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2004 ANNUAL CONFERENCE OF THE AUSTRALASIAN ASSOCIATION FOR LOGIC

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The 2004 annual conference of the Australasian Association of Logic was hosted by the Computer Science Department of the University of Otago, Dunedin, New Zealand. Quoting Martin Bunder: "If the AAL had been held annually (but it has not), this would have been the 40th AAL." Martin Bunder was also present at the first AAL, in 1965. Eleven papers were presented at AAL 2004. The conference was organized by Hans van Ditmarsch of the University of Otago. Abstracts of contributed talks given at the conference and of a talk presented by title, follow.

Abstracts of contributed talks

ROSS BRADY, *Normalized Natural Deduction for Some Fragments of Relevant Logics.*
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I have previously established normalized natural deduction systems for the full sentential relevant logics **DW** and **DJ**. I have also previously noted that the style of natural deduction system involved does not extend to the stronger logic **TW**, nor to its positive fragment **TW**+. However, it does apply to some other fragments of **TW**. In this paper, I establish normalized natural deduction systems for the $\{\to\}$- and $\{\to, \&\}$-fragments of the relevant logics: **TW**, **RW**, **T** and **R**. I also make use of these to establish decidability for the $\{\to\}$-fragments of **TW** and **RW**.

MARTIN BUNDER, *Rough Consequence Logic.*
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The rough consequence logic of Chakraborty and Banerjee, based on the modal logic **S5**, developed to handle rough equality, can also be thought of as a "possibility logic" as it has the property: $\vdash A \Leftrightarrow \vdash_{\mathbf{S5}} MA$. This paper proves a number of interesting results in the logic as well as for other rough consequence (or possibility) logics based on weaker modal logics. It also shows some limitations of rough consequence logics as a means of handling rough equality.

HANS VAN DITMARSCH AND BARTELD KOOI, *Unsuccessful updates.*
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Suppose we discuss New Zealand trees, and we tell you: "You don't know that Hans has a kowhai tree in his garden." Before we said so, you did not know that Hans owned such a tree, but after the announcement, that is no longer true: now you *do* know. In [1] and [2] this is called an *unsuccessful update*: a formula that becomes false after its announcement. Formally, it is a φ such that $[\varphi]\neg\varphi$ is is invalid. Here $[\varphi]$ is a dynamic modal operator for the announcement of φ. If atom p describes that Hans has a khowhai tree in his garden, and if Hans is agent 1 and you are agent 2, then K_2p stands for 'You know that p,' and the unsuccessful update is $p \wedge \neg K_2p$, because $[p \wedge \neg K_2p]\neg(p \wedge \neg K_2p)$ is true. Analysis of information systems (card games, cryptology, 'muddy children') and 'philosophical puzzles' (Hangman Paradox) reveals a growing number of dynamic phenomena that can be described or explained by unsuccessful updates. We also investigate the syntactic characterization (sublanguage) of the successful updates, e.g., every formula of form $C\varphi$ is successful (where C stands for –entire group– common knowledge), or in other words: $[C\varphi]C\varphi$ is valid.

[1] J.D. Gerbrandy, *Bisimulations on Planet Kripke*, ILLC Dissertation Series DS-1999-01, University of Amsterdam, 1999.
[2] H.P. van Ditmarsch, *Knowledge games*, ILLC Dissertation Series DS-2000-06, University of Groningen, 2000.

DAVID FRIGGENS, *A modal proof theory for polynomial coalgebras.*
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Coalgebras are of increasing interest in computer science for their use in modelling certain types of data structures and state-transition systems, in particular the ever popular object-oriented programming paradigm.

There have been many different logics developed for reasoning about coalgebras of particular functors, most involving modal logic. We define a modal logic for coalgebras of polynomial functors, extending Rößiger's logic [2], whose proof theory was limited to using finite constant sets, by adding an operation from Goldblatt [1]. From the semantics we define a canonical coalgebra that provides a natural construction of a final coalgebra for the relevant functor. We then give an infinitary axiomatization and syntactic proof relation that is sound and complete for countable constant sets.

[1] R. Goldblatt, *Equational logic of polynomial coalgebras*, In P. Balbiani, N.-Y. Suzuki, F. Wolter, & M. Zakharyaschev (eds.), ***Advances in modal logic,***

volume 4, `www.aiml.net`, pp. 149–184, King's College Publications, London, 2003.
[2] M. Rössiger, *From modal logic to terminal coalgebras*, ***Theoretical Computer Science***, vol. 260, pp. 209–228, 2001.

RODERIC A. GIRLE, *Go with the Flow: The Natural Sequence.*
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It is sometimes suggested that the sequence of Modal Logics: **S0.5**, **S1**, **S2**, **S3**, **S4**, **S5** is not as "natural" as the sequence: **S0.5**, **S0.9**, **S2**, **S3**, **S4**, **S5**. In both sequences there is an ascending chain of validity inclusion so that, as far as theorems go: **S0.5** $\subseteq$ **S1** $\subseteq$ **S2** $\subseteq$ **S3** $\subseteq$ **S4** $\subseteq$ **S5** and **S0.5** $\subseteq$ **S0.9** $\subseteq$ **S2** $\subseteq$ **S3** $\subseteq$ **S4** $\subseteq$ **S5**. But there is also the inclusion sequence: **S0.5** $\subseteq$ **S0.9** $\subseteq$ **S1** $\subseteq$ **S2** $\subseteq$ **S3** $\subseteq$ **S4** $\subseteq$ **S5**.

