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2026 NORTH AMERICAN ANNUAL MEETING OF THE ASSOCIATION FOR SYMBOLIC LOGIC

University of Pennsylvania Philadelphia, PA, USA July 19–22, 2026

Program Committee: Rachael Alvir, Patricia Blanchette, James Cummings (chair), Maryanthe Malliaris, and Andre Scedrov.

Local Organizing Committee: Aaron Anderson, William Ewald (co-chair), Kenneth Gill, Giorgi Japaridze, Steven Lindell, Andre Scedov (co-chair), Val Tannen, Henry Towsner (co-chair), and Scott Weinstein.

The meeting is in the Carey Law School. The registration table in Golkin Hall Lobby. The plenary and tutorial lectures as well as the panel discussion are in Fitts Auditorium. The special sessions and contributed papers are in Silverman Hall. The Welcome Reception is on the third floor of the University Museum on Sunday 6:00-8:00pm. Please enter the Museum via the Main Entrance on South Street. See `https://awainverse.github.io/asl-nam-2026/` for additional information.

This conference is a satellite meeting of the International Congress of Mathematicians, also taking place in Philadelphia, July 23–30, 2026.

SUNDAY, July 19

Morning

8:00 – 9:00	Registration.
9:00 – 9:50	Tutorial Lecture 1: **Matthew Harrison-Trainor** (University of Illinois Chicago), *Computable structure theory and infinitary logic.*
10:00 – 10:20	Coffee.
10:30 – 11:20	Tutorial Lecture 1: **Nicholas Ramsey** (Notre Dame), *$NSOP_1$ theories.*
11:30 – 12:20	Invited Lecture: **Jack Lutz** (Iowa State), *Effective fractal dimensions.*

Afternoon

2:00 – 4:20	Special Sessions CT1, ML1, and ST1. See pages 3–5.
4:30 – 5:20	Invited Lecture: **Lawrence Moss** (Indiana University), *How to not give up on logic.*
6:00 – 8:00	Welcome Reception. University Museum, 3rd floor. *Please enter via the Main Entrance on South Street.*

MONDAY, July 20

Morning

9:00 – 9:50	Tutorial Lecture 2: **Matthew Harrison-Trainor** (University of Illinois Chicago), *Computable structure theory and infinitary logic.*
10:00 – 10:20	Registration and coffee.
10:30 – 11:20	Tutorial Lecture 2: **Nicholas Ramsey** (Notre Dame), *$NSOP_1$ theories.*
11:30 – 12:20	Invited Lecture: **Vincenzo De Risi** (CNRS, Laboratoire SPHERE), *Drawing lines on water: an inferential interpretation of Euclid's postulates.*

Afternoon

2:00 – 4:20	Special Sessions CT2, CS 1, MT2, and ST2. See pages 3–5.
4:30 – 5:50	Contributed Talks. See pages 5–6.

TUESDAY, July 21

Morning

9:00 – 9:50	Invited Lecture: **Caroline Terry** (University of Illinois Chicago), *On the structure of sets of bounded VC_2-dimension in elementary abelian p-groups.*
10:00 – 10:20	Coffee.
10:30 – 11:20	Tutorial Lecture 3: **Nicholas Ramsey** (Notre Dame), *$NSOP_1$ theories.*
11:30 – 12:20	Invited Lecture: **Will Brian** (University of North Carolina at Charlotte), *Big generic models.*

Afternoon

2:00 – 4:20	Special Sessions CS2 and PT. See pages 3–5.
4:00 – 4:20	Coffee.
4:30 – 5:50	Contributed Talks. See pages 5–6.

WEDNESDAY, July 22

Morning

9:00 – 9:50	Invited Lecture: **Juliette Kennedy** (University of Helsinki), *On the nuancing of first order logic: the view from set theory.*
10:00 – 10:20	Coffee.
10:30 – 11:20	Tutorial Lecture 3: **Matthew Harrison-Trainor** (University of Illinois Chicago), *Computable structure theory and infinitary logic.*
11:30 – 12:20	Retiring Presidential Address: **Phokion Kolaitis** (University of California Santa Cruz), *Reflections on logic and databases.*

Afternoon

2:00 – 4:20	Panel on Hilbert's consistency program. **William Ewald, Anton Freund, and Wilfried Sieg**
4:30 – 5:50	Contributed Talks. See pages 5–6.

SPECIAL SESSIONS

CT. Computability Theory

(Organized by Denis Hirschfeldt and Karen Lange)

Session CT1: Sunday, July 19, Silverman Hall S-240a.

2:00 – 2:20 **Jason Block** (College of William & Mary), *Computability for tree presentations of continuum-size structures.*

2:30 – 2:50 **Neil Lutz** (Swarthmore College), *Algorithmic information bounds for distances and orthogonal projections.*

3:00 – 3:20 **Peter Gerdes** (Indiana University), *Comparing notions of dense computability on ω^ω and 2^ω.*

3:30 – 3:50 **David Gonzalez** (Notre Dame), *Effective aspects of the tree of tuples construction.*

4:00 – 4:20 **Valentina Harizanov** (George Washington University), *Complexity of exact and approximate isomorphisms.*

Session CT2: Monday, July 20, Silverman Hall S-240a.

2:00 – 2:20 **Meng-Che "Turbo" Ho** (New College of Florida), *Scott analysis of the Farey graph.*

2:30 – 2:50 **Johanna Franklin** (Hofstra University), *Highness for Scott rank.*

3:00 – 3:20 **Patrick Lutz** (University of Michigan), *The Kučera-Gács Theorem and computable measures.*

3:30 – 3:50 **Mariya Soskova** (University of Wisconsin), *Intuitionism and computing with partial information.*

4:00 – 4:20 **Heidi Benham** (University of Connecticut), *Problem reducibilities of topologically inspired order principles.*

CS. Logic in Computer Science

(Organized by Elaine Pimentel and Val Tannen)

Session CS1: Monday, July 20, Silverman Hall S-240b.

2:00 – 2:20 **Farzaneh Derakhshan** (Illinois Institute of Technology), *Mixed assurance reasoning via labeled bunches.*

2:30 – 2:50 **Robert Andrews** (University of Waterloo), *A survey of the Ideal Proof System.*

3:00 – 3:20 **Ilya Shapirovsky** (New Mexico State University), *On modal satisfiability problems in geometric spaces.*

3:30 – 3:50 **Henry Towsner** (University of Pennsylvania), *What proofs can be..*

4:00 – 4:20 **Phokion Kolaitis** (University of California Santa Cruz), *On disjunctions of dependence atoms.*

Session CS2: Tuesday, July 21, Silverman Hall S-240a.

2:00 – 2:20 **Joanna Boyland** (Carnegie Mellon), *A proof-theoretic compilation from natural deduction to the semi-axiomatic sequent calculus.*

2:30 – 2:50 **Andre Scedrov** (University of Pennsylvania), *Complexity for product-free infinitary action logic.*

3:00 – 3:20 **Carolyn Talcott** (Computer Science Laboratory, SRI), *Diverse roles of logic based models.*

3:30 – 3:50 **Will Stafford** (Kansas State University), *'Fine-style' proof theoretic semantics for B.*

4:00 – 4:20 **Shay Logan** (Kansas State University), *An epistemic probabilistic dynamic logic.*

MT. Model Theoretic Algebra (in memoriam Zoé Chatzidakis)

(Organized by Ben Castle and Franziska Jahnke)

Session MT1: Sunday, July 19, Silverman Hall S-240b.

2:00 – 2:20 **Blaise Boissonneau** (Heinrich Heine University), *Some fields, no medal.*

2:30 – 2:50 **Matthias Stout** (McMaster University), *Formalizing the model theory of valued fields.*

3:00 – 3:20 **Atticus Stonestrom** (Notre Dame), *On NIP approximate groups.*

3:30 – 3:50 **Scott Mutchnik** (University of Illinois Chicago), *Classifying classification-theoretic properties.*

4:00 – 4:20 **Ronan O'Gorman** (University of California Berkeley), *Abstract group chunks.*

Session MT2: Monday, July 20, Silverman Hall S-245a.

2:00 – 2:20 **Christian d'Elbée** (University of the Basque Country), *Lie methods for omega-categorical Engel groups.*

2:30 – 2:50 **Alexi Block Gorman** (ILLC), *Characterizing geometries in automatic structures.*

3:00 – 3:20 **Nicolas Chavarria Gomez** (University of Illinois Urbana-Champaign), *Binding groups in continuous logic.*

3:30 – 3:50 **Yuyan He** (Notre Dame), *Sum-product phenomenon via dimension.*

4:00 – 4:20 **Jananan Arulseelan** (Iowa State University), *Continuous model-theoretic operator algebra.*

PT. Proof Theory

(Organized by Michael Rathjen and James Walsh)

Session PT1: Tuesday, July 21, Silverman Hall S-240b.

2:00 – 2:20 **Katalin Bimbó** (University of Alberta), *Single cut rules.*

2:30 – 2:50 **Elijah Gadsby** (CUNY Graduate Center), *On the slowing-down phenomenon.*

3:00 – 3:20 **Anton Freund** (University of Würzburg), *Fraïssé's conjecture and partial impredicativity.*

3:30 – 3:50 **Andreas Weiermann** (Ghent University), *Some averaged zero one laws for segments of proof-theoretic ordinals.*

ST. Set Theory

(Organized by Justin Moore and Dima Sinapova)

Session ST1: Sunday, July 19, Silverman Hall S-245a.

2:00 – 2:20 **Nathaniel Bannister** (Carnegie Mellon), *Condensed sets and the Solovay model.*

2:30 – 2:50 **James Cummings** (Carnegie Mellon), *Generating sets for ultrafilters.*

3:00 – 3:20 **Victoria Gitman** (CUNY Graduate Center), *Reflection in set theory without powersets.*

3:30 – 3:50 **Siiri Kivimäki** (University of Helsinki), *Scott analysis for uncountable models and Aronszajn trees.*

4:00 – 4:20 **Fanxin Wu** (University of California, Irvine), *One- and two-cardinal trees.*

Session ST2: Monday, July 20, Silverman Hall S-280.

2:00 – 2:20 **Filippo Calderoni** (Rutgers), *The space of finitely generated groups and classification problems.*
2:30 – 2:50 **Cecelia Higgins** (Rutgers), *Spectral theory for Borel pmp graphs.*
3:00 – 3:20 **Riley Thornton** (Carnegie Mellon), *Entropy and ultraproducts.*
3:30 – 3:50 **Allison Wang** (Carnegie Mellon), *Topological realizations of CBERs.*

CONTRIBUTED TALKS

MONDAY, July 20

Session I-A, 4:30-6:00, Silverman Hall S-240a.

4:30 – 4:50 **William Adkisson** (University of California Los Angeles), *Strong tree properties on segments of successors of singulars.*
5:00 – 5:20 **Rishi Banerjee** (University of Illinois Chicago), *Structurable equivalence relations and $L_{\omega_1,\omega}$ interpretations.*
5:30 – 5:50 **Yiping Miao** (University of California Berkeley), *Generic reals and gauge dimensions.*

Session I-B, 4:30-6:00, Silverman Hall S-240b.

4:30 – 4:50 **Jeremy Beard** (Carnegie Mellon University), *Limit models in strictly stable AECs.*
5:00 – 5:20 **Katie Ellman-Aspnes** (Notre Dame), *Approximating $NSOP_1$ structures.*
5:30 – 5:50 **James E. Hanson** (Iowa State University), *Small large cardinals and neostability theory.*

Session I-C, 4:30-6:00, Silverman Hall S-245a.

4:30 – 4:50 **Yuxiao Fu** (University of Connecticut), *Weihrauch degrees of embeddability problems.*
5:00 – 5:20 **Logan Heath** (University of Wisconsin), *Uubs and suubs as theory spectra.*
5:30 – 5:50 **Dhruv Kulshreshtha** (University of Wisconsin), *A robust subclass of the nontotal continuous degrees.*

TUESDAY, July 21

Session II-A, 4:30-5:50, Silverman Hall S-240a.

4:30 – 4:50 **Robert S. Lubarsky** (Florida Atlantic University), *Harrington's Principle in second-order arithmetic.*
5:00 – 5:20 **Robert S. Lubarsky** (Florida Atlantic University), *A possibly new proof of a possibly old theorem.*
5:30 – 5:50 **Morenikeji Neri** (TU Darmstadt), *Extracting bounds from proofs involving ultraproducts.*

Session II-B, 4:30-6:00, Silverman Hall S-240b.

4:30 – 4:50 **Connor Lockhart** (University of Maryland), *Pseudofiniteness of the Farey graph and random tesselations.*
5:00 – 5:20 **Devrim Pekmezci** (University of Illinois Chicago), *Local revised Ellis group conjecture.*
5:30 – 5:50 **Jacob Stern** (CUNY Graduate Center), *Divisible ordered abelian groups that are not weakly o-minimal.*

Session II-C, 4:30-6:00, Silverman Hall S-245a.

4:30 – 4:50 **Tyler Markkanen** (Springfield College), *Deciding the density of computable and c.e. sets.*

5:00 – 5:20 **Karthik Ravishankar** (University of Wisconsin), *Ahmad pairs and the local structure of the enumeration degrees.*

5:30 – 5:50 **Joey Veltri** (Penn State University), *Effective recurrence for computable measure-preserving transformations.*

WEDNESDAY, July 22

Session III-A, 4:30-6:00, Silverman Hall S-240a.

