

Logical Foundations Of Mathematics And Computational Complexity A Gentle Introduction Springer Monographs In Mathematics

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Computability in Context - S Barry Cooper 2011-02-25

Computability has played a crucial role in mathematics and computer science, leading to the discovery, understanding and classification of decidable/undecidable problems, paving the way for the modern computer era, and affecting deeply our view of the world. Recent new paradigms of computation, based on biological and physical models, address in a radically new way questions of efficiency and challenge assumptions about the so-called Turing barrier. This volume addresses various aspects of the ways computability and theoretical computer science enable scientists and philosophers to deal with mathematical and real-world issues, covering problems related to logic, mathematics, physical processes, real computation and learning theory. At the same time it will focus on different ways in which computability emerges from the real world, and how this affects our way of thinking about everyday computational issues. Contents: Computation, Information, and the Arrow

of Time (P Adriaans & P van Emde Boas)The Isomorphism Conjecture for NP (M Agrawal)The Ershov Hierarchy (M M Arslanov)Complexity and Approximation in Reoptimization (G Ausiello et al.)Definability in the Real Universe (S B Cooper)HF-Computability (Y L Drshov et al.)The Mathematics of Computing Between Logic and Physics (G Longo & T Paul)Liquid State Machines: Motivation, Theory, and Applications (W Maass)Experiments on an Internal Approach to Typed Algorithms in Analysis (D Normann)Recursive Functions: An Archeological Look (P Odifreddi)Reverse Mathematics and Well-Ordering Principles (M Rathjen & A Weiermann)Discrete Transfinite Computation Models (P D Welch)Readership: Researchers in computational mathematics, logic, and theoretical computer science. Keywords: Computability; Logic; Real World; Turing Barrier; Real Computation; Learning Theory

Gödel '96 - Petr Hájek 2017-03-02

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 sixth publication in the Lecture Notes in Logic series, collects the proceedings of the conference 'Logical Foundations of Mathematics, Computer Science, and Physics - Kurt Gödel's Legacy', held in Brno, Czech Republic, on the 90th anniversary of Gödel's birth. The broad range of speakers who participated in this event affirms the continuing importance of Gödel's work in logic, physics, and the philosophy and foundations of mathematics and computer science. The papers in this volume range over all these topics and contribute to our present understanding of them.

Logical Foundations of Computer Science - Sergei Adian 1997-05-28

A Sobolev gradient of a real-valued functional is a gradient of that functional taken relative to the underlying Sobolev norm. This book shows how descent methods using such gradients allow a unified treatment of a wide variety of problems in differential equations. Equal emphasis is placed on numerical and theoretical matters. Several concrete applications are made to illustrate the method. These applications include (1) Ginzburg-Landau functionals of superconductivity, (2) problems of transonic flow in which type depends locally on nonlinearities, and (3) minimal surface problems. Sobolev gradient constructions rely on a study of orthogonal projections onto graphs of closed densely defined linear transformations from one Hilbert space to another. These developments use work of Weyl, von Neumann and Beurling.

Mathematics and Metaphilosophy - Justin Clarke-Doane 2022-06-30

This Element discusses the problem of mathematical knowledge, and its broader philosophical ramifications. It argues that the challenge to explain the (defeasible) justification of our mathematical beliefs ('the justificatory challenge'), arises insofar as disagreement over axioms bottoms out in disagreement over intuitions. And it argues that the challenge to explain their reliability ('the reliability challenge'), arises to the extent that we could have easily had different beliefs. The Element

shows that mathematical facts are not, in general, empirically accessible, contra Quine, and that they cannot be dispensed with, contra Field. However, it argues that they might be so plentiful that our knowledge of them is unmysterious. The Element concludes with a complementary 'pluralism' about modality, logic and normative theory, highlighting its surprising implications. Metaphysically, pluralism engenders a kind of perspectivalism and indeterminacy. Methodologically, it vindicates Carnap's pragmatism, transposed to the key of realism.

