

# Mathematical Logic For Computer Science 2nd Edition

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## **A Course on Mathematical Logic** - Shashi Mohan Srivastava 2013-01-16

This is a short, modern, and motivated introduction to mathematical logic for upper undergraduate and beginning graduate students in mathematics and computer science. Any mathematician who is interested in getting acquainted with logic and would like to learn Gödel's incompleteness theorems should find this book particularly useful. The treatment is thoroughly mathematical and prepares students to branch out in several areas of mathematics related to foundations and computability, such as logic, axiomatic set theory, model theory, recursion theory, and computability. In this new edition, many small and large changes have been made throughout the text. The main purpose of this new edition is to provide a healthy first introduction to model theory, which is a very important branch of logic. Topics in the new chapter include ultraproduct of models, elimination of quantifiers, types, applications of types to model theory, and applications to algebra, number theory and geometry. Some proofs, such as the proof of the very important completeness theorem, have been completely rewritten in a more clear and concise manner. The new edition also introduces new topics, such as the notion of elementary class of structures, elementary diagrams, partial elementary maps, homogeneous structures, definability, and many more.

## **Mathematical Logic** - Wei Li 2014-11-07

Mathematical logic is a branch of mathematics that takes axiom systems and mathematical proofs as its objects of study. This book shows how it can also provide a foundation for the development of information science and technology. The first five chapters systematically present the core topics of classical mathematical logic, including the syntax and models of first-order languages, formal inference systems, computability and representability, and Gödel's theorems. The last five chapters present extensions and developments of classical mathematical logic, particularly the concepts of version sequences of formal theories and their limits, the system of revision calculus, proschemes (formal descriptions of proof methods and strategies) and their properties, and the theory of inductive inference. All of these themes contribute to a formal theory of axiomatization and its application to the process of developing information technology and scientific theories. The book also describes the paradigm of three kinds of language environments for theories and it presents the basic properties required of a meta-language environment. Finally, the book brings these themes together by describing a workflow for scientific research in the information era in which formal methods, interactive software and human invention are all used to their advantage. The second edition of the book includes major revisions on the proof of the completeness theorem of the Gentzen system and new contents on the logic of scientific discovery, R-calculus without cut, and the operational semantics of program debugging. This book represents a valuable reference for graduate and undergraduate students and researchers in mathematics, information science and technology, and other relevant areas of natural sciences. Its first five chapters serve as an undergraduate text in mathematical logic and the last five chapters are addressed to graduate students in relevant disciplines.

## **Logic, Sets, and Recursion** - Robert L. Causey 2006

The new Second Edition incorporates a wealth of exercise sets, allowing students to test themselves and review important topics discussed throughout the text."--Jacket.

## **Connecting Discrete Mathematics and Computer Science** - David Liben-Nowell 2022-08-04

An approachable textbook connecting the mathematical foundations of computer science to broad-ranging and compelling applications throughout the field.

## **Concrete Mathematics: A Foundation for Computer Science** - Ronald L. Graham 1994

## **Logic, Mathematics, and Computer Science** - Yves Nievergelt 2015-10-13

This text for the first or second year undergraduate in mathematics, logic, computer science, or social sciences, introduces the reader to logic, proofs, sets, and number theory. It also serves as an excellent independent study reference and resource for instructors. Adapted from Foundations of Logic and Mathematics: Applications to Science and Cryptography © 2002 Birkhäuser, this second edition provides a modern introduction to the foundations of logic, mathematics, and computers science, developing the theory that demonstrates construction of all mathematics and theoretical computer science from logic and set theory. The focuses is on foundations, with specific statements of all the associated axioms and rules of logic and set theory, and provides complete details and derivations of formal proofs. Copious references to literature that document historical development is also provided. Answers are found to many questions that usually remain unanswered: Why is the truth table for logical implication so unintuitive? Why are there no recipes to design proofs? Where do these numerous mathematical rules come from? What issues in logic, mathematics, and computer science still remain unresolved? And the perennial question: In what ways are we going to use this material? Additionally, the selection of topics presented reflects many major accomplishments from the twentieth century and includes applications in game theory and Nash's equilibrium, Gale and Shapley's match making algorithms, Arrow's Impossibility Theorem in voting, to name a few. From the reviews of the first edition: "...All the results are proved in full detail from first principles...remarkably, the arithmetic laws on the rational numbers are proved, step after step, starting from the very definitions!...This is a valuable reference text and a useful companion for anybody wondering how basic mathematical concepts can be rigorously developed within set theory." —MATHEMATICAL REVIEWS "Rigorous and modern in its theoretical aspect, attractive as a detective novel in its applied aspects, this paper book deserves the attention of both beginners and advanced students in mathematics, logic and computer sciences as well as in social sciences." —Zentralblatt MATH

