Spring 2015

- **January 27**
  Organizational Meeting

- **February 3**

  Luise-Charlotte Kappe (Binghamton University)
  Finite coverings: a journey through groups, loops, rings and semigroups

  Abstract: A group is said to be covered by a collection of subsets if each element of the group belongs to at least one subset in the collection: the collection of subsets is called a covering of the group. On the bottom of page 105 of Derek Robinson's “Finiteness Conditions and Generalized Soluble Groups I”, there are two theorems which served as my roadmap for exploring finite coverings of groups, loops, rings and semigroups. The first one, an unpublished result by Reinhold Baer, is stated as follows. Baer's Theorem: A group is central-by-finite if and only if it has a finite covering by abelian subgroups. The second one, due to Bernhard Neumann, is stated as follows. Neumann's Lemma: Let G be a group having a covering by finitely many cosets by not necessarily distinct subgroups. If we omit any cosets of subgroups of infinite index, the remaining cosets will still cover the group. In my talk I will report on my journeys through groups, loops, rings and semigroups, on what I discovered there about finite coverings together with several fellow travelers and on some discoveries which might still lie ahead.

- **February 10**

  Marcin Mazur (Binghamton University)
  Algebra and Number Theory on the 2014 Putnam Competition

  Abstract: I will discuss some of the problems from the 2014 Putnam which have algebraic flavor.

- **February 17**

  Eran Crockett (Binghamton University)
  Varieties generated by finite algebras

  Abstract: Varieties generated by finite algebras are an important example in universal algebra. This talk will focus on the questions you can ask about these varieties, including when are they locally finite, residually finite, or finitely based.

- **February 17**

  Marcelo Aguiar (Cornell) (In the Combinatorics Seminar, 1:15 - 2:15 PM, WH-100E):
  The Steinberg Torus and the Coxeter Complex of a Weyl Group

  Abstract: Associated to a root system Φ, there is a torus equipped with a particular triangulation. This was introduced by Steinberg and further studied by Dilks, Petersen, and Stembridge. In joint work with Kyle Petersen, we exhibit a module structure for this complex over the Coxeter complex of Φ. The structure is obtained from geometric considerations involving affine hyperplane arrangements. As a consequence, we obtain a module structure on the space spanned by affine descent classes of a Weyl group, over the classical descent algebra of

Solomon. We provide combinatorial models (picture) when Φ is of type A or C. The talk will not assume any background in root systems or hyperplane arrangements.

- **February 24**

  Nick Devin (Binghamton University)
  Solvable subgroups of PLo(I)

  Abstract: I will present conditions that ensure a subgroup of PLo(I), the group of piecewise-linear homeomorphisms of the unit interval, will be solvable–in particular, conditions that ensure a subgroup of PLo(I) has derived length n. I will give a geometric classification of the solvable subgroups of PLo(I), and talk about a minimal non-solvable subgroup in PLo(I).

- **February 26**

  Eric Swartz (Western Australia) (In the Geometry and Topology Seminar, 2:50–3:50, WH-100E)
  Generalized quadrangles with symmetry

  Abstract: A generalized quadrangle is a point-line incidence geometry Q such that (1) any two points lie on at most one line, and (2) given a line l and a point P not incident with l, P is collinear with a unique point of l. Generalized quadrangles are a specific type of generalized polygon, which were first introduced by Tit s in 1959 as geometries associated to classical groups. It is natural, then, to ask the question: if one starts with the abstract definition of a generalized quadrangle, which ones are highly symmetric? I will discuss the background of this question, leading to the following recent work: An antiflag of a generalized quadrangle is a non-incident point-line pair (P, l), and we say that the generalized quadrangle Q is antiflag-transitive if the group of collineations (automorphisms that send points to points and lines to lines) is transitive on the set of all antiflags. We prove that if a finite, thick generalized quadrangle Q is antiflag-transitive, then Q is one of the following: the unique generalized quadrangle of order (3,5), a classical generalized quadrangle, or a dual of one of these. This is joint work with John Bamberg and Cai-Heng Li, and this talk will assume no prior knowledge of finite geometry.

- **March 3**

  No talk this week

- **March 10**

  Joseph Mennuti (Binghamton University)
  Classifications of Simple Jordan Algebras

  Abstract: Zelmanov's theorem classifies a simple Jordan algebra as an algebra of a bilinear form, an algebra of Hermitian type, or an Albert algebra. I will try to concentrate on the specific examples of Hermitian matrices and spin-factor and the original motivation of Jordan algebras coming from quantum mechanics.

- **March 17**

  John Brown (Binghamton University)

A Proof of Brauer's Theorem on Induced Characters, Part Two: The Symmetric Groups

Abstract: The Brauer Theorem on Induced Characters states that every virtual character of a finite group can be written as a linear combination of induced characters coming from linear characters of Brauer elementary subgroups. Last Fall we showed that the result holds for nilpotent groups. We also showed that the result holds for all finite groups if it holds for the symmetric groups. In this talk, we will complete the proof by showing that the result does hold for the symmetric groups. The talk will be pretty much self-contained.

