

Deontic Logic In Computer Science

Deontic logic originated from moral philosophy and the philosophy of law as an attempt to formalise normative and legal reasoning. This book draws on the experience of researchers - working in fields as diverse as Artificial Intelligence, linguistics, computer system specification and law - who have discovered the benefits of deontic logic when applied to solving computer science and AI problems. A useful logic in which to specify normative system behaviour, deontic logic has a broad spectrum of possible applications within the field: from legal expert systems to natural language processing, database integrity to electronic contracting and the specification of fault-tolerant software. This book provides a unique and timely assessment of the practical value of deontic logic for computer scientists in AI and law and, more particularly, in such areas as distributed AI and intelligent cooperative information systems.

such questions for centuries (unrestricted by the capabilities of any hardware). The principles governing the interaction of several processes, for example, are abstract and similar to principles governing the cooperation of two large organisations. A detailed rule-based effective but rigid bureaucracy is very much similar to a complex computer program handling and manipulating data. My guess is that the principles underlying one are very much the same as those underlying the other. I believe the day is not far away in the future when the computer scientist will wake upon a morning with the realisation that he is actually a kind of formal philosopher!

The projected number of volumes for this Handbook is about 18. The subject has evolved and it is as if it has become interrelated to such an extent that it no longer makes sense to dedicate volumes to topics. However, the volumes do follow some natural groupings of chapters.

I would like to thank our authors and readers for their contributions and their commitment in making this Handbook a success. Thanks also to

our publication administrator Mrs J. Spurr for her usual dedication and excellence and to Kluwer Academic Publishers for their continuing support for the Handbook. Dov Gabbay King's College London x Logic II IT Natural Program Artificial Intelligence programming processing ification, verification, concurrency Temporal Expressive Expressive Planning. Extension of logic power of tense power for re Time dependent Horn clause operators. current events. dent data. with time Temporal Specification Event calculus. capability. indices. Separation of tempo- Persistence Event calculus. ration of past ral control. through time Temporal logic from future Decision problem the Frame programming. Problem. Temporal lems. Model checking. modal query language. temporal transactions. Modal logic. generalised Action logic Belief revision. Negation by Multi-modal quantifiers Inferential failure and logics databases modality Algorithmic Discourse representation New logics. General theory Procedural logic proof representation. Generic theory of reasoning. modal logic Direct computation Non-monotonic computation on systems linguistic input Non Resolving Loop checking. Intrinsic logical Negation by monotonic ambiguity Non-monotonic discipline for failure. Deductive reasoning ties. Machine decisions about AI. Evolving temporal databases translation. loops. Faults and communication in systems. communicating classification. databases Relevance theory Probabilistic logical analysis Real time systems Expert systems Semantics for and fuzzy logic of language terms terms. Machine logic programs logic learning Intuitionistic Quantifiers in Constructive Intuitionistic Horn clause logic logic reasoning and logic is a better logic is really proof theory logical basis intuitionistic.

This volume presents the refereed proceedings of the 11th International Conference on Deontic Logic in Computer Science, DEON 2012, held in Bergen, Norway, in July 2012. The 14 revised papers included in the volume were carefully reviewed and selected from 29 submissions. Topics covered include logical study of normative reasoning, formal analysis of normative concepts and normative systems, formal specification of aspects of norm-governed multi-agent systems and autonomous agents, normative aspects of protocols for communication, negotiation and multi-agent decision making, formal representation of legal knowledge, formal specification of normative systems for the management of bureaucratic processes in public or private administration, and applications of normative logic to the specification of database integrity constraints.

This book constitutes the refereed proceedings of the 8th International Workshop on Deontic Logic in Computer Science, DEON 2006, held in Utrecht, Netherlands in July 2006. Presents 18 revised full papers together with the abstracts of 3 invited talks. The papers are devoted to the relationship between normative concepts and computer science, artificial intelligence, philosophy, organization theory, and law. Special emphasis is placed on artificial normative systems.

