

Formal Aspects of Context

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This volume collects the proceedings of the International and Interdisciplinary Conference on Modelling and Using Context, held in Rio de Janeiro in January 1997, which proved to be the first in a series. (The second was held in Trento in 1999, the third in Dundee in 2001.)

The theory of context is important and problematic—problematic because the intuitions are confused, because of the disparate disciplines that are involved, and because the chronic problem in cognitive science of how to arrive at a productive relation between formalizations and applications applies with particular force to this area. This uneven but interesting volume illustrates all of these points.

“Formal and computational models of context for natural language generation” by Kees van Deemter and Jan Odijk illustrates the point concerning theory and practice. Concentrating on the generation of appropriate pitch accents in monologues, it is essentially a system description, emphasizing constraints on desirable output and functionality of system components. It is impossible to tell from the description how principled and portable the system is, or what the relation is to the relevant theories.

“Requirements for dialogue context management” by Harry Bunt is mainly concerned with producing an eclectic assortment of categories for thinking about contexts.

“Contextual constraints on thematization in written discourse: An empirical study” by Julia Lavid describes a corpus study of “chaining strategies” in various genres. The author hopes that the corpus will be useful in generation applications.

“Context and implicitness: Consequences for traditional and computer-assisted text analysis” by Mark Galliker and Daniel Weimer represents the inverse relation between importance of the application area and strength of the methodology. This application of social psychology to texts involving the expression of prejudice is highly subjective and appears to lack a methodology for analyzing and evaluating the relevant texts.

“A context-based mechanization of multi-agent reasoning” by Alessandro Cimatti and Luciano Serafini discusses a formalization and mechanization of the reasoning involved in the “three wise men puzzle” in a belief-contexts framework (Giunchiglia 1993). The paper would be hard to understand without some familiarity with this material. The wise-men puzzle is not a toy problem, but it would be good to know how to use the framework to deal with more realistic examples. It would be good to know what the advantages are of this approach compared with multimodal theorem-

proving (Gasquet 1995; Stone 1998). The belief-context approach appears to be more flexible, but I am not sure whether the flexibility is needed for the desired applications.

"Presuppositions in context: Constructing bridges" by Paul Piwek and Emiel Kraemer deals with bridging anaphora—constructions such as *Bill's car wouldn't run; the fuel line was clogged*. Such constructions are one of the more promising domains for exploring interactions between commonsense knowledge and natural language interpretation. This article combines van der Sandt's theory of presupposition (van der Sandt 1992) with Constructive Type Theory (Martin-Löf 1984) in a creative way to tackle this problem—the basic idea is that the information needed for this inference can often be extracted from a proof. This is a good example of the sort of interdisciplinary work that can be most productive in this area of research.

"Reasoning with multilevel contexts in semantic metanetworks" by Vagan Y. Terzian and Seppo Puuronen deals with semantic nets that are partitioned into a semantic hierarchy. The semantics for the formalism is murky. The only advantage to semantic network formalisms that I am aware of is that the graphical structure can support useful algorithms; but this paper does not discuss algorithms at all.

"Contextual learning: Towards using contexts to achieve generality" by Pierre Bonzon contains a logic programming formalization of a core part of the theory of contexts. Bonzon's idea is that Horn clause learning can then be used to learn reasoning rules that explicitly refer to context. An example is sketched, but there are few details about the learning algorithm, and apparently no full-scale application of the ideas has been developed.

"Contextual deontic logic" by Leon W. N. van der Torre and Yao-Hua Tan presents an explicit representation of contexts as propositions in formalizing statements of conditional obligation, and uses this idea to deploy a solution to the paradoxes of obligation. This paper makes a genuine contribution to deontic logic, but does not seem to shed much light on the general theory of context. The solution in this paper would be more persuasive if the authors could show how it could be used to formalize medium-scale domains; the idea may suffer from the problem that in practice it may be difficult to construct the appropriate context for a judgment of obligation.

"A local models semantics for propositional attitudes" by Fausto Giunchiglia and Chiara Ghidini develops a theme from Fausto Giunchiglia's previous research (e.g., Giunchiglia and Serafini 1994), using a contextual logic to formalize attitudes such as belief. There is good support for the authors' claim that this type of formalization is often much more appropriate from the standpoint of implementation. But if an explicit, general syntactic theory is added to the logic, it becomes inconsistent due to modifications of the Liar Paradox of the sort provided by Montague (1963). I am not sure how the authors would deal with these paradoxes.

"Context-based semantics for information integration" by Luciano Serafini and Chiara Ghidini is perhaps the most successful paper in this volume at relating formal theory to applications. The authors provide a semantics in the style of Giunchiglia and Ghidini (1998) for "federated data bases," which are systems of distributed, autonomous databases subject to fairly loose global constraints. Local models semantics provide a way to approach this topic without having to construct a single homogeneous, complete ontology. The paper contains well-developed, realistic examples. The challenge would be to integrate the standards of correctness that their specification provides with algorithms that have the speed and scalability required for database applications.

"Structured contexts with fibred semantics" by Dov M. Gabbay and Rolf Nossum is inspired by John McCarthy's work on contexts, and provides a modal formalization of the ideas based on labeled deductive systems. There is an axiomatization and a

completeness proof. This formalism provides a good logical foundation for contexts, for applications in which the meanings of terms do not change from context to context.

References

- Gasquet, Olivier. 1995. Optimization of deduction for multi-modal logics. In László Pólos and Michael Masuch, editors, *Applied Logic: How, What, and Why? Logical Approaches to Natural Language*. Kluwer Academic Publishers, Dordrecht, pages 61–77.
- Giunchiglia, Fausto. 1993. Contextual reasoning. *Epistemologica*, 16:345–364. Also IRST-Technical Report 9211-20, IRST, Trento, Italy.
- Giunchiglia, Fausto and Chiara Ghidini. 1998. Local models semantics, or contextual reasoning = locality + compatibility. In Anthony G. Cohn, Lenhart Schubert, and Stuart C. Shapiro, editors, *KR'98: Principles of Knowledge Representation and Reasoning*. Morgan Kaufmann, San Francisco, CA, pages 282–289. Also IRST-Technical Report 9701-07, IRST, Trento, Italy.
- Giunchiglia, Fausto and Luciano Serafini. 1994. Multilanguage hierarchical logics, or: How to do without modal logics. *Artificial Intelligence*, 65(1):29–70. Also IRST-Technical Report 9110-07, IRST, Trento, Italy.
- Martin-Löf, Per. 1984. *Intuitionistic Type Theory*. Bibliopolis, Naples.
- Montague, Richard. 1963. Syntactical treatments of modality, with corollaries on reflection principles and finite axiomatizability. *Acta Philosophica Fennica*, 16:153–167.
- Stone, Matthew. 1998. *Modality in Dialogue: Planning, Pragmatics and Computation*. Ph.D. thesis, Department of Computer Science, University of Pennsylvania, Philadelphia, PA.
- van der Sandt, Rob A. 1992. Presupposition projection as anaphora resolution. *Journal of Semantics*, 9:333–377.

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