4:30 – 4:50 **Helena Rios** (Notre Dame), *On Hilbert's conception of mathematical objects.*

Session III-B, 4:30-6:00, Silverman Hall S-240b.

4:30 – 4:50 **Yuki Takahashi** (University of California Berkeley), *Dependent dividing and sub-additivity of burden.*

5:00 – 5:20 **Brian Wynne** (Lehman College), *Existentially closed abelian lattice-ordered groups.*

5:30 – 5:50 **Hongyu Zhu** (University of Wisconsin), *A complete bounded theory with unbounded types.*

Abstract of the Retiring Presidential Address

▶ PHOKION G. KOLAITIS, *Reflections on logic and databases.*
Computer Science and Engineering Department, University of California Santa Cruz.
E-mail: kolaitis@ucsc.edu.

During the past six decades, there has been a continuous and fruitful interaction between logic on the one side and the theory and practice of database systems on the other side. The aim of this talk is to reflect on some aspects of this interaction with particular emphasis on the uses of logic as a database query language and as a specification language for data management tasks.

Abstract of invited tutorial

▶ MATTHEW HARRISON-TRAINOR, *Computable structure theory and infinitary logic.*
Department of Mathematics, Statistics, and Computer Science, University of Illinois, Chicago.
E-mail: mht@uic.edu.

Computable structure theory is an area of logic that applies techniques from computability theory to study countable mathematical structures such as graphs, linear orders, or groups. The goal is to understand and measure the complexity of working with these structures, including the complexity of describing a structure, of constructing a copy of a structure, of determining whether two structures are isomorphic, or of computing an isomorphism between two structures. This tutorial will introduce some of the central techniques and ideas of computable structure theory.

One of the central themes of computable structure theory has been connections between relative computability and the infinitary logic $\mathcal{L}_{\omega_1\omega}$. This is the first-order logic with countably infinite conjunctions and disjunctions. The guiding principle is that,

in many instances, robust computational properties emerge from underlying structural features expressible within $\mathcal{L}_{\omega_1\omega}$. For example, the Ash-Knight-Manasse-Slaman-Chisholm theorem states that given some relation $R \subseteq A^n$ on a structure $\mathcal{A}$, if for every copy $\mathcal{B}$ of $\mathcal{A}$ the image of R in $\mathcal{B}$ is computably enumerable relative to $\mathcal{B}$, this must be because R has an infinitary existential definition in $\mathcal{A}$. This tutorial will explore a number of different aspects or realizations of this motif that computation and infinitary logic are connected. Among other topics, we will give an introduction to computability-theoretic forcing, which is a central technique for proving such connections, and several applications including connections between functors and interpretations. We will also touch on the back-and-forth relations and their central role in computable structure theory, and the Scott analysis and its role in Vaught's conjecture.

▸ RAMSEY, NICHOLAS, *$NSOP_1$ theories*.
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In recent years, the class of NSOP_1 theories has received a lot of attention and there is a growing consensus that the property SOP_1 marks a significant dividing line within model theory. The name NSOP_1 is unfortunate; it casts an excessively technical light on what is ultimately a very natural class of first-order theories, containing the familiar stable and simple theories but incorporating several new examples. The structure theory for NSOP_1 theories centers on a theory of independence called *Kim-independence*, which corresponds to independence *at a generic scale*. The NSOP_1 theories are exactly the theories in which Kim-independence is well-behaved. In this tutorial, we will try to explain some of this theory, but also situate it in a broader context. We will give a big picture overview why model theorists got so interested in independence relations and why independence ended up being the right place to look for a structure theory in certain corners of the model-theoretic map. We will show how the theory for NSOP_1 can be viewed as a natural evolution of the earlier structure theories for stable and simple theories, and also describe where things may go from here in the future.

Abstracts of invited plenary lectures

▸ WILL BRIAN, *Big generic models*.
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Given a suitable class $\mathcal{K}$ of finite structures, a theorem of Fraïssé shows how to construct a special countable model, called the Fraïssé limit of $\mathcal{K}$, the unique dense G_δ (a.k.a., "generic") isomorphism type in the space of all countable structures built from $\mathcal{K}$. Assuming the Continuum Hypothesis (CH), the same is true one cardinality higher: if $\mathcal{K}$ satisfies the hypotheses of Fraïssé's Theorem, then there is a unique generic isomorphism type in the space of all size-$\mathfrak{c}$ structures built from $\mathcal{K}$, and furthermore, these special models of size $\mathfrak{c}$ have properties analogous to their corresponding Fraïssé limits. Some classes of finite structures do not satisfy the hypotheses of Fraïssé's theorem, and these classes do not have a Fraïssé limit. Interestingly, however, a class $\mathcal{K}$ may have no Fraïssé limit, but still have a unique size-$\mathfrak{c}$ generic model under CH. In other words, under CH, big generic models exist for any even broader range of classes than Fraïssé limits do, giving rise to Fraïssé-like uncountable structures with no true countable analogues. We will describe some aspects of the construction of these higher Fraïssé limits, and give several examples of familiar structures that can be understood in this way.

▶ VINCENZO DE RISI, *Drawing lines on water: an inferential interpretation of Euclid's postulates.*

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The talk discusses the origins of axiomatic thought in Greece, and in particular the role of Euclid's postulates in the *Elements* (4th–3rd century BCE). It appears that Euclid and his contemporaries conceived of these principles of proof in a manner very different from modern geometric axioms, and that they were designed with purposes and functions quite distinct from those of modern axioms. In particular, the talk puts forward two conjectures regarding the origin and role of the postulates. (1) Hypothesis on the dialectical origin of the postulates: an analysis of Greek sources suggests that these principles were initially introduced to counter skeptical arguments regarding the possibility of geometry. Through the postulates, Euclid intended to guarantee a minimum of ideality of geometric operations, without having to engage with philosophical theses on the ontology of mathematics, and to distance theoretical geometry from Greek practices of measuring the earth and sky. (2) Hypothesis on the inferential role of the postulates: as a consequence of the first hypothesis, the talk suggests that the postulates of Euclid's *Elements* did not have a semantic role and therefore did not assert primitive truths about geometric objects. On the contrary, they served to enable proofs and had a purely performative and inferential role. This radically distinguishes ancient postulates from modern axioms, which are instead semantic and express elementary facts about objects in a domain. The talk concludes with some general reflections on the origin of axiomatic thinking, on the peculiarities of this form of organization of mathematical thought, and on the historical possibility of discovering alternative geometries in ancient Greece.

▶ JULIETTE KENNEDY, *On the nuancing of first order logic: the view from set theory.*

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Fundamental to the practice of logic is the dogma regarding the first order/second order logic distinction, namely that it is ironclad. Was it always so? The emergence of the set theoretic paradigm is an interesting test case. Early workers in foundations generally used higher order systems in the form of type theory; but then higher order systems were gradually abandoned in favour of first order set theory—a transition that was completed, more or less, by the 1930s.

In this talk I will look at first order logic (FOL) from various points of view, arguing that the distinction between first order and higher order logics, such as second order logic, is somewhat context dependent. From the philosophical or foundational point of view this complicates the picture of first order logic as a canonical logic. At the same time other set-theoretic perspectives reinforce the canonicity of FOL.

▶ JACK H. LUTZ, *Effective fractal dimensions.*

Department of Computer Science, Iowa State University, 139 Durham Center for Computation and Communications, 613 Morrill Road Ames, Iowa 50011, USA.
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This talk surveys research progress on effectivizations of Hausdorff and packing dimensions. The effectivizations range from algorithmic, i.e., Σ_1^0, through time-and space-bounded to finite-state. The progress includes applications in geometric measure theory, algorithmic information theory, computational complexity, and analytic number theory. The conceptual unity underlying such diverse applications is emphasized.

▶ LAWRENCE MOSS, *How to not give up on logic.*
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One of the original motivations for logic is as a foundation for inference in language – the study of what follows from what – especially when we use sentences that formalize easily, and where "inference" is understood as "model-theoretic consequence". We can motivate Aristotle's syllogistic logic by its connection to inference in language. Contemporary logic developed largely to address the foundations of mathematics. Once of it centerpieces is first-order logic and fully mathematical definitions of logical consequence. As everyone knows, standard logical systems like first-order logic are much more powerful than syllogistic logic. Contemporary logic renders syllogistic logic largely obsolete. Anyways, the matter of inference in language is also not well-studied by logicians. It also is not addressed much by linguistic semanticists, though they have tools like Montague grammar and its descendants which really could address it.

This talk returns to inference in language, asking contemporary questions on an ancient topic.

Since the late 2010's, machines can do logical inference in natural language at human level, if not better in some ways. Thus, we have a watershed moment in the history of logic. One might even think that we should give up on understanding human inference in language, either on idealized inference as we usually do in logic, or on actual human-level inference, mistakes and all, as cognitive scientists prefer to do. This talk is for people who don't want to give up on logic as a tool for understanding inference in language.

My one sentence-summary above ignores an important development. Around the time that language models started to do well on "NLI" (natural language inference, in a specific stylized sense), several groups of people were exploring traditional tools that can perform inference on the computer. I survey a number of directions that come from this work and from more recent work that combines logic and AI. First, extended forms of syllogistic logic can handle much of what goes on in everyday inference. There are a plethora of logical systems in this area. The axioms and rules of inference are attractive, the systems are complete, and their consequence relations are decidable. In some cases there are computer implementations and teaching materials. Second, there is a "monotonicity calculus", a kind of order-theoretic version of the typed lambda calculus, where the order has to do with inference in a general sense. Finally, we can put logic together with AI in a number of ways. So the talk will end with a survey of current work in the neuro-symbolic AI area that call on logic.

▶ CAROLINE TERRY, *On the structure of sets of bounded VC_2-dimension in elementary abelian p-groups.*
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We begin by presenting work of the author and Julia Wolf from 2021 showing that any subset of an elementary abelian p-group of bounded VC_2-dimension is well approximated by a union of atoms of a quadratic factor (in other words, by a union of fibres of a bilinear form). This result relies on a general quadratic arithmetic regularity lemma of Green and Tao, and consequently, yields bounds on the linear and quadratic complexities of the factor which are of tower-type. We then present more recent work which improves the bound on the quadratic complexity to logarithmic (joint with Julia Wolf), and work which improves the bound on the linear complexity to triple exponential (joint with Hannah Sheats).

Abstract of the panel discussion

▸ W.B. EWALD, ANTON FREUND, AND WILFRIED SIEG, *The Hilbert Problem.*
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Our panel intends to examine The Hilbert Problem. This is not a mathematical problem formulated by Hilbert but rather an intellectual problem facing the community of logicians, mathematicians, and philosophers concerned with the foundations of mathematics. Formulated as a question, the problem is this: "Has Hilbert's work had a lasting impact on foundational investigations?" We try to provide material for reflection on this problem by addressing three other questions, namely, "What have we learned about Hilbert's foundational thinking and work?", "What are highlights of subsequent proof theoretic work?", and "What are methodological frames for the (foundational) aspirations of proof theory?".

1. Addressing misconceptions about Hilbert. (Ewald) The most prevalent misconception is the assertion that Hilbert's finitist consistency program was just a reaction to the growing influence of Brouwer's and Weyl's intuitionism, and that its failure was established by Gödel's incompleteness theorems. Due to the reexamination of Hilbert's unpublished lecture notes in Göttingen, it is now clear that Hilbert's methodological interests are deeply rooted in the evolution of "modern" mathematics in the second half of the 19th century. Another deep-seated misconception is to attribute to Hilbert a philosophical formalism when he viewed the formalizability of mathematics as a tool for addressing the consistency problem with constructive, finitist means.

2. Directions in proof theory. (Freund) An ordinal-centered part of proof theoretic investigations was sparked by Gentzen's work on elementary number theory. It was extended to subsystems of analysis (second-order arithmetic) and then to subsystems of ZF set theory. The mathematical results that have been obtained by quite complex constructions are impressive. Other important directions are, for example, Gödel's functional interpretation, the proof-mining program, reverse mathematics, proof theoretic semantics, as well as applications in computer science.

3. A philosophical perspective. (Sieg) Stepping back from the details of historical developments and proof theoretic results, one can look at the remarkable volumes of "Grundlagen der Mathematik" in which the mathematical work of Hilbert and Bernays culminated. As for the foundational/ philosophical side, one can take the reflections of Bernays (from the 1930s to the mid-1970s) as a starting-point to describe "methodological frames" that can, in turn, be mathematically investigated. - There is one other direction for proof theory that was intended to become Hilbert's 24th Paris Problem; namely, to consider mathematical proofs as objects. This seems to be a promising direction for future investigation.

