
WORKSHOP REPORT

Second International Workshop on Nonmonotonic Reasoning

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The contributions to this workshop indicate substantial advances in the technical foundations of the field. They also show that it is time to evaluate the existing approaches to commonsense reasoning problems.

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The Workshop

The Second International Workshop on Nonmonotonic Reasoning was held from 12–16 June 1988 in Grasse, a small village near Lake Chiemsee in southern Germany. It was jointly organized by Johan de Kleer, Matthew Ginsberg, Erik Sandewall, and myself. Financial support for the workshop came from the American Association for Artificial Intelligence (AAAI), Deutsche Forschungsgemeinschaft (DFG), The European Communities (Project Cost-13), Linköping University, and SIEMENS AG. Support was sufficient enough to provide free accommodations at the workshop as well as partly subsidize the travel expenses of the participants.

The organizing committee selected 15 papers from more than 80 submissions to be presented at the workshop, and John McCarthy presented an additional invited paper. Sixteen papers might seem few for a workshop program that filled three full days, but one of our major goals was to encourage and facilitate intensive discussions to exchange ideas, results, and different opinions. To this end, the number of participants was also kept relatively small. Thirty-four researchers attended the workshop, 20 from North America and 14 from Europe.

One of the major achievements was to bring together people from different research areas in nonmonotonic reasoning for a period of intensive exchange. These areas included nonmonotonic logic, truth maintenance, logic programming, and philosophy. During the workshop, many links

between these fields became much clearer. For example, new relations between circumscription and assumption-based truth maintenance were discovered, and a close connection between stratified logic programs and truth maintenance systems without so-called odd and even loops became clear. The hope is that the connections established at the workshop will contribute to a cross-fertilization of the various research activities.

Technical Results

The technical results presented at the workshop can roughly be classified into four groups.

Well-Behaved Nonmonotonic Theories

Several authors discussed desirable technical properties for nonmonotonic theories and suitable sufficient restrictions that guarantee these properties. David Makinson claimed *cumulative monotony* to be one such desirable property. A nonmonotonic inference relation is cumulatively monotonic if the following holds: If a set A of axioms infers both p and q (viewed in isolation), then $A \cup \{p\}$ infers q . Stratified logic programs, Kurt Konolige's hierarchic autoepistemic logic, and related approaches impose syntactical restrictions on nonmonotonic theories that guarantee the existence of a unique and well-defined extension. Paul Morris redefined the notion of extension by modifying a theory lacking extensions in a way such that the new theory has an extension.

Semantical Theories

The preferential models approach to the semantics of nonmonotonic reasoning seems to have become the predominant one, and some extensions to it have been proposed. Erik Sandewall suggested preferences between partial models, and Allen Brown and Yoav Shoham modified the definition of preference relations to semantically capture the notion of "well-foundedness" in truth maintenance.

Applications of Nonmonotonic Logic

Doug Appelt and Kurt Konolige demonstrated the utility of autoepistemic logic to formalize speech act theory. Several other applications were discussed by Michael Gelfond, Scott Goodwin and Randy Goebel, and Rich Thomason and John Horty.

The Implementation of Nonmonotonic Logics

Michael Gelfond and Vladimir Lifschitz described a mapping from a suitably restricted class of circumscriptive theories onto logic programs with negation, and Matthew Ginsberg presented a circumscriptive theorem prover founded on an assumption-based truth maintenance system (ATMS). Michael Dixon and Johan de Kleer presented a paper on their new implementation of ATMS on a connection machine, which by view of the relations between ATMS and circumscription might serve as part of an efficient nonmonotonic logic theorem prover. Oskar Dressler suggested an ATMS extension to include nonmonotonic justifications, which should facilitate the mapping of nonmonotonic rules to ATMS. Finally, Bart Selman and Henry Kautz presented some complexity results for default reasoning and showed that even slight modifications of the expressiveness of a default theory can lead to drastic differences in its complexity.

Back to the Roots: Formalizing Common Sense

In spite of the many strong technical results that have been produced, it is still far from clear whether existing approaches are sufficient to formalize

common sense. Presentations given by Rich Thomason and John Horty, Michael Gelfond, Matthew Ginsberg, and Scott Goodwin and Randy Goebel suggest that many open problems still exist with the formalization of commonsense approaches to the frame problem and inheritance by default. Some of the discussions showed that often there are no obvious ways to use some nonmonotonic logic to solve these problems and, furthermore, that our intuitions of what a correct solution should look like are sometimes contradictory.

John McCarthy made this problem area the main issue of his presentation and urged the people working in the field to come back to its roots and work on the formalization of commonsense reasoning patterns. Vladimir Lifschitz presented a list of benchmark problems as a challenge to every particular approach to nonmonotonic reasoning.

Further technical results are needed, particularly on such problems as the relation between different semantic and proof theoretical approaches, the implementation and complexity of special classes of nonmonotonic theories, and the logical foundations of truth maintenance. However, much more must be learned on how useful the existing logics and systems are in formalizing and mechanizing AI approaches to hard problems; otherwise, it will be hard to properly assess the real value of technical results and identify important directions for future work.

Conclusion and Outlook

In summary, the snapshot of the state of the art in nonmonotonic reasoning taken in Grassau indicates a substantial progress toward a consolidation of the technical foundations of nonmonotonic reasoning. Compared to the situation four years ago, much clearer semantic theories are available, and important steps toward an effective mechanization of nonmonotonic reasoning have been made. It was generally agreed that the formalization of commonsense reasoning should be a top-level item for future research.

The Third International Workshop on Nonmonotonic Reasoning will be held in 1990, and it will be organized by Kurt Konolige. Edited proceedings of the 1988 workshop are available. (Springer Lecture Notes in Artificial Intelligence 346: Proceedings of the Second International Workshop on Nonmonotonic Reasoning, 1988. Eds. Reinfrank, M., de Kleer, J., Ginsberg, M., and Sandewall, E. Berlin, West Germany: Springer-Verlag.)

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