The idea is that it is more natural to have **S0.9** in the sequence than **S1**. This idea is often prompted by a consideration of the axiom systems for these logics. But there is also an interesting sequence when we consider the Kripke semantics or the Model-set/model-system semantics for these systems. In the semantic sequence the simplest natural sequence does not contain either **S0.9** or **S1**, just: **S0.5** $\subseteq$ **S2** $\subseteq$ **S3** $\subseteq$ **S4** $\subseteq$ **S5**.

In this paper we will look at what might lie behind this idea of a "natural" sequence of modal logics.

GUIDO GOVERNATORI AND ANTONINO ROTOLO, *On the Axiomatization of Elgesem's Logic of Ability and Agency.*
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We investigate the semantics of the modal logic of agency and ability (LAA) proposed by Elgesem [1]. LAA is a classical bi-modal logic with the axioms: $EA \to A$, $EA \wedge EB \to E(A \wedge B)$, $EA \to CA$, and $\neg C\top$, where E and C are, respectively, the modal operators of agency and ability. For the semantics Elgesem adopts selection function models $\mathcal{S} = \langle W, f, v\rangle$, where W is a set of possible worlds, f is a function from $W \times 2^W$ to 2^W, and v is a valuation function. The modal operators are evaluated by the following clauses

$$w \models EA \text{ iff } w \in f(w, |A|) \qquad w \models CA \text{ iff } f(w, |A| \neq \emptyset)$$

where $|A| = \{w : w \models A\}$. Moreover f satisfies the conditions: $f(w, X) \subseteq X$, $f(w, X) \cap f(w, Y) \subseteq f(w, X \cap Y)$, and $f(w, W) = \emptyset$.

It is immediate to see that $\neg C\bot$ is valid in the above class of models. We propose a class of neighbourhood models $\langle W, N^C, N^E, v\rangle$ where N^C and N^E

are functions from $W \times 2^W$ to 2^{2^W} such that N^E is closed under intersection, $\forall w \forall X \in N^E_w(w \in X)$, $\forall w(W \notin N^C_w)$, and $N^E \subseteq N^C$. We prove that this class of models characterises LAA, but $\neg C\bot$ is not valid. Hence LAA is incomplete with regard to the intended selection function semantics. We show how to modify the selection function semantics to regain completeness. We point out that the resulting semantics relies on non-normal worlds. Accordingly we argue that an alternative semantics can be given in terms of multi-relation Kripke models with non-normal worlds. Finally we discuss some philosophical issues about the interpretation and appropriateness of the three types of semantics.

[1] D. Elsegem. *The modal logic of agency*, ***Nordic Journal of Philosophical Logic***, vol. 2(2), pp. 1–46, 1997.

SUSAN ROGERSON, *A Pure Implication Logic and its Dual.*
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In [4] we give a family of finite-valued implicational logics L_n. This paper looks at the corresponding infinite-valued logic L_∞. Using the completeness results for the implicational fragment of Abelian logic [3] we can easily give an axiomatization of L_∞ with the sole rule being reverse modus ponens. However, we resort to the results of [1,2] to show that the axioms in the result above also give an axiomatization of L_∞ with the sole rule being modus ponens.

[1] J. A. Kalman, *Substitution-and-detachment systems related to abelian groups*, In J. C. Butcher (ed.), ***A Spectrum of Mathematics: Essays presented to H.G. Forder***, pp. 22–31, Auckland University Press, 1971.
[2] J. A. Kalman, *Axiomatizations of Logics with Values in Groups*, ***J. London Math. Soc.***, vol. 14, pp. 193–199, 1976.
[3] R.K. Meyer & J.K. Slaney, *Abelian Logic (From A to Z)*, In G. Priest, R. Routley & J. Norman (eds.), ***Paraconsistent Logic – Essays on the Inconsistent***, pp. 245–288, Philosophia Verlag, München, 1989.
[4] S. Rogerson, & S. Butchart, *Naive comprehension and contracting implications*, ***Studia Logica***, vol. 71, pp. 119–132, 2002.

SVEN HARTMANN, SEBASTIAN LINK, AND KLAUS-DIETER SCHEWE,
Weak Functional Dependencies in Higher-Order Datamodels and XML.
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We present an axiomatisation for weak functional dependencies, i.e. disjunctions of functional dependencies, in the presence of several constructors for complex values [1]. These constructors are the tuple constructor, list-, set- and multiset-constructors, an optionality constructor, and a union constructor. The theory is smooth and rather uniform, if the union-constructor is absent. In this case we obtain a Brouwer-algebra of subattributes. The major tool used

in the completeness proof is to show that we can construct two complex values that coincide exactly on a given ideal (with some additional properties) in this Brouwer algebra.