Complexity and Real Computation - Lenore Blum 2012-12-06

The classical theory of computation has its origins in the work of Goedel, Turing, Church, and Kleene and has been an extraordinarily successful framework for theoretical computer science. The thesis of this book, however, is that it provides an inadequate foundation for modern scientific computation where most of the algorithms are real number algorithms. The goal of this book is to develop a formal theory of computation which integrates major themes of the classical theory and which is more directly applicable to problems in mathematics, numerical analysis, and scientific computing. Along the way, the authors consider such fundamental problems as: * Is the Mandelbrot set decidable? * For simple quadratic maps, is the Julia set a halting set? * What is the real complexity of Newton's method? * Is there an algorithm for deciding the knapsack problem in a polynomial number of steps? * Is the Hilbert Nullstellensatz intractable? * Is the problem of locating a real zero of a degree four polynomial intractable? * Is linear programming tractable over the reals? The book is divided into three parts: The first part provides an extensive introduction and then proves the fundamental NP-completeness theorems of Cook-Karp and their extensions to more general number fields as the real and complex numbers. The later parts of the book develop a formal theory of computation which integrates major themes of the classical theory and which is more directly applicable to problems in mathematics, numerical analysis, and scientific computing.

Logical Foundations of Computer Science - Sergei Artemov 2017-12-22

This book constitutes the refereed proceedings of the International Symposium on Logical Foundations of Computer Science, LFCS 2018, held in Deerfield Beach, FL, USA, in January 2018. The 22 revised full papers were carefully reviewed and selected from 22 submissions. The scope of the Symposium is broad and includes constructive mathematics and type theory; homotopy type theory; logic, automata, and automatic structures; computability and randomness; logical foundations of programming; logical aspects of computational complexity; parameterized complexity; logic programming and constraints; automated deduction and interactive theorem proving; logical methods in protocol and program verification; logical methods in program specification and extraction; domain theory logics; logical foundations of database theory; equational logic and term rewriting; lambda and combinatory calculi; categorical logic and topological semantics; linear logic; epistemic and temporal logics; intelligent and multiple-agent system logics; logics of proof and justification; non-monotonic reasoning; logic in game theory and social software; logic of hybrid systems; distributed system logics; mathematical fuzzy logic; system design logics; and other logics in computer science.

Logical Foundations of Proof Complexity - Stephen Cook 2014-03-06

This book treats bounded arithmetic and propositional proof complexity from the point of view of computational complexity. The first seven chapters include the necessary logical background for the material and are suitable for a graduate course. Associated with each of many complexity classes are both a two-sorted predicate calculus theory, with induction restricted to concepts in the class, and a propositional proof system. The result is a uniform treatment of many systems in the literature, including Buss's theories for the polynomial hierarchy and many disparate systems for complexity classes such as AC_0 , $AC_0(m)$, TC_0 , NC_1 , L , NL , NC , and P .

Alasdair Urquhart on Nonclassical and Algebraic Logic and Complexity of Proofs - Ivo Düntsch 2021-09-24

This book is dedicated to the work of Alasdair Urquhart. The book starts out with an introduction to and an overview of Urquhart's work, and an

autobiographical essay by Urquhart. This introductory section is followed by papers on algebraic logic and lattice theory, papers on the complexity of proofs, and papers on philosophical logic and history of logic. The final section of the book contains a response to the papers by Urquhart.

Alasdair Urquhart has made extremely important contributions to a variety of fields in logic. He produced some of the earliest work on the semantics of relevant logic. He provided the undecidability of the logics R (of relevant implication) and E (of relevant entailment), as well as some of their close neighbors. He proved that interpolation fails in some of those systems. Urquhart has done very important work in complexity theory, both about the complexity of proofs in classical and some nonclassical logics. In pure algebra, he has produced a representation theorem for lattices and some rather beautiful duality theorems. In addition, he has done important work in the history of logic, especially on Bertrand Russell, including editing Volume four of Russell's Collected Papers.

The Best Writing on Mathematics 2014 - Mircea Pitici 2014-11-23

Collects essays on mathematics, from the importance of big data and the varying forms of Klein bottles to fountain design and the possible shape of the universe.