Time is ubiquitous in information systems. Almost every enterprise faces the problem of its data becoming out of date. However, such data is often valuable, so it should be archived and some means to access it should be provided. Also, some data may be inherently historical, e.g., medical, cadastral, or judicial records. Temporal databases provide a uniform and systematic way of dealing with historical data. Many languages have been proposed for temporal databases, among others temporal logic. Temporal logic combines abstract, formal semantics with the amenability to efficient implementation. This chapter shows how temporal logic can be used in temporal database applications. Rather than presenting new results, we report on recent developments and survey the field in a systematic way using a unified formal framework [GHR94; Ch094]. The handbook [GHR94] is a comprehensive reference on mathematical foundations of temporal logic. In this chapter we study how temporal logic is used as a query and integrity constraint language. Consequently, model-theoretic notions, particularly for model satisfaction, are of primary interest. Axiomatic systems and proof methods for temporal logic [GHR94] have found so far relatively few applications in the context of information systems. Moreover, one needs to bear in mind that for the standard linearly-ordered time domains temporal logic is not recursively axiomatizable [GHR94] so recursive axiomatizations are by necessity incomplete.

Deontic logic deals with obligation, permission and related normative concepts. This textbook introduces three frameworks that have dominated the landscape of deontic logic:

monadic deontic logic, dyadic deontic logic, and input/output logic. It describes their language, semantics, proof theory, and gives soundness and completeness theorems. The addition of exercises makes the book ideal for self-study or as a textbook in class. Deontic logic remains neutral on application issues. Over the years, it has been applied in a variety of fields, including philosophy, ethics, linguistics, computer science, and the law. This textbook will serve as a valuable resource for students and researchers wishing to gain a practical understanding of deontic logic for use in their work.

In this volume, John Horty brings to bear his work in logic to present a framework that allows for answers to key questions about reasons and reasoning, namely: What are reasons, and how do they support actions or conclusions?

A broad introduction to the subject; many exercises with full solutions are provided.

This volume presents the refereed proceedings of the 10th International Conference on Deontic Logic in Computer Science, DEON 2010, held in Fiesole, Italy, in July 2010. The 18 revised papers included in the volume were carefully reviewed and selected from 34 submissions. Topics covered include connections preferences, deontic logic and contrary-to-duties, the use of input/output logic, the study of norm dynamics, models of agents and institutions, argumentation, compliance, and various alternative analyses of deontic notions.

This volume presents the refereed proceedings of the 12th International Conference on Deontic Logic and Normative Systems, DEON 2014, held in Ghent, Belgium, in July 2014. The 17 revised papers and the 2 invited papers included in this volume were carefully reviewed and selected from 31 submissions. Topics covered include challenges from natural language for deontic logic; the relationship between deontic and other types of modality: epistemic modality, imperatives, supererogatory, etc.; the deontic paradoxes; the modeling of normative concepts other than obligation and permission, e.g., values; the game-theoretical aspects of deontic reasoning; the emergence of norms; norms from a conversational and pragmatic point of view; and norms and argumentation.

The 3rd Workshop on Formal Approaches to Agent-Based Systems (FAABS-III) was held at the Greenbelt Marriott Hotel (near NASA Goddard Space Flight Center) in April 2004 in conjunction with the IEEE Computer Society. The first FAABS workshop was held in April 2000 and the second in October 2002. Interest in agent-based systems continues to grow and this is seen in the wide range of conferences and journals that are addressing the research in this area as well as the prototype and developmental systems that are coming into use. Our third workshop, FAABS-III, was held in April, 2004. This volume contains the revised papers and posters presented at that workshop. The Organizing Committee was fortunate in having significant support in the planning and organization of these events, and were privileged to have well-renowned keynote speakers Prof. J. Moore (FAABS-I), Prof. Sir Roger Penrose (FAABS-II), and Prof. John McCarthy (FAABS-III), who spoke on the topic of self-aware computing systems, auguring perhaps a greater interest in autonomic computing as part of future FAABS events. We are grateful to all who attended the workshop, presented papers or posters, and participated in panel sessions and both formal and informal discussions to make the workshop a great success. Our thanks go to the NASA Goddard Space Flight Center, Codes 588 and 581 (Software Engineering Laboratory) for their financial support and to the IEEE Computer Society (Technical Committee on Complexity in Computing) for their sponsorship and organizational assistance.

