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Foundations of Software Science and Computational Structures
Logics in Artificial Intelligence
Temporal Logic

KANE CAMRYN

Handbook of Temporal Reasoning in Artificial Intelligence Springer Science & Business Media
Abstract: "The logic TLR, introduced in [1], is a temporal logic that is insensitive to stuttering but still possesses a well-defined next operator. Due to the combination of these two features, it presents an attractive foundation for studying refinement between reactive programs in a TL framework. A drawback of TLR is that completeness is achieved at the price of introducing the previous operator, as the only past operator, and is otherwise not used for specification or verification. This drawback is corrected in this paper which presents a pure future version of the logic, called FTLR, eliminating the previous operator. An alternative axiomatic system, not dependent on the removed operator, is presented and shown to be complete."
A Journey from Process Algebra via Timed Automata to Model Learning Springer
This book is about the verification of reactive systems. A reactive system is a system that maintains an ongoing interaction with its environment, as opposed to computing some final value on termination. The family of reactive systems includes many classes of

programs whose correct and reliable construction is con sidered to be particularly challenging, including concurrent programs, embedded and process control programs, and operating systems. Typical examples of such systems are an air traffic control system, programs controlling mechanical devices such as a train, or perpetually ongoing processes such as a nuclear reactor. With the expanding use of computers in safety-critical areas, where failure is potentially disastrous, correctness is crucial. This has led to the introduction of formal verification techniques, which give both users and designers of software and hardware systems greater confidence that the systems they build meet the desired specifications. Framework The approach promoted in this book is based on the use of temporal logic for specifying properties of reactive systems, and develops an extensive verification methodology for proving that a system meets its temporal specification. Reactive programs must be specified in terms of their ongoing behavior, and temporal logic provides an expressive and natural language for specifying this behavior. Our framework for specifying and verifying temporal properties of reactive systems is based on the following four components: 1. A computational model to describe the behavior of reactive systems. The model adopted in this book is that of a Fair Transition System (FTS).

Temporal Logic of Programs Springer

It is with great pleasure that we are presenting to the community the second edition of this extraordinary handbook. It has been over 15 years since the publication of the first edition and there have been great changes in the landscape of philosophical logic since then. The first edition has proved invaluable to generations of students and researchers in formal philosophy and language, as well as to consumers of logic in many applied areas. The main logic article in the Encyclopaedia Britannica 1999 has described the first edition as 'the best starting point for exploring any of the topics in logic'. We are confident that the second edition will prove to be just as good! The first edition was the second handbook published for the logic commu nity. It followed the North Holland one volume Handbook of Mathematical Logic, published in 1977, edited by the late Jon Barwise. The four volume Handbook of Philosophical Logic, published 1983-1989 came at a fortunate temporal junction at the evolution of logic. This was the time when logic was gaining ground in computer science and artificial intelligence circles. These areas were under increasing commercial pressure to provide devices which help and/or replace the human in his daily activity. This pressure required the use of logic in the modelling of human activity and organisa tion on the one hand and to provide the theoretical basis for the computer program constructs on the other.

Computer Science Logic Springer Verlag

Introduction to the temporal logic of - in particular paral- lel - programs.Divided into three main parts: - Presenta- tion of the pure temporal logic: language, semantics, and proof theory; - Representation of programs and their proper- ties within the language of temporal logic; - Application of the logical apparatus to the verification of program proper- ties including a new embedding of Hoare's logic into the temporal framework.

