

Substructural Logics: A Primer

by

Francesco Paoli

Substructural Logics

Kazumi Nakamatsu, Jair Minoro Abe



Substructural Logics:

An Introduction to Substructural Logics Greg Restall, 2002-09-11 This book introduces an important group of logics that have come to be known under the umbrella term substructural. Substructural logics have independently led to significant developments in philosophy, computing and linguistics. An Introduction to Substructural Logics is the first book to systematically survey the new results and the significant impact that this class of logics has had on a wide range of fields. The following topics are covered: Proof Theory, Propositional Structures, Frames, Decidability, Coda. Both students and professors of philosophy, computing, linguistics and mathematics will find this to be an important addition to their reading.

Substructural Logics: A Primer F. Paoli, 2002-05-31 The aim of the present book is to give a comprehensive account of the state of the art of substructural logics, focusing both on their proof theory (especially on sequent calculi and their generalizations) and on their semantics (both algebraic and relational). It is for graduate students in either philosophy, mathematics, theoretical computer science or theoretical linguistics, as well as specialists and researchers.

Algebraic Perspectives on Substructural Logics Davide Fazio, Antonio Ledda, Francesco Paoli, 2020-11-07 This volume presents the state of the art in the algebraic investigation into substructural logics. It features papers from the workshop ASubL Algebra Substructural Logics Take 6, held at the University of Cagliari, Italy. This event is part of the framework of the Horizon 2020 Project SYSMICS: SYntax meets Semantics, Methods, Interactions and Connections in Substructural logics. Substructural logics are usually formulated as Gentzen systems that lack one or more structural rules. They have been intensively studied over the past two decades by logicians of various persuasions. These researchers include mathematicians, philosophers, linguists and computer scientists. Substructural logics are applicable to the mathematical investigation of such processes as resource-conscious reasoning, approximate reasoning, type-theoretical grammar and other focal notions in computer science. They also apply to epistemology, economics and linguistics. The recourse to algebraic methods (or better, the fecund interplay of algebra and proof theory) has proved useful in providing a unifying framework for these investigations. The ASubL series of conferences, in particular, has played an important role in these developments. This collection will appeal to students and researchers with an interest in substructural logics, abstract algebraic logic, residuated lattices, proof theory, universal algebra and logical semantics.

Hiroakira Ono on Substructural Logics Nikolaos Galatos, Kazushige Terui, 2021-12-13 This volume is dedicated to Hiroakira Ono's work on substructural logics. Chapters written by well-established academics cover topics related to universal algebra, algebraic logic and the Full Lambek calculus. The book includes a short biography about Hiroakira Ono. The book starts with detailed surveys on universal algebra, abstract algebraic logic, topological dualities and connections to computer science. It further contains specialised contributions on connections to formal languages, recognizability in residuated lattices and connections to the finite embedding property, covering systems for modal substructural logics, results on the existence and disjunction properties and finally a study of conservativity of expansions.

This book will be primarily of interest to researchers working in algebraic and non classical logic

Substructural Logics Peter Joseph Schroeder-Heister, Kosta Došen, 1993 The new area of logic and computation is now undergoing rapid development This has affected the social pattern of research in the area A new topic may rise very quickly with a significant body of research around it The community however cannot wait the traditional two years for a book to appear This has given greater importance to thematic collections of papers centred around a topic and addressing it from several points of view usually as a result of a workshop summer school or just a scientific initiative Such a collection may not be as coherent as a book by one or two authors yet it is more focused than a collection of key papers on a certain topic It is best thought of as a thematic collection a study in the area of logic and computation The new series Studies in Logic and Computation is intended to provide a home for such thematic collections Substructural logics are nonclassical logics which arose in response to problems in foundations of mathematics and logic theoretical computer science mathematical linguistics and category theory They include intuitionistic logic relevant logic BCK logic linear logic and Lambek's calculus of syntactic categories Substructural logics differ from classical logics and from each other in their presuppositions about Gentzen's structural rules although their presuppositions about the deductive role of logical constants are invariant Substructural logics have been a subject of study for logicians during the last sixty years Specialists have often worked in isolation however largely unaware of the contributions of others This book brings together new papers by some of the most eminent authorities in these various traditions to produce a unified view of substructural logics