Theory and Applications of Models of Computation - Manindra Agrawal 2008-04-30

This proceedings volume examines all major areas in computer science, mathematics (especially logic) and the physical sciences, especially computation, algorithms, complexity and computability theory.

Automated Deduction - A Basis for Applications Volume I Foundations - Calculi and Methods Volume II Systems and Implementation Techniques Volume III Applications - Wolfgang Bibel 2013-03-09

1. BASIC CONCEPTS OF INTERACTIVE THEOREM PROVING

Interactive Theorem Proving ultimately aims at the construction of powerful reasoning tools that let us (computer scientists) prove things we cannot prove without the tools, and the tools cannot prove without us. Interaction typically is needed, for example, to direct and control the reasoning, to speculate or generalize strategic lemmas, and sometimes

simply because the conjecture to be proved does not hold. In software verification, for example, correct versions of specifications and programs typically are obtained only after a number of failed proof attempts and subsequent error corrections. Different interactive theorem provers may actually look quite different: They may support different logics (first-order or higher-order, logics of programs, type theory etc.), may be generic or special-purpose tools, or may be targeted to different applications. Nevertheless, they share common concepts and paradigms (e.g. architectural design, tactics, tactical reasoning etc.). The aim of this chapter is to describe the common concepts, design principles, and basic requirements of interactive theorem provers, and to explore the bandwidth of variations. Having a 'person in the loop', strongly influences the design of the proof tool: proofs must remain comprehensible, - proof rules must be high-level and human-oriented, - persistent proof presentation and visualization becomes very important.

Logic, Language, Information, and Computation - Agata Ciabattoni
2022-09-08

Edited in collaboration with FoLLI, the Association of Logic, Language and Information this book constitutes the refereed proceedings of the 28th Workshop on Logic, Language, Information and Computation, WoLLIC 2022, Iasi, Romania, in September 2022. The 25 full papers presented included with 8 extra abstracts, 5 invited talks and 3 tutorials were fully reviewed and selected from 46 submissions. The conference aims fostering interdisciplinary research in pure and applied logic.

Logical Approaches to Computational Barriers - Arnold Beckmann
2006-06-26

This book constitutes the refereed proceedings of the Second International Conference on Computability in Europe, CiE 2006, held in Swansea, UK, June/July 2006. The book presents 31 revised full papers together with 30 invited papers, including papers corresponding to 8 plenary talks and 6 special sessions on proofs and computation, computable analysis, challenges in complexity, foundations of programming, mathematical models of computers and hypercomputers, and Gödel centenary: Gödel's legacy for computability.

Computability Theory and Foundations of Mathematics - Kazuyuki Tanaka
2022-05-18

This volume features the latest scientific developments in the fields of computability theory and logical foundations of mathematics as well as applications. The scope involves the topics of Computability Theory, Reverse Mathematics, Nonstandard Analysis, Proof Theory, Set Theory, Philosophy of Mathematics, Constructive Mathematics, Theory of Randomness and Computational Complexity Theory.

Logical Foundations of Computer Science - Sergei Artemov
2015-12-14

This book constitutes the refereed proceedings of the International Symposium on Logical Foundations of Computer Science, LFCS 2016, held in Deerfield Beach, FL, USA in January 2016. The 27 revised full papers were carefully reviewed and selected from 46 submissions. The scope of the Symposium is broad and includes constructive mathematics and type theory; homotopy type theory; logic, automata, and automatic structures; computability and randomness; logical foundations of programming; logical aspects of computational complexity; parameterized complexity; logic programming and constraints; automated deduction and interactive theorem proving; logical methods in protocol and program verification; logical methods in program specification and extraction; domain theory logics; logical foundations of database theory; equational logic and term rewriting; lambda and combinatory calculi; categorical logic and topological semantics; linear logic; epistemic and temporal logics; intelligent and multiple-agent system logics; logics of proof and justification; non-monotonic reasoning; logic in game theory and social software; logic of hybrid systems; distributed system logics; mathematical fuzzy logic; system design logics; and other logics in computer science.

