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2010–2011 WINTER MEETING OF THE ASSOCIATION FOR SYMBOLIC LOGIC

New Orleans Marriott and Sheraton New Orleans Hotels
New Orleans, LA

January 8–9, 2011

The 2010–2011 Winter Meeting of Association for Symbolic Logic was held on January 8–9, 2011 at the New Orleans Marriott and Sheraton New Orleans Hotels, in conjunction with the annual Joint Mathematics Meetings. The members of the Program Committee were Alfred Dolich, Bart Kastermans, and Michael Mislove (Chair). The program consisted of seven invited 50-minute talks and seven contributed talks. The ASL hosted a welcoming reception on January 8 at the Sheraton New Orleans Hotel.

In addition, there was a joint AMS–ASL Special Session, **Logic and analysis**, organized by Jeremy Avigad, Ulrich W. Kohlenbach and Henry Towsner, and an AMS/MAA/MER Special Session on Mathematics and Education Reform on **Logic in the undergraduate curriculum**, organized by W. H. Barker, W. G. McCallum and B. G. Saunders. Both special sessions took place on January 7.

The 50-minute invited addresses of the ASL meeting were:

Samson Abramsky (University of Oxford), *Relational hidden variables and non-locality*.

Andreas Blass (University of Michigan), *Special ultrafileters, generic ultrafilters and partitions*.

Larry Moss (Indiana University), *Final coalgebras: a survey*.

Alf Onshuus Niño (Universidad de los Andes), *Ordered groups definable in o-minimal theories*.

Patrick Speissegger (McMaster University), *O-minimality and Hilbert's 16th Problem*.

Juris Steprans (York University), *Maximal almost disjoint families*.

Monica VanDieren (Robert Morris University), *Independence results in the model theory of infinitary logics*.

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
MICHAEL MISLOVE

Abstracts of invited talks

► SAMSON ABRAMSKY, *Relational hidden variables and non-locality*.
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1079-8986/12/1801-0006/$1.80

We use a simple relational framework to develop the key notions and results on *hidden variables* and *non-locality*. The extensive literature on these topics in the foundations of quantum mechanics is couched in terms of probabilistic models, and properties such as locality and no-signalling are formulated probabilistically. We show that to a remarkable extent, the main structure of the theory, through the major No-Go theorems and beyond, survives intact under the replacement of probability distributions by mere relations. In particular, probabilistic notions of independence are replaced by purely logical ones.

We also study the relationships between quantum systems, probabilistic models and relational models. Probabilistic models can be reduced to relational ones by the 'possibilistic collapse', in which non-zero probabilities are conflated to (possible) truth. We show that all the independence properties we study are preserved by the possibilistic collapse, in the sense that if the property in its probabilistic form is satisfied by the probabilistic model, then the relational version of the property will be satisfied by its possibilistic collapse. More surprisingly, we also show a *lifting property*: if a relational model satisfies one of the independence properties, then there is a probabilistic model whose possibilistic collapse gives rise to the relational model, and which satisfies the probabilistic version of the property. These probabilistic models are constructed in a canonical fashion by a form of maximal entropy or indifference principle.

► ANDREAS BLASS, *Special ultrafilters, generic ultrafilters, and partitions*.
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The theories of ultrafilters (non-principal, on the natural numbers) and of forcing are linked in several ways. Various notions of forcing produce ultrafilters with interesting properties. Ultrafilters also serve as constituents of other notions of forcing. And the two can be combined: First force to produce an ultrafilter and then use it for further forcing. A recurring theme in the study of such connections is the use of partition properties of ultrafilters, properties related to Ramsey's theorem and its generalizations. I plan to give a survey of these topics, beginning with the simplest sort of generic ultrafilter (with the nicest partition properties) and ending with recent results on other forms of genericity.

► LAWRENCE S. MOSS, *Final coalgebras: A survey*.
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The area of coalgebra originated as a general study of discrete dynamical systems aimed at applications in the theory computation. It may be regarded as a generalization of parts of automata theory. But because the generalization is category-theoretic, it has connections with other areas, including ones which might interest participants in the AMS and ASL meetings: universal algebra, non-wellfounded set theory, general topology, modal logic, and even aspects of analysis and combinatorics.

My talk will be an introduction to coalgebra for a mathematics audience. I will be especially concerned with constructions of 'final coalgebras'; these are duals to initial algebras, but the construction methods are usually more intricate, and the resulting objects more interesting. I will try to present as many different examples as possible, hinting at the theory of coalgebra and making the case that it is is a subject of broad interest in logic and mathematics.