Abstracts of invited talks in the Special Session on Computability Theory

▸ HEIDI BENHAM, *Problem reducibilities of topologically inspired order principles.*
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A recent paper by Benham, DeLapo, Dzhafarov, Solomon, and Villano [1] analyzes computability theoretical and reverse mathematical strength of a topological theorem by Ginsburg and Sands [2], along with that of weakened versions of the theorem. The original theorem states that every infinite topological space has an infinite subspace homeomorphic to one of the following on the natural numbers: indiscrete, initial segment, final segment, discrete, or cofinite. In this original paper, it is claimed that the theorem is a consequence of Ramsey's Theorem for pairs, and though it has been shown by Benham, et al. that the full theorem is equivalent to ACA_0 over RCA_0, there is a weakened version that is equivalent to the chain/antichain principle (CAC), a consequence of Ramsey's Theorem for pairs (RT^2). One interesting feature of the proof of this equivalence is that, not only an application CAC, but also an application of the ascending/descending sequence principle (ADS), which is a consequence of CAC, is used. This inspires the question of whether this weakened version of the Ginsburg–Sands Theorem and CAC, when viewed as problems, are Weihrauch equivalent.

I will present some new progress that has been made on this question. This progress involves developing several new combinatorial problems related to CAC and ADS, one of which is Weihrauch equivalent to the weakened version of the Ginsburg-Sands Theorem, and showing a variety of reducibilities between them.

[1] Heidi Benham, Andrew DeLapo, Damir D. Dzhafarov, Reed Solomon, and Java Darleen Villano, *The Ginsburg–Sands theorem and computablity theory*, ***Advances in Mathematics***, vol. 444 (2024), no. 109618, 57, pp. 1–57.

[2] John Ginsburg and Bill Sands, *Minimal infinite topological spaces*, ***The American Mathematical Monthly***, vol. 86 (1979), no. 7 pp. 574–576.

▸ JASON BLOCK, *Computability for tree presentations of continuum-size structures.*
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(Joint work with Russell Miller). Although immune from traditional computability theory, many continuum-size structures can be effectively presented as the set of paths through a countable tree. We discuss several variants for how to define tree presentations and examine the complexity of subsets, elementarity of substructures and computability of Skolem functions for our tree presentable structures. Additionally, we define the notion of *tree-decidability* as an analog to the definition of decidability for countable structures. We will see how these notions apply to certain well-known tree presentable structures, such as the p-adic integers.

▸ JOHANNA FRANKLIN*, DINO ROSSEGGER, AND DAN TURETSKY, *Highness for Scott rank.*
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A Turing degree is said to be high for isomorphism if it can compute an isomorphism between any pair of isomorphic computably presented structures. Here, we define a similar notion: a degree is said to be high for Scott rank α if, for every computable structure $\mathcal{A}$ of Scott rank α and all computable $\mathcal{B} \cong \mathcal{A}$, it computes an isomorphism from $\mathcal{B}$ to $\mathcal{A}$. We define highness for computably defined Scott rank α similarly, and we characterize the degrees with these properties for $0 < \alpha < \omega_1^{ck}$.

▸ PETER GERDES, *Comparing notions of dense computability on ω^ω and 2^ω.*
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A relatively new topic in computability theory [2, 3, 1, 4] is the study of notions of computation that are robust against mistakes on some kind of small set. However, despite the recent popularity of this topic relatively foundational questions about the notions of reducibility involved still persist. In this talk, I will examine two notions of robust information coding, effective dense reducibility and coarse reducibility and answer the question posed in [1]: whether the degrees of functions under these reductions are the same as the degrees of sets. Specifically, I will show that the uniform (and hence non-uniform) coarse degree of every sufficiently generic function (element of ω^ω) does not contain a set while every non-uniform (and hence uniform) effective dense degree contains a set. Time permitting, I will explore the vastly different complexities of these two notions of robust information coding.

[1] Eric P. Astor, Denis R. Hirschfeldt, and Carl G. Jockusch, *Dense computability, upper cones, and minimal pairs*, ***Computability***, vol. 8 (2019), no. 2, pp. 155–177.

[2] Damir D. Dzhafarov and Gregory Igusa, *Notions of robust information coding*, ***Computability***, vol. 6 (2017), no. 2, pp. 105–124.

[3] Carl G. Jockusch Jr. and Paul E. Schupp, *Generic computability, Turing degrees, and asymptotic density*, ***Journal of the London Mathematical Society***, vol. 85 (2012), no. 2, pp. 472–490.

[4] Sebastiaan A. Terwijn, *Computability and measure*, Ph.D. thesis, University of Amsterdam, 1998.

▸ DAVID GONZALEZ, *Effective aspects of the tree of tuples construction.*
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The tree of tuples construction was first described by Friedman and Stanley in their 1989 paper, which introduced the notion of Borel reducibility. Of the reductions they describe, it is the most complicated and unfamiliar. That said, it is very powerful, and it has been used in many sophisticated arguments involving Borel reductions. Recent work has gone into understanding the complexity of this construction from the point of view of computability. We discuss the effect of the construction on the existence of computable Scott sentences describing the isomorphism type of a structure. We will also describe the effectiveness of partial inverses that act on all structures of a particular Scott rank.

This talk is based on joint work with Julia Knight and Matthew Harrison-Trainor.

▸ DAVID GONZALEZ, MENG-CHE "TURBO" HO*, AND JULIA KNIGHT, *Scott analysis of the Farey Graph.*
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The Farey sequence of order n is the sequence of reduced fractions with denominators $\leq n$, arranged in order of increasing size. The Farey graph encodes adjacency in the Farey sequence. The Farey graph appears in many ares of math, including number theory, hyperbolic geometry, and geometric group theory.

In [1], Khangheshlaghi and Tent gave a set of axioms for the theory T of the Farey graph: it is a graph with no vertices of valency 1 where every edge is contained in

exactly two triangles and every finite subgraph has a removable vertex. They showed that T is ω-stable of rank ω. They also showed elimination of quantifiers in a language with some added predicates.

We consider the Scott analysis of the models of the theory T of the Farey graph. We show that the Farey graph has a computable Π_2 Scott sentence, and in fact, it is the only model of T with a Π_2 Scott sentence (Scott rank 1). We show that T is Σ_1-small, namely, has only countably many Σ_1 types, but not Σ_2-small. We charaterize the models of T with parametrized Scott rank 1 as those containing only finitely many copies of the Farey graph. Finally, we show that $\mathrm{Mod}(T)$ lies on top under Borel embeddings.

[1] Zahra Mohammadi Khangheshlaghi and Katrin Tent, *On the model theory of the Farey graph*, arXiv2503.02121.

▸ VALENTINA HARIZANOV, *Complexity of exact and approximate isomorphisms.*
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We investigate how isomorphic copies of countable structures relate via isomorphisms of certain arithmetic complexity, as well as via effective approximate isomorphisms that are sufficiently accurate as measured using the notion of asymptotic density. For example, when computable isomorphic structures are not computably isomorphic, we investigate whether they are approximately computably isomorphic, such as generically computably isomorphic. We say that an isomorphism F from a structure A to a structure B is *generically computable* if there is a substructure of A with a computably enumerable universe C, with both C and its image under F being of asymptotic density one, and there is a partial computable function θ with domain C such that θ is equal to F on C. This investigation can be generalized to Δ_n isomorphisms and generic Δ_n isomorphisms.

This is joint work with Wesley Calvert, Doug Cenzer, and David Gonzalez.

▸ NEIL LUTZ, *Algorithmic information bounds for distances and orthogonal projections.*
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We introduce a new technique for proving bounds on the Kolmogorov complexity of geometric objects in Euclidean space, such as points and lines. We apply this technique to prove two theorems on algorithmic information theory, both of which have consequences for well-known problems in geometric measure theory. First, we show that for any point x in the plane and any other point y sufficiently independent of x, the distance between x and y retains at least half the complexity of the original point x. By the point-to-set principle of J. Lutz and N. Lutz, this yields an improved lower bound on the Hausdorff dimension of pinned distance sets, a topic closely related to Falconer's distance set conjecture. Second, we prove an analogous result for orthogonal projections: for any point x in the plane and any line through the origin which is sufficiently independent of x, the projection of x onto that line retains at least half the complexity of x. As a consequence, we obtain a generalization of a theorem of Bourgain on exceptional sets for orthogonal projections. This is joint work with Peter Cholak, Mariana Csörnyei, Patrick Lutz, Elvira Mayordomo, and D.M. Stull.

▸ PATRICK LUTZ, *The Kučera-Gács Theorem and computable measures.*
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The Kučera-Gács Theorem states that every real is computable by some Martin-Löf random real. We consider the question of whether this holds for every non-trivial (i.e. not completely atomic) computable measure and show that it does not. In particular, there is a non-trivial computable measure μ on $2^{\mathbb{N}}$ such that no real which is Martin-Löf random for μ computes $0'$. Moreover, the measure μ that we construct to prove this theorem has a number of other interesting properties. For example, every real which is Martin-Löf random for μ is actually 2-random for μ. In other words, μ exhibits a kind of "speed-up" property with respect to levels of randomness. Our proof uses ideas first developed independently by Levin and Kautz to prove related results and we will explain how this new result fits into the context of their results.

► MARIYA SOSKOVA, *Intuitionism and computing with partial information.*
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Following a program developed by Kolmogorov, Medvedev [5] and Muchnik [6] introduced lattices of mass problems of total functions to provide a semantics for intermediate propositional logics. While the full Medvedev and Muchnik lattices model the Jankov logic (JAN)—the intermediate logic obtained by adding to intuitionistic propositional calculus the weak law of excluded middle—it was eventually shown by Skvortsova [7] and by Sorbi and Terwijn [8] that specific initial segments of these lattices model exactly the intuitionistic propositional calculus (IPC). Both results were later improved by Kuyper [2, 3], who explicitly exhibited initial segments arising from "natural" mass problems.

In this work, we shift the focus to the framework of partial information by investigating the Dyment and Dyment–Muchnik lattices, which were introduced by Dyment [1]. These lattices are based on enumeration reducibility ($\leq_e$) rather than Turing reducibility. We prove that there exist initial segments of both the Dyment and Dyment–Muchnik lattices that yield Brouwer algebras modeling exactly IPC. The construction for the Dyment–Muchnik lattice is of particular interest: unlike the Muchnik case, which relies on the Lachlan-Lebeuf theorem [4] for initial segments of Turing degrees, our result requires the construction of a splitting class of enumeration degrees. This highlights a significant structural divergence, as we observe that several naturally definable classes of enumeration degrees—despite being downwards closed—fail to form splitting classes. Finally, we show that, like their total counterparts, the full Dyment and Dyment–Muchnik lattices model JAN.

This is joint work with Ganchev, Shafer, Slaman, and Sorbi.

[1] E. Z. Dyment, *Certain properties of the Medvedev lattice*, ***Mathematics of the USSR Sbornik***, vol. 30 (1976), pp. 321–340.

[2] R. Kuyper, *Natural factors of the Muchnik lattice capturing IPC*, ***Annals of Pure and Applied Logic***, vol. 164 (2013), no. 10, pp. 1025–1036.

[3] ——— *Natural factors of the Medvedev lattice capturing IPC*, ***Archive for Mathematical Logic*** vol. 53 (2014), no, 7, pp. 865–879.

[4] A.H. Lachlan and R. Lebeuf, *Countable initial segments of the degrees.* ***The Journal of Symbolic Logic***, vol. 41 (1976), pp. 289–300.

[5] Y.T. Medevdev, *Degrees of difficulty of the mass problems* ***Doklady Akademii Nauk SSSR***, vol. 104 (1955), no. 4, pp. 501–504.

[6] A.A. Muchnik, *Title of article On strong and weak reducibility of algorithmic problems*, ***Sibirskii Matematicheskii Zhurnal*** vol. 4 (1963), pp. 1328–1341.

[7] E.Z. Skvortsova, *Faithful interpretation of the intuitionistic propositional calculus by an initial segment of the Medvedev lattice*, ***Siberian Mathematics Journal***, vol. 29 (1988), no. 1, pp. 133–139.

[8] A. Sorbi and S. Terwijn, *Intuitionistic logic and Muchnik degrees*, ***Algebra Universalis***, vol. 67 (2012), no. 2, pp. 175–188.

Abstracts of invited talks in the Special Session on Logic in Computer Science

▶ ROBERT ANDREWS, *A survey of the ideal proof system.*
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Propositional proof complexity is a subfield of theoretical computer science that studies the difficulty of proving propositional tautologies. The long-term goal of proof complexity is to shed light on—and ideally resolve—the NP versus coNP question by finding families of propositional tautologies that cannot be efficiently proved in increasingly stronger proof systems. This rich area studies various proof systems inspired by logic, algebra, and geometry, and has found surprising connections to other areas of computer science such as circuit complexity, cryptography, and the theory of total search problems.

A recent paper of Grochow and Pitassi [1] introduced a new proof system based on Hilbert's Nullstellensatz, which they called the *Ideal Proof System*. Proofs in the Ideal Proof System are certificates for ideal (non-)membership in polynomial rings and are represented in a succinct manner using arithmetic circuits. On the one hand, this succinct representation makes the Ideal Proof System rather strong, and hence makes it challenging to prove lower bounds on the size of proofs; on the other hand, this enables the use of tools from arithmetic circuit complexity in studying the Ideal Proof System and restrictions thereof. This talk will introduce the Ideal Proof System and survey the past decade of progress towards proving lower bounds on the size of proofs in the Ideal Proof System.

