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The XI Latin American Symposium on Mathematical Logic was held in Mérida, Venezuela, July 6–10, 1998. The Symposium was sponsored by the Association for Symbolic Logic, Instituto Venezolano de Investigaciones Científicas, Universidad Central de Venezuela, Universidad de Los Andes (Mérida, Venezuela), Universidad Simón Bolívar, National Science Foundation, Consejo Nacional de Investigaciones Científicas y Tecnológicas, Fundacite (Mérida), The British Council, French Embassy in Venezuela, Fundación Gran Mariscal de Ayacucho, CORDIPLAN, and Programa Talven.

Plenary talks were delivered by: T. Carlson, R. Cignoli, E. Hrushovski, R. Laver, V. Lifschitz, M. Magidor, F. Miraglia, A. Nies, M. Pouzet, and W. H. Woodin. The invited speakers for the Special Sessions were the following. Set Theory: J. Bagaria, I. Farah, G. Hjorth, K. Hauser, S. Friedman, A. Mathias, S. Solecki, and S. Todorćević. Model Theory: X. Caicedo, E. Casanovas, M. Dickmann, J. Flum, J. Henle, J. Iovino, C. Ortiz, M. Otero, I. Stewart, C. Videla, and A. Villaveces. Algebraic Logic: M. Abad. G. Martinez, R. Lewin, and A. Petrovich. Logic in Computer Science: E. Haeusler, J. Lobo, V. Marek, and R. Pino. Non-Classical Logics: I. D'Ottaviano, E. G. K. Lopez-Escobar, D. Mundici, and C. Pizzi. Categorical Logic and Lambda Calculus: R. De Castro and P. Severi.

Four short courses preceded the Symposium (July 1–4):

Daniele Mundici (Universitá di Milano), *Algebra of logics.*.
Iain A. Stewart (University of Leicester), *Finite model theory.*.
Joan Bagaria (Universitat de Barcelona), *The many faces of the continuum.*.
Victor Marek (University of Kentucky), *Computations with non-monotonic logics.*.

Abstracts of invited and contributed talks, and contributed communications presented by title follow.

For the Program Committee
CARLOS AUGUSTO DI PRISCO

Abstracts of invited and contributed talks

► MANUEL ABAD, *Separating sets for maximal subalgebras of pseudocomplemented distributive lattices*.
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The Frattini subalgebra of an algebra A, denoted $\Phi(A)$, is defined to be the intersection

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of all its maximal proper subalgebras. For a Boolean algebra with at least eight elements, every non-trivial element is both included and excluded by maximal proper subalgebras. Furthermore, every proper subalgebra is the intersection of maximal subalgebras. Then, for a Boolean algebra B, it is always the case that $\Phi(B) = \{0, 1\}$. On the other hand, K. M. Koh proved that for every lattice L there is a lattice K such that $L \simeq \Phi(K)$. An analogous statement holds in the variety of distributive lattices. In this work we investigate a similar problem in the variety of pseudocomplemented distributive lattices. Associated with every subalgebra of a pseudocomplemented distributive lattice L is a separating set, constructed from the topological space associated to L. In this paper we characterize those separating sets corresponding to maximal subalgebras of pseudocomplemented distributive lattices.

► JOAN BAGARIA, *On Solovay models*.
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By a Solovay model (over L) we mean the $L(\mathbb{R})$ of the Levy collapse over L of an inaccessible cardinal to ω_1. It is a remarkable fact, discovered by Woodin, that Solovay models are characterized by the two following properties:

(1) for every real x, ω_1 is inaccessible in $L[x]$, and
(2) every real is generic over L for a countable poset.

In this talk we discuss some of the properties of Solovay models under various further assumptions (up to weak-compactness) on the inaccessible, Levy-collapsed, cardinal. In particular, we investigate the absoluteness of the models under forcing extensions, as well as some of their combinatorial properties on ω_1.

► RICARDO BIANCONI, *Some remarks on Schanuel's conjecture*.
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Schanuel's conjecture is the statement:

"if $x_1, \ldots, x_n \in \mathbb{C}$ are linearly independent over $\mathbb{Q}$, then the transcendence degree of $\mathbb{Q}(x_1, \ldots x_n, \exp(x_1), \ldots, \exp(x_n))$ over $\mathbb{Q}$ is at least n". This is true if $x_1, \ldots, x_n$ are algebraic numbers [4], but it is still open in the general case. It implies that the theory of the real exponential field is decidable [3]. Let Γ be a divisible ordered group and $K = \mathbb{C}((t^\Gamma))$ be the field of Puisieux series with complex coefficients with the standard valuation v and let $\mu(K)$ be the set of elements of K with strictly positive value. Let $a_1, \ldots, a_n \in \mu(K)$ linearly independent over $\mathbb{Q}$, $F = \mathbb{Q}(a_1, \ldots, a_n, \exp a_1, \ldots, \exp a_n)$, $\Gamma_0 = v(F^\times)$ and m the dimension of Γ_0 as a $\mathbb{Q}$ linear space. We prove that the transcendence degree over $\mathbb{Q}$ of F is at least $n + m$ by transferring a Theorem from [1] and using tools from [2] and we apply it to some models of the theory T_{an} studied in [2].

[1] J. Ax, *On Schanuel's conjectures*, ***Annals of Mathematics***, vol. 93 (1971), pp. 252–268.

[2] L. van den Dries, A. Macintyre, and D. Marker, *The elementary theory of restricted analytic fields with exponentiation*, ***Annals of Mathematics***, vol. 140 (1994), pp. 183–205.

[3] A. Macintyre and A. J. Wilkie, *On the decidability of the real exponential field*, pp. 441–467, in ***Kreiseliana: About and around Georg Kreisel*** (P. Odifreddi, editor), A. K. Peters Ltd., Wellesley, MA, 1996.

[4] C. Siegel, ***Transcendental numbers***, Annals of Mathematical Studies, no. 16, Princeton University Press, Princeton, 1949.

► HOWARD A. BLAIR AND VICTOR W. MAREK, *Complete algebras with applications to default logic*.
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In Rieter's default logic a typical closed default rule prescribes an instance of the following inference pattern when reasoning about what we know in a situation Σ: If sentence α is true of what we currently know about Σ, and each of sentences $\beta_1, \dots, \beta_n$ (called justifications) are independently consistent with what we know about Σ, then sentence γ is true of Σ also. The attempt to extend the semantics of such inference patterns to nonclosed formulas has been obstructed by the difficulty that a justification β_i is consistent with what we know about Σ only because what we currently know about Σ together with β_i has some model mostly having little to do with Σ. Some progress around this obstruction was initiated by Lifschitz [3], and extended by recent papers of Kaminski [1], and Kaminski, Makowsky and Tiomkin [2]. We further extend the work reported in these recent papers by identifying a key notion involved in the semantics of non-closed default rules: Valuations of the variables in non-closed default rules should map into the universe of a complete algebra, an algebra for which any consistent theory whose function symbols are interpreted by that algebra has a model over that algebra. The algebra constructed in the argument of the Henkin completenes theorem for languages without logical equality is a complete algebra. We define and study a model theory based upon complete algebras. We define stable models over complete algebras of default theories and show that the theories of stable models agree with Reiter's extensions in the case of closed default theories, and are invariant across all complete algebras. We obtain results on the closure properties of complete algebras.

[1] M. Kaminski, *A comparative study of open default theories*, ***Artificial Intelligence***, vol. 77 (1995), pp. 285–319.

[2] M. Kaminski, J. A. Makowsky, and M. Tiomkin, *Extensions for open default theories via the domain closure assumtpion*, ***Journal of Logic and Computation***, vol. 8 (1998), pp. 169–199.

[3] V. Lifschitz, *On open defaults*, in ***Proceedings of the symposium on computational logic*** (J. Lloyd, editor), Springer-Verlag, Berlin, 1990, pp. 80–95.

► REGINA C. M. BRAGANÇA, EDWARD HERMANN HAEUSLER, AND LUIZ CARLOS P. D. PEREIRA, *A new cut-free sequent calculus for S5*.
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The definition of a Cut-Free sequent calculus for S5 is a well-known problem. Traditional cut-elimination strategies do not seem to work for S5 and the main reason for this fact is that sequent calculus systems for S5 do not seem to be closed under "permutative" reductions. On the other hand, this problem is already solved for at least one Natural Deduction formalization of S5, where strong structural restrictions on the form of the branches of derivations guarantee a normalization result [2]. The aim of the present work is to define a new sequent calculus SC_5 for S5 where these strong global structural restrictions are simulated. The new restrictions are defined through the concepts of *Deductive Determinant* ([1]) and *Left/Right* parts of formulas. The concepts of *Left/Right* parts can be considered as a natural extension to a modal setting of the concepts of Negative and Positive parts described in [3]. We show that SC_5 is sound and complete and we prove the cut-elimination theorem for SC_5 using

Gentzen's standard procedure.

This approach to a cut-free formalization of S5 can be seen as dual to the analytic-cut approach. While the latter restricts the form of the cut-rule in order to have cut-elimination, the former restricts relationships among the subformulas of formulas present in applications of some modal rules in order to ensure that permutation of rules does not affect the standard cut-elimination procedure.

[1] E. H. Haeusler, *Automatic theorem proving: An attempt to improve readability of proofs generated by resolution*, ***Contemporary Mathematics***, vol. 69 (1988).

[2] Dag Prawitz, ***Natural deduction***, Almqvist & Wiksell, Stockholm, 1965.

[3] K. Schutte, ***Proof theory***, Springer-Verlag, Berlin, 1977.

[4] R. M. Smullyan, *Analytic cut*, ***Journal of Symbolic Logic***, vol. 33 (1968), no. 4, pp. 560–564.

► XAVIER CAICEDO, *Topological methods in abstract model theory*.
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Topological methods have been utilized from the beginning in the model theory of first order logic $L_{\omega\omega}$ and occasionally in infinitary logic, mainly via Stone spaces of Lindenbaum algebras (cf. Rasiowa and Sikorski [7], Morley in his proof of the categoricity theorem [5], or Morley on $L_{\omega_1\omega}$ [6]), or via spaces of countable models (cf. Ehrenfeucht-Mostowski [4], Vaught [8]). Although these methods do not necessarily work for extensions of $L_{\omega\omega}$, topological ideas may be applied fruitfully to abstract model theory by considering uniform spaces of structures and uniformly continuous operations between them (cf. [1], [2], [3]). The basic properties of model theoretic logics and important results of abstract model theory appear then as pure topological or continuity phenomena. Applications include characterizations of definability properties and compactness in abstract logics.

[1] X. Caicedo, *Compactness and normality in abstract logics*, ***Annals of Pure and Applied Logic***, vol. 59 (1993), pp. 33–43.

[2] X. Caicedo, *Continuous operations on spaces of structures*, ***Quantifiers: Logics, models logics and computation***, vol. I (M. Krynicki, M. Mostowski, and L. W. Szczerba, editors), Kluwer Academic Publishers, 1995, pp. 263–296.

[3] X. Caicedo, *The abstract compactness theorem revisited*, in ***Logic and Foundations of Mathematics***, Kluwer Academic Publishers, to appear.

[4] A. Ehrenfeucht and A. Mostowski, *A topological space of models of first order theories*, ***Bulletin de L'Academie Polonaise des Sciences***, vol. IX (1961), pp. 369–373.