► ALF ONSHUUS, *Ordered groups definable in o-minimal theories*.
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In this talk we will show that every ordered group G definable in an o-minimal theory (for example the real field) has a normal series $N_1 \trianglelefteq \cdots \trianglelefteq N_r = G$ where r is the dimension of G and such that N_{i+1}/N_i is an ordered abelian o-minimal group. We will then state results which will bring us closer to a complete characterization of such groups.

► PATRICK SPEISSEGGER, *O-minimality and Hilbert's 16th problem*.
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Let F be the family of all polynomial vector fields of degree d in the plane. Hilbert's 16th problem conjectures that there is a finite bound on the number of limit cycles of the vector fields belonging to F. This as yet open problem (if d is at least 2) has a tantalizingly model-theoretic flavor, but no model-theoretic framework has been discovered so far to capture it. On the other hand, Roussarie's finite cyclicity conjecture reduces the problem to a localized (in the parameter space) one. In recent joint work with Kaiser and Rolin, we used o-minimality (a branch of model theory) to establish Roussarie's conjecture in a very special case. Our hope is to extend our approach to a generic case of this conjecture. I will give a survey of the result in the special case and of some of the difficulties we encounter in the generic case.

► JURIS STEPRĀNS, *Maximal almost disjoint families*.
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Variations on Shelah's construction of a maximal family of almost disjoint subsets of the integers will be discussed. Some of these will answer questions about almost disjoint families, while others will shed light on the original construction of Shelah.

► MONICA VANDIEREN, *Independence results in the model theory of infinitary logics*.
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Initial results in the development of a model theory for infinitary logic were splattered with set theoretic assumptions and sometimes turned to be independent of ZFC. Later on set theoretic assumptions continued to show up in model theoretic results for non-first-order logics because they served as a stand-in for compactness. We will provide a brief history of the interplay between set theory and model theory and highlight some recent advancements.

Abstracts of contributed talks

► JUSTIN BRODY, *Stability in generic graphs with free non-algebraic extensions*.
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The Hrushovski construction proceeds by amalgamating a class of finite structures to obtain a *generic structure*. Associated with the construction is a closure operator, whose properties determine the resulting generic. In the more studied examples of the construction, closed extensions of a finite substructure of the generic are algebraic over their base, which leads to a stable generic. Restricting our attention to classes of graphs, we will examine amalgamations in which closed extensions need not be algebraic. We will discuss conditions on the closure operator under which the generic is stable, and also conditions under which the generic is essentially undecidable.

► DAMIR D. DZHAFAROV AND CARL MUMMERT, *Reverse mathematics and equivalents of the axiom of choice*.
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We study the reverse mathematics of certain maximality principles that are equivalent to the axiom of choice in set theory. We show that these principles have a wide range of strengths in the context of second-order arithmetic, and identify new natural principles weaker than ACA_0 and incomparable with WKL_0.

► JEFFRY HIRST AND JESSICA MILLER, *More reverse mathematics of the Heine–Borel theorem*.
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One of the earliest results involving WKL_0 is Friedman's theorem showing the equivalence of WKL_0 and the Heine–Borel Theorem for $[0, 1]$. (See [1].) In response to a question of Friedman, work in [2] shows that the Heine–Borel Theorem for closed subsets of $\mathbb{Q} \cap [0, 1]$ is also equivalent to WKL_0. This talk extends these results, giving a characterization of those subsets of $[0, 1]$ for which the Heine–Borel Theorem is equivalent to WKL_0 and those for which it is not.

[1] Harvey M. Friedman, *Systems of second order arithmetic with restricted induction, I, II (abstracts)*, ***The Journal of Symbolic Logic***, vol. 41 (1976), no. 2, pp. 557–559.
[2] Jeffry L. Hirst, *A note on compactness of countable sets*, ***Reverse mathematics 2001*** (Stephen G. Simpson, editor), Association for Symbolic Logic, La Jolla, CA, 2005, pp. 219–221.

► CHRIS LASKOWSKI AND CHRISTOPHER SHAW, *Definable choice for a class of weakly o-minimal structures*.
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Given that any o-minimal densely ordered group has full definable choice (namely, definable Skolem functions and uniform elimination of imaginaries), it is a natural question to ask whether this can be achieved in the weakly o-minimal setting. We examine the case of a structure $\mathcal{M}'$ obtained by adding a new convex predicate to an o-minimal structure $\mathcal{M}$. If the new predicate is interpreted by a convex set whose endpoints lie outside of $M \cup \{\pm\infty\}$, then the resulting structure is properly weakly o-minimal and has a weakly o-minimal theory. We show that in this case, definable Skolem functions are present precisely when $\mathcal{M}'$ is valuational (as defined in [3]). Together with a simple application of compactness, this yields the result that no such structure may have full definable choice.

