

Mathematical Reasoning and Heuristics

C. Cellucci & D. Gillies Editors

Mathematical Reasoning And Heuristics

Cesare Cozzo, Emiliano Ippoliti



Mathematical Reasoning And Heuristics:

Mathematical Reasoning and Heuristics Carlo Cellucci, Donald Gillies, 2005 This volume is a collection of papers on philosophy of mathematics which deal with a series of questions quite different from those which occupied the minds of the proponents of the three classic schools logicism formalism and intuitionism The questions of the volume are not to do with justification in the traditional sense but with a variety of other topics Some are concerned with discovery and the growth of mathematics How does the semantics of mathematics change as the subject develops What heuristics are involved in mathematical discovery and do such heuristics constitute a logic of mathematical discovery What new problems have been introduced by the development of mathematics since the 1930s Other questions are concerned with the applications of mathematics both to physics and to the new field of computer science Then there is the new question of whether the axiomatic method is really so essential to mathematics as is often supposed and the question which goes back to Wittgenstein of the sense in which mathematical proofs are compelling Taking these questions together they give part of an emerging agenda which is likely to carry philosophy of mathematics forward into the twenty first century *The Philosophy of Mathematical Practice* Paolo Mancosu, 2008-06-19 There is an urgent need in philosophy of mathematics for new approaches which pay closer attention to mathematical practice This book will blaze the trail it offers philosophical analyses of important characteristics of contemporary mathematics and of many aspects of mathematical activity which escape purely formal logical treatment **From a Heuristic Point of View** Cesare Cozzo, Emiliano Ippoliti, 2014-07-03 How do we get new knowledge Following the maverick tradition in the philosophy of science Carlo Cellucci gradually came to the conclusion that logic can only fulfill its role in mathematics science and philosophy if it helps us to answer this question He argues that mathematical logic is inadequate and that we need a new logic framed in a naturalistic conception of knowledge and philosophy the heuristic conception This path from logic to a naturalistic conception of knowledge and philosophy explains the title *From a Heuristic Point of View* which recalls the celebrated collection of essays *From a Logical Point of View* by Willard Van Orman Quine the father of modern naturalized epistemology The word heuristic points to Cellucci's favorite theme and the main difference between him and Quine the emphasis on discovery and building a logic for generating new knowledge This book is a collection of essays from leading figures in this field who discuss criticize or expand on the main topics in Cellucci's work dealing with some of the most challenging questions in logic science and philosophy **Effective Mathematics Lessons Through An Eclectic Singapore Approach: Yearbook 2015, Association Of Mathematics Educators** Khoon Yoong Wong, 2015-05-21 With this seventh volume as part of the series of yearbooks by the Association of Mathematics Educators in Singapore we aim to provide a range of learning experiences and teaching strategies that mathematics teachers can judiciously select and adapt in order to deliver effective lessons to their students at the primary to secondary level Our ultimate goal is to develop successful problem solvers who are able to understand concepts master

fundamental skills reason logically apply mathematics enjoy learning and strategise their thinking These qualities will prepare students for life long learning and careers in the 21st century The materials covered are derived from psychological theories education praxis research findings and mathematics discourse mediated by the author s professional experiences in mathematics education in four countries over the past four decades They are organised into ten chapters aligned with the Singapore mathematics curriculum framework to help teachers and educators from Singapore and other countries deepen their understanding about the so called Singapore Maths The book strikes a balance between mathematical rigour and pedagogical diversity without rigid adherence to either This is relevant to the current discussion about the relative roles of mathematics content knowledge and pedagogical content knowledge in effective teaching It also encourages teachers to develop their own philosophy and teaching styles so that their lessons are effective efficient and enjoyable to teach