## **Mathematical Logic for Computer Science** - Mordechai Ben-Ari 2012-12-06

This is a mathematics textbook with theorems and proofs. The choice of topics has been guided by the needs of computer science students. The method of semantic tableaux provides an elegant way to teach logic that is both theoretically sound and yet sufficiently elementary for undergraduates. In order to provide a balanced treatment of logic, tableaux are related to deductive proof systems. The book presents various logical systems and contains exercises. Still further, Prolog source code is available on an accompanying Web site. The author is an Associate Professor at the Department of Science Teaching, Weizmann Institute of Science. [Mathematical Logic for Computer Science](#) - M. Ben-Ari 2003

## **Discrete Mathematics Using a Computer** - Cordelia Hall 2013-04-17

Several areas of mathematics find application throughout computer science, and all students of computer science need a practical working understanding of them. These core subjects are centred on logic, sets, recursion, induction, relations and functions. The material is often called discrete mathematics, to distinguish it from the traditional topics of continuous mathematics such as integration and differential equations. The central theme of this book is the connection between computing and discrete mathematics. This connection is useful in both directions: • Mathematics is used in many branches of computer science, in applications including program specification, datastructures, design and analysis of algorithms, database systems, hardware design, reasoning about the correctness of implementations, and much more; • Computers can

help to make the mathematics easier to learn and use, by making mathematical terms executable, making abstract concepts more concrete, and through the use of software tools such as proof checkers. These connections are emphasised throughout the book. Software tools (see Appendix A) enable the computer to serve as a calculator, but instead of just doing arithmetic and trigonometric functions, it will be used to calculate with sets, relations, functions, predicates and inferences. There are also special software tools, for example a proof checker for logical proofs using natural deduction.

**A Course in Mathematical Logic** - Yu.I. Manin 2013-06-29

1. This book is above all addressed to mathematicians. It is intended to be a textbook of mathematical logic on a sophisticated level, presenting the reader with several of the most significant discoveries of the last ten or fifteen years. These include: the independence of the continuum hypothesis, the Diophantine nature of enumerable sets, the impossibility of finding an algorithmic solution for one or two old problems. All the necessary preliminary material, including predicate logic and the fundamentals of recursive function theory, is presented systematically and with complete proofs. We only assume that the reader is familiar with "naive" set theoretic arguments. In this book mathematical logic is presented both as a part of mathematics and as the result of its self-perception. Thus, the substance of the book consists of difficult proofs of subtle theorems, and the spirit of the book consists of attempts to explain what these theorems say about the mathematical way of thought. Foundational problems are for the most part passed over in silence. Most likely, logic is capable of justifying mathematics to no greater extent than biology is capable of justifying life.

2. The first two chapters are devoted to predicate logic. The presentation here is fairly standard, except that semantics occupies a very dominant position, truth is introduced before deducibility, and models of speech in formal languages precede the systematic study of syntax.

**Mathematical Logic** - H.-D. Ebbinghaus 2013-03-14

This introduction to first-order logic clearly works out the role of first-order logic in the foundations of mathematics, particularly the two basic questions of the range of the axiomatic method and of theorem-proving by machines. It covers several advanced topics not commonly treated in introductory texts, such as Fraïssé's characterization of elementary equivalence, Lindström's theorem on the maximality of first-order logic, and the fundamentals of logic programming.

**Logic for Computer Science** - Steve Reeves 1990

An understanding of logic is essential to computer science. This book provides a highly accessible account of the logical basis required for reasoning about computer programs and applying logic in fields like artificial intelligence. The text contains extended examples, algorithms, and programs written in Standard ML and Prolog. No prior knowledge of either language is required. The book contains a clear account of classical first-order logic, one of the basic tools for program verification, as well as an introductory survey of modal and temporal logics and possible world semantics. An introduction to intuitionistic logic as a basis for an important style of program specification is also featured in the book.