[1] L. van den Dries, *Dense pairs of o-minimal structures*, ***Fundamenta Mathematicae***, vol. 157 (1998), no. 1, pp. 61–78.

[2] ———, *T-convexity and tame extensions II*, ***The Journal of Symbolic Logic***, vol. 62 (1997), no. 1, pp. 14–34.

[3] D. MacPherson, D. Marker, and C. Steinhorn, *Weakly o-minimal structures and real closed fields*, ***Transactions of the American Mathematical Society***, vol. 352 (2000), no. 12, pp. 5435–5483.

[4] D. Marker, *Omitting types in o-minimal theories*, ***The Journal of Symbolic Logic***, vol. 51 (1986), no. 1, pp. 63–74.

▶ JOHN G. MERSCH, *A pretabular classical relevance logic*.
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In this paper we construct an extension, $\mathcal{L}$, of Anderson and Belnap's relevance logic **R** that is classical in the sense that the logic contains $p \ \& \ \neg p \rightarrow q$ as a theorem, and we prove that $\mathcal{L}$ is pretabular in the sense that while it does not have a finite characteristic matrix, every proper normal extension of it does. The construction makes use of De Morgan monoids defined on Boolean algebras whose fusion operator is maximal among all the possible fusion operators on Boolean algebras. We end the paper by commenting on the possibility of finding other classical relevance logics that are also pretabular.

▶ SHICHANG SONG, *Type spaces and Wasserstein spaces*.
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Ben Yaacov [1] showed that types (over parameters) in the theory ARV of atomless random variable spaces correspond precisely to (conditional) distributions in probability. Moreover, in [2] he showed that the logic topology on types corresponds to the topology of weak convergence of distributions. During this talk, I will define a metric d^* between types, which is equivalent to the usual d-metric between types in continuous model theory; see [3]. Then, I will show that the type space under the d^*-metric is isometric to the Wasserstein space under Wasserstein distance. After this, I will show how the Kantorovich–Rubinstein duality formula from optimal transport theory yields a formula for the d^*-metric. Finally, using results from model theory, I will generalize some results in optimal transport theory.

[1] I. Ben Yaacov, *On theories of random variables*, submitted.

[2] I. Ben Yaacov, A. Berenstein, C. W. Henson, *Almost indiscernible sequences and convergence of canonical bases*, submitted, arXiv:0907.4508.

[3] I. Ben Yaacov, A. Berenstein, C. W. Henson, and A. Usvyatsov, *Model theory for metric structures*, ***Model theory with applications to algebra and analysis***, vol. 2 (Zoé Chatzidakis, Dugald Macpherson, Anand Pillay, and Alex Wilkie, editors), London Math Society Lecture Note Series, no. 350, Cambridge University Press, 2008, pp. 315–427.

▶ IOANNIS SOULDATOS, *Characterizing infinite cardinals by countable linear orderings*.
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A countable linear ordering L is said to characterize an infinite cardinal κ, if the Scott sentence of L has a model of cardinality κ, but no models of cardinality κ^+. Some recent results in this context will be discussed.

[1] G. Hjorth, *Knight's model, its automorphism group, and characterizing the uncountable cardinals*, ***Journal of Mathematical Logic***, vol. 2 (2002), no. 1, pp. 113–144

[2] C. Landraitis, *$L_{\omega_1\omega}$ equivalence between countable and uncountable linear orderings*, ***Fundamenta Mathematicae***, vol. 107 (1980), no. 2, pp. 99–112.

[3] I. Souldatos, *Notes on cardinals that are characterizable by a complete (Scott) sentence*, submitted, eprint can be found in http://arxiv.org/abs/1007.2426

Abstracts of papers submitted by title

▶ JOHN CORCORAN, *Paracounterexamples: virtual counterexamples*.
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We continue discussions reported in this BULLETIN vol. 11 (2005) p. 460 and pp. 554–555. Two propositions are [*logically*] *equivalent* if each logically implies the other. We use a standard, two-quantifier, first-order language interpreted in the set N of numbers [non-negative integers]. As usual, a number n is defined to be a *counterexample* for a given proposition P iff P is of the form $\forall x\, \mathrm{P}(x)$ and n does not satisfy the condition $\mathrm{P}(x)$. Thus, a counterexample for a given proposition $\forall x\, \mathrm{P}(x)$ cannot be a counterexample for equivalent propositions that are not universal quantifications nor, in particular, for the equivalent negated existential $\sim\exists x \sim \mathrm{P}(x)$. To relax strictness, consider the broader notion *paracounterexample* [or *virtual counterexample*]: a number n is a *paracounterexample* for P if n is a counterexample for a proposition equivalent to P. Thus, zero—although not a counterexample—is a paracounterexample for "There is no number that is not positive".