Residuated Lattices: An Algebraic Glimpse at Substructural Logics Nikolaos Galatos, Peter Jipsen, Tomasz Kowalski, Hiroakira Ono, 2007-04-25 The book is meant to serve two purposes The first and more obvious one is to present state of the art results in algebraic research into residuated structures related to substructural logics The second less obvious but equally important is to provide a reasonably gentle introduction to algebraic logic At the beginning the second objective is predominant Thus in the first few chapters the reader will find a primer of universal algebra for logicians a crash course in nonclassical logics for algebraists an introduction to residuated structures an outline of Gentzen style calculi as well as some tidbits of proof theory the celebrated Hauptsatz or cut elimination theorem among them These lead naturally to a discussion of interconnections between logic and algebra where we try to demonstrate how they form two sides of the same coin We envisage that the initial chapters could be used as a textbook for a graduate course perhaps entitled Algebra and Substructural Logics As the book progresses the first objective gains predominance over the second Although the precise point of equilibrium would be difficult to specify it is safe to say that we enter the technical part with the discussion of various completions of residuated structures These include Dedekind McNeille completions and canonical extensions Completions are used later in investigating several finiteness properties such as the finite model property generation of varieties by their finite members and finite embeddability The algebraic analysis of cut elimination that follows also takes recourse to completions Decidability of logics equational and quasi equational theories

comes next where we show how proof theoretical methods like cut elimination are preferable for small logics theories but semantic tools like Rabin's theorem work better for big ones Then we turn to Glivenko's theorem which says that a formula is an intuitionistic tautology if and only if its double negation is a classical one We generalise it to the substructural setting identifying for each substructural logic its Glivenko equivalence class with smallest and largest element This is also where we begin investigating lattices of logics and varieties rather than particular examples We continue in this vein by presenting a number of results concerning minimal varieties maximal logics A typical theorem there says that for some given well known variety its subvariety lattice has precisely such and such number of minimal members where values for such and such include but are not limited to continuum countably many and two In the last two chapters we focus on the lattice of varieties corresponding to logics without contraction In one we prove a negative result that there are no nontrivial splittings in that variety In the other we prove a positive one that semisimple varieties coincide with discriminator ones Within the second more technical part of the book another transition process may be traced Namely we begin with logically inclined technicalities and end with algebraically inclined ones Here perhaps algebraic rendering of Glivenko theorems marks the equilibrium point at least in the sense that finiteness properties decidability and Glivenko theorems are of clear interest to logicians whereas semisimplicity and discriminator varieties are universal algebra par excellence It is for the reader to judge whether we succeeded in weaving these threads into a seamless fabric

Interval / Probabilistic Uncertainty and Non-classical Logics Van-Nam Huynh, Yoshiteru Nakamori, Hiroakira Ono, Jonathan Lawry, Vladik Kreinovich, Hung T. Nguyen, 2008-01-11 This book contains the proceedings of the first International Workshop on Interval Probabilistic Uncertainty and Non Classical Logics Ishikawa Japan March 25-28 2008 The workshop brought together researchers working on interval and probabilistic uncertainty and on non classical logics It is hoped this workshop will lead to a boost in the much needed collaboration between the uncertainty analysis and non classical logic communities and thus to better processing of uncertainty

Advances in Logic Based Intelligent Systems Kazumi Nakamatsu, Jair Minoru Abe, 2005 LAPTEC 2005 promoted the discussion and interaction between researchers and practitioners focused on both theoretical and practical disciplines concerning logics applied to technology with diverse backgrounds including all kinds of intelligent systems having classical or non classical logics as underlying common matters

Logic and Implication Petr Cintula, Carles Noguera, 2022-01-01 This monograph presents a general theory of weakly implicative logics a family covering a vast number of non classical logics studied in the literature concentrating mainly on the abstract study of the relationship between logics and their algebraic semantics It can also serve as an introduction to abstract algebraic logic both propositional and first order with special attention paid to the role of implication lattice and residuated connectives and generalized disjunctions Based on their recent work the authors develop a powerful uniform framework for the study of non classical logics In a self contained and didactic style starting from very elementary notions they build a general theory with a substantial number of

abstract results The theory is then applied to obtain numerous results for prominent families of logics and their algebraic counterparts in particular for superintuitionistic modal substructural fuzzy and relevant logics The book may be of interest to a wide audience especially students and scholars in the fields of mathematics philosophy computer science or related areas looking for an introduction to a general theory of non classical logics and their algebraic semantics

