The Algebra Seminar

The seminar will meet in-person on Tuesdays in room WH-100E at 2:45 p.m. There should be refreshments served at 3:45 in our new lounge/coffee room, WH-104. Masks are optional.

Anyone wishing to give a talk in the Algebra Seminar this semester is requested to contact the organizers at least one week ahead of time, to provide a title and abstract. If a speaker prefers to give a zoom talk, the organizers will need to be notified at least one week ahead of time, and a link will be posted on this page.

If needed, the following link would be used for a zoom meeting (Meeting ID: 948 2031 8435, Passcode: 053702) of the Algebra Seminar:

Algebra Seminar Zoom Meeting Link

Organizers: Alex Feingold, Daniel Studenmund and Hung Tong-Viet

To receive announcements of seminar talks by email, please email one of the organizers with your name, email address and reason for joining this list if you are external to Binghamton University.

Fall 2025

- **August 19**
  Organizational Meeting

  Please think about giving a talk in the Algebra Seminar, or inviting an outside speaker.

- **August 26**
  Ryan McCulloch (Binghamton University)
  The commuting graph and the centralizer graph of a group

  Abstract: Let G be a group. The commuting graph $\mathfrak{C}(G)$ for G is the graph whose vertices are $G-Z(G)$ and if $a, b \in G-Z(G)$, $a \neq b$, then there is an edge between a and b if $ab = ba$. A close cousin of $\mathfrak{C}(G)$ is the centralizer graph, which we define. When a connected component of $\mathfrak{C}(G)$ is a complete graph, the corresponding component in the centralizer graph is an isolated vertex, and we call such a component trivial. Otherwise, the natural bijection between the commuting graph and the centralizer graph preserves the diameter of connected components. One sees that if G is a Frobenius group with a nonabelian kernel and a nonabelian complement where the complement has nontrivial center, then the centralizer graph of G has more than one nontrivial component. Can this happen in a p-group? The answer is yes! In fact, for any specified number k of nontrivial components and any diameter sizes $n_1,\dots, n_k$, one can construct a p-group of nilpotency class 2 whose centralizer graph has these specs. This is joint work with

Mark Lewis.

- **September 2**
  No Meeting (Monday classes meet)

- **September 9**
  Chris Schroeder (Binghamton University)
  A topological quantum field theory and invariants of finite groups

  Abstract: In this talk, we will discuss the properties of finite groups that are witnessed by the group invariants arising in the context of Dijkgraaf-Witten theory, a topological quantum field theory, as invariants of surfaces. Assuming the theory is derived from the complex group algebra of a finite group, these invariants are generalizations of the commuting probability, an invariant that has been well studied in the literature. The main goal of this talk is to construct these invariants from scratch, assuming no previous knowledge of quantum mechanics.

- **September 16**
  Alex Feingold (Binghamton University)
  Lie Algebras, Representations, Roots, Weights, Weyl groups and Clifford Algebras

  Abstract: Lie algebras and their representations have been well-studied and have applications in mathematics and physics. The classification of finite dimensional Lie algebras over **C** by Killing and Cartan inspired the classification of finite simple groups. Geometry and combinatorics are both involved through root and weight systems of representations, with the Weyl group of symmetries playing a vital role. Infinite dimensional Kac-Moody Lie algebras have deeply enriched the subject and connected with string theory and conformal field theory. In a collaboration with Robert Bieri and Daniel Studenmund, we have been studying tessellations of Euclidean and hyperbolic spaces which arise from the action of affine and hyperbolic Weyl groups. Our goal has been to define and study piecewise isometry groups acting on such tessellations. Today I will present background material on Lie algebras, representations and examples which show the essential structures. I will present a construction of representations of the orthogonal Lie algebras, $so(2n,F)$, of type D_n as matrices and also using Clifford algebras to get spinor representations.

- **September 23**
  No Algebra Seminar

- **September 30**
  Thu Quan (Binghamton University)
  A generalization of Camina pairs and orders of elements in cosets

  Abstract: Let G be a finite group with a nontrivial proper subgroup H. If H is normal in G and for every element $x\in G\setminus H$, x is conjugate to xh for all $h\in H$, then the pair (G,H) is called a Camina pair. In 1992, Kuisch and van der Waall proved that (G,H) is a Camina pair if and only if every nontrivial irreducible character of H induces homogeneously to G. In this talk, we discuss the equivalence of these two conditions on the pair (G,H) without assuming that H is normal in G. Furthermore, we determine the structure of H under the hypothesis that, for every element $x\in G\setminus H$ of odd order, all elements in the coset xH also have odd order.