[5] M. Morley, *Categoricity in power*, ***Transactions of the American Mathematical Society***, vol. 114 (1965), pp. 514–538.

[6] M. Morley, *Applications of topology to $L_{\omega_1\omega}$*, in ***Proceedings of the Tarski symposium***, Proceedings in Pure Mathematics, no. 25, American Mathematical Society, 1974, pp. 234–240.

[7] H. Rasiowa and R. Sikorski, *A proof of the completeness theorem of Gödel*, ***Fundamenta Mathematicae***, vol. 37 (1950), pp. 193–200.

[8] R. Vaught, *Invariant sets in topology and logic*, ***Fundamenta Mathematicae***, vol. 82 (1974), pp. 269–294.

► TIMOTHY CARLSON, *Axioms of infinity, proof-theoretic ordinals, and patterns of resemblance*.
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We will discuss an approach to proof-theoretic analysis which identifies the search for proof-theoretic ordinals with the study of axioms of infinity. More specifically, we are concerned with axioms of infinity which are described in terms of embeddings and patterns formed by finite collections of embeddings. The simplest case is provided by a continuous hierarchy of structures M_α $(\alpha \in \mathrm{ORD})$ where the embeddings are given by the pairs (α, β) such that $M_\alpha \preceq_{\Sigma_1} M_\beta$. Let $\leq_1$ be the collection of such pairs. When "..." is a list of reasonable operations on the class of ordinals ORD, the order in which isomorphism types of finite substructures of $(\mathrm{ORD}, \dots, \leq, \leq_1)$ arise is independent of the hierarchy with some fairly mild assumptions on the hierarchy. These patterns provide descriptions of important proof-theoretic ordinals, e.g., when "..." is empty the ordinal is ε_0 and when "..." consists of 0 and + the result is the proof-theoretic ordinal of $KP\ell_0$ (or, equivalently, $\Pi^1_1 - CA_0$). These patterns are called *patterns of resemblance of order* 1. We will discuss patterns of resemblance of arbitrary finite orders which correspond to the relations $\preceq_{\Sigma_n}$ $(n \in \omega)$ within hierarchies. We will discuss a program to show the resulting patterns provide the proof-theoretic ordinal of formal second-order arithmetic.

► ENRIQUE CASANOVAS, *Characterizing simple theories*.
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Simple theories were introduced by S. Shelah in [3] as a generalization of stable theories where some forking machinery can still be developed. B. Kim and A. Pillay were able to prove that simple theories can be characterized as the only theories having an independence notion with some basic properties, including the independence theorem over a model. In practice there are sometimes difficulties to show in a straightforward way that a given theory is simple. In [2] we extend some methods of [3] concerning cardinalities of families of pairwise incompatible partial types and we obtain more manageable characterizations of simplicity. We develop a similar analysis of supersimplicity and a local study of simplicity in terms of the number of types.

As a result we can characterize simple theories by the property that for all formulas φ, for all κ, λ, any family of pairwise incompatible positive partial φ-types of cardinality $\leq \kappa$ over a set of cardinality $\leq \lambda$ is at most of cardinality $\lambda^\omega + 2^\kappa$. Moreover we have found an example of a simple theory where the bound $\lambda^\omega + 2^\kappa$ is achieved. This theory cannot be low in the sense of [1].

[1] S. BUECHLER, *Lascar strong types in some simple theories*, ***Journal of Symbolic Logic***, to appear.

[2] E. CASANOVAS, *The number of types in simple theories*, ***Annals of Pure and Applied Logic***, to appear.

[3] S. SHELAH, *Simple unstable theories*, ***Annals of Mathematical Logic***, vol. 19 (1980), pp. 177–203.

► ROBERTO CIGNOLI, *Pseudocomplemented BL-algebras*.
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BL-algebras were introduced by P. Hájek as algebraic models of the logics defined by continuous t-norms on the real segment [0, 1] [5]. Important examples of BL-algebras are *MV-algebras* [2, 3], *linear Heyting algebras* [7], and *PL-algebras* [6, 4].

In this talk *pseudocomplemented BL-algebras* are introduced as a common abstraction of linear Heyting algebras and PL-algebras.

Free boolean algebras are retracts of free pseudocomplemented BL-algebras, and this property will be used to give a description of free pseudocomplemented BL-algebras. This gives a unified method to characterize free algebras in the classes of linear Heyting algebras

[8], PL-algebras [4] and also Stone algebras [1]. Complete proofs will appear in a joint paper with A. Torrens.

[1] R. BALBES and A. HORN, *Stone lattices*, ***Duke Mathematical Journal***, vol. 37 (1970), pp. 537–545.

[2] R. CIGNOLI, I. D'OTAVIANO, and D. MUNDICI, ***Álgebras das lógicas de Lukasiewicz***, Coleção CLE, vol. 12, Universidade Estadual de Campinas, 2nd ed., Campinas, SP, 1994.

[3] R. CIGNOLI and D. MUNDICI, *An invitation to Chang's MV-algebras*, in ***Conference on algebra and model theory, Dresden 1995*** (M. Droste and R. Göbel, editors), Gordon and Breach, Readings, UK, 1997, pp. 171–197.

[4] R. CIGNOLI and A. TORRENS, *An algebraic analysis of product logic*, to appear.

[5] P. HÁJEK, ***Metamathematics of fuzzy logic***, Kluwer Academic Publishers, to appear.

[6] P. HÁJEK, L. GODO, and F. ESTEVA, *A complete many-valued logic with product conjunction*, ***Archive for Mathematical Logic***, vol. 35 (1996), pp. 191–208.

[7] A. HORN, *Logic with truth values in a linearly ordered Heyting algebra*, ***Journal of Symbolic Logic***, vol. 34 (1969), pp. 395–408.

[8] A. HORN, *Free L-algebras*, ***Journal of Symbolic Logic***, vol. 34 (1969), pp. 475–480.

► RODRIGO DE CASTRO, *Some approaches to the solution of recursive domain equations*.

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Within a categorical framework, we investigate some concrete representations of Scott domains and give constructions of their sum, product, lifting and lifted function space. The constructions induce the corresponding ones on Complete Partial Orders (CPOs) and provide a machinery for the solution of domain equations.

All this is achieved, firstly, via a new approach to Scott Information Systems and next via appropriately defined closure operators.

► OMAR DE LA CRUZ, *Finiteness and weak choice principles*.

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It is a theorem in *ZF* that every finite family of non-empty sets has a choice function. However, without the Axiom of Choice (*AC*), the notion of finiteness itself is not so clear, since different statements that express properties that we expect finite sets to have (and which are equivalent under *AC*) are not provable equivalent in *ZF*. The usual definition is that of equivalence with a natural number; it is this notion of finiteness for which the statement at the beginning is true.

This work studies the relative strength of principles obtained by modifying the statement above to use less restrictive notions of finiteness, like the ones considered in [4], [3], and [1] and others. Let $\mathcal{F}$ be a class of sets considered to be finite according to some notion of finiteness. Then the principle $C(\mathcal{F})$ states that every family $F \in \mathcal{F}$ of non-empty sets has a choice function. It happens that these principles are always independent from ZF, unless $\mathcal{F}$ is the usual notion of finiteness mentioned above.

Another group of principles $C^{-}(\mathcal{F})$ is studied, which states that for every infinite family $F \in \mathcal{F}$ of sets there is an infinite subfamily $F' \subset F$ with a choice function. Many easy relations can be found between these statements and between these and some other well known choice principles; other not so trivial relations are established in this paper, and some results about the relations between some notions of finiteness. It turns out that these interrelations are different for *ZF* than for *ZFA*, the set theory with atoms.

[1] P. HOWARD and J. RUBIN, *Weak forms of the axiom of choice*, preprint.

[2] T. JECH, ***The axiom of choice***, North-Holland, Amsterdam, 1973.

[3] A. LEVY, *The independence of various definitions of finiteness*, ***Fundamenta Mathematicae***, vol. 46 (1958), pp. 1–13.

[4] A. TARSKI, *Sur les ensembles finis*, ***Fundamenta Mathematicae***, vol. 6 (1924), pp. 45–95.

► JOSÉ P. DÍAZ VARELA, *Symmetric structure for closure algebras*.
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This paper is devoted to the study of the variety of symmetric closure algebras SC introduced in [2]. A symmetric closure algebra is a system $(A, \wedge, \vee, Q, -, \sim, 0, 1)$ where $(A, \wedge, \vee, Q, -, 0, 1)$ is a closure algebra [1] and $\sim$ is unary operation satisfying the De Morgan laws and the prescription $Q \sim Q(x) = \sim Q(x)$ (Q is the interior operator). If we put $x \to y = Q(-x \vee y)$, then $(Q(A), \wedge, \vee, \sim, \to)$ is a symmetric Heyting algebra, as defined by A. Monteiro in [3]. We investigate the lattice of congruences of an algebra in SC and we characterize the subdirectly irreducibles. We prove that SC is generated by its finite members. Finally, we give a complete equational description for several subvarieties of SC.

[1] W. J. BLOK, *Varieties of interior algebras*, ***Ph. D. Thesis***, University of Amsterdam, 1976.

[2] J. P. DÍAZ VARELA, *Algebras de Clausura y su Estructura Simétrica*, ***Tesis Doctoral***, Universidad Nacional del Sur, 1997.

[3] A. MONTEIRO, *Sur les algèbres de Heyting symetriques*, ***Portugaliae Mathematica***, vol. 39 (1980), Fasc. 1–4, pp. 1–237.

► M. DICKMANN, D. GLUSCHANKOF AND F. LUCAS, *The order structure of the real spectrum of commutative rings*.
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Coste and Roy introduced, at the end of the 1970s, the real spectrum of commutative rings with unit (rings, for short); this construction turned out to be a fundamental tool in real algebraic geometry.

Real spectra are spectral spaces with the additional property that the set of specializations of a point is linearly ordered; i.e., they form a root-system (the dual of a tree) under the order of specialization.

An outstanding question in this area was to determine whether any spectral space with this property is (homeomorphic to) the real spectrum of a ring. In 1994 Delzell and Madden constructed a counterexample (but the question of an "intrinsic" characterization of the real spectra amongst spectral spaces is still open).

In the present paper we show that any jump-dense, complete root-system is order-isomorphic to the real spectrum of a ring. This result confirms that the Delzell-Madden counterexample arises for essentially topological, not merely ordinal, reasons.

In the course of the proof we introduce, among other things, a new, and rather interesting, class of (sub)rings of formal power series.

► ITALA M. LOFFREDO D'OTTAVIANO AND HERCULES A. FEITOSA, *Many-valued logics and translations*.
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[1] proposes a general notion of translation between logics and presents an initial segment of a general theory of translation. Logics are defined in the most general sense, as sets with consequence relations, and translations between logics as consequence—relation preserving maps, such a characterization being more general than those usually found in the literature. A function $T: A \to B$ is a translation from the logic (A, C_A) into the logic (B, C_B) if, for every $X \subseteq A$: $T(C_A(X)) \subseteq C_B(T(X))$.

In this sense logics together with translations form a bicomplete category of which topological spaces with topological continuous functions constitute a full subcategory.

An important subclass of translations, the conservative translations, which strongly preserve consequence relations, are introduced and studied in [2]. *Conservative translations* are translations such that, for every set $X \cup \{a\} \subseteq A$:

$$a \in C_A(X) \iff T(a) \in C_B(T(X)).$$

We initiated the development of a theory of conservative translations, and the use of the Lindenbaum algebras associated to logical systems, when they can be defined, showed to be a fundamental method to determine the existence of conservative translations between the systems we have studied.