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

Recent Trends in Philosophical Logic Roberto Ciuni, Heinrich Wansing, Caroline Willkommen, 2014-04-29 This volume presents recent advances in philosophical logic with chapters focusing on non classical logics including paraconsistent logics substructural logics modal logics of agency and other modal logics The authors cover themes such as the knowability paradox tableaux and sequent calculi natural deduction definite descriptions identity truth dialetheism and possible worlds semantics The developments presented here focus on challenging problems in the specification of fundamental philosophical notions as well as presenting new techniques and tools thereby contributing to the development of the field Each chapter contains a bibliography to assist the reader in making connections in the specific areas covered Thus this work provides both a starting point for further investigations into philosophical logic and an update on advances techniques and applications in a dynamic field The chapters originate from papers presented during the Trends in Logic XI conference at the Ruhr University Bochum June 2012

Petr Hájek on Mathematical Fuzzy Logic Franco Montagna, 2014-09-23 This volume celebrates the work of Petr Hájek on mathematical fuzzy logic and presents how his efforts have influenced prominent logicians who are continuing his work The book opens with a discussion on Hájek's contribution to mathematical fuzzy logic and with a scientific biography of him progresses to include two articles with a foundation flavour that demonstrate some important aspects of Hájek's production namely a paper on the development of fuzzy sets and another paper on some fuzzy versions of set theory and arithmetic Articles in the volume also focus on the treatment of vagueness

building connections between Hájek's favorite fuzzy logic and linguistic models of vagueness. Other articles introduce alternative notions of consequence relation namely the preservation of truth degrees which is discussed in a general context and the differential semantics. For the latter a surprisingly strong standard completeness theorem is proved. Another contribution also looks at two principles valid in classical logic and characterize the three main t-norm logics in terms of these principles. Other articles with an algebraic flavour offer a summary of the applications of lattice ordered groups to many valued logic and to quantum logic as well as an investigation of prelinearity in varieties of pointed lattice ordered algebras that satisfy a weak form of distributivity and have a very weak implication. The last part of the volume contains an article on possibilistic modal logics defined over MTL chains a topic that Hájek discussed in his celebrated work *Metamathematics of Fuzzy Logic* and another one where the authors besides offering unexpected premises such as proposing to call Hájek's basic fuzzy logic HL instead of BL propose a very weak system called SL as a candidate for the role of the really basic fuzzy logic. The paper also provides a generalization of the prelinearity axiom which was investigated by Hájek in the context of fuzzy logic.

Logic, Language, and Computation Nick Bezhanishvili, Sebastian Löbner, Kerstin Schwabe, Luca Spada, 2011-07-18 Edited in collaboration with FoLLI the Association of Logic Language and Information this book constitutes the refereed proceedings of the 8th International Tbilisi Symposium on Logic Language and Computation TbiLLC 2009 held in Bakuriani Georgia in September 2009. The 20 revised full papers included in the book were carefully reviewed and selected from numerous presentations given at the symposium. The focus of the papers is on the following topics: natural language syntax semantics and pragmatics; constructive modal and algebraic logic; linguistic typology and semantic universals; logics for artificial intelligence; information retrieval; query answer systems; logic games and formal pragmatics; language evolution and learnability; computational social choice; historical linguistics; history of logic.