- **October 7**

No Algebra Seminar

- **October 14**

Hung Tong-Viet (Binghamton University)

Orders of commutators and Products of conjugacy classes in finite groups

Abstract: Let G be a finite group, $x\in G$, and let p be a prime. In this talk, we explore conditions that forces x to lie in certain characteristic subgroups of G. In particular, we prove that the commutator $[x,g]$ is a p-element for all $g\in G$ if and only if x is central modulo $O_p(G)$, the largest normal p-subgroup of G. This result unifies and generalizes aspects of both the Baer-Suzuki theorem and Glauberman's Z_p^*-theorem. Additionally, we show that if $x\in G$ is a p-element and there exists an integer $m\ge 1$ such that for every $g\in G$, the commutator $[x,g]$ is either trivial or has order m, then the subgroup generated by the conjugacy class of x is solvable. As an application, we confirm a conjecture of Beltran, Felipe, and Melchor: if K is a conjugacy class in G such that the product $K^{-1}K=1\cup D\cup D^{-1}$ for some conjugacy class D, then the subgroup generated by K is solvable.

- **October 21**

Inna Sysoeva (Binghamton University)

Welded braid groups, their (irreducible) representations and linearity questions

Abstract: Welded braid group WB_n is a generalization of a classical braid group $B_n,$ for which some crossings are allowed to be “welded”. From the group-theoretical point of view, WB_n is finitely presented by braid-like and permutation-like generators and relations. In this talk I am going to define welded braid groups and describe how they are related to the classical braid groups, the groups of automorphisms of free groups and some other interesting groups. I will present my recent results on the classification of the irreducible representations of WB_n of dimension $\leq n$ (https://arxiv.org/abs/2412.21133) No prior knowledge of the aforementioned groups and their representations is expected.

- **October 28**

Daniel Studenmund (Binghamton University)

Non-simplicity of commensurators of free groups

Abstract: The abstract commensurator of a group is the group of ``germs of automorphisms,'' equivalence classes of isomorphisms between finite-index subgroups. The abstract commensurator of a finitely-generated free group is a fundamental object in mathematics that has a rich structure. We will discuss some results exploring the structure of the commensurator joint with Khalid Bou-Rabee and Edgar Bering, and discuss a recent preprint of Barnea, Ershov, Le Boudec, Reid, Vannacci, and Weigel that proves that the commensurator has no simple finite-index subgroup.

- **November 4**

James Hyde (Binghamton University)

On the Permutational Boone-Higman Conjecture

Abstract: The Boone-Higman Conjecture asserts that a finitely generated group has solvable word problem exactly if it embeds into some finitely presented simple group. I will survey the work that has been done on the Boone-Higman Conjecture and describe work of Jim Belk, Francesco Fournier-Facio, Matt Zaremsky and myself relating it to its permutational variant.

- **November 11**

  Tae Young Lee (Binghamton University)

  Relations between character values of symmetric groups

  Abstract: I will discuss some polynomial relations between the values of complex irreducible characters of finite symmetric groups, and their consequences. In particular, I will show that no irreducible character can vanish on certain sets of conjugacy classes, and use these sets to prove that if n satisfies certain conditions, then it is impossible to cover S_n\{1} with the zero sets of three irreducible characters.

- **November 18**

  Nguyen N. Hung (University of Akron)

  The McKay theorem with degree inequality

  Abstract: The McKay theorem, recently proved by Cabane and Späth, states that for a finite group G and a prime p, there exists a bijection τ between the irreducible p'-degree characters of G and those of a p-Sylow normalizer. Giannelli proposed that such a bijection should also satisfy the degree inequality $\tau(\chi)(1) \le \chi(1)$ for every irreducible p'-degree character χ of G. Proving this strengthened version requires establishing the “inductive McKay condition” with the additional degree inequality, which in turn requires our understanding of the smallest p'-degree of G and the largest p'-degree of its normalizer. In this talk, I will discuss the details and outline the proof in the case $p = 2$. This is joint work with J. Miquel Martinez and G. Navarro.

- **November 25**

  Pratik Misra (Binghamton University)

  Directed Gaussian graphical models with toric vanishing ideals

  Abstract: Directed Gaussian graphical models use directed acyclic graphs (DAGs) to encode conditional independence relations among jointly Gaussian random variables. Beyond their statistical interpretation, these DAGs also provide a combinatorial parametrization of the covariance matrices that lie in the model, allowing us to view them as algebraic varieties. Understanding the vanishing ideals, that is, the defining polynomial equations of these varieties offers valuable insights into fundamental statistical problems such as model identifiability and causal discovery. In this talk, I will discuss recent progress toward characterizing those DAGs whose vanishing ideals are toric ideals. In particular, I will present some combinatorial criteria for constructing such DAGs from smaller ones that already have toric vanishing ideals. A key ingredient in this characterization is a monomial map known as the shortest trek map, which plays a central role in describing toric Gaussian DAG models. These results provide a generalized solution to a conjecture of Sturmfels and Uhler, originally posed for undirected graphical models.

- **December 2**

  No Algebra Seminar

- Pre-2014 semesters
- Fall 2014
- Spring 2015
- Fall 2015

- Spring 2016
- Fall 2016
- Spring 2017
- Fall 2017
- Spring 2018
- Fall 2018
- Spring 2019
- Fall 2019
- Spring 2020
- Fall 2020
- Spring 2021
- Fall 2021
- Spring 2022
- Fall 2022
- Spring 2023
- Fall 2023
- Spring 2024
- Fall 2024
- Spring 2025