The aim of this paper is to present, using algebraic semantics, some conservative translations involving classical logic and non-classical logics, in special involving classical logic and the many-valued logics of Lukasiewicz and Post.

[1] J. J. Da Silva, I. M. L. D'Ottaviano, and A. M. Sette, *Translations between logics*, in ***Models, algebras and proofs*** (X. Caicedo and C. H. Montenegro, editors), Lecture Notes in Pure and Applied Mathematics, no. 203, Marcel Dekker, Inc., New York, 1999, pp. 435–448.

[2] H. A. Feitosa, *Traduções conservativas* (Conservative translations), ***Doctoral Thesis***, Universidade Estadual de Campinas.

► ILIJAS FARAH, *F_σ P-ideals and Banach spaces*.

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Any sequence $\{x_n\}$ in a Banach space defines an ideal I on $\mathbb{N}$ by

$$\mathcal{I} = \left\{ A : \lim_n \left\| \sum_{i \in A \cap n} x_i \right\| < \infty \right\}.$$

Moreover, any such $\mathcal{I}$ is a *P-ideal* (i.e., it is σ-directed under the inclusion modulo finite). We shall show that if $\{x_n\}$ is the standard basis of a Tsirelson space ([1]), then $\mathcal{I}$ is an F_σ P-ideal which refutes a trichotomy conjecture of Kechris ([2]) and Mazur ([3]) about Borel equivalence relations.

[1] P. G. Casazza and T. J. Shura, *Tsirelson's space*, Lecture Notes in Mathematics, no. 1363, Springer-Verlag, Berlin, 1980.

[2] A. S. Kechris, *Rigidity properties of Borel ideals on the integers*, ***Topology and its Applications***, to appear.

[3] K. Mazur, *Towards the dichotomy for F_σ-ideals*, 1996, preprint.

► JÖRG FLUM, *Games and logics*.

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We show that graph-games and the game of life play a central role for the complexity classes PTIME and PSPACE, respectively. In particular, we obtain normal forms for logics capturing these complexity classes. Moreover, we present an application of the results in database theory.

[1] J. FLUM, M. KUBIERSCHKY, and B. LUDÄSCHER, *Games and total datalog queries*, ***Theoretical Computer Science***, to appear.

► ANTONIO JOSE GONÇALVES DE FREITAS, *A obra lógica de Petrus Hispanus Portucalensis, e sua importância actual*.
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Between 1205 and 1210 was born in Lisbon Pedro Julião, who is historically identified with *Petrus Hispanus Portugalensis* and the Pope John XXI. He wrote 37 works in different branches of knowledge such as: Medicine, Logic, Theology, Philosophy, etc. His logical works include the *Tractatus* and the *Syncategoreumatas*, the former had a great divulgation in Middle Age and in Modern Age, with more than 300 manuscripts and more than 200 editions after imprent. From 300 years it was the logical textbook in European Universities, with exception of Oxford that uses its own logic textbook. It is possible that throughout the *Societatis Iesus* some versions of the *Tractatus* were used in Latinamerican oldest Universities. It contains basically the Aristotelical logic, and medieval logical researches. The *Syncategoreumatas* is a non-textbook work and for this reason hadn't the same divulgation as the *Tractatus*, but it is of more interest from the pointview of Artificial Intelligence research, because in it there is a discussion of the importance of syncategoreumatics words in the validity of logical inferences.

► SY D. FRIEDMAN, *Genericity and large cardinals*.
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If δ is a Woodin cardinal in an inner model M and R is a real which "preserves A-strength" for all $A \subseteq \delta$ in M, then R is set-generic over M. We show that this result is best possible: If M is an extender model with no Woodin cardinal, then by class-forcing over M, it is possible to produce a real R which is not set-generic over M, yet "preserves A-strength" for all $A \subseteq \delta$ in M. Thus generalizations of Jensen coding are possible up to, but not including, a Woodin cardinal.

► HERNANDO GAITÁN, *Equational basis for varieties of quasi-Stone algebras*.
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In this talk we exploit the fact that any quasi-Stone algebra can be turned into a distributive lattice with quantifier (= double negation) to give equational basis for each one of the varieties of quasi-Stone algebras. Quasi-Stone algebras are introduced in [2] while equational basis for the varieties of distributive lattices with a quantifier are given in [1].

[1] H. GAITAN, *Varieties of distributive lattices with a quantifier*, submitted.
[2] N. H. and H. P. SANKAPPANAVAR, *Quasi-Stone algebras*, ***Mathematical Logic Quarterly***, vol. 39 (1993), pp. 255–268.

► JORGE I. GUIER, *Boolean products of real closed valuation rings*.
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As far as we know, the most general notion of a real closed ring is the one given by Niels Schwartz. We are interested in a particular class of such structures: the class of projectable real closed rings with the first convexity property.

We show, using Keimel's second special representation theorem, that every ring in this class is a boolean product of real closed valuation rings (RCVR) and real closed fields in the language of ordered rings.

Using model theoretic properties of RCVR proved by Cherlin and Dickmann, an axiomatisation of the class of boolean products of real closed valuation rings, in the language of ordered rings with the divisibility relation is given. Using results of model theory of sheaves (Boffa and Cherlin [1]), elimination of quantifiers of the theory given by this axiomatisation (adding the non-existence of minimal idempotents) is proved in the language of lattice ordered rings with an extra function symbol representing division (locally).

[1] M. BOFFA and G. CHERLIN, *Elimination des quantificateurs dans les faisceaux*, ***Comptes Rendus de l'Académie des Sciences***, vol. 290 (1980), pp. 355–357.

[2] G. CHERLIN and M. A. DICKMANN, *Real closed rings II: Model theory*, ***Annals of Pure and Applied Logic***, vol. 25 (1983), pp. 213–231.

[3] D. GLUSCHANKOF and F. LUCAS, *Hyper-regular lattice-ordered groups*, ***Journal of Symbolic Logic***, vol. 58 (1993), pp. 1342–1358.

[4] J. I. GUIER, *Produits booléens d'anneaux réels clos*, in ***Séminaire de structures algébriques ordonnées 1995–96*** (Delon, Dickmann, and Gondard, editors), Paris VII-CNRS Logique, Prépublications, no. 61, Paris, 1997.

[5] N. SCHWARTZ, *Real closed rings—Examples and applications*, in ***Séminaire de Structures Algébriques Ordonnées 1995–96*** (Delon, Dickmann, and Gonard, editors), Paris VII-CNRS Logique, Prépublications, no. 61, Paris, 1997.

► CLAUDIO GUTIÉRREZ, *A categorical rewriting Lemma*.

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We isolate a rewriting lemma which appears in various guises in different areas of Mathematics and Computer Science. The categorical setting seems to be the most appropriate to express it in the right generality.

Let $\mathcal{A}$ be a category, and let A, B objects of $\mathcal{A}$. Define $A \sim B$ if and only if there are arrows $A \xrightarrow{f} B$ and $B \xrightarrow{g} A$. For non-isomorphic objects A, B, define the relation $A \Longrightarrow B$ (A *rewrites* to B) if and only if there exists a factorization $A \xrightarrow{e} B \xrightarrow{m} A$ with e epi and m mono. Write $\Longrightarrow^*$ ($\Longleftrightarrow^*$) for the reflexive and transitive (reflexive, symmetric and transitive) closure of $\Longrightarrow$.

LEMMA. *Let $\mathcal{A}$ be a category in which every object has finitely many sub-objects and quotient-objects, and every arrow has an epi-mono factorization. Then the following assertions hold*:

1. $\Longrightarrow$ *is sound and complete for* $\sim$, *i.e.*, $A \Longleftrightarrow^* B$ *if and only if* $A \sim B$.
2. $\Longrightarrow$ *terminates, i.e., there is no infinite chain* $A_1 \Longrightarrow A_2 \Longrightarrow \cdots$.
3. $\Longrightarrow$ *is confluent, i.e., if* $A \Longleftrightarrow^* B$ *then there exists* C *with* $A \Longrightarrow^* C$ *and* $B \Longrightarrow^* C$.

The applications of the Lemma are manifold, for example, existence of: bases for finite dimensional vector spaces, independent sets for finite axiomatizations, normal forms for representable allegories, normal forms for the free union-free algebra of relations; decidability of the equational theory of allegories; minimization of: deterministic finite automata. cojunctive queries, tableaux queries.

[1] N. DERSHOWITZ and J.-P. JOUANNAUD, *Rewrite systems*, in ***Handbook of theoretical computer science***, vol. B (J. van Leeuwen, editor), MIT Press, 1990.

[2] P. FREYD and A. SCEDROV, ***Categories and allegories***, North-Holland Mathematical Library, no. 39, North-Holland, Amsterdam, 1990.

► KAI HAUSER, *Definable sets of real numbers and core model theory*.
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There is an intimate connection between analytic properties of sets of real numbers definable in second order number theory, and the fine structure of canonical inner models for large cardinals. I will describe it in a particular setting, sketch some partial results and state some related conjectures.

► JIM HENLE, *Infinitesimals without nonstandard analysis: An introduction to nonnonstandard analysis*.
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Nonstandard analysis has not fulfilled its early promise. At the research level, it remains a somewhat esoteric field. Most mathematicians are unaware of its results or even of its existence. At the teaching level, it remains an ideosyncratic approach, used by very few. Today, with the battle raging between 'traditional' and 'reform' calculus, infinitesimals seem irrelevant.

We propose an alternative approach to analysis. It is 'standard' in the sense that it uses no logic, and does not need the Axiom of Choice. It is 'nonstandard' in that is uses infinitesimals. It is thoroughly rigorous. The proofs are startlingly similar to those of nonstandard analysis.

It is partly old (originally formulated by Laugwitz and Schmieden) and partly new. It seems to combine the best of the standard and nonstandard worlds. The most recent work is in measure theory.

Finally, a slight alteration in the method produces an approach to the theorems of calculus that is thoroughly standard and that might be relevant to the current debate over reform.

► G. HJORTH, *Variations on Scott*.
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There are many results known for the "logic action", or more generally continuous actions of the infinite symmetric group on Polish spaces, that have been first proved by use of the Scott analysis, and only later generalized to arbitrary Polish group actions and even then frequently in a haphazard or accidental fashion. I will talk about attempts to generalize the Scott analysis to arbitrary Polish group actions, and thereby obtain unified proofs.

The work here is far from complete. There are still results known for the actions of the infinite symmetric group with the aid of the Scott analysis which remain open for general Polish groups.

[1] H. Becker and A. S. Kechris, *The descriptive set theory of Polish group actions*, London Mathematical Society Lecture Notes Series, no. 232, Cambridge University Press, Cambridge, 1996.

[2] H. J. Keisler, *Model theory for infinitary logic*, North-Holland, Amsterdam, 1971.

[3] R. Sami, *The topological Vaught conjecture*, ***Transactions of the American Mathematical Society***, vol. 341 (1994), pp. 335–353.

► EHUD HRUSHOVSKI, *Robinson theories and the Lascar group*.
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Model theory classically associates a topological space to any first order theory: the space of types, or the Stone space of the Tarski-Lindenbaum Boolean algebra of formulas. This and related spaces are totally disconnected. In 1982 Lascar found a larger compact topological space associated to any first order theory; it is often equal to the type space, but sometimes is not; a natural compact topological group action captures the difference between them. This construction has moved to center stage in recent investigations of simple theories. I will describe the space, the group, and some recent results concerning them.