Unfortunately, the apparently well-motivated relaxation proves to be too broad, and virtually useless. Every positive number is a paracounterexample for "Every number is positive". The reason is that the latter is equivalent to "Every number that equals itself is such that every number is positive", or "Every number x is such that, if x equals itself, then every number is positive". No number satisfies the condition "if x equals itself, then every number is positive". Generalizing this reasoning yields a proof of the *Paracounterexample Lemma*: every number is a paracounterexample for every false number-theoretic proposition. We leave open the question of whether there is a rigorously definable and useful concept broader than "counterexample" and narrower than "paracounterexample". Acknowledgements: Berit Brogaard, Mark Brown, James Cargile, Mary Mulhern, Robert Rovetto, and José Miguel Sagüillo.

▶ JOHN CORCORAN AND JUSTIN DONHAUSER, *Implications of implication*.
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This self-contained lecture identifies dozens of distinct uses of the word *implication* in logic. It complements without overlap the article: J. Corcoran, *Meanings of implication*, ***Dialogos***, vol. 9 (1973), pp. 59–76, Spanish translation by Jose M. Sagüillo, *Significados de la Implicacion*, ***Agora***, vol. 5 (1985), pp. 279–294, reprinted in R. Hughes, editor, ***Philosophical companion to first-order logic***, Hackett, Indianapolis, 1993.

For example, "Every false proposition implies itself"—no antecedent, no consequent—*is an implication of* "Every proposition implies itself". It would be a mistake to seek a meaning of *implication* in the unitary relational expression *is an implication of*—which is coextensive with *is implied by*. It would be like the mistake of seeking a meaning of *icati* in *implication*. Both would be segmentation fallacies. The two-word sequence *is an* is sometimes masked by an ellipsis—giving a deceptive common-noun appearance to relational occurrences of *implication*: in *every implication is a proposition*, the word *implication* is elliptical for the eight words *proposition that is an implication of some proposition*.

Tarski calls "If Abe arrives, Ben begins" an *implication*—using *implication* as a common noun, rather than in a relational expression. Used in this syntactic manner, every implication has antecedent and consequent. The syntactic sense is not expressed in *is an implication of*. Prepositions, such as *of*, are not required after *implication* as a common noun.

The word *implication* is also used as a proper name of any of several relations as: implication relates a set of propositions to an individual proposition. Each such proper-name use also gives rise to a common-noun use for the "instances" of the relation named by the proper name: there are implications between conjunctions and their conjuncts.

► JOHN CORCORAN AND COREY MCGRATH, *Predicates and predications*.
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A person who states that four is square *predicates*, or affirms, the property being square *of* the number four. Here the action verb 'to predicate' is used to express a *three-place* action: a *person* predicates a *property* of an *entity*. In the sentence 'four is square', the word 'four' is *the* [grammatical] subject and 'is square' is *the* predicate. Here the word 'predicate' is part of an expression for a *two-place* grammatical relation: a *phrase* is the [grammatical] predicate of a *sentence*. In a third sense, any phrase that occurs as *the* predicate of a sentence is *a predicate*, using the word as a non-relational common noun.

A person who states that four is a number that is a square that is even *predicates* the property being a number that is a square that is even *of* the number four. The 10-word phrase

is a number that is a square that is even

is *the* grammatical predicate of the 11-word sentence 'four is a number that is a square that is even' although that sentence contains occurrences of *five* other predicates: 'is a number that is a square', 'is a number', 'is a square that is even', 'is a square' and 'is even'. A person who uses the 11-word sentence to state that four is a number that is a square that is even makes *one* predication, but uses *six* predicates. This lecture is an introduction to a neglected topic: the uses of the words 'predicate' and 'predication' in logic. Authors discussed include Aristotle, Boole, DeMorgan, Peirce, Frege, Russell, Tarski, and Church. It builds on lectures abstracted in this BULLETIN vol. 11 (2005), p. 117 and vol. 12 (2006), pp. 353–354.

► JOHN CORCORAN AND SRIRAM NAMBIAR, *Truth-values and formal truth-value distributions of arguments*.
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This lecture introduces pedagogically useful terminology. Examples are expressed in a first-order language interpreted in the integers. For convenience we use ordinary variable-enhanced English: the English sentence 'every integer x is such that x is finite' translates the first-order sentence '$\forall x\ \mathrm{F}(x)$'; 'every integer' translates the quantifier '$\forall$' applied to integers, or 'integer x' translates the integral variable 'x' following '$\forall$'. All normal arithmetic concepts are treated as primitive.

