The Bulletin of Symbolic Logic
Volume 19, Number 3, Sept. 2013

XV LATIN AMERICAN SYMPOSIUM ON MATHEMATICAL LOGIC (SLALM 2012)

SPONSORED BY THE ASSOCIATION FOR SYMBOLIC LOGIC

Bogotá, Colombia
June 4–8, 2012

The Fifteenth Latin-American Symposium on Mathematical Logic was held at the Universidad de los Andes in Bogotá, Colombia, June 4–9, 2012. The symposium was preceded by three tutorial courses in model theory, set theory, and algebraic logic presented at the Universidad Nacional de Colombia, May 30–June 2. About 110 researchers and students from Latin America and other continents participated in the meeting.

The Symposium had the scientific sponsorship of the Association for Symbolic Logic and the two host universities. It received financial support from these institutions and from the U.S. National Science Foundation, the International Mathematical Union (IMU), COLCIENCIAS, the Academia Colombiana de Ciencias Exactas, Físicas y Naturales, the Universidad Sergio Arboleda, and the Universidad Antonio Nariño.

The Program Committee included: Xavier Caicedo (Universidad de los Andes, Bogotá, Chair), Walter Carnielli, (Universidade Estuadual de Campinas (UNICAMP), Brazil), Roberto Cignoli (Universidad de Buenos Aires), Carlos Di Prisco (IVIC, Caracas), Rod Downey (Victoria University, Wellington), Angus Macintyre (Queen Mary College, London), Menachem Magidor (Hebrew University of Jerusalem), Francisco Miraglia (Universidade de São Paulo, Brazil), and Charles Steinhorn (Vassar College, New York).

The Organizing Committee included: Alexander Berenstein (Chair), Xavier Caicedo, Ramiro de la Vega, John Goodrick, Alf Onshuus (all from Universidad de los Andes, Bogotá); Andrés Villaveces, Fernando Zalamea (both from Universidad Nacional de Colombia, Bogotá); Carlos A. Di Prisco (IVIC), and José Iovino (University of Texas at San Antonio).

The following tutorials were offered:

Hans Adler (University of Vienna, Austria), *Recent developments in model theory*.

Andrés Eduardo Caicedo (Boise State University, Boise, USA), *Determinacy and inner model theory*.

Nikolaos Galatos (University of Denver, Colorado, USA), *Algebraic Logic: Algebraic Proof Theory*.

The Symposium program included thirteen invited plenary lectures. It also included twenty-eight invited talks in four special sessions: Algebraic and Non-Classical Logics, Model Theory, Recursion and Computer Science Logic, and Set Theory. Twenty short communications were also contributed to the meeting.

The following plenary lectures were delivered:

Josep Maria Font (University of Barcelona, Spain), *Logics preserving degrees of truth and the hierarchies of abstract algebraic logic*.

1079-8986/13/1903-0005/$3.30
DOI:10.2178/bsl.1903050

Deirdre Haskell (McMaster University, Hamilton, Canada), *Model theory and motivic integration*.

Denis Hirschfeldt (University of Chicago, USA), *The reverse mathematics of realizing and omitting types*.

Ulrich Kohlenbach (Technische Universität Darmstadt, Germany), *Recent developments in proof mining: bounds from proofs in nonlinear ergodic theory*.

Benedikt Löwe (ILLC, Universiteit van Amsterdam, The Netherlands), *Looking upwards and downwards in the set-theoretic multiverse*.

Antonio Montalbán (University of Chicago, USA), *The boundary of determinacy within second order arithmetic*.

Justin Moore (Cornell University, Ithaca, USA), *Iterated forcing and the Continuum Hypothesis*.

Daniele Mundici (University of Florence, Firenze, Italy), *Geometry of the Dubuc-Poveda strong semisimplicity property*.

Alf Onshuus (Universidad de los Andes, Bogotá, Colombia), *VC-density and dp-rank in model theory*.

Valeria de Paiva (Rearden Commerce, Foster City, CA, USA), *Dialectica categories' surprising application—mapping cardinal invariants*.

Thomas Scanlon (University of California, Berkeley, USA), *Arithmetic dynamics from logic*.

Simon Thomas (Rutgers University, NJ, USA), *On the Bergman Property for infinite products of finite groups*.

Jouko Väänanen (University of Helsinki, Finland, and University of Amsterdam, The Netherlands), *Dependence and independence in logic*.

Abstracts of tutorials, plenary lectures, invited special session talks, and contributed papers follow.

For the Program Committee
XAVIER CAICEDO

For the Organizing Committee
ALEXANDER BERENSTEIN

Abstracts of Invited Plenary talks

► JOSEP MARIA FONT, *Logics preserving degrees of truth and the hierarchies of abstract algebraic logic*.

Department of Probability, Logic, and Statistics, Faculty of Mathematics, University of Barcelona, E-08071 Barcelona, Spain.
E-mail: jmfont@ub.edu.

In this talk I argue that the definition of a logic by preservation of all degrees of truth is a better rendering of the idea of consequence in a many-valued context than the usual truth-preserving scheme, which uses a single designated element or subset. I will review some results recently obtained in the investigation of this proposal by applying techniques of abstract algebraic logic, in the framework of Łukasiewicz logics and in the larger one of substructural logics, that is, logics defined by varieties of (commutative and integral) residuated lattices.

► DEIRDRE HASKELL, *Model theory and motivic integration.*
Department of Mathematics and Statistics, McMaster University, 1280 Main St. W, Hamilton ON L8S 4K1, Canada.
E-mail: haskell@math.mcmaster.ca.

The model theory of valued fields has recently drawn the attention of mathematicians working in subjects from differential geometry to algebraic number theory because of its essential role in the theory of motivic integration. Motivic integration is a measure theory on varieties defined over a valued field. It differs from a standard integration theory in two fundamental ways, both of which use logic. The first is that the measure is a function into a ring, instead of into the real numbers. The second is that the measure is a function defined on a formula, instead of on the set defined by the formula. These two abstractions make the calculations uniform across different fields, as well as allowing for a transfer principle; that is, if a first-order property holds for all but finitely many primes then it holds in characteristic zero. This level of generality is made possible by working with a valued field as a structure in a first-order language. Model-theoretic results about valued fields are used to develop the integration theory. My goal in this talk is to explain both the algebraic context and the relevant model-theoretic results which go into constructing the integration theory. No previous knowledge about valued fields will be assumed.

► DENIS HIRSCHFELDT, *The reverse mathematics of realizing and omitting types*.
Department of Mathematics, University of Chicago, 5734 S. University Avenue, Chicago, IL 60637, USA.
E-mail: drh@math.uchicago.edu.

I will discuss recent work on the computability theoretic and proof theoretic strength of constructions of special models (such as atomic and homogeneous models) that involve realizing and omitting types. The combinatorial character of these constructions place many of them in the rich reverse mathematical world of principles provable from Ramsey's Theorem for Pairs.

► ULRICH KOHLENBACH, *Recent developments in proof mining: Bounds from proofs in nonlinear ergodic theory*.
Research Group Logic, Department of Mathematics, Technische Universität Darmstadt, Schlossgartenstrasse 7, D-64289 Darmstadt, Germany.
E-mail: kohlenbach@mathematik.tu-darmstadt.de.

In this talk we give a survey on recent applications of the 'proof mining' program. This program is concerned with the extraction of effective uniform bounds from ineffective proofs in analysis using techniques from proof theory.

We will focus on problems in ergodic theory. More specifically, we discuss new explicit uniform rates of metastability (in the sense of Tao) for the von Neumann Mean Ergodic Theorem (for uniformly convex Banach spaces) as well as Baillon's weak nonlinear ergodic theorem. We then discuss rates of asymptotic regularity as well as metastability of a strong nonlinear ergodic theorem for Halpern iterations due to Wittmann in the Hilbert space case, Shioji/Takahashi for Banach spaces with uniformly Gâteaux differentiable norm and Saejung for CAT(0)-spaces. The bound on the latter two results have been established in joint work with L. Leuştean using a novel method of eliminating Banach limits as well as a new logical metatheorem for uniformly smooth Banach spaces. We also present a quantitative version due to Safarik of another strong nonlinear ergodic theorem by Baillon (for odd operators) and Wittmann for much more general operators. Finally, we discuss a quadratic rate of asymptotic regularity recently extracted (jointly with Körnlein) for the important class of accretive operators in Banach space.

► BENEDIKT LÖWE, *Looking upwards and downwards in the set-theoretic multiverse*.
Institute for Logic, Language and Computation (ILLC), Universiteit van Amsterdam, P.O. Box 94242, 1090 GE Amsterdam, The Netherlands.
E-mail: `b.loewe@uva.nl`.

In 2008, we determined the "modal logic of forcing", the set of those modal statements that are valid if you interpret the modal necessity operator as "in all forcing extensions" and replace the propositional variables by arbitrary sentences of the language of set theory. In terms of the set-theoretic multiverse, this modal fragment corresponds to looking upwards from a particular model of set theory. In this talk reporting on joint work with Joel Hamkins, we shall consider the natural dual operation of looking downwards, i.e., finding a ground model of which the current model of set theory is a forcing extension. We shall explore some properties of the modal logic of this operation and determine which combinations of modal logics for the upwards and downwards part of the multiverse are possible.

► ANTONIO MONTALBÁN, *The boundary of determinacy within second order arithmetic*.
Department of Mathematics, University of Chicago, 5734 S. University Avenue, Chicago, IL 60637, USA.
E-mail: `antonio@math.uchicago.edu`.

We find the exact level at which determinacy stops being provable in second order arithmetic, or equivalently for this type of sentences, in ZFC without the power set axiom.

This is joint work with Richard A. Shore.

► JUSTIN MOORE, *Iterated forcing and the Continuum Hypothesis*.
555 Malott Hall, Department of Mathematics, Cornell University, Ithaca, NY 14853-4201, USA.
E-mail: `justin@math.cornell.edu`.

Building on Jensen's proof that the Souslin Hypothesis is consistent with the Continuum Hypothesis, Shelah developed a criteria for proving that an iteration of forcings does not introduce new real numbers. By work of Devlin and Shelah, this criteria necessarily involves more than just the requirement that the individual iterands do not add reals and that they preserve stationary subsets of ω_1.

