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2004–05 WINTER MEETING OF THE ASSOCIATION FOR SYMBOLIC LOGIC

Atlanta Marriott Marquis, Atlanta, Georgia
January 7–8, 2005

A Winter Meeting of the Association for Symbolic Logic was held on January 7–8, 2005 at the Atlanta Marriott Marquis, in conjunction with the annual Joint Mathematics Meetings. The members of the Program Committee were Renling Jin, Akihiro Kanamori (Chair), and Alexandra Shlapentokh. The program included seven invited 50-minute talks and eight contributed talks. The ASL hosted a welcoming reception on January 7th at the Magnolia Room of the Atlanta Marriot Marquis. The ASL sponsored a subsession of the AMS-MAA-MER Special Session on Mathematics and Education Reform, **Mathematical Logic in the Undergraduate Curriculum**, organized by J. Hirst, on January 5th. In addition, on January 6–7, prior to the ASL meeting, there was a joint AMS–ASL Special Session, **Reverse Mathematics**, organized by J. Hirst and R. Solomon. On January 6th there also was joint AMS-ASL sponsored Panel Discussion, **The Continuum Hypothesis Revisited: New Perspectives**, featuring Paul J. Cohen, Donald A. Martin, and W. Hugh Woodin, and moderated by Keith Devlin.

The 50-minute delivered invited addresses were:

Matthias Aschenbrenner (University of Illinois at Chicago), *Asymptotic differential algebra*.

Alexander Berenstein (University of Illinois at Urbana), *Generic groups of automorphisms of probability spaces and Hilbert spaces*.

Andres Caicedo, (Institut für formale Logik, Vienna), *Projective well-orderings of the reals*.

Joseph Mileti (University of Chicago), *Partition theorems and computability theory*.

Bjorn Poonen (University of California at Berkeley), *Extensions of Hilbert's Tenth Problem*.

W. Hugh Woodin (University of California at Berkeley), *Structural equivalences for the determinacy of real games*.

Tetsuya Ishiu (University of Kansas, Lawrence) was unable able to attend, and his invited 50-minute talk, *The non-stationary ideal and club guessing ideals*, had to be cancelled.

Abstracts of the invited talks and contributed talks given (in person or by title) by members of the Association for Symbolic Logic follow.

For the Program Committee
AKIHIRO KANAMORI

Abstracts of invited talks

► MATTHIAS ASCHENBRENNER, *Asymptotic differential algebra*.
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Asymptotic differential algebra deals with the interplay between two approaches to the asymptotic theory of real-valued functions: *Hardy fields* and *fields of transseries*, such as the *field of logarithmic-exponential series*. Both are intimately related with the theory of o-minimal expansions of the real field, and with Écalle's solution of the Dulac problem.

I will report on joint work with Lou van den Dries and Joris van der Hoeven concerning algebraic differential equations in this setting.

► ALEXANDER BERENSTEIN, *Generic groups of automorphisms of probability spaces and Hilbert spaces*.
Department of Mathematics, University of Illinois at Urbana-Champaign, 1409 W. Green Street, Urbana, IL 61801, USA.
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Let G be a countable discrete group. We prove that the existentially closed structures among those consisting of a Hilbert space with a group G of automorphisms is axiomatizable by positive sentences using an approximate semantics. Using a theorem by Hulanicki, we show G is amenable if and only if countable copies of the regular representation of G induces an existentially closed structure.

We also prove that when G is amenable, the class of existentially closed structures among those consisting of a measure algebra of a probability space with a group G of automorphisms is axiomatizable by positive sentences. The separable generic structures are the ones coming from the free actions of G on a Lebesgue space. This family includes the regular action of G on the Lebesgue space.

The second part of this talk is joint work with C. Ward Henson.

► ANDRÉS EDUARDO CAICEDO, *Projective well-orderings of the reals*.
Institut für Formale Logik Universität Wien Währinger Straße 25, A-1090 Wien, Austria.
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We show that if there is no inner model with omega many strong cardinals, then there is a (set) forcing extension of the universe with a projective well-ordering of the reals. This relates to, and extends, earlier results on the strength of projective absoluteness. We actually find a correspondence between the number of strong cardinals in inner models, and the complexity of the well-ordering. We also investigate what happens when we limit ourselves to set forcing extensions by reasonable forcings.

This is joint work with Ralf-Dieter Schindler.

