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Finite Model Theory

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Finite Model Theory 2nd Edition

Sanjiv Kapoor



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Finite Model Theory Heinz-Dieter Ebbinghaus, Jörg Flum, 1999-08-18 This is a thoroughly revised and enlarged second edition that presents the main results of descriptive complexity theory that is the connections between axiomatizability of classes of finite structures and their complexity with respect to time and space bounds The logics that are important in this context include fixed point logics transitive closure logics and also certain infinitary languages their model theory is studied in full detail The book is written in such a way that the respective parts on model theory and descriptive complexity theory may be read independently

Finite Model Theory Heinz-Dieter Ebbinghaus, Jörg Flum, 2013-06-29 Finite model theory has its origin in classical model theory but owes its systematic development to research from complexity theory The book presents the main results of descriptive complexity theory that is the connections between axiomatizability of classes of finite structures and their complexity with respect to time and space bounds The logics that are important in this context include fixed point logics transitive closure logics and also certain infinitary languages their model theory is studied in full detail Other topics include DATALOG languages quantifiers and oracles 0 1 laws and optimization and approximation problems The book is written in such a way that the resp parts on model theory and descriptive complexity theory may be read

independently *Saturated Model Theory (2nd Edition)* Gerald E Sacks, 2009-10-02 This book contains the material for a first course in pure model theory with applications to differentially closed fields Topics covered in this book include saturated model criteria for model completeness and elimination of quantifiers Morley rank and degree of element types categoricity in power two cardinal theorems existence and uniqueness of prime model extensions of substructures of models of totally transcendental theories and homogeneity of models of 1 categorical theories *Finite Model Theory and Its Applications*

Erich Grädel, Phokion G. Kolaitis, Leonid Libkin, Maarten Marx, Joel Spencer, Moshe Y. Vardi, Yde Venema, Scott Weinstein, 2007-06-04 Finite model theory as understood here is an area of mathematical logic that has developed in close connection with applications to computer science in particular the theory of computational complexity and database theory One of the fundamental insights of mathematical logic is that our understanding of mathematical phenomena is enriched by elevating the languages we use to describe mathematical structures to objects of explicit study If mathematics is the science of patterns then the media through which we discern patterns as well as the structures in which we discern them command our attention It is this aspect of logic which is most prominent in model theory the branch of mathematical logic which deals with the relation between a formal language and its interpretations No wonder then that mathematical logic and finite model theory in particular should find manifold applications in computer science from specifying programs to querying databases computer science is rife with phenomena whose understanding requires close attention to the interaction between language and structure This volume gives a broad overview of some central themes of finite model theory expressive power descriptive complexity and zero one laws together with selected applications to database theory and artificial intelligence especially

constraint databases and constraint satisfaction problems The nal chapter provides a concise modern introduction to modal logic which emp sizes the continuity in spirit and technique with nite model theory

Elements of Finite Model Theory

Leonid Libkin,2013-03-09 Finite model theory is an area of mathematical logic that grew out of computer science applications The main sources of motivational examples for finite model theory are found in database theory computational complexity and formal languages although in recent years connections with other areas such as formal methods and verification and artificial intelligence have been discovered The birth of finite model theory is often identified with Trakhtenbrot s result from 1950 stating that validity over finite models is not recursively enumerable in other words completeness fails over finite models The tech nique of the proof based on encoding Turing machine computations as finite structures was reused by Fagin almost a quarter century later to prove his cel ebrated result that put the equality sign between the class NP and existential second order logic thereby providing a machine independent characterization of an important complexity class In 1982 Immerman and Vardi showed that over ordered structures a fixed point extension of first order logic captures the complexity class PTIME of polynomial time computable propertiE s Shortly thereafter logical characterizations of other important complexity classes were obtained This line of work is often referred to as descriptive complexity A different line of finite model theory research is associated with the de velopment of relational databases By the late 1970s the relational database model had replaced others and all the basic query languages for it were es sentially first order predicate calculus or its minor extensions