Parts of Shelah's criteria had an *ad hoc* nature to them. Additionally, new problems arose in the 1990s which required weakening Shelah's criteria. In some cases this was possible, while in others the problems resisted all attempts to solve them.

After developing this context, the talk will discuss two recent developments which show that the incremental progress made in the 1990s can not be subsumed into a more general theory of iterated forcing. First, there are two forcing axioms which are each consistent with the continuum hypothesis but which jointly negate it. Second, there is a new example of a combinatorial consequence of CH which "stands behind" the previously *ad hoc* part of Shelah's criteria, making it more essential than it had previously been believed.

► DANIELE MUNDICI, *Geometry of the Dubuc–Poveda strong semisimplicity property*.
Department of Mathematics, "Ulisse Dini", University of Florence, Viale Morgagni, 67/a – 50134 Firenze, Italy.
E-mail: `mundici@math.unifi.it`.

An algebra A is strongly semisimple (in the sense of Dubuc–Poveda) if every principal congruence of A is the intersection of maximal congruences of A. While this notion is stated in very general and purely algebraic terms, for lattice-ordered abelian groups (with or without unit) and for MV-algebras, strong semisimplicity turns out to be deeply related to the tangent space of their maximal spectra. We will discuss the geometry of strong semisimplicity, and its role in the visualization of syntactic and semantic consequence in infinite-valued Łukasiewicz logic, the underlying logic of MV-algebras.

► ALF ONSHUUS, *VC-density and dp-rank in model theory*.
Departamento de Matemáticas, Universidad de los Andes, Cra 1 Nro 18A- 12 Bogotá, Colombia.
E-mail: aonshuus@uniandes.edu.co.

VC-dimension and VC-density were introduced by Vapnik and Chervonenkis to measure, in some way, the complexity of a family of subsets of a given universe. This notion has had important applications in statistics an learning theory, usually in the framework where one looks at a definable family of definable sets (usually in a cartesian power of the real or the real exponential field). In this context model theory becomes relevant; in fact, any model where all uniform definable families of definable sets have finite VC-dimension is precisely what Shelah independently defined as a dependent theory (also known as a theory with NIP). This connection of "VC-theory" with model theory was discovered by Laskowski and is the setting of the talk.

We will study another connection discovered later. Turns out that another important notion of VC-theory, VC-density, is quite related to type counting and to dp-rank (a rank introduced by Shelah in the context of dependent theories). We will show some of the connections of model theory with VC-density, and show some evidence of a strong relation between VC-density and dp-rank.

► VALERIA DE PAIVA, *Dialectica Categories surprising application—mapping cardinal invariants*.
Rearden Commerce, 1051 E Hillsdale Blvd, 6th Floor, Foster City, CA 94404, USA.
E-mail: valeria.depaiva@gmail.com.

Goethe famously said that "Mathematicians are like Frenchmen: whatever you say to them they translate into their own language and forthwith it is something entirely different." True. Even more true of category theorists. Following this great tradition of appropriating other people's work, I want to tell you how I learned about "cardinalities of the continuum" from Blass and Morgan and da Silva and how I want to rock their boat, just a little, in the direction of my kind of mathematics. To this end I will introduce you to Dialectica Categories, an internal model of Gödel's Dialectica Interpretation that happens to be a very clever model of Linear Logic too. Time permitting I will mention some of its other applications.

► THOMAS SCANLON, *Arithmetic dynamics from logic*.
University of California, Berkeley, Mathematics Department, Evans Hall, Berkeley, CA, 94720-3840, USA.
E-mail: scanlon@math.berkeley.edu.

Dynamics, as the study of iterations of operations, is central to many parts of mathematics. From the logical point of view, one would expect that questions about discrete dynamical systems, even when restricted to reasonably tame categories, would suffer from Gödel incompleteness phenomena, and this, of course, is true. However, for many problems in algebraic dynamics, that is, those dynamical systems defined by rational functions, ideas from the model theory of difference fields, valued fields, and o-minimality can bring some order to the chaos.

► SIMON THOMAS, *On the Bergman Property for infinite products of finite groups*.
Department of Mathematics, Rutgers University, Hill Center for the Mathematical Sciences, 110 Frelinghuysen Road, Piscataway, NJ 08854-8019, USA.
E-mail: sthomas@math.rutgers.edu.

For each prime p, let $SL(2, p)$ be the corresponding special linear group over the field with p elements. Then, by considering the ultraproduct with respect to any nonprincipal ultrafilter, it is easily seen that the full direct product $\prod SL(2, p)$ has countable cofinality. In recent joint work, Jindra Zapletal and I considered the question of whether the existence of a nonprincipal ultrafilter is either necessary or sufficient in order to prove this result. Perhaps surprisingly, the answer turned out to involve large cardinals, a suitable Ramsey theorem and the asymptotic representation theory of finite groups.

► JOUKO VÄÄNANEN, *Dependence and independence in logic*.
Department of Mathematics and Statistics, Gustaf Hällströmin katu 2b, PL 68, FIN-00014 University of Helsinki, Finland.
E-mail: `jouko.vaananen@helsinki.fi`.

The goal in dependence logic is to establish a basic theory of dependence and independence underlying seemingly unrelated subjects such as causality, random variables, bound variables in logic, database theory, the Theory of Social Choice, and Quantum Mechanics. The concepts of (in)dependence in the different fields of science and humanities have surprisingly much in common and a common logic is starting to emerge. I will give an overview of the present state of this area of research.

Abstracts of invited talks in the special session on Algebraic Logic and Non Classical Logics

► MANUELA BUSANICHE, *Strong semisimplicity in MV-algebras*.
Instituto de Matemática Aplicada del Litoral CONICET-UNL, Güemes 3450, S3000GLN Santa Fe, Argentina.
E-mail: `mbusaniche@santafe-conicet.gov.ar`.

Recall that the n-generated free MV-algebra is the MV-algebra of all McNaughton functions $f\colon [0,1]^n \to [0,1]$, with pointwise operations of negation $(\neg f)(x) = 1 - f(x)$, truncated addition $(g \oplus f)(x) = \min(1, g(x) + f(x))$, and the zero function as constant (see [1]). A McNaughton function $f\colon [0,1]^n \to [0,1]$ is a piecewise linear continuous function, such that each linear piece has integer coefficients. Therefore, as stated in [3], one of the main tools to analyze MV-algebras is that of polyhedral geometry. That is what we shall use to study strong semisimplicity in the class of finitely generated MV-algebras.

An MV-algebra A is called *strongly semisimple* if for any $a \in A$ the intersection of all maximal ideals J such that $a \in J$ is the ideal generated by a. This is equivalent to saying that every principal quotient of A is semisimple 0 (see [2, Definition 4.7]).

We say that a finitely generated MV-algebra A is *polyhedral* if there is a polyhedron $P \subseteq [0,1]^n$ such that A is isomorphic to the MV-algebra of restrictions to P of McNaughton functions in the n-cube. We will show that every polyhedral MV-algebra is strongly semisimple. Then, to understand the failure of strong semisimplicity in semisimple MV-algebras we present a finitely generated semisimple MV-algebra that is not strongly semisimple. Lastly we study a sufficient condition for an n-generated semisimple MV-algebra not to be strongly semisimple.

The presentation is based on a joint work with Daniele Mundici.

[1] R. Cignoli, I. M. L. D'Ottaviano and D. Mundici, ***Algebraic foundations of many-valued reasoning***, Trends in Logic, vol. 7, Kluwer Academic Publishers, 2000.

[2] E. Dubuc and Y. Poveda, *Representation theory of MV-algebras*, ***Annals of Pure and Applied Logic***, vol. 161 (2010), pp. 1024–1046.

[3] D. Mundici, ***Advanced in Łukasiewicz calculus and MV-algebras***, Trends in Logic, vol. 35, Springer, 2011.

► MARCELO E. CONIGLIO, *First-order paraconsistent logics*.
Centre for Logic, Epistemology and the History of Science, State University of Campinas, P.O. BOX 6133, Zip Code 13083-970, Campinas (SP), Brazil.
E-mail: `coniglio@cle.unicamp.br`.

One of the basic features of a negation $\neg$ within a given logic **L** is the so-called 'explosiveness', which states that from a contradiction 'P and $\neg P$' everything is derivable in **L**. Thus, classical logic (and many other logics) equate ‘consistency’ with ‘freedom from contradictions’. Paraconsistency is the study of logic systems with a negation $\neg$ such that not every contradiction of the form ‘P and $\neg P$’ trivializes, that is, such that explosiveness is not always the case. This forces a re-analysis of the relationship between consistency, contradictoriness, inconsistency and triviality.

The *Logics of Formal Inconsistency* (LFIs), proposed by W. Carnielli and J. Marcos, play an important role in the universe of paraconsistent logics, since they internalize in the object language the very notions of consistency and inconsistency by means of specific connectives (primitives or not). This generalizes the strategy of N.C.A. da Costa, which introduced the well-known hierarchy of systems C_n, for $n > 0$. *Dialetheism*, mainly developed by G. Priest, is a different approach to paraconsistency based on the existence of ‘real contradictions’ (called *dialetheias*).

It is worth noting that most of the paraconsistent systems proposed in the literature are propositional. However, there exist several paraconsistent systems defined over first-order languages. In this talk some proposals for first-order paraconsistent logics will be analyzed and compared. The first-order extension of several LFIs will be presented (joint work with T. Rodrigues), as well as a Herbrand theorem for these systems, obtained by adapting the proof of S. Buss. Finally, a first-order LFI with a 3-valued semantics generalizing classical tarskian semantics will be introduced, showing its relations with evolutionary databases (due to W. Carnielli, J. Marcos and S. de Amo) and G. Priest’s first-order logic **LP** (joint work with L. H. Silvestrivi).

► NIKOLAOS GALATOS, *A category equivalence of varieties and the Beth definability property*.
Department of Mathematics, University of Denver, 2360 S. Gaylord Street, Denver, CO 80208, USA.
E-mail: ngalatos@du.edu.