► TETSUYA ISHIU, *The non-stationary ideal and club guessing ideals*.
University of Kansas at Lawrence, 405 Snow Hall, 1469 Jayhawk Boulevard, Lawrence, KS 66045, USA.
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The notion of a club guessing sequence, introduced by Shelah, plays a critical role in the current development of set theory. Shelah also proposed the ideal associated with a club guessing sequence. It is a good indicator of the behavior of the sequence and has a strong relationship with the non-stationary ideal. We will discuss the resemblance and the difference between the non-stationary ideal and club guessing ideals.

[The talk was not given; it was presented by title.]

► JOSEPH MILETI, *Partition theorems and computability theory*.
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We will analyze various partition theorems (such as Ramsey's Theorem) with the aim of understanding the complexity of solutions to computable instances in terms of the Turing degrees and the arithmetical hierarchy. After surveying some known results for Ramsey's Theorem, we will examine theorems allowing infinitely many colors (such as the Canonical Ramsey Theorem and the Regressive Function Theorem of Kanamori and McAloon). This study unearths some interesting relationships between these theorems and Konig's Lemma, and these connections will be emphasized.

► BJORN POONEN, *Extensions of Hilbert's Tenth Problem*.
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Hilbert's Tenth Problem was to find an algorithm to decide, given a multivariable polynomial equation with coefficients in Z, whether it has a solution with coordinates in Z. Around 1970, Matijasevic completed a proof that no such algorithm exists. On the other hand, replacing Z by Q in both places results in a question whose answer is not known. I will present a survey of recent progress on this and related questions.

► W. HUGH WOODIN, *Structural equivalences for the determinacy of real games*.
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Suppose that Γ is a σ-algebra of sets of reals which is closed under images and preimages by continuous functions on the reals. If every set in Γ is determined then certain structural properties for Γ follow. In certain situations, that is for certain specific examples of σ-algebras, equivalences are known. In the general situation of an arbitrary σ-algebra the problem is much more difficult. We discuss recent results on the outright equivalence in the situation that all real games given by sets in Γ are determined (with strategies suitably coded by sets in Γ). While this is a stronger determinacy hypothesis there is no further restriction assumed.

Abstracts of contributed talks

► WESLEY CALVERT, VALENTINA HARIZANOV, JULIA F. KNIGHT, AND SARA MILLER, *Description and comparison of computable structures*.
Department of Mathematics, 255 Hurley Hall, University of Notre Dame, Notre Dame, IN 46556, USA.
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I will address two related questions which arise in computable model theory. First, given a computable structure, what is its simplest description, up to isomorphism? Second, given some class of computable structures, how difficult is it to distinguish nonisomorphic members?

In particular, let K be a class of computable structures, and let $I(K)$ denote the set of indices for members of K. We write $I(\mathcal{A})$ for the set of indices for a structure $\mathcal{A}$. Write $E(K)$ for the set of ordered pairs from $I(K)$ which index isomorphic members of K. Now, if $\mathcal{A}$ is computable, $I(\mathcal{A})$ is Σ^1_1, and if $I(K)$ is hyperarithmetical, then $E(K)$ is Σ^1_1.

Often when $E(K)$ is complete at some level (for instance, Π^0_3), this completeness is witnessed by $I(\mathcal{A})$ for some $\mathcal{A} \in K$. It is interesting to explore when there is such a witness. It is also interesting that for some K, any member will work as such a witness. Several examples will be given to illustrate these phenomena.

► Y. FIRAT ÇELİKLER, *Results in geometry of D-semianalytic and subanalytic sets over non-Archimedean fields*.
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Several people obtained quantifier elimination theorems concerning the analytic theory of non-Archimedean complete fields, including Denef and van den Dries, Lipshitz, Schoutens, and Lipshitz and Robinson. These theorems also give an important insight into the geometric properties of definable sets over such fields. For example the quantifier elimination theorem by Lipshitz states that in the three sorted language $\mathcal{L}_{an}^{D}$ which contains symbols for members of rings of separated power series $S_{m,n}$ and restricted division operators D_0 and D_1, a definable (subanalytic) subset of $(\bar{K}^{\circ})^m$ is in fact quantifier free definable (D-semianalytic) where $\bar{K}$ is a complete algebraically closed non-Archimedean field. Using this fact Lipshitz and Robinson obtained several results in geometry of subanalytic subsets of $(\bar{K}^{\circ})^m$ including the Smooth Stratification Theorem.

I plan to present several similar and other results in the geometry of subanalytic and D-semianalytic subsets of $(K^{\circ})^m$ in the language $\mathcal{L}_{an}^{D}$ where K is an arbitrary non-Archimedean complete field which is *not necessarily algebraically closed*. These results are proved in [1] and [2] and include results on the dimension theory of such sets as well as uniformity results for fibers of D-semianalytic sets. At the center of these results is the Parameterized Normalization Lemma for D-semianalytic sets which is one of the main results of [1].