[1] Joshua A. Grochow and Toniann Pitassi, *Circuit Complexity, Proof Complexity, and Polynomial Identity Testing: The Ideal Proof System*, ***Journal of the ACM***, vol. 65 (2018), no. 6, pp. 37:1–37:59.

▶ JOANNA BOYLAND, *A proof-theoretic compilation from natural deduction to the semi-axiomatic sequent calculus.*
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The semi-axiomatic sequent calculus (Sax) is a dialect of the sequent calculus whose computational interpretation makes store explicit, making it a good intermediate language for a compiler. We exhibit a translation from natural deduction to Sax that preserves truth and the subformula property. In related work, we have shown an extension of this translation (allowing recursion) to be observationally correct with respect to an operational semantics. Because the source and target languages and the translation are based on proof theory, they extend to adjoint logic (which combines structural and substructural logic) but for simplicity we will present the purely linear version. Our translation has been implemented in a research compiler for a substructural functional programming language.

(Joint work with Frank Pfenning)

▶ FARZANEH DERAKHSHAN, *Mixed assurance reasoning via labeled bunches.*
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Large software systems are usually multi-component and concurrent. While formal verification provides the highest assurance, it is not realistic to verify all components of a system. Instead, lower-effort approaches, such as testing, have been widely adopted in industry to analyze non-critical components. As such, a large system may include components analyzed differently: some are fully verified, and the rest are tested. Currently, there is no reasoning system that can soundly compose these heterogeneous analyses and derive the overall formal guarantees of the entire system. The traditional compositional reasoning technique is sound for verified components that undergo over-approximated reasoning, but not for components that undergo under-approximated reasoning, e.g., via testing. In this talk, I will present our proof system, LabelBI, which provides a logical foundation for composing heterogeneous analysis, allowing for deploying both over-approximated (verification) and under-approximated (testing) reasoning. LabelBI focuses on systems that can be modeled as a collection of communicating processes. Each process owns its internal resources and a set of channels through which it communicates with other processes. The key idea of LabelBI is to quantify the guarantees obtained about the behavior of a process as a test level, which captures the constraints under which each guarantee is analyzed to be true. The domain of the test level is determined by the internal resources of the process. LabelBI is designed based on the logic of bunched implications that allows for distinguishing between shared and disjoint underlying resources. I will present the key ideas behind the design of LabelBI and explain its soundness properties, established via a trace semantics and cut elimination. Time permitting, I will also demonstrate the implementation of LabelBI.

▸ PHOKION G. KOLAITIS, *On disjunctions of dependence atoms.*
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Dependence logic is a formalism that augments the syntax of first-order logic with dependence atoms asserting that the value of a variable is determined by the values of some other variables, that is, dependence atoms express functional dependencies in relational databases. On finite structures, dependence logic captures NP, hence there are sentences of dependence logic whose model-checking problem is NP-complete. In fact, it is known that there are disjunctions of three dependence atoms whose model-checking problem is NP-complete. Motivated from considerations in database theory, we study the model-checking problem for disjunctions of two unary dependence atoms and establish a trichotomy theorem, namely, for each such formula, one of the following is true for the model-checking problem: (i) it is NLOGSPACE-complete; (ii) it is LOGSPACE-complete; (iii) it is first-order definable (hence, in AC^0). This is joint work with Nicolas Fröhlich and Arne Maier at the Leibniz University of Hannover.

▸ SHAY ALLEN LOGAN, *An epistemic probabilistic dynamic logic.*
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Suppose you've written a pair of programs $\mathtt{p}$ and $\mathtt{q}$ and you're at least 90% that each of the following is true:

1. Whenever A is true of the state of your machine, a successful execution of $\mathtt{p}$ will put the machine in a state where B is true, and
2. Whenever C is true of the state of your machine, a successful execution of $\mathtt{q}$ will put the machine in a state where D is true.

Using the language of propositional dynamic logic (PDL), these are beliefs about the probability of $A \to [\mathtt{p}]B$ and $C \to [\mathtt{q}]D$ being true.

Now let $\mathtt{r}$ be the program $?\mathtt{A}; \mathtt{p} \cup ?\mathtt{C}; \mathtt{q}$. Intuitively, $\mathtt{r}$ executes $\mathtt{p}$ if A is true or $\mathtt{q}$ is

C is true. Given that you are at least 90% confident in each of the above statements, how confident should you be in the claim that successful executions of `r` terminate in states where $B \vee D$ is true?

The purpose of my talk is to introduce and motivate a logic that can be used to answer this sort of question. Syntactically, the language I consider has atomic formulas of the form $\Pr(\gamma) > q$ where γ is a formula in the language of PDL and q is a rational number. Intuitively, these formulas are meant to be interpreted as giving (epistemic) probability judgments modeling credences—e.g. the first of the claims discussed above is represented via the formula $\Pr(A \to [\mathtt{p}]B) > 0.9$.

This much has been done before. The novelty in what I'll present is in my semantics, where the probability operators are interpreted via probability measures on the space of all possible program valuations. This gives a decidedly more epistemic interpretation to the resulting logic than is present in existing systems. I will present a few proof systems for the validities of this language and state metatheoretic results for them.

► MAX KANOVICH, STEPAN L. KUZNETSOV, AND ANDRE SCEDROV*, *Complexity for product-free infinitary action logic.*
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Infinitary action logic ACT_ω [2] is an infinitary substructural logic with product and two residuals, lattice operations, constants 0 and 1, and Kleene star. Theoremhood in ACT_ω is Π^0_1-complete [2]; derivability from hypotheses is Π^1_1-complete [4]. We consider the *product-free fragment* of ACT_ω, where there are no product and join, no constants, and Kleene star is replaced by so-called *iterative divisions*: $A^* \setminus B$ and $B \,/\, A^*$. Unlike ACT_ω itself, this fragment is strongly complete w.r.t. natural classes of models: on formal languages and on binary relations [5]. For this fragment, we proved Π^1_1-completeness of derivability from hypotheses [3], combining ideas of Kozen [4] and Buszkowski [1].

[1] Wojciech Buszkowski, *Some decision problems in the theory of syntactic categories*, ***Zeitschrift für mathematische Logik und Grundlagen der Mathematik***, vol. 28 (1982), pp. 539–548.

[2] Wojciech Buszkowski, Ewa Palka, *Infinitary action logic: complexity, models and grammars*, ***Studia Logica***, vol. 89 (2008), no. 1, pp. 1–18.

[3] Max Kanovich, Stepan L. Kuznetsov, Andre Scedrov, *Complexity of equational theories for relational and language action lattices*, ***Relational and Algebraic Methods in Computer Science***, LNCS vol. 16526, Springer, 2026 (to appear).

[4] Dexter Kozen, *On the complexity of reasoning in Kleene algebra*, ***Information and Computation***, vol. 179 (2002), pp. 152–162.

[5] Stepan L. Kuznetsov, *Strong conservativity and completeness for fragments of infinitary action logic*, ***Siberian Electronic Mathematical Reports***, vol. 21 (2024), no. 2, pp. 789–809.

► ILYA SHAPIROVSKY, *On modal satisfiability problems in geometric spaces.*
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Modal language is known to be an efficient formalism for working with relational structures: while various properties of relations are modally expressible, the resulting

theories are often decidable. In this talk, I will be interested in languages with distance-induced modalities. This direction has been studied since the 2000s by A. Kurucz, O. Kutz, H. Sturm, N.-Y. Suzuki, F. Wolter, M. Zakharyaschev, and others; see, e.g., [5, 8, 3, 4]. The corresponding modal languages are expressive enough to capture aspects of spaces such as colorability, packing problems, as well as various forms of dimension and connectedness.

I will present a series of recent results. I will discuss decidability of modal satisfiability in the class of (connected) non-k-colorable graphs [6]. Then I will give an overview of recent results on modal expressivity in real and rational metric spaces obtained in joint work with G. Agnew, U. Gutierrez-Hougardy, J. Harding, and J. West [1]. Finally, I will announce our joint result with J. Harding on the logic of connected metric spaces: in the language of topological, universal, and a single distance modality, this logic enjoys both a finite axiomatization and the finite model property, which yields that the corresponding satisfiability problem is decidable [2]. This result sharpens the one by V. Shehtman [7] on the logic of connected spaces with universal and topological modalities, and makes progress towards the decision problem in richer modal languages [3, Problem 6].

[1] Gabriel Agnew, Uzias Gutierrez-Hougardy, John Harding, Ilya Shapirovsky, and Jackson West, *On distance logics of Euclidean spaces*, 2025, ***Studia Logica***, to appear.

[2] John Harding and Ilya Shapirovsky, *On modal logics of connectedness in metric spaces*, 2026, in preparation.

[3] A. Kurucz, F. Wolter, and M. Zakharyaschev, *Modal logics for metric spaces: Open problems*, ***We will show them! essays in honour of dov gabbay, volume two*** (Sergei N. Artëmov, Howard Barringer, Artur S. d'Avila Garcez, Luís C. Lamb, and John Woods, editors), College Publications, 2005, pp. 193–108.

[4] O. Kutz, *Notes on logics of metric spaces*, ***Studia Logica***, vol. 85 (2007), no. 1, pp. 75–104.

[5] O. Kutz, H. Sturm, N.-Y. Suzuki, F. Wolter, and M. Zakharyaschev, *Axiomatizing distance logics*, ***Journal of Applied Non-Classical Logics***, vol. 12 (2002), no. 3-4, pp. 425–439.

[6] Ilya Shapirovsky, *Decidability of modal logics of non-k-colorable graphs*, ***Logic, language, information, and computation*** (Helle Hvid Hansen, Andre Scedrov, and Ruy J.G.B. de Queiroz, editors), Springer Nature Switzerland, 2023, pp. 351–361.

[7] V. B. Shehtman, *"Everywhere" and "Here"*, ***Journal of Applied Non-Classical Logics***, vol. 9 (1999), no. 2-3, pp. 369–379.

[8] F. Wolter and M. Zakharyaschev, *A logic for metric and topology*, ***The Journal of Symbolic Logic***, vol. 70 (2005), no. 3, pp. 795–828.

▸ SHAY LOGAN AND WILL STAFFORD*, *'Fine-style' proof theoretic semantics for B*.
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'Fine-style' models of relevance logics replace the ternary accessibility relation of Routley-Meyer models with a binary accessibility relation and a binary application operation on the points in the model. It is noteworthy that a prominent interpretation of these models interprets those points as theories [1, 2]. Theories are viewed syntactically as sets of sentences closed under some minimal theory-building practices. This setup has several philosophical and technical parallels to a proof-theoretic semantics, namely the base-extension semantics developed in [3, 4, 5, 6]. However, from the proof-theoretic perspective the appearance of logical operators in the theories is suspect. The

goal of this paper is to show that this suspicion can be allayed. Rather than treating the points in the models as theories, the advocate of 'Fine-style' models can derive theories from rules governing inferences between atomic formulas. We provide a 'Fine-style' base-extension semantics for the positive fragment of B and its extensions. The identity element and application operation are directly constructed from atomic rules and the 'Fine-style' implication condition is supplemented with a modification of the conjunction and disjunction conditions found in [7].

[1] Kit Fine, *Models for entailment*, ***Journal of Philosophical Logic***, vol. 3 (1974), no. 4, pp. 347–372.

[2] Shay Allen Logan, ***Relevance Logic***, Cambridge Elements, Cambridge University Press, 2024.

[3] Tor Sandqvist, *Classical Logic Without Bivalence*, ***Analysis***, vol. 69 (2009), no. 2, pp. 211–218.

[4] ——— *Base-extension Semantics for Intuitionistic Sentential Logic*, ***Logic Journal of the IGPL***, vol. 23 (2015), no. 5, pp. 719–731.

[5] Alexander V. Gheorghiu, Tao Gu, and David J. Pym, *Proof-Theoretic Semantics for Intuitionistic Multiplicative Linear Logic*, ***Studia Logica***, (2024), pp. 1–61.

[6] Alexander V. Gheorghiu and David J. Pym, *From proof-theoretic validity to base-extension semantics for intuitionistic propositional logic*, ***Studia Logica***, (2025), pp. 1–33.

[7] Tao Gu, and Alexander V. Gheorghiu, and David J. Pym, *Proof-theoretic semantics for the logic of bunched implications*, ***Studia Logica***, (2025), pp. 1-52.

▶ CAROLYN TALCOTT, *Diverse roles of logic based models.*
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Logic based models can be used in many ways in designing and/or understanding natural and constructed systems. The traditional role is formal analysis to check satisfaction of logical properties of interest or find problems that need to be fixed. The same model can be used in other ways including simple prototyping, performance analysis, as a system component, a test generator, or a hypothesis generator. Using the same model to answer different questions provides a coherent picture and allows to sytematically relate different views of a system under study.

In this talk we will we describe a variety of roles of logical models based on experience using models specified in the Maude rewriting logic language. We discuss features, techniques, and tools supporting different uses of logical models.

▶ HENRY TOWSNER, *What proofs can be.*
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Throughout proof theory, proofs are often taken to be well-founded (often finite) trees of inferences. Theories of inductive definitions, among other theories, bump up against the limitations of this perspective, and a variety of formalisms have been used to push beyond this - Girard's beta-proofs, non-well-founded proofs, proofs-as-functions. We briefly describe some features of these approaches, the way these perspectives are essentially equivalent, and the way well-foundedness reasserts itself as a core property of proofs.