The Beth definability property for a consequence relation states that implicit definability implies explicit definability. For algebraizable logics this is equivalent to the demand that epimorphisms between algebraic models of the logic are all surjective. In order to establish this property for (odd) Sugihara monoids, the algebraic models of the relevance logic RM (relevance with the mingle axiom) and of the uninorm logic UIML, we show that they are categorically equivalent to a variety of enriched relative Stone/Gödel algebras (with a nucleus), making use of R. McKenzie’s characterization of category equivalence for varieties. The definition of the operations for the resulting algebras is related to multiplication of upper triangular matrices on modules over irings, and the appropriate modifications to these definitions are inspired by truth conditions for Kripke-style semantics for relevant and paraconsistent logics. Apart from (a strong version of) the Beth definability for RM and UIML, other applications of the category equivalence include (hereditary) structural completeness and strong amalgamation for various varieties of Sugihara monoids.

This is joint work with J. Raftery.

► VINCENZO MARRA, *Sheaf-theoretic representations of MV-algebras via Priestley duality*.
Dipartimento di Informatica e Comunicazione, Room P121, Universitá degli Studi di Milano, via Comelico 39/41, I-20135 Milano, Italy.
E-mail: vincenzo.marra@unimi.it.

In 1958, C. C. Chang introduced MV-algebras as the equivalent algebraic semantics of Łukasiewicz infinite-valued propositional logic. By now MV-algebras sport a substantial array of connections with several other fields of mathematics, from piecewise linear topology to integration theory over Riesz spaces. Representation (or duality) theorems for classes of MV-algebras often play a key role in fostering such connections. Useful representation theorems for the entire class of MV-algebras, by contrast, have been much harder to come by. The best that can be done at present is to use sheaves. Two representation theorems for an arbitrary MV-algebra as the algebra of global sections of a sheaf of MV-algebras with special properties, over a base space which is either compact Hausdorff, or spectral, were obtained by Filipoiu and Georgescu in 1995, and by Dubuc and Poveda in 2010. We show that both representation theorems flow naturally from our analysis of the structure of the Priestley space dual to the underlying lattice of the MV-algebra in question. In particular, we obtain in this manner a proof of the Dubuc–Poveda Pushout-Pullback Lemma, i.e., the gluing axiom for sheaves, that uses a minimal amount of MV-algebraic background. As a further consequence of interest, we establish a broad MV-algebraic generalisation of a classical result by Kaplansky from 1947, stating that a compact Hausdorff space is uniquely determined to within a homeomorphism by its lattice of real-valued continuous functions.

This is joint work with Mai Gehrke (Paris) and Sam van Gool (Nijmegen and Paris).

► MATÍAS MENNI, *The manifestation of Hilbert's Nullstellensatz in Lawvere's Axiomatic Cohesion*.
Universidad Nacional de La Plata, calle 50 y 115, 1900 La Plata, Argentina.
E-mail: matias.menni@gmail.com.

Some of the interest of non-classical logics stems from their use in clarifying and generalizing classical results. A source of examples is the role that the interpretation of intuitionistic logic in toposes has in independence results, in completeness theorems, and in the formalization of the use of infinitesimals in differential geometry. Another example, to be discussed in this talk, is the part that Hilbert's Nullstellensatz plays in certain models of Axiomatic Cohesion (Lawvere, TAC 2007). Any connected geometric morphism $p^* \dashv p_* : \mathcal{E} \to \mathcal{S}$ between toposes $\mathcal{E}$ and $\mathcal{S}$ such that $p^* : \mathcal{S} \to \mathcal{E}$ has a left adjoint $p_! : \mathcal{E} \to \mathcal{S}$ determines a natural transformation $\theta : p_* \to p_!$. The (abstract) *Nullstellensatz* is said to hold if θ is epi. If Ω denotes the subobject classifier of $\mathcal{E}$ then *Sufficient Cohesion* holds if $p_!\Omega = 1$.

Experience with the intended examples suggests the following intuition: $p^* : \mathcal{S} \to \mathcal{E}$ is the inclusion of the category of 'discrete spaces' into that of all 'spaces', its right adjoint $p_* : \mathcal{E} \to \mathcal{S}$ assigns to each 'space' its associated '(discrete) space of points', and the left adjoint $p_! : \mathcal{E} \to \mathcal{S}$ assigns the associated space of 'pieces'. With this in mind, Sufficient Cohesion says that the space of truth values is connected (making the internal logic of $\mathcal{E}$ very non-classical), and the Nullstellensatz says that every piece has a point. We explain why, for a fixed field k, Hilbert's Nullstellensatz implies the abstract one in a model of Axiomatic Cohesion $p : \mathcal{E} \to \mathcal{S}$ where $\mathcal{S}$ is the Galois topos of k.

► CARLES NOGUERA, *Non-associative substructural logics: alternative axiomatization, algebraic and logical properties*.
Artificial Intelligence Research Institute, Spanish National Research Council, Campus de la Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain.
E-mail: cnoguera@iiia.csic.es.

Galatos and Ono have studied in a recent paper a non-associative version of full Lambek calculus, which we call here SL. They have introduced a Gentzen-style and a Hilbert-style calculus for SL and proved that it is algebraizable and its equivalent algebraic semantics is the variety of lattice-ordered residuated unital groupoids. On the other hand, Cintula and Noguera have developed (in ***Handbook of Mathematical Fuzzy Logic***, College Publications, 2011) a general algebraic framework to deal with substructural logics with SL as the base logic. They introduced the notion of almost MP-based logic (a logic with a Hilbert-style presentation where *modus ponens* is the only binary rule, there are no rules with more than two premises, and all unary rules are of the form $\varphi \vdash \delta(\varphi)$, for $\delta \in$ DT, where the set of terms DT satisfies some desired properties) and proved that every almost MP-based substructural logic enjoys a local deduction theorem and a certain form of proof by cases property. The main associative substructural logics are almost MP-based. However the problem was left open for SL and other non-associative logics. In this talk we positively solve it. We present an alternative Hilbert-style axiomatization of SL which allows to show that it is almost MP-based, and hence the same holds for all its axiomatic extensions. We obtain several interesting logical and algebraic consequences of this fact: a form of the local deduction theorem, a description of intersection of filters and of the filter generated by a set, an axiomatization of intersection of two axiomatic extensions of a given logic, and equational bases of varieties of SL-algebras generated by positive universal classes of SL-algebras. Finally, as another by-product of our alternative Hilbert system for SL, we show how to axiomatize the logic of linearly ordered residuated unital groupoids.

This is joint work with Petr Cintula, Zuzana Haniková, Rostislav Horčík.

► ARNOLD OOSTRA, *A lattice of Intuitionistic Existential Graphs systems*.
Universidad del Tolima, Barrio Santa Helena A.A. 546 Ibagué Colombia.
E-mail: aaoostra@gmail.com.

Early in the 20th century Charles S. Peirce introduced a system of diagrams called by himself Existential Graphs which, among other features, provides a totally graphic method for Classical Logic at different levels: Propositional, First Order and some Modal Logics. A very slight modification of Peirce's original system renders Existential Graphs for Intuitionistic Logic at the same levels. In this talk we show a series of Existential Graphs systems for various segments of Intuitionistic Propositional Calculus and also for all finitely axiomatizable Intermediate propositional logics. Besides the intrinsic interest of these graphic representations (and their First Order and Modal extensions), it is worth mentioning they provide novel axiomatizations for Boolean algebras, Heyting algebras and some of their generalizations.

► RAMÓN PINO PÉREZ, *An improvement to revision operators*.
Departamento de Matemáticas, Facultad de Ciencias, Universidad de Los Andes, Mérida 5101, Venezuela.
E-mail: pino@ula.ve.

The aim of this talk is to give a presentation of improvement operators. These operators are close to belief revision operators introduced by Alchourrón Gärdenfors and Makinson in the seminal paper of ***The Journal of Symbolic Logic*** of 1985. One important difference between our improvement operators and the classical ones in the AGM framework lies in the postulate of success: "the new piece of information has to belong to beliefs after revision". Unlike the classical revision operators, our operators do not satisfy this postulate. However they incorporate the new piece of information in a mild manner. In some sense the "degree of plausibility" of the new piece of information improves. We will show that our operators are well adapted to treat the problem of minimal change and that their iterated version has a behavior like the classical AGM revision operators.

This is a joint work with Sébastien Konieczny and Mattia Medina Grespan.

Abstracts of invited talks in the special session on Recursion Theory

► URI ANDREWS, *Universal computably enumerable equivalence relations*.
Department of Mathematics, University of Wisconsin, 480 Lincoln Drive, Madison, WI 53706-1388, USA.
E-mail: andrews@math.wisc.edu.

I will discuss computably enumerable equivalence relations (ceers) under the reducibility $R \leq S$ if there exists a computable function f such that, for every x, y, $x \mathrel{R} y$ if and only if $f(x) \mathrel{S} f(y)$. I will discuss how the uniformly effectively inseparable ceers coincide with the uniformly finitely precomplete ceers and the uniformly universal ceers, in particular showing that they are universal, but there are effectively inseparable ceers which are not universal. Also, I may discuss how the jump operator on ceers introduced by Gao and Gerdes is strictly increasing on non-univeral ceers.

This is joint work with Steffen Lempp, Joseph S. Miller, Keng Meng Ng, Luca San Mauro, and Andrea Sorbi.

► EDWARD HERMANN HAEUSLER, *On the computational complexity of purely implicational logic: a proof-theoretical discussion*.
Departamento de Informática, Pontifícia Universidade Catolica do Rio de Janeiro, Rio de Janeiro, RJ 22453-900, Brasil.
E-mail: hermann@inf.puc-rio.br.