The presence of the union-constructor, however, complicates all results and proofs significantly. We lose the distributivity of the Brouwer-algebra, and several additional axioms are needed. The difficulty arises from the fact that the combination of disjoint unions with sets, multisets and lists introduces the need for restructuring, i.e. non-trivial equivalences between subattributes.

In particular, if the union-constructor is absent, a subset of the rules is complete for the implication of ordinary functional dependencies, but this does not hold, if the union constructor is present. Furthermore, if the union-constructor is only coupled with the list-constructor, a similar result can be achieved, which captures the gist of XML treated as a complex value datamodel [2].

[1] S. Hartmann, S. Link, & K.-D. Schewe, *Weak Functional Dependencies in Higher-Order Datamodels*, In D. Seipel & J.M. Turull Torres (eds.), ***Foundations of Information and Knowledge Systems***, pp. 134–154, Springer LNCS 2942, 2004.
[2] S. Hartmann, S. Link, & K.-D. Schewe, *The Logic of Functional Dependencies over XML Documents*. Submitted for publication, 2004.

JEREMY SELIGMAN, *Knowledge in Perspective: some connections between situation theory and dynamic epistemic logic.*
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The metaphor of information flowing has been used to motivate and explain a number of quite difference models of information acquisition and exchange, including those of situation theory and dynamic epistemic logic. I will describe a recent suggestion by van Benthem to combine two conceptions of information flow in one formal framework, using modal logic, and compare it with an alternative approach using the notion of an infomorphism (also known as Chu-morphism) between classifications.

HARTLEY SLATER, *Hilbert and Gödel versus Penrose and Turing.*
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Penrose has been puzzled about what Gödel's results show about our differences from machines. I demonstrate in this paper that the crucial difference is that, while computers can deal with formulas, only humans can deal with facts. That arises because a Turing machine cannot determine how its formulas are to be interpreted, while we can.

The detail of the proof involves a technical re-working of Gödel's first theorem using Hilbert's epsilon calculus. The universal statement which we can know to be true, but which systems such as PM cannot derive, is equivalent to an elementary statement involving a certain epsilon term. When we choose the standard model for Arithmetic we make that epsilon term refer to a finite number, even though, because of the possibility of non-standard models, there is no formal proof, within the system, that the relevant epsilon term does refer to such a number. The finiteness of the referent of the epsilon term, in the standard model, means there is a finite proof of the associated universal statement.

KEES VERMEULEN, *Modal Interaction in Discourse.*
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In natural language texts indicators of modality occur that we would like to analyse as modal operators in logic. However, the modalities in texts interact in a way that is hard to transform in a compositional way into a translation into ordinary modal logic. I will introduce the basic phenomena of modal interaction by giving examples and propose an indexed form of modal logic that can account for them in a compositional way. The logic proposed obtains a dynamic semantics: formulas of the indexed modal language are interpreted as update operators on information states. Several results about the logic proposed will be discussed, most prominently a decidability result.

Examples of modal interaction:

(1) A lion might come in. It would eat you first. It will eat me later.
(2) A lion might come in. It could eat you first. It could eat me first instead.

Here the modality in each second sentence depends on the situation introduced by the first modality. Then the modalities in the third sentences interact with the previous modalities in distinct ways: 'sequentially' in (1), but more 'parallel' in (2).

[1] K. Vermeulen, *Type declaration for modal subordination*, In E. Thijsse & H. Bunt (eds.), ***Proceedings IWCS3***, pp. 297–308, Tilburg University, 1999.
[2] K. Vermeulen, *Classifying modal interaction in discourse*, In: P. Monachesi & R. Bernardi (eds.), ***Proceedings of CLIN10***, `http://odur.let.rug.nl/~vannoord/Clin`, pp. 213 – 221, Utrecht University, 1999.
[3] K. Vermeulen, *Two approaches to modal interaction in discourse*, In P. Dekker (ed.), ***Proceedings of the Amsterdam Colloquium***, pp. 49–54, University of Amsterdam, 1999.

Abstract of talk presented by title

KATALIN BIMBÓ, *A treatment for ACT.*
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ACT—action logic—is a natural extension of REG (see [2]). As it is well-known, ACT is equationally axiomatizable, however, it seems not to have a Kripke semantics. We show that insights from gaggle theory (see [1]) (as well as from the four-valued semantics of the minimal substructural logic LS) allow us to define a relational semantics for ACT that is adequate.

[1] J. M. Dunn, *Gaggle theory: An abstraction of Galois connections and residuation with applications to negation and various logical operations*, In J. van Eijck (ed.), ***Logics in AI: European Workshop JELIA '90***, Lecture Notes in Computer Science 478, pp. 31–51, Springer, Berlin, 1990.

[2] V. R. Pratt, *Action logic and pure induction*, In J. van Eijck (ed.), ***Logics in AI: European Workshop JELIA '90***, Lecture Notes in Computer Science 478, pp. 97–120, Springer, Berlin, 1990.