Abstracts of invited talks in the Special Session on
Model Theoretic Algebra (in memoriam Zoé Chatzidakis)

▸ JANANAN ARULSEELAN, *Continuous model-theoretic operator algebra.*
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We will discuss how continuous model theory can be used to study operator algebraic structures such as C*-algebras and von Neumann algebras. We will overview some recent directions of work in these topics.

▸ ALEXI BLOCK GORMAN, *Characterizing geometries in automatic structures.*
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Ever since Julius Büchi established a connection between automata and structures coming from mathematical logic, there has been a rich exploration of this correspondence. There is a natural link between the boolean algebra of definable sets and that of automata and the "regular languages" that they recognize. When we take the further step of associating strings in an integer base with the numbers that they represent, we are also able to draw connections between geometric phenomena and properties of automata. For example, say that a subset X of the reals is "k-regular" if there is a Büchi automaton that accepts the base-k representations of every element of X, and rejects the representations of each element in its complement. Generalizing this, any additive group of numbers is k-regular if all of its definable sets are k-regular, and this lets us talk about "automatic groups" and automatic structures. In this talk, we will characterize automatic subgroups of the real additive group by their geometries, and discuss more generally for which classes of automatic structures do we know the possible geometries are that arise, with an eye toward locating them concretely in the world of "tame geometry" beyond o-minimality.

▸ BLAISE BOISSONNEAU, *Some fields, no medal.*
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The classification of fields regarding model theoretic dividing lines is an open problem with many interesting conjectures. I will state the main conjectures on stable, NIP, simple and NTP2 fields, present some of the literature on this subject, and focus in more details on recent developments in NTP2 fields, with the quantifier elimination results for some Hahn series field of positive characteristic, obtained in collaboration with Sylvy Anscombe. This notably applies to the Hanh series field with residue field Fp and with value group Q, in which every formula is equivalent to positive boolean combination of formulas with one existential quantifier and one polynomial equation. A large fragment of these formulas are known to be NTP2, although some gap remains.

▸ NICOLAS CHAVARRIA GOMEZ, *Binding groups in continuous logic.*
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In joint work-in-progress with Rahim Moosa, we explore the notion of internality in continuous logic and show that, whenever this phenomenon arises in a metric structure, a definable binding group arises together with it. This requires navigating some of the difficulties of what definability means in the continuous sense. We also explore some

related concepts regarding the properties of the action of this group.

▶ CHRISTIAN D'ELBÉE, *Lie methods for omega-categorical Engel groups.*
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A structure (group, Lie algebra, associative algebra, etc) M is ω-categorical if there is a unique countable model of its first-order theory, up to isomorphism. This model theoretic notion has a dynamical definition: M is ω-categorical if and only if there are only finitely many orbits in the component-wise action of $\mathrm{Aut}(M)$ on the cartesian power M^n, for all natural numbers n. In 1981, Wilson conjectured that any ω-categorical locally nilpotent p-group is nilpotent. If true, a quite satisfactory decomposition of every ω-categorical group would follow. This conjecture is very much open more than 40 years later. The analogue statement for Lie algebras (every locally nilpotent ω-categorical Lie algebra is nilpotent) is also open. Both statements can be reformulated as: is any ω-categorical Engel group/Lie algebra nilpotent. As such, those questions are connected to Burnside-type problems and the work of Higman, Kostrikin, Zelmanov, Vaughan-Lee, etc. In this talk, methods for reducing group-theoretic questions to Lie algebra questions (so-called *Lie methods in group theory*) will be expounded in the ω-categorical context, in order to solve some cases of the Wilson conjecture.

▶ YUYAN HE, *Sum-product phenomenon via dimension.*
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A classical result of Erdős and Szemeredi [2] shows that there is no subset A of the integers such that both the sumset $A+A$ and the productset AA are small. Breuillard, Katz and Tao [1] found a similar result for the subsets of finite prime fields of "medium size". On the side of model theory, Hrushovski's [3] pseudo-finite dimensions has been shown useful in the study of finite combinatorics.

We show that under certain mild assumptions on an abstract dimension theory, a "medium sized" type-definable subset of a field with small sumset and productset in the sense of not expanding in dimension indicates the existence of a definable subfield of the same dimension. This is based on joint work with Sergei Starchenko.

[1] Jean Bourgain, Nets Katz, and Terence Tao, *A sum-product estimate in finite fields, and applications*, ***Geometric and Functional Analysis***, vol. 14 (2004), pp. 27–57.

[2] Paul Erdős and Endre Szemerédi, *On sums and products of integers*, ***Studies in Pure Mathematics: To the Memory of Paul Turán*** (Paul Erdős, László Alpár, Gábor Halász and András Sárközy, editors), Birkhäuser Basel, Basel, 1983, pp. 213–218.

[3] Ehud Hrushovski, *On Pseudo-Finite Dimensions*, ***Notre Dame Journal of Formal Logic***, vol. 54 (2013), no. 3-4, pp. 463–495.

▶ SCOTT MUTCHNIK, *Classifying classification-theoretic properties.*
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This is on joint work with Gabriel Day.

Shelah's classical hierarchy of unstable first-order theories has seen surprising success in classifying and developing a structure theory for some of the most important

algebraic objects appearing throughout mathematics. Some of the properties in this hierarchy have been known to satisfy the condition, examined by Shelah and later by Bailetti, of straight definability: they are characterized by a pattern of consistency and inconsistency within an individual formula. For example, the class of NSOP_2 theories, shown by Chernikov and Ramsey to contain the theory of omega-free PAC fields, is straightly definable, as is the class of NTP_2 theories, which Montenegro shows contains the theory of pseudo-real closed fields. However, it has been open whether the framework of straight definability is powerful enough to capture all of the classical properties necessary to classify key cases of algebraic interest: while the class of NSOP_4 theories includes, say, the theories of the curve-excluding fields of Johnson and Ye and of the generic c-nilpotent Lie algebras of D'Elbée, Müller, Ramsey and Siniora, it has not been known whether NSOP_n is straightly definable for n greater than 3, even when n is an integer.

We discuss our proof that, contrary to expectations, NSOP_n is straightly definable when n is an integer. Incidentally, our argument resolves a question of García and Mennuni on characterizing NSOP_n in terms of posets. If time permits, we will also give an application of Saracino's theorem, as well as work of Bodirsky, Bodor and Marimon, to implications between positively straightly definable properties for countably categorical theories, with special consequences under the assumption that NSOP_2 is equal to NSOP_3.

[1] Michele Bailetti, *A Walk on the Wild Side: Notions of maximality in first-order theories*, arXiv.2409.19236 (2024).

[2] Manuel Bodirsky, Bertalan Bodor, and Paolo Marimon, *Taking model-complete cores*, arXiv.2512.21278 (2025).

[3] Artem Chernikov and Nicholas Ramsey, *On model-theoretic tree properties*, ***Journal of Mathematical Logic***, vol. 16 (2016), no. 2, 1650009.

[4] Christian D'Elbée, Isabel Müller, Nicholas Ramsey, and Daoud Siniora, *A two-sorted theory of nilpotent Lie algebras*, arXiv.2407.12452 (2024).

[5] Dario García and Rosario Mennuni, *Model-theoretic dividing lines via posets*, arXiv.2209.00571 (2022).

[6] Will Johnson and Jinhe Ye, *Curve-excluding fields*, arXiv.2303.06063 (2023).

[7] Saharon Shelah, *On what I do not understand (and have something to say), model theory*, arXiv.9910158 (1999).

▶ RONAN O'GORMAN, *Abstract group chunks.*
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The Group Chunk Theorem, and its extension the Group Configuration Theorem, are important results in geometric stability theory which allow one to construct groups out of generically defined data. We will explain how, using category theory, the Group Chunk Theorem can be generalized far beyond the model-theoretic setting and connected to related results in topology and algebraic geometry. Time permitting, we will also discuss how a key step in the proof of the Group Configuration Theorem can be carried out in a scheme-theoretic setting to obtain new results in algebraic geometry.

▶ MATHIAS STOUT, *Formalizing the model theory of valued fields.*
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In recent years, formal proof verification has become an important mathematical

topic in its own right. Modern interactive theorem provers such as Lean 4 and powerful automation tools are bringing us closer to a new reality where new mathematical discoveries also come with a formal certificate of soundness. However, to make this into a reality, more foundational results need to be formalized.

This talk will present ongoing work towards the formalization of key results in the model theory of valued fields. In particular, I will highlight parts of the supporting infrastructure that are more broadly (re)usable, such as

- a framework for syntax and semantics in many-sorted first-order logic,
- foundational theorems, including the compactness theorem and (relative) quantifier elimination tests.

No prior knowledge of Lean will be assumed. This is joint work with D. Haskell, A. Crighton and J. Nicholson.

Abstracts of invited talks in the Special Session on Proof Theory

▸ KATALIN BIMBÓ, *Single cut rules.*
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I formulate *NLL* (normal linear logic) from [8] as *LNLL*, a two-sided sequent calculus (with connectives $\rightarrow, \circ, +, \vee, !, ?, \boldsymbol{t}$). $L\mathbf{R}^+$ is the sequent calculus introduced by Dunn (see [7, 1]) for the positive fragment of $\mathbf{R}$, the logic of relevant implication (with connectives $\rightarrow, \circ, \wedge, \vee, \boldsymbol{t}$). For each calculus, I specify a single cut rule, then I define contraction measure — along the lines of [3, 4] and [5]. I show that a triple induction on the degree of the cut formula, on the contraction measure of the cut and on the rank of the cut produces a direct proof of the admissibility of the single cut rule. The proofs illustrate the flexibility of this proof method, which had been shown to succeed in simpler sequent systems such as *LK* and *LJ*. *LNLL* has modalized contraction rules, whereas $L\mathbf{R}^+$ has two structural connectives and two types of structures; these features indicate certain intricacies stemming from the perspicacious character of the logics.

Time permitting, I will compare (i) the definition of contraction measure to some ideas from [6, Ch. 5, §§C, D], and (ii) the triple inductive proofs of the single cut rule to proofs of the admissibility of cut using Curry's method from [6], Dunn's method from [1, §28.5] and Belnap's method for display calculuses from [2]. I contend that the use of contraction measure in the proof of the cut theorem avoids the opacity that arises in proofs that rely on mix and multi-cut.

[1] Alan R. Anderson and Nuel D. Belnap, ***Entailment: The Logic of Relevance and Necessity***, vol. I., Princeton University Press, Princeton, NJ, 1975.

[2] Nuel D. Belnap, *Display logic*, ***Journal of Philosophical Logic***, vol. 11 (1982), pp. 375–417.

[3] Katalin Bimbó, *The decidability of the intensional fragment of classical linear logic*, ***Theoretical Computer Science***, vol. 597 (2015), pp. 1–17.

[4] ——— *On the decidability of certain semi-lattice based modal logics.* ***Automated Reasoning with Analytic Tableaux and Related Methods. (TABLEAUX 2017)***, (R. A. Schmidt and C. Nalon, editors), vol. 10501 of LNAI, Springer, 2017, pp. 44–61.

[5] Katalin Bimbó and J. Michael Dunn, *Modalities in lattice-R*, ***Relevance Logics and other Tools for Reasoning. Essays in Honor of J. Michael Dunn***, (K. Bimbó, editor), (vol. 46 of Tributes), College Publications, London, UK, 2022,

pp. 89–127.

[6] Haskell B. Curry, ***Foundations of Mathematical Logic***, McGraw-Hill Book Company, New York, NY, 1963.

[7] J. Michael Dunn, *A 'Gentzen system' for positive relevant implication, (abstract)*, ***The Journal of Symbolic Logic***, vol. 38, no. 2 (1973), pp. 356–357.

[8] Alexei P. Kopylov, *Decidability of linear affine logic*, ***Special issue: LICS 1995***, (A. R. Meyer, editor), (vol. 164 of Information and Computation), IEEE, 2001, pp. 173–198.

► ANTON FREUND*, KATARZYNA W. KOWALIK, AND DAVIDE MANCA, *Fraïssé's conjecture and partial impredicativity.*
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Fraïssé's conjecture (by now a classical theorem of Laver [4]) states that any sequence $(L_i)_{i\in\mathbb{N}}$ of countable (or just σ-scattered) linear orders admits $i < j$ such that L_i embeds into L_j. In the setting of reverse mathematics, Shore [6] has shown that Fraïssé's conjecture entails arithmetical transfinite recursion, while Montalbán [5] has proved that it follows from the statement that the antichain with three elements is a Δ^0_2-better-quasi-ordering, which in turn follows from Π^1_1-comprehension. The first author of this abstract has recently established a new lower bound on the strength of finite better-quasi-orderings [1]. Via an analysis of Montalbán's proof, he has also established a new upper bound on the strength of Fraïssé's conjecture [2]: the latter is provable in a certain theory $\Pi^1_1\text{-}\mathsf{CA}^\Gamma_0$ of partial impredicativity (cf. the work of Towsner [8] and of Suzuki and Yokoyama [7]), which is strictly weaker than Π^1_1-comprehension. As part of this work, he has introduced a cofinite version of the Δ^0_2-Ramsey theorem, which may be of independent interest. In a joint article in preparation [3], the three authors of this abstract give an ordinal analysis of the aforementioned theory $\Pi^1_1\text{-}\mathsf{CA}^\Gamma_0$, which yields a combinatorial bound on the strength of Fraïssé's conjecture. The talk is intended as an accessible introduction to some of the results that are described in this abstract.