The computational complexity of SAT for purely implicational propositional logic is known to be PSPACE-complete. Intuitionistic Propositional Logic is known to be PSPACE-complete also, while Classical Propositional Logic is CONP-complete for Tautology checking and NP-complete for Satisfiability checking. We show how proof-theoretical results on Natural Deduction help analysing the Purely Implicational Propositional Logic complexity regarded its polynomial relationship to Intuitionistic and Classical Propositional Logics. We provide a complete and sound deduction system for Implicational Propositional Logic that is able to provide counter-models and proofs. We hope that the analysis of the size of the objects provided by this tool from purely implicational formulas is worth of helping the understanding the relationship between the computational complexity of the logics involved in this study.

► JUHA KONTINEN, *Complexity results for dependence logic*.
Department of Mathematics and Statistics, University of Helsinki, Room B316, P.O. Box 68, Gustaf Hällströmin katu 2b, FIN-00014 Helsinki, Finland.
E-mail: juha.kontinen@helsinki.fi.

Dependence Logic, introduced by Jouko Väänänen in 2007, is a new logic incorporating the concept of dependence into first-order logic. The expressive power of dependence logic coincides with that of existential second-order logic, and the complexity class NP over finite structures. In the past few years, dependence logic has grown into a new framework in which various notions of dependence and independence can be formalized. We review recent results regarding the expressive power and complexity of certain fragments and extensions of dependence logic.

► CARLOS ORTIZ, *Logics of residue classes in descriptive complexity*.
Department of Computer Science and Mathematics, Arcadia University, 450 S. Easton Road, Glenside, PA 19038, USA.
E-mail: ortizc@arcadia.edu.

We present a hierarchy of finite-model logics that are extensions of first order logic with built-in order and modular quantifiers. We prove separation results among these logics using arguments and results from algebraic number theory and from model theory of finite fields.

There are various motivations for studying these logics. They are closely related to circuit complexity classes, in particular to the classes such as AC^0 and ACC^0 contained within NC^1. Furthermore, the class of finite fields possess strong *asymptotic properties* (essentially this means that the definable sets behave nicely). These properties are obtained using classical methods of model theory and results of algebraic geometry. The celebrated result of Chatzidakis, van den Dries and Macintyre on the estimates of the cardinality of first order definable sets in finite fields is only the most recent example of these properties. The above-mentioned logics provide a mechanism to use asymptotic properties on descriptive complexity problems.

This is ongoing work with Argimiro Arratia.

► RICARDO OSCAR RODRÍGUEZ, *Modal Extensions of fuzzy logics*.
Departamento de Computación, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, Pabellón I, Ciudad Universitaria, (1428) Buenos Aires, Argentina.
E-mail: ricardo@dc.uba.ar.

In the last years there has been a growing number of papers about combining modal and fuzzy logics (in the sense of P. Hajek as many-valued residuated logics).

The purpose of this talk is to give an overview about the problem of searching a syntactical characterization of modal many-valued logics defined by fuzzy Kripke frames, i.e., structures $\langle W, R, e\rangle$ where W is no-empty set and both the accessibility relation R and the interpretation of propositions e are many-valued over the same residuated algebra. Thus, the logics introduced either by many-valued accessibility relations over classical logic or by classical accessibility relations over many-valued logics could be considered as extensions of this doubly many-valued semantics; indeed, the general logic is minimal.

Unfortunately, within this general framework nobody has been able to find a syntactic characterization of the notion of modal many-valued logic that works in all the cases. The difficulties arise from the fact that it does not know a general method to axiomatize the modal many-valued logics given by the class of all fuzzy Kripke frames (i.e., the minimal ones). It turns out that the only minimal logics axiomatized in the literature are the ones where the many-valued counterpart is given by a finite Heyting algebra, the standard (infinite) Gödel algebra or a finite residuated algebra (in particular Łukasiewicz algebra).

Throughout the talk it will be shown the difficulties of our enterprise and we will try to specify which conditions should satisfy this syntactic notion. We will also review the works in the literature that fits inside the general proposed framework.

► JORGE PETRUCIO VIANA, *Graph calculi for algebras of binary relations*.
Inst. of Mathematics and Statistics, UFF: Universidade Federal Fluminense, Niterói, Brazil.
E-mail: petrucio@cos.ufrj.br.

Traditionally, formulas are written on a single line. S. Curtis and G. Lowe suggested a more visually appealing alternative for the case of binary relations: using graphs for expressing properties and reasoning about relations in a natural way. We extended their approach to diagrams that are sets of graphs (cf. [1, 2, 3] and the bibliographies therein.) The basic intuitions are quite simple, leading to playful and powerful systems for deriving inclusions between diagrams that are consequences of sets of inclusions between diagrams taken as hypotheses. Our systems treat positive, negative, and intuitionistic information. In this talk we summarize these achievements, presenting proper formulations of these systems as logical calculi and discussing soundness, completeness and decidability.

This is joint work with Renata de Freitas, Paulo A. S. Veloso, and Sheila R. M. Veloso.

[1] R. de Freitas, P. A. S. Veloso, S. R. M. Veloso, and P. Viana, *Positive fork graph calculus*, ***Logical Foundations of Computer Science, 2009***, (S. N. Artëmov and A. Nerode, editors), Lecture Notes in Computer Science, vol. 5407, 2009, pp. 152–163.

[2] ———, *A calculus for graphs with complement*, ***Diagrams***, (A. K. Goel et al., editors), Lecture Notes in Computer Science, vol. 6170, 2011, pp. 84–98.

[3] R. de Freitas and P. Viana, *A graph calculus for proving intuitionistic relation algebraic equations*, ***Diagrams***, (Ph. T. Cox et al., editors), Lecture Notes in Computer Science, vol. 7352, 2012, 324–326.

Abstracts of invited talks in the special session on Set Theory

► ANDRÉS CAICEDO, *Forcing with $\mathbb{P}_{max}$ over models of strong versions of determinacy*.
Boise State University, Boise, ID 83725-1555, USA.
E-mail: caicedo@math.boisestate.edu.

Hugh Woodin introduced $\mathbb{P}_{\max}$, a definable poset, and showed that, when forcing with it over $L(\mathbb{R})$ (in the presence of determinacy), one recovers choice, and obtains a model of many combinatorial assertions for which simultaneous consistency was not known by traditional forcing techniques. $\mathbb{P}_{\max}$ can be applied to larger models of determinacy. As part of joint work with Larson, Sargsyan, Schindler, Steel, and Zeman, we show how this allows us to calibrate the strength of different square principles.

► ALI ENAYAT, *Set theory with a Class of Indiscernibles*.
Department of Mathematics and Statistics, American University, Washington, 4400 Massachusetts Avenue, NW, Washington, DC 20016, USA.
E-mail: ali.enayat@gmail.com.

This talks concerns a system ZFCI of set theory formulated in the language $\{\in, I(x), <\}$, where $I(x)$ is a unary predicate to distinguish a class of indiscernibles and $<$ is a binary relation for a global well-ordering. The axioms of ZFCI consist of ZFC plus a sentence expressing "I is a proper class of ordinals"; a schema expressing that $<$ is a global well-ordering; the replacement scheme for formulae using I and $<$; and scheme asserting that $(I, <)$ is a class of order indiscernibles for formulae in the language $\{\in, <\}$.

ZFCI goes well beyond ZFC since it proves the existence of n-Mahlo cardinals for each concrete natural number n, but it does not prove the statement $\forall n\, \exists\kappa$ "κ is n-Mahlo cardinal". Indeed, one can precisely describe the first order consequences of ZFCI in the usual language of set theory $\{\in\}$. Here is the key result:

THEOREM A. $\mathsf{ZFCI} \vdash \sigma \iff \mathsf{ZFC} + \Lambda \vdash \sigma$ *for every sentence* σ *in the language of set theory* $\{\in\}$, *where*:

$$\Lambda := \{\exists\kappa \text{ “}\kappa \text{ is } n\text{-Mahlo and } V_\kappa \prec_{\Sigma_n} V\text{”}: n < \omega\}.$$

► LUCIA RENATO JUNQUEIRA, *There is more than one useful way to create a new topological space from a space and an elementary submodel containing it.*.
Instituto de Matemática e Estatística — IME-USP, Universidade de Sao Paulo, Rua do Matão, 1010, Cidade Universitária, São Paulo, SP, CEP 05508-090, Brasil.
E-mail: lucia@ime.usp.br.

We have previously used a "subobject" created from a topological space and an elementary submodel. Recently a "quotient object" has been used instead. Given a topological space X, a base $\mathcal{B}$ for it, and an elementary submodel containing both, we define a set of equivalence classes $X/(M, \mathcal{B})$ with a topology that is weaker than the quotient topology. We discuss some applications and some subtleties.

► DILIP RAGHAVAN, *Bounding, splitting, and almost disjointness*.
Kobe University, 1-1, Rokkodai, Nada-ku, Kobe 657-8501, Japan.
E-mail: raghavan@math.toronto.edu.

A famous (still) open problem in the theory of cardinal invariants of the continuum asks whether $\mathfrak{d} = \aleph_1$ implies $\mathfrak{a} = \aleph_1$. A variation of this question is "does $\mathfrak{b} = \mathfrak{s} = \aleph_1$ already imply that $\mathfrak{a} = \aleph_1$?". We will shed some light on this question by examining when it is possible to destroy a MAD family without increasing either $\mathfrak{b}$ or $\mathfrak{s}$.

This is joint work with J. Brendle.

► VICTOR TORRES-PÉREZ, *Rado's Conjecture and square sequences*.
Kurt Gödel Research Center for Mathematical Logic, Währinger Strasse 25, 1090 Wien, Austria.
E-mail: victor.torres.perez@univie.ac.at.

Rado's Conjecture (RC) is the following statement: A family of intervals of a linearly ordered set is the union of countably many disjoint subfamilies (σ-disjoint if and only if every subfamily of size is (σ)-disjoint.

Todorcevic has shown that RC is independent with ZFC. He has also shown some interesting consequences. For example, RC implies that the continuum has size at most $\aleph_2$, a strong form of Chang's conjecture holds; SCH holds; the negation of Jensen's square principle $\square_\kappa$ for every uncountable κ, etc. In this talk we will focus on the influence of Rado's Conjecture over certain Aronszajn trees and some types of square principles in a two cardinal version.

This a joint work with Stevo Todorcevic.