► LÚCIA RENATO JUNQUEIRA, *Applications of elementary submodels to general topology*.
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The use of elementary submodels has become a standard tool in set-theoretic topology and infinitary combinatorics. It enables one to capture various complicated closure arguments within the "$\prec$". See, e.g., [1], [2]. In our talk we will direct our attention to the study of the tool itself, i.e., we will define a new topological operation using elementary submodels of a "model of set theory" ([3]). Let M be such an elementary submodel and $(X, \mathcal{T})$ be a topological space with $X, \mathcal{T} \in M$. In contrast to first order theories, "X restricted to M" is not necessarily a subobject of X. We therefore define X_M to be $X \cap M$ with the topology generated by $\{\, U \cap M : U \in \mathcal{T} \cap M \,\}$ and consider:

(i) What properties of X does X_M retain?
(ii) Is X_M a (nice image of a) subspace of X?

We will give some topological conditions under which we have (ii). As for (i), we have for instance:

THEOREM. *If X is T_i, $i \leq 3\ 1/2$ (separable, first countable, second countable), so is X_M.*

THEOREM ([4]). *It is consistent that $(2^{\omega_1})_M$ is not normal for every M with cardinality $\aleph_1$ and such that $\omega_1 \subseteq M$.*

Further work on the topic can be found in [7], [6], [5].

[1] A. DOW, *An introduction to applications of elementary submodels to topology*, ***Topology Proceedings***, vol. 13 (1988), pp. 17–72.
[2] A. FIDELI and S. WATSON, *Elementary submodels and cardinal functions*, ***Topology Proceedings***, to appear.
[3] L. R. JUNQUEIRA and F. D. TALL, *The topology of elementary submodels*, ***Topology and its Applications***, vol. 82 (1998), pp. 239–266.
[4] L. R. JUNQUEIRA, *On normality of elementary subspaces of* 2^{ω_1}, preprint.
[5] L. R. JUNQUEIRA, *Upwards preservation by elementary submodels*, preprint.
[6] K. KUNEN and F. D. TALL, *The real line in elementary submodels of set theory*, preprint.
[7] F. D. TALL, *If it smells like the reals* . . . , preprint.

► SÉBASTEIN KONIECZNY AND RAMÓN PINO-PÉREZ, *An analysis of merging from a logical point of view*.
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In a growing number of situations, we face conflicting information coming from several sources. The problem is to reach a coherent piece of information from these contradicting ones. Many different merging methods have already been proposed. Instead of giving one particular merging method, in this work we present a characterization of such methods following the rationality postulates they satisfy. We shall call merging operators those methods that obey a minimal set of rational merging postulates. Then we shall investigate two subclasses of merging operators: arbitration operators and majority operators.

This work is related to the AGM framework of revision theory [1]. Revision is the process of adapting a knowledge base in view of new evidence. One basic assumption of revision is that the new piece of information is more reliable than the old knowledge base, but this is not always the case. In particular we analyse the case in which the new piece of information is as reliable as the old one. Moreover we study the case in which we have more than two sources of information.

We point out the differences between *arbitration* and *majority*. The intuitive difference between arbitration and majority operators is that arbitration operators reach a consensus between the protagonists' views by trying to satisfy as much as possible all the protagonists, whereas majority operators "elect", in a sense, the result of the merging by taking the majority into account. In other words arbitration operators try to minimize individual dissatisfaction, whereas majority operators try to minimize global dissatisfaction. One of our main concerns in this work is to state these intuitions in a formal way.

[1] C. Alchourrón, P. Gärdenfors, and D. Makinson, *On the logic of the theory change: Partial meet contraction and revision functions*, ***Journal of Symbolic Logic***, vol. 50 (1985), pp. 510–530.

► RICHARD LAVER, *The $L[\mathbb{R}]$'s at higher cardinals.*
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Let λ be a singular strong limit cardinal of cofinality ω. Then many of the basic results about descriptive set theory and $L[\mathbb{R}]$, which are provable in $ZF + DC$, have analogues at $\lambda(V_{\lambda+1}$ being the analogue of $\mathbb{R})$ under $ZF + \lambda - DC$. Woodin has shown that a strong large cardinal axiom (there's an elementary $j : L[V_{\lambda+1}] \to L[V_{\lambda+1}]$ with cr $j < \lambda$) implies that $L[V_{\lambda+1}]$ has many properties similar to those of $L[\mathbb{R}]$ under AD. A summary will be given of some of these theorems, and results about reflecting parts of the axiom to cardinals $\lambda' < \lambda$ will be stated.

► JEFF LEANING, *Disassociated indiscernibles: Forcing two normal ultrafilters from a vertical repeat point.*
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We define a new generalization of Prikry forcing [1], and develop the so-called Prikry Property and a genericity criterion. After defining *vertical repeat point*, a large cardinal of consistency strength strictly less than that of a measurable cardinal of Mitchell order two, we show:

Theorem. *Upon disassociated indiscernible forcing over the core model, the least vertical repeat point hosts exactly two normal measures.*

This makes progress toward establishing an old conjecture: that the consistency strength of a measurable cardinal hosting exactly two normal measures is that of a single measaurable cardinal.

[1] Karel Prikry, *Changing measurable into accessible cardinals*, ***Dissertationes Mathematicae (Rozprawy Mathematycne)***, vol. 68 (1971), pp. 359–378.

► RENATO A. LEWIN, IRENE F. MIKENBERG, AND MARÍA G. SCHWARZE, *On free annotated algebras.*
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In [2] the authors proved that certain systems of annotated logics are algebraizable in the sense of [1]. Later in [3, 4] the study of the associated quasi-varieties of annotated algebras is initiated.

In this communication we continue the study of the these classes of algebras, in particular, we report some recent results about the free annotated algebras.

Funding has been provided by Fondecyt, grant 1960931.

[1] W. J. Blok and D. Pigozzi, *Algebraizable logics*, ***Memoirs of the American Mathematical Society***, vol. 77 (1978), p. 396.

[2] R. A. Lewin, I. F. Mikenberg, and M. G. Schwarze, *On the algebraizability of annotated logics*, ***Studia Logica***, vol. 59 (1997), no. 3, pp. 359–386.

[3] R. A. Lewin, I. F. Mikenberg, and M. G. Schwarze, *Matrix semantics for annotated logics*, to appear in proceedings of the X Latin American symposium on mathematical logic, Bogota, Columbia, 1995.

[4] R. A. Lewin, I. F. Mikenberg, and M. G. Schwarze, *Algebras and matrices for annotated logics*, submitted to proceedings of WAAL, Barcelona, 1997.

► VLADIMIR LIFSCHITZ, *Describing actions*.
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This talk is about a formal language for describing the effects of actions on fluents. An *action* is something that can be "executed" and then may change the state of the world. A *fluent* is something that depends on the state of the world. For instance, entering a room is an action; the number of people in the room is a fluent affected by this action. Drinking is an action; being thirsty is a fluent affected by this action. Getting married is an action; marital status is a fluent affected by this action.

The design of languages for describing actions is a central problem in the subarea of Artificial Intelligence that studies commonsense knowledge and reasoning. Recent work on this problem treats the relationship between an action and its effects as an instance of a more general concept—*causation*, and distinguishes between asserting a proposition P and asserting that P "has a cause" [1]. The proposal presented in this talk is based on the simplified version of Geffner's theory due to McCain and Turner [3].

This is joint work with Enrico Giunchiglia, reported in the forthcoming paper [2].

[1] Hector Geffner, *Causal theories for nonmonotonic reasoning*, ***Proceedings of AAAI***, vol. 90 (1990), pp. 524–530.

[2] Enrico Giunchiglia and Vladimir Lifschitz, *An action language based on causal explanation*: *Preliminary report*, ***Proceedings of AAAI***, vol. 98 (1998), to appear.

[3] Norman McCain and Hudson Turner, *Causal theories of action and change*, ***Proceedings of AAAI***, vol. 97 (1997), pp. 460–465.

► JORGE LOBO, *From action theories to active databases*.
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Actions theories attempt to formalize the effects that actions have on the world and provide us with tools to reason about actions and change. They are used as formal models to understand and develop dynamic systems where state changes play a central role. In this talk I will present an example of how an action theory can be used to describe the behavior of a simple dynamic system. I will present a formal framework for active databases. An active database comprises a regular database (i.e., a finite set of function-free ground atomic formulas) plus a set of rules that can be triggered by database events such as insertions, deletions or other types of modifications that can be applied to the database. Once a rule is triggered, the rule can generate new events (i.e., new modifications) that could trigger new rules. Rules are typically used to maintain the consistency of the data stored in the database. For example: "if a new student is accepted into the department (an insertion), an advisor should be selected and assigned to the student (another insertion is generated)". Our formalization consists of three basic steps:

1. We define a language to describe the elementary actions or events that can occur in a particular database.
2. We provide an automaton-based semantics for the databases. I.e., models of the active database will be a set of automata.
3. Based on the model semantics, we define an entailment relation between a database and queries that specify if selected properties hold in the dynamic environment after the execution of a series of actions.

The basis of our approach is the *entailment* relation. This relation will allow us to explore the behavior of "What-If" scenarios such as: "Is the particular sequence action executable?", or "Will a sequence of actions trigger certain active rule?" If time permits I will also describe how a theorem prover of the entailment relation can be implemented using logic programs.

► E. G. K. LÓPEZ-ESCOBAR AND FRANCISCO MIRAGLIA, *From definitions to logistics to connectives*.
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Following ideas introduced by Gentzen, Leśniewski and Tarski, we show that the concepts inherent in a *Definition*, namely: *equivalence* and *universal quantification*, suffice to define all the other familiar intuitionistic connectives and quantifiers. The formal system in which the programme can be carried out we call the *Intuitionistic Protothetic* and it enjoys the Leśniewskian property that definitions can be added at will and automatically become theses of the Protothetic.

A complete semantics of Beth models is given for the Protothetic and the proof of completeness is carried out in an intuitionistic metatheory. Semantics in the Cantor discontinuum, as well as algebraic semantics are considered.

The equivalence invariant defined operators are called the *truth-functions of the Intuitionistic Protothetic* and examples and reasons are given why it is reasonable to identify the *intuitionistic connectives* with the *truth functions of the Intuitionistic Protothetic*.

► MENACHEM MAGIDOR, *The club filter on $P_\kappa(\lambda)$ is almost never saturated*.
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THEOREM. *The closed unbounded filter on $P_\kappa(\lambda)$ is not λ^+ saturated, unless $\kappa = \lambda = \omega_1$.*

This finishes a collection of results by Shelah, Gitik-Shelah, Burke and Matsubara.