[1] Anton Freund, *On the logical strength of the better quasi order with three elements*, ***Transactions of the American Mathematical Society***, vol. 376 (2023), pp. 6709–6727.

[2] Anton Freund, *Fraïssé's conjecture, partial impredicativity and well-ordering principles, part I*, ***Proceedings of the American Mathematical Society***, vol. 153 (2025), pp. 937–946.

[3] Anton Freund, Katarzyna W. Kowalik, and Davide Manca, *Fraïssé's conjecture, partial impredicativity and well-ordering principles, part II*, in preparation.

[4] Richard Laver, *On Fraïsse's order type conjecture*, ***The Annals of Mathematics, Second Series***, vol. 93 (1971), no. 1, pp. 89–111.

[5] Antonio Montalbán, *Fraïsse's conjecture in Π^1_1-comprehension*, ***Journal of Mathematical Logic***, vol. 17 (2017), no. 2, article no. 1750006.

[6] Richard Shore, *On the strength of Fraïssé's conjecture*, ***Logical Methods. In Honor of Anil Nerode's Sixtieth Birthday*** (John Crossley, Jeffrey Remmel, Richard Shore, and Moss Sweedler, editors), Progress in Computer Science and Applied Logic,

vol. 12, Birkhäuser, Boston (MA), 1993, pp. 782–813.

[7] Yudai Suzuki and Keita Yokoyama, *On the* Π^1_2 *consequences of* Π^1_1-CA_0, ***Journal of Mathematical Logic***, to appear, doi:10.1142/S0219061325500151.

[8] Henry Towsner, *Partial impredicativity in reverse mathematics*, ***The Journal of Symbolic Logic***, vol. 78 (2013), no. 2, pp. 459–488.

► ELIJAH GADSBY, *On the slowing-down phenomenon.*
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In the calibration of the strength of mathematical theories, consistency statements have long played a key role. However, it was shown by Friedman, Rathjen and Weiermann [2] that by sufficiently slowing down the enumeration of the axioms of PA, one can construct a consistency statement unprovable in PA, yet strictly weaker than the usual Con(PA).

We will show that this phenomenon is general and construct 'slow consistency' statements for a variety of theories of strength up to the Bachmann-Howard Ordinal. Along the way, we will resolve a natural variant of a question posed by Freund and Pakhomov [1] concerning the relationship between fast-growing functions and 'finite consistency' statements. In the case of extensions of theories by consistency statements, a connection with Π^0_1 ordinals will be seen.

[1] Anton Freund and Fedor Pakhomov, *Short proofs for slow consistency*, ***Notre Dame Journal of Formal Logic***, vol. 61 (2013), no. 1, pp. 31–49.

[2] Sy-David Friedman, Michael Rathjen and Andreas Weiermann, *Slow consistency*, ***Annals of Pure and Applied Logic***, vol. 164 (2013), no. 3, pp. 382–393.

► ANDREAS WEIERMANN, *Some averaged zero one laws for segments of proof-theoretic ordinals.*
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We prove some averaged zero laws for ordinals stemming from segments of some prominent proof-theoretic ordinals like ε_0 and Γ_0. The results are based on a mixture of analytic methods and tools from logic. We believe that our results will hold in very general contexts. We also believe that our results will hold for pointwise limits.

We firstly consider zero one laws with respect to the Mahler norm T. Let $T(0) := 0$ and let $T(\alpha) := 2^{T(\alpha_1)} + \cdots + 2^{T(\alpha_k)}$ if $\alpha = \omega^{\alpha_1} + \cdots + \omega^{\alpha_k}$ is in Cantor normal form. We show first (while acknowledging partial support by AI for carrying out some routine steps) as an auxiliary result that there is a real constant C such that for all natural numbers $n > 1$ we have

$$\#\{\alpha < \varepsilon_0 : T(\alpha) = n\} \leq \exp(\exp(C\sqrt{\log(n)})).$$

Since ordinals below ε_0 correspond canonically to rooted non planar trees this result is also of general interest for tree counting since (using the Mahler norm) we obtain a tree counting function which is subexponential.

For a sentence φ in the language of linear orders and a natural number $n > 0$ let

$$\delta_{\varepsilon_0}(\varphi)(n) := \frac{\#\{\alpha < \varepsilon_0 : \alpha \models \varphi \wedge T(\alpha) = n\}}{\#\{\alpha < \varepsilon_0 : T(\alpha) = n\}}.$$

Using our auxiliary result we will show that

$$\lim_{x\to\infty} \frac{1}{x} \cdot \sum_{n=1}^{x} \delta_{\varepsilon_0}(\varphi)(n) \in \{0, 1\}.$$

A similar result holds for Γ_0 instead of ε_0. We conjecture that $\lim_{n\to\infty} \delta_{\varepsilon_0}(\varphi)(n) \in \{0,1\}$.

We secondly consider the standard Gödel coding of ordinals: For $\alpha < \varepsilon_0$ let its Gödel number $G(\alpha)$ be defined as follows. $G(0) = 1$ and if $\alpha = \omega^{\alpha_1} + \cdots + \omega^{\alpha_k}$ is in Cantor normal form then let $G(\alpha) = p_1^{G(\alpha_1)} \cdot \ldots \cdot p_k^{G(\alpha_k)}$ where p_i is the i-th prime number.

Using our first auxiliary result we prove that for all real numbers $x > e^e$ we have

$$\#\{\alpha < \varepsilon_0 : G(\alpha) \leq x\} \leq \exp(\exp(C\sqrt{\log(\log(x))})).$$

For a sentence φ in the language of linear orders and a real number $t > 1$ let

$$\Delta_{\varepsilon_0}(\varphi)(t) := \frac{\#\{\alpha < \varepsilon_0 : \alpha \models \varphi \wedge G(\alpha) \leq t\}}{\#\{\alpha < \varepsilon_0 : G(\alpha) \leq t\}}.$$

Using our previous results we will show that

$$\lim_{x\to\infty} \frac{1}{\log(x)} \cdot \int_1^x \Delta_{\varepsilon_0}(\varphi)(t)dt/t \in \{0,1\}.$$

A similar result holds for Γ_0 instead of ε_0. We conjecture that $\lim_{t\to\infty} \Delta_{\varepsilon_0}(\varphi)(t) \in \{0,1\}$.

Our results here differ from previous results from [1] where we were able to show limit laws (but not zero one laws) for ε_0 with respect to the standard norm function or the Matula coding of ordinals.

[1] A. Weiermann and A.R. Woods, *Some natural zero one laws for ordinals below ε_0*, ***How the World Computes***, CiE 2012 (S.B. Cooper, A. Dawar, B. Löwe, editors), Lecture Notes in Computer Science, vol. 7318. Springer, Berlin, Heidelberg, 2012, 723–732.

Abstracts of invited talks in the Special Session on Set Theory

► NATHANIEL BANNISTER, *Condensed Sets and the Solovay Model.*
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We exhibit a geometric morphism from the Grothendieck topos representing the Solovay model to the κ-pyknotic sets of Barwick–Haine and Clausen–Scholze. We then sketch a proof of Clausen–Scholze's resolution of the Whitehead problem for discrete condensed abelian groups using the properties of this morphism and automatic continuity in the Solovay model. Based on joint work with Dianthe Basak.

[1] Nathaniel Bannister and Dianthe Basak, *Condensed Sets and the Solovay Model*, arXiv.2602.09283 (2026).

► FILIPPO CALDERONI, *The space of finitely generated groups and classification problems.*
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In this talk we shall recall the Polish space of finitely generated groups and discuss some classification problems in combinatorial group theory.

► JAMES CUMMINGS, *Generating sets for ultrafilters.*
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I discuss some results on forcing the existence of ultrafilters with specified generating sets, and the remaining open problems. (This is joint work with Tom Benhamou, Gabe Goldberg, Yair Hayut, and Alejandro Poveda.)

▸ VICTORIA GITMAN, *Reflection in set theory without powersets.*
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The *Reflection principle* - the scheme of assertions that every formula (with parameters) reflects to a transitive set - holds in models of ZFC (even ZF) as witnessed by elements of the V_α-hierarchy. It turns out the existence of powersets, which underlies the V_α-hierarchy, is necessary for the Reflection principle because it can fail in models of the theory ZFC^-, axiomatizing set theory without powersets. Models of ZFC^- with a failure of the Reflection principle are notoriously hard to construct and only a few broad types are currently available to analyze. We can weaken the Reflection principle to obtain a family of partial reflection principles: given a set or class A, we say that the *partial Reflection principle for* A holds if whenever a formula with parameters from A holds, then it holds in a transitive set. We show that there are models of ZFC^- in which the Reflection principle fails, but the (strongest) partial Reflection principle for V holds, separating the principles. We also show that there is a model of ZFC^- in which the partial Reflection principle for $\{\omega_1\}$ fails. Finally, the Reflection principle for $\mathbb{R}$ holds in all currently available models of ZFC^- and it is open whether it can fail.

▸ CECELIA HIGGINS, *Spectral theory for Borel pmp graphs.*
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In classical spectral graph theory, one associates to finite graphs Hermitian matrices, such as the adjacency matrix, that encode graphical information. The spectral properties of these matrices are then leveraged to analyze the combinatorial features, including vertex coloring, edge coloring, and matching, of the corresponding graphs. Analogously, one can associate bounded, self-adjoint operators, such as the adjacency operator, to Borel pmp graphs of bounded degree. In this talk, we present new descriptive combinatorics results for pmp graphs that involve the application of spectral theory to their associated operators. This is joint work with Pieter Spaas and Alexander Tenenbaum.

▸ SIIRI KIVIMÄKI, *Scott analysis for uncountable models and Aronszajn trees.*
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Countable first-order structures are classified up to isomorphism according to their Scott sentences. There does not exist analogous complete classification for uncountable models. The study of so-called wider Aronszajn trees - trees of height $\aleph_1$ with no uncountable branch - arose in an attempt to extend the Scott analysis to models of size $\aleph_1$. I will discuss the history of this program as well as recent results. This is joint work with Omer Ben-Neria, Menachem Magidor and Jouko Väänänen.

▸ RILEY THORNTON, *Entropy and ultraproducts.*
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There is a natural notion of ultraproduct for sparse graphs on measure spaces which has applications to ergodic theory, descriptive set theory, and combinatorics. Entropy is a powerful tool for understanding these ultraproducts (in particular for distinguishing them). I will give an explanation of some of this background for set theorists and report some recent applications.

▸ ALLISON WANG, *Topological realizations of CBERs*.
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In a recent paper, Frisch, Kechris, Shinko, and Vidnyánszky proved many results about topological realizations of countable Borel equivalence relations (CBERs). We discuss some of their results about compactly graphable CBERs and make partial progress toward the question of whether every aperiodic CBER has a compactly graphable realization.

▸ FANXIN WU, *One- and two-cardinal trees*.
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A κ-tree can be viewed as an attempt to approximate some desired object of size κ using initial segments. Similarly, a (κ, λ)-tree approximates some desired object of size λ using fragments of size smaller than κ. I will discuss some results and questions about both types of trees, with a focus on Aronszajn and Kurepa trees.

Abstracts of contributed talks

▸ WILLIAM ADKISSON, *Strong Tree properties on segments of successors of singulars*.
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A longstanding project in set theory is to build a model of ZFC in which the tree property holds at every regular cardinal above $\aleph_1$. Obtaining the tree property at successors of singular cardinals is of particular interest. In 2015, Golshani and Hayut proved that it was consistent for the tree property to hold at an arbitrarily long countable initial segment of successors of singular cardinals. We will discuss how to generalize this result in two ways. First, we modify their construction to obtain strengthenings of the tree property, the strong and super tree properties, along a countable segment of successors of singular cardinals. Next, we use this construction for multiple different cofinalities simultaneously, to obtain for each $n < \omega$ the tree property on an initial segment of successors of singulars of cofinality ω_n.

▸ JUAN AGUILERA AND ROBERT S. LUBARSKY*, *Harrington's Principle in second-order arithmetic*.
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Harrington's Principle HP [2] asserts the existence of a real g such that the g-admissible ordinals are all cardinals in L. It is well known that, over ZF, HP is equivalent to the existence of $0^\sharp$. Cheng and Schindler [1] showed that the proof of such works over fourth-order arithmetic, but not second- or third-order. In particular, they showed that second-order arithmetic plus HP is equiconsistent with merely ZFC. In this talk I discuss a refinement of that latter result, examining HP over fragments of second-order arithmetic. Put somewhat roughly, HP + Π^1_n-Comprehension is equiconsistent with ZF with the Replacement schema restricted to Σ_n-Reflection.