► CARLOS UZCÁTEGUI, *Borel selectors for families of sets*.
Facultad de Ciencias, Departamento de Matemática, Universidad de Los Andes, Mérida, Venezuela, Sector La Hechicera, Núcleo universitario Pedro Rincón Gutiérrez, Edf. A, Mérida 5101 Venezuela.
E-mail: uzca@ula.ve.

Let $\mathcal{H}$ be a collection of infinite subsets of a countable set X and let $\widehat{\mathcal{H}}$ be the upward closure of $\mathcal{H}$, that is to say,

$$\widehat{\mathcal{H}} = \{A \subseteq X : (\exists H \in \mathcal{H})\ H \subseteq A\}.$$

A selector for $\mathcal{H}$ is a function $\Phi\colon X^{[\infty]} \to X^{[\infty]}$ (where $X^{[\infty]}$ is the collection of infinite subsets of X) such that

$$\Phi(A) \subseteq A \ \ \& \ \ \Phi(A) \in \mathcal{H} \text{ for all } A \in \widehat{\mathcal{H}}.$$

We will present some results regarding the question of whether a family $\mathcal{H}$ admits a selector Φ which is a Borel function.

The original motivation for this work is related to the classical Ramsey theorem: Given a coloring $c : \mathbb{N}^{[2]} \to 2$ of the 2-elements subsets of $\mathbb{N}$, there is an infinite $B \subseteq \mathbb{N}$ homogeneous for c, that is to say, c is constant on $B^{[2]}$. The question is whether there exists a Borel function that selects an infinite c-homogeneous subset of a given infinite set $A \subseteq \mathbb{N}$. In other words, does the collection $\mathcal{H}_c$ of all c-homogeneous infinite sets admit a Borel selector? We show that the answer is positive. We also present results about the existence of Borel selectors for the collection of homogeneous sets given by Galvin's lemma, a well known extension of Ramsey's theorem.

This kind of questions also fits naturally in the context of some well studied combinatorial properties like selectivity, q^+, p and p^+. We will discuss several of these properties.

Abstracts of invited talks in the special session on Model Theory

► JUAN DIEGO CAYCEDO, *Tameness of expansions of the real and complex fields*.
Albert-Ludwigs-Universität Freiburg, Eckerstrasse 1, 79104 Freiburg, Germany.
E-mail: juan-diego.caycedo@math.uni-freiburg.de.

The complex field and the real ordered field are prototypical examples of well-behaved structures from the model-theoretic viewpoint, although in rather different ways. Indeed, in both cases there is a certain geometric understanding of definable sets. Natural questions are what expansions of these structures introducing new definable sets admit similar results and where is there a dividing line between "tame" and "wild" expansions.

In the case of the real field, a rich theory has been developed for o-minimal expansions. Also, a meaningful division is obtained when tame expansions are defined to be those which do not define the set of integer numbers.

I will discuss the case of expansions of the complex field through several examples related to complex exponentiation and present recent joint work with A. Gunaydin and P. Hieronymi that uses the predimension method to show tameness of expansions of the real field by certain non-locally closed trajectories of linear vector fields.

► ARTEM CHERNIKOV, *Weak independence theorem in NTP2 theories*.
Université Claude Bernard Lyon 1, 43 Boulevard 11 Novembre 1918, 69100 Villeurbanne, France.
E-mail: art.chernikov@gmail.com.

Independence theorem of Kim and Pillay is one of the main results about forking in simple theories. It turns out that a weak form of the independence theorem can be formulated and proved in a much larger class of NTP2 theories (introduced by Shelah and containing both simple and NIP theories). As an application, we show that over extension bases for non-forking in NTP2 theories, Lascar strong type is equivalent to Kim–Pillay strong type.

This is joint work with Itai Ben Yaacov.

► VINICIUS CIFÚ LOPES, *Pseudofinite and pseudocompact metric structures*.
Universidade Federal do ABC, Av. dos Estados, 5001, Santo André, SP 09210-971, Brazil.
E-mail: vinicius@ufabc.edu.br.

We initiate the study of pseudofiniteness in continuous logic. We introduce a related concept, namely that of pseudocompactness, and investigate the relationship between the two concepts. We establish some basic properties of pseudofiniteness and pseudocompactness and provide many examples. We also investigate the injective-surjective phenomenon for definable endofunctions in pseudofinite structures.

This is joint work with Isaac Goldbring, then-UCLA, now at UI-Chicago.

► ALF DOLICH, *Expansions of o-minimal theories by a dense independent predicate*.
City University of New York, Kingsborough Community College, 2001 Oriental Boulevard, Brooklyn, NY 11235-2398, USA.
E-mail: adolich@gmail.com.

Let T be an o-minimal theory in a language L. Let L_H be L augmented with a new unary predicate H and let T_H be the L_H-theory containing T and stating that H is a dense independent (in the sense of the definable closure operator for T) subset. T_H is complete and any L_H-formula is T_H equivalent to a Boolean combination of certain special existential formulas. We study models, M, of T_H. In particular we will discuss a decomposition theorem for definable subsets of arbitrary Cartesian powers of M and a result indicating that definable functions of arbitrary arity are "close" to being definable in the underlying o-minimal structure.

► JOHN GOODRICK, *The Schröder–Bernstein property and a-saturated models*.
Departamento de Matemáticas, Universidad de los Andes, Cra 1 Nro 18A- 12 Bogotá, Colombia.
E-mail: jr.goodrick427@uniandes.edu.co.

We say that a class (K, Mor) of structures K with a distinguished class *Mor* of injections between them is Schröder–Bernstein (or SB) if any two Mor-biembeddable structures in K are isomorphic. We focus on the case where K is a subclass of $\mathit{Mod}(T)$ for some first-order theory T and $\mathit{Mor} = \mathit{Elem}$ are the elementary embeddings between them.

While characterizing the theories T such that $(\mathit{Mod}(T), \mathit{Elem})$ is SB seems to be complicated, it turns out to be much easier to consider the case where K consists of all the sufficiently saturated models of T (we use a-saturation, which is slightly weaker than T^+-saturation). We can completely characterize the theories T for which the class of a-saturated models is SB when T is unstable (in which case this will never be SB) and when T is superstable. Extending these results to all theories T would seem to require answering difficult long-open questions on the existence of regular types in strictly stable theories.

► JANAK DANIEL RAMAKRISHNAN, *Partial orders in o-minimal structures*.
CMAF, Universidade de Lisboa, Av. Prof. Gama Pinto, 2, 1649-003 Lisboa, Portugal.
E-mail: janakdaniel@gmail.com.

We show that partial orders definable in several "tame" ordered structures can be definably extended to linear orders. Our technique extends a straightforward one on well-ordered structures, and holds for many variants of o-minimal structures, as well as for ordered structures not usually considered tame, such as non-standard models of PA.

This is joint work with C. Steinhorn.

► MARGARET THOMAS, *Rational points and integer-valued definable functions*.
Zukunftskolleg, Fachbereich Mathematik und Statistik, Universität Konstanz, Postfach 216, D-78457 Konstanz, Germany.
E-mail: margaret.thomas@uni-konstanz.de.

Pila and Wilkie's theorem concerning the density of rational and algebraic points lying on sets definable in o-minimal expansions of the real field has already had far-reaching consequences for Diophantine geometry. Wilkie has conjectured an improvement to their result for sets definable in the real exponential field. We shall illustrate how the already proven one-dimensional case of this conjecture has consequences for the growth behaviour of the analytic functions definable in this structure which take integer values at natural number arguments. These results are related to a classical theorem of Pólya; we show that if a definable, analytic function $f\colon [0,\infty)^k \to \mathbb{R}$ is such that $f(\mathbb{N}^k) \subseteq \mathbb{Z}$, and, for every $\epsilon > 0$, f grows slower than $\exp(r^{\epsilon})$ (where r is the distance from the origin), then f is a polynomial over $\mathbb{Q}$.

This result is joint work with Gareth O. Jones and Alex J. Wilkie.

► XAVIER VIDAUX, *Uniform definability and undecidability in classes of structures*.
Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Departamento de Matemática, Casilla 160 C, Concepción, Chile.
E-mail: xvidaux@udec.cl.

We present a concept of *uniform encodability of theories* and develop tools related to this concept. As an application we obtain general undecidability results which are uniform for large families of structures. For example we show that there is no algorithm to answer whether a system of polynomial equations over $Z[z]$ has or does not have solutions in all but finitely many polynomial rings $F_p[z]$ with F_p a finite field.

In the way, we define uniformly among odd characteristics the equivalence relation "$x \sim y$ if and only if there is some integer s for which $y = x^{p^s}$" in large classes of function fields and in polynomial rings.

This is joint work with Hector Pasten (Queen's University, Canada) and Thanases Pheidas (University of Crete, Greece).

This research was financed by research project FONDECYT 1090233.

Abstracts of contributed talks

► FRANQUI CÁRDENAS, *Unfoldable cardinals and gap-2 morasses*.
Universidad Nacional de Colombia, Avenida Carrera 30 Nro 45-03, edificio 404, Bogotá, Colombia.
E-mail: fscardenasp@unal.edu.co.

In this talk I present a consistency result for a certain type of large cardinal and gap-2 morasses, obtained with a forcing extension model where GCH fails. Unfoldable cardinals and gap-2 morasses exist in L if there are unfoldable cardinals.

► WALTER CARNIELLI, *Inconsistent set theory and Cantor's intuitions*.
Centre for Logic, Epistemology and the History of Science and Department of Philosophy, State University of Campinas at Campinas, SP, Brazil.
E-mail: carniell@cle.unicamp.br.

This talk is part of a project (in joint work with Marcelo E. Coniglio) that intends to revive the debate about the uses of paraconsistent reasoning in the foundations of set theory. By means of employing quantified versions of the Logics of Formal Inconsistency and by taking consistency as a predicate in such logics, we show how consistent and inconsistent sentences, as well as consistent and inconsistent sets, can be handled without falling into triviality. We lay the grounds for new paraconsistent set-theories under this perspective (such as **ZFmbC** and **ZFCil**) and establish their non-triviality. By recalling how George Cantor himself, in his efforts towards founding set theory more than a century ago, not only used a form of 'inconsistent sets' in his mathematical reasoning, but regarded contradictions as beneficial, we show how Cantor's view of inconsistent collections can be related to ours.