Theory and Applications of Models of

Computation Springer Science & Business Media
This book is an introduction to temporal logic, a now flourishing branch of philosophical logic whose origin is of recent date, its main impetus having been provided by the publication in the late 1950s of A. N. PRIOR'S pioneering book, Time and Modality (Oxford, The Clarendon Press, 1957). Virtually all work in the field to around 1966 is surveyed in PRIOR'S elegant treatise Past, Present and Future (Oxford, The Clarendon Press, 1967). In consequence, it is no simple matter to write a comprehensive book on the subject with out merely rehearsing material already dealt with in PRIOR'S works. We believe, however, that the present book succeeds in this difficult endeavor because it approaches established materials from wholly novel points of departure, and is thus able to attain new perspectives and achieve new results. Its introductory character notwithstanding, the present work is consequently in substantial measure devoted to an exposition of new findings and a demonstration of new results. Parts of the book have been published previously. Chapter II is a modified version of an article of the same title by N. RESCHER and JAMES GARSON in The Journal of Symbolic Logic (vol. 33 [1968], pp.537-548). And Chapter XIII is a modified version of the article "Temporally Conditioned Descriptions" by N. RESCHER and JOHN ROBISON in Ratio, vol. 8 (1966), pp. 46-54. The authors are grateful to Professors GARSON and ROBISON, and to the editors of the jounal involved, for their permission to use this materials here.
Formal Modeling and Analysis of Timed Systems Springer Science & Business Media
This book constitutes the proceedings of the 15th International Workshop on Computational Logic in Multi-Agent Systems, CLIMA XV, held in Prague, Czech Republic, in August 2014. The 12 regular papers were carefully reviewed and selected from 20 submissions. The purpose of the CLIMA workshops is to provide a forum for discussing techniques, based on computational logic, for representing, programming and reasoning about agents and multi-agent systems in a formal way. This edition will feature two special sessions: logics for agreement technologies and logics for games, strategic reasoning, and social choice.
Formal Modeling and Analysis of Timed Systems Cambridge University Press
This innovative monograph explores a new mathematical formalism in higher-order temporal logic for proving properties about the behavior of systems. Developed by the authors, the goal of this novel approach is to explain what occurs when multiple, distinct system components interact by using a category-theoretic description of behavior types based on sheaves. The authors demonstrate how to analyze the behaviors of elements in continuous and discrete dynamical systems so that each can be translated and compared to one another. Their temporal logic is also flexible enough that it can serve as a framework for other logics that work with similar models. The book begins with a discussion of behavior types, interval domains, and translation invariance, which serves as the groundwork for temporal type theory. From there, the authors lay out the logical preliminaries they need for their temporal modalities and explain the soundness of those logical semantics. These results are then applied to hybrid dynamical systems, differential equations,

and labeled transition systems. A case study involving aircraft separation within the National Airspace System is provided to illustrate temporal type theory in action. Researchers in computer science, logic, and mathematics interested in topos-theoretic and category-theory-friendly approaches to system behavior will find this monograph to be an important resource. It can also serve as a supplemental text for a specialized graduate topics course.

Temporal Logic of Programs Springer Science & Business Media

Modal logics, originally conceived in philosophy, have recently found many applications in computer science, artificial intelligence, the foundations of mathematics, linguistics and other disciplines. Celebrated for their good computational behaviour, modal logics are used as effective formalisms for talking about time, space, knowledge, beliefs, actions, obligations, provability, etc. However, the nice computational properties can drastically change if we combine some of these formalisms into a many-dimensional system, say, to reason about knowledge bases developing in time or moving objects. To study the computational behaviour of many-dimensional modal logics is the main aim of this book. On the one hand, it is concerned with providing a solid mathematical foundation for this discipline, while on the other hand, it shows that many seemingly different applied many-dimensional systems (e.g., multi-agent systems, description logics with epistemic, temporal and dynamic operators, spatio-temporal logics, etc.) fit in perfectly with this theoretical framework, and so their computational behaviour can be analyzed using the developed machinery. We start with concrete examples of applied one- and many-dimensional modal logics such as temporal, epistemic, dynamic, description, spatial logics, and various combinations of these. Then we develop a mathematical theory for handling a spectrum of 'abstract' combinations of modal logics - fusions and products of modal logics, fragments of first-order modal and temporal logics - focusing on three major problems: decidability, axiomatizability, and computational complexity. Besides the standard methods of modal logic, the technical toolkit includes the method of quasimodels, mosaics, tilings, reductions to monadic second-order logic, algebraic logic techniques. Finally, we apply the developed machinery and obtained results to three case studies from the field of knowledge representation and reasoning: temporal epistemic logics for reasoning about multi-agent systems, modalized description logics for dynamic ontologies, and spatio-temporal logics. The genre of the book can be defined as a research monograph. It brings the reader to the front line of current research in the field by showing both recent achievements and directions of future investigations (in particular, multiple open problems). On the other hand, well-known results from modal and first-order logic are formulated without proofs and supplied with references to accessible sources. The intended audience of this book is logicians as well as those researchers who use logic in computer science and artificial intelligence. More specific application areas are, e.g., knowledge representation and reasoning, in particular, terminological, temporal and spatial reasoning, or reasoning about agents. And

we also believe that researchers from certain other disciplines, say, temporal and spatial databases or geographical information systems, will benefit from this book as well. Key Features: • Integrated approach to modern modal and temporal logics and their applications in artificial intelligence and computer science • Written by internationally leading researchers in the field of pure and applied logic • Combines mathematical theory of modal logic and applications in artificial intelligence and computer science • Numerous open problems for further research • Well illustrated with pictures and tables