- **March 18 (Wednesday), 3:30 PM, WH-100E**

Craig Dodge (Allegheny College)
Searching for simple modules of the centralizer algebra

Abstract: Let G be a finite group with subgroup H. We define the centralizer algebra kG^H to be $$kG^H = \{a \in kG \mid ah = ha, \forall h \in H\}$$ for field k. As part of a larger project, Ellers and Murray have been working to uncover information about the blocks and the simple modules of these centralizer algebras. In this talk we will be addressing the problem of classifying the simple modules of the centralizer algebra $k\Sigma_n^{\Sigma_l}$, where Σ_n is the symmetric group on n letters and $l < n$. We will examine a potential solution to the problem proposed by Ellers and Murray, which was inspired by a classification of James for the simple $k\Sigma_n$-modules.

- **March 24**

Matt Evans (Binghamton University)
On a theorem of Birkhoff

Abstract: This will be an expository talk on a theorem of Birkhoff's from universal algebra: every algebra is (isomorphic to) a subdirect product of subdirectly irreducible algebras. I will give all definitions and theorems relevant for the proof and give some examples from group theory and lattice theory.

- **March 31**

Adam Allan (Binghamton University)
Frobenius Algebras

Abstract: Frobenius introduced a concept for algebras known as the 'Frobenius condition' that began to be studied by Brauer, Nesbitt, and Nakayama extensively in the 1930's and that has since that time played a crucial role in modular representation theory and the theory of arbitrary associative algebras. In this talk we will survey the history of this and related conditions, the importance that these conditions play in understanding group algebras and more general finite dimensional associative algebras, and some areas of current research.

- **April 7**

Spring Break

- **April 14**

Nick Devin (Binghamton University)
Classes of Elementary Amenable Groups (first part of the admission to candidacy exam).

Abstract: Elementary amenable groups are groups that can be assembled, via extensions and direct unions, from finite groups and abelian groups. Associated to an elementary amenable group is an elementary class: an ordinal number which tells how many “steps” are needed to assemble the group. Using a recent embedding theorem for countable groups, due to Osin and Olshanskii, I will provide a complete classification of the ordinal numbers that can occur as the elementary class of a countable group and, more specifically, of a finitely generated group.

- **April 14, 4.15 PM**

Nick Devin (Binghamton University)
Constructing Osin and Olshanskii's Embedding for Countable Groups (second part of the admission to candidacy exam).

Abstract : This is a continuation of my first talk on a recent embedding theorem for groups due to Osin and Olshanskii. I will discuss how the embedding used in the first talk is constructed. Building the embedding relies heavily on wreath products. Lemmas needed for the theorem will be proved, and definitions, including parallelogram-free subsets of a group, exponential growth of a subset of a finitely-generated group, and metabelian groups, will be explained.

- **April 21**

Josh Wiscons (Hamilton College)
Recognizing PGL_3 via generic 4-transitivity

Abstract: The groups of finite Morley rank are a class of groups equipped with a (finite) model-theoretic notion of dimension. The most important examples of these groups are the linear algebraic groups over algebraically closed fields, and in this case, Morley rank corresponds to the usual Zariski dimension. Recently, Borovik and Cherlin initiated a broad study of permutation groups of finite Morley rank with a key topic being high degrees of \emph{generic} transitivity; this is a very natural notion of transitivity that has previously been studied in various forms for actions of algebraic groups. One of the main problems is to show that there is a natural upper bound on the degree of generic transitivity that depends only upon the rank of the set being acted on. Such a bound has been known for a few decades when the set being acted on has rank 1, and in this talk, I will present recent work, joint with Tuna Alt\i{}nel, addressing the case of rank 2. Various side problems, including some from the algebraic category, will also be discussed. The talk will require no prior knowledge of Morley rank; an intuition for the way in which dimension (and degree) behave for affine varieties will suffice.

- **April 28**

Rachel Skipper (Binghamton University)
Just infinite groups (first part of the admission to candidacy exam).

Abstract: A just infinite group is an infinite group whose every proper quotient is finite. Since every finitely generated infinite group surjects onto a just infinite group, if we wish to find an infinite group with a particular property that survives in quotients, the class of just infinite groups can provide one. In the first talk, I will present some of the structure theory of just infinite groups and also discuss just infinite branch groups which have geometric representations allowing for concrete manipulations. In particular, I will spend some time discussing the first Grigorchuk group.

- **April 28, 4.15 PM**

Rachel Skipper (Binghamton University)
Just infinite groups, part 2 (second part of the admission to candidacy exam).

Abstract: In the second talk, I will prove a trichotomy that divides the class of just infinite groups and then show how to build a branch structure when G has an infinite structure lattice. I will end with a discussion of (abstract) free subgroups sitting inside just infinite profinite groups.

- **May 5**

Andrew Kelley (Binghamton University)
Counting subgroups according to their index (first part of the admission to candidacy exam).

Abstract: How many subgroups of a given index does a finitely generated group have? As the index increases, this number may grow rapidly. How fast (asymptotically) is this so called "subgroup growth"? And how does it relate to the algebraic, structural properties of the group? A few results in this area of subgroup growth will be stated; some groups have superexponential subgroup growth, others–exponential, and still others–polynomial. The subgroup counting technique emphasized will be to count homomorphisms into finite groups.

- **May 5, 4:15 PM**

Andrew Kelley (Binghamton University)
Polynomial subgroup growth: the pro-p case and more (second part of the admission to candidacy exam).

Abstract: Which finitely generated pro-p groups have their number of subgroups bounded above by a polynomial function of the index? The answer is very nice, and a (somewhat) complete proof will be given. Beyond the pro-p case, it turns out that finitely generated groups which have polynomial subgroup growth can also be described succinctly. In proving part of this theorem, a fundamental technique for counting subgroups will be illustrated: counting complements in extensions.