Lecture Notes in Artificial Intelligence 3301

Edited by J. G. Carbonell and J. Siekmann

Subseries of Lecture Notes in Computer Science

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Conditionals, Information, and Inference

International Workshop, WCII 2002
Hagen, Germany, May 13-15, 2002
Revised Selected Papers

Springer

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Library of Congress Control Number: 2005925863

CR Subject Classification (1998): I.2, F.4

ISSN 0302-9743
ISBN-10 3-540-25332-7 Springer Berlin Heidelberg New York
ISBN-13 978-3-540-25332-7 Springer Berlin Heidelberg New York

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India
Printed on acid-free paper SPIN: 11408017 06/3142 5 4 3 2 1 0

Preface

Conditionals are fascinating and versatile objects of knowledge representation. On the one hand, they may express rules in a very general sense, representing, for example, plausible relationships, physical laws, and social norms. On the other hand, as default rules or general implications, they constitute a basic tool for reasoning, even in the presence of uncertainty. In this sense, conditionals are intimately connected both to information and inference.

Due to their non-Boolean nature, however, conditionals are not easily dealt with. They are not simply true or false — rather, a conditional "if A then B" provides a context, A, for B to be plausible (or true) and must not be confused with "A entails B" or with the material implication "not A or B." This illustrates how conditionals represent information, understood in its strict sense as reduction of uncertainty. To learn that, in the context A, the proposition B is plausible, may reduce uncertainty about B and hence is information. The ability to predict such conditioned propositions is knowledge and as such (earlier) acquired information.

The first work on conditional objects dates back to Boole in the 19th century, and the interest in conditionals was revived in the second half of the 20th century, when the emerging Artificial Intelligence made claims for appropriate formal tools to handle "generalized rules." Since then, conditionals have been the topic of countless publications, each emphasizing their relevance for knowledge representation, plausible reasoning, nonmonotonic inference, and belief revision. Indeed, conditionals have raised a considerable amount of scientific work, not only in Artificial Intelligence and computer science, but also in philosophy and the cognitive sciences. To date, diverse default and conditional theories have been brought forth, in quantitative as well as in qualitative frameworks, but clear benchmarks are still in discussion. Therefore, the proper handling of conditional information is still a challenge both for theoretical issues and practical applications.

The papers presented in this volume are extended and revised versions of contributions to the *Workshop on Conditionals, Information, and Inference – WCII 2002* which took place on the campus of the FernUniversität in Hagen in May 2002. The intention of this workshop was to bring together researchers interested in and working with conditionals and information processing, in order to present new results, discuss open problems and intensify cooperation. Logicians, philosophers, computer scientists, and scientists concerned with the cognitive meaning of conditionals for processing information all contributed to realizing this aim, ensuring that conditionals were discussed in an adequately broad scope. The topic of conditionals, in particular their relevance for information and inference, proved to bear an amazingly vigorous power to provide a unifying forum for studying and comparing different approaches to the crucial

questions of knowledge and reasoning, for discussing different viewpoints, and for bridging different areas researchers are working in. To give an impression of this creative and fruitful atmosphere, and to show its results are the principal aims of this volume.

Ernest W. Adams points out clearly the insufficiencies of classical logic in handling conditionals adequately, emphasizing the dynamic nature of conditionals and their crucial meaning for practical reasoning. *Philip G. Calabrese* investigates deductive relations on conditionals which can be built from four basic implication relations. Moreover, he considers the question of how much confidence can be attached to probability values computed by using the principle of maximum entropy. *Didier Dubois* sketches a unifying framework for plausible reasoning under incomplete information, based on confidence relations. Inference is achieved by conditioning, thereby imitating standard probabilistic inference in an ordinal environment.

In the section with regular papers, *Jean-François Bonnefon* and *Dennis Hilton* begin with presenting an argumentative approach to interpreting conditional statements, offering a broader view on conditional human reasoning by taking a speaker's intention into account. In *Emil Weydert*'s paper, conditionals both serve as building blocks for epistemic states and provide new evidence which has to be incorporated by revision. He proposes a method to perform such a revision of epistemic states by new conditional beliefs which can also be used for iterated revision. Belief revision is also the concern of *Richard Booth*'s paper. Its main purpose is to make a start on a theory of iterated non prioritized revision, differentiating between regular beliefs and core beliefs.

Rainer Osswald makes use of conditional relationships to express observation categoricals, and to represent default assumptions in observational logic. He interprets defaults in two ways: first, as intutionistic conditionals, and, second, in a Reiter-style way. *Piotr Chrzastowski-Wachtel* and *Jerzy Tyszkiewicz* present a Maple package for experimenting with conditional event algebras. Their implementation uses the correspondence of conditional events to Moore machines and Markov chains, and offers the possibility of deriving symbolic results. *František Matúš* uses discrete structures built from matrices to discover conditional independences in Gaussian vectors. *Christoph Beierle* and *Gabriele Kern-Isberner* address the question of how probabilistic logic and probabilistic conditional logic can be formalized as abstract logical systems, using the framework of institutions. They further investigate the formal logical relationships between these two logics and propositional logic.

Jeff B. Paris and *A. Vencovská* apply the maximum entropy paradigm to problems in inductive reasoning. They show not only that this yields results in accordance with common sense, but also that "reasons" can be found to explain these results. *Manfred Schramm* and *Bertram Fronhöfer* use modified maximum entropy techniques to make incomplete Bayesian networks complete. They deal with two concepts of incompleteness, and consider two different MaxEnt-modifications.

Our special thanks go to our invited speakers Ernest Adams, Phil Calabrese, and Didier Dubois, for enhancing the workshop and the present volume with their ideas, but we are also indebted to all participants for joining us in Hagen for an inspiring workshop. We thank all authors for revising and extending their papers for this volume, and all referees for their critical, but helpful work. We are especially grateful to Jörg Siekmann and Springer for making this publication possible. Finally, this volume would not have come into existence without the FernUniversität in Hagen's generous supporting of the *WCII 2002*-workshop.

October 2004

Gabriele Kern-Isberner
Wilhelm Rödder
Friedhelm Kulmann

FernUniversität in Hagen

Organization

The Workshop on Conditionals, Information, and Inference 2002 (WCII 2002) was initiated and organized by the Department of Computer Science and the Department of Operations Research, University in Hagen.

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