

Basic Proof Theory

A. S. Troelstra and
H. Schwichtenberg



Basic Proof Theory

S.R. Buss



Basic Proof Theory:

Basic Proof Theory A. S. Troelstra, H. Schwichtenberg, 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

Basic Proof Theory Anne Sjerp Troelstra, Helmut Schwichtenberg, 2000 Introduction to proof theory and its applications in mathematical logic theoretical computer science and artificial intelligence

Structural Proof Theory Sara Negri, Jan von Plato, 2008-07-10 A concise introduction to structural proof theory a branch of logic studying the general structure of logical and mathematical proofs

An Introduction to Proof Theory Paolo Mancosu, Sergio Galvan, Richard Zach, 2021 Proof theory is a central area of mathematical logic of special interest to philosophy It has its roots in the foundational debate of the 1920s in particular in Hilbert's program in the philosophy of mathematics which called for a formalization of mathematics as well as for a proof using philosophically unproblematic finitary means that these systems are free from contradiction Structural proof theory investigates the structure and properties of proofs in different formal deductive systems including axiomatic derivations natural deduction and the sequent calculus Central results in structural proof theory are the normalization theorem for natural deduction proved here for both intuitionistic and classical logic and the cut elimination theorem for the sequent calculus In formal systems of number theory formulated in the sequent calculus the induction rule plays a central role It can be eliminated from proofs of sequents of a certain elementary form every proof of an atomic sequent can be transformed into a simple proof This is Hilbert's central idea for giving finitary consistency proofs The proof requires a measure of proof complexity called an ordinal notation The branch of proof theory dealing with mathematical systems such as arithmetic thus has come to be called ordinal proof theory The theory of ordinal notations is developed here in purely combinatorial terms and the consistency proof for arithmetic presented in detail

Proof Theory Peter Aczel, Harold Simmons, Stanley S. Wainer, 1992 The lecture courses in this work are derived from the SERC Logic for IT Summer School and Conference on Proof Theory held at Leeds University The contributions come from acknowledged experts and comprise expository and research articles put together in this book they form an invaluable introduction to proof theory that is aimed at both mathematicians and computer scientists

Proofs and Computations Helmut Schwichtenberg, Stanley S. Wainer, 2011-12-15

Driven by the question What is the computational content of a formal proof this book studies fundamental interactions between proof theory and computability It provides a unique self contained text for advanced students and researchers in mathematical logic and computer science Part I covers basic proof theory computability and Gödel's theorems Part II studies and classifies provable recursion in classical systems from fragments of Peano arithmetic up to Π_1^1 CA0 Ordinal analysis and the Schwichtenberg-Wainer subrecursive hierarchies play a central role and are used in proving the modified finite Ramsey and extended Kruskal independence results for PA and Π_1^1 CA0 Part III develops the theoretical underpinnings of the first author's proof assistant MINLOG Three chapters cover higher type computability via information systems a constructive theory TCF of computable functionals realizability Dialectica interpretation computationally significant quantifiers and connectives and polytime complexity in a two sorted higher type arithmetic with linear logic

Handbook of Proof Theory
S.R. Buss, 1998-07-09 This volume contains articles covering a broad spectrum of proof theory with an emphasis on its mathematical aspects The articles should not only be interesting to specialists of proof theory but should also be accessible to a diverse audience including logicians mathematicians computer scientists and philosophers Many of the central topics of proof theory have been included in a self contained expository of articles covered in great detail and depth The chapters are arranged so that the two introductory articles come first these are then followed by articles from core classical areas of proof theory the handbook concludes with articles that deal with topics closely related to computer science

Proof Theory
Katalin Bimbo, 2014-08-20 Although sequent calculi constitute an important category of proof systems they are not as well known as axiomatic and natural deduction systems Addressing this deficiency Proof Theory Sequent Calculi and Related Formalisms presents a comprehensive treatment of sequent calculi including a wide range of variations It focuses on sequent calculi for various non classical logics from intuitionistic logic to relevance logic linear logic and modal logic In the first chapters the author emphasizes classical logic and a variety of different sequent calculi for classical and intuitionistic logics She then presents other non classical logics and meta logical results including decidability results obtained specifically using sequent calculus formalizations of logics The book is suitable for a wide audience and can be used in advanced undergraduate or graduate courses Computer scientists will discover intriguing connections between sequent calculi and resolution as well as between sequent calculi and typed systems Those interested in the constructive approach will find formalizations of intuitionistic logic and two calculi for linear logic Mathematicians and philosophers will welcome the treatment of a range of variations on calculi for classical logic Philosophical logicians will be interested in the calculi for relevance logics while linguists will appreciate the detailed presentation of Lambek calculi and their extensions