The Mathematics Enthusiast Bharath Sriraman,2015-10-01 The Mathematics Enthusiast TME is an eclectic internationally circulated peer reviewed journal which focuses on mathematics content mathematics education research innovation interdisciplinary issues and pedagogy The journal exists as an independent entity It is published on a print on demand basis by Information Age Publishing and the electronic version is hosted by the Department of Mathematical Sciences University of Montana The journal is not affiliated to nor subsidized by any professional organizations but supports PMENA Psychology of Mathematics Education North America through special issues on various research topics

Common Sense, Reasoning, and Rationality Renee Elio,2002-02-07 As the eleventh volume in the New Directions in Cognitive Science series formerly the Vancouver Studies in Cognitive Science series this work promises superb scholarship and interdisciplinary appeal It addresses three areas of current and varied interest common sense reasoning and rationality While common sense and rationality often have been viewed as two distinct features in a unified cognitive map this volume offers novel even paradoxical views of the relationship Comprised of outstanding essays from distinguished philosophers it considers what constitutes human rationality behavior and intelligence covering diverse areas of philosophy psychology cognitive science and computer science Indeed it is at the forefront of cognitive research and promises to be of unprecedented influence across numerous disciplines

Studying Virtual Math Teams Gerry Stahl,2010-05-03 Studying Virtual Math Teams centers on detailed empirical studies of how students in small online groups make sense of math issues and how they solve problems by making meaning together These studies are woven together with materials that describe the online environment and pedagogical orientation as well as reflections on the theoretical implications of the findings in the studies The nature of group cognition and shared meaning making in collaborative learning is a foundational research issue in CSCL More generally the theme of sense making is a central topic in information science While many authors allude to these topics few have provided this kind of detailed analysis of the mechanisms of intersubjective meaning making This book presents a coherent research agenda that has been pursued by the author and his research group The book opens with descriptions of

the project and its methodology as well as situating this research in the past and present context of the CSDL research field. The core research team then presents five concrete analyses of group interactions in different phases of the Virtual Math Teams research project. These chapters are followed by several studies by international collaborators discussing the group discourse, the software affordances, and alternative representations of the interaction, all using data from the VMT project. The concluding chapters address implications for the theory of group cognition and for the methodology of the learning sciences. In addition to substantial introductory and concluding chapters, this important new book includes analyses based upon the author's previous research, thereby providing smooth continuity and an engaging flow that follows the progression of the research. The VMT project has dual goals: a) to provide a source of experience and data for practical and theoretical explorations of group knowledge building, and b) to develop an effective online environment and educational service for collaborative learning of mathematics. Studying Virtual Math Teams reflects these twin orientations, reviewing the intertwined aims and development of a rigorous science of small group cognition and a Web 2.0 educational math service. It documents the kinds of interactional methods that small groups use to explore math issues and provides a glimpse into the potential of online interaction to promote productive math discourse.

The Heuristic View Emiliano Ippoliti, Fabio

Sterpetti, 2025-10-01 This volume offers a series of thought-provoking analyses that explore non-mainstream perspectives on knowledge acquisition and scientific discovery. A central theme across many of the contributions is the heuristic conception of method, a view that finds its philosophical roots in Imre Lakatos's work in the philosophy of mathematics and more distantly in Platonic notions of philosophical inquiry. Knowledge acquisition is frequently conceptualized as a form of problem solving, and problem solving is typically regarded as a rational endeavor. However, the dominant view in the philosophy of science has long held that scientific discovery resists systematic explanation in terms of logic and rationality. If an alternative account of discovery grounded in these terms can be developed, it would represent a significant theoretical advancement. The essays collected in this book critically assess the promise and limitations of such non-standard accounts and investigate the possibility of framing scientific discovery within a logical and rational framework. This volume will be of particular interest to scholars in the philosophy of science, epistemology, philosophy of mathematics, and philosophy of logic, as well as to scientists engaged in theoretical inquiry and graduate students working in these or related areas.

