A LOGICAL APPROACH TO DISCRETE MATH

David Gries
Fred B. Schneider

Theorem:
$$(\forall x \mid : P \Rightarrow Q) \;=\; \{x \mid P\} \subseteq \{x \mid Q\}$$

Proof:
$$\{x \mid P\} \subseteq \{x \mid Q\}$$
$$= \quad \langle \text{Def. of Subset } \subseteq , \text{ with } v \text{ not}$$
$$\quad\quad \text{occurring free in } P \text{ or } Q \rangle$$
$$(\forall v \mid v \in \{x \mid P\} : v \in \{x \mid Q\})$$
$$= \quad \langle v \in \{x \mid R\} \;\equiv\; R[x := v] , \text{ twice} \rangle$$
$$(\forall v \mid P[x := v] : Q[x := v])$$
$$= \quad \langle \text{Trading: Dummy renaming} \rangle$$
$$(\forall x \mid : P[x := v][v := x] \Rightarrow$$
$$\quad\quad Q[x := v][v := x])$$
$$= \quad \langle R[x := v][v := x] \;\equiv\; R \text{ if } v$$
$$\quad\quad \text{does not occur free in } R , \text{ twice} \rangle$$
$$(\forall x \mid : P \Rightarrow Q)$$

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A Logical Approach To Discrete Math

Jules Desharnais,Walter Guttmann,Stef Joosten

A Logical Approach To Discrete Math:

   A Logical Approach to Discrete Math David Gries,Fred B. Schneider,1993-10-22 Here the authors strive to change the way logic and discrete math are taught in computer science and mathematics while many books treat logic simply as another topic of study this one is unique in its willingness to go one step further The book traets logic as a basic tool which may be applied in essentially every other area   **A Logical Approach to Discrete Math** David Gries,Fred B. Schneider,2013-03-14 This text attempts to change the way we teach logic to beginning students Instead of teaching logic as a subject in isolation we regard it as a basic tool and show how to use it We strive to give students a skill in the propo sitional and predicate calculi and then to exercise that skill thoroughly in applications that arise in computer science and discrete mathematics We are not logicians but programming methodologists and this text reflects that perspective We are among the first generation of scientists who are more interested in using logic than in studying it With this text we hope to empower further generations of computer scientists and math ematicians to become serious users of logic Logic is the glue Logic is the glue that binds together methods of reasoning in all domains The traditional proof methods for example proof by assumption con tradiction mutual implication and induction have their basis in formal logic Thus whether proofs are to be presented formally or informally a study of logic can provide understanding   *A Logical Approach to Discrete Math* David Gries,Fred B. Schneider,2014-01-15   **Instructor's Manual, A Logical Approach to Discrete Math** David Gries,Fred B. Schneider,1993   **FM 2006: Formal Methods** Jayadev Misra,Tobias Nipkow,Emil Sekerinski,2006-08-10 This book presents the refereed proceedings of the 14th International Symposium on Formal Methods FM 2006 held in Hamilton Canada August 2006 The book presents 36 revised full papers together with 2 invited contributions and extended abstracts of 7 invited industrial presentations organized in topical sections on interactive verification formal modelling of systems real time industrial experience specification and refinement programming languages algebra formal modelling of systems and more   Algebraic Methodology and Software Technology V.S. Alagar,Maurice Nivat,1995-05-21 This volume constitutes the proceedings of the 4th International Conference on Algebraic Methodology and Software Technology held in Montreal Canada in July 1995 It includes full papers or extended abstracts of the invited talks refereed selected contributions and research prototype tools The invited speakers are David Gries Jeanette Wing Dan Craigen Ted Ralston Ewa Orlowska Krzysztof Apt Joseph Goguen and Rohit Parikh The 29 refereed papers presented were selected from some 100 submissions they are organized in sections on algebraic and logical foundations concurrent and reactive systems software technology logic programming and databases   *Interactive Theorem Proving* Jeremy Avigad,Assia Mahboubi,2018-07-03 This book constitutes the refereed proceedings of the 9th International Conference on Interactive Theorem Proving ITP 2018 held in Oxford UK in July 2018 The 32 full papers and 5 short papers presented were carefully reviewed and selected from 65 submissions The papers feature research in the area of logical frameworks and interactive proof assistants The topics include

