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2011 WINTER MEETING OF THE ASSOCIATION FOR SYMBOLIC LOGIC

Washington Marriott Wardman Park Hotel
Washington, DC

December 27–29, 2011

A meeting of the Association for Symbolic Logic was held December 27–29, 2011, at the Washington Marriott Wardman Park Hotel, Washington DC, in conjunction with the annual meeting of the Eastern Division of the American Philosophical Association. The Program Committee consisted of Michael Glanzberg and Philip Kremer (Chair). The ASL hosted a reception on the evening of Tuesday, December 27.

The program consisted of two invited speaker sessions:

Invited Speaker Session on Dynamical Semantics

Nate Charlow (University of Toronto), *Dynamic Analysis for Practical Language*.
William Starr (Cornell University), *Expressing 'May' and 'Must'*.

Invited Speaker Session on Lambda calculi, type systems, and applications to natural language

Chung-chieh Shan (Cornell University), *Functional modularity in the lambda calculus*.
Chris Barker (New York University), *Using monads to compute multidimensional meanings*.
Oleg Kiselyov (Independent Scholar, Monterey CA), *Syntax-semantics interface and the non-trivial computation of meaning*.

The program also included one session of contributed papers in which one talk was presented.

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 ASL
Matt Valeriote

Abstracts of talks in the invited session on Dynamical Semantics

► NATE CHARLOW, *Dynamic analysis for practical language*.
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We defend dynamic analyses of imperatives (DAIs) against two kinds of objection. DAIs are those which (i) treat imperatives as having conventionalized performative- cum-directive use/force, (ii) privilege that conventional use in an analysis of their meaning. One kind of objection to DAIs targets (i), by arguing imperatives have no conventional use (or else that use is too motley to underwrite an adequate account of their meaning). Another kind targets (ii), by identifying apparent semantic facts about imperatives that seem to lack a

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satisfactory dynamic explanation. I argue that (i$*$) while the data adduced to undermine the existence of a conventional use for imperatives do undermine many extant accounts, they do not undermine DAIs as such, (ii$*$) a dynamic account can give a satisfactory account of the semantics of a wide range of imperative constructions—one, at least, as satisfactory as its major static competitor (the modal analysis).

► WILLIAM STARR, *Expressing 'May' and 'Must'*.
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Language is used to talk about the world and this makes it enticing to say that the meaning of symbol is the thing in the world it is about. Frege generalized the relation between a name and its referent to capture the meaning of symbols that don't seem to fit this model, e.g., *and*. *Dynamic semantics* [1] proposes an alternative to *referential semantics*: a symbol's meaning is the characteristic change its use brings about. This talk explores the relationship between these approaches by comparing an analysis of deontic *may* and *must* in modal logic to a new dynamic analysis inspired by my previous work on imperatives [3]. Reconstructing the classical concepts of truth and logical consequence in this setting will illustrate three previously unheralded resources of dynamic semantics: it allows (1) a definition of many evaluative concepts, truth among them, (2) logical consequence relations sensitive to various evaluative concepts and (3) connectives that combine sentences for which different evaluative concepts are appropriate (e.g., declaratives and imperatives). These resources allow for a better treatment of *may* and *must*: they can account for their *performative* and *free choice* behavior [2]. The dynamic approach can be aligned with the idea that language is about the world by loosening the relationship between meaning and reference, just as Frege hypothesized. But this time the loosening admits of a rigorous formal semantics.

[1] JEROEN GROENENDIJK, MARTIN STOKHOF, FRANK VELTMAN, AND SHALOM LAPPIN, *Coreference and modality*, ***The handbook of contemporary semantic theory***, Blackwell Publishers, Oxford, 1996, pp. 179–213.

[2] HANS KAMP, *Free choice permission*, ***Proceedings of the Aristotelian Society***, vol. 74 (1973), pp. 57–74.

[3] WILLIAM STARR, *A preference semantics for imperatives*, MS, Cornell University, 2011, http://williamstarr.net/research.

Abstracts of talks in the invited session on Lambda Calculi, Type Systems, and Applications to Natural Language

► CHRIS BARKER, *Using monads to compute multidimensional meanings*.
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Natural language utterances convey information across a number of dimensions simultaneously. These dimensions include presuppositions, focus/background articulation, and expressive attitudes (e.g., the contribution of *damn* in *The damn dog got out again*). Each of these dimensions motivates a separate computation, parallel to but distinct from the main compositional construction of at-issue truth conditions.