**Foundations of Logic and Mathematics** - Yves Nievergelt 2012-12-06

This modern introduction to the foundations of logic and mathematics not only takes theory into account, but also treats in some detail applications that have a substantial impact on everyday life (loans and mortgages, bar codes, public-key cryptography). A first college-level introduction to logic, proofs, sets, number theory, and graph theory, and an excellent self-study reference and resource for instructors.

**LOGICS FOR COMPUTER SCIENCE, SECOND EDITION** - SINGH, ARINDAMA 2018-06-01

Designed primarily as an introductory text on logic for computer science, this well-organized book deals with almost all the basic concepts and techniques that are pertinent to the subject. It provides an excellent understanding of the logics used in computer science today. Starting with the logic of propositions, it gives a detailed coverage of first order logic and modal logics. It discusses various approaches to the proof theory of the logics, e.g. axiomatic systems, natural deduction systems, Gentzen systems, analytic tableau, and resolution. It deals with an important application of logic to computer science, namely, verification of programs. The book gives the flavour of logic engineering through computation tree logic, a logic of model checking. The book concludes with a fairly detailed discussion on nonstandard logics including intuitionistic logic, Lukasiewicz logics, default logic, autoepistemic logic, and fuzzy logic. The Second Edition includes applications of compactness theorem to many interesting problems relevant to mathematics and computer

science. It also presents the undecidability of first order logic, inexpressibility of truth, and incompleteness of Peano's Arithmetic in a comprehensive and lively manner. Besides students of Computer Science, those offering courses in Mathematics and Philosophy would greatly benefit from this study. KEY FEATURES • Provides numerous worked-out examples which not only illustrate the concepts and theory developed, but also give a lead to the succeeding notions. • Exercises at the end of each section aim at reinforcing and mastering the techniques, raising issues and preparing background for further development of the subject. • Problems of theoretical nature, which are important for learning the subject, are included at the end of each chapter. • The reader is constantly provoked to work out the details, promoting interactive learning.

**Logic in Computer Science** - Michael Huth 2004-08-26

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.

**Mathematical Logic for Computer Science** - Lu Zhongwan 1998-08-22

Mathematical logic is essentially related to computer science. This book describes the aspects of mathematical logic that are closely related to each other, including classical logic, constructive logic, and modal logic. This book is intended to attend to both the peculiarities of logical systems and the requirements of computer science. In this edition, the revisions essentially involve rewriting the proofs, increasing the explanations, and adopting new terms and notations. Contents: Prerequisites: Sets Inductive Definitions and Proofs Notations Classical Propositional Logic: Propositions and Connectives Propositional Language Structure of Formulas Semantics Tautological Consequence Formal Deduction Disjunctive and Conjunctive Normal Forms Adequate Sets of Connectives Classical First-Order Logic: Proposition Functions and Quantifiers First-Order Language Semantics Logical Consequence Formal Deduction Prenex Normal Form Axiomatic Deduction System: Axiomatic Deduction System Relation between the Two Deduction Systems Soundness and Completeness: Satisfiability and Validity Soundness Completeness of Propositional Logic Completeness of First-Order Logic Completeness of First-Order Logic with Equality Independence Compactness, Löwenheim-Skolem, and Herbrand Theorems: Compactness Löwenheim-Skolem's Theorem Herbrand's Theorem Constructive Logic: Constructivity of Proofs Semantics Formal Deduction Soundness Completeness Modal Propositional Logic: Modal Propositional Language Semantics Formal Deduction Soundness Completeness of T Completeness of S4, B, S5 Modal First-Order Logic: Modal First-Order Language Semantics Formal Deduction Soundness Completeness Equality Readership: Computer scientists. keywords:

**Logic for Mathematics and Computer Science** - Stanley Burris 1998

This text is intended for one semester courses in Logic, it can also be applied to a two semester course, in either Computer Science or Mathematics Departments. Unlike other texts on mathematical logic that are either too advanced, too sparse in examples or exercises, too traditional in coverage, or too philosophical in approach, this text provides an elementary "hands-on" presentation of important mathematical logic topics, new and old, that is readily accessible and relevant to all students of the mathematical sciences -- not just those in traditional pure mathematics.