Building Theories David

Danks, Emiliano Ippoliti, 2018-01-18 This book explores new findings on the long-neglected topic of theory construction and discovery and challenges the orthodox current division of scientific development into discrete stages: the stage of generation of new hypotheses, the stage of collection of relevant data, the stage of justification of possible theories, and the final stage of selection from among equally confirmed theories. The chapters, written by leading researchers, offer an interdisciplinary perspective on various aspects of the processes by which theories rationally should and descriptively are built. They address issues such as the role of problem solving and heuristic reasoning in theory building, how inferences and models shape the

pursuit of scientific knowledge the relation between problem solving and scientific discovery the relative values of the syntactic semantic and pragmatic view of theories in understanding theory construction and the relation between ampliative inferences heuristic reasoning and models as a means for building new theories and knowledge Through detailed arguments and examinations the volume collectively challenges the orthodox view s main tenets by characterizing the ways in which the different stages are logically temporally and psychologically intertwined As a group the chapters provide several attempts to answer long standing questions about the possibility of a unified conceptual framework for building theories and formulating hypotheses

Transforming Mathematics Instruction Yeping Li,Edward A. Silver,Shiqi Li,2014-07-05 This book surveys and examines different approaches and practices that contribute to the changes in mathematics instruction including 1 innovative approaches that bring direct changes in classroom instructional practices 2 curriculum reforms that introduce changes in content and requirements in classroom instruction and 3 approaches in mathematics teacher education that aim to improve teachers expertise and practices It also surveys relevant theory and methodology development in studying and assessing mathematics instruction Classroom instruction is commonly seen as one of the key factors contributing to students learning of mathematics but much remains to be understood about teachers instructional practices that lead to the development and enactment of effective classroom instruction and approaches and practices developed and used to transform classroom instruction in different education systems *Transforming Mathematics Instruction* is organized to help readers learn not only from reading individual chapters but also from reading across chapters and sections to explore broader themes including Identifying what is important in mathematics for teaching and learning emphasized in different approaches Exploring how students learning is considered and facilitated through different approaches and practices Understanding the nature of various approaches that are valued in different systems and cultural contexts Probing culturally valued approaches in identifying and evaluating effective instructional practices The book brings new research and insights into multiple approaches and practices for transforming mathematics instruction to the international community of mathematics education with 25 chapters and four section prefaces contributed by 56 scholars from 10 different education systems This rich collection is indispensable reading for mathematics educators researchers teacher educators curriculum developers and graduate students interested in learning about different instructional practices approaches for instructional transformation and research in different education systems It will help readers to reflect on approaches and practices that are useful for instructional changes in their own education systems and also inspire them to identify and further explore new areas of research and program development in improving mathematics teaching and learning

Heuristic Strategies in the Speeches of Cicero Gábor Tahin,2013-11-23 This book introduces a new form of argumentative analysis rhetorical heuristics The method applies the concepts of heuristic thinking probability and contingency in order to develop a better understanding of complex arguments in classical oratory A new theory is required because Greek and Roman rhetoric cannot