The following theorem plays an important role in the proof:

THEOREM. *Let $\langle \kappa_\delta \mid \delta < \eta \rangle$ be a sequence of distinct regular uncountable cardinals. Let $S_\delta \subseteq \kappa_\delta$ $(\delta < \eta)$ be a stationary subset of κ_δ all of whose points are of cofinality ω. Let $\kappa_\infty = \sup\{\kappa_\delta : \delta < \eta\}$, and let $\mathcal{A} = \langle \kappa_\infty, \dots \rangle$ be a structure in a countable language. Then, there exists an elementary substructure $\mathcal{N}$ of $\mathcal{A}$ such that $\forall\delta < \eta$ $(\kappa_\delta \in \mathcal{N} \Longrightarrow \sup(\mathcal{N} \cap \kappa_\delta) \in S_\delta)$.*

► M. VICTORIA MARSHALL AND M. GLORIA SCHWARZE, *Distinguished sets in theories without foundation*.
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Let V_1 be the class set theory obtained from $VNBG^-$ (Von Neumann-Bernays-Godel without Foundation) with a weak version of this axiom, that avoids finite cycles $x_1 \in x_2 \in x_3 \in \cdots \in x_n \in x_1$.

In this work we study the definability of different notions of Distinguished Set for classes in V_1 according to different versions of the Axiom of Choice.

This research was partially supported by Fondecyt 1940695, DIPUC 97/178PF and Fondecyt 1980855. There are several notions in set theories that are defined using the Axiom of Foundation. In order to consider theories without this axiom it is necessary to study the definability of those notions.

[1] N. Brunner, *75 years of independence proofs by Fraenkel-Mostowski permutation models*, ***Mathematica Japonica***, vol. 43 (1996), pp. 177–199.

[2] R. Chuaqui, ***Axiomatic set theory***, North-Holland, Amsterdam, 1981.

[3] J. D. Halpern, *The independence of the axiom of choice from the Boolean prime ideal theorem*, ***Fundamenta Mathematicae***, vol. 55 (1964), pp. 57–66.

[4] K. Kunen, ***Set Theory***, North-Holland, Amsterdam, 1980.

[5] M. Victoria Marshall and M. Gloria Schwarze, *Rank in set class theory without regularity*, 1996, preprint.

[6] L. Rieger, *A contribution to Gödel's axiomatic set theory, I*, ***Czechoslovak Mathematical Journal***, vol. 9 (1957), pp. 323–357.

► M. VICTORIA MARSHALL AND M. GLORIA SCHWARZE, *Models for set class theories without foundation*.

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There are several notions in set theory that are defined using the Axiom of Foundation. In order to consider theories without this axiom it is necessary to study the definability of those notions.

Let V_1 be the class set theory obtained from $VNBG^-$ (Von Neumann-Bernays-Godel without Foundation) with a weak version of this axiom, that avoids finite cycles $x_1 \in x_2 \in x_3 \in \cdots \in x_n \in x_1$.

The purpose of this work is to adapt the Fraenkel-Mostowski's model constructions used for ZF^- to obtain models for V_1.

This research was partially supported by Fondecyt 1940695, DIPUC 97/17PF and Fondecyt 1980855.

[1] N. Brunner, *75 years of independence proofs by Fraenkel-Mostowski permutation models*, ***Mathematica Japonica***, vol. 43 (1996), pp. 177–199.

[2] R. Chuaqui, ***Axiomatic set theory***, North-Holland, Amsterdam, 1981.

[3] J. D. Halpern, *The independence of the axiom of choice from the Boolean prime ideal theorem*, ***Fundamenta Mathematicae***, vol. 55 (1964), pp. 57–66.

[4] K. Kunen, ***Set theory***, North-Holland, Amsterdam, 1980.

[5] M. Victoria Marshall and M. Gloria Schwarze, *Rank in set class theory without regularity*, 1996, preprint.

[6] L. Rieger, *A contribution to Gödel's axiomatic set theory, I*, ***Czechoslovak Mathematical Journal***, vol. 9 (1957), pp. 323–357.

► CARLOS M. MARTINEZ, *Lógica modal no-normal algebrizable*.

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Se muestra un ejemplo de una Lógica Modal no-normal que es algebrizable en el sentido de Blok-Pigozzi.

[1] W. J. BLOK and D. PIGOZZI, *Algebrizable logics*, ***Memoirs of the American Mathematical Society***, vol. 77 (1989), no. 396, pp. vi–78.

► CARLOS M. MARTINEZ AND GUILLERMO R. ORTIZ, *Lema de Conmutación*.
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Se da una formulación del Lema de Conmutación y una prueba del mismo. Además, se da como aplicación que dada una categoría $\mathbb{C}$, los puntos de los $\mathbb{C}$-conjuntos se relacionan con los filtrantes de $\mathbb{C}$ a través de un funtor pleno, fiel y esencialmente sobreyectivo. Finalmente se presenta el caso particular de la aplicación a funtores representables.

La relevancia de este singular resultado se hizo notoria en el seminario de Lógica Categórica dirigido por el Profesor G. Reyes en la P.U.C. de Chile (1996–97).

► NESTOR GUILLERMO MARTÍNEZ, *On Priestly duality for many valued logics*.
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Two applications of a Priestley type topological duality for MV-algebras are developed. In the first one, we give a characterization of the chains in which the MV-implication is unique and we show that the different implications in a chain are in correspondence with the different De morgan negations that can be defined. In the second one we start the study of the class of formulae of the propositional n-valued calculus that can be simulated by classical 2-valued formulae.

► A. R. D. MATHIAS, *Ghosts and limits*.
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In earlier work on an iteration problem in dynamical systems, I showed that for the shift function operating on Baire space, initial points may be found to yield any given countable ordinal as the moment of stabilisation, and that the construction might be modified to the case of compact subspaces such as 5^{ω}, yielding initial points scoring arbitrarily large countable ordinals.

In the present talk I shall show that no points in the previous class of examples can score exactly a countable limit ordinal, but that other points can be found which do so.

► RALPH MCKENZIE AND JAPHETH WOOD, *The type set of a variety is not computable*.
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Several problems involving the local structure of finite algebras are shown to be unsolvable by interpreting the halting problem of Turing machines. Specifically, these problems are to decide, given a finite algebra **A**, whether the type-set (in the sense of the Tame Congruence Theory of Universal Algebra) of the variety generated by **A**, which is a subset of $\{1, 2, 3, 4, 5\}$, omits 2, or 3, or 4, or 5, respectively.

► IRENE L. MIKENBERG AND ELENA H. OLIVOS, *Algebraic operators on classes of partial algebras*.
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When working with classes of partial algebras we obtain different notions of homomorphism and subalgebra which extend the usual concepts of universal algebra. These notions give rise to four homomorphism operators and four subalgebra operators which are partially ordered by $O \leq O'$, if $O(K) \subseteq O'(K)$, for every class K of similar partial algebras.

In this work we study the po-monoid generated by these operators.

Funding for the first author has been provided by Fondecyt, grant 1960931 and for the second author by Dirección de Investigación y Dirección de Perfeccionamiento de la Universidad de la Frontera.

[1] P. Burmeister, ***A model theoretic oriented approach to partial algebras***, Akademie-Verlag, Berlin, 1986.

[2] S. Burris and H. Sankappanavar, ***A course in universal algebra***, Springer-Verlag, New York, 1981.

[3] D. Pigozzi, *On some operations on classes of algebras*, ***Algebra Universalis***, vol. 2 (1972), pp. 346–353.

► F. MIRAGLIA, *Marshall's conjecture for Pithagorean fields*.
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I shall present joint work with M. Dickmann (Ëquipe de Logique, Univ. Paris VII), that yields an affirmative solution to the following well-known problem in the reduced theory of quadratic forms, due to M. Marshall (1972):

> Let ψ be a quadratic form over a Pythagorean field F and let $n \geq 1$ be an integer. Assume that the total signature of ψ is congruent to $0 \mod 2^n$. Is it true that ψ belongs to the nth power of the fundamental ideal of F?

For the proof, we shall need the theory of special groups, together with methods from algebraic K-theory and Galois Cohomology.

► DANIELE MUNDICI, *New results in many-valued logic*.
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As shown in [2], the infinite-valued calculus of Łukasiewicz is deeply related to abelian lattice-ordered groups and AF C^*-algebras. Several books and papers witness the growing attention for this topic. Furthermore, the vocabulary between toric varieties and fans [1] allows one to translate the desingularization problem for a toric variety V into the problem of suitably refining a certain complex $F(V)$ of polyhedral cones. The same techniques are used to compute disjunctive normal forms in the infinite-valued propositional calculus. We discuss the resulting cross-fertilization, in the light of [3] and [4].

[1] G. Ewald, ***Combinatorial convexity and algebraic geometry***, Graduate Texts in Matheamtics, Springer-Verlag, Berlin, Heidelberg, New York, vol. 168 (1996).

[2] D. Mundici, *Interpretation of AF C^*-algebras in Łukasiewicz sentenial calculus*, ***Journal of Functional Analysis***, vol. 46 (1986), pp. 15–63.

[3] S. AGUZZOLI and D. MUNDICI, *An algorithmic desingularization of 3-dimensional toric varieties*, ***Tohoku Mathematical Journal***, vol. 46 (1994), pp. 557–572.

[4] D. MUNDICI, *Łukasiewicz normal forms and toric desingularizations*, in ***Proceedings logic colloquium '93*** (W. Hodges et al., editors), Oxford University Press, 1996, pp. 401–423.

► ANDRE NIES, *Approximations to biinterpretability with* **N**.
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Biinterpretability of a structure A with the natural numbers $\mathbf{N}$ means that A and $\mathbf{N}$ are modeltheoretically equivalent. A weaker condition, biinterpretability with parqameters, still implies that A and $\mathbf{N}$ share many properties, for instance being a prime model. We discuss approximations to those conditions for various structures from computability theory, for instance the computably enumerable many-one and Turing degrees, which still suffice to determine the complexity of the theory and obtain interesting definability results. For instance, in work joint with Shore and Slaman it is proved that Low_2 and High_1 are definable without parameters in the c. e. Turing degrees.

► C. E. ORTIZ, *How to omit infinitary formulas in metric structures*.
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Many important questions in functional analysis require the construction of complex normed spaces verifying infinitary properties. A natural model theoretical tool to construct complex structures in classical model theory is the Omitting Types Theorem. Although there exist versions of the Omitting Types Theorem for infinitary formulas in normed spaces, they do not take full advantage of the norm's properties.

Based on a study of the most important counterexamples in Banach space theory in the last 20 years (in particular those derived from Tsirelson's space [1]), we prove a very general theorem for omitting infinitary formulas in classes of normed spaces. The proof of this result is based on the notion of approximate truth for infinitary formulas and on its relationship to the notion of convergence in normed spaces.

[1] B. S. TSIRELSON, *Not every Banach space contains ℓ_p or c_0*, ***Functional Analysis and its Applications***, vol. 8 (1974), pp. 138–141.

► MAURICIO OSORIO AND CLAUDIA ZEPEDA, *Confluence and provability closures: Tools to define well-behaved semantics*.
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Normal programs extend definite programs by allowing a *negation as failure* operator $\neg$. We have here a departure from classic logic, to a nonmonotonic formalism. The class of well-behaved nonmonotonic semantics has been studied in detail in [2, 3, 1] in order to understand the logic of logic programming. Three conjectures (7.20, 7.21 and 7.22 in [1]) are given that declare this class rather small. We claim that these conjectures are false. The current research on confluence and provability closures reported in [5, 4] give a first evidence that the class is broader. These papers introduce three semantics: WFS^{m2}, $\mathrm{WFS}^{2'}$ and WFS^2 that in turn refute conjecture 7.20. We show in the full paper that $\mathrm{WFS}^{2'} \leq \mathrm{WFS}^2$ and we conjecture that $\mathrm{WFS}^{m2} = \mathrm{WFS}^2$. Our research suggests that the class of well-behaved semantics is much larger than it is conjectured and we would like to give (eventually) a precise characterization of this class in terms of confluence and/or provability closures.

