The Algebra Seminar

The seminar will meet in-person on Tuesdays in room WH-100E at 2:50 p.m. There should be refreshments served at 4:00 in room WH-102. As of Saturday, March 26, 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: 981 8719 2351) of the Algebra Seminar:

Algebra Seminar Zoom Meeting Link

Organizers: Alex Feingold and Hung Tong-Viet

To receive announcements of seminar talks by email, please join the seminar's mailing list.

Spring 2022

- **January 25**
  Organizational Meeting

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

- **February 1**
  Alex Feingold (Binghamton University)
  Groups acting on hyperbolic spaces

  Abstract: The well-known action of $PSL(2,R)$ on hyperbolic 2-space by Moebius transformations $z\to \frac{az+b}{cz+d}$, gives tesselations by hyperbolic triangles when the action is restricted to an arithmetic group such as $PSL(2,Z)$. This is the math behind the famous Escher picture ``Circle Limit IV” when hyperbolic 2-space is viewed as the Poincaré disk. Hyperbolic 3-space can be viewed as the interior of a unit ball, or an upper half-space in the real quaternions, and the group of all isometries is $PSL(2,C)$. I will discuss this material, and whether it might lead to an understanding of how an infinite dimensional hyperbolic Kac-Moody group might act on a hyperbolic ∞-space.

- **February 8**
  Daniel Studenmund (Binghamton University)
  The profinite topology and related constructions

  Abstract: This talk will give an intro to, and examples of, the profinite topology on an abstract group. After reviewing the example of the p-adic topologies on the integers and rationals, we will define the profinite topology and give Furstenberg's proof of the infinitude of primes. We will use this to define the abstract commensurator of a group and provide some examples. Examples will connect with the theory of profinite groups, Galois groups, and non-Archimedean local fields.

- **February 15**
  No speaker

- **February 22**
  Daniel Studenmund (Binghamton University)
  The profinite topology and related constructions, part 2

  Abstract: We will briefly review the definition of the profinite topology on a group and the definition of the group of germs of automorphisms, and give some examples. We then explain how this topological language naturally appears in statements of 1) Neukirch and Uchida about rigidity in Galois groups of number fields, and 2) Bass–Milnor–Serre, and others, about the congruence subgroup property of certain arithmetic groups.

- **March 1**
  Cisil Karaguzel (University of California, Santa Cruz)
  Stable perfect isometries of blocks of finite groups

  Abstract: Let $(\mathbb{K},\mathcal{O},\mathbb{F})$ be a p-modular system which is large enough for finite groups G and H. Let $ A$ be a p-block of the group algebra $\mathcal{O}G$, and B be a p-block of the group algebra $\mathcal{O}H$. In 1990, Michel Broué introduced the definition of a perfect isometry between the p-blocks A and B which is a generalized $\mathbb{K}$-valued character leading to a special bijection between the sets of ordinary irreducible characters of A and B. In this talk, we introduce and investigate the notion of stable perfect isometries–a way to consider *perfect isometries up to generalized projective characters* of the corresponding p-blocks. Our interest lies in understanding in which cases a stable perfect isometry can be lifted to a perfect isometry. We will answer this question for the p-block $\mathcal{O}P$ where P is an abelian p-group. (Joint work with Robert Boltje).

- **March 8**
  Hung Tong-Viet (Binghamton University)
  Odd degree rational irreducible characters

  Abstract: A complex irreducible character χ of a finite group G is said to be rational (or real) if χ takes only rational (or real) values, that is, $\chi(g)\in\mathbb{Q}$ (or $\chi(g)\in\mathbb{R}$) for all $g\in G.$ An element $g\in G$ is said to be rational if $\chi(g)\in\mathbb{Q}$ for all irreducible characters χ of G. Similarly, an element $g\in G$ is real if $\chi(g)\in \mathbb{R}$ for all irreducible characters χ of G or equivalently g and g^{-1} are conjugate in G. The Itô-Michler theorem for the prime $p=2$ states that if all irreducible characters of G have odd degree, then G has a normal abelian Sylow 2-subgroup P. A real version of this theorem was obtained by Dolfi, Navarro and Tiep in 2008. It was shown that if all irreducible real characters of G have odd degree, then G has a normal Sylow 2-subgroup. There is no rational version of this result since all the irreducible rational characters of the non-abelian simple group $\textrm{PSL}_2(3^{f})$, where $f\ge 3$ is an odd integer, have odd degree. In this talk, we discuss a new variant of the above mentioned result for rational characters. This is a joint work with P. H. Tiep.