Logical Foundations of Computer Science - Sergei Artemov
2021-12-17

This book constitutes the refereed proceedings of the International Symposium on Logical Foundations of Computer Science, LFCS 2022, held in Deerfield Beach, FL, USA, in January 2022. The 23 revised full papers were carefully reviewed and selected from 35 submissions. The

scope of the Symposium is broad and includes constructive mathematics and type theory; homotopy type theory; logic, automata, and automatic structures; computability and randomness; logical foundations of programming; logical aspects of computational complexity; parameterized complexity; logic programming and constraints; automated deduction and interactive theorem proving; logical methods in protocol and program verification; logical methods in program specification and extraction; domain theory logics; logical foundations of database theory; equational logic and term rewriting; lambda and combinatory calculi; categorical logic and topological semantics; linear logic; epistemic and temporal logics; intelligent and multiple-agent system logics; logics of proof and justification; non-monotonic reasoning; logic in game theory and social software; logic of hybrid systems; distributed system logics; mathematical fuzzy logic; system design logics; other logics in computer science.

Logical Foundations of Mathematics and Computational Complexity - Pavel Pudlák 2013-04-22

The two main themes of this book, logic and complexity, are both essential for understanding the main problems about the foundations of mathematics. *Logical Foundations of Mathematics and Computational Complexity* covers a broad spectrum of results in logic and set theory that are relevant to the foundations, as well as the results in computational complexity and the interdisciplinary area of proof complexity. The author presents his ideas on how these areas are connected, what are the most fundamental problems and how they should be approached. In particular, he argues that complexity is as important for foundations as are the more traditional concepts of computability and provability. Emphasis is on explaining the essence of concepts and the ideas of proofs, rather than presenting precise formal statements and full proofs. Each section starts with concepts and results easily explained, and gradually proceeds to more difficult ones. The notes after each section present some formal definitions, theorems and proofs. *Logical Foundations of Mathematics and Computational Complexity* is aimed at graduate students of all fields of mathematics who are

interested in logic, complexity and foundations. It will also be of interest for both physicists and philosophers who are curious to learn the basics of logic and complexity theory.

The Incomputable - S. Barry Cooper 2017-05-05

This book questions the relevance of computation to the physical universe. Our theories deliver computational descriptions, but the gaps and discontinuities in our grasp suggest a need for continued discourse between researchers from different disciplines, and this book is unique in its focus on the mathematical theory of incomputability and its relevance for the real world. The core of the book consists of thirteen chapters in five parts on extended models of computation; the search for natural examples of incomputable objects; mind, matter, and computation; the nature of information, complexity, and randomness; and the mathematics of emergence and morphogenesis. This book will be of interest to researchers in the areas of theoretical computer science, mathematical logic, and philosophy.

Forcing with Random Variables and Proof Complexity - Jan Krajíček 2010-12-23

This book introduces a new approach to building models of bounded arithmetic, with techniques drawn from recent results in computational complexity. Propositional proof systems and bounded arithmetics are closely related. In particular, proving lower bounds on the lengths of proofs in propositional proof systems is equivalent to constructing certain extensions of models of bounded arithmetic. This offers a clean and coherent framework for thinking about lower bounds for proof lengths, and it has proved quite successful in the past. This book outlines a brand new method for constructing models of bounded arithmetic, thus for proving independence results and establishing lower bounds for proof lengths. The models are built from random variables defined on a sample space which is a non-standard finite set and sampled by functions of some restricted computational complexity. It will appeal to anyone interested in logical approaches to fundamental problems in complexity theory.

Logic and Complexity - Richard Lassaigne 2012-12-06

Logic and Complexity looks at basic logic as it is used in Computer Science, and provides students with a logical approach to Complexity theory. With plenty of exercises, this book presents classical notions of mathematical logic, such as decidability, completeness and incompleteness, as well as new ideas brought by complexity theory such as NP-completeness, randomness and approximations, providing a better understanding for efficient algorithmic solutions to problems. Divided into three parts, it covers: - Model Theory and Recursive Functions - introducing the basic model theory of propositional, 1st order, inductive definitions and 2nd order logic. Recursive functions, Turing computability and decidability are also examined. - Descriptive Complexity - looking at the relationship between definitions of problems, queries, properties of programs and their computational complexity. - Approximation - explaining how some optimization problems and counting problems can be approximated according to their logical form. Logic is important in Computer Science, particularly for verification problems and database query languages such as SQL. Students and researchers in this field will find this book of great interest.

