

Abstracts presented by title

- ▶ LEONA F. FASS, *Intelligent applications of modeling techniques: logic-based and commonsense*.

P.O. Box 2914, Carmel CA 93921, USA.

E-mail: lff4@cornell.edu.

Formal behavioral modeling techniques can be utilized effectively in the development and refinement of practical systems. We find that logic-based research in the constrained theoretical realm, producing “perfect” results, can be adapted to produce improved approximating and “commonsense” models in actual practice. We describe applications [2,3] and potential applications to the behavioral data-mining of link analysis; agent design; synthesis of specified systems; and detection of defects in systems already deployed.

In link analysis, we show that behavior of an economic sub-domain can be modeled, approximating an entire domain’s (often unpredictable) behavior. For agent design, our approach to problem decomposition and minimized realization of components has utility, as in the congregation formation of Brooks and Durfee [1]. We see that applications of formal modeling techniques abound in Khatib and Pecheur [6] and Fischer and Smith [4], where logic-based construction of deployed systems and refinement/correction of systems are described. Examples include Waldinger’s [7] deductive construction of goal-directed agent systems, and Kant’s [5] analyst-specified refinement of mathematical modeling code.

In numerous applications, we find that local commonsense experts, with information unanticipated in the development of global formal models, can help to produce accurate results and achieve problem goals.

[1] C. H. BROOKS and E. H. DURFEE, *Congregation formation in information economies*, Papers from the *AAAI workshop on artificial intelligence for electronic commerce*, Orlando FL, July 1999, AAAI Press WS99-01, pp. 62–68.

[2] L. F. FASS, *Establishing software ‘correctness’ by logical and algebraic means*, *Proceedings of the fifth international joint conference on information sciences*, Atlantic City, NJ, February 2000, vol. I, pp. 639–642.

[3] ———, *Modeling techniques for intelligent business*, preliminary version, invited for presentation at the *American Association for Artificial Intelligence national meeting, workshop on artificial intelligence for intelligent business*, Edmonton AB, July 2002.

[4] B. FISCHER and D. R. SMITH, EDITORS, Papers from the *AAAI Spring symposium on logic-based program synthesis: state of the art and future trends*, Stanford University, March 2002, AAAI Press SS02-05.

[5] E. KANT, *A commercial program synthesis system for computational finance*, invited symposium talk, abstracted in [4], p. 3.

[6] L. KHATIB and C. PECHEUR, EDITORS, Papers from the *AAAI Spring symposium on model-based validation of intelligence*, Stanford University, March 2001, AAAI Press SS01-04.

[7] R. WALDINGER, *Deductive chat lines for multiple agents*, invited symposium talk, abstracted in [4], p. 5.

- ▶ MARC A. MOFFETT, *Generalized quantifiers and NP conjunction in intensional algebraic logic*.

Department of Philosophy, University of Colorado, Boulder, Colorado, 80309, USA.

E-mail: moffett@ucsub.colorado.edu.

NP conjunction is not defined in intensional algebraic logic [1] nor, in its standard development, is there any way of introducing it that preserves the benefits of a cross-categorical boolean interpretation. We develop a variant of this logic that treats boolean conjunction as a level-shifting operation [3] conjoining non-boolean entities whose extensions are defined

over boolean domains.

We assume a sorted domain (consisting of kinds D_{-2} , particulars D_{-1} , propositions D_0 , and n -ary relations-in-intension D_n) and a set \mathcal{E} of extensionalization functions: for all $\partial \in \mathcal{E}$, if $x \in D_{-2}$, then $\partial(x) \subseteq D$; if $x \in D_{-1}$, then $\partial(x) \subseteq D_1$; if $x \in D_0$, then $\partial(x) = n$ for $n \in \{0, 1\}$; if $x \in D_1$, then $\partial(x) \subseteq D$; if $x \in D_n$, then $\partial(x) \subseteq D_n$. The extension of a particular is effectively a generalized quantifier [2]: $\partial(x) = \{\varphi \in D_1 \mid \varphi(x) = 1\}$. Determiners are treated as extension-shifting operations on kinds:

$$\partial(\mathbf{det}_\forall k) = \{\varphi \mid [\forall x \in \partial(k)]\varphi(x) = 1\}.$$

$$\partial(\mathbf{det}_\exists k) = \{\varphi \mid [\exists x \in \partial(k)]\varphi(x) = 1\}.$$

This yields uniform boolean extensions for NP semantic values. Consequently, we are able to define both boolean conjunction and an associated predication operation for generalized quantifiers:

$$x \in \partial(\mathbf{conj}\langle\varphi_1, \varphi_2\rangle) \text{ iff}_{\text{def}} x \in \partial(\varphi_1) \wedge x \in \partial(\varphi_2).$$

$$\partial(\mathbf{pred}_{\text{GQ}}\langle\varphi, x\rangle) = 1 \text{ iff}_{\text{def}} \varphi \in \partial(x).$$

[1] G. BEALER, *Quality and concept*, Oxford University Press, 1982.

[2] J. BARWISE and R. COOPER, *Generalized quantifiers and natural language*, *Linguistics and Philosophy*, vol. 4 (1981), pp. 159–219.

[3] B. PARTEE, *Noun phrase interpretation and type shifting principles*, *Studies in Discourse Representation Theory and the Theory of Generalized Quantifiers* (Groenendijk, de Jong, and Stokhof, editors), Dordrecht, Foris.

- SAEED SALEHI, *Decidable formulas of intuitionistic primitive recursive arithmetic*.
Turku Center for Computer Science, Lemminkäisenk. 14 A, FIN-20520 Turku.
E-mail: saeed@cs.utu.fi.

By formalizing some classical facts about provably total and provably recursive functions of intuitionistic primitive recursive arithmetic (*iPRA*) we prove that the set of decidable formulas of *iPRA* and of $i\Sigma_1^+$ (intuitionistic Σ_1 -induction in the language of *PRA*, [3]) coincide with the set of their provably Δ_1 -formulas and the set of their provably atomic formulas. So, based on quantifier logic, *iPRA* differs from *PRA* afterward the decidability of atomic (and Δ_1) formulas, although the propositional counterpart of these two theories are equal. By the same methods we shall give another proof of a theorem of Marković and De Jongh [1]: the decidable formulas of Heyting Arithmetic *HA* are its (provably) Δ_1 -formulas.

[1] ZORAN MARKOVIĆ, *On the structure of Kripke models of Heyting arithmetic*, *Mathematical Logic Quarterly*, vol. 39 (1993), pp. 531–538.

[2] SAEED SALEHI, *Decidable formulas of intuitionistic primitive recursive arithmetic*, *Reports on Mathematical Logic*, vol. 36 (2002), pp. 55–61.

[3] KAI F. WEHMEIER, *Fragments of HA based on Σ_1 -induction*, *Archive for Mathematical Logic*, vol. 37 (1997), pp. 37–49.