**Logic for Applications** - Anil Nerode 2012-12-06

In writing this book, our goal was to produce a text suitable for a first course in mathematical logic more attuned than the traditional textbooks to the recent dramatic growth in the applications of logic to computer science. Thus our choice of topics has been heavily influenced by such applications. Of course, we cover the basic traditional topics - syntax, semantics, soundness, completeness and compactness - as well as a few more advanced results such as the theorems of Skolem-Löwenheim and Herbrand. Much of our book, however, deals with other less traditional topics. Resolution theorem proving plays a major role in our

treatment of logic, especially in its application to Logic Programming and PROLOG. We deal extensively with the mathematical foundations of all three of these subjects. In addition, we include two chapters on nonclassical logic- modal and intuitionistic - that are becoming increasingly important in computer science. We develop the basic material on the syntax and semantics (via Kripke frames) for each of these logics. In both cases, our approach to formal proofs, soundness and completeness uses modifications of the same tableau method introduced for classical logic. We indicate how it can easily be adapted to various other special types of modal logics. A number of more advanced topics (including nonmonotonic logic) are also briefly introduced both in the nonclassical logic chapters and in the material on Logic Programming and PROLOG.

Mathematical Logic - George Tourlakis 2011-03-01

A comprehensive and user-friendly guide to the use of logic in mathematical reasoning. Mathematical Logic presents a comprehensive introduction to formal methods of logic and their use as a reliable tool for deductive reasoning. With its user-friendly approach, this book successfully equips readers with the key concepts and methods for formulating valid mathematical arguments that can be used to uncover truths across diverse areas of study such as mathematics, computer science, and philosophy. The book develops the logical tools for writing proofs by guiding readers through both the established "Hilbert" style of proof writing, as well as the "equational" style that is emerging in computer science and engineering applications. Chapters have been organized into the two topical areas of Boolean logic and predicate logic. Techniques situated outside formal logic are applied to illustrate and demonstrate significant facts regarding the power and limitations of logic, such as: Logic can certify truths and only truths. Logic can certify all absolute truths (completeness theorems of Post and Gödel). Logic cannot certify all "conditional" truths, such as those that are specific to the Peano arithmetic. Therefore, logic has some serious limitations, as shown through Gödel's incompleteness theorem. Numerous examples and problem sets are provided throughout the text, further facilitating readers' understanding of the capabilities of logic to discover mathematical truths. In addition, an extensive appendix introduces Tarski semantics and proceeds with detailed proofs of completeness and first incompleteness theorems, while also providing a self-contained introduction to the theory of computability. With its thorough scope of coverage and accessible style, Mathematical Logic is an ideal book for courses in mathematics, computer science, and philosophy at the upper-undergraduate and graduate levels. It is also a valuable reference for researchers and practitioners who wish to learn how to use logic in their everyday work.

**A Mathematical Introduction to Logic** - Herbert Enderton 2001-01-23

A Mathematical Introduction to Logic, Second Edition, offers increased flexibility with topic coverage, allowing for choice in how to utilize the textbook in a course. The author has made this edition more accessible to better meet the needs of today's undergraduate mathematics and philosophy students. It is intended for the reader who has not studied logic previously, but who has some experience in mathematical reasoning. Material is presented on computer science issues such as computational complexity and database queries, with additional coverage of introductory material such as sets. \* Increased flexibility of the text, allowing instructors more choice in how they use the textbook in courses. \* Reduced mathematical rigour to fit the needs of undergraduate students

*A Concise Introduction to Mathematical Logic* - Wolfgang Rautenberg 2010-07-01

Mathematical logic developed into a broad discipline with many applications in mathematics, informatics, linguistics and philosophy. This text introduces the fundamentals of this field, and this new edition has been thoroughly expanded and revised.

**MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE, Second Edition** - BATHUL, SHAHNAZ 2015-10-31

This book, in its Second Edition, provides the basic concepts and applications of discrete mathematics and graph theory. The book is aimed at undergraduate students of computer science and engineering, and information technology. It is also suitable for undergraduate and postgraduate students of computer science, mathematics and computer applications. The book exposes the students to fundamental knowledge in: - Mathematical logic, tautology and normal forms - Elementary set theory, functions and their relations - Algebraic structure, binary operation, group theory and homomorphism - Theory of permutations and combinations, binomial and multinomial theorems - Recurrence relations and methods of solving them -

Graph theory, spanning tree, Eulerian and Hamiltonian circuits and isomorphism Key Features Includes a large number of worked-out problems for sound understanding of the concepts. Offers chapter-end exercises to test students' comprehension of theory. Gives a quiz section at the end of each chapter to help students prepare for the competitive examinations. Incorporates short questions asked in universities' examinations.

**Mathematical Logic** - Wei Li 2010-02-26

Mathematical logic is a branch of mathematics that takes axiom systems and mathematical proofs as its objects of study. This book shows how it can also provide a foundation for the development of information science and technology. The first five chapters systematically present the core topics of classical mathematical logic, including the syntax and models of first-order languages, formal inference systems, computability and representability, and Gödel's theorems. The last five chapters present extensions and developments of classical mathematical logic, particularly the concepts of version sequences of formal theories and their limits, the system of revision calculus, proschemes (formal descriptions of proof methods and strategies) and their properties, and the theory of inductive inference. All of these themes contribute to a formal theory of axiomatization and its application to the process of developing information technology and scientific theories. The book also describes the paradigm of three kinds of language environments for theories and it presents the basic properties required of a meta-language environment. Finally, the book brings these themes together by describing a workflow for scientific research in the information era in which formal methods, interactive software and human invention are all used to their advantage. This book represents a valuable reference for graduate and undergraduate students and researchers in mathematics, information science and technology, and other relevant areas of natural sciences. Its first five chapters serve as an undergraduate text in mathematical logic and the last five chapters are addressed to graduate students in relevant disciplines.

**Mathematical Logic for Computer Science** - Mordechai Ben-Ari 2012-06-16

Mathematical Logic for Computer Science is a mathematics textbook with theorems and proofs, but the choice of topics has been guided by the needs of students of computer science. The method of semantic tableaux provides an elegant way to teach logic that is both theoretically sound and easy to understand. The uniform use of tableaux-based techniques facilitates learning advanced logical systems based on what the student has learned from elementary systems. The logical systems presented are: propositional logic, first-order logic, resolution and its application to logic programming, Hoare logic for the verification of sequential programs, and linear temporal logic for the verification of concurrent programs. The third edition has been entirely rewritten and includes new chapters on central topics of modern computer science: SAT solvers and model checking.

*Logic for Computer Scientists* - Uwe Schöning 2009-11-03

This book introduces the notions and methods of formal logic from a computer science standpoint, covering propositional logic, predicate logic, and foundations of logic programming. The classic text is replete with illustrative examples and exercises. It presents applications and themes of computer science research such as resolution, automated deduction, and logic programming in a rigorous but readable way. The style and scope of the work, rounded out by the inclusion of exercises, make this an excellent textbook for an advanced undergraduate course in logic for computer scientists.

Mathematical Logic For Computer Science, 2E - Ben-Ari 2005-01-01

Logic for Computer Scientists - Uwe Schöning 1994-07-15

This book introduces the notions and methods of formal logic from a computer science standpoint, covering propositional logic, predicate logic, and foundations of logic programming. The classic text is replete with illustrative examples and exercises. It presents applications and themes of computer science research such as resolution, automated deduction, and logic programming in a rigorous but readable way. The style and scope of the work, rounded out by the inclusion of exercises, make this an excellent textbook for an advanced undergraduate course in logic for computer scientists.

Mathematical Logic - R.O. Gandy 2001-12-05

Mathematical Logic is a collection of the works of one of the leading figures in 20th-century science. This collection of A.M. Turing's works is intended to include all his mature scientific writing, including a substantial

quantity of unpublished material. His work in pure mathematics and mathematical logic extended considerably further; the work of his last years, on morphogenesis in plants, is also of the greatest originality and of permanent importance. This book is divided into three parts. The first part focuses on computability and ordinal logics and covers Turing's work between 1937 and 1938. The second part covers type theory; it provides a general introduction to Turing's work on type theory and covers his published and unpublished works between 1941 and 1948. Finally, the third part focuses on enigmas, mysteries, and loose ends. This concluding section of the book discusses Turing's Treatise on the Enigma, with excerpts from the Enigma Paper. It also delves into Turing's papers on programming and on minimum cost sequential analysis, featuring an excerpt from the unpublished manuscript. This book will be of interest to mathematicians, logicians, and computer scientists.

