical Change of Ring Adjunction
Tyler Anway, University of Texas at Arlington

Abstract: Given any ring homomorphism Q → R we can define an adjoint pair of functors (called the Change of Rings Adjunction) between the categories R-Mod and Q-Mod. My talk will consist of discussing the classical example of this as well as closure under summands of certain subcategories. I will then briefly mention how this topic extends to triangulated categories/functors and "thickness" of subcategories.

Paramodular Forms Coming From Elliptic Curves via sym^3 Lifting
Manami Roy, University of Oklahoma

Abstract: Let E be an elliptic curve of conductor N over $\mathbb{Q}$. Using the sym^3 lifting, we can construct a paramodular form of weight 3 associated to E. I will explain this construction which uses local representation coming from E at each prime p, and the functoriality of sym^3lifting. Also, I will give an explicit formula for the level of this paramodular form in terms of N, when N satisfies one the following conditions

- $4 \nmid N$ and $9 \nmid N$
- If $4 \mid N$ and $9 \mid N$, then E has potentially multiplicative reduction at $p = 2$ and $p = 3$ respectively.

Double Structures on Conics in $\mathbb{P}^3$
Fazle Rabby, Texas Christian University

Abstract: Let Y be a smooth connected curve in $\mathbb{P}^3$. A multiplicity structure on Y is some curve Z that as a topological space has the same set of points as Y , but has more functions defined on it than Y . Using Ferrand's construction, I will describe all double structures on conics in $\mathbb{P}^3$ and give their total ideals.