

# STRUCTURAL PROOF THEORY:

Uncovering capacities of the  
mathematical mind

Wilfried Sieg  
Carnegie Mellon

# Structural Proof Theory

**Katalin Bimbo**



## **Structural Proof Theory:**

**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      **Structural Proof Theory** Aaron Brookes, 2017-04-12 Structural proof theory is a branch of logic that studies the general structure and properties of logical and mathematical proofs This book is both a concise introduction to the central results and methods of structural proof theory and a work of research that will be of interest to specialists The book is designed to be used by students of philosophy mathematics and computer science A special feature of the volume is a computerized system for developing proofs interactively downloadable from the web and regularly updated      **Essays in Structural Proof Theory** Laura Tesconi, 2013

*An Introduction to Proof Theory* Paolo Mancosu, Sergio Galvan, Richard Zach, 2021-08-12 An Introduction to Proof Theory provides an accessible introduction to the theory of proofs with details of proofs worked out and examples and exercises to aid the reader's understanding It also serves as a companion to reading the original pathbreaking articles by Gerhard Gentzen The first half covers topics in structural proof theory including the G del Gentzen translation of classical into intuitionistic logic and arithmetic natural deduction and the normalization theorems for both NJ and NK the sequent calculus including cut elimination and mid sequent theorems and various applications of these results The second half examines ordinal proof theory specifically Gentzen's consistency proof for first order Peano Arithmetic The theory of ordinal notations and other elements of ordinal theory are developed from scratch and no knowledge of set theory is presumed The proof methods needed to establish proof theoretic results especially proof by induction are introduced in stages throughout the text Mancosu Galvan and Zach's introduction will provide a solid foundation for those looking to understand this central area of mathematical logic and the philosophy of mathematics      **Structural Proof Theory** Jeffrey Holt, 2017-12-12 The book is designed to be used by students of philosophy mathematics and computer science A special feature of the volume is a computerized system for developing proofs interactively downloadable from the web and regularly updated This book is both a concise introduction to the central results and methods of structural proof theory and a work of research that will be of interest to specialists      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 *Tools and Techniques for Formalising Structural Proof Theory* Peter Chapman, University of St. Andrews. School of Mathematics and Statistics, 2010

**Dag Prawitz on Proofs and Meaning** Heinrich Wansing, 2014-11-27 This volume is dedicated to Prof Dag Prawitz and his outstanding contributions to philosophical and mathematical logic Prawitz's eminent contributions to structural proof theory or general proof theory as he calls it and inference based meaning theories have been extremely influential in the development of modern proof theory and anti realistic semantics In particular Prawitz is the main author on natural deduction in addition to Gerhard Gentzen who defined natural deduction in his PhD thesis published in 1934 The book opens with an introductory paper that surveys Prawitz's numerous contributions to proof theory and proof theoretic semantics and puts his work into a somewhat broader perspective both historically and systematically Chapters include either in depth studies of certain aspects of Dag Prawitz's work or address open research problems that are concerned with core issues in structural proof theory and range from philosophical essays to papers of a mathematical nature Investigations into the necessity of thought and the theory of grounds and computational justifications as well as an examination of Prawitz's conception of the validity of inferences in the light of three dogmas of proof theoretic semantics are included More formal papers deal with the constructive behaviour of fragments of classical logic and fragments of the modal logic S4 among other topics In addition there are chapters about inversion principles normalization of proofs and the notion of proof theoretic harmony and other areas of a more mathematical persuasion Dag Prawitz also writes a chapter in which he explains his current views on the epistemic dimension of proofs and addresses the question why some inferences succeed in conferring evidence on their conclusions when applied to premises for which one already possesses evidence

### **Proof Theory**

Wolfram Pohlers, 2008-10-01 The kernel of this book consists of a series of lectures on inductive proof theory which I gave during my time at the Westfälische Wilhelms Universität in Münster It was planned as a successor of Springer Lecture Notes in Mathematics 1407 However when preparing it I decided to also include material which has not been treated in SLN 1407 Since the appearance of SLN 1407 many innovations in the area of ordinal analysis have taken place Just to mention those of them which are addressed in this book Buchholz simplified local predicativity by the invention of operator controlled derivations of Chapter 9 Chapter 11 Weiermann detected applications of methods of impredicative proof theory to the characterization of the provable recursive functions of predicative theories of Chapter 10 Beckmann improved Gentzen's boundedness theorem which appears as Stage Theorem Theorem 6.6.1 in this book to Theorem 6.6.9 a theorem which is very satisfying in itself though its real importance lies in the ordinal analysis of systems weaker than those treated here Besides these innovations I also decided to include the analysis of the theory REF as an example of a subtheory of set theory whose ordinal analysis only  $\epsilon_0$  requires a first step into impredicativity The ordinal analysis of FXP of non 0-1 monotone definable inductive definitions in Chapter 13 is an application of the 1 analysis of REF