*Basic Proof Theory* - A. S. Troelstra 2000-07-27

This introduction to the basic ideas of structural proof theory contains a thorough discussion and comparison of various types of formalization of first-order logic. Examples are given of several areas of application, namely: the metamathematics of pure first-order logic (intuitionistic as well as classical); the theory of logic programming; category theory; modal logic; linear logic; first-order arithmetic and second-order logic. In each case the aim is to illustrate the methods in relatively simple situations and then apply them elsewhere in much more complex settings. There are numerous exercises throughout the text. In general, the only prerequisite is a standard course in first-order logic, making the book ideal for graduate students and beginning researchers in mathematical logic, theoretical computer science and artificial intelligence. For the new edition, many sections have been rewritten to improve clarity, new sections have been added on cut elimination, and solutions to selected exercises have been included.

**A Friendly Introduction to Mathematical Logic** - Christopher C. Leary 2015

At the intersection of mathematics, computer science, and philosophy, mathematical logic examines the power and limitations of formal mathematical thinking. In this expansion of Leary's user-friendly 1st edition, readers with no previous study in the field are introduced to the basics of model theory, proof theory, and computability theory. The text is designed to be used either in an upper division undergraduate classroom, or for self study. Updating the 1st Edition's treatment of languages, structures, and deductions, leading to rigorous proofs of Gödel's First and Second Incompleteness Theorems, the expanded 2nd Edition includes a new introduction to incompleteness through computability as well as solutions to selected exercises.

Mathematics for Computer Science - Eric Lehman 2017-03-08

This book covers elementary discrete mathematics for computer science and engineering. It emphasizes mathematical definitions and proofs as well as applicable methods. Topics include formal logic notation, proof methods; induction, well-ordering; sets, relations; elementary graph theory; integer congruences; asymptotic notation and growth of functions; permutations and combinations, counting principles; discrete probability. Further selected topics may also be covered, such as recursive definition and structural induction; state machines and invariants; recurrences; generating functions.

**Three Views of Logic** - Donald W. Loveland 2014-01-26

Demonstrating the different roles that logic plays in the disciplines of computer science, mathematics, and philosophy, this concise undergraduate textbook covers select topics from three different areas of logic: proof theory, computability theory, and nonclassical logic. The book balances accessibility, breadth, and rigor, and is designed so that its materials will fit into a single semester. Its distinctive presentation of traditional logic material will enhance readers' capabilities and mathematical maturity. The proof theory portion presents classical propositional logic and first-order logic using a computer-oriented (resolution) formal system. Linear resolution and its connection to the programming language Prolog are also treated. The computability component offers a machine model and mathematical model for computation, proves the equivalence of the two approaches, and includes famous decision problems unsolvable by an algorithm. The section on nonclassical logic discusses the shortcomings of classical logic in its treatment of implication and an alternate approach that improves upon it: Anderson and Belnap's relevance logic. Applications are included in each section. The material on a four-valued semantics for relevance logic is presented in textbook form for the first time. Aimed at upper-level undergraduates of moderate analytical background, *Three Views of Logic* will be useful in a variety of classroom settings. Gives an exceptionally broad view of

logic Treats traditional logic in a modern format Presents relevance logic with applications Provides an ideal text for a variety of one-semester upper-level undergraduate courses

**Logic And Discrete Mathematics: A Computer Science Perspective** - Grassmann 2007-09

Mathematical Logic for Computer Science - Zhongwan Lu 1998

Mathematical logic is essentially related to computer science. This book describes the aspects of mathematical logic that are closely related to each other, including classical logic, constructive logic, and modal logic. This book is intended to attend to both the peculiarities of logical systems and the requirements of computer science. In this edition, the revisions essentially involve rewriting the proofs, increasing the explanations, and adopting new terms and notations.

Logic and Complexity - Richard Lassaing 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.