[1] Y. F. Çelikler, *Dimension theory and parameterized normalization for D-semianalytic sets over non-Archimedean fields*, Submitted.

[2] ———, *Parameterized stratification and piece number of D-semianalytic sets*, In preparation.

► DENNIS F. CUDIA, *Sensitivity and specificity of the genetic code*.
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Let $Y = U \vee C$, $R = A \vee G$, $N = Y \vee R$. *Sensitivity* $a(p,q)$ of effect p for cause q is defined by $a(p,q) = P(p \mid q)$. *Specificity* $b(p,q)$ of effect p for cause q is defined by $b(p,q) = P(\sim p \mid \sim q)$. If d is the degeneracy of a codon FMH for the amino acid p and $d \leq 4$ then $a(p,\text{NMN}) = a(p,\text{FNN}) = d/16$ and $a(p,\text{NNH}) = 1/16$; and $b(p,\text{NMN}) = b(p,\text{FNN}) = 1$ and $b(p,\text{NNH}) = (49-d)/48$. If $p =$ Serine with codons UCN $\vee$ AGY then $a(p,\text{NCN}) = a(p,\text{UNN}) = 1/4$ and $a(p,\text{NNA}) = 1/16$; and $b(p,\text{NCN}) = b(p,\text{UNN}) = 23/24$ and $b(p,\text{NNA}) = 43/48$. Also $a(p,\text{NGN}) = a(p,\text{ANN}) = a(p,\text{NNU}) = 1/8$; and $b(p,\text{NGN}) = b(p,\text{ANN}) = b(p,\text{NNU}) = 11/12$. If $p =$ Leucine with CUN $\vee$ UUR then $a(p,\text{NUN}) = 3/8$, $a(p,\text{CNN}) = 1/4$, $a(p,\text{NNU}) = 1/16$; and $b(p,\text{NUN}) = 1$, $b(p,\text{CNN}) = 23/24$, $b(p,\text{NNU}) = 43/48$. Also $a(p,\text{NUN} = 3/8$, $a(p,\text{UNN}) = a(p,\text{NNA}) = 1/8$; and $b(p,\text{NUN}) = 1$, $b(p,\text{UNN}) = b(p,\text{NNA}) = 11/12$. If $p =$ Arginine with CGN $\vee$ AGR then values of sensitivities and specificities are the same as those for Leucine with CGN and AGR, respectively, corresponding to CUN and UUR, respectively. Hence the amino acid effect is not less sensitive to the middle base than to the first base for all amino acids and for Leucine and Arginine it is 3/2 and 3 times, respectively, more sensitive to the middle base than to the first base for (CUN and CGN) and (UUR and AGR), respectively.

[1] D. Cudia, *Inductive logic of the genetic code*, ***Notices of the American Mathematical Society***, vol. 25 (2004) no. 4.

► MOSES KLEIN, *Lusin sets, free abelian groups, and homeomorphisms of the Baer-Specker group*.
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The Baer-Specker group P is the additive group of infinite integer sequences. It has long been known that all countable subgroups of this group are free abelian groups, and that some of its uncountable subgroups are free. We call a subset S of P pure-free if the pure subgroup of P which it generates is a free abelian group, and topologically pure-free if this property is preserved by all homeomorphisms of P to itself, where P has the product topology. We prove that any uncountable topologically pure-free subset is a Lusin set; consequently it is consistent with ZFC that no such set exists.

► ROBERT S. LUBARSKY, CZF $+$ *full separation is equiconsistent with Second Order Arithmetic*.
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CZF is an axiomatization of set theory powerful enough to do most standard mathematics, while at the same time remaining constructive in a strong sense: not only is the underlying logic intuitionistic, the theory is predicative, being equiconsistent with KP, ID, and other natural theories generally taken as the limit of predicativity. In order to keep CZF predicative, its separation axiom schema is limited to Δ_0 formulas. Rathjen conjectured that CZF augmented with the separation schema for all formulas would be equiconsistent with Second Order Arithmetic, making the former theory non-predicative. This conjecture is shown to be correct, via a realizability interpretation.

PETER ACZEL, *The type theoretic interpretation of constructive set theory*, ***Logic Colloquium '77*** (A. MacIntyre, L. Pacholski, and J. Paris, editors), North-Holland, Amsterdam, 1978, pp. 55-66

———, *The type theoretic interpretation of constructive set theory: choice principles*, (A. S. Troelstra and D. van Dalen, editors), ***The L. E. J. Brouwer Centenary Symposium***, North-Holland, Amsterdam, 1982, pp. 1–40.