This book presents research in an interdisciplinary field, resulting from the vigorous and fruitful cross-pollination between traditional deontic logic and computer science. AI researchers have used deontic logic as one of the tools in modelling legal reasoning. Computer scientists have discovered that computer systems (including their interaction with other computer systems and with human agents) can often be productively modelled as norm-governed. So, for example, deontic logic has been applied by computer scientists for specifying bureaucratic systems, access and security policies, and soft design or integrity constraints, and for modelling fault tolerance. In turn, computer scientists and AI researchers have also discovered (and made it clear to the rest of us) that various formal tools (e.g. nonmonotonic, temporal and dynamic logics) developed in computer science and artificial intelligence have interesting applications to traditional issues in deontic logic. This volume presents some of the best work done in this area, with the selection at once reflecting the general interdisciplinary (and international) character that this area of research has taken on, as well as reflecting the more specific recent inter-disciplinary developments between traditional deontic logic and computer science.

An acceptable argument may be defeated by a new line of reasoning when new information activates competing normative principles. The failure of classical deontic logic to model these features leads to paradoxes, and moral theorists generally respond by ignoring deontic logic. The book presents new models for normative reasoning relevant to philosophy, law, management and artificial intelligence.

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This volume presents a variety of papers bearing on the relation between deontic logics, logics of action, and normative systems, i.e. systems of or about interacting agents (computers, human beings, corporations, etc.) whose behaviour is subject to ideal constraints that may not always be fulfilled in practice. The papers range from theoretical studies of the logical and conceptual tools needed, to studies of various applications. The set of papers collected in this book should be of interest to investigators working in a variety of fields, from philosophy, logic and legal theory to artificial intelligence, computer and management sciences, since it covers topics ranging from theoretical research on foundational issues in deontic and action logics, defeasible reasoning, decision theory, ethical theory, and legal theory, to research on a variety of issues relevant to applications connected with expert systems in the law, document specification,

automation of defeasible reasoning, specification of responsibilities and powers in organizations, normative systems specification, confidentiality in database systems, and a host of other applications.

Recent years have seen the development of powerful tools for verifying hardware and software systems, as companies worldwide realise the need for improved means of validating their products. There is increasing demand for training in basic methods in formal reasoning so that students can gain proficiency in logic-based verification methods. The second edition of this successful textbook addresses both those requirements, by continuing to provide a clear introduction to formal reasoning which is both relevant to the needs of modern computer science and rigorous enough for practical application. Improvements to the first edition have been made throughout, with extra and expanded sections on SAT solvers, existential/universal second-order logic, micro-models, programming by contract and total correctness. The coverage of model-checking has been substantially updated. Further exercises have been added. Internet support for the book includes worked solutions for all exercises for teachers, and model solutions to some exercises for students.

This book describes extensions of deontic logic. Deontic logic is a branch of philosophical logic involving reasoning with norms, obligations, prohibitions and permissions. The extensions concern the logical structure of legal rules and legal reasoning. Their function is to improve the representation of legal knowledge and enhance deontic logic through increased expressibility. The resulting formulas acquire new meanings, not expressible in standard deontic logic, which are subject to fresh interpretations. The author offers an extensive analysis of the representation of actors, to whom the norms are directed, and authorities who enact the norms. Moreover, a distinction is made between enactment and applicability. A modality of enactment can be used to express inconsistent enacted norms in a consistent way. An authority-hierarchy is introduced to filter out the applicable norms from the set of enacted norms. Some related philosophical questions will be discussed regarding the applications of formalisms that are intrinsic to practical science with respect to 'consistency' and 'universality'. The formalisms and applications considered here are relevant for law, philosophy and computer science, with a special focus on the improvement of legal expert systems and intelligent support for legal professionals.

"Logic and law have a long history in common, but the influence has been mostly one-sided, except perhaps in the 5th and 6th centuries B.C., where disputes at the market place or in tribunals in Greece seem to have stimulated a lot of reflection among sophistic philosophers on such topics as language and truth. Most of the time it was logic that influenced legal thinking, but in the last 50 years logicians began to be interested in normative concepts and hence in law"--