Proceedings of the 12th Asian Logic Conference - Rod Downey
2013-05-07

The Asian Logic Conference is the most significant logic meeting outside of North America and Europe, and this volume represents work presented at, and arising from the 12th meeting. It collects a number of interesting papers from experts in the field. It covers many areas of logic. Contents: Resolute Sequences in Initial Segment Complexity (G Barmpalias and R G Downey) Approximating Functions and Measuring Distance on a Graph (W Calvert, R Miller and J Chubb Reimann) Carnap and McKinsey: Topics in the Pre-History of Possible-Worlds Semantics (M J Cresswell) Limits to Joining with Generics and Randoms (A R Day and D D Dzhaferov) Freedom & Consistency (M Detlefsen) A van Lambalgen Theorem for Demuth Randomness (D Diamondstone, N Greenberg and D Turetsky) Faithful Representations of Polishable Ideals (S Gao) Further Thoughts on Definability in the Urysohn Sphere (I Goldbring) Simple Completeness Proofs for Some Spatial Logics of the Real Line (I

Hodkinson) On a Question of Csima on Computation-Time Domination (X Hua, J Liu and G Wu) A Generalization of Beth Model to Functionals of High Types (F Kachapova) A Computational Framework for the Study of Partition Functions and Graph Polynomials (T Kotek, J A Makowsky and E V Ravve) Relation Algebras and R (T Kowalski) Van Lambalgen's Theorem for Uniformly Relative Schnorr and Computable Randomness (K Miyabe and J Rute) Computational Aspects of the Hyperimmune-Free Degrees (K M Ng, F Stephan, Y Yang and L Yu) Calibrating the Complexity of Δ_2 Sets via Their Changes (A Nies) Topological Full Groups of Minimal Subshifts and Just-Infinite Groups (S Thomas) TW-Models for Logic of Knowledge-cum-Belief (S C-M Yang) Readership: Researchers in mathematical logic and algebra, computer scientists in artificial intelligence and fuzzy logic. Keywords: Asian Logic Conference; Logic; Computability; Set Theory; Modal Logic
Mathematics and Computation - Avi Wigderson 2019-10-29

An introduction to computational complexity theory, its connections and interactions with mathematics, and its central role in the natural and social sciences, technology, and philosophy Mathematics and Computation provides a broad, conceptual overview of computational complexity theory—the mathematical study of efficient computation. With important practical applications to computer science and industry, computational complexity theory has evolved into a highly interdisciplinary field, with strong links to most mathematical areas and to a growing number of scientific endeavors. Avi Wigderson takes a sweeping survey of complexity theory, emphasizing the field's insights and challenges. He explains the ideas and motivations leading to key models, notions, and results. In particular, he looks at algorithms and complexity, computations and proofs, randomness and interaction, quantum and arithmetic computation, and cryptography and learning, all as parts of a cohesive whole with numerous cross-influences. Wigderson illustrates the immense breadth of the field, its beauty and richness, and its diverse and growing interactions with other areas of mathematics. He ends with a comprehensive look at the theory of computation, its methodology and aspirations, and the unique and fundamental ways in

which it has shaped and will further shape science, technology, and society. For further reading, an extensive bibliography is provided for all topics covered. Mathematics and Computation is useful for undergraduate and graduate students in mathematics, computer science, and related fields, as well as researchers and teachers in these fields. Many parts require little background, and serve as an invitation to newcomers seeking an introduction to the theory of computation. Comprehensive coverage of computational complexity theory, and beyond High-level, intuitive exposition, which brings conceptual clarity to this central and dynamic scientific discipline Historical accounts of the evolution and motivations of central concepts and models A broad view of the theory of computation's influence on science, technology, and society Extensive bibliography