The compositional challenge is that elements within different dimensions can sometimes interact in constrained ways. For instance, certain expressions can take content from the focus/background dimension and inject it into the at-issue dimension: *only* in *John only DRINKS Perrier* means roughly 'The unique thing that John does to Perrier is drink it'. Thus *only* builds an at-issue assertion out of the background property associated with the focussed phrase *DRINKS*. This phenomenon is known as 'association with focus'.

In contrast, there is no parallel phenomenon of association with expressives: there is no operator analogous to *only* that transfers content from the expressive dimension to the at-issue dimension. Thus English does not have a genuine word *onlyex* such that *The damn dog onlyex got out* asserts 'The unique opinion I have about the dog getting out is that I disapprove'. So we must allow a kind of interaction across the focus/at-issue dimensions that we do not allow across the expressive/at-issue dimensions.

The theory of programming languages provides tools for managing multiple layers of meaning and their interaction. Adding a monad to a direct (simple) computation adds a new layer, a new computational dimension. In particular, the continuation monad is especially useful, and provides powerful yet elegant techniques for tracking multiple semantic dimensions such as quantifier scope, focus/background articulation, expressives, and more within a single, unified computation.

In this talk, I will characterize monads and illustrate their application to natural language with a simple compositional fragment.

► OLEG KISELYOV, *Syntax-semantics interface and the non-trivial computation of meaning*.
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We describe the relationship between the surface form of a sentence and its meaning as two non-trivial but mechanical interpretations of the same (hidden) abstract form. Our approach, in the tradition of abstract categorial grammar (ACG), deals with several languages: The language $\mathcal{A}$ is the language of abstract form; the language $\mathcal{I}$ is the language in which we write a compositional interpreter of $\mathcal{A}$, which produces a term in a language $\mathcal{T}$. The language $\mathcal{A}$ is simply-typed lambda-calculus with constants.

A syntactic interpretation $\mathcal{I}_{syn}$ gives a surface form for a sentence corresponding to $\mathcal{A}$; $\mathcal{T}_{syn}$ is a set of strings or utterances. This interpretation is responsible for word order, case marking, subject-verb agreement, etc. Therefore, $\mathcal{A}$ is abstracted from these syntactic details. $\mathcal{A}$ can be determined from $\mathcal{T}_{syn}$ by parsing. If the abstract language is simple—that is, its constants have types of low order—parsing is tractable. This is the case for our ACGs.

A semantic interpretation $\mathcal{I}_{sem}$ computes the meaning of $\mathcal{A}$ as a logical formula; $\mathcal{T}_{sem}$ is thus the language of higher-order logic. $\mathcal{I}_{sem}$ deals with quantifiers, pronouns, question words and their interactions. Our $\mathcal{I}_{sem}$ interpreter is non-trivial: it may fail. Although we may parse a sentence to an abstract form, we may fail to compute any meaning for it, if the sentence just 'doesn't make sense'. Our $\mathcal{I}_{sem}$ is not a regular lambda-calculus: it expresses computational effects such as mutation and continuations, and it is not normalizable.

The computational effects let us express in a modular fashion the interaction of a phrase with its context, and analyze different scopes of quantifiers and scoping islands.

► CHUNG-CHIEH SHAN, *Functional modularity in the lambda calculus*.
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A module is a part of a *description* of a system, not necessarily a physical part. For example, a program that is stored only in compiled form by the computer running it may nevertheless be better described by source code, so the program may have source modules that are hard to recover at run time. This functional notion of modularity is relevant for organisms, species, and scientists because they all need to adapt to changes in the environment without re-learning, re-evolving, or re-discovering each new system from scratch.

Lambda calculi and type systems offer expressive ways to describe natural language and thus carve out its modules. In particular, lambda calculi can express modules that operate on other modules, and type systems can circumscribe information flow among modules whose operation is tightly intertwined. I will illustrate the use of this expressivity with two examples: First, Abstract Categorial Grammars can carve out PF and LF as a collection of modules mediated by syntax. Second, monad transformers can carve out side effects such as continuations and state as a collection of modules mediated by lexical items.