The *truth-value of a premise-conclusion argument* is TT, TF, FT, or FF according as the premises and conclusion are all true, the premises are all true and conclusion false, the premises are not all true and conclusion true, or the premises are not all true and conclusion false.

The truth-values of the following four invalid arguments are respectively TT, TF, FT, and FF.

$$\begin{array}{r} (1-1)=0 \\ (2+2)=4 \\ \hline (3\cdot 3)=9 \end{array} \qquad \begin{array}{r} (1-1)=0 \\ (2+2)=4 \\ \hline (3\cdot 3)=8 \end{array} \qquad \begin{array}{r} (1-1)=0 \\ (2+2)=6 \\ \hline (3\cdot 3)=9 \end{array} \qquad \begin{array}{r} (1-1)=0 \\ (2+2)=6 \\ \hline (3\cdot 3)=8 \end{array}$$

In discussion, the first argument can be said to be *true-true*, the second *true-false*, etc. The truth-values of the following three valid arguments are respectively TT, FT, and FF.

$$\frac{\begin{array}{c}(2+2)=4\\(2\cdot 2)=4\end{array}}{(2+2)=4}\qquad\qquad \frac{\begin{array}{c}(1+1)=2\\(1\cdot 1)=2\end{array}}{(1+1)=2}\qquad \frac{\begin{array}{c}(1+1)=3\\(1\cdot 1)=3\end{array}}{(1+1)=3}$$

Given any premise-conclusion argument, its *formal truth-value distribution* [*FTVD*] is the set of truth-values of the set of arguments in the same form as the given argument. Every two arguments in the same form have the same FTVD. For example, each of the four invalid arguments above has {TT, TF, FT, FF} as FTVD and each of the three valid arguments above has{TT, FT, FF}. Since every argument has a truth-value, no argument has the null set as FTVD. One-premise arguments whose premise and conclusion are tautologies have {TT}; those whose premise is a tautology and conclusion a self-contradiction have {TF}; those whose premise is a self-contradiction and conclusion a tautology have {FT}; and those whose premise and conclusion are self-contradictions have {FF}. Similar considerations lead to the conclusion that for each of the 15 non-empty subsets of {TT, TF, FT, FF} there is an integral argument having that set as its FTVD.

► PAOLO LIPPARINI, *An ordering on ultrafilters*.
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If T is a class of topological spaces, let us define the *Comfort* (*pre-*)*order relative to* T as follows. For ultrafilters D and E, we write $E \leq_{T,C} D$ if and only if every D-compact topological space belonging to T is also E-compact. If T is the class of all topological spaces, we shall omit it.

Makowsky and Shelah defined the notion of an ultrafilter *related* to a logic. Throughout, we shall refer to the improved definition by Caicedo [1]. We shall say that a logic $\mathcal{L}$ is D*-compact*, in place of saying that D is related to $\mathcal{L}$.

DEFINITION 1. We define as follows the Caicedo–Makowsky–Shelah (pre-)order. $E \leq_{CMS} D$ means that every D-compact logic is E-compact.

As an immediate corollary of results from [1], for every pair of ultrafilters D and E, if $E \leq_C D$, then $E \leq_{CMS} D$.

THEOREM 2. *Suppose that λ is an infinite cardinal, D is not (λ, λ)-regular, and E is (λ, λ)-regular. Then $E \not\leq_C D$. More generally*:

1. *$E \not\leq_{T,C} D$, where T is the class of Hausdorff normal topological spaces.*
2. *$E \not\leq_{T,C} D$, where T is the class of Tychonoff topological Boolean Algebras.*
3. *$E \not\leq_{CMS} D$ (even if we restrict the order to logics generated by at most* 2 *cardinality quantifiers)*

Theorem 2 strongly suggests the hypothesis that the study of compactness properties both of logics and of (products of) topological spaces actually deals with properties of the Comfort and related orders, and that problems about (transfer of) compactness are best stated as problems about these orders.

See [2] for more details and even more general notions.

[1] X. CAICEDO, *The abstract compactness theorem revisited*, ***Logic and Foundations of Mathematics***, (A. Cantini et al., editors), Kluwer Academic Publishers, 1999, pp. 131–141.

[2] P. LIPPARINI, *Some more problems about orderings of ultrafilters*, `arXiv:1005.2590` (2010).