———, *The type theoretic interpretation of constructive set theory: inductive definitions*, (R. B. Marcus et al., editors), ***Logic, methodology and philosophy of science VII***, North-Holland, Amsterdam, 1986, pp. 17–49.

PETER ACZEL and MICHAEL RATHJEN, *Notes on constructive set theory*, Technical Report 40, 2000/2001, Mittag-Leffler Institute, Sweden, 2001.

MICHAEL RATHJEN, *The strength of some Martin-Löf type theories*, ***Archive for Mathematical Logic***, (1994), p. 347–385.

ALEX SIMPSON, *Constructive set theories and their category-theoretic models*, http://www.dcs.ed.ac.uk/home/als/Research/cst.pdf

► ROBERT MIGNONE, *Closed subsets of stationary sets in P omega-one omega-two*.
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H. Friedman showed in [1] that every stationary subset of omega-one contains closed subsets of arbitrary length below omega-one. In [2] Friedman's result is shown to be insufficient to characterize stationary sets in omega-one and an internal structure of closed subsets of stationary sets is given that is necessary and sufficient for sets in omega-one to be stationary.

Earlier work by Silver, Prikry and Solovay demonstrated that the same characterization would not hold in ZFC for cardinals larger than omega-one. In particular, under the assumption of the axiom of constructability, every cardinal above omega-one has a stationary subset that has no closed subset of length omega-one (see [3]).

Here, the focus is the set of all subsets of alpha of size less than aleph-one (call this P omega-one alpha), for any alpha between omega-one and omega-two, inclusive. First, the internal structure of closed subsets of stationary sets in omega-one is recast in the context of P omega-one alpha for alpha less than omega-two and greater than or equal to omega-one. Next, a class of stationary sets in P omega-one omega-two is defined that weaves together stationary sets in P omega-one alpha for stationary many alpha below omega-two. For these stationary sets in P omega-one omega-two, there is an internal structure analogous to the structure on omega-one given in [2].

[1] Harvey Friedman, *On closed sets of ordinals*, ***Proceedings of the American Mathematical Society***, vol. 43 (1974), pp. 190–191.

[2] Robert J. Mignone, *A structural approach to stationary sets*, ***Mathematica Japonica***, vol. 39 (1994), pp. 503–508.

[3] Karel Prikry and Robert M. Solovay, *On partitions into stationary sets*, ***The Journal of Symbolic Logic***, vol. 40 (1975), pp. 75–80.

► NEIL W. TENNANT, *The Gärdenfors Impossibility Theorem does not show that genuine belief-revision functions cannot be montonic*.
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Peter Gärdenfors proved a theorem which has been widely accepted as demonstrating that it is impossible to combine the Ramsey test for conditionals with certain basic postulates for rational belief-revision. His proof is a reductio ad absurdum of those postulates in combination with (what he takes to be) a principle of monotonicity for revisions that is implied by the Ramsey test. I show here that the prevailing interpretation of Gärdenfors' result is unwarranted. One can actually establish a contrary consistency result. This requires only a slight adjustment to the postulates of AGM-theory, in order to ensure that the three operations of expansion, contraction and revision trichotomize the domain of theory-changes. Given our new postulates for the properly restricted theory-change operations, rational belief-revision functions can satisfy a principle of monotonicity for revisions.

► DOLPH ULRICH, *On the existence of a single axiom for implicational **R-mingle***.
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The implicational fragment $\mathbf{RM}_{\rightarrow}$ of the system **R-mingle** of [1] has recently been given a concise axiomatization by Ernst, Fitelson, Harris, and Wos [2]: with substitution and detachment as rules, the axioms $\mathbf{B}' = CCpqCCqrCpr$, $\mathbf{C}^* = CpCCpqq$, and $CCCpCCCqprqrr$ suffice.

Wos and Pieper [4] ask, as their open question **OQ29.RM**, if there exists a two-axiom basis for $\mathbf{RM}_{\rightarrow}$. The answer is "yes", for $\mathbf{B}'$ and $\mathbf{C}^*$ condense exactly into the single axiom $CCpqCCCrCCrssCqtCpt$. (I note that the pair $\{\mathbf{B}', \mathbf{C}^*\}$ is itself a compression of the equivalent axiom set consisting of $\mathbf{B}'$, $\mathbf{C} = CCpCqrCqCpr$, and $\mathbf{I}' = CCpqCpq$.)