[1] Gerhard Brewka, Jürgen Dix, and Kurt Konolige, ***Nonomotonic reasoning*: *An overview***, CSLI Lecture Notes, no. 73, CSLI Publications, Stanford, CA, 1997.

[2] Jürgen Dix, *A classification-theory of semantics of normal logic programs*: *I. Strong properties*, ***Fundamenta Informaticae***, vol. XXII, 1995, no. 3, pp. 227–255.

[3] Jürgen Dix, *A classification-theory of semantics of normal logic programs*: *II. Weak properties*, ***Fundamenta Informaticae***, vol. XXII, 1995, no. 3, pp. 257–288.

[4] Jürgen Dix and Mauricio Osorio, ***Towards well-behaved semantics suitable for aggregation***, Research Report 11-97, University of Koblenz, Germany (also a poster paper at ISLP97).

[5] Jürgen Dix and Mauricio Osorio, *Provability closures in logic programming*, in ***Proceedings of the international symposium of computer science in Mexico***, (I. P. N., editors), 1997.

► MARGARITA OTERO, *Groups definable in o-minimal structures*.
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(Joint work with Alessandro Berarducci.)

A linearly ordered structure $\mathcal{R} = \langle R, <, \dots \rangle$ is o-minimal if every definable subset of R is a finite union of intervals (endpoints in $R \cup \{+\infty\} \cup \{-\infty\}$) and points.

A group G is definable in $\mathcal{R}$ if G is a definable subset of R^k and the graph of the group operation is a definable subset of R^{3k}. We shall consider groups definable in an o-minimal expansion $\mathcal{R}$ of a real closed field R. Such groups are equipped with a unique definable C^p-manifold structure (see [2]). When the group is not definable-compact we have some information about its definable subgroups (see [3]).

We shall develop some intersection theory for definable C^p-manifolds which will allow us to give a topological invariant for definable-compact such groups and prove Lefschetz Fix Point Theorem in an o-minimal context (see [1]).

[1] A. Berarducci and M. Otero, *Intersection theory for o-minimal manifolds*, preprint.

[2] A. Pillay, *On groups and fields definable in o-minimal structures*, ***Journal of Pure and Applied Algebra***, vol. 53 (1988), pp. 239–255.

[3] Y. Peterzil and C. Steinhorn, *Definable compactness and definible subgroups of o-minimal groups*, preprint.

► ALEJANDRO PETROVICH, *A topological duality for partially ordered sets*.
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A *totally order-disconnected topological space* is a triple $(X, \leq, \tau)$ such that $(X, \leq)$ is a poset, (X, τ) is a topological space and given x, $y \in X$ such that $x \not\leq y$ there is a clopen (= closed and open) increasing set U such that $x \in U$ and $y \notin U$. *A Priestley space* is a compact totally order-disconnected topological space.

H. A. Priestley showed that there is a duality between the category of bounded distributive lattices and homomorphisms and the category of Priestley spaces and continuous order-preserving maps.

A classical result due to G. Birkhoff says that *every finite partially ordered set is isomorphic to the partially ordered set of the prime filters of a finite distributive lattice.* This result is an easy consequence of Priestley's duality.

We generalize this result to arbitrary partially ordered sets by showing that there is a duality between the category of partially ordered sets and order-preserving maps and the category whose objects are certain topological lattices. These topological lattices are in particular Priestley spaces. It is worthwhile to point out that there is an interesting connection between this duality and the Priestley duality for distributive lattices. This connection is the fact that the dual of a bounded distributive lattice is a Priestley space, while the dual of a poset is a Priestley space with additional structures.

► CLAUDIO PIZZI, *Contingency and propositional quantifiers*.
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The standard definition of contingency in terms of possibility allows us to identify contingency fragments of normal modal systems (Kuhn [3]). By a well known result, however, it turns out that if contingency is taken as a primitive operator necessity cannot be defined in terms of contingency in the most interesting normal systems which are weaker than KT (Cresswell [1]). The aim of the paper is to discuss this problem by extending normal modal systems with a minimal basis for propositional quantifiers. It turns out, then, that in the weakest contingency system which is identifiable in such extensions the problem of defining necessity in terms of contingency receives a straightforward solution. The problem is also discussed by considering two variants of the basic systems for propositional quantifiers (see Fine [2]) and looking at the behaviour of more complex contingency operators. This family of contingency logics may also receive a semantical analysis, which turns out to be useful in specific applications of contingency language.

[1] M. J. Cresswell, *Necessity and contingency*, ***Studia Logica***, vol. 47 (1988), pp. 145–149.

[2] K. Fine, *Propositional quantifiers in modal logic*, ***Theoria***, vol. 36 (1970), pp. 336–346.

[3] S. Kuhn, *Minimal non-contingency logic*, ***Notre Dame Journal of Formal Logic***, vol. 36 (1995), pp. 230–234.

► MAURICE POUZET, *The cofinality of ordered sets*.
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In this lecture, I will report on the collaboration with E. C. Milner over the years, particularly on our last work. Let P be a partially ordered set (poset). A subset $A \subseteq P$ is cofinal if every $x \in P$ is majorized by some $y \in A$, and the *cofinality* of P, denoted by $\mathrm{cf}(P)$, is the least cardinal κ such that P contains a cofinal subset of size κ. We say that P is *cofinally homogeneous* if $\mathrm{cf}(\uparrow x) = \mathrm{cf}(P)$ holds for each $x \in P$. We extend a decomposition result of Hajnal and Sauer obtained under stronger assumptions.

Theorem 1. *Let P be a cofinally homogeneous poset. If $\kappa = \mathrm{cf}(P)$ is singular, then P contains a direct sum of λ cofinally homogeneous posets each of cofinality κ provided that $\lambda = \omega$ or $\lambda = \mathrm{cf}(\kappa)$ and $\kappa^{<\lambda} = \kappa$, or $\kappa^{\lambda} = \kappa$.*

We do not know whether the weaker condition $\kappa^{<\lambda} = \kappa$ suffices. A positive answer would have the following consequence that we prove directly.

Theorem 2. *Let P be a poset having singular cofinality κ and let λ be an infinite cardinal satisfying $\kappa^{<\lambda} = \kappa$. If P does not embed T_λ, the tree consisting of all finite sequences of ordinals less than λ ordered by extension, then P contains a cofinal subset which is a direct sum of subsets of cofinality strictly less than κ.*

A special case of Theorem 2 is that, without any set-theoretic assumptions, *an updirected poset with singular cofinality embeds the binary tree T_2*. In this direction, we also prove that *if $\mathrm{cf}(P)$ is singular and P is updirected then it contains an induced copy of the direct product $\omega \otimes \cdots \otimes \omega$ of a finite number of copies of the ω-chain*; *if, moreover, κ is a singular strong limit cardinal, then the dimension of P is at least* $\log\log(\mathrm{cf}(\kappa))$.

[1] M. M. Day, *Oriented systems*, ***Duke Mathematics Journal***, vol. 11 (1944), pp. 201–229.

[2] A. Hajnal and E. C. Milner, *On k-independent subsets of a closure*, ***Studia Scientiarum Mathematicarum Hungarica***, vol. 26 (1991), pp. 467–470.

[3] A. Hajnal and N. Sauer, *Complete subgraphs of infinite multipartite graphs and antichains in partially ordered sets*, ***Discrete Mathematics***, vol. 59 (1986), pp. 61–67.

[4] H. A. Kierstead and E. C.Milner, *The dimension of the finite subsets of κ*, ***Order***, vol. 13 (1996), pp. 227–231.

[5] F. Hausdorff, *Grundzüger einer Theorie der geordneten Menger*, ***Mathematische Annalen***, vol. 65 (1908), pp. 435–505.

[6] E. C. Milner and M. Pouzet, *On the independent subsets of a closure system with singular dimension*, ***Algebra Universalis***, vol. 21 (1985), pp. 25–32.

[7] E. C. Milner and M. Pouzet, *On the cofinality of partially ordered sets*, ***Ordered Sets*** (I. Rival, editor) Reidel, 1982, pp. 279–298.

[8] E. C. Milner and M. Pouzet, *On the width of ordered sets and Boolean algebras*, ***Algebra Universalis***, vol. 23 (1986), pp. 242–253.

[9] E. C. Milner and M. Pouzet, *Posets with singular confinality*, 1997, preprint.

[10] E. C. Milner and K. Prikry, *The cofinality of partially ordered sets*, ***Proceedings of the London Mathematical Society***, vol. 16 (1983), pp. 454–470.

► LAURA A. RUEDA, *The variety of linear Heyting algebras with a quantifier*.
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This paper continues the investigation of certain varieties whose study is motivated by predicate logic. These varieties appeared in the paper [1] concerning distributive lattices with a quantifier, or Q-distributive lattices, and since then have been investigated by several authors, among others, by H. Priestley in [2].

As a natural generalization, one is led to consider the operation of quantification on Heyting algebras. A Q-Heyting algebra is an algebra $(H; \wedge, \vee, 0, 1, \nabla)$ of type $(2, 2, 0, 0, 1)$ such that $(H; \wedge, \vee, 0, 1)$ is a Heyting algebra and the unary operation ∇ satisfies the following conditions, for any $a, b \in H$:

$$(Q_0) \qquad \nabla 0 = 0,$$

$$(Q_1) \qquad a \wedge \nabla a = a,$$

$$(Q_2) \qquad \nabla(a \wedge \nabla b) = \nabla a \wedge \nabla b,$$

and

$$(Q_3) \qquad \nabla(a \vee b) = \nabla a \vee \nabla b.$$

This paper is devoted to the study of the variety $\mathcal{QH}_L$ of linear Q-Heyting algebras. Subdirectly irreducible and simple members of $\mathcal{QH}_L$ are determined and some general properties of the lattice $\Lambda(\mathcal{QH}_L)$ of subvarieties of $\mathcal{QH}_L$ are investigated. We prove that this variety is generated by its finite members and that $\Lambda(\mathcal{QH}_L)$ is complete. We also provide equational bases for some subvarieties of $\mathcal{QH}_L$. Finally, we study the variety of linear Q-Heyting algebras generated by chains.

The main tool we use in this work is the duality between Heyting algebras and certain topological spaces developed by Priestley.

[1] R. Cignoli, *Quanitifers on distributive lattices*, ***Discrete Mathematics***, vol. 96 (1991), pp. 183–197.

[2] H. A. Priestley, *Natural dualities for varieties of distributive latties with a quantifier*, ***Banach Center Publications***, vol. 28 (1993) Warszawa, pp. 291–310.

► PAULA SEVERI, *An algorithm for type theory*.

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In this paper we present a simplification for the system called Type Theory in [1] and give a type checking algorithm. The first simplification consists in removing the substitution rules which are easily proved to be admissible. The second simplification consists in replacing the equality judgement by $\beta\eta$-conversion between raw terms. In order to prove the equivalence between this presentation and the original one, we prove correctness of a type checking algorithm for this theory based in the simplificated rules.

[1] B. Nordström, K. Petersson, and J. M. Smith, ***Programming in Martin-Löf's type theory*; *An introduction***, Oxford Science Publications, 1990.

