

4 METHODS OF MATHEMATICAL PROOF

Definition 4.1 (Proof). A proof is a sequence of statements used to show that a proposition is true.

Here are some important terminologies associated to proofs.

Definition 4.2 (Theorem). A theorem is a proposition that has been shown to be true.

Definition 4.3 (Lemma). A lemma is a proven proposition that is used as a stepping stone to a larger result rather than as a statement of interest by itself.

Definition 4.4 (Corollary). A corollary is a proposition that can be established directly from a theorem that has been proven.

Definition 4.5 (Conjecture). A conjecture is a conclusion or proposition based on incomplete information, for which no proof or disproof has yet been found.

Definition 4.6 (Axiom). Axioms are assumptions about a mathematical structure and are assumed to be true.

Direct Proof: To prove the implication $P \implies Q$, we assume P is true. We then use P , axioms, definitions and previously derived results to show that Q is true. A direct proof has the following form.

Suppose that P is true.

⋮

(argumentation)

⋮

Therefore Q is true.

Example 4.1. Let a , b and c be integers. Prove that if $a|b$ and $b|c$, then $a|c$.

Solution. Let a , b and c be integers. Suppose that $a|b$ and $b|c$. Then, by definition, there are integers m and n such that $b = am$ and $c = bn$. Thus, we have that

$$c = bn = (am)n = a(mn) = af, \quad (4.1)$$

where $t = mn \in \mathbb{Z}$. Therefore, $a|c$. ■

Example 4.2. Prove that $b - a$ is odd whenever a and b are consecutive perfect squares.

Solution. Suppose that a and b are consecutive perfect squares. Then, $a = k^2$ and $b = (k+1)^2$ for some $k \in \mathbb{Z}$. It follows that

$$b - a = (k+1)^2 - k^2 = k^2 + 2k + 1 - k^2 = 2k + 1. \quad (4.2)$$

Hence, $b - a$ is odd. ■

Methods Analytical Proof Mathematical Thinking

Stephen Fratini

Methods Analytical Proof Mathematical Thinking:

Methods of the Analytical Proof Edited by Paul F. Kisak, 2015-11-25 In mathematics an analytic proof is a proof of a theorem in analysis that only makes use of methods from analysis and which does not predominantly make use of algebraic or geometrical methods The term was first used by Bernard Bolzano who first provided a non analytic proof of his intermediate value theorem and then several years later provided proof of the theorem which was free from intuitions concerning lines crossing each other at a point and so he felt happy calling it analytic Bolzano 1817 Bolzano's philosophical work encouraged a more abstract reading of when a demonstration could be regarded as analytic where a proof is analytic if it does not go beyond its subject matter Sebastik 2007 In proof theory an analytic proof has come to mean a proof whose structure is simple in a special way due to conditions on the kind of inferences that ensure none of them go beyond what is contained in the assumptions and what is demonstrated This book details the methods and means by which an analytic proof is formulated

Teaching Discipline-Specific Literacies in Grades 6-12 Vicky I. Zygouris-Coe, 2014-10-30

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Mathematics Teaching Reimagined Nathan D. Lang-Raad, 2025-04-08 Transform mathematics instruction with the comprehensive mathematical competencies CMC framework a research based model that integrates seven essential competencies conceptual and procedural integration problem solving logical reasoning communication tool use pattern recognition and student engagement Through practical classroom strategies and real world examples create learning environments where students build deep mathematical proficiency through meaningful connected experiences K 12 teachers can use this book to Implement the seven mathematical competencies through detailed curriculum planning instruction and assessment

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Descartes's Mathematical Thought C. Sasaki,2013-03-09 Covering both the history of mathematics and of philosophy Descartes's Mathematical Thought reconstructs the intellectual career of Descartes most comprehensively and originally in a global perspective including the history of early modern China and Japan Especially it shows what the concept of *mathesis universalis* meant before and during the period of Descartes and how it influenced the young Descartes In fact it was the most fundamental mathematical discipline during the seventeenth century and for Descartes a key notion which may have led to his novel mathematics of algebraic analysis

Mathematical Thinking and Writing Randall Maddox,2001-07-24 The ability to construct proofs is one of the most challenging aspects of the world of mathematics It is essentially the defining moment for those testing the waters in a mathematical career Instead of being submerged to the point of drowning readers of Mathematical Thinking and Writing are given guidance and support while learning the language of proof construction and critical analysis Randall Maddox guides the reader with a warm conversational style through the task of gaining a thorough understanding of the proof process and encourages inexperienced mathematicians to step up and learn how to think like a mathematician A student's skills in critical analysis will develop and become more polished than previously conceived Most significantly Dr Maddox has the unique approach of using analogy within his book to clarify abstract ideas and clearly demonstrate methods of mathematical precision