Strongly Correlated Fermions and Bosons in Low-Dimensional Disordered Systems - Igor V. Lerner 2002-07-31

The physics of strongly correlated fermions and bosons in a disordered environment and confined geometries is at the focus of intense experimental and theoretical research efforts. Advances in material technology and in low temperature techniques during the last few years led to the discoveries of new physical of atomic gases and a possible metal phenomena including Bose condensation insulator transition in two-dimensional high mobility electron structures. Situations where the electronic system is so dominated by interactions that the old concepts of a Fermi liquid do not necessarily make a good starting point are now routinely achieved. This is particularly true in the theory of low dimensional systems such as carbon nanotubes, or in two dimensional electron gases in high mobility devices where the electrons can form a variety of new structures. In many of these systems disorder is an unavoidable complication and lead to a host of rich physical phenomena. This has pushed the forefront of fundamental research in condensed matter towards the edge where the interplay between many-body correlations and quantum interference enhanced by disorder has become the key to the understanding of novel phenomena.

Bounded Arithmetic, Propositional Logic and Complexity Theory - Jan

Krajicek 1995-11-24

Discusses the deep connections between logic and complexity theory, and lists a number of intriguing open problems.

Foundations of Software Science and Computation Structures -

Jean Goubault-Larrecq 2020-04-17

This open access book constitutes the proceedings of the 23rd International Conference on Foundations of Software Science and Computational Structures, FOSSACS 2020, which took place in Dublin, Ireland, in April 2020, and was held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2020. The 31 regular papers presented in this volume were carefully reviewed and selected from 98 submissions. The papers cover topics such as categorical models and logics; language theory, automata, and games; modal, spatial, and temporal logics; type theory and proof theory; concurrency theory and process calculi; rewriting theory; semantics of programming languages; program analysis, correctness, transformation, and verification; logics of programming; software specification and refinement; models of concurrent, reactive, stochastic, distributed, hybrid, and mobile systems; emerging models of computation; logical aspects of computational complexity; models of software security; and logical foundations of data bases.

Martin Davis on Computability, Computational Logic, and

Mathematical Foundations - Eugenio G. Omodeo 2017-01-27

This book presents a set of historical recollections on the work of Martin Davis and his role in advancing our understanding of the connections between logic, computing, and unsolvability. The individual contributions touch on most of the core aspects of Davis' work and set it in a contemporary context. They analyse, discuss and develop many of the ideas and concepts that Davis put forward, including such issues as contemporary satisfiability solvers, essential unification, quantum computing and generalisations of Hilbert's tenth problem. The book starts out with a scientific autobiography by Davis, and ends with his responses to comments included in the contributions. In addition, it includes two previously unpublished original historical papers in which

Davis and Putnam investigate the decidable and the undecidable side of Logic, as well as a full bibliography of Davis' work. As a whole, this book shows how Davis' scientific work lies at the intersection of computability, theoretical computer science, foundations of mathematics, and philosophy, and draws its unifying vision from his deep involvement in Logic.

Gödel's Disjunction - Leon Horsten 2016-09-08

The logician Kurt Gödel in 1951 established a disjunctive thesis about the scope and limits of mathematical knowledge: either the mathematical mind is not equivalent to a Turing machine (i.e., a computer), or there are absolutely undecidable mathematical problems. In the second half of the twentieth century, attempts have been made to arrive at a stronger conclusion. In particular, arguments have been produced by the philosopher J.R. Lucas and by the physicist and mathematician Roger Penrose that intend to show that the mathematical mind is more powerful than any computer. These arguments, and counterarguments to them, have not convinced the logical and philosophical community. The reason for this is an insufficiency of rigour in the debate. The contributions in this volume move the debate forward by formulating rigorous frameworks and formally spelling out and evaluating arguments that bear on Gödel's disjunction in these frameworks. The contributions in this volume have been written by world leading experts in the field.

Computation and Logic in the Real World - S. Barry Cooper 2007-06-11

This book constitutes the refereed proceedings of the Third International Conference on Computability in Europe, CiE 2007, held in Sienna, Italy, in June 2007. The 50 revised full papers presented together with 36 invited papers were carefully reviewed and selected from 167 submissions.

