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## **A Mathematical Introduction to Logic** *Elsevier*

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 Mathematical Introduction to Logic** *Elsevier*

This book gives a mathematical treatment of the basic ideas and results of logic. It is intended to serve as a textbook for an introductory mathematics course in logic at the junior-senior level. The objectives are to present the important concepts and theorems of logic and to explain their significance and their relationship to the reader's other mathematical work.

**An Introduction to Mathematical Logic** *Courier Corporation*

This comprehensive overview of mathematical logic is designed primarily for advanced undergraduates and graduate students of mathematics. The treatment also contains much of interest to advanced students in computer science and philosophy. Topics include propositional logic; first-order languages and logic; incompleteness, undecidability, and indefinability; recursive functions; computability; and Hilbert's Tenth Problem. Reprint of the PWS Publishing Company, Boston, 1995 edition.

**A Friendly Introduction to Mathematical Logic** *Lulu.com*

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 Godel'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.

**Introduction to Mathematical Logic** *World Scientific*

This is a systematic and well-paced introduction to mathematical logic. Excellent as a course text, the book does not presuppose any previous knowledge and can be used also for self-study by more ambitious students. Starting with the basics of set theory, induction and computability, it covers propositional and first-order logic their syntax, reasoning systems and semantics. Soundness and completeness results for Hilbert's and Gentzen's systems are presented, along with simple decidability arguments. The general applicability of various concepts and techniques is demonstrated by highlighting their consistent reuse in different contexts. Unlike in most comparable texts, presentation of syntactic reasoning systems precedes the semantic explanations. The simplicity of syntactic constructions and rules of a high, though often neglected, pedagogical value aids students in approaching more complex semantic issues. This order of presentation also brings forth the relative independence of syntax from the semantics, helping to appreciate the importance of the purely symbolic systems, like those underlying computers. An overview of the history of logic precedes the main text, in which careful presentation of concepts, results and examples is accompanied by the

informal analogies and illustrations. These informal aspects are kept clearly apart from the technical ones. Together, they form a unique text which may be appreciated equally by lecturers and students occupied with mathematical precision, as well as those interested in the relations of logical formalisms to the problems of computability and the philosophy of mathematical logic.

**Introduction to Logic** *Courier Corporation*

Part I of this coherent, well-organized text deals with formal principles of inference and definition. Part II explores elementary intuitive set theory, with separate chapters on sets, relations, and functions. Ideal for undergraduates.

**Introduction to Mathematical Logic** *Springer Science & Business Media*

This is a compact introduction to some of the principal topics of mathematical logic. In the belief that beginners should be exposed to the most natural and easiest proofs, I have used free-swinging set-theoretic methods. The significance of a demand for constructive proofs can be evaluated only after a certain amount of experience with mathematical logic has been obtained. If we are to be expelled from "Cantor's paradise" (as nonconstructive set theory was called by Hilbert), at least we should know what we are missing. The major changes in this new edition are the following. (1) In Chapter 5, Effective Computability, Turing-computability is now the central notion, and diagrams (flow-charts) are used to construct Turing machines. There are also treatments of Markov algorithms, Herbrand-Gödel-computability, register machines, and random access machines. Recursion theory is gone into a little more deeply,

including the s-m-n theorem, the recursion theorem, and Rice's Theorem. (2) The proofs of the Incompleteness Theorems are now based upon the Diagonalization Lemma. Löb's Theorem and its connection with Gödel's Second Theorem are also studied. (3) In Chapter 2, Quantification Theory, Henkin's proof of the completeness theorem has been postponed until the reader has gained more experience in proof techniques. The exposition of the proof itself has been improved by breaking it down into smaller pieces and using the notion of a scapegoat theory. There is also an entirely new section on semantic trees.

**Elements of Set Theory** *Academic Press*

This is an introductory undergraduate textbook in set theory. In mathematics these days, essentially everything is a set. Some knowledge of set theory is necessary part of the background everyone needs for further study of mathematics. It is also possible to study set theory for its own interest--it is a subject with intriguing results about simple objects. This book starts with material that nobody can do without. There is no end to what can be learned of set theory, but here is a beginning.

**A Profile of Mathematical Logic** *Courier Corporation*

This introduction to mathematical logic explores philosophical issues and Gödel's Theorem. Its widespread influence extends to the author of Gödel, Escher, Bach, whose Pulitzer Prize-winning book was inspired by this work.