► JAIRO JOSÉ DA SILVA, *Husserl's two notions of completeness*.
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In 1901 Husserl addressed the Mathematical Society in Göttingen in order to present his views on two problems related to a question that had occupied him since 1890: How to justify the use of "imaginary" elements in mathematics?

These problems are the following: To characterize what an "imaginary" object is from the perspective of a formal axiomatic system (the ontological problem), and to investigate the conditions for derivability to be an equivalent of truth in formal axiomatic systems (the epistemological problem).

In order to deal with these questions Husserl introduced two related notions, which he called relative and absolute definiteness, that offered him the keys to the solution of both problems. In the paper I intend to show how, and why, Husserl arrived at these notions and their relevance, according to Husserl, to the problem of imaginary elements in mathematics. I also argue, contrary to most commentators, that is was the first, not the second notion that Husserl considered germane to the notion of completeness involved in Hilbert's axiom of completeness. Commentators also find Husserl's suspicion that Hilbert had actually found inspiration in his ideas for the axiom of completeness proposed in "Uber den Zahlbegriff" based on a confusion, which according to them Husserl makes between syntactic and semantic completeness. One of the conclusions of this paper is that such confusion cannot be so readily attributed to Husserl.

This paper intends also to throw some light on the question of the influence of Frege's criticism of "Philosophie der Arithmetik" on Husserl's philosophical development.

This research was partially funded by a grant from FUNDUNESP.

► SLAWOMIR SOLECKI, *Complexity of Haar null sets*.
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All groups considered are Polish, that is, separable complete. Each locally compact Polish group has a left-translation invariant Borel measure defined on it. Any two such measures give rise to the same invariant ideal of sets of measure zero—the σ-ideal of Haar measure zero sets. Christensen extended the definition of Haar measure zero sets to arbitrary Polish groups and called sets in this ideal Haar null. (Of course, if a group is not locally compact, there cannot be a Borel left-translation invariant measure on it but, by Christensen, we do have an invariant σ-ideal of sets which coincides with Haar measure zero sets if the group is locally compact.) Haar null sets have now many applications in Banach space theory.

It is a well-known fact that the family of closed Haar null sets on a locally compact group is Borel (in a suitable topology on closed subsets of the group). Kechris asked if any non-locally compact group can have this property. In the talk, I will outline a proof of a theorem that shows that this is impossible for abelian groups, that is, for an abelian Polish group, the family of closed Haar null sets is Borel if and only if the group is locally compact. In fact, I will prove a theorem that shows that the ideal of non-dominating subsets of ω^ω is, in a sense, "Rudin-Keisler" below the ideal of Haar null sets on a non-locally compact Polish abelian group. Many known facts about Haar null sets are consequences of this general result, for example, compact subsets of a non-locally compact abelian group are Haar null (Dougherty) or the Haar null ideal on a non-locally compact abelian group does not have the countable chain condition (Dougherty, Solecki). I will survey these consequences in the talk.

► IAIN A. STEWART, *Hierarchies of program schemes*.
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I shall exhibit a close relationship between certain extensions of first-order logic by uniform sequences of Lindström quantifiers and the classes of problems accepted by certain program schemes (all structures in which formulae or program schemes are interpreted are finite). The basic program schemes I consider are essentially built around while instructions which allow quantifier-free first-order tests. The first (simple) result is a program schematic characterization of Immerman's transitive closure logic and the second is an extension of this result to the situation where the program schemes have access to a pushdown store and the path system operator replaces the transitive closure operator in the logic. I shall prove hierarchy results for the classes of program schemes, which translate to logical hierarchy results. Moreover, these hierarchy results are obtained not by playing Ehrenfeucht-Fraïssé games but merely by considering computation traces in executions of program schemes on finite structures. I shall show how our hierarchy results extend earlier ones due to Grädel and McColm in that our hierarchies remain proper even when restricted to problems involving trees. This is joint work with Argimiro Arratia-Quesada (Universidad Simón Bolívar) and Savita Chauhan (University of Wales Swansea).

► STEVO TODORCEVIC, *Tukey reductions between analytic ideals*.
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This is a study of analytic ideals on the integers that represent some aspect of the Lebesgue measure or Baire category on the reals.

► JOSÉ MARÍA TURULL TORRES, *On the computability and expressibility of untyped queries*.
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The definition of *computable query* of Chandra and Harel [1] included *untyped queries*, that is, queries whose answers are relations of possibly different arities on different structures. However, it seems that in the work which followed on the subject, untyped queries were not considered at all, neither in the abstract machines side nor in the logic framework. So that queries like *the set of automorphisms of a structure*, defined as a query which induces a $2n$-ary relation in every structure I of size n, cannot be computed by any relational or reflective machine, nor expressed by any formula of any logic. One important application for which untyped queries can be used is to express numerical queries, that is, queries which range over the naturals. So, we propose to re-introduce untyped queries in the study of Query Computability. For that purpose we define an extension of the Reflective Machine which we called *untyped Reflective Machine*. In the logic framework, we define a new quantifier, which we call *conditional quantifier*, and we build with it an infinitary logic ($\mathcal{L}^c_{\omega_1\omega}$). The difference between this logic and $\mathcal{L}_{\omega_1\omega}$ is that a formula of our logic can induce relations of a different arity on different structures. Then we prove several completeness results regarding both formalisms. We also define an undecidable fragment of $\mathcal{L}_{\omega_1\omega}$ which exactly captures the sub-class of the *total and typed* computable queries.

This work has been partially supported by Grant 1011049 of the Academy of Finland and by a Grant of Universidad CAECE, Argentina.

[1] A. CHANDRA and D. HAREL, *Computable queries for relational data bases*, ***Journal of Computer and System Sciences***, vol. 21 (1980), pp. 156–178.

► CARLOS R. VIDELA, *New undecidable subfields of $\tilde{\mathbb{Q}}$*.
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Let k be a number field and $M \subset \tilde{\mathbb{Q}}$ a pro-p extension of k. Let $\tilde{\mathbb{Z}}$ be the ring of all algebraic integers in $\tilde{\mathbb{Q}}$. We prove $\tilde{\mathbb{Z}} \cap M$ is first-order definable in M (we allow parameters from M). Using results of Julia Robinson and the above theorem we show that the field of real numbers constructible using ruler and scale is undecidable. Using results on elliptic curves we show that cyclotomic towers are undecidable too.

► ANDRÉS VILLAVECES, *The Łoś conjecture in abstract elementary classes with no maximal models*.
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I will present some results of joint work with Saharon Shelah toward establishing a version of the Łoś Conjecture on Categoricity in some specific contexts in Abstract Elementary Classes.

Morley proved the Categoricity Theorem for first order logic (FOL). That result may be seen as a first toward Stability Theory in that context. In trying to extend Classification Theory to contexts **much wider** than FOL, a first natural 'test question' is the following.

QUESTION. *What version of the Categoricity Theorem (Łoś Conjecture) do we have*?

Of course, such a question must be posed with much greater accuracy in order to be meaningful. In the past, work has been done by Maakai, Kolman and Shelah (see the introduction to [1] for an account of the history of the problem) in various natural contexts (existence of strongly compact cardinals, of measurable cardinals and amalgamation in the Abstract Elementary Class).

I will discuss two central issues toward the goal in question:

(1) The import of set theoretical hypothesis in this work (how to reduce them).
(2) The existence of saturated models and a notion of non-forking in our context.

[1] SAHARON SHELAH and ANDRÉS VILLAVECES, *Toward categoricity for classes with no maximal models*, ***Annals of Pure and Applied Logic***, accepted.

► W. HUGH WOODIN, *The continuum hypothesis*.
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We discuss a formal version of the following informal theorem.

"THEOREM". *Suppose ϕ is an axiom which settles, modulo consistency statements, the theory of the powerset of ω_1. Then ϕ implies that the Continuum Hypothesis is false.*

Abstracts of communications presented by title

► DANIEL DURANTE PEREIRA ALVES, *A proof by Howard of strong normalization in typed lambda-calculus*.
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In Howard [2] we have an ordinal analysis of the theory $\mathcal{I}$ presented in Gödel [1] as an interpretation for the first order intuitionistic arithmetic $\mathcal{H}$. $\mathcal{I}$ is a equational and quantifier-free theory of primitive recursive functionals of finite types that can be formalized in typed λ-calculus. In his analysis Howard defined the axiomatic equalities of $\mathcal{I}$ in terms of reductions, reducing the concept of equality to the concept: *to have the same normal form.* Then he proved that any reduction sequence for any term of $\mathcal{I}$ finishes in less than ε_0 steps.

Analyzing Howard's proof method we noticed that, despising the specific axiomatic equalities reductions of the system $\mathcal{I}$, and just applying its method to be β-reductions of typed λ-calculus, we obtain a proof that any reduction sequence for any typed λ-term finishes in less than ω steps. In other words, there is a result of Strong Normalization for typed λ-calculus hidden in this article. Such fact is important not only due the original proof method used by Howard, as well as for being this article previous to the well-known proofs of Strong Normalization for typed λ-calcululs.

[1] K. Gödel, *Über eine bisher noch nicht benützete Erweiterung des finiten Standpunktes*, ***Dialectica*** vol. 12 (1958), pp. 280–287.

[2] W. A. Howard, *Assignment of ordinals to terms for primitive recursive functionals of finite type*, ***Intuitionism and Proof Theory***, 1970, pp. 443–458.

► MARCELO ARENAS AND LEOPOLDO BERTOSSI, *Specifications of database updates and hypothetical temporal queries*.
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In this paper a history-encoding based methodological developed by Chomicki [2] for checking dynamic database integrity constraints is integrated into a situation-calculus [3] based specification of relational database updates [1] as proposed by Reiter [4]. By doing this, it is possible to:

(1) Answer queries about a whole hypothetical evolution of a database, without having to update the entire database and keep all the information associated to the generated states,
(2) State and prove dynamic integrity constrains as static integrity constraints,
(3) Transform history dependent preconditions for updates into local preconditions.

The methodology presented here takes advantage of translations between first order past temporal logic formulas and state bounded situation calculus queries and constraints.

[1] L. Bertossi, M. Arenas, and C. Ferretti, *SCDBR*: *An automated reasoner for specifications of database updates*, ***Journal of Intelligent Information Systems***, to appear.

[2] J. Chomicki, *Efficient checking of temporal integrity constraints using bounded history encoding*, ***ACM Transactions on Database Systems***, vol. 20 (1995), no. 2, pp. 149–186.

[3] J. McCarthy and P. Hayes, *Some philosophical problems from the standpoint of artificial intelligence*, in ***Machine Intelligence***, vol. 4 (B. Meltzer and D. Michie, editors), Edinburgh University Press, 1969, pp. 463–502.

[4] R. Reiter, *On specifying database updates*, ***Journal of Logic Programming***, vol. 25 (1995), no. 1, pp. 53–91.

▶ MARIA CLAUDIA CABRINI GRACIO, *Logic bases for representation of reasoning under uncertainty*.
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Classical first-order logic can only properly represent our knowledge about the universe when complete information about facts is available. There are, however, several situations where only partial knowledge is available, and even then the human natural reasoning can make non-trivial and justifiable inferences from such facts.

In situations of this sort, classical logic cannot be an adequate model for natural reasoning. An important question, related to well-known problems on philosophy of science, is whether or not it is really possible to provide logically well-founded models of this sort. In this paper, we first analyse some proposals concerning the non-monotonic approach for the formalization of reasoning under uncertainty as well as the monotonic system proposed by [1]. We present a critical comparative analysis of these systems, identifying situations where such theories can be applied, and raising some problems they do not solve.