theoretical foundations and implementation aspects of the technology as well as applications to verifying hardware and software systems to ensure their safety and security and applications to the formal verication of mathematical results Chapters 2 10 26 29 30 and 37 are available open access under a Creative Commons Attribution 4 0 International License via link springer com   **Smart Education and e-Learning 2021** Vladimir L. Uskov,Robert J. Howlett,Lakhmi C. Jain,2021-06-05 This book contains the contributions presented at the 8th International KES Conference on Smart Education and e Learning KES SEEL 2021 which being held as a virtual conference on June 14 16 2021 It contains high quality peer reviewed papers that are grouped into several interconnected parts smart education smart e learning smart education systems and technology smart education case studies and research digital education and economics in smart university smart university development organizational managerial and social Issues smart universities and their Impact on students with disabilities This book serves as a useful source of research data and valuable information on current research projects best practices and case studies for faculty scholars Ph D students administrators and practitioners all those who are interested in smart education and smart e learning   Teaching and Learning Formal Methods C. Neville Dean,Michael G. Hinchey,1996-09-17 As computer systems continue to advance the positions they hold in human society continue to gain power Computers now control the flight of aircraft the cooling systems in chemical plants and feedback loops in nuclear reactors Because of the vital roles these systems play there has been growing concern about the reliability and safety of these advanced computers Formal methods are now widely recognized as the most successful means of assuring the reliability of complex computer systems Because formal methods are being mandated in more and more international standards it is critical that engineers managers and industrial project leaders are well trained and conversant in the application of these methods This book covers a broad range of issues relating to the pedagogy of formal methods The contributors all acknowledged experts have based their contributions on extensive experiences teaching and applying formal methods in both academia and industry The two editors both well known in this area propose various techniques that can help to dismiss myths that formal methods are difficult to use and hard to learn Teaching and Learning Formal Methods will be an indispensable text for educators in the fields of computer science mathematics software engineering and electronic engineering as well as to management and product leaders concerned with trainingrecent graduates Offers proven methods for teaching formal methods even to students who lack a strong background in mathematics Addresses the important role that formal methods play in society and considers their growing future potential Includes contributions from several pioneers in the area Features a foreword written by Edsger W Dijkstra   Relational and Algebraic Methods in Computer Science Jules Desharnais,Walter Guttmann,Stef Joosten,2018-10-22 This book constitutes the proceedings of the 17th International Conference on Relational and Algebraic Methods in Computer Science RAMiCS 2018 held in Groningen The Netherlands in October November 2018 The 21 full papers and 1 invited paper presented together with 2 invited abstracts and 1 abstract of