**Mathematical Logic** *Springer Science & Business Media*

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.

**An Algebraic Introduction to Mathematical Logic** *Springer Science & Business Media*

This book is intended for mathematicians. Its origins lie in a course of lectures given by an algebraist to a class which had just completed a substantial course on abstract algebra. Consequently, our treatment of the subject is algebraic. Although we assume a reasonable level of sophistication in algebra, the text requires little more than the basic notions of group, ring, module, etc. A more detailed knowledge of algebra is required for some of the exercises. We also assume a familiarity with the main ideas of set theory, including cardinal numbers and Zorn's Lemma. In this book, we carry out a mathematical study of the logic used in mathematics. We do this by constructing a mathematical model of logic and applying mathematics to analyse the properties of the model. We therefore regard all our existing knowledge of mathematics as being applicable to the analysis of the model, and in particular we accept set theory as part of the meta-language. We are not attempting to construct a foundation on which all mathematics is to be based—rather, any conclusions to be drawn about the foundations of mathematics

come only by analogy with the model, and are to be regarded in much the same way as the conclusions drawn from any scientific theory.

**A Concise Introduction to Mathematical Logic** *Springer*

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.

**Mathematics and Logic** *Courier Corporation*

Fascinating study of the origin and nature of mathematical thought, including relation of mathematics and science, 20th-century developments, impact of computers, and more. Includes 34 illustrations. 1968 edition."

**An Introduction to Mathematical Logic and Type Theory**

**To Truth Through Proof** *Springer Science & Business Media*

In case you are considering to adopt this book for courses with over 50 students, please contact [ties.nijssen@springer.com](mailto:ties.nijssen@springer.com) for more information. This introduction to mathematical logic starts with propositional calculus and first-order logic. Topics covered include syntax, semantics, soundness, completeness, independence, normal forms, vertical paths through negation normal formulas, compactness, Smullyan's Unifying Principle, natural deduction, cut-elimination, semantic tableaux, Skolemization, Herbrand's Theorem, unification, duality, interpolation, and definability. The last three chapters of

the book provide an introduction to type theory (higher-order logic). It is shown how various mathematical concepts can be formalized in this very expressive formal language. This expressive notation facilitates proofs of the classical incompleteness and undecidability theorems which are very elegant and easy to understand. The discussion of semantics makes clear the important distinction between standard and nonstandard models which is so important in understanding puzzling phenomena such as the incompleteness theorems and Skolem's Paradox about countable models of set theory. Some of the numerous exercises require giving formal proofs. A computer program called ETPS which is available from the web facilitates doing and checking such exercises. Audience: This volume will be of interest to mathematicians, computer scientists, and philosophers in universities, as well as to computer scientists in industry who wish to use higher-order logic for hardware and software specification and verification.

**A Mathematical Introduction to Logic** *Academic Press*

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

**Mathematical Logic** *Courier Corporation*

Contents include an elementary but thorough overview of mathematical logic of 1st order; formal number theory; surveys of the work by Church, Turing, and others, including Gödel's completeness theorem, Gentzen's theorem, more.

**Introduction to Elementary Mathematical Logic** *Courier Corporation*

This lucid, non-intimidating presentation by a Russian scholar explores propositional logic, propositional calculus, and predicate logic. Topics include computer science and systems analysis, linguistics, and problems in the foundations of mathematics. Accessible to high school students, it also constitutes a valuable review of fundamentals for professionals. 1970 edition.

**Logic and Discrete Mathematics**

**A Concise Introduction, Solutions Manual** *John Wiley & Sons*

Solutions manual to accompany Logic and Discrete Mathematics: A Concise Introduction This book features a unique combination of comprehensive coverage of logic with a solid exposition of the most important fields of discrete mathematics, presenting material that has been tested and refined by the authors in university courses taught over more than a decade. Written in a clear and reader-friendly style, each section

ends with an extensive set of exercises, most of them provided with complete solutions which are available in this accompanying solutions manual.