Temporal Information Processing Technology and Its Applications Springer Science & Business Media

The subject of Time has a wide intellectual appeal across different dis ciplines. This has shown in the variety of reactions received from readers of the first edition of the present Book. Many have reacted to issues raised in its philosophical discussions, while some have even solved a number of the open technical questions raised in the logical elaboration of the latter. These results will be recorded below, at a more convenient place. In the seven years after the first publication, there have been some noticeable newer developments in the logical study of Time and temporal expressions. As far as Temporal Logic proper is concerned, it seems fair to say that these amount to an increase in coverage and sophistication, rather than further break-through innovation. In fact, perhaps the most significant sources of new activity have been the applied areas of Linguistics and Computer Science (including Artificial Intelligence), where many intriguing new ideas have appeared presenting further challenges to temporal logic. Now, since this Book has a rather tight composition, it would have been difficult to interpolate this new material without endangering intelligibility.

Advances in Computing and Information - ICCI '90 Springer Science & Business Media

Time is a fascinating subject and has long since captured mankind's imagination, from the ancients to modern man, both adult and child alike. It has been studied across a wide range of disciplines, from the natural sciences to philosophy and logic. Today, thirty plus years since Prior's work in laying out foundations for temporal logic, and two decades on from Pnueli's seminal work applying of temporal logic in specification and verification of computer programs, temporal logic has a strong and thriving international research community within the broad disciplines of computer science and artificial intelligence. Areas of activity include, but are certainly not restricted to: Pure Temporal Logic, e. g. temporal systems, proof theory, model theory, expressiveness and complexity issues, algebraic properties, application of game theory; Specification and Verification, e. g. of reactive systems, ofreal-time components, of user interaction, of hardware systems, techniques and tools for verification, execution and prototyping methods; Temporal Databases, e. g. temporal representation, temporal query ing, granularity of time, update mechanisms, active temporal data bases, hypothetical reasoning; Temporal Aspects in AI, e. g. modelling temporal phenomena, in terval temporal calculi, temporal nonmonotonicity, interaction of temporal reasoning with

action/knowledge/belief logics, temporal planning; Tense and Aspect in Natural Language, e. g. models, ontologies, temporal quantifiers, connectives, prepositions, processing tempo ral statements; Temporal Theorem Proving, e. g. translation methods, clausal and non-clausal resolution, tableaux, automata-theoretic approaches, tools and practical systems.

Springer Science & Business Media

This book constitutes the refereed proceedings of the 7th International Symposium on Frontiers of Combining Systems, FroCoS 2007, held in Trento, Italy, September 16-18, 2009. The 20 revised full papers presented were carefully reviewed and selected. The papers are organized in topical sections on combinations of logics, theories, and decision procedures; constraint solving and programming; combination issues in rewriting and programming as well as in logical frameworks and theorem proving systems.

The Temporal Logic of Reactive and Concurrent Systems Springer Science & Business Media

The Annual Conference of the European Association for Computer Science Logic, CSL 2002, was held in the Old College of the University of Edinburgh on 22–25 September 2002. The conference series started as a programme of Int- national Workshops on Computer Science Logic, and then in its sixth meeting became the Annual Conference of the EACSL. This conference was the sixteenth meeting and eleventh EACSL conference; it was organized by the Laboratory for Foundations of Computer Science at the University of Edinburgh. The CSL 2002 Programme Committee considered 111 submissions from 28 countries during a two week electronic discussion; each paper was refereed by at least three reviewers. The Committee selected 37 papers for presentation at the conference and publication in these proceedings. The Programme Committee invited lectures from Susumu Hayashi, Frank Neven, and Damian Niwinski;´ the papers provided by the invited speakers appear at the front of this volume. In addition to the main conference, two tutorials – 'Introduction to Mu- Calculi' (Julian Brad?eld) and 'Parametrized Complexity' (Martin Grohe) – were given on the previous day.

Many-Dimensional Modal Logics: Theory and Applications IOS Press

Temporal LogicSpringer Science & Business Media

Larisa Maksimova on Implication, Interpolation, and Definability Springer

This book constitutes the refereed proceedings of the 6th International Conference on Formal Modeling and Analysis of Timed Systems, FORMATS 2008, held in Saint Malo, France, September 2008. The 17 revised full papers presented together with 3 invited talks were carefully reviewed and selected from 37 submissions. The papers are organized in topical sections on extensions of timed automata and semantics; timed games and logic; case studies; model-checking of probabilistic systems; verification and test; timed petri nets.