Abstract of contributed paper

► BILLY JOE LUCAS, *Two theories concerning having the right to prove what you know*.
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Take L with O (P) the strong (weak) deontic operator, and uK (uE) the strong knowledge (evidence) operators, indexed to an agent u. As instance of the idea that one has a right to prove true whatever *is* true, consider sub-cases. Theory One: You have a (weak) right (no prohibition) to have sufficient evidence for the truth of any proposition you know. Theory Two: you have a right (uEp if uKp).

THEORY 1. $uK\alpha \vdash_1 PuE\alpha$.

THEORY 2. $\vdash_2 P(uK\alpha \supset uE\alpha)$, i.e., $\sim O(uK\alpha \cdot \sim uE\alpha)$.

A neutral universal frame (NUF) for L: $\langle W, W^O, R^O, W^{uK}, R^{uK}, W^{uE}, R^{uE}\rangle$, each W^* some non-empty subset of W, R^* a binary relation on W^* (for $*$ any of O, uK, uE). As default, we have no R defined on W and $\cup W^* \subsetneq W$. Our theories require additional constraints.

THEORY 3. $\vdash_3 uK\alpha \supset uE\alpha$.

THEOREM 1. *Theory* 1 *is characterized by any set of canonical* (NU) *frames such that* $\forall x \exists y\, [xR^O y \cdot \forall z\, (yR^{uE} z \supset xR^{uK} z)]$; *Theory* 2 *is characterized by* NU *frames such that* $\forall x \exists y\, [xR^0 y \cdot \forall z\, (yR^{uE} z \supset yR^{uK} z)]$ *and Theory* 3 *by* NU *frames*: $\forall x \forall y\, (xR^{uE} y \supset xR^{uK} y)$.

THEOREM 2. $\vdash_{1+3}$ *Theory* 2, *the only provable implication from any one or two of the three theories to a third*; *Theories* 1 *and* 2 *each prove* $O\alpha \supset P\alpha$; *Theory* 3 (*only*) *proves*: $O(uK\alpha \supset uE\alpha)$.

Abstracts of papers presented by title

► JOHN CORCORAN, *Tarski's three-implication theorem*.
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Alfred Tarski's teaching emphasized the ambiguity of 'implies' in mathematical logic. One of the easiest of his favorite illustrations he called *The Three-Implication Theorem* (T3IT). T3IT is one sentence using 'implies' in three senses (per. comm.). His formulations varied; one is informally paraphrased:

Given a finite premise set and a conclusion,
the condition that the premise set *implies* the conclusion *implies*
the condition that the conjunction of the premises *implies* the conclusion.

T3IT is in a meta-meta-language of object-languages containing the premises and conclusion. The first 'implies' expresses the logical-implication relation for those sentences and thus is *meta-linguistic*. The second 'implies' is *meta-meta-linguistic*. The third indicates the *object-language*'s only-if connective, or "material implication". These were Tarski's points (per. comm.). But the sentence admits of other readings.

To clarify Tarski's interpretation, we can roughly paraphrase T3IT without using 'implies', where *the corresponding conditional of a given finite argument* is one of the conditionals whose antecedent conjoins the premises and whose consequent is the conclusion.

For a given argument to be valid
it is necessary
for its corresponding conditional to be true.

The validity of a given argument
is sufficient
for the truth of its corresponding conditional.

Although Tarski made these and related points before 1973, I learned them from him (per. comm.) after finishing [1], which mentions fifteen senses of 'implies' including the first and third above. However, [1] does not consider Tarski's meta-meta sense nor does it put various senses into one sentence. This lecture builds on [1] using Tarski's ideas.

[1] JOHN CORCORAN, *Meanings of implication*, ***Diálogos***, vol. 9 (1973), pp. 59–76, Spanish translation by José M. Sagüillo, ***Agora***, vol. 5 (1985), pp. 279–294, reprinted in R. Hughes, editor, ***Philosophical companion to first-order logic***, Hackett, Indianapolis, 1993.