This volume contains the workshop proceedings of DEON 2004, the Seventh International Workshop on Deontic Logic in Computer Science. The DEON workshop series aims at bringing together researchers interested in topics related to the use of deontic logic in computer science. It traditionally promotes research in the relationship between normative concepts and computer science, artificial intelligence, organisation theory, and law. In addition to these topics, DEON 2004 placed special emphasis on the relationship between deontic logic and multi-agent systems. The workshop was held in Madeira, Portugal, on 26–28 May 2004. This volume includes all 15 papers presented at the workshop, as well as two abstracts from the two outstanding invited speakers we were privileged to host: Prof Mark Brown (Syracuse University, USA), and Prof Mike Wooldridge (University of Liverpool, UK). The reader will find that the topics covered span from theoretical investigations on deontic concepts and their formalisation in logic, to the use of deontic formalisms to verify and reason about multi-agent systems applications. We believe this makes it a well-balanced and interesting volume. We wish to thank all those who contributed to this workshop, and especially the authors of the submitted papers and the referees. They were all forced to work on a very tight timescale to make this volume a reality.

Relevant to philosophy, law, management, and artificial intelligence, these papers explore the applicability of nonmonotonic or defeasible logic to normative reasoning. The resulting systems purport to solve well-known deontic paradoxes and to provide a better treatment than classical deontic logic does of prima facie obligation, conditional obligation, and priorities of normative principles.

The Handbook of Deontic Logic and Normative Systems presents a detailed overview of the main lines of research on contemporary deontic logic and related topics. Although building on decades of previous work in the field, it is the first collection to take into account the significant changes in the landscape of deontic logic that have occurred in the past twenty years. These changes have resulted largely, though not entirely, from the interaction of deontic logic with a variety of other fields, including computer science, legal theory, organizational theory, economics, and linguistics. This first volume of the Handbook is divided into three parts, containing nine chapters in all, each written by leading experts in the field. The first part concentrates on historical foundations. The second examines topics of central interest in contemporary deontic logic. The third presents some new logical frameworks that have now become part of the mainstream literature. A second volume of the Handbook is currently in preparation, and there may be a third after that.

The eighth volume of the Second Edition contains major contributions on the Logic of Questions, Sequent Systems for Modal Logics, Deontic Logic as well as Deontic Logic and Contrary-to-duties. Audience: Students and researchers whose work or interests involve philosophical logic and its applications.

John Horty effectively develops deontic logic (the logic of ethical concepts like obligation and permission) against the background of a formal theory of agency. He incorporates certain elements of decision theory to set out a new deontic account of what agents ought to do under various conditions over extended periods of time. Offering a conceptual rather than technical emphasis, Horty's framework allows a number of recent issues from moral theory to be set out clearly and discussed from a uniform point of view.

This work represents an attempt to show that standard systems of deontic logic (taken as attempts to codify normal deontic reasoning) run into a number of difficulties. It also presents a new system of deontic logic and argues that it is free from the shortcomings of standard systems.

This volume presents the refereed proceedings of the 9th International Conference on Deontic Logic in Computer Science, DEON 2008, held in Luxembourg in July 2008. The 16 revised full papers presented together with 4 invited talks were carefully reviewed and selected for inclusion in the book. The topics addressed are development of formal systems of deontic logic and related areas of logic, and applications. Of particular interest is the interaction between computer systems and their users; the papers focus also on the special topic of logical approaches to deontic notions in computer science in the area of security and trust, encompassing applications in e-commerce as well as traditional areas of computer security.

This book constitutes the refereed proceedings of the 7th International Workshop on Deontic Logic in Computer Science, DEON 2004, held in Madeira, Portugal, in May 2004. The 15 revised full papers presented together with the abstracts of 2 invited talks were carefully reviewed and selected for inclusion in the book. The papers are devoted to the relationship between normative concepts and computer science, artificial intelligence, organization theory, and law; in addition to these topics, special emphasis is placed on the relationship between deontic logic and multiagent systems.

The practical benefits of computational logic need not be limited to mathematics and computing. As this book shows, ordinary people in their everyday lives can profit from the recent advances that have been developed for artificial intelligence. The book draws upon related developments in various fields from philosophy to psychology and law. It pays special attention to the integration of logic with decision theory, and the use of logic to improve the clarity and coherence of communication in natural languages such as English. This book is essential reading for teachers and researchers who may be out of touch with the latest developments in computational logic. It will also be useful in any undergraduate course that teaches practical thinking, problem solving or communication skills. Its informal presentation makes the book accessible to readers from any background, but optional, more formal, chapters are also included for those who are more technically oriented.

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