*Proof Analysis* Sara Negri, Jan von

Plato,2011-09-29 This book continues from where the authors previous book Structural Proof Theory ended It presents an extension of the methods of analysis of proofs in pure logic to elementary axiomatic systems and to what is known as philosophical logic A self contained brief introduction to the proof theory of pure logic is included that serves both the mathematically and philosophically oriented reader The method is built up gradually with examples drawn from theories of order lattice theory and elementary geometry The aim is in each of the examples to help the reader grasp the combinatorial behaviour of an axiom system which typically leads to decidability results The last part presents as an application and extension of all that precedes it a proof theoretical approach to the Kripke semantics of modal and related logics with a great number of new results providing essential reading for mathematical and philosophical logicians [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 [Arnon Avron on Semantics and](#)

[Proof Theory of Non-Classical Logics](#) Ofer Arieli,Anna Zamansky,2021-07-30 This book is a collection of contributions honouring Arnon Avron s seminal work on the semantics and proof theory of non classical logics It includes presentations of advanced work by some of the most esteemed scholars working on semantic and proof theoretical aspects of computer science logic Topics in this book include frameworks for paraconsistent reasoning foundations of relevance logics analysis and characterizations of modal logics and fuzzy logics hypersequent calculi and their properties non deterministic semantics algebraic structures for many valued logics and representations of the mechanization of mathematics Avron s foundational and pioneering contributions have been widely acknowledged and adopted by the scientific community His research interests are very broad spanning over proof theory automated reasoning non classical logics foundations of mathematics and applications of logic in computer science and artificial intelligence This is clearly reflected by the diversity of topics discussed in the chapters included in this book all of which directly relate to Avron s past and present works This book is of interest to

computer scientists and scholars of formal logic      *Model and Proof Theory of Constructive ALC* Stephan Scheele, 2015-07-02      **Proof Theory for Fuzzy Logics** George Metcalfe, Nicola Olivetti, Dov M. Gabbay, 2008-11-27 Fuzzy logics are many valued logics that are well suited to reasoning in the context of vagueness They provide the basis for the wider field of Fuzzy Logic encompassing diverse areas such as fuzzy control fuzzy databases and fuzzy mathematics This book provides an accessible and up to date introduction to this fast growing and increasingly popular area It focuses in particular on the development and applications of proof theoretic presentations of fuzzy logics the result of more than ten years of intensive work by researchers in the area including the authors In addition to providing alternative elegant presentations of fuzzy logics proof theoretic methods are useful for addressing theoretical problems including key standard completeness results and developing efficient deduction and decision algorithms Proof theoretic presentations also place fuzzy logics in the broader landscape of non classical logics revealing deep relations with other logics studied in Computer Science Mathematics and Philosophy The book builds methodically from the semantic origins of fuzzy logics to proof theoretic presentations such as Hilbert and Gentzen systems introducing both theoretical and practical applications of these presentations      *Applied Proof Theory: Proof Interpretations and their Use in Mathematics* Ulrich Kohlenbach, 2008-05-23 This is the first treatment in book format of proof theoretic transformations known as proof interpretations that focuses on applications to ordinary mathematics It covers both the necessary logical machinery behind the proof interpretations that are used in recent applications as well as via extended case studies carrying out some of these applications in full detail This subject has historical roots in the 1950s This book for the first time tells the whole story      **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      **Cuts and Completions** Frederik Möllerström Lauridsen, 2019      **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      *Proof And Computation Ii: From Proof Theory And Univalent Mathematics To Program Extraction And Verification* Klaus Mainzer, Helmut Schwichtenberg, Peter Michael Schuster, 2021-07-27 This book is for graduate students and researchers introducing modern foundational research in mathematics computer science and philosophy from an interdisciplinary point of view Its scope includes proof theory constructive mathematics and type theory univalent mathematics and point free approaches to topology extraction of certified programs from proofs automated proofs in the automotive industry as well as the philosophical and historical background of proof theory By filling the gap between under graduate level textbooks and advanced research papers the book gives a scholarly account of recent developments and emerging branches of the aforementioned fields      [Proof Theory of Modal Logic](#) Heinrich Wansing, 2013-06-29 Proof Theory of Modal Logic is devoted to a thorough study of proof systems for modal logics that is logics of necessity possibility knowledge belief time computations etc It contains many new technical results and presentations of novel proof procedures The volume is of immense importance for the interdisciplinary fields of logic knowledge representation and automated deduction

## **Structural Proof Theory** Book Review: Unveiling the Power of Words

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