- **March 15**
  No Seminar
  Spring Break

- **March 22**
  Sailun Zhan (Binghamton University)
  McKay graphs of the finite subgroups of $SL(2,\mathbb{C})$

  Abstract: We will give an introduction to the McKay graph and the Mckay correspondence. Namely, the one-to-one correspondence between the Mckay graphs of the finite subgroups G of $SL(2,\mathbb{C})$ and the affine simply laced Dynkin diagrams. We will also discuss the relations between these diagrams and the resolution of singularities of $\mathbb{C}^2$ quotient by G.

- **March 29**
  Zach Costanzo (Binghamton University)
  Codegrees of the real-valued characters of a finite group

  Abstract: The influence of the set of character degrees of a finite group G has been well studied. Over the past twenty years, it has also become clear that we can restrict our view to characters which take their values in a particular subfield of the complex numbers while still gaining some knowledge of the group's structure. During that same time, the so-called codegrees of the characters have been studied. In this talk, I will define codegree, and give some insight into the impact the codegrees of the real-valued characters have on the structure of finite groups.

- **April 5**
  Yong Yang (Texas State University)
  Regular orbits of finite primitive solvable groups

  Abstract: The case when a linear group G acting primitively on the vector space V is of central importance in the theory of representations of solvable groups. In short, such groups have an invariant e that measures their complexity. It is known that if $e > 118$, G has a regular orbit. I was able to improve this result dramatically by classifying all the cases when the regular orbit exists. In some of my early papers, I gave a coarse classification of the existence of regular orbits for primitive solvable linear groups, and the results have been widely used by other people and myself to study related problems of arithmetic properties of group invariants. A more detailed final classification has been completed in some of my recent work along with several further applications.

- **April 12**
  Mark L. Lewis (Kent State University)
  Groups having all elements off a normal subgroup with prime power order

  Abstract: We consider a finite group G with a normal subgroup N so that all elements of $G \setminus N$ have prime power order. We prove that if there is a prime p so that all the elements in $G \setminus N$ have

p-power order, then either G is a p-group or $G = PN$ where P is a Sylow p-subgroup and $(G,P,P \cap N)$ is a Frobenius-Wielandt triple. We also prove that if all the elements of $G \setminus N$ have prime power orders and the orders are divisible by two primes p and q, then G is a $\{ p, q \}$-group and G/N is either a Frobenius group or a 2-Frobenius group. If all the elements of $G \setminus N$ have prime power orders and the orders are divisible by at least three primes, then all elements of G have prime power order and G/N is nonsolvable.

- **April 19**
  No Seminar (Following Monday's schedule)

- **April 26**
  Chris Schroeder (Binghamton University)
  A guided tour of the representation theory of finite groups of Lie type

  Abstract: The Lie algebra determines many aspects of the structure theory and representation theory of a Lie group. Remarkably, linear algebraic groups defined over algebraically closed fields of non-zero characteristic exhibit many of the same properties. In this expository talk we cover the basics of linear algebraic groups, with a focus on how geometric properties over an algebraically closed field descend to properties of finite subgroups defined over finite fields. The finite groups which arise in this way are called finite groups of Lie type and play a major role in the classification of finite simple groups. We discuss Deligne and Lusztig's classification of irreducible complex representations of finite groups of Lie type, which relies on a cohomology theory originally constructed to solve the Weil conjectures. We also provide some applications.

- **May 3**
  Jonathan Doane (Binghamton University)
  An infinite Fibonacci-like tree

  Abstract: You may be familiar with the Fibonacci (sequence) rabbit problem. Essentially, the growth of a hypothetical rabbit population can be described by an infinite binary tree, whose levels correspond perfectly with the Fibonacci sequence. Formally, we can think of rooted paths down this tree as functions from the natural numbers to a two-element set, subject to some conditions. This talk introduces a slight twist on these conditions and illustrates how Boolean semirings (of all things) come into play!

- 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