Proof Theory in Computer Science
Reinhard Kahle, Peter Schroeder-Heister, Robert Stärk, 2003-06-30 Proof theory has long been established as a basic discipline of mathematical logic It has recently become increasingly relevant to computer science The deductive apparatus provided by proof theory has proved useful for metatheoretical purposes as well as for practical

applications Thus it seemed to us most natural to bring researchers together to assess both the role proof theory already plays in computer science and the role it might play in the future The form of a Dagstuhl seminar is most suitable for purposes like this as Schlo Dagstuhl provides a very convenient and stimulating environment to scuss new ideas and developments To accompany the conference with a proc dings volume appeared to us equally appropriate Such a volume not only xes basic results of the subject and makes them available to a broader audience but also signals to the scienti c community that Proof Theory in Computer Science PTCS is a major research branch within the wider eld of logic in computer science

Computational Logic and Proof Theory Georg Gottlob,Alexander Leitsch,Daniele Mundici,1997-08-13 This book constitutes the refereed proceedings of the 5th Kurt G del Colloquium on Computational Logic and Proof Theory KGC 97 held in Vienna Austria in August 1997 The volume presents 20 revised full papers selected from 38 submitted papers Also included are seven invited contributions by leading experts in the area The book documents interdisciplinary work done in the area of computer science and mathematical logics by combining research on provability analysis of proofs proof search and complexity

Proof Theory and Algebra in Logic Hiroakira Ono,2019-08-02 This book offers a concise introduction to both proof theory and algebraic methods the core of the syntactic and semantic study of logic respectively The importance of combining these two has been increasingly recognized in recent years It highlights the contrasts between the deep concrete results using the former and the general abstract ones using the latter Covering modal logics many valued logics superintuitionistic and substructural logics together with their algebraic semantics the book also provides an introduction to nonclassical logic for undergraduate or graduate level courses The book is divided into two parts Proof Theory in Part I and Algebra in Logic in Part II Part I presents sequent systems and discusses cut elimination and its applications in detail It also provides simplified proof of cut elimination making the topic more accessible The last chapter of Part I is devoted to clarification of the classes of logics that are discussed in the second part Part II focuses on algebraic semantics for these logics At the same time it is a gentle introduction to the basics of algebraic logic and universal algebra with many examples of their applications in logic Part II can be read independently of Part I with only minimum knowledge required and as such is suitable as a textbook for short introductory courses on algebra in logic

Proofs and Computations Helmut Schwichtenberg,Stanley S. Wainer,2011-12-15 Driven by the question What is the computational content of a formal proof this book studies fundamental interactions between proof theory and computability It provides a unique self contained text for advanced students and researchers in mathematical logic and computer science Part I covers basic proof theory computability and G del s theorems Part II studies and classifies provable recursion in classical systems from fragments of Peano arithmetic up to Π_1^1 CA0 Ordinal analysis and the Schwichtenberg Wainer subrecursive hierarchies play a central role and are used in proving the modified finite Ramsey and extended Kruskal independence results for PA and Π_1^1 CA0 Part III develops the theoretical underpinnings of the first author s proof assistant MINLOG Three chapters cover higher type

computability via information systems a constructive theory TCF of computable functionals realizability Dialectica interpretation computationally significant quantifiers and connectives and polytime complexity in a two sorted higher type arithmetic with linear logic *The Method of Socratic Proofs* Dorota Leszczyńska-Jasion, 2025-06-13 This book contains a systematic and formal attempt to model solutions to problems such as Is it possible to prove a question Is it possible to prove something by the use of questions Do the existing paradigms in the logic of questions allow one to combine questions and proofs What are the results in this field In developing answers the book focuses on the applications of the method of Socratic proofs and goes beyond that It starts out with an overview of the leading paradigms issues problems and ready solutions in the logic of questions and places Inferential Erotetic Logic and the method of Socratic proofs against a wider background It then introduces these two methods in more detail and explains how they can be used for classical logic intuitionistic propositional logic and for basic modal logics Next the book deals with issues specific to the field of the logic of questions introducing the tools of Minimal Erotetic Semantics MiES The final chapters describe the translations between proof systems from a Socratic transformation derived in an erotetic calculus into a sequent system Sets, Models and Proofs Ieke Moerdijk, Jaap van Oosten, 2018-11-23 This textbook provides a concise and self contained introduction to mathematical logic with a focus on the fundamental topics in first order logic and model theory Including examples from several areas of mathematics algebra linear algebra and analysis the book illustrates the relevance and usefulness of logic in the study of these subject areas The authors start with an exposition of set theory and the axiom of choice as used in everyday mathematics Proceeding at a gentle pace they go on to present some of the first important results in model theory followed by a careful exposition of Gentzen style natural deduction and a detailed proof of Gödel's completeness theorem for first order logic The book then explores the formal axiom system of Zermelo and Fraenkel before concluding with an extensive list of suggestions for further study The present volume is primarily aimed at mathematics students who are already familiar with basic analysis algebra and linear algebra It contains numerous exercises of varying difficulty and can be used for self study though it is ideally suited as a text for a one semester university course in the second or third year Advances in Natural Deduction Luiz Carlos Pereira, Edward Haeusler, Valeria de Paiva, 2014-07-08 This collection of papers celebrating the contributions of Swedish logician Dag Prawitz to Proof Theory has been assembled from those presented at the Natural Deduction conference organized in Rio de Janeiro to honour his seminal research Dag Prawitz's work forms the basis of intuitionistic type theory and his inversion principle constitutes the foundation of most modern accounts of proof theoretic semantics in Logic Linguistics and Theoretical Computer Science The range of contributions includes material on the extension of natural deduction with higher order rules as opposed to higher order connectives and a paper discussing the application of natural deduction rules to dealing with equality in predicate calculus The volume continues with a key chapter summarizing work on the extension of the Curry Howard isomorphism itself a by product of the work on natural deduction