Second, using a similar approach as in [1], we investigate new logic systems which are monotonic extensions of classical predicate logic and which formalize some forms of reasoning under uncertainty, as the intuitive notions of "majority", "almost always" and "it is plausible that".

These new systems are defined through generalized quantifiers over mathematical structures. For each system we provide a complete axiomatization, and investigate basic model-theoretic properties.

[1] W. A. Carnielli and P. A. S. Veloso, *Ultrafilter logic and generic reasoning*, in ***Computational logic and proof theory*** (Proceedings of the Third Kurt Gödel Colloquium) (G. Gottlob, A. Leitsch, and A. Mundici, editors), Lecture Notes in Computer Science, no. 1289, Springer-Verlag, Berlin-Heidelberg-New York, 1997.

▶ WALTER A. CARNIELLI, *The crossing of logics and the paradox of Curry*.
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The well-known *Curry paradox* as given by H. Currin in 1942 (cf. [3]) shows that any system of combinatory logic containing implication and closed under the rules of:

(1) Absorption: $A \rightarrow (A \rightarrow B)/A \rightarrow B$, and
(2) Modus Ponens: $A, A \rightarrow B/B$

is deductively trivial. Since no form of negation is involved, this is called *positive triviality*. Very few logical systems can evade Curry's objection, and the ones which do (as the logics of Łukasiewicz where the Rule of Absorption is not valid) may fall into *negative triviality* resulting from inconsistency. Paraconsistent logics avoid negative (but not positive) triviality.

We show, by means of the *non-deterministric semantics*, how to combine Łukasiewicz logics with an additional negation so as to define absolute non-trivial logics, which avoid positive and negative triviality. Specializing from the notions introduced in [1], we define the *crossing* $Ł_n \times Ł_n$ of $Ł_n$ as the collection of tautologies preserved under a certain class of valuations called *non-deterministic valuations*, where $n \in \omega + 1$.

It can be shown that $Ł_n \times Ł_n$ are subsystems of Łukasiewicz logics which are paraconsistent and bypass Curry's objection, and hence define absolute non-trivial logics. Moreover $Ł_n \times Ł_n$ are not finitely-valued logics (even for finite n), but can be finitely axiomatizable.

It is an open question to prove whether or not $Ł_n \times Ł_n$ are decidable, as well as to characterize which varieties of MV-(sub)algebras (cf. [2]) are appropriate to represent them.

[1] W. A. CARNIELLI, *Non-deterministic semantics and dual logics*, ***Soft Computing***, to appear.

[2] R. CIGNOLI, I. D'OTTAVIANO, and D. MUNDICI, *Álgebras das lógicas de Łukasiewicz*, ***Coleção CLE***, vol. 12 (1994), UNICAMP, Campinas,

[3] H. CURRY, *The inconsistency of certain formal logics*, ***Journal of Symbolic Logic***, vol. 7 (1942), pp. 115–117.

► MARCELO E. CONIGLIO, *Objects with extent in categorical logic*.
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We present here a generalization, for any logical category $\mathcal{C}$, of the notion of the extent EB of B in $\mathrm{Sh}(\Omega)$, which permits us to expand the category of first-order structures in $\mathcal{C}$.

DEFINITION. Given a logical category $\mathcal{C}$, $E(B) \equiv_{\text{def}} \exists_f(B) \hookrightarrow \mathbf{1}$ is the extent of B, where $f : B \to \mathbf{1}$.

In $\mathrm{Sh}(\Omega)$, $E(B) = \mathbf{1}_{|EB}$ (identified with EB). A constant $a : A$ will be interpeted in M as an arrow $M(a) : E(M(A)) \to M(A)$; in $\mathrm{Sh}(\Omega)$, $M(a)$ is a global section of $M(A)$. The formal properites of EB are preserved by $E(B)$. A *context* is now defined as $C = (\vec{x}; \vec{a})$ (x_i are variables and a_j are constants). The greatest value $GV_M(\phi, C)$ of a formula ϕ in a structure M and a context C is defined in a natural way, such that $[\phi]^M_C \leq GV_M(\phi, C) \hookrightarrow M(C)$. We set: $M \models (\vdash \Delta)$ if $[\phi]^M_C = GV_M(\phi, C)$ (C is the context of $\phi = \bigvee \Delta$); if $\Gamma \vdash \Delta$) as usual. The logic $G^1_{\mathbb{T}}$ in [3] is modified, obtaining:

THEOREM. *The modified logic $\bar{G}^1_{\mathbb{T}}$ is sound and complete for categorical semantics with extents.*

We have now two classes of theorems: the "weak" ones ($\vdash \phi$ is value) and the "strong" ones ($\top \vdash \phi$ is valid, recapturing the clasical meaning of $\vdash \phi$). Now the structures can deal simultaneously with different theories in which the objects with constants do not necessarily have extent $\mathbf{1}$.

[1] M. E. CONIGLIO, *The logic of sheaves over right-sided and idempotent quantales*, ***Doctoral Thesis*** (Portuguese), São Paulo University, 1997.

[2] P. JOHNSTONE, *Notes on categorical logic*, Wollic '97, Fortaleza, 1997.

[3] M. MAKKAI and G. E. REYES, ***First-order categorical logic***, Lecture Notes in Mathematics, no. 611, Springer-Verlag, Berlin, 1977.

► HÉRCULES A. FEITOSA AND ITALA M. LOFFREDO D'OTTAVIANO, *Is there a translation from intuitionistic logic into classical logic?*.
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Based on [1], this paper proposes the concept of conservative translation between logics.

A *conservative translation* from a logical system $\mathcal{L}_1$ into a logical system $\mathcal{L}_2$ is a function $T : Form(\mathcal{L}_1) \to Form(\mathcal{L}_2)$ between the sets of formulas of both systems such that, for every $\Delta \cup \{a\} \subseteq Form(\mathcal{L}_1)$:

$$\Delta \vdash_{\mathcal{L}_1} \alpha \iff T(\Delta) \vdash_{\mathcal{L}_2} T(\alpha).$$

Conservative translations strongly preserve consequence relations and we have obtained necessary and sufficient conditions for a translation being conservative.

In the literature, several conservative translations from classical propositional logic into intuitionistic propositional logic are usually mentioned, as for example Kolmogoroff's and Gentzen's translations. The known Gödel interpretation is not a translation in our sense.

In this paper we study the problem of the existence of a conservative translation from the Heyting intuitionistic logic H into classical propositional logic CPL. We also discuss the existence of conservative translations from the modal system $\mathbf{S}_4$ into H and into CPL.

[1] J. J. da Silva, I. M. L. D'Ottaviano, and A. M. Sette, *Translations between logics*, in ***Models, algebras and proofs*** (X. Caicedo and C. H. Montenegro, editors), Lecture Notes in Pure and Applied Mathematics, no. 203, Marcel Dekker, Inc., New York, 1999, pp. 435–448.

[2] H. A. Feitosa, *Traduções conservativas* (Conservative translations), ***Doctoral Thesis***, Universidade Estadual de Campinas, Campinas.

► JOSÉ IOVINO, *Model theory and ℓ_p subspaces of Banach spaces*.
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The following question has played a central role in the development of Banach space geometry.

Let X be an arbitrary Banach space. Does X contain any of the classical sequence spaces ℓ_p $(1 \leq p < \infty)$ or c_0?

The first example of a space not containing ℓ_p or c_0 was constructed by B. Tsirel'son in [6]. This phenomenon was even more dramatic for the dual of the Tsirel'son's example [1], which later became also known as the Tsirel'son space and has been used as cornerstone for further variations of the original.

After Tsirel'son's example, the question remained open whether every Banach space has a spreading model isometric to ℓ_p or c_0. The question was answered negatively by E. Odell and Th. Schlumprecht in [5]. W. T. Gowers [2] constructed a space that contains no isomorphic copy of c_0, ℓ_1, or an infinite dimensional reflexive space.

On the positive side, the strongest result is J.-L. Krivine's celebrated block representability theorem [3] which states that given any arbitrary sequence (x_n) in a Banach, there exists p with $1 \leq p \leq \infty$ such that ℓ_p is block finitely represented in (x_n). Another famous positive result is the theorem due to J.-L. Krivine and B. Maurey [4] that every stable Banach space contains some ℓ_p almost isometrically.

I will discuss a model theoretical principle (regarding indiscernible sequences over Banach spaces) which appears to provide the most general answer to the original question. In particular, the positive results mentioned in the preceding paragraph follow as easy consequences of it. This principle also gives new information about the extent to which the classical sequence spaces occur as subspaces of spreading models.

[1] T. Figiel and W. B. Johnson, *A uniformly convex Banach space which contains no l_p*, ***Compositio Mathematica*** vol. 29 (1974), pp. 179–190.

[2] W. T. Gowers, *A Banach space not containing c_0, l_1 or a reflexive subspace*, ***Transactions of the American Mathematical Society***, vol. 344 (1994), no. 1, pp. 407–420.

[3] J.-L. Krivine, *Sous-espaces de dimension finie des espaces de Banach reticulés*, ***Annals of Mathematics***, vol. 104 (1976), pp. 1–29.

[4] J.-L. Krivine and B. Maurey, *Espaces de Banach stables*, ***Israel Journal of Mathematics***, vol. 39 (1981), no. 4, pp. 273–295.

[5] E. Odell and Th. Schlumprecht, *On the richness of the set of ps in Krivine's theorem*, in ***Geometric aspects of functional analysis*** (Israel, 1992–1994), Operator Theory: Advances and Applications, no. 77, Burkhäuser, Basel, 1995, pp. 177–198.

[6] B. S. Tsirel'son, *It is impossible to imbed l_p of c_0 into an arbitrary Banach space*, ***Funktsional'nyī Analiz i ego Prilozheniya***, vol. 8 (1974), no. 2, pp. 57–60.

► CARLOS MONTENEGRO, *Cancellable constructions*.
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We consider constructions Φ that take a finite set X and give a finite set $\Phi(X)$ whose elements are constructed from the elements of X. The constructions we consider have the property that $|X| = |Y|$ if and only if $|\Phi(Y)| = |\Phi(X)|$. (For example, $\Phi(X) = P(X)$ the power set of X, or $\Phi(X) = X^n$ its n-cartesian product.) If there is an injection (surjection) from $\Phi(X)$ to $\Phi(Y)$ then there is one from X to Y. Suppose we are given an injection (surjection) $F : \Phi(X) \rightarrow \Phi(Y)$. Can we use F to define an injection (surjection) $f : X \rightarrow Y$ that is independent of how the elements of X and Y are named? I.e., if we rename (permute) the elements of X, and the elements of Y that induces a permutation of the elements of $\Phi(X)$ and of $\Phi(Y)$. We want the function f to be independent of these permutations, that is, given any F we should obtain an $\Psi(f)$ such that for any permutation σ of X and β of Y the function $(\sigma, \beta)F : x \rightarrow \beta F(\sigma^{-1}x)$ produces the function $(\sigma, \beta)f : y \rightarrow \beta f(\sigma^{-1}y)$. The starting point is the work of Feldman and Propp [1] where this study was done for bijections.
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[1] D. Feldman and J. Propp, *Producing new bijections from old*, ***Advances in Mathematics***, vol. 113 (1995), pp. 1–44.