a tutorial were carefully selected from 31 submissions The papers are organized in the following topics Theoretical foundations reasoning about computations and programs and applications and tools **Certified Programs and Proofs** Jean-Pierre Jouannaud,Zhong Shao,2011-11-18 This book constitutes the referred proceedings of the First International Conference on Certified Programs and Proofs CPP 2011 held in Kenting Taiwan in December 2011 The 24 revised regular papers presented together with 4 invited talks were carefully reviewed and selected from 49 submissions They are organized in topical sections on logic and types certificates formalization proof assistants teaching programming languages hardware certification miscellaneous and proof perls *Mathematical Logic* George Tourlakis,2011-03-01 A comprehensive and user friendly guide to the use of logic in mathematical reasoning Mathematical Logic presents a comprehensive introduction to formal methods of logic and their use as a reliable tool for deductive reasoning With its user friendly approach this book successfully equips readers with the key concepts and methods for formulating valid mathematical arguments that can be used to uncover truths across diverse areas of study such as mathematics computer science and philosophy The book develops the logical tools for writing proofs by guiding readers through both the established Hilbert style of proof writing as well as the equational style that is emerging in computer science and engineering applications Chapters have been organized into the two topical areas of Boolean logic and predicate logic Techniques situated outside formal logic are applied to illustrate and demonstrate significant facts regarding the power and limitations of logic such as Logic can certify truths and only truths Logic can certify all absolute truths completeness theorems of Post and G del Logic cannot certify all conditional truths such as those that are specific to the Peano arithmetic Therefore logic has some serious limitations as shown through G del s incompleteness theorem Numerous examples and problem sets are provided throughout the text further facilitating readers understanding of the capabilities of logic to discover mathematical truths In addition an extensive appendix introduces Tarski semantics and proceeds with detailed proofs of completeness and first incompleteness theorems while also providing a self contained introduction to the theory of computability With its thorough scope of coverage and accessible style Mathematical Logic is an ideal book for courses in mathematics computer science and philosophy at the upper undergraduate and graduate levels It is also a valuable reference for researchers and practitioners who wish to learn how to use logic in their everyday work **Private Sector Perspectives on Department of Defense Information Technology and Cybersecurity Activities** United States. Congress. House. Committee on Armed Services. Subcommittee on Terrorism, Unconventional Threats, and Capabilities,2010 ZUM '95: The Z Formal Specification Notation Jonathan P. Bowen,1995-08-23 This book presents the proceedings of the 9th International Conference of Z Users ZUM 95 held in Limerick Ireland in September 1995 The book contains 34 carefully selected papers on Z using Z applications of Z proof testing industrial usage object orientation animation of specification method integration and teaching formal methods Of particular interest is the inclusion of an annotated Z bibliography listing 544 entries While focussing on Z by far the most

commonly used formal method both in industry and application the volume is of high relevance for the whole formal methods community **Edsger Wybe Dijkstra** Krzysztof R. Apt,Tony Hoare,2022-07-14 Edsger Wybe Dijkstra 1930 2002 was one of the most influential researchers in the history of computer science making fundamental contributions to both the theory and practice of computing Early in his career he proposed the single source shortest path algorithm now commonly referred to as Dijkstra s algorithm He wrote with Jaap Zonneveld the first ALGOL 60 compiler and designed and implemented with his colleagues the influential THE operating system Dijkstra invented the field of concurrent algorithms with concepts such as mutual exclusion deadlock detection and synchronization A prolific writer and forceful proponent of the concept of structured programming he convincingly argued against the use of the Go To statement In 1972 he was awarded the ACM Turing Award for fundamental contributions to programming as a high intellectual challenge for eloquent insistence and practical demonstration that programs should be composed correctly not just debugged into correctness for illuminating perception of problems at the foundations of program design Subsequently he invented the concept of self stabilization relevant to fault tolerant computing He also devised an elegant language for nondeterministic programming and its weakest precondition semantics featured in his influential 1976 book A Discipline of Programming in which he advocated the development of programs in concert with their correctness proofs In the later stages of his life he devoted much attention to the development and presentation of mathematical proofs providing further support to his long held view that the programming process should be viewed as a mathematical activity In this unique new book 31 computer scientists including five recipients of the Turing Award present and discuss Dijkstra s numerous contributions to computing science and assess their impact Several authors knew Dijkstra as a friend teacher lecturer or colleague Their biographical essays and tributes provide a fascinating multi author picture of Dijkstra from the early days of his career up to the end of his life Lectures in Logic and Set Theory: Volume 1, Mathematical Logic George Tourlakis,2003-01-09 This two volume work bridges the gap between introductory expositions of logic or set theory on one hand and the research literature on the other It can be used as a text in an advanced undergraduate or beginning graduate course in mathematics computer science or philosophy The volumes are written in a user friendly conversational lecture style that makes them equally effective for self study or class use Volume 1 includes formal proof techniques a section on applications of compactness including nonstandard analysis a generous dose of computability and its relation to the incompleteness phenomenon and the first presentation of a complete proof of Godel s 2nd incompleteness since Hilbert and Bernay s Grundlagen theorem **Algebraic Methodology and Software Technology** Armando M. Haeberer,2003-05-20 AMAST s goal is to advance awareness of algebraic and logical methodology as part of the fundamental basis of software technology Ten years and seven conferences after the start of the AMAST movement I believe we are attaining this The movement has propagated throughout the world assembling many enthusiastic specialists who have participated not only in the conferences which are now annual but also in the innumerable other