Automated Deduction – CADE-22 Springer Science & Business Media

This book constitutes the proceedings of the 23rd International Workshop on Computer Science Logic, CSL 2009, held in Coimbra, Portugal, in September 2009. The 34 papers presented together with 5 invited talks were carefully reviewed and selected from 89 full paper submissions.

All current aspects of logic in computer science are addressed, ranging from foundational and methodological issues to application issues of practical relevance. The book concludes with a presentation of this year's Ackermann award, the EACSL Outstanding Dissertation Award for Logic in Computer Science.

Transactions of Computational Collective Intelligence IV Springer

This edited volume focuses on the work of Professor Larisa Maksimova, providing a comprehensive account of her outstanding contributions to different branches of non-classical logic. The book covers themes ranging from rigorous implication, relevance and algebraic logic, to interpolation, definability and recognizability in superintuitionistic and modal logics. It features both her scientific autobiography and original contributions from experts in the field of non-classical logics. Professor Larisa Maksimova's influential work involved combining methods of algebraic and relational semantics. Readers will be able to trace both influences on her work, and the ways in which her work has influenced other logicians. In the historical part of this book, it is possible to trace important milestones in Maksimova's career. Early on, she developed an algebraic semantics for relevance logics and relational semantics for the logic of entailment. Later, Maksimova discovered that among the continuum of superintuitionisitc logics there are exactly three pretabular logics. She went on to obtain results on the decidability of tabularity and local tabularity problems for superintuitionistic logics and for extensions of S4. Further investigations by Maksimova were aimed at the study of fundamental properties of logical systems (different versions of interpolation and definability, disjunction property, etc.) in big classes of logics, and on decidability and recognizability of such properties. To this end she determined a powerful combination of algebraic and semantic methods, which essentially determine the modern state of investigations in the area, as can be seen in the later chapters of this book authored by leading experts in non-classical logics. These original contributions bring the reader up to date on the very latest work in this field.

STACS 92 Springer

This book constitutes the refereed proceedings of the 8th International Conference on Foundations of Software Science and Computation Structures, FOSSACS 2005, held in Edinburgh, UK in April 2005 as part of ETAPS. The 30 revised full papers presented together with 2 invited papers were carefully reviewed and selected from 108 submissions. The papers are organized in topical sections on rule formats and bisimulation, probabilistic models, algebraic models, games and automata, language analysis, partial order models, logics, coalgebraic modal logics, and computational models.

Time & Logic Springer Science & Business Media

Reactive systems are computing systems which are interactive, such as real-time systems, operating systems, concurrent systems, control systems, etc. They are among the most difficult computing systems to program. Temporal logic is a formal tool/language which yields excellent results in specifying reactive systems. This volume, the first of two, subtitled Specification, has a self-contained introduction to temporal logic

and, more important, an introduction to the computational model for reactive programs, developed by Zohar Manna and Amir Pnueli of Stanford University and the Weizmann Institute of Science, Israel, respectively.

Computational Logic in Multi-Agent Systems Elsevier

"Temporal Information Processing Technology and Its Applications" systematically studies temporal information processing technology and its applications. The book covers following subjects: 1) time model, calculus and logic; 2) temporal data models, semantics of temporal variable ‘now’ temporal database concepts; 3) temporal query language, a typical temporal database management system: TempDB; 4) temporal extension on XML, workflow and knowledge base; and, 5) implementation patterns of temporal applications, a typical example of temporal application. The book is intended for researchers, practitioners and graduate students of databases, data/knowledge management and temporal information processing. Dr. Yong Tang is a professor at the Computer School, South China Normal University, China.

Temporal Logics and Their Applications Elsevier

Temporal Logic: From Ancient Ideas to Artificial Intelligence deals with the history of temporal logic as well as the crucial systematic questions within the field. The book studies the rich contributions from ancient and medieval philosophy up to the downfall of temporal logic in the Renaissance. The modern rediscovery of the subject, which is especially due to the work of A. N. Prior, is described, leading into a thorough discussion of the use of temporal logic in computer science and the understanding of natural language. Temporal Logic: From Ancient Ideas to Artificial Intelligence thus interweaves linguistic, philosophical and computational aspects into an informative and inspiring whole.

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