Reflections on the Foundations of Mathematics - Wilfried Sieg 2017-03-30

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 fifteenth publication in the Lecture Notes in Logic series, collects papers presented at the symposium 'Reflections on the Foundations of Mathematics' held in celebration of Solomon Feferman's 70th birthday (The 'Feferfest') at Stanford University, California in 1988. Feferman has shaped the field of foundational research for nearly half a century. These papers reflect his broad interests as well as his approach to foundational research, which emphasizes the solution of mathematical and philosophical problems. There are four sections, covering proof theoretic analysis, logic and computation, applicative and self-applicative theories, and philosophy of modern mathematical and logic thought.

Kurt Gödel and the Foundations of Mathematics - Matthias Baaz 2011-06-06

This volume commemorates the life, work and foundational views of Kurt Gödel (1906–78), most famous for his hallmark works on the completeness of first-order logic, the incompleteness of number theory, and the consistency - with the other widely accepted axioms of set theory - of the axiom of choice and of the generalized continuum hypothesis. It explores current research, advances and ideas for future directions not only in the foundations of mathematics and logic, but also in the fields of computer science, artificial intelligence, physics, cosmology, philosophy, theology and the history of science. The discussion is supplemented by personal reflections from several scholars who knew Gödel personally, providing some interesting insights into his life. By putting his ideas and life's work into the context of current thinking and perceptions, this book will extend the impact of Gödel's fundamental work in mathematics, logic, philosophy and other disciplines for future generations of researchers.

Logical Foundations of Computer Science - Sergei Artemov 2019-12-13

This book constitutes the refereed proceedings of the International Symposium on Logical Foundations of Computer Science, LFCS 2020, held in Deerfield Beach, FL, USA, in January 2020. The 17 revised full papers were carefully reviewed and selected from 30 submissions. The scope of the Symposium is broad and includes constructive mathematics

and type theory; homotopy type theory; logic, automata, and automatic structures; computability and randomness; logical foundations of programming; logical aspects of computational complexity; parameterized complexity; logic programming and constraints; automated deduction and interactive theorem proving; logical methods in protocol and program verification; logical methods in program specification and extraction; domain theory logics; logical foundations of database theory; equational logic and term rewriting; lambda and combinatory calculi; categorical logic and topological semantics; linear logic; epistemic and temporal logics; intelligent and multiple-agent system logics; logics of proof and justification; non-monotonic reasoning; logic in game theory and social software; logic of hybrid systems; distributed system logics; mathematical fuzzy logic; system design logics; other logics in computer science.

Principia Mathematica - Alfred North Whitehead 1910

Logical Foundations of Proof Complexity - Stephen Cook 2010-01-25

This book treats bounded arithmetic and propositional proof complexity from the point of view of computational complexity. The first seven chapters include the necessary logical background for the material and are suitable for a graduate course. Associated with each of many complexity classes are both a two-sorted predicate calculus theory, with induction restricted to concepts in the class, and a propositional proof system. The complexity classes range from AC_0 for the weakest theory up to the polynomial hierarchy. Each bounded theorem in a theory translates into a family of (quantified) propositional tautologies with polynomial size proofs in the corresponding proof system. The theory proves the soundness of the associated proof system. The result is a uniform treatment of many systems in the literature, including Buss's theories for the polynomial hierarchy and many disparate systems for complexity classes such as AC_0 , $AC_0(m)$, TC_0 , NC_1 , L , NL , NC , and P .

Computational Complexity - Sanjeev Arora 2009-04-20

New and classical results in computational complexity, including interactive proofs, PCP, derandomization, and quantum computation.

Ideal for graduate students.