via methods of category theory that have been successfully applied to linear logic as well as many other contributions from highly regarded authorities With an illustrious group of contributors addressing a wealth of topics and applications this volume is a valuable addition to the libraries of academics in the multiple disciplines whose development has been given added scope by the methodologies supplied by natural deduction The volume is representative of the rich and varied directions that Prawitz work has inspired in the area of natural deduction **Logical Theory and Semantic Analysis** Stig Kanger, 1974-06-30 **Decidability of Logical Theories and Their Combination** João Rasga, Cristina

Sernadas, 2020-10-20 This textbook provides a self contained introduction to decidability of first order theories and their combination The technical material is presented in a systematic and universal way and illustrated with plenty of examples and a range of proposed exercises After an overview of basic first order logic concepts the authors discuss some model theoretic notions like embeddings diagrams and elementary substructures The text then goes on to explore an applicable way to deduce logical consequences from a given theory and presents sufficient conditions for a theory to be decidable The chapters that follow focus on quantifier elimination decidability of the combination of first order theories and the basics of computability theory The inclusion of a chapter on Gentzen calculus cut elimination and Craig interpolation as well as a chapter on combination of theories and preservation of decidability help to set this volume apart from similar books in the field Decidability of Logical Theories and their Combination is ideal for graduate students of Mathematics and is equally suitable for Computer Science Philosophy and Physics students who are interested in gaining a deeper understanding of the subject The book is also directed to researchers that intend to get acquainted with first order theories and their combination

Modal Logic Patrick Blackburn, Maarten de Rijke, Yde Venema, 2002-08-22 This is an advanced 2001 textbook on modal logic a field which caught the attention of computer scientists in the late 1970s Researchers in areas ranging from economics to computational linguistics have since realised its worth The book is for novices and for more experienced readers with two distinct tracks clearly signposted at the start of each chapter The development is mathematical prior acquaintance with first order logic and its semantics is assumed and familiarity with the basic mathematical notions of set theory is required The authors focus on the use of modal languages as tools to analyze the properties of relational structures including their algorithmic and algebraic aspects and applications to issues in logic and computer science such as completeness computability and complexity are considered Three appendices supply basic background information and numerous exercises are provided Ideal for anyone wanting to learn modern modal logic Automated Reasoning with Analytic Tableaux and Related Methods Uwe Egly, Christian G. Fermüller, 2003-08-02 This book constitutes the refereed proceedings of the International Conference on Automated Reasoning with Analytic Tableaux and Related Methods TABLEUX 2002 held in Copenhagen Denmark in July August 2002 The 20 revised full papers and two system descriptions presented together with two invited contributions were carefully reviewed and selected for inclusion in the book All current issues surrounding the

mechanization of logical reasoning with tableaux and similar methods are addressed Among the logic calculi investigated are linear logic temporal logic modal logics hybrid logic multi modal logics fuzzy logics Goedel logic Lukasiewicz logic intermediate logics quantified boolean logic and of course classical first order logic **Dick de Jongh on Intuitionistic and Provability Logics** Nick Bezhanishvili, Rosalie Iemhoff, Fan Yang, 2024-07-25 This book is dedicated to Dick de Jongh's contributions to the theory of intuitionistic and provability logics Consisting of 13 chapters written by leading experts this book discusses de Jongh's original contributions and consequent developments that have helped to shape these fields The book begins with an autobiographic note by Dick de Jongh which discusses the main themes of his work and places the other contributions in context The next four chapters explore the De Jongh Sambin fixed point theorem and other contributions to provability and interpretability logics The following four chapters focus on modal intuitionistic and intuitionistic modal logics They discuss independence of formulas unification and de Jongh formulas in intuitionistic and modal logics Then there follow two chapters on the other two areas to which Dick de Jongh made important contributions the theory of well partial orders and formal learning theory The second to last chapter on Origami Geometry can be seen as representing the Master of Logic program of the Institute for Logic Language and Computation ILLC in which de Jongh invested a lot of energy The book ends with a complete bibliography of Dick de Jongh in the last chapter This volume provides a vital overview and continuation of de Jongh's prolific work in the theory of intuitionistic and provability logics

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web apr 21 2020 natural language processing is a branch of artificial intelligence that attempts to bridge that gap between what a machine recognizes as input and the human language this is so that when we speak or type naturally the machine produces an output in line with what we said

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web natural language processing nlp refers to the branch of computer science and more specifically the branch of artificial intelligence or ai concerned with giving computers the ability to understand text and spoken words in much the same way human beings can nlp combines computational linguistics rule based modeling of human language

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