► J. L. CASTIGLIONI AND HERNÁN SAN MARTÍN, *Remarks about the coproduct in some subvarieties of the variety of Heyting algebras with successor*.
Facultad de Ciencias Exactas, Universidad Nacional de La Plata, CC 172, La Plata (1900), Argentina.
E-mail: hernan_sm5@hotmail.com.
Consejo Nacional de Investigaciones Científicas y Técnicas, Av. Rivadavia, 1917 C1033AAJ CABA, Argentina.

In [3] Kuznetsov introduced an operation on Heyting algebras as an attempt to build an intuitionistic version of the provability logic of Gödel–Löb, which formalizes the concept of provability in Peano Arithmetic. This unary operation, which we shall call *successor*, was also studied by Caicedo and Cignoli in [2], and by Esakia in [1]. In particular, in [2] it was considered as an example of an implicit compatible operation on Heyting algebras.

A S-*algebra* is a Heyting algebra endowed with its successor function, when it exists. Let n be a natural number. We say that a S-algebra H has height n if $S^{(n)}(0) = 1$ and n is the minimum natural number with this property, and we write $\mathcal{SH}_n$ for the class of S-algebras of height less or equal to n. This class is a variety with defining the equations of S-algebras together with the additional equation $S^{(n)}(0) = 1$.

In this talk we shall give a description of the coproduct in $\mathcal{SH}_n$ ([4]) between two algebras H_1 and H_2, with H_1 or H_2 satisfying prelinearity.

[1] X. Caicedo and R. Cignoli, *An algebraic approach to intuitionistic connectives*, ***The Journal of Symbolic Logic***, vol. 66 (2001), no. 4, pp. 1620–1636.

[2] L. Esakia, *The modalized Heyting calculus: a conservative modal extension of the Intuitionistic Logic*, ***Journal of Applied Non-Classical Logics***, vol. 16 (2006), no. 3–4, pp. 349–366.

[3] A. V. Kuznetsov, *On the propositional calculus of intuitionistic provability*, ***Soviet Mathematics Doklady***, vol. 32 (1985), pp. 18–21.

[4] H. J. San Martín, ***Algebras de Heyting con sucesor***, Ph.D. thesis, Facultad de Ciencias Exactas, Universidad Nacional de La Plata, Argentina, 2011.

► PABLO CELAYES AND MAURICIO TELLECHEA, *Algebraically expandable classes of D_{01ab}*.
Universidad Nacional de Córdoba, Medina Allende s/n, Ciudad Universitaria, CP: X5000HUA Córdoba, Argentina.
E-mail: mauriciotellechea@gmail.com.

Lattices are algebraic structures ubiquitous in the field of logic. In this talk we will study some aspects of the structure of the variety D_{01ab} of bounded distributive lattices with two constants in relation to the problem of characterizing the algebraically expandable subclasses of this variety.

An algebraically expandable (AE) class is a class of algebras of the same type axiomatizable by sentences of the form $\forall\vec{x}\,\exists!\vec{z} \bigwedge p_i(\vec{x},\vec{z}) = q_i(\vec{x},\vec{z})$. These classes are interesting because it is possible to define new operations in the algebras of the class, apart from those given by the function symbols of the type [1].

Let F be the subclass of all members of D_{01ab} with two or three elements. Since sentences of the form $\forall\vec{x}\,\exists!\vec{z} \bigwedge p_i(\vec{x},\vec{z}) = q_i(\vec{x},\vec{z})$ are preserved by sheaves and every member of D_{01ab} can be represented as a global subdirect product with factors in F [2], a first step in the above described characterization problem is describing the AE subclasses of F. We will give some advances in connection with this problem; in particular, we will give several interesting algebraically expandable subclasses of D_{01ab} arising from the corresponding subclasses of F.

[1] M. Campercohli and D. Vaggione, *Algebraic functions*, ***Studia Logica***, vol. 98 (2011), pp. 285–306.

[2] H. Gramaglia and D. Vaggione, *Birkhoff-like sheaf representation of varieties of lattice expansions*, ***Studia Logica***, vol. 56 (1996), pp. 111–131.

► PETR CINTULA, ZUZANA HANIKOVÁ, ROSTISLAV HORČÍK, AND CARLES NOGUERA, *Semilinear non-associative substructural logics: completeness properties and complexity*.
Institute of Computer Science, Academy of Sciences of the Czech Republic, Pod Vodárenskou věží 2, 182 07 Prague, Czech Republic.
E-mail: cintula@cs.cas.cz.
E-mail: hanikova@cs.cas.cz.
E-mail: horcik@cs.cas.cz.
Artificial Intelligence Research Institute, Spanish National Research Council, Campus de la Universitat Autònoma de Barcelona, 08193 Bellaterra, Catalonia, Spain.

As presented in ***Handbook of Mathematical Fuzzy Logic*** (P. Cintula, P. Hájek, C. Noguera (eds.), College Publications, 2011), fuzzy logics can be seen as a particular subfamily of substructural logics whose defining property is completeness with respect to linearly ordered algebras, also called *chains*. Following the terminology introduced in a previous paper by Cintula and Noguera (Implicational (Semilinear) Logics I, *Archive for Mathematical Logic* vol. 49 (2010), pp. 417–446) these logics and their algebraic counterparts are called *semilinear*, because the subdirectly irreducible members of the corresponding classes of algebras are chains. Some of these logics (e.g., Łukasiewicz or Gödel–Dummett logic) even enjoy 'better' forms of completeness with respect to special classes of chains, such as those with domain being the real or rational unit interval or a finite set.

In this talk we study semilinear non-associative substructural logics. In another talk we show how these systems can be axiomatized; now we focus on their completeness properties and their complexity. Our base logic is the semilinear extension of the non-associative full Lambek calculus SL studied by Galatos and Ono (Cut elimination and strong separation for substructural logics, *Annals of Pure and Applied Logic*, 161: 1097–1133, 2010). We call it SL^{ℓ}, the logic of totally ordered residuated unital groupoids; moreover we consider for every set of axioms corresponding to structural rules, $\mathrm{S} \subseteq \{\mathrm{e}, \mathrm{c}, \mathrm{i}, \mathrm{o}\}$, its associated semilinear logic $\mathrm{SL}^{\ell}_{\mathrm{S}}$. We prove that $\mathrm{SL}^{\ell}_{\mathrm{S}}$ is complete with respect to the class of all countably infinite dense SL_{S}-chains, and with respect to the class of all SL_{S}-chains on $[0, 1]$. Moreover we prove the finite embeddability property for SL-chains and so we obtain completeness of SL with respect to the class of finite SL-chains. Finally, we show that the equational theory (and even the universal theory) of semilinear lattice-ordered residuated unital groupoids is coNP-complete.

► PABLO CUBIDES, *C-minimal structures*.
Equipe de Logique (URA 753 du CNRS), UFR de Mathématiques, Université Paris Diderot de Paris 7, case 7012, site Chevaleret, 75205 PARIS CEDEX 13, France.
E-mail: cubikova@logique.jussieu.fr.

C-minimal structures constitute an interesting abstract setting in which one can test properties one would like to lift from stable and o-minimal theories to the NIP context. Many properties shared by this two tame type of structures such as existence of prime models, algebraic closure having the exchange property, etc., are not in general true for C-minimal ones. Yet, by work of Haskell and Macpherson they have a cell decomposition theorem and a well-behaved notion of dimension. We present a slightly different approach to these theorems and we show some applications to the study of definable types together with some examples.

► RODOLFO C. ERTOLA BIRABEN, *On a Problem posed by López-Escobar*.
Centro de Lógica – CLE, Universidade Estadual de Campinas – UNICAMP, Rua Sérgio Buarque de Holanda, 251, Barão Geraldo, CEP 13083 – 859, Campinas, SP, Brasil.
E-mail: rcertola@yahoo.com.ar.

In 1985 (see [4], p. 118), López-Escobar posed the following problem: "Suppose that S is a schema, essentially involving quantifiers, such that S is provable in the Classical Predicate Calculus, but not in the Intuituionistic Predicate Calculus, IPC. Then, is there a sentential connective $\oplus$ (with associated rules) so that the Intuituionistic Sentential Caclulus (ISC) $+\oplus$ is a conservative extension of ISC and $IPC + \oplus \vdash S$?" Moreover, he mentioned, as a possible example for S, the formula $\forall x\neg\neg Px \to \neg\neg\forall x Px$. This formula, well known not to be derivable in IPC, is sometimes known as the Kuroda Formula.

We will talk about solutions of the given problem in the case of some formulas such as Kuroda's and relate those solutions to the issue of intuitionistic connectives as dealt, e.g., in [1], [2], [3] and [4].

[1] X. Caicedo and R. Cignoli, *An algebraic approach to intuitionistic connectives*, ***The Journal of Symbolic Logic***, vol. 66 (2001), pp. 1620–1636.

[2] D. M. Gabbay, *On some new intuitionistic propositional connectives I*, ***Studia Logica***, vol. 36 (1977), pp. 127–139.

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[4] E. G. K. López-Escobar, *On intuitionistic sentential connectives I*, ***Revista Colombiana de Matemáticas***, vol. 19 (1985), pp. 117–130.

► FRANCISCO GUEVARA, *Uniformly Fréchet ideals*.
Facultad de Ciencias, Departamento de Matemática, Universidad de Los Andes, Mérida, Venezuela, Sector La Hechicera, Núcleo universitario Pedro Rincón Gutiérrez, Edf. A, Mérida 5101, Venezuela.
E-mail: guevara@ula.ve.

An ideal I on a countable set X is called Fréchet (following [4]) if for all $A \notin I$ there is $B \in I^{\perp}$ infinite such that $B \subseteq A$, where $I^{\perp}$ is the orthogonal of I. When an ideal I is Fréchet there is a function $F\colon 2^X \to 2^X$ such that $A \notin I \Leftrightarrow F(A) \subseteq A, F(A)$ is infinite and $F(A) \in I^{\perp}$.