**First-Order Logic** *Springer Science & Business Media*

Except for this preface, this study is completely self-contained. It is intended to serve both as an introduction to Quantification Theory and as an exposition of new results and techniques in "analytic" or "cut-free" methods. We use the term "analytic" to apply to any proof procedure which obeys the subformula principle (we think of such a procedure as "analysing" the formula into its successive components). Gentzen cut-free systems are perhaps the best known example of analytic proof procedures. Natural deduction systems, though not usually analytic, can be made so (as we demonstrated in [3]). In this study, we emphasize the tableau point of view, since we are struck by its simplicity and mathematical elegance. Chapter I is completely introductory. We begin with preliminary material on trees (necessary for the tableau method), and then treat the basic syntactic and semantic fundamentals of propositional logic. We use the term "Boolean valuation" to mean any assignment of truth values to all formulas which satisfies the usual truth-table conditions for the logical connectives. Given an assignment of truth-values to all propositional variables, the truth-values of all other formulas under this assignment is usually defined by an inductive procedure. We indicate in Chapter I how this inductive definition can be made explicit-to this end we find useful the notion of a formation tree (which we discuss earlier).

**A First Course in Mathematical Logic and Set Theory** *John Wiley & Sons*

A mathematical introduction to the theory and applications of logic and set theory with an emphasis on writing proofs Highlighting the applications and notations of basic mathematical concepts within the framework of logic and set theory, *A First Course in Mathematical Logic and Set Theory* introduces how logic is used to prepare and structure proofs and solve more complex problems. The book begins with propositional logic, including two-column proofs and truth table applications, followed by first-order logic, which provides the structure for writing mathematical proofs. Set theory is then introduced and serves as the basis for defining relations, functions, numbers, mathematical induction, ordinals, and cardinals. The book concludes with a primer on basic model theory with applications to abstract algebra. *A First Course in Mathematical Logic and Set Theory* also includes: Section exercises designed to show the interactions between topics and reinforce the presented ideas and concepts Numerous examples that illustrate theorems and employ basic concepts such as Euclid's lemma, the Fibonacci sequence, and unique factorization Coverage of important theorems including the well-ordering theorem, completeness theorem, compactness theorem, as well as the theorems of Löwenheim-Skolem, Burali-Forti, Hartogs, Cantor-Schröder-Bernstein, and König An excellent textbook for students studying the foundations of mathematics and mathematical proofs, *A First Course in Mathematical Logic and Set Theory* is also appropriate for readers preparing for careers in mathematics education or computer science. In addition, the book

is ideal for introductory courses on mathematical logic and/or set theory and appropriate for upper-undergraduate transition courses with rigorous mathematical reasoning involving algebra, number theory, or analysis.

### **Introduction to Mathematical Logic**

**Set Theory Computable Functions Model Theory** *Springer Science & Business Media*

This book is intended as an undergraduate senior level or beginning graduate level text for mathematical logic. There are virtually no prerequisites, although a familiarity with notions encountered in a beginning course in abstract algebra such as groups, rings, and fields will be useful in providing some motivation for the topics in Part III. An attempt has been made to develop the beginning of each part slowly and then to gradually quicken the pace and the complexity of the material. Each part ends with a brief introduction to selected topics of current interest. The text is divided into three parts: one dealing with set theory, another with computable function theory, and the last with model theory. Part III relies heavily on the notation, concepts and results discussed in Part I and to some extent on Part II. Parts I and II are independent of each other, and each provides enough material for a one semester course. The exercises cover a wide range of difficulty with an emphasis on more routine problems in the earlier sections of each part in order to familiarize the reader with the new notions and methods. The more difficult exercises are accompanied by hints. In some cases significant theorems are developed step by step with hints in the problems. Such

theorems are not used later in the sequence.

### **Introduction to Mathematical Logic** *Springer Science & Business Media*

This book grew out of lectures. It is intended as an introduction to classical two-valued predicate logic. The restriction to classical logic is not meant to imply that this logic is intrinsically better than other, non-classical logics; however, classical logic is a good introduction to logic because of its simplicity, and a good basis for applications because it is the foundation of classical mathematics, and thus of the exact sciences which are based on it. The book is meant primarily for mathematics students who are already acquainted with some of the fundamental concepts of mathematics, such as that of a group. It should help the reader to see for himself the advantages of a formalisation. The step from the everyday language to a formalised language, which usually creates difficulties, is discussed and practised thoroughly. The analysis of the way in which basic mathematical structures are approached in mathematics leads in a natural way to the semantic notion of consequence. One of the substantial achievements of modern logic has been to show that the notion of consequence can be replaced by a provably equivalent notion of derivability which is defined by means of a calculus. Today we know of many calculi which have this property.