Contemporary Mathematical Thinking Frédéric Patras,2023-04-13 This book deals with the evolution of mathematical thought during the 20th century Representing a unique point of view combining mathematics philosophy and history on this issue it presents an original analysis of key authors for example Bourbaki Grothendieck and Husserl As a product of 19th and early 20th century science a canon of knowledge or a scientific ideology mathematical structuralism had to give way The succession is difficult still in progress and uncertain To understand contemporary mathematics its progressive liberation from the slogans of modern mathematics and the paths that remain open today it is first necessary to deconstruct the history of this long dominant current Another conception of mathematical thought emerged in the work of mathematicians such as Hilbert or Weyl which went beyond the narrow epistemological paths of science in the making In this tradition mathematical thought was accompanied by a philosophical requirement Modernity teaches us to revive it The book is intended for a varied

public mathematicians concerned with understanding their discipline philosophers of science and the erudite public curious about the progress of mathematics Mathematical Thought From Ancient to Modern Times, Volume 3 Morris Kline, 1990-03-01 This comprehensive history traces the development of mathematical ideas and the careers of the men responsible for them Volume 1 looks at the disciplines origins in Babylon and Egypt the creation of geometry and trigonometry by the Greeks and the role of mathematics in the medieval and early modern periods Volume 2 focuses on calculus the rise of analysis in the 19th century and the number theories of Dedekind and Dirichlet The concluding volume covers the revival of projective geometry the emergence of abstract algebra the beginnings of topology and the influence of Gödel on recent mathematical study **Mathematical Thinking** John P. D'Angelo, Douglas Brent West, 1997 Developing logical thinking and fundamental mathematical ideas and using problems that pique students mathematical curiosity this work aims to prepare readers for all upper division mathematics courses and improve their skills in presenting coherent arguments *Advanced Mathematical Thinking* David Tall, 2006-04-11 Advanced Mathematical Thinking has played a central role in the development of human civilization for over two millennia Yet in all that time the serious study of the nature of advanced mathematical thinking what it is how it functions in the minds of expert mathematicians how it can be encouraged and improved in the developing minds of students has been limited to the reflections of a few significant individuals scattered throughout the history of mathematics In the twentieth century the theory of mathematical education during the compulsory years of schooling to age 16 has developed its own body of empirical research theory and practice But the extensions of such theories to more advanced levels have only occurred in the last few years In 1976 The International Group for the Psychology of Mathematics known as PME was formed and has met annually at different venues round the world to share research ideas In 1985 a Working Group of PME was formed to focus on Advanced Mathematical Thinking with a major aim of producing this volume The text begins with an introductory chapter on the psychology of advanced mathematical thinking with the remaining chapters grouped under three headings the nature of advanced mathematical thinking cognitive theory and reviews of the progress of cognitive research into different areas of advanced mathematics

Descartes's Mathematical Thought Chikara Sasaki, 1989 Mathematical Thinking John P. D'Angelo, Douglas Brent West, 2000 This survey of both discrete and continuous mathematics focuses on the logical thinking skills necessary to understand and communicate fundamental ideas and proofs in mathematics rather than on rote symbolic manipulation Coverage begins with the fundamentals of mathematical language and proof techniques such as induction then applies them to easily understood questions in elementary number theory and counting then develops additional techniques of proofs via fundamental topics in discrete and continuous mathematics Topics are addressed in the context of familiar objects easily understood engaging examples and over 700 stimulating exercises and problems ranging from simple applications to subtle problems requiring ingenuity ELEMENTARY CONCEPTS Numbers Sets and Functions Language and Proofs Properties of

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Mathematics Methods for Elementary and Middle School Teachers

Mary M. Hatfield,2004-04-29 An activity based approach to teaching with an emphasis on using manipulatives to build conceptual understanding This invaluable book combines practical teaching ideas video examples updated assessment techniques and the NCTM Assessment Standards to give teachers all the background they need to introduce elementary and middle school students to the wonders of mathematics

[Automated Reasoning with Analytic Tableaux and Related Methods](#) Harrie de Swart,1998-04-22 This volume contains the papers presented at TABLEAUX 98 the International Conference on Analytic Tableaux and Related Methods held on May 5 8 1998 in Oisterwijk conference centre Boschoord near Tilburg The Netherlands This conference was a continuation of international workshops conferences on Theorem Proving with Analytic Tableaux and Related Methods held in Laut bach near Karlsruhe 1992 Marseille 1993 Abingdon near Oxford 1994 St Goar near Koblenz 1995 Terrasini near Palermo 1996 and Pont a Mousson near Nancy 1997 Tableau methods have been found to be a convenient formalism for automating deduction in various non standard logics as well as in classical logic Areas of application include verification of software and computer systems deductive databases knowledge representation and its required inference engines and system diagnosis The conference brought together researchers interested in all aspects theoretical foundations implementation techniques systems development and applications of the mechanization of reasoning with tableaux and related methods From the 34 papers submitted 17 original research papers and 3 original system descriptions were selected by the program committee for presentation at the conference and for inclusion in these proceedings together with the invited lectures Abstracts of the tutorials have also been included These proceedings also contain the summary of the comparison of theorem provers for modal propositional logics as part of the Tableaux 98 conference together with the contributions of the persons who participated in this comparison As before Tableaux 98 attracted interest from many parts of the world with papers from many countries

Descartes and His School

Kuno Fischer,1890

Fundamental Approaches to Software Engineering

,2000

The New Education

,1891

[Cornell University Courses of Study](#) Cornell University,2006

The Journal of Education

,1891

Mathematics Teacher ,2000

[Mathematical Thinking](#) Stephen Fratini,2020-08-10 The purpose of this book is to improve the reader's analytical skills through the study and practice of mathematical thinking where mathematical thinking includes algorithms logic methods of reasoning methods of proof modeling and universal mathematical laws As a byproduct the reader is provided with a brief introduction to many areas of mathematics including calculus combinatorics probability statistics

graph theory linear algebra and several other areas The intended audience includes students advanced high school and college and folks in general who are interested in improving their analytical thinking skills and at the same time learning some mathematics For those who don t deal with mathematics on a regular basis this will not be an easy read but hopefully the benefits will be worth it The prerequisites are fairly basic i e high school algebra a little bit of basic geometry and some prior exposure to mathematical proofs Most of the topics in the book are developed from basic principles

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