[1] Yong Cheng and Ralf Schindler, *Harrington's Principle in Higher Order Arithmetic*, ***The Journal of Symbolic Logic***, v. 80 (2015), pp. 477–489

[2] Leo Harrington, *Analytic Determinacy and* $0^\sharp$, ***The Journal of Symbolic Logic***, v. 43 (1978), pp. 685–693

[3] Juan Aguilera and Robert Lubarsky, *Harrington's Principle in Second-Order Arithmetic*, submitted.

▶ RISHI BANERJEE, *Structurable equivalence relations and* $L_{\omega_1,\omega}$ *interpretations.*
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Many important classes of countable Borel equivalence relations (CBERs) can be characterized in terms of structurability by particular infinitary theories, and many classical theorems express that any CBER structurable by a particular theory is also structurable by some other theory. Here, a CBER is structurable by an infinitary theory if we can put a model of the theory on each equivalence class in a uniform Borel way. We will discuss a correspondence between infinitary interpretations between theories and implications between structurability notions. This is joint work with Ronnie Chen.

▶ JEREMY BEARD, *Limit models in strictly stable AECs.*
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Limit models are a useful replacement for saturated models in abstract elementary classes, where saturated models can be less well behaved than in first order. The question of which limit models are isomorphic has proved important when approaching the main test question of AECs, Shelah's categoricity conjecture. Historically, limit models have mostly been studied in superstable AECs.

In this talk, we'll discuss recent results that shed light on how limit models behave in *strictly stable* AECs. In particular, we present (as much as time allows):

1. A full characterisation of isomorphism types of limit models with a nicely behaved forking-like relation - 'long' limits are isomorphic, and 'short' limits are non-isomorphic. In particular, this applies to all first order stable theories [3].
2. The most general 'positive' isomorphism of limit models result (to my knowledge), assuming only a relation with weak forms of uniqueness and extension (similar to λ-splitting) [1].
3. 'Long' limit models are disjoint (non-forking) amalgamation bases [2].

[1] Jeremy Beard, *Long limit models are isomorphic assuming a splitting-like relation*, arXiv.2511.18665 (2025).

[2] ——— *Disjoint non-forking amalgamation in stable AECs*, arXiv.2601.12439 (2026).

[3] Jeremy Beard and Marcos Mazari-Armida, *On the spectrum of limit models*, ***Annals of Pure and Applied Logic***, vol. 176, no. 10, pp. 103647.

▸ KATIE ELLMAN-ASPNES, *Approximating $NSOP_1$ structures.*
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In her graduate thesis, Gwyneth Harrison-Shermoen developed an abstract framework for approximating structures of a given theory, which generalized the notion of smoothly approximable structures. At the time it was unclear how broadly the framework applied due to a lack of examples. In this talk we'll discuss how several well-understood NSOP_1 theories are in fact approximable by simple structures via this framework (with slight modification), and what structural properties we may or may not be able to conclude from such an approximation. We will also discuss a notion of limit dimension as a candidate for recovering Kim-independence in the limit structure from the approximation.

▸ YUXIAO FU, *Weihrauch degrees of embeddability problems.*
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Embeddability between countable structures gives rise to natural decision problems whose complexity depends on both the underlying class and the formulation of the problem. Weihrauch reducibility provides a useful framework for analyzing this uniform computational content. In this talk, I will discuss classifications of embeddability for several classes of countable first-order structures, including linear orders, partial orders, tournaments, and equivalence relations, and compare fixed-source and uniform versions of the embeddability problem. I will also explain how recent work by Cipriani and Pauly on graph embeddability fits into this picture.

▸ JAMES E. HANSON, *Small large cardinals and neostability theory.*
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Neostability theory is the branch of model theory that studies certain classes of combinatorially tame first-order theories and more generally local combinatorial tameness within arbitrary theories. These tameness notions are often intimately linked to the behavior of indiscernible sequences. We will discuss some recent applications of certain small large cardinals (between ineffable and Erdős) in model-theoretic neostability theory and in particular their use in building certain special indiscernible sequences.

▸ LOGAN HEATH, *Uubs and suubs as theory spectra.*
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The degrees of nonstandard models of true arithmetic ($\mathcal{D}_{\mathsf{TA}}$) are known to be the spectrum of an atomic theory [2], but not the spectrum of any ω-stable theory [1]. Exploring which sorts of theories (superstable, stable, etc.) can have $\mathcal{D}_{\mathsf{TA}}$ as their spectrum led us to consider the uniform upper bounds (uubs) and subuniform upper bounds (suubs) of the arithmetic sets as theory spectra. This produced examples of theory spectra which are spectra of superstable, atomic theories, but not spectra of small theories, a division not previously witnessed by theory spectra. We discuss these spectra and their relation to our ongoing efforts to clarify which sorts of theories can

have $\mathcal{D}_{\mathsf{TA}}$ as their spectrum.

[1] Uri Andrews, Mingzhong Cai, David Diamondstone, Steffen Lempp, and Joseph S. Miller, *Theory spectra and classes of theories*, ***Transactions of the American Mathematical Society***, vol. 379 (2017), no. 4, pp. 6493–6510.

[2] Uri Andrews and Julia F. Knight, *Spectra of atomic theories*, ***Journal of Symbolic Logic***, vol. 78 (2013), no. 4, pp. 1189–1198.

▶ DHRUV KULSHRESHTHA, *A robust subclass of the nontotal continuous degrees.*
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In 2004, Miller introduced the continuous degrees, which measure the computability-theoretic content of elements of computable metric spaces, and showed that they properly extend the Turing degrees [3]. To show the existence of nontotal (i.e., non-Turing) continuous degrees, Miller constructed a *diagonally not computably diagonalizable (DNCD)* sequence: a sequence $\alpha \in [0,1]^\omega$ such that if $\varphi_e^\alpha \downarrow \in [0,1]$, then $\alpha(e) = \varphi_e^\alpha$, i.e., α lists the α-computable reals from $[0,1]$ *in order*.

In 2013, Day and Miller showed that Levin's *neutral measures* [2] also give examples of nontotal continuous degrees [1]. These are measures on Cantor space for which every infinite binary sequence is random, even though tests have access to the measure itself.

It remains open whether every nontotal continuous degree contains a DNCD sequence or a neutral measure. In this talk, I will discuss ongoing work with Joseph S. Miller in which we show that the degrees of DNCD sequences coincide with those of (weakly) neutral measures. These are exactly the continuous degrees $\mathbf{a}$ such that every Turing degree above $\mathbf{a}$ is PA relative to $\mathbf{a}$. They form a robust class, whether or not it is a *proper* subclass of the nontotal continuous degrees.

[1] Adam R. Day and Joseph S. Miller, *Randomness for non-computable measures*, ***Transactions of the American Mathematical Society***, vol. 365 (2013), no. 7, pp. 3575–3591.

[2] L.A. Levin, *Uniform tests of randomness*, ***Soviet Mathematics Doklady***, vol. 17 (1976), no. 2, pp. 337–340.

[3] Joseph S. Miller, *Degrees of unsolvability of continuous functions*, ***The Journal of Symbolic Logic***, vol. 69 (2004), no. 2, pp. 555–584.

▶ CONNOR LOCKHART, *Pseudofiniteness of the Farey graph and random tesselations.*
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We prove that the theory of the Farey graph F is pseudofinite by constructing a sequence of finite structures that satisfy increasingly large subsets of its first-order axiomatization. We show that while no finite planar graph can satisfy these axioms for sufficiently large substructures, they can be satisfied by triangulations densely embedded on orientable surfaces of higher genus. This gives a curious result that the Farey graph arises as the generic of a smooth class of finite structures, yet the finite structures which witness pseudofiniteness cannot be substructures of F. We also show that the theory of the Farey graph arises as an almost sure theory of random tessellations of asymptotically high genus surfaces.

▶ ROBERT S. LUBARSKY, *A possibly new proof of a possibly old theorem.*
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The arithmetic μ-calculus is that fragment of second-order arithmetic which augments first-order arithmetic with least and greatest fixed points of positive inductive definitions. The main result of [4] is that the Σ_2-definable reals in the μ-calculus are exactly those which are Σ_1-definable over L_σ, where σ has many equivalent characterizations: the least ordinal which is Π_1 gap-reflecting on admissibles, the least place where winning strategies for Player I in Σ^0_2 games have shown up, the least non-Gandy ordinal, and the closure point of parallel feedback Turing computations, to name only a few. Sadly, the proof given there is wanting. In this talk, I will give a complete and simpler proof of that result.

[1] Fred Abramson and Gerald Sacks, *Uncountable Gandy Ordinals*, ***Journal of the London Math. Soc.***, Vol. 14 (2) (1976), pp. 387-392

[2] Juan Aguilera and Robert Lubarsky, *On winning strategies for F_σ games*, ***The Journal of Symbolic Logic***, to appear.

[3] Richard Gostanian, *The Next Admissible Ordinal*, ***Annals of Mathematical Logic***, vol. 17 (1979), pp. 171–203

[4] Robert Lubarsky, *μ-definable Sets of Integers*, ***The Journal of Symbolic Logic***, vol. 58 (1993), pp. 291–313

[5] Yiannis Moschovakis, *Descriptive Set Theory*, 2nd edition, American Mathematical Society, 2009

[6] P. Wolfe, *The strict determinateness of certain infinite games*, ***Pacific Journal of Mathematics***, vol. 5 (1955), pp. 841-847

▶ STEPHEN FLOOD, MATTHEW JURA, OSCAR LEVIN, AND TYLER MARKKANEN*,
Deciding the density of computable and c.e. sets.
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How hard is it to determine whether an infinite set of natural numbers has asymptotic density 1? While density provides an intuitive way to measure the size of a set, many of the decision problems that involve density are surprisingly intricate. In this talk, we classify the computational complexity of deciding whether a computable or computably enumerable set has a given density. We sketch some of our core constructions and show that the index set of c.e. sets with *upper* density 1 is Π^0_2-complete. We describe the modifications needed to handle a set's *lower* density and how this raises the complexity to Π^0_4. Similar gaps in complexity arise when comparing the decision problems for sets of density 0 to those of density 1, and when comparing the problems for computable sets to those for c.e. sets. We conclude with an application to equitable colorings and our plans to extend the Hajnal-Szemerédi Theorem to computable graphs. This is joint work with Stephen Flood, Matthew Jura, and Oscar Levin.

▶ YIPING MIAO, *Generic reals and gauge dimensions.*
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There are two orthogonal smallness notions, meager and null. Set theoretic forcing provides a canonical comeager set (a set whose complement is meager, so a 'large set'). We investigate the size of such sets under geometric measure theory perspective, characterize the gauge profiles for the set of Cohen generics (the canonical topology on Cantor set), Mathias generics and Sacks generics. We will also take a step aside and look at Random real forcing. We give a characterization of the set of reals with effective Hausdorff dimension s and use this characterization to separate it from Diophantine approximations.

▸ MORENIKEJI NERI, *Extracting bounds from proofs involving ultraproducts.*
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An important application of ultraproducts in mathematics is the derivation of uniform bounds for existential statements via their validity in ultrapowers. More precisely, in the setting of first-order logic, one has the following principle:

THEOREM. *Let T be a first order theory and $\{\varphi_n\}$ a collection of first order formulas. Suppose that for all non-principal ultrafilters $\mathcal{U}$ and all first order structures $\mathcal{M}$ with $\mathcal{M}_\mathcal{U} \models T$, we have that there exists $n \in \mathbb{N}$ such that $\mathcal{M}_\mathcal{U} \models \varphi_n$. Then there exists $N \in \mathbb{N}$ such that for all $\mathcal{M} \models T$ there exists $n \leq N$ with $\mathcal{M} \models \varphi_n$.*

The proof of this result is inherently *nonconstructive*, which raises the natural question of whether bounds obtained in this way can be made explicit. This question lies close to the heart of *proof mining* [3], a program in mathematical logic, initiated by Kohlenbach and collaborators, that seeks to extract effective quantitative information from proofs in mainstream mathematics.

Proof mining is underpinned by general proof-theoretic tools known as *logical metatheorems*, which guarantee that proofs carried out in suitable formal systems admit highly uniform computational content. These metatheorems not only provide algorithms for extracting this content, but also bounds their complexity in terms of the logical principles used.

In case studies, most notably the work of Simmons and Towsner [4], it has been observed that analyzing proofs based on the theorem above through the lens of existing metatheorems of proof mining often yields explicit uniform bounds. Building on earlier work of Günzel and Kohlenbach [2], we present a new metatheorem that explains this phenomenon in a systematic way. As an application, we derive new explicit bounds for results in [1] which we obtained through this methodology.

This is joint work with Ulrich Kohlenbach and Jin Wei.

[1] GABRIEL CONANT, ANAND PILLAY, AND CAROLINE TERRY, *A group version of stable regularity*, ***Mathematical Proceedings of the Cambridge Philosophical Society***, vol. 168 (2020), no. 2, pp. 405–413.

[2] DANIEL GÜNZEL AND ULRICH KOHLENBACH, *Logical metatheorems for abstract spaces axiomatized in positive bounded logic*, ***Advances in Mathematics***, vol. 290 (2016), pp. 503–551.

[3] ULRICH KOHLENBACH, *Applied Proof Theory: Proof Interpretations and their Use in Mathematics*, ***Springer Monographs in Mathematics. Springer Berlin, Heidelberg, 2008***

[4] WILLIAM SIMMONS AND HENRY TOWSNER, *Proof mining and effective bounds in differential polynomial rings*, ***Advances in Mathematics***, vol. 343 (2019), pp. 567–623.