► JOHN CORCORAN AND WILLIAM FRANK, *What is string theory*?
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String theory—or *concatenation theory*—studies abstract *strings*—or *concatenations*—of *characters* exclusively and intrinsically. The qualification 'exclusively' separates string theory from many-sorted disciplines such as semantic arithmetic [1], which studies numerals (strings of digits) and the numbers they denote. The qualification 'intrinsically' separates it from empirical and technological subjects—e.g., cognitive psychology, computability theory, and information science—that study *manipulation* of concrete string *tokens* by persons or machines. Empirical disciplines don't study strings *intrinsically*—apart from tokens; they study strings *extrinsically*—through tokens.

We distinguish *concatenation*—the abstract two-place *operation* coupling abstract strings [string *types*]—from *juxtaposition*—the humanly performed *manipulation* literally conjoining concrete inscriptions [string *tokens*]. Abstract, non-empirical string theory is distinguished not only from semantics and pragmatics but also from empirical *juxtaposition theory or syntactics*, which studies tokens manipulated by humans. Pragmatics encompasses semantics and syntactics.

Building on [2], we describe string theory's subject matter, its basic concepts, and its basic laws. We also discuss its axiomatizations.

The expression *string theory* occurs above as a necessarily singular proper *name* of a study—a distinctively human institution having a historical development; *science* and *discipline* are synonyms for *study* in this sense. Historians have yet to decide when string theory emerged as a recognizable science with laws and open problems.

But *string theory* also occurs as a pluralizable *common noun* denoting axiomatized and non-axiomatized interpreted deductive theories each having a formal language and an intended interpretation. Two infinite families of axiomatized string theories are studied in [2].

[1] JOHN CORCORAN, *Semantic arithmetic: a preface*, ***Agora***, vol. 14 (1995), pp. 149–156.

[2] JOHN CORCORAN, WILLIAM FRANK, AND MICHAEL MALONEY, *String theory*, ***The Journal of Symbolic Logic***, vol. 39 (1974) pp. 625–637.

► JOHN CORCORAN AND CALVIN JONGSMA, *Term-distribution definitions*.
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We survey term-distribution definitions in traditional logic building on [1] and using notation from this BULLETIN, vol. 15 (2009), p. 133 and vol. 17 (2011), pp. 152–153.

Consider four categorical propositions.

(Every 1* Some 23 * No 4) subject is (124 *not 3) a predicate.

The subject is distributed only in the two universal propositions, 1 and 4; the predicate is distributed only in the two negative propositions, 3 and 4.

DEFINITION (from [1]). The indicated occurrence of term X in proposition FX is distributed iff the two premises FX and "every Y is an X" together imply FY—FY being the result of replacing the indicated occurrence of X in FX by term Y.

For example, the above two universal propositions together with "Every term is a subject" imply respectively:

(Every 5* No 6) term is a predicate.

And the two negatives together with "Every term is a predicate" imply respectively:

(Some 7 * No 8) subject is (8 *not 7) a term.

Intuitively—very roughly—the indicated occurrence of X in FX is distributed iff FX attributes to every species of X what it attributes to X. For example, the above two universal propositions imply respectively:

(Every 5* No 6) distributed subject is a predicate.

And the two negatives imply respectively:

(Some 7 * No 8) subject is (8 *not 7) a distributed predicate.

The "intuition" suggests a definition applicable in certain contexts.

DEFINITION. The indicated occurrence of X in FX is distributed iff FX implies FYX—Y a suitable adjective, FYX the result of replacing the indicated occurrence of X in FX by YX.

[1] JOHN CORCORAN, *Three rules of distribution: One counterexample*, ***The Journal of Symbolic Logic***, vol. 52 (1987), pp. 886–887.

► JOHN CORCORAN AND COREY MCGRATH, *Predications in ancient logic*.
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Our previous study "Predicates and predications"—abstracted in this BULLETIN, vol. 18 (2012), p. 148—identified several grammatical categories employing the word 'predicate': common nouns, two-place relation verbs taking linguistic subjects, three-place action verbs taking human subjects, and others.

'True' is a *predicate*.
'True' is *a predicate of* certain sentences.
Tarski *predicates* 'true' *of* sentences.

This more-limited study focuses on ancient logic taking examples from [1] as representative.

Predication entered logic at the very beginning: the Greek title of Aristotle's ***Categories*** is often translated *predicates*. The noun 'predicate' is used in ***Categories*** in a primary sense (as above) but also in a secondary sense as in the following.