Lectures on Logic and Computation - Nick Bezhanishvili 2012-06-23

The European Summer School in Logic, Language and Information (ESSLLI) is organized every year by the Association for Logic, Language and Information (FoLLI) in different sites around Europe. The main focus of ESSLLI is on the interface between linguistics, logic and computation. ESSLLI offers foundational, introductory and advanced courses, as well as workshops, covering a wide variety of topics within the three areas of interest: Language and Computation, Language and Logic, and Logic and Computation. During two weeks, around 50 courses and 10 workshops are offered to the attendants, each of 1.5 hours per day during a five days week, with up to seven parallel sessions. ESSLLI also includes a student session (papers and posters by students only, 1.5 hour per day during the two weeks) and four evening lectures by senior scientists in the covered areas. The 6 course notes were carefully reviewed and selected. The papers are organized in topical sections on computational complexity, multi-agent systems, natural language processing, strategies in games and formal semantics.

Logic and Complexity - Richard Lassaigne 2004-01-20

Logic and Complexity looks at basic logic as it is used in Computer Science, and provides students with a logical approach to Complexity theory. With plenty of exercises, this book presents classical notions of mathematical logic, such as decidability, completeness and incompleteness, as well as new ideas brought by complexity theory such as NP-completeness, randomness and approximations, providing a better understanding for efficient algorithmic solutions to problems. Divided into three parts, it covers: - Model Theory and Recursive Functions - introducing the basic model theory of propositional, 1st order, inductive definitions and 2nd order logic. Recursive functions, Turing computability and decidability are also examined. - Descriptive Complexity - looking at the relationship between definitions of problems, queries, properties of programs and their computational complexity. - Approximation - explaining how some optimization problems and counting problems can be approximated according to their logical form.

Logic is important in Computer Science, particularly for verification problems and database query languages such as SQL. Students and researchers in this field will find this book of great interest.

Logic Colloquium '01 - Matthias Baaz 2017-03-30

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 twentieth publication in the Lecture Notes in Logic series, contains the proceedings of the 2001 European Summer Meeting of the Association for Symbolic Logic, held at the Vienna University of Technology. Two long articles present accessible expositions on resolution theorem proving and the determinacy of long games. The remaining articles cover separate research topics in many areas of mathematical logic, including applications in computer science, proof theory, set theory, model theory, computability theory, linguistics and aspects of philosophy. This collection will interest not only mathematical logicians but also philosophical logicians, historians of logic, computer scientists, formal linguists and mathematicians working in algebra, abstract analysis and topology.

Models and Algorithms of Time-Dependent Scheduling - Stanisław Gawiejnowicz 2020-06-13

This is a comprehensive study of various time-dependent scheduling problems in single-, parallel- and dedicated-machine environments. In addition to complexity issues and exact or heuristic algorithms which are typically presented in scheduling books, the author also includes more advanced topics such as matrix methods in time-dependent scheduling, time-dependent scheduling with two criteria and time-dependent two-agent scheduling. The reader should be familiar with the basic notions of

calculus, discrete mathematics and combinatorial optimization theory, while the book offers introductory material on theory of algorithms, NP-complete problems, and the basics of scheduling theory. The author includes numerous examples, figures and tables, he presents different classes of algorithms using pseudocode, he completes all chapters with extensive bibliographies, and he closes the book with comprehensive symbol and subject indexes. The previous edition of the book focused on computational complexity of time-dependent scheduling problems. In this edition, the author concentrates on models of time-dependent job processing times and algorithms for solving time-dependent scheduling problems. The book is suitable for researchers working on scheduling, problem complexity, optimization, heuristics and local search algorithms.

Proof Complexity - Jan Krajíček 2019-03-28

Offers a self-contained work presenting basic ideas, classical results, current state of the art and possible future directions in proof complexity.

Logic and Computational Complexity - International Workshop on Logic and Computational Complexity 1995-08-02

This book contains revised versions of papers invited for presentation at the International Workshop on Logic and Computational Complexity, LCC '94, held in Indianapolis, IN in October 1994. The synergy between logic and computational complexity has gained importance and vigor in recent years, cutting across many areas. The 25 revised full papers in this book contributed by internationally outstanding researchers document the state-of-the-art in this interdisciplinary field of growing interest; they are presented in sections on foundational issues, applicative and proof-theoretic complexity, complexity of proofs, computational complexity of functionals, complexity and model theory, and finite model theory.