▸ DEVRIM PEKMEZCI, *Local revised Ellis group conjecture.*
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Newelski introduced tools from topological dynamics into model theory to generalize the notion of a generic type from stable group theory to arbitrary theories, adapting Ellis's theory to the definable setting and introducing the Ellis group conjecture, which relates the model theoretic connected component of an NIP group to the ideal subgroup of its Ellis semigroup [4]. As later predicted by Pillay, the conjecture was established for definably amenable groups in NIP theories by Chernikov and Simon [2]. However, it was shown to be false in arbitrary NIP theories [3]. As a weakening of the conjecture, Chernikov, Gannon, and Krupiński proved that the so-called tau-topology on the ideal group is Hausdorff for countable NIP structures [1]. As a step toward a local theory of the subject, we show that Newelski's original construction can be adapted to a suitable local type space of an NIP bi-invariant formula in an arbitrary theory. Moreover, the arguments in [1] apply in the local case, as we observe that the aforementioned type space is also tame.

[1] Artem Chernikov, Kyle Gannon, and Krzysztof Krupiński, *Definable convolution and idempotent Keisler measures III. Generic stability, generic transitivity, and revised Newelski's conjecture*, arXiv:2406.00912 (2024).

[2] Artem Chernikov and Pierre Simon, *Definably amenable NIP groups*, ***Journal of the American Mathematical Society***, vol. 31 (2018), no. 3, pp. 609–641.

[3] Jakub Gismatullin, Davide Penazzi, and Anand Pillay, *Some model theory of* $SL(2,\mathbb{R})$, ***Fundamenta Mathematicae***, vol. 229 (2015), no. 2, pp. 117–128.

[4] Ludomir Newelski, *Topological dynamics of definable group actions*, ***The Journal of Symbolic Logic***, vol. 74 (2009), no. 1, pp. 50–72.

▸ KARTHIK RAVISHANKAR, *Ahmad pairs and the local structure of the enumeration degrees.*
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The local structure of the enumeration degrees are the degrees below $0'_e$ consisting of the Σ_2 sets. This is a very rich and well studied structure with several interesting properties such as density, join irreducibility etc. Another structural property of interest here are Ahmad pairs-sets (A, B) such that $A \not\leq_e B$ and every $Z <_e A$ also satisfies $Z \leq_e B$. In this talk, we will survey some of the fascinating structural and definability properties of this structure and contrast it with the Δ_2 as well as the c.e. Turing degrees. We will end with some new work on Ahmad pairs and its consequences for the $\forall\exists$-theory of the structure.

▸ HELENA RIOS, *On Hilbert's conception of mathematical objects.*
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I will discuss Hilbert's view of mathematical objects as relational structures governed by axioms. As such, I will distinguish the relationship between syntax and semantics for Hilbert at the turn of the century from the one that operates today in modern model theory. I will argue that, while Hilbert's axiomatic approach in the *Grundlagen* was a precursor to modern model-theoretic approaches, Hilbert's project was not only

centered around the notion of satisfaction of axioms by models (as used in his consistency proofs). Rather, he had also an ultimate aim to *define* mathematical objects through axiomatization alone, for he believed one could only establish the existence of mathematical objects by finding consistent axioms characterizing them.

To understand how he intended to achieve this aim, we will focus on Hilbert's axiom of completeness as a capstone of his axiomatic method, allowing for univocal definitions of specific mathematical objects through axioms. Here, we will critically use Husserl's understanding of Hilbert's project to illuminate the latter's views, and we will show that what Hilbert's axiom of completeness guarantees is subtly different from categoricity.

[1] Steve Awodey and Erich Reck, *Completeness and Categoricity, Part I*, *History and Philosophy of Logic*, vol. 23 (2002), no. 1, pp. 1–30.

[2] Gottlob Frege and David Hilbert, ***Gottlob Frege: Philosophical and Mathematical Correspondence***, (Hans Kaal, translator; Brian McGuinness, editor), Oxford, 1980, pp. 31-52.

[3] David Hilbert, ***The Foundations of Geometry***, (E.J. Townsend, translator). Open Court, 1950.

[4] Edmund Husserl, *On the transition through the impossible and the completeness of an axiom system*, (Dallas Willard, translator), ***Philosophy of Arithmetic***, Kluwer, 2003.

▸ JACOB STERN, *Divisible ordered abelian groups that are not weakly o-minimal.*
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For expansions of linear orders many different notions of minimality may be considered. Among the most restrictive of these is weak o-minimality [**?**] while among the least restrictive is dp-minimality, but there are also many other interrelated notions. We expand on machinery introduced by Guingona and Flenner to show that in the context of divisible ordered abelian groups many of these notions coincide. In particular we show that a locally convexly orderable expansion of a divisible ordered abelian group is weakly o-minimal. This proves the equivalence of several intermediate minimality notions and gives several nice algebraic properties of such structures. This is joint work with Alfred Dolich.

▸ YUKI TAKAHASHI, *Dependent dividing and sub-additivity of burden.*
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We discuss Chernikov's conjecture that the burden is sub-additive. As partial progress toward this conjecture, we show that if a theory T has a stronger version of dependent dividing (which we call existentially NIP dividing), then the burden for the type $\{\overline{x} = \overline{x}\}$ is sub-additive, i.e., Shelah's $\kappa^n_{inp}(T)$ is sub-additive.

▸ JOEY VELTRI, *Effective recurrence for computable measure-preserving transformations.*
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Let $(X, \mathcal{B}, \mu)$ be a probability space and $T : X \to X$ be a *measure-preserving transformation*, i.e., $\mu(T^{-1}(A)) = \mu(A)$ for each measurable set A. The Poincaré Recurrence Theorem states that whenever $\mu(A) > 0$, almost every point in A will eventually return to A under the action of T.

Many such "almost everywhere" theorems of analysis have been translated to a

computability-theoretic setting in which one can identify precisely the full-measure set of points with the desired property. This requires imposing certain computability assumptions on the objects in question and typically guarantees the property for all random points, using the tools of algorithmic randomness to describe exactly what "random" means. (See [1] and [2], for example, which effectivize Birkhoff's Ergodic Theorem in different ways for Martin-Löf random points.)

In this talk, I will provide several effective versions of the Poincaré Recurrence Theorem for computable (not necessarily ergodic) measure-preserving transformations. This involves guaranteeing various recurrence properties if a point is sufficiently random or generic, as well as forcing recurrence to fail otherwise by constructing a computable transformation which witnesses this from a test capturing the point.

[1] Laurent Bienvenu, Adam R. Day, Mathieu Hoyrup, Ilya Mezhirov, and Alexander Shen, *A constructive version of Birkhoff's ergodic theorem for Martin-Löf random points*, ***Information and Computation***, vol. 210 (2012), pp. 21–30.

[2] Johanna N. Y. Franklin and Henry Towsner, *Randomness and non-ergodic systems*, ***Moscow Mathematical Journal***, vol. 14 (2014), no. 4, pp. 714–744.

▸ BRIAN WYNNE, *Existentially closed abelian lattice-ordered groups.*
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An abelian lattice-ordered group (ℓ-group, for the sake of brevity) is an abelian group $(G, +)$ endowed with a translation invariant lattice ordering, i.e., $(G, \leq)$ is a lattice and $a \leq b$ implies $a + c \leq b + c$ for all a, b, c in G. A prototypical example of an ℓ-group is $C(X)$, the set of all continuous real-valued functions on a topological space X, with pointwise addition and order. Let T be the theory of ℓ-groups, viewed as structures for the first-order language $\{+, -, 0, \wedge, \vee\}$ (here $\wedge, \vee$ are binary function symbols corresponding to the lattice operations of meet and join, respectively). T is a $\forall$-theory, so every ℓ-group can be embedded in an existentially closed (e.c.) ℓ-group. In the 1970's, Glass and Pierce exhibited concrete examples of e.c. ℓ-groups, showed that T has no model companion, and identified some of the properties of finitely generic (f.g.) ℓ-groups and infinitely generic (i.g.) ℓ-groups (in the sense of model-theoretic forcing). Soon after that Saracino and Wood found a simple, order-algebraic characterization of the f. g. ℓ-groups among the e.c. ℓ-groups, and Weispfenning obtained a simple, order-algebraic characterization of the e.c. ℓ-groups. Whether there is such a characterization of the i.g. ℓ-groups remains an open question. I will present some of my work towards addressing that question, which involves the construction of e.c. ℓ-groups via Fraïssé limits and the upper extension operation of Ball, Conrad, and Darnel.

▸ HONGYU ZHU, *A complete bounded theory with unbounded types.*
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Say a first-order theory is bounded if for some finite n, it is $\forall_n$-axiomatizable; Similarly for a type. This notion is closely related to descriptive complexity and provides a measure of complexity for theories and types. In an attempt to connect the complexity of theories and that of their types, we show the existence of a bounded (in fact universal) theory which has an unbounded type. The construction uses trees, and one key step of the proof is showing the pseudofiniteness of finite-height trees.

Abstracts of talks presented by title

▸ JOACHIM MUELLER-THEYS, *The dissimilarity or Gloria's theorem*.
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I. Many years ago, we came across *co-relations* $x\,\widetilde{P}\,y :\leftrightarrow Px \wedge Py$, along with $\operatorname{Sym}\widetilde{P}$, $\operatorname{Trans}\widetilde{P}$, but $\operatorname{Refl}\widetilde{P} \leftrightarrow \operatorname{Total}\widetilde{P} \leftrightarrow \operatorname{Total}P$.

Much later, we recognised that $Px \wedge Py$ is proper definiens for *property similarity* $x \sim_P y$ too. For example, $1 \sim_{\text{odd}} 3$. A further approach are *Cartesian squares* $x\,P^2\,y :\leftrightarrow x\,P\times P\,y :\leftrightarrow Px \wedge Py$.

$\operatorname{Total}(\sim_P) \leftrightarrow \operatorname{Total}P$ implies $\neg\,\exists P\,(\operatorname{Partial}P \wedge \operatorname{AllSim}_P)$: *In no universe (domain), there exists a partial (non-total) property with respect to which all individuals (objects) are similar.*

$\operatorname{Refl}(\sim_P) \leftrightarrow \operatorname{Total}(\sim_P)$ clarifies the relationship to *reflexive-symmetric similarity*: $\operatorname{PropSim}(\sim) \wedge \big(\operatorname{Refl}(\sim) \wedge \operatorname{Sym}(\sim)\big) \leftrightarrow \operatorname{Total}(\sim)$.

II. Equality with respect to single properties may be defined/characterized as follows: $x \equiv_P y :\leftrightarrow (Px \leftrightarrow Py) \leftrightarrow (Px \wedge Py) \vee (\neg Px \wedge \neg Py) \leftrightarrow x \sim_P y \vee x \sim_{\overline{P}} y$, whence $x \equiv_{\overline{P}} y \leftrightarrow x \equiv_P y$; $x \sim_P y$, $x \sim_{\overline{P}} y \to x \equiv_P y$, but not vice versa. $2 \equiv_{\text{odd}} 4$.

Our theorem $\operatorname{Total}(\equiv_P) \leftrightarrow \operatorname{Total}P \vee \operatorname{Empty}P$ implies $\neg\,\exists P\,(\operatorname{Normal}P \wedge \operatorname{AllEq}_P)$: *In no universe, there exists a normal (neither total nor empty) property with respect to which all individuals are equal.*

III. AllSim_Q may be relativised: $\operatorname{AllSim}_Q P :\leftrightarrow \forall x,y\,(x\,P^2\,y \to x \sim_Q y)$ ("all P are Q-similar"). $\operatorname{AllSim}_Q P \leftrightarrow P\mathrm{a}Q$, where $P\mathrm{a}Q := P \sqsubseteq Q := \forall x\,(Px \to Qx)$. Accordingly, $\operatorname{SomeDiss}_Q P \leftrightarrow P\mathrm{o}Q$. We found the theorem $\operatorname{AllEq}_Q P \leftrightarrow P\mathrm{u}Q$, where $P\mathrm{u}Q := P\mathrm{a}Q \vee P\mathrm{e}Q$, $P\mathrm{e}Q := P\mathrm{a}\overline{Q}$. Consequently, $\operatorname{SomeUneq}_Q P \leftrightarrow P\mathrm{p}Q$ $(:= P\mathrm{i}Q \wedge P\mathrm{o}Q)$. $\operatorname{AllEq}_Q P$; $\operatorname{AllSim}_Q P$, $\operatorname{AllSim}_{\overline{Q}} P$, $\operatorname{SomeDiss}_{\overline{Q}} P$; $\operatorname{SomeDiss}_Q P$; $\operatorname{SomeUneq}_Q P$ constitute a logical hexagon.

Cf. "The Unequality Theorem", Logic Colloquium 2025, to appear in *The Bulletin of Symbolic Logic*. Among others, the work owes Andreas Haltenhoff, Wilfried Buchholz, Jean-Yves Béziau, Gloria Thurn & Taxis, Ulrike Hahn, Eriko & Yasuko Makinose, Square community, Nikos Mastorakis (IEEE), and'P'.P.