### **Introduction to Mathematical Logic** ...

**A Concise Introduction to Mathematical Logic** *Springer Science & Business Media*

This book is unique in treating mathematical logic in a concise and streamlined fashion. This allows many important topics to be covered in a one semester course. Although the book is intended for use as a graduate text the first three chapters can be understood by undergraduates interested in mathematical logic. The remaining chapters contain material on logic programming for computer scientists, model theory, recursion theory, Godel's Incompleteness Theorems, and applications of mathematical logic. Philosophical and foundational problems of mathematics are discussed throughout the text, and the author has provided exercises for each chapter, as well as hints to selected exercises. Traditional logic as a part of philosophy is one of the oldest scientific disciplines. Mathematical logic, however, is a relatively young discipline and arose from the endeavors of Peano, Frege, Russell and others to create a logistic foundation for mathematics.

**A Beginner's Guide to Mathematical Logic** *Courier Corporation*

Combining stories of great writers and philosophers with quotations and riddles, this completely original text for first courses in mathematical logic examines problems related to proofs, propositional logic and first-order logic, undecidability, and other topics. 2013 edition.

**Introduction to Mathematical Logic** *Book World Promotions*

**Introduction to Mathematical Logic**

**First Course in Mathematical Logic** *Courier Corporation*

Rigorous introduction is simple enough in presentation and context for wide

range of students. Symbolizing sentences; logical inference; truth and validity; truth tables; terms, predicates, universal quantifiers; universal specification and laws of identity; more.

**Mathematical Logic**

**Foundations for Information Science** *Springer Science & Business Media*

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.

### **Philosophical and Mathematical Logic** *Springer*

This book was written to serve as an introduction to logic, with in each chapter - if applicable - special emphasis on the interplay between logic and philosophy, mathematics, language and (theoretical) computer science. The reader will not only be provided with an introduction to classical logic, but to philosophical (modal, epistemic, deontic, temporal) and intuitionistic logic as well. The first chapter is an easy to read non-technical Introduction to the topics in the book. The next chapters are consecutively about Propositional Logic, Sets (finite and infinite), Predicate Logic, Arithmetic and Gödel's Incompleteness Theorems, Modal Logic, Philosophy of Language, Intuitionism and Intuitionistic Logic, Applications (Prolog; Relational Databases and SQL; Social Choice Theory, in particular Majority Judgment) and finally, Fallacies and Unfair Discussion Methods. Throughout the text, the author provides some impressions of the historical development of logic: Stoic and Aristotelian logic, logic in the Middle Ages and Frege's Begriffsschrift, together with the works of George Boole (1815-1864) and August De Morgan (1806-1871), the origin of modern logic. Since "if ..., then ..." can be considered to be the heart of logic, throughout this book much attention is paid to

conditionals: material, strict and relevant implication, entailment, counterfactuals and conversational implicature are treated and many references for further reading are given. Each chapter is concluded with answers to the exercises. Philosophical and Mathematical Logic is a very recent book (2018), but with every aspect of a classic. What a wonderful book! Work written with all the necessary rigor, with immense depth, but without giving up clarity and good taste. Philosophy and mathematics go hand in hand with the most diverse themes of logic. An introductory text, but not only that. It goes much further. It's worth diving into the pages of this book, dear reader! Paulo Sérgio Argolo

### **Perspectives on the History of Mathematical Logic** *Springer Science & Business Media*

This volume offers insights into the development of mathematical logic over the last century. Arising from a special session of the history of logic at an American Mathematical Society meeting, the chapters explore technical innovations, the philosophical consequences of work during the period, and the historical and social context in which the logicians worked. The discussions herein will appeal to mathematical logicians and historians of mathematics, as well as philosophers and historians of science.

### **Principia Mathematica**

### **Algebraic Methods of Mathematical Logic** *Elsevier*

Algebraic Methods of Mathematical Logic focuses on the algebraic methods of mathematical logic, including Boolean algebra, mathematical language, and arithmetization. The book first offers

information on the dialectic of the relation between mathematical and metamathematical aspects; metamathematico-mathematical parallelism and its natural limits; practical applications of methods of mathematical logic; and principal mathematical tools of mathematical logic. The text then elaborates on the language of mathematics and its symbolization and recursive construction of the relation of consequence. Discussions focus on recursive construction of the relation of consequence, fundamental descriptively-semantic rules, mathematical logic and mathematical language as a material system of signs, and the substance and purpose of symbolization of mathematical language. The publication examines expressive possibilities of symbolization; intuitive and mathematical notions of an idealized axiomatic mathematical theory; and the algebraic theory of elementary predicate logic. Topics include the notion of Boolean algebra based on joins, meets, and complementation, logical frame of a language and mathematical theory, and arithmetization and algebraization. The manuscript is a valuable reference for mathematicians and researchers interested in the algebraic methods of mathematical logic.