provide detailed answers to problems of strategic argumentation in the analysis of speeches Building on scholarship in Ciceronian oratory this book moves beyond the extant terminology and employs a concept of heuristic reasoning derived from the psychology of decision making and mathematical problem solving The author analyses selected passages from Cicero's forensic speeches where arguments of probability are deployed and shows that the Sophistic concept of probability can link ancient rhetoric and modern theories of argumentation Six groups of heuristics are identified each of which represents a form of probabilistic reasoning by which the orator plays upon the perception of the jurors *Singapore Math and Science Education Innovation* Oon Seng Tan, Ee Ling Low, Eng Guan Tay, Yaw Kai Yan, 2021-08-04 This edited volume explores key areas of interests in Singapore math and science education including issues on teacher education pedagogy curriculum assessment teaching practices applied learning ecology of learning talent grooming culture of science and math vocational education and STEM It presents to policymakers and educators a clear picture of the education scene in Singapore and insights into the role of math and science education in helping the country excel beyond international studies such as PISA the pedagogical and curricula advancements in math and science learning and the research and practices that give Singaporean students the competitive edge in facing the uncertain and challenging landscape of the future Imre Lakatos and the Guises of Reason John Kadvany, 2001-04-09 An exploration of the philosophy of science and mathematics of Hungarian emigre Imre Lakatos demonstrating its contemporary relevance **Effective Teaching Strategies for Dyscalculia and Learning Difficulties in Mathematics** Marie-Pascale Noël, Giannis Karagiannakis, 2022-03-28 Effective Teaching Strategies for Dyscalculia and Learning Difficulties in Mathematics provides an essential bridge between scientific research and practical interventions with children It unpacks what we know about the possible cognitive causation of mathematical difficulties in order to improve teaching and therefore learning Each chapter considers a specific domain of children's numerical development counting and the understanding of numbers understanding of the base 10 system arithmetic word problem solving and understanding rational numbers The accessible guidance includes a literature review on each topic surveying how each process develops in children the difficulties encountered at that level by some pupils and the intervention studies that have been published It guides the reader step by step through practical guidelines of how to assess these processes and how to build an intervention to help children master them Illustrated throughout with examples of materials used in the effective interventions described this essential guide offers deep understanding and effective strategies for developmental and educational psychologists special educational needs and or disabilities coordinators and teachers working with children experiencing mathematical difficulties Handbook of Psychology, Educational Psychology Irving B. Weiner, William M. Reynolds, Gloria E. Miller, 2012-10-16 Psychology is of interest to academics from many fields as well as to the thousands of academic and clinical psychologists and general public who can't help but be interested in learning more about why humans think and behave as they do This award winning twelve volume reference covers every

aspect of the ever fascinating discipline of psychology and represents the most current knowledge in the field This ten year revision now covers discoveries based in neuroscience clinical psychology s new interest in evidence based practice and mindfulness and new findings in social developmental and forensic psychology Models of Simon Kumaraswamy Vela Velupillai,2017-11-22 Herbert Simon 1916 2001 is mostly celebrated for the theory of bounded rationality and satisficing This book of essays on Models of Simon tackles these topics that he broached in a professional career spanning more than 60 years Expository material on the fundamental concepts he introduced are re interpreted in terms of the theory of computability This volume frames the behavioural issues of concern for economists such as hierarchy causality near diagonal linear dynamical systems discovery the contrasts between the notion of heuristics and the Church Turing Thesis of Computability Theory There is consistently an emphasis on the historical origins of the concepts Simon worked with in emphasising Human Problem Solving and Decision Making by rational individuals and institutions like Organizations The main feature of the results in the book are its emphasis on the procedural aspects of human problem solving decision making and the remarkable way Simon harnessed many tools of mathematical logic mathematics cognitive sciences economics and econometrics This long awaited volume is an important read for those who study economic theory and philosophy microeconomics and political economy as well as those interested in the great Herbert Simon s work **Springer**

Handbook of Model-Based Science Lorenzo Magnani,Tommaso Bertolotti,2017-05-22 This handbook offers the first comprehensive reference guide to the interdisciplinary field of model based reasoning It highlights the role of models as mediators between theory and experimentation and as educational devices as well as their relevance in testing hypotheses and explanatory functions The Springer Handbook merges philosophical cognitive and epistemological perspectives on models with the more practical needs related to the application of this tool across various disciplines and practices The result is a unique reliable source of information that guides readers toward an understanding of different aspects of model based science such as the theoretical and cognitive nature of models as well as their practical and logical aspects The inferential role of models in hypothetical reasoning abduction and creativity once they are constructed adopted and manipulated for different scientific and technological purposes is also discussed Written by a group of internationally renowned experts in philosophy the history of science general epistemology mathematics cognitive and computer science physics and life sciences as well as engineering architecture and economics this Handbook uses numerous diagrams schemes and other visual representations to promote a better understanding of the concepts This also makes it highly accessible to an audience of scholars and students with different scientific backgrounds All in all the Springer Handbook of Model Based Science represents the definitive application oriented reference guide to the interdisciplinary field of model based reasoning