We study ideals such that the function F can be found Borel. Such ideals will be called uniformly Fréchet ideals.

In [1] we can find results (different from the ones presented here) related to the extraction of converging sequences in a Borel way in separable Rosenthal compacta.

We present some examples of uniformly Fréchet ideals.

1. Let I_c be the ideal on $\mathbb{N}^{<\mathbb{N}}$ generated by the chains $\overline{\alpha} = \{\alpha \restriction m\colon m \in \mathbb{N}\}$, $\alpha \in \mathbb{N}^{\mathbb{N}}$. I_c was studied in [2]. It is Borel and uniformly Fréchet, while $I_c^{\perp}$ is Π^1_1–complete and it is not uniformly Fréchet.
2. I_c is a particular case of a more general construction already studied in [3]. Let $\mathcal{A} \subseteq \mathbb{N}^{\mathbb{N}}$ be an analytic family and denote by $I(\mathcal{A})$ the ideal generated by $\{\overline{\alpha}\colon \alpha \in \mathcal{A}\}$. Then $I(\mathcal{A})$ is Fréchet and when $\mathcal{A}$ is Borel, then $I(\mathcal{A})$ is also Borel and uniformly Fréchet.

[1] Gabriel Debs, *Borel extractions of converging sequences in compact sets of Borel functions*, ***Journal of Mathematical analysis and its aplications***, vol. 350 (2009), pp. 731–744.

[2] Pandelis Dodos and Vassilis Kandellopoulos, *On pairs of definable orthogonal families*, ***Illinois Journal of Mathematics***, vol. 52 (2008), no. 1, pp. 181–201.

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[4] Stevo Todorčević, *Analytic gaps*, ***Fundamenta Mathematicae***, vol. 150 (1996), pp. 55–66.

► VINCENT GUINGONA, *On VC-minimal theories*.
Department of Mathematics, University of Notre Dame, 255 Hurley Hall, Notre Dame, IN 46556, USA.
E-mail: guingona.1@nd.edu.

I discuss recent developments in VC-minimal theories. This includes examining VC-minimality and variants in abelian groups, ordered abelian groups, ordered fields, and valued fields. I also exhibit interesting properties of VC-minimal theories, including eliminiation of imaginaries in one variable and interpretability of infinite linear orders.

Some of this work is joint with Joseph Flenner.

► DANIEL LIMA VENTURA, MAURICIO AYALA-RINCÓN, AND FAIROUZ KAMAREDDINE, *Intersection types and explicit substitution*.
Instituto de Informática, Universidade Federal de Goiás, Goiânia G.0., Brasil.
E-mail: daniel@inf.ufg.br.
Grupo de Teoria da Computação, Departamento de Matemática e Departamento de Ciência da Computação, Universidade de Brasília, Brasília D.F., Brasil.
E-mail: ayala@unb.br.
School of Mathematical and Computer Sciences, Heriot-Watt University, Edinburgh, Scotland, UK.
E-mail: fairouz@macs.hw.ac.uk.

Intersection types (IT) provides polymorphism, a basic feature for modern computational typing systems, in a finitary way. IT systems satisfy important properties such as principal typings, providing modularity (data abstraction). Moreover, IT characterise strong normalisation, that is a term is strong normalising if and only if it is typable. Explicit substitution (ES) calculi are extensions of the λ-calculus in which the operation of substitution, originally defined as a metaoperation, is specified in the calculus, filling the gap between theoretical systems and eventual implementations. The proposal of IT systems for ES calculi, besides the analysis of termination properties, can finally provide a theoretical typing system with good properties for computational systems and closer to real implementations. We present a brief overview about IT, ES and what was already done to put those two disciplines together.

► HUGO LUIZ MARIANO AND FRANCISCO MIRAGLIA, *Some preservation properties of the profinite hull functor of special groups and applications*.
Institute of Mathematics and Statistics, University of São Paulo, S. Paulo, Brazil.
E-mail: hugomar@ime.usp.br.
E-mail: miraglia@ime.usp.br.

Profinite RSGs appeared (in the dual setting of orderings spaces) in the 1980s. In this work we show that the profinite hull functor ($\mathcal{P}$) of reduced special groups (RSG) preserves finite products (but does not preserves infinitary products, in general) and, in a certain way, it also preserves SG extensions. This allows: (i) to provide a description of the profinite fan that is the profinite hull of a given fan; (ii) to establish that $\mathcal{P}$ preserves chain length (in [2] is proved that this functor preserves stability index). Thus the Profinite hull functor seems more "well-behaved" than the Boolean hull functor, as the latter increases the chain length (strictly, in some cases) and often strictly decreases the stability index. We apply the universal property of $\mathcal{P}$ and some results on the profinite hull of products, quotients and filtered colimits of RSGs, to provide a new model-theoretic proof that the class of the RSGs satisfying a generalized local-global principle [3] is an elementary class axiomatizable by Horn sentences, a result appearing in [1].

[1] V. Astier and M. Tressl, *Axiomatization of local-global principles for pp-formulas in spaces of orderings*, ***Archive for Mathematical Logic***, vol. 44 (2005), pp. 77–95.

[2] H. L. Mariano and F. Miraglia, *The Boolean and profinite hulls of reduced special groups*, ***Logic Journal of the IGPL***, vol. 21 (2013), no. 2, pp. 160–182.

[3] M. A. Marshall, *Open questions in the theory of spaces of orderings*, ***The Journal of Symbolic Logic***, vol. 67 (2001), pp. 341–352.

► HUGO LUIZ MARIANO AND CAIO DE ANDRADE MENDES, *Analysing categories of signatures*.
Institute of Mathematics and Statistics, University of São Paulo, São Paulo, Brazil.
E-mail: hugomar@ime.usp.br.
E-mail: caio.mendes@usp.br.

We analyse two categories of finitary signatures underlying to (propositional) logics: the categories $\mathcal{S}_s$ ([1]) and $\mathcal{S}_f$ ([3]). $\mathcal{S}_s$ has a very **s**imple notion of morphism, but it is too **s**trict: $\mathcal{S}_s$ has good categorial properties (is a complete/cocomplete ω-accessible category), but does not allows a good treatment of the identity problem for logics ([2]). $\mathcal{S}_f$ has a more **f**lexible notion of morphism: it allows a better treatment of the identity problem for logics but, on the other hand, $\mathcal{S}_f$ has serious categorial defects. We define a pair of (faithful) functors $\mathcal{S}_s \overset{(+)}{\rightarrow} \underset{(-)}{\rightarrow}\rightleftarrows \mathcal{S}_f$, such that $(+)$ is left adjoint to $(-)$. We consider the (endo)functor in $\mathcal{S}_s$, $T := (-) \circ (+)$ and we prove that T preserves filtered colimits and reflects isos/epis/monos. We consider the monad (or triple) canonically associated to this adjunction, $\mathcal{T} = (T, \mu, \eta)$, and we prove that $\mathcal{S}_f = Kleisli(\mathcal{T})$: this result entails that the category of logics $\mathcal{L}_f$ build over $\mathcal{S}_f$ has: unconstrained fibrings, i.e., coproducts, and "constrained" fibrings, i.e., colimits with base diagram "in" $\mathcal{S}_s$ (i.e., obtained via $(+)\colon \mathcal{S}_s \longrightarrow \mathcal{S}_f$). We finish the work with some additional informations on isomorphisms, sections, retractions and idempotents in $\mathcal{S}_f$.

[1] P. Arndt, R. A. Freire, O. O. Luciano, and H. L. Mariano, *A global glance on categories in Logic*, ***Logica Universalis***, vol. 1 (2007), pp. 3–39.

[2] J. Y. Béziau, *From consequence operator to universal logic: A survey of general abstract logic*, ***Logica Universalis: Towards a general theory of logic***, (J.-Y. Beziau, editor), Birkhäuser, Basel, 2005.

[3] J. Bueno-Soler, M. E. Coniglio, and W. A. Carnielli, *Possible-translations algebraizability*, ***Paraconsistency with no frontiers***, (J.-Y. Beziau, W. Carnielli, editors), North-Holland, 2006.

► IVAN MARTÍNEZ, *Semantics for some non-classical Possibilistic Logics*.
Benemérita Universidad Autónoma de Puebla, Av. San Claudio y 14 Sur, Ciudad Universitaria, C.P. 72570, Puebla, México.
E-mail: imartinez@fcfm.buap.mx.

In the mid 80's, Dubois and Prade introduced Possibilistic Logic, a logic in which a parameter in $(0, 1]$ (or more generally, in a bounded and totally ordered set) is associated to each classical formula. Such a parameter represents the degree of certainty of the corresponding formula. This logic is based on classical logic and it has been useful in modeling problems where incomplete or partially contradictory information exists. Also, the semantics and syntactic aspects of Possibilistic Logic are established, as well as a theorem on soundness and completeness. Subsequently, other authors have extended these concepts involving different logics, for example, Description Logics and some intermediate logics. We consider relevant to develop Possibilistic Intuitionistic Logic and Possibilistic Cω Logic, to study their syntactic properties and to give them suitable semantics, as well as the feasibility to develop the same study with elements of their corresponding lattices.

In this talk, we first review an axiomatic system for Possibilistic Intuitionistic Logic and we present one for Possibilistic Cω Logic as well as some syntactic properties and we give them suitable semantics by extending semantics that have already been defined for Intuitionism and Cω Logic.

This is joint with Jose Arrazola y Rubén Vélez.

► JOSÉ GREGORIO MIJARES, *On Galvin's lemma and Ramsey spaces*.
Departamento de Matemáticas, Pontificia Universidad Javeriana, Colombia and Escuela de Matemáticas Universidad Central de Venezuela, Pontificia Universidad Javeriana, Carrera 7 No. 40 – 62, Bogotá, Colombia.
E-mail: jmijares@javeriana.edu.co, jose.mijares@ciens.ucv.ve.