### Language in Action

#### **Categories, Lambdas and Dynamic Logic** *MIT Press*

Language in Action demonstrates the viability of mathematical research into the foundations of categorial grammar, a topic at the border between logic and linguistics. Since its initial publication it has become the classic work in the foundations of categorial grammar. A

new introduction to this paperback edition updates the open research problems and records relevant results through pointers to the literature. Van Benthem presents the categorial processing of syntax and semantics as a central component in a more general dynamic logic of information flow, in tune with computational developments in artificial intelligence and cognitive science. Using the paradigm of categorial grammar, he describes the substructural logics driving the dynamics of natural language syntax and semantics. This is a general type-theoretic approach that lends itself easily to proof-theoretic and semantic studies in tandem with standard logic. The emphasis is on a broad landscape of substructural categorial logics and their proof-theoretical and semantic peculiarities. This provides a systematic theory for natural language understanding, admitting of significant mathematical results. Moreover, the theory makes possible dynamic interpretations that view natural languages as programming formalisms for various cognitive activities.

#### **Proofs from THE BOOK** *Springer Science & Business Media*

According to the great mathematician Paul Erdős, God maintains perfect mathematical proofs in The Book. This book presents the authors candidates for such "perfect proofs," those which contain brilliant ideas, clever connections, and wonderful observations, bringing new insight and surprising perspectives to problems from number theory, geometry, analysis, combinatorics, and graph theory. As a result, this book will be fun reading for anyone with an interest in mathematics.

## Mathematical Logic and Model Theory

### **A Brief Introduction** *Springer Science & Business Media*

Mathematical Logic and Model Theory: A Brief Introduction offers a streamlined yet easy-to-read introduction to mathematical logic and basic model theory. It presents, in a self-contained manner, the essential aspects of model theory needed to understand model theoretic algebra. As a profound application of model theory in algebra, the last part of this book develops a complete proof of Ax and Kochen's work on Artin's conjecture about Diophantine properties of  $p$ -adic number fields. The character of model theoretic constructions and results differ quite significantly from that commonly found in algebra, by the treatment of formulae as mathematical objects. It is therefore indispensable to first become familiar with the problems and methods of mathematical logic. Therefore, the text is divided into three parts: an introduction into mathematical logic (Chapter 1), model theory (Chapters 2 and 3), and the model theoretic treatment of several algebraic theories (Chapter 4). This book will be of interest to both advanced undergraduate and graduate students studying model theory and its applications to algebra. It may also be used for self-study.

### **Concise Introduction to Logic and Set Theory** *CRC Press*

This book deals with two important branches of mathematics, namely, logic and set theory. Logic and set theory are closely related and play very crucial roles in the foundation of mathematics, and together produce several results in all of mathematics. The topics of logic

and set theory are required in many areas of physical sciences, engineering, and technology. The book offers solved examples and exercises, and provides reasonable details to each topic discussed, for easy understanding. The book is designed for readers from various disciplines where mathematical logic and set theory play a crucial role. The book will be of interest to students and instructors in engineering, mathematics, computer science, and technology.

### **Logic and Structure** *Springer Science & Business Media*

New corrected printing of a well-established text on logic at the introductory level.

### **An Introduction to Gödel's Theorems** *Cambridge University Press*

Peter Smith examines Gödel's Theorems, how they were established and why they matter.

### **The Art of Logic in an Illogical World** *Basic Books*

How both logical and emotional reasoning can help us live better in our post-truth world In a world where fake news stories change election outcomes, has rationality become futile? In *The Art of Logic in an Illogical World*, Eugenia Cheng throws a lifeline to readers drowning in the illogic of contemporary life. Cheng is a mathematician, so she knows how to make an airtight argument. But even for her, logic sometimes falls prey to emotion, which is why she still fears flying and eats more cookies than she should. If a mathematician can't be logical, what are we to do? In this book, Cheng reveals the inner workings and limitations of logic, and explains why a logic -- for

example, emotion -- is vital to how we think and communicate. Cheng shows us how to use logic and alogic together to navigate a world awash in bigotry, mansplaining, and manipulative memes. Insightful, useful, and funny, this essential book is for anyone who wants to think more clearly.