Essential Logic for Computer Science - Rex Page 2019-01-08

An introduction to applying predicate logic to testing and verification of software and digital circuits that focuses on applications rather than theory. Computer scientists use logic for testing and verification of software and digital circuits, but many computer science students study logic only in the context of traditional mathematics, encountering the subject in a few lectures and a handful of problem sets in a discrete math course. This book offers a more substantive and rigorous approach to logic that focuses on applications in computer science. Topics covered include predicate logic, equation-based software, automated testing and theorem proving, and large-scale computation. Formalism is emphasized, and the book employs three formal notations: traditional algebraic formulas of propositional and predicate logic; digital circuit diagrams; and the widely used partially automated theorem prover, ACL2, which provides an accessible introduction to mechanized formalism. For readers who want to see formalization in action, the text presents examples using Proof Pad, a lightweight ACL2 environment. Readers will not become ACL2 experts, but will learn how mechanized logic can benefit software and hardware engineers. In addition, 180 exercises, some of them extremely challenging, offer opportunities for problem solving. There are no prerequisites beyond high school algebra. Programming experience is not required to understand the book's equation-based approach. The book can be used in undergraduate courses in logic for computer science and introduction to computer science and in math courses for computer science students.

Logic for Computer Science - Jean H. Gallier 2015-06-18

This advanced text for undergraduate and graduate students introduces mathematical logic with an emphasis on proof theory and procedures for algorithmic construction of formal proofs. The self-contained treatment is also useful for computer scientists and mathematically inclined readers interested in the formalization of proofs and basics of automatic theorem proving. Topics include propositional logic and its resolution, first-order logic, Gentzen's cut elimination theorem and applications, and Gentzen's sharpened Hauptsatz and Herbrand's theorem. Additional subjects include resolution in first-order logic; SLD-resolution, logic programming, and the foundations of PROLOG; and many-sorted first-order logic. Numerous problems appear throughout the book, and two Appendixes provide practical background information.

*First-Order Logic and Automated Theorem Proving* - Melvin Fitting 2012-12-06

There are many kinds of books on formal logic. Some have philosophers as their intended audience, some

mathematicians, some computer scientists. Although there is a common core to all such books, they will be very different in emphasis, methods, and even appearance. This book is intended for computer scientists. But even this is not precise. Within computer science formal logic turns up in a number of areas, from program verification to logic programming to artificial intelligence. This book is intended for computer scientists interested in automated theorem proving in classical logic. To be more precise yet, it is essentially a theoretical treatment, not a how-to book, although how-to issues are not neglected. This does not mean, of course, that the book will be of no interest to philosophers or mathematicians. It does contain a thorough presentation of formal logic and many proof techniques, and as such it contains all the material one would expect to find in a course in formal logic covering completeness but, not incompleteness issues. The first item to be addressed is, What are we talking about and why are we interested in it? We are primarily talking about truth as used in mathematical discourse, and our interest in it is, or should be, self evident. Truth is a semantic concept, so we begin with models and their properties. These are used to define our subject.

Discrete Structures, Logic, and Computability - James L. Hein 2001

Discrete Structure, Logic, and Computability introduces the beginning computer science student to some of the fundamental ideas and techniques used by computer scientists today, focusing on discrete structures,

logic, and computability. The emphasis is on the computational aspects, so that the reader can see how the concepts are actually used. Because of logic's fundamental importance to computer science, the topic is examined extensively in three phases that cover informal logic, the technique of inductive proof; and formal logic and its applications to computer science.

**Sets, Logic and Maths for Computing** - David Makinson 2012-02-27

This easy-to-follow textbook introduces the mathematical language, knowledge and problem-solving skills that undergraduates need to study computing. The language is in part qualitative, with concepts such as set, relation, function and recursion/induction; but it is also partly quantitative, with principles of counting and finite probability. Entwined with both are the fundamental notions of logic and their use for representation and proof. Features: teaches finite math as a language for thinking, as much as knowledge and skills to be acquired; uses an intuitive approach with a focus on examples for all general concepts; brings out the interplay between the qualitative and the quantitative in all areas covered, particularly in the treatment of recursion and induction; balances carefully the abstract and concrete, principles and proofs, specific facts and general perspectives; includes highlight boxes that raise common queries and clear confusions; provides numerous exercises, with selected solutions.