Logic Colloquium '02 Zoé Chatzidakis,Peter Koepke,Wolfram

Pohlers,2017-03-31 Since their inception the Perspectives in Logic and Lecture Notes in Logic series have published seminal works by leading logicians Many of the original books in the series have been unavailable for years but they are now in print once again This volume the twenty seventh publication in the Lecture Notes in Logic series contains the proceedings of two conferences the European Summer Meeting of the Association for Symbolic Logic and the Colloquium Logicum held in M nster Germany in August 2002 This compilation of articles from some of the world s preeminent logicians spans all areas of mathematical logic including philosophical logic and computer science logic It contains expanded versions of a number of invited plenary talks and tutorials that will be of interest to graduate students and researchers in the field of mathematical logic

Theoretical Optics

Hartmann Römer,2006-03-06 Starting from basic electrodynamics this volume provides a solid yet concise introduction to theoretical optics containing topics such as nonlinear optics light matter interaction and modern topics in quantum optics including entanglement cryptography and quantum computation The author with many years of experience in teaching and research goes way beyond the scope of traditional lectures enabling readers to keep up with the current state of knowledge Both content and presentation make it essential reading for graduate and PhD students as well as a valuable reference for researchers

FST TCS 2000: Foundations of Software Technology and Theoretical Science Sanjiv

Kapoor,2000-11-29 This book constitutes the refereed proceedings of the 20th international Conference on Foundations of

Software Technology and Theoretical Computer Science FST TCS 2000 held in New Delhi India in December 2000 The 36 revised full papers presented were carefully reviewed and selected from a total of 141 submissions also included are six invited papers The volume provides broad coverage of the logical and mathematical foundations of computer science and spans the whole range of theoretical computer science *Computer Science Logic* Julian Bradfield, 2003-08-02 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 International 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 Bradfield and Parametrized Complexity Martin Grohe were given on the previous day

Structures in Logic and Computer Science Jan Mycielski, Grzegorz Rozenberg, Arto Salomaa, 1997-07-23 The book summarises contemporary knowledge about the theory of atomic and molecular clusters New results are discussed on a high theoretical level Access to this field of research is given by an explanation of the various subjects in introductory chapters Semantics in Databases Leopoldo Bertossi, Gyula O.H. Katona, Klaus-Dieter Schewe, Bernhard Thalheim, 2003-04-07 This book constitutes the thoroughly refereed post proceedings of the Second International Workshop on Semantics in Databases held in Dagstuhl Castle Germany in January 2001 The 10 revised full papers presented together with an introduction by the volume editors were carefully selected during two rounds of reviewing Among the aspects of database semantics discussed are semantic constraints paraconsistency logic foundations of databases ER modeling type hierarchies null values consistency enforcement logic based pattern languages and semantic classification of queries Among the classes of databases dealt with are deductive databases relational databases distributed information systems and tree structured data

Descriptive Complexity, Canonisation, and Definable Graph Structure Theory Martin Grohe, 2017-08-17 Descriptive complexity theory establishes a connection between the computational complexity of algorithmic problems the computational resources required to solve the problems and their descriptive complexity the language resources required to describe the problems This groundbreaking book approaches descriptive complexity from the angle of modern structural graph theory specifically graph minor theory It develops a definable structure theory concerned with the logical definability of graph theoretic concepts such as tree decompositions and embeddings The first part starts with an introduction to the background from logic complexity and graph theory and

develops the theory up to first applications in descriptive complexity theory and graph isomorphism testing It may serve as the basis for a graduate level course The second part is more advanced and mainly devoted to the proof of a single previously unpublished theorem properties of graphs with excluded minors are decidable in polynomial time if and only if they are definable in fixed point logic with counting *Handbook of Formal Languages* Grzegorz Rozenberg,1997 This third volume of the Handbook of Formal Languages discusses language theory beyond linear or string models trees graphs grids pictures computer graphics Many chapters offer an authoritative self contained exposition of an entire area Special emphasis is on interconnections with logic **Logical Foundations of Database Transformations for Complex-Value Databases** Qing