Science and the Pursuit of Wisdom Leemon McHenry,2013-05-02 Nicholas Maxwell s provocative and highly original philosophy of science urges a revolution in academic inquiry affecting all branches of learning so that the single minded

pursuit of knowledge is replaced with the aim of helping people realize what is of value in life and make progress toward a more civilized world This volume of essays from an international interdisciplinary group of scholars engages Maxwell in critical evaluation and celebrates his contribution to philosophy spanning forty years Several of the contributors like Maxwell took their inspiration from Sir Karl Popper's philosophy of science and were connected to the department he created at the London School of Economics In the introductory chapter Maxwell provides an overview of his thought and then defends his views against objections in a concluding essay

Oxford Handbook of Numerical Cognition Roi Cohen Kadosh, Ann Dowker, 2015-07-30 How do we understand numbers Do animals and babies have numerical abilities Why do some people fail to grasp numbers and how we can improve numerical understanding Numbers are vital to so many areas of life in science economics sports education and many aspects of everyday life from infancy onwards Numerical cognition is a vibrant area that brings together scientists from different and diverse research areas e.g. neuropsychology cognitive psychology developmental psychology comparative psychology anthropology education and neuroscience using different methodological approaches e.g. behavioral studies of healthy children and adults and of patients electrophysiology and brain imaging studies in humans single cell neurophysiology in non human primates habituation studies in human infants and animals and computer modeling While the study of numerical cognition had been relatively neglected for a long time during the last decade there has been an explosion of studies and new findings This has resulted in an enormous advance in our understanding of the neural and cognitive mechanisms of numerical cognition In addition there has recently been increasing interest and concern about pupils' mathematical achievement in many countries resulting in attempts to use research to guide mathematics instruction in schools and to develop interventions for children with mathematical difficulties This handbook brings together the different research areas that make up the field of numerical cognition in one comprehensive and authoritative volume The chapters provide a broad and extensive review that is written in an accessible form for scholars and students as well as educationalists clinicians and policy makers The book covers the most important aspects of research on numerical cognition from the areas of development psychology cognitive psychology neuropsychology and rehabilitation learning disabilities human and animal cognition and neuroscience computational modeling education and individual differences and philosophy Containing more than 60 chapters by leading specialists in their fields the Oxford Handbook of Numerical Cognition is a state of the art review of the current literature

Psychology and Mathematics Education Gila Hanna, Laura Macchi, Karin Binder, Laura Martignon, Katharina Loibl, 2023-09-05 Modern Mathematics is constructed rigorously through proofs based on truths which are either axioms or previously proven theorems Thus it is par excellence a model of rational inquiry Links between Cognitive Psychology and Mathematics Education have been particularly strong during the last decades Indeed the Enlightenment view of the rational human mind that reasons makes decisions and solves problems based on logic and probabilities was shaken during the second half of the twentieth century Cognitive psychologists

discovered that humans thoughts and actions often deviate from rules imposed by strict normative theories of inference Yet these deviations should not be called errors as Cognitive Psychologists have demonstrated these deviations may be either valid heuristics that succeed in the environments in which humans have evolved or biases that are caused by a lack of adaptation to abstract information formats Humans as the cognitive psychologist and economist Herbert Simon claimed do not usually optimize but rather satisfice even when solving problem This Research Topic aims at demonstrating that these insights have had a decisive impact on Mathematics Education We want to stress that we are concerned with the view of bounded rationality that is different from the one espoused by the heuristics and biases program In Simon s bounded rationality and its direct descendant ecological rationality rationality is understood in terms of cognitive success in the world correspondence rather than in terms of conformity to content free norms of coherence e g transitivity

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