Logic and the Modalities in the Twentieth Century Dov M. Gabbay, John Woods, 2006-05-10 *Logic and the Modalities in the Twentieth Century* is an indispensable research tool for anyone interested in the development of logic including researchers, graduate and senior undergraduate students in logic, history of logic, mathematics, history of mathematics, computer science and artificial intelligence, linguistics, cognitive science, argumentation theory, philosophy and the history of ideas. This volume is number seven in the eleven volume *Handbook of the History of Logic*. It concentrates on the development of modal logic in the 20th century, one of the most important undertakings in logic's long history. Written by the leading researchers and scholars in the field, the volume explores the logics of necessity and possibility, knowledge and belief, obligation and permission, time, tense and change, relevance and more. Both this volume and the *Handbook* as a whole are definitive reference tools for students and researchers in the history of logic, the history of philosophy and any discipline such as mathematics, computer science, artificial intelligence for whom the historical background of his or her work is a salient consideration. Detailed and comprehensive chapters covering the entire range of modal logic. Contains the latest scholarly

discoveries and interpretative insights that answer many questions in the field of logic *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 **Language and Logics** Howard Gregory, 2015-07-08 Taking linguistics students beyond the classical forms often taught in introductory courses Language and Logics offers a comprehensive introduction to the wide variety of useful non classical logics that are commonly used in research Including a brief review of classical logic and its major assumptions this textbook provides a guided tour of modal many valued and substructural logics The textbook starts from simple and intuitive concepts clearly explaining the logics of language for linguistics students who have little previous knowledge of logic or mathematics Issues are presented and discussed clearly before going on to introduce symbolic notation While not avoiding technical detail the book focuses throughout on helping students develop an intuitive understanding of the field with particular attention to conceptual questions and to the tailoring of logical systems to thinking about different applications in linguistics and beyond This is an ideal introductory volume for advanced undergraduates and beginning postgraduate students in linguistics and for those specializing in semantics

Logic and Scientific Methods Maria Luisa Dalla Chiara, Kees Doets, Daniele Mundici, Johan van Benthem, 2013-06-29 This is the first of two volumes comprising the papers submitted for publication by the invited participants to the Tenth International Congress of Logic Methodology and Philosophy of Science held in Florence August 1995 The Congress was held under the auspices of the International Union of History and Philosophy of Science Division of Logic Methodology and Philosophy of Science The invited lectures published in the two volumes demonstrate much of what goes on in the fields of the Congress and give the state of the art of current research The two volumes cover the traditional subdisciplines of mathematical logic and philosophical logic as well as their interfaces with computer science linguistics and philosophy Philosophy of science is broadly represented too including general issues of natural sciences social sciences and humanities The papers in Volume One are concerned with logic mathematical logic the philosophy of logic and mathematics and computer science Fibering Logics Dov M. Gabbay, 1998-11-05 Modern applications of logic in mathematics theoretical computer science and linguistics require combined systems involving many different logics working together In this book the author offers a basic methodology for combining or fibering systems This means that many existing complex systems can be broken down into simpler components hence making them much easier to manipulate Using this methodology the book discusses ways of obtaining a wide variety of multimodal modal intuitionistic modal substructural and fuzzy systems in a uniform way It also covers self fibred languages which allow formulae to apply to themselves The book also studies sufficient conditions for transferring properties of the component logics into properties of the combined system **Proceedings of**

the 7th & 8th Asian Logic Conferences Mariko Yasugi, 2003 The 7th and the 8th Asian Logic Conferences belong to the series of logic conferences inaugurated in Singapore in 1981 This meeting is held once every three years and rotates among countries in the Asia Pacific region with interests in the broad area of logic including theoretical computer science It is now considered a major conference in this field and is regularly sponsored by the Association for Symbolic Logic This book contains papers OCo many of them surveys by leading experts OCo of both the 7th meeting in Hsi Tou Taiwan and the 8th in Chongqing China The volume planned for the 7th meeting was interrupted by the earthquake in Taiwan and the decision was made to combine the two proceedings The 8th conference is also the ICM2002 Satellite Conference on Mathematical Logic

Logic, Language, Information, and Computation Rosalie Iemhoff, Michael Moortgat, Ruy de Queiroz, 2019-06-23 Edited in collaboration with FoLLI the Association of Logic Language and Information this book constitutes the refereed proceedings of the 26th Workshop on Logic Language Information and Communication WoLLIC 2019 held in Utrecht The Netherlands in July 2019 The 41 full papers together with 6 invited lectures presented were fully reviewed and selected from 60 submissions The idea is to have a forum which is large enough in the number of possible interactions between logic and the sciences related to information and computation and yet is small enough to allow for concrete and useful interaction among participants

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