The intransitive verb is not the only *predicate* Aristotle treats.
The complemented transitive verb is not the only *predicate* Aristotle treats.

In a primary sense, a noun denotes the individuals in its extension; in a secondary sense a noun denotes kinds, sorts, or types. In a primary sense of *animal*, Socrates is an animal. In a secondary sense, the tiger is an animal.

Aristotle also uses the noun 'predicate' in a third sense in which every predicate carries the syntax of a common noun as opposed to a verb phrase ([1], pp. 109f, 118f, 122, 158f) as in the following.

Every predicate is a term.
Every subject is a predicate.

This lecture treats a neglected topic: the uses of the words 'predicate' and 'predication' and their synonyms, translations, and cognates in ancient logic. Authors discussed include Aristotle, Chrysippus, Galen, Porphyry, and Sextus Empiricus. It builds on lectures abstracted in this BULLETIN, vol. 11 (2005) p. 117 and vol. 12 (2006) pp. 353–354.

[1] JONATHAN BARNES, ***Truth, etc.: Six lectures on ancient logic***, Oxford University Press, Oxford, 2007.

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In 2004 Jonathan Barnes gave Oxford University's prestigious John Locke Lectures on a surprising topic: ancient logic. Each chapter of [1] is a revised and enlarged version of one of those six lectures. [1]'s publication was an important event in a broader field: history and philosophy of logic. Each chapter gives new perspective on some currently relevant aspect of ancient logic.

The 551-page book is meticulously produced with tasteful font choices, helpful section divisions, sparing use of logical notation, and surprisingly few printing errors—given extensive use of Greek and Latin quotations. Although the book is thoroughly grounded in modern symbolic logic, analytic philosophy, classical philology, and the scholarship on ancient logic—even readers new to these areas can follow the discussion with understanding, profit, and pleasure.

In this presentation, we describe [1]'s highpoints for modern logicians and philosophers of logic. Chapter 1, on ancient theories of truth, at once supports and questions Tarski's theory. Chapter 2 treats ancient analyses of the simple proposition. It contrasts the two-part "subject-predicate" view with the three-part "subject-copula-predicate" view—both ultimately eclipsed by Peirce's multi-place-predicate view and Frege's multi-place-function view. Chapter 3 discusses connectives: truth-functional, causal, inferential, etc. Chapter 4 concerns logical form. Chapter 5 opens with a lucid description of Aristotle's truth-and-consequence theory of demonstration with the syllogistic as underlying logic providing the deductions; its central concern, however, is the tortured question of whether logic is a science or an instrument. Chapter 6, the last, considers several topics related to ancient debates about the nature and proper roles of syllogisms.

[1] JONATHAN BARNES, ***Truth, etc.: Six Lectures on ancient logic***, Oxford University Press, Oxford, 2007.

► PAOLO LIPPARINI, *Weak initial compactness for every λ is equivalent to D-pseudocompactness for every D*.
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Let λ, μ be infinite cardinals, and X be a topological space. X is *weakly initially λ-compact* (resp., *weakly initially $< \lambda$-compact*) iff every open cover of X of cardinality at most λ (resp., $< \lambda$) has a finite subset with dense union. If D is an ultrafilter over some set I, X is *D-pseudocompact* iff every I-indexed sequence of nonempty open sets of X has some D-limit point, where x is a *D-limit point* of the sequence $(O_i)_{i \in I}$ if and only if, for every neighborhood U of x in X, $\{i \in I \mid U \cap O_i \neq \emptyset\} \in D$.

THEOREM 1. *If X is weakly initially λ-compact, and $2^\mu \leq \lambda$, then X is D-pseudocompact, for every ultrafilter D over any set of cardinality $\leq \mu$.*

COROLLARY 2. (a) *If $2^\mu \leq \lambda$, then the product of any family of weakly initially λ-compact topological spaces is weakly initially μ-compact.*

(b) *If λ is a strong limit cardinal, then any product of weakly initially $< \lambda$-compact topological spaces is weakly initially $< \lambda$-compact.*

(c) *Every open cover of X has a finite subset with dense union iff X is D-pseudocompact for every ultrafilter D.*

(d) *A Hausdorff topological space is H-closed iff it is D-pseudocompact for every ultrafilter D.*