Open question **OQ30.RM** of [4] is more difficult: does there exist a *single* axiom for $\mathbf{RM}_{\rightarrow}$? However, the axiom set $\mathbf{B}'$, $\mathbf{K4} = CpCCCqqCCrrCCssCCttCpuu$, and $\mathbf{RM3} = CCCCCpqrCqpCsrCsr$ will also do for $\mathbf{RM}_{\rightarrow}$. By a technique of Rezus [3], then, $CCCpCCCqqCCrrCCssCCttCpuuCCCCCvwCCwxCvxCCCCCCyzaCzyCbaCbaccCCdCCCeeCCffCCggCChhCdiijj$ is such an axiom. Indeed, with that as 1 and Dx.y the most general result of detaching an instance of formula y from an instance of formula x, D1.D1.1 = 2. $CCCCpqCCqrCprCCCCCCstuCtsCvuCvuww$, DD1.1D1.1 = **K4**, D2.1 = **RM3**, and D2.**K4** = $\mathbf{B}'$.

[1] J. M. Dunn, *Algebraic completeness results for R-mingle and its extensions*, ***The Journal of Symbolic Logic***, vol. 35 (1970), pp. 1–13.

[2] Z. Ernst, B. Fitelson, K. Harris, and L. Wos, *A concise axiomatization of* $RM_{\rightarrow}$, ***Bulletin of the Section of Logic***, vol. 30 (2001), pp. 191–194.

[3] A. Rezus, *On a theorem of Tarski*, ***Libertas Mathematica***, vol. 2 (1982), pp. 63–97.

[4] L. Wos and G. Pieper, ***Automated reasoning and the discovery of missing and elegant proofs***, Rinton Press, Paramus, 2003.

Abstracts presented by title

► JOHN CORCORAN, *Counterexamples and proexamples*.
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Every perfect number that is not even is a counterexample for the universal proposition that every perfect number is even. Conversely, every counterexample for the proposition "every perfect number is even" is a perfect number that is not even. Every perfect number that is odd is a proexample for the existential proposition that some perfect number is odd. Conversely, every proexample for the proposition "some perfect number is odd" is a perfect number that is odd. As trivial these remarks may seem, they can not be taken for granted, even in mathematical and logical texts designed to introduce their respective subjects. One well-reviewed book on counterexamples in analysis says that in order to demonstrate that a universal proposition is false it is necessary and sufficient to construct a counterexample. It is easy to see that it is not necessary to construct a counterexample to demonstrate that the proposition "every true proposition is known to be true" is false—necessity fails. Moreover the mere construction of an object that happens to be a counterexample does not by itself demonstrate that it is a counterexample—sufficiency fails. In order to demonstrate that a universal proposition is false it is neither necessary nor sufficient to construct a counterexample. Likewise, of course, in order to demonstrate that an existential proposition is true it is neither necessary nor sufficient to construct a proexample. This article defines the above relational concepts of counterexample and of proexample, it discusses their surprising history and philosophy, it gives many examples of uses of these and related concepts in the literature and it discusses some of the many errors that have been made as a result of overlooking the challenging subtlety of the proper use of these two basic and indispensable concepts.

► ADIB BEN JEBARA, *About the strength of Evil*.
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This text reminds of part of the abstract "All things are numbers" of Logic Colloquium 2001, adding details.

The relativity of evil does not apply to the hard core of Evil. A problem associated with Evil is generally stated "why does God allow the suffering of innocent people?" Can Evil become restricted?

An attribute of Evil can be deduced from an adjective attached to Evil. For instance, Evil is murderous, murder is an attribute of Evil. We can count n attributes with a similarity between them, then n others. Evil is infinite because it has an existence which is not temporary and is somehow omnipresent. As Evil is infinite, the set of adjectives attached to it can be assumed to be infinite. Types of attributes can be defined as attributes are more or less offensive. The number of attributes of Evil of a given type is the infinite sum $n + n + n + \dots$.

There are also attributes which combine attributes, such as bloodthirsty murder. If we combine one of n attributes with one of n others, we will get $n \cdot n$ attributes. If we combine more than two attributes, the number of attributes will be finally the infinite product $n \cdot n \cdot n \cdot \dots$.

But these infinite sums and products could be not well defined because the axiom of choice could be not true, but a particular case of it true. See http://www.math.lsa.umich.edu/~ablass/dpcc.pdf.

The strength of Evil can be considered a consequence of its numbers of attributes and could change if some of these numbers are no more really infinite but not well defined. Mr. Andreas Blass pointed out that the existence of a lexicographic order of the attributes would make the infinite sums and products always well defined. I assume that there is no well ordering of the set of attributes.