activities that AMAST promotes and supports We are now facing the Seventh International Conference on Algebraic Methodology and Software Technology AMAST 98 The previous meetings were held in Iowa City USA 1989 and 1991 in Enschede The Netherlands 1993 in Montreal Canada 1995 in Munich Germany 1996 and in Sydney Australia 1997 This time it is Brazil s turn in a very special part of this colorful country Amazonia Thus if we have done more it is by standing on the shoulders of giants The effort started by Teodor Rus Arthur Fleck and William A Kirk at AMAST 89 was consolidated in AMAST 91 by Teodor Rus Maurice Nivat Charles Rattray and Giuseppe Scollo Then came modular construction of the building wonderfully carried out by Giuseppe Scollo Vangalur Alagar Martin Wirsing and Michael Johnson as Program Chairs of the AMAST conferences held between 1993 and 1997 *Mathematical Logic for Computer Science* Mordechai Ben-Ari,2012-12-06 Mathematical Logic for Computer Science is a mathematics textbook with theorems and proofs but the choice of topics has been guided by the needs of computer science students The method of semantic tableaux provides an elegant way to teach logic that is both theoretically sound and yet sufficiently elementary for undergraduates To provide a balanced treatment of logic tableaux are related to deductive proof systems The logical systems presented are Propositional calculus including binary decision diagrams Predicate calculus Resolution Hoare logic Z Temporal logic Answers to exercises for instructors only as well as Prolog source code for algorithms may be found via the Springer London web site http www springer com 978 1 85233 319 5 Mordechai Ben Ari is an associate professor in the Department of Science Teaching of the Weizmann Institute of Science He is the author of numerous textbooks on concurrency programming languages and logic and has developed software tools for teaching concurrency In 2004 Ben Ari received the ACM SIGCSE Award for Outstanding Contributions to Computer Science Education **Software Engineering and Formal Methods** Dimitra Giannakopoulou,Gwen Salaün,2014-08-04 This book constitutes the refereed proceedings of the 12th International Conference on Software Engineering and Formal Methods SEFM 2014 held in Grenoble France in September 2014 The 23 full papers presented together with 3 invited and 6 tool papers were carefully reviewed and selected from 106 submissions They are organized in topical section on program verification testing component based systems real time and embedded systems model checking and automata learning program correctness and adaptive and multi agent systems *Developments in Nonstandard Mathematics* Nigel J Cutland,Vitor Neves,A F Oliveira,Jose Sousa-Pinto,2020-01-30 This book contains expository papers and articles reporting on recent research by leading world experts in nonstandard mathematics arising from the International Colloquium on Nonstandard Mathematics held at the University of Aveiro Portugal in July 1994 Nonstandard mathematics originated with Abraham Robinson and the body of ideas that have developed from this theory of nonstandard analysis now vastly extends Robinson s work with infinitesimals The range of applications includes measure and probability theory stochastic analysis differential equations generalised functions mathematical physics and differential geometry moreover the theory has implicaitons for the teaching of calculus and

analysis This volume contains papers touching on all of the abovbe topics as well as a biographical note about Abraham Robinson based on the opening address given by W A J Luxemburg who knew Robinson to the Aveiro conference which marked the 20th anniversary of Robinson s death This book will be of particular interest to students and researchers in nonstandard analysis measure theory generalised functions and mathematical physics

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