

# Lecture Notes in Computer Science

548

Edited by G. Goos and J. Hartmanis

Advisory Board: W. Brauer D. Gries J. Stoer



R. Kruse P. Siegel (Eds.)

# Symbolic and Quantitative Approaches to Uncertainty

European Conference ECSQAU  
Marseille, France, October 15-17, 1991  
Proceedings

**Springer-Verlag**

Berlin Heidelberg New York  
London Paris Tokyo  
Hong Kong Barcelona  
Budapest

## Series Editors

Gerhard Goos  
GMD Forschungsstelle  
Universität Karlsruhe  
Vincenz-Priessnitz-Straße 1  
W-7500 Karlsruhe, FRG

Juris Hartmanis  
Department of Computer Science  
Cornell University  
Upson Hall  
Ithaca, NY 14853, USA

## Volume Editors

Rudolf Kruse  
Computer Science Department, Technical University of Braunschweig  
Bultenweg 74/75, W-3300 Braunschweig, FRG

Pierre Siegel  
EIRP-Université de Provence - case H  
3 place Victor Hugo, F-13331 Marseille Cedex 3, France

CR Subject Classification (1991): I.2.3

ISBN 3-540-54659-6 Springer-Verlag Berlin Heidelberg New York  
ISBN 0-387-54659-6 Springer-Verlag New York Berlin Heidelberg

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer-Verlag. Violations are liable for prosecution under the German Copyright Law.

© Springer-Verlag Berlin Heidelberg 1991  
Printed in Germany

Typesetting: Camera ready by author  
Printing and binding: Druckhaus Beltz, Hemsbach/Bergstr.  
45/3140-543210 - Printed on acid-free paper

# Preface

In recent years a variety of formalisms have been developed which address such aspects of handling imperfect knowledge as uncertainty, vagueness, imprecision, incompleteness, and partial inconsistency. Some of the most familiar approaches in this research field are nonmonotonic logics, modal logics, probability theory (Bayesian and non-Bayesian), belief function theory, and fuzzy sets and possibility theory.

The ESPRIT Basic Research Action 3085, entitled Defeasible Reasoning and Uncertainty Management Systems (DRUMS), aims to contribute to the elucidation of similarities and differences between the formalisms mentioned above. It consists of 11 active European research groups working on this topic. Their activities have already been coordinated, but there is a need for a larger forum where researchers working on imperfect knowledge in Europe can meet and discuss their scientific results. The European Conference on Symbolic and Quantitative Approaches to Uncertainty (ECSQAU), sponsored by ESPRIT Basic Research Action 3085, serves this need.

This volume contains the papers accepted for the ECSQAU, several articles presenting the activities of the DRUMS groups, two manuscripts by invited speakers. Unfortunately, due to lack of time, the third invited speaker, L. Zadeh, could not provide a paper.

The Executive Scientific Committee for the conference consisted of: Philippe Besnard (Rennes), John Bigham (London), Michael Clarke (London), Didier Dubois (Paris), Rudolf Kruse (chair, Braunschweig).

Our particular thanks go to the many referees who have been part of the reviewing process for this conference. We gratefully acknowledge the work of the reviewers who were also members of the scientific committee: B. Bouchon-Meunier, M. Delgado, D. Driankov, L. Farinas del Cerro, J. Fox, Ch. Froidevaux, D.M. Gabbay, R. Lopez de Mantaras, A. Mamdani, O. Paillet, H. Prade, M. Reinfrank, E. Sanchez, P. Smets, D.J. Spiegelhalter, K. Sundermeyer, D. Vermeir, C. Whitney, H.-J. Zimmermann, as well as the other reviewers: J. Gebhardt, J. Heinsohn, F. Klawonn, B. Nebel, U.G. Oppel, G. Paaß.

We would like to thank the universities in Braunschweig and Marseille for the support they gave the organizers, and we extend our gratitude to Detlef Nauck for his efficient and knowledgeable support. Pierre Siegel was responsible for the local organization in Marseille.

We hope that this conference will lead to future joint research and successful collaboration in Europe.

August 1991

Rudolf Kruse, Pierre Siegel

# Table of Contents

## Invited Lectures

Abduction in Labelled Deductive Systems - A Conceptual Abstract .....	3
<i>D.M. Gabbay</i>	
Nonmonotonic Inference, Expectations, and Neural Networks .....	12
<i>P. Gärdenfors</i>	

## DRUMS Presentations

Introduction .....	31
Imprecise Quantifiers and Conditional Probabilities .....	33
<i>S. Amarger, D. Dubois, and H. Prade</i>	
Default Logics .....	38
<i>P. Besnard</i>	
Propagation of Uncertainty in Dependence Graphs .....	42
<i>J. Cano, M. Delgado, and S. Moral</i>	
Efficient Algorithms for Belief Functions Based on the Relationship Between Belief and Probability .....	48
<i>M. Clarke and N. Wilson</i>	
A Brief Overview of Possibilistic Logic .....	53
<i>D. Dubois, J. Lang, and H. Prade</i>	
A Modal Analysis of Possibility Theory .....	58
<i>L. Fariñas del Cerro and A. Herzig</i>	
An Extended Logic Language for Representing Belief .....	63
<i>J. Fox, P. Krause, and M. Dohnal</i>	