We present (following [4]) an abstract version of Galvin's lemma, within the framework of the theory of Ramsey spaces (see [6] for the definition). Some instances of it are well known important results like Galvin's lemma itself [1], Ramsey's theorem [5], Ramsey's theorem for n-parameter sets [2] or the Graham–Leeb–Rothschild theorem [3]. Nevertheless, some of them have been little explored before, as far as we are concerned. Some open problems will be discussed.

[1] F. Galvin, *A generalization of Ramsey's theorem*, ***Notices of the American Mathematical Society***, vol. 15, p. 548 (1968).

[2] R. L. Graham and B. L. Rothschild, *Ramsey's theorem for n-parameter sets*, ***Transactions of the American Mathematical Society***, pp. 257–292 (1971).

[3] R. L. Graham, K. Leeb, and B. L. Rothschild, *Ramsey's theorem for a class of categories*, ***Advances in Mathematics***, vol. 8 (1972), pp. 417–433.

[4] J. G. Mijares, *On Galvin's lemma and Ramsey spaces*, ***Annals of Combinatorics***, (2012) DOI: 10.1007/s00026-012-0135-8.

[5] F. P. Ramsey, *On a problem of formal logic*, ***Proceedings of the London Mathematical Society, Series 2***, vol. 30 (1929), pp. 264–286.

[6] S. Todorcevic, ***Introduction to Ramsey spaces***, Princeton University Press, Princeton, NJ, 2010.

► DIANA MONTOYA, *Nociones de Forcing presentadas como Cocientes*.
Departamento de Matemáticas, Universidad de los Andes, Cra 1 Nro 18A- 12 Bogotá, Colombia.
E-mail: dc.montoya152@uniandes.edu.co.

Estudiamos nociones de forcing que se presentan como cocientes de un espacio polaco X módulo un ideal sobre X, específicamente trabajamos con dos nociones: la primera es el cociente $P_I = B(X)/I$ de subconjuntos borelianos de X, módulo un σ- ideal I; la segunda es: dado un conjunto contable Y, y J un ideal sobre Y, consideramos el cociente $Q_J = \wp(Y)/J$, en ambas nociones el es la inclusión módulo el ideal J. Basados en el trabajo de Hrušák–Zapletal en [2] estudiamos la relación entre los cocientes P_I y Q_J cuando $X = \omega^\omega$ y J es el ideal traza de I. Finalmente, estudiamos dos casos particulares, cuando I es el ideal de los conjuntos magros y cuando es el ideal de los conjuntos de medida 0. En estos casos probamos que el forcing restante R es σ-cerrado, damos caracterizaciones para el ideal $tr(I)$ en los dos casos y, con el fin de estudiar quien es exactamente el forcing restante R para el caso de conjuntos magros, estudiamos el cardinal invariante del continuo $\mathfrak{h}$, el número de distributividad, respondiendo afirmativamente una pregunta formulada por Balcar, Hernandez-Hernandez–Hrušák y en [1].

Trabajo conjunto con Joerg Brendle y Ramiro de La Vega.

[1] Bohuslav Balcar, Fernando Hernández-Hernández and Michael Hrušák, *Combinatorics of dense subsets of the rationals*, ***Fundamenta Mathematicae***, vol. 183 (2004), no. 1, 59–80.

[2] Michael Hrušák and Jindřich Zapletal, *Forcing with quotients*, ***Archive for Mathematical Logic***, vol. 47 (2008), no. 7–8, 719–739.

► CELIMO ALEXANDER PEÑA, *Espacios uniformes y MV-álgebras*.
Universidad del Valle, Colombia, Ciudad Universitaria Meléndez, Calle 13 No 100-00, Cali, Colombia.
E-mail: alexander.pere@gmail.com.

Se presentan dos resultados que relacionan los espacios uniformes y las MV-álgebras:

- Una representación dual entre la categoría de los espacios uniormes Hausdorff compactos y la categoría de las MV-álgebras semisimples, para esto se hace uso de la correspondencia que existe entre la estructura topológica y la estructura uniforme en el caso Hausdorff compacto.
- La definición de una uniformidad para toda MV-álgebra a partir de la función distancia, la cual está estrechamente ligada a la cantidad de ideales de la MV-álgebra.

► YURI POVEDA, *The intimate relationship between the McNaughton and the Chinese theorems*.
Universidad Tecnológica de Pereira, Pereira, Vereda La Julita, Risaralda, Colombia.
E-mail: `yapoveda@utp.edu.co`.

We will show the intimate relationship between McNaughton Theorem and the Chinese Theorem for MV-algebras. We develop a very short and simple proof of McNaughton Theorem. The arguing is elementary and right out of the definitions. We exhibit the theorem as just an instance of the Chinese theorem. Since the variety of MV-algebras is arithmetic, the Chinese theorem holds for MV-algebras. However, to stress how elementary is our proof of McNaughton, we will also show a simple proof of the Chinese Theorem for MV-algebras. We will not assume any prior knowledge of MV-algebras by the audience.

This is joint work with Eduardo J. Dubuc.

► JUAN RICARDO PRADA, *Gráficos existenciales Alfa y teoría de categorías*.
Universidad del Tolima, Barrio Santa Helena, Ibagué, Colombia.
E-mail: `juanplomada_2005@hotmail.com`.

Los gráficos existenciales, propuestos hace un poco más de cien años por el lógico norteamericano Charles Sanders Peirce, se analizan desde la perspectiva de la teoría de categorías considerando a los gráficos existenciales Alfa como un conjunto preordenado con el fin de estudiar sus propiedades categóricas y sus principales características, encontrando así una estrecha relación con las categorías monoidales, las categorías simétricas, las categorías cerradas, las categorías $*$-autónomas y las categorías enriquecidas. Dichas categorías se estudian porque presentan una relación cercana con las reglas de transformación de los gráficos existenciales Alfa, con la definición de iteración para los gráficos en el contexto categórico dado en [2], la definición de fuerza en [4], y la definición de borramiento*, nociones que son fundamentales para determinar las reglas de transformación Alfa generalizadas.

*Un borramiento en una categoría monoidal $\mathcal{V}$ es una transformación natural $U \otimes V \xrightarrow{\beta_{U,V}} U$.

[1] Michael Barr, ***-Autonomous categories***, Lecture Notes in Mathematics, vol. 752, Springer, 1979.

[2] Geraldine Brady and Todd H. Trimble, *A categorical interpretation of C. S. Peirce's propositional logic Alpha*, ***Journal of Pure and Applied Algebra***, vol. 149 (2000), pp. 213–239.

[3] S. Eilenberg and G. M. Kelly, *Closed categories*, ***Proceedings of the Conference on Categorical Algebra***, Springer, 1966, pp. 421–562.

[4] Peter T. Johnstone, ***Sketches of an elephant: A topos theory compendium***, Dos volúmenes, Clarendon Press, Oxford, 2002.

[5] Fernando Zalamea, *A category-theoretic reading of Peirce's system: pragmaticism, continuity and the existential graphs*, ***New essays on Peirce's mathematical philosophy***, (Matthew Moore, editor), Open Court, Chicago, 2010, pp. 203-233.

► PEDRO SÁNCHEZ TERRAF, *Logics for Markov decision processes*.
Universidad Nacional de Córdoba, Medina Allende s/n, Ciudad Universitaria, CP: X5000HUA Córdoba, Argentina.
E-mail: `sterraf@famaf.unc.edu.ar`.

Larsen and Skou introduced a modal logic, based on Hennessy–Milner's, to describe behavior for Probabilistic Transition Systems. Later Desharnais et al. proved that already a fragment of that logic is complete for bisimilarity on the broad class of *labelled Markov processes* (LMP) over analytic spaces, whereas Larsen and Skou only considered discrete systems.

We extended the LMP model with non-determinism and studied bisimulations. We developed a logic complete for bisimilarity over analytic spaces under the assumption of *image-finiteness*.

In this talk I will survey these results, some (counter)examples and open problems concerning the new model and its logic.

This is joint work with Pedro D'Argenio and Nicolás Wolovick.

Supported by CONICET and SECYT-UNC.

► YEVGENIY VASILYEV, *Linearity and expansions of geometric theories*.
Department of Mathematics, Memorial University of Newfoundland, Grenfell Campus, Corner Brook, NL A2H 6P9, Canada.
E-mail: yvasilyev@grenfell.mun.ca.

A theory is called geometric if in all of its models algebraic closure satisfies the exchange property and the theory eliminates the infinity quantifier. Examples include o-minimal, strongly minimal and SU-rank 1 theories. In a joint work with Alexander Berenstein, we introduce several equivalent conditions, including weak local modularity, weak one-basedness and generic linearity, which are closed under reducts and provide a common generalization of the "classical" linearity notions used in the strongly minimal, SU-rank 1, o-minimal, as well as geometric C-minimal settings, to the general class of geometric theories. One of our main tools, the lovely pair expansion, allows us to find a connection between linearity and the presence of vector spaces over division rings, which, in the countably categorical case, turn out to be interpretable in the pair theory. I will also talk about other types of expansions of geometric theories, such as expansions by independent "dense" subsets.

► PEDRO ZAMBRANO, *A stability transfer theorem in d-tame Metric Abstract Elementary Classes*.
Department of Mathematics, Universidad Nacional de Colombia, Av. Cra 30 nro 45-03, Bogotá, Colombia.
E-mail: phzambranor@unal.edu.co.

In discrete Abstract Elementary Classes, J. Baldwin, D. Kueker and M. Van Dieren proved a stability transfer theorem, under tameness and omega-locality. We will talk about a stability transfer theorem in d-tame Metric Abstract Elementary Classes, under epsilon-local character of a suitable notion of independence which is well-behaved in this setting.

[1] J. Baldwin, D. Kueker, and M. Van Dieren, *Upward stability transfer for tame abstract elementary classes*, ***Notre Dame Journal of Formal Logic***, vol. 47 (2006), no. 2, pp. 291–298.

[2] P. Zambrano, *A stability transfer theorem in d-tame Metric Abstract Elementary Classes*, ***Mathematical Logic Quarterly***, (2012), accepted.

[3] ———, *Around superstability in Metric Abstract Elementary Classes*, Ph.D. Thesis, Universidad Nacional de Colombia, 2011.