Wang,2010 Database transformations consist of queries and updates which are two fundamental types of computations in any databases the first provides the capability to retrieve data and the second is used to maintain databases in light of ever changing application domains This dissertation aims to lay down the foundations for establishing a theoretical framework of database transformations in the context of complex value databases The previous findings reveal that it is very difficult to characterise common features of database queries and updates in a way which is meaningful for further investigations Nevertheless the advent of the sequential Abstract State Machine ASM thesis capturing sequential algorithms sheds light on the study of database transformations Observing that the class of computations described by database transformations may be formalised as algorithms respecting database principles we propose the database ASM thesis for a complete characterisation of database transformations It turns out that every database transformation characterised by five postulates can be behaviourally simulated by a database Abstract State Machine DB ASM with the same signature and background and vice versa Furthermore a logic for DB ASMs is defined In spite of bounded non determinism permitted by DB ASMs the logic is proven to be sound and complete Fundamentals of Mathematical Logic Peter G. Hinman,2018-10-08 This introductory

graduate text covers modern mathematical logic from propositional first order and infinitary logic and G del s Incompleteness Theorems to extensive introductions to set theory model theory and recursion computability theory Based on the author s more than 35 years of teaching experience the book develops students intuition by presenting complex ideas in the simplest context for which they make sense The book is appropriate for use as a classroom text for self study and as a reference on the state of modern logic **Logical Aspects of Computational Linguistics** Philippe de Groote,Glyn

Morrill,Christian Retore,2003-06-29 This book constitutes the refereed proceedings of the 4th International Conference on Logical Aspects of Computational Linguistics LACL 2001 held in Le Croisic France in June 2001 The 16 revised full papers presented together with two invited papers were carefully reviewed and selected for presentation Among the topics covered are categorical grammars dependency grammars formal language theory grammatical inference hyperintensional semantics minimalism type logical semantics language learning and natural language processing *Mathematical Foundations of Computer Science 2005* Joanna Jedrzejowicz,2005-08-17 This book constitutes the refereed proceedings of the 30th

International Symposium on Mathematical Foundations of Computer Science MFCS 2005 held in Gdansk Poland in August September 2005 The 62 revised full papers presented together with full papers or abstracts of 7 invited talks were carefully reviewed and selected from 137 submissions All current aspects in theoretical computer science are addressed ranging from quantum computing approximation automata circuits scheduling games languages discrete mathematics combinatorial optimization graph theory networking algorithms and complexity to programming theory formal methods and mathematical logic

The Development of Modern Logic Leila Haaparanta, 2009-06-18 This edited volume presents a comprehensive history of modern logic from the Middle Ages through the end of the twentieth century In addition to a history of symbolic logic the contributors also examine developments in the philosophy of logic and philosophical logic in modern times The book begins with chapters on late medieval developments and logic and philosophy of logic from Humanism to Kant The following chapters focus on the emergence of symbolic logic with special emphasis on the relations between logic and mathematics on the one hand and on logic and philosophy on the other This discussion is completed by a chapter on the themes of judgment and inference from 1837 1936 The volume contains a section on the development of mathematical logic from 1900 1935 followed by a section on main trends in mathematical logic after the 1930s The volume goes on to discuss modal logic from Kant till the late twentieth century and logic and semantics in the twentieth century the philosophy of alternative logics the philosophical aspects of inductive logic the relations between logic and linguistics in the twentieth century the relationship between logic and artificial intelligence and ends with a presentation of the main schools of Indian logic The *Development of Modern Logic* includes many prominent philosophers from around the world who work in the philosophy and history of mathematics and logic who not only survey developments in a given period or area but also seek to make new contributions to contemporary research in the field It is the first volume to discuss the field with this breadth of coverage and depth and will appeal to scholars and students of logic and its philosophy

Quantifiers and Cognition: Logical and Computational Perspectives Jakub Szymanik, 2016-02-19 This volume on the semantic complexity of natural language explores the question why some sentences are more difficult than others While doing so it lays the groundwork for extending semantic theory with computational and cognitive aspects by combining linguistics and logic with computations and cognition Quantifier expressions occur whenever we describe the world and communicate about it Generalized quantifier theory is therefore one of the basic tools of linguistics today studying the possible meanings and the inferential power of quantifier expressions by logical means The classic version was developed in the 1980s at the interface of linguistics mathematics and philosophy Before this volume advances in classic generalized quantifier theory mainly focused on logical questions and their applications to linguistics this volume adds a computational component the third pillar of language use and logical activity This book is essential reading for researchers in linguistics philosophy cognitive science logic AI and computer science

Andrzej Mostowski and Foundational Studies A. Ehrenfeucht, Andrzej Ehrenfeucht, V.W. Marek, M.

Srebrny,2008-03-06 Andrzej Mostowski was one of the leading 20th century logicians This volume examines his legacy devoted both to his scientific heritage and to the memory of him as a great researcher teacher organizer of science and person It includes the bibliography of Mostowski s writings

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