## VIII

Graded Default Logics .....	70
<i>Ch. Froidevaux, P. Chatalic, and J. Mengin</i>	
Linguistically Expressed Uncertainty: Its Elicitation and Use in Modular Expert Systems .....	76
<i>L. Godo and R. Lopez de Mantaras</i>	
Reasoning with Mass Distributions and the Context Model .....	81
<i>R. Kruse, J. Gebhardt, and F. Klawonn</i>	
Advance Prototyping .....	86
<i>S. Parsons</i>	
The Transferable Belief Model .....	91
<i>P. Smets, Y-T Hsia, A. Saffiotti, R. Kennes, H. Xu, and E. Umkehrer</i>	
 Contributed Papers	
Learning with CASTLE .....	99
<i>S. Acid, L.M. de Campos, A. González, and R. Molina</i>	
A New Approach to Inference Under Uncertainty for Knowledge Based Systems .....	107
<i>J.F. Baldwin</i>	
Learning of Uncertain Classification Rules in Medical Diagnosis .....	115
<i>E. Binaghi</i>	
Assertional Default Theories .....	120
<i>G. Brewka</i>	
The Reliability of Reasoning with Unreliable Rules and Propositions .....	125
<i>L. Cardona, J. Kohlas, and P.A. Monney</i>	
Uncertainty in the Valuation of Risky Assets .....	130
<i>A. Chateauneuf, R. Kast, and A. Lapied</i>	
Assessment of Qualitative Judgements for Conditional Events in Expert Systems .....	135
<i>G. Coletti, A. Gilio, and R. Scozzafava</i>	

Automated Reasoning About an Uncertain Domain .....	141
<i>F.S. Corrêa da Silva, D. Robertson, and P. Chung</i>	
Using Defeasible Logic for a Window on a Probabilistic Database: Some Preliminary Notes .....	146
<i>J. Cussens and A. Hunter</i>	
From Data Analysis to Uncertainty Knowledge Analysis .....	153
<i>E. Diday</i>	
Difference Fuzzy Relation Equations: Studies in Dynamical Systems .....	161
<i>A. Di Nola, W. Pedrycz, and S. Sessa</i>	
Towards a <i>Logic</i> for a Fuzzy Logic Controller .....	166
<i>D. Driankov and H. Hellendoorn</i>	
Handling Active Databases with Partial Inconsistencies .....	171
<i>O. Etzion</i>	
An Extension of the Possibility Theory in View of the Formalization of Approximate Reasoning .....	176
<i>L. Gâcogne</i>	
Probabilistic Regions of Persistence .....	182
<i>S.D. Goodwin, E. Neufeld, and A. Trudel</i>	
Formalizing Pertinence Links in Inheritance Reasoning: Preliminary Report .....	190
<i>E. Grégoire</i>	
A Hybrid Approach for Modeling Uncertainty in Terminological Logics .....	198
<i>J. Heinsohn</i>	
Fuzzy Control Research at Siemens Corporate R&D .....	206
<i>H. Hellendoorn and M. Reinfrank</i>	
Handling Partially Ordered Defaults in TMS .....	211
<i>U. Junker and G. Brewka</i>	

Computing Extensions of Default Theories .....	219
<i>F. Lévy</i>	
An Evidential Reasoning Approach to the Classification of Satellite Images .....	227
<i>G. Lohmann</i>	
PRESS - A Probabilistic Reasoning Expert System Shell .....	232
<i>Z. Luo and A. Gammernann</i>	
Induction of Uncertain Rules and the Sociopathicity Property in Dempster-Shafer Theory .....	238
<i>Y. Ma and D.C. Wilkins</i>	
Hierarchical Default Logic .....	246
<i>C. MacNish</i>	
A Logic of Imprecise Monadic Predicates and its Relation to the S5-Modal Fuzzy Logic .....	254
<i>A. Nakamura</i>	
Every Complex System can be Determined by a Causal Probabilistic Network Without Cycles and Every Such Network Determines a Markov Field .....	262
<i>U.G. Oppel</i>	
Probabilistic Default Reasoning Involving Continuous Variables .....	267
<i>G. Paass</i>	
Revision in Propositional Calculus .....	272
<i>O. Papini</i>	
A Constraint-based Approach to Uncertain and Imprecise Reasoning. Application to Expert Systems .....	277
<i>T. Pontet</i>	
Random Closed Sets: A Unified Approach to the Representation of Imprecision and Uncertainty .....	282
<i>P. Quinio and T. Matsuyama</i>	



Knowledge Extraction in Trivalued Propositional Logic .....	287
<i>A. Rauzy</i>	
Using Maximum Entropy to Identify Unsafe Assumptions in Probabilistic Expert Systems .....	292
<i>P.C. Rhodes and G.R. Garside</i>	
On Truth and Utility .....	297
<i>E.H. Ruspini</i>	
On Commitment and Cumulativity in Default Logics .....	305
<i>T. Schaub</i>	
A Tableau-Based Characterisation for Default Logic .....	310
<i>C.B. Schwind and V. Risch</i>	
Restraining the Proliferation of Worlds in Probabilistic Logic Entailments .....	318
<i>P. Snow</i>	
Managing Uncertainty in Environmental Analysis: An Application to Measurement Data Interpretation .....	323
<i>M. Spies</i>	
Handling Uncertainty in Knowledge-Based Computer Vision .....	328
<i>L.E. Sucar, D.F. Gillies</i>	
Probabilistic Reasoning with Facts and Rules in Deductive Databases .....	333
<i>H. Thöne, U. Güntzer, and W. Kießling</i>	
An Entity-Relationship Approach to the Modelling of Vagueness in Databases .....	338
<i>R.M. Vandenberghe and R.M. de Caluwe</i>	
A Preferential Model Semantics for Default Logic .....	344
<i>F. Voorbraak</i>	
Elementary Hyperentailment - Nonmonotonic Reasoning About Defaults .....	352
<i>E. Weydert</i>	
Author Index .....	361