

Model-Based Reasoning in Scientific Discovery

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Model Based Reasoning In Scientific Discovery

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Model Based Reasoning In Scientific Discovery:

Model-Based Reasoning in Scientific Discovery L. Magnani, N.J. Nersessian, Paul Thagard, 2012-12-06 The volume is based on the papers that were presented at the International Conference Model Based Reasoning in Scientific Discovery MBR 98 held at the Collegio Ghislieri University of Pavia Pavia Italy in December 1998 The papers explore how scientific thinking uses models and explanatory reasoning to produce creative changes in theories and concepts The study of diagnostic visual spatial analogical and temporal reasoning has demonstrated that there are many ways of performing intelligent and creative reasoning that cannot be described with the help only of traditional notions of reasoning such as classical logic Traditional accounts of scientific reasoning have restricted the notion of reasoning primarily to deductive and inductive arguments Understanding the contribution of modeling practices to discovery and conceptual change in science requires expanding scientific reasoning to include complex forms of creative reasoning that are not always successful and can lead to incorrect solutions The study of these heuristic ways of reasoning is situated at the crossroads of philosophy artificial intelligence cognitive psychology and logic that is at the heart of cognitive science There are several key ingredients common to the various forms of model based reasoning to be considered in this book The models are intended as interpretations of target physical systems processes phenomena or situations The models are retrieved or constructed on the basis of potentially satisfying salient constraints of the target domain

Model-Based Reasoning in Science and Technology Ángel Nepomuceno-Fernández, Lorenzo Magnani, Francisco J. Salguero-Lamillar, Cristina Barés-Gómez, Matthieu Fontaine, 2019-10-24 This book discusses how scientific and other types of cognition make use of models abduction and explanatory reasoning in order to produce important and innovative changes in theories and concepts Gathering revised contributions presented at the international conference on Model Based Reasoning MBR18 held on October 24-26 2018 in Seville Spain the book is divided into three main parts The first focuses on models reasoning and representation It highlights key theoretical concepts from an applied perspective and addresses issues concerning information visualization experimental methods and design The second part goes a step further examining abduction problem solving and reasoning The respective papers assess different types of reasoning and discuss various concepts of inference and creativity and their relationship with experimental data In turn the third part reports on a number of epistemological and technological issues By analyzing possible contradictions in modern research and describing representative case studies this part is intended to foster new discussions and stimulate new ideas All in all the book provides researchers and graduate students in the fields of applied philosophy epistemology cognitive science and artificial intelligence alike with an authoritative snapshot of the latest theories and applications of model based reasoning

Model-Based Reasoning in Science and Technology Lorenzo Magnani, Claudia Casadio, 2016-07-01 This book discusses how scientific and other types of cognition make use of models abduction and explanatory reasoning in order to produce important or creative changes in theories and concepts It includes

revised contributions presented during the international conference on Model Based Reasoning MBR 015 held on June 25 27 in Sestri Levante Italy The book is divided into three main parts the first of which focuses on models reasoning and representation It highlights key theoretical concepts from an applied perspective addressing issues concerning information visualization experimental methods and design The second part goes a step further examining abduction problem solving and reasoning The respective contributions analyze different types of reasoning discussing various concepts of inference and creativity and their relationship with experimental data In turn the third part reports on a number of historical epistemological and technological issues By analyzing possible contradictions in modern research and describing representative case studies in experimental research this part aims at fostering new discussions and stimulating new ideas All in all the book provides researchers and graduate students in the field of applied philosophy epistemology cognitive science and artificial intelligence alike with an authoritative snapshot of current theories and applications of model based reasoning

Logical and Computational Aspects of Model-Based Reasoning L. Magnani,N.J. Nersessian,Claudio Pizzi,2012-12-06 Information technology has been in recent years under increasing commercial pressure to provide devices and systems which help replace the human in his daily activity This pressure requires the use of logic as the underlying foundational workhorse of the area New logics were developed as the need arose and new foci and balance has evolved within logic itself One aspect of these new trends in logic is the rising importance of model based reasoning Logics have become more and more tailored to applications and their reasoning has become more and more application dependent In fact some years ago I myself coined the phrase direct deductive reasoning in application areas advocating the methodology of model based reasoning in the strongest possible terms Certainly my discipline of Labelled Deductive Systems allows to bring pieces of the application areas as labels into the logic I therefore heartily welcome this important book to Volume 25 of the Applied Logic Series and see it as an important contribution in our overall coverage of applied logic

Model-Based Reasoning L. Magnani,N.J. Nersessian,2012-12-06 There are several key ingredients common to the various forms of model based reasoning considered in this book The term model comprises both internal and external representations The models are intended as interpretations of target physical systems processes phenomena or situations and are retrieved or constructed on the basis of potentially satisfying salient constraints of the target domain The book's contributors are researchers active in the area of creative reasoning in science and technology

Model-Based Reasoning, Abductive Cognition, Creativity Emiliano Ippoliti,Lorenzo Magnani,Selene Arfini,2024-11-20 This book discusses how scientific and other types of cognition make use of models abduction and explanatory reasoning in order to produce important innovative and possibly creative changes in theories and concepts Gathering revised contributions presented at the international conference on Model Based Reasoning MBR023 held on June 7 9 2023 in Rome Italy the book addresses various intertwined topics ranging from the epistemology and applications of models also concerning the problem of knowledge production and

scientific methodology information visualization experimental methods and design to the analysis of their role in cognition decision making also with respect to social implications The problem of model based cognition is also illustrated taking advantage of recent results regarding problem solving abduction and logic paying attention to a critique of the dominant and received approaches to the aim of fostering new discussions and stimulate new ideas All in all the book provides researchers and graduate students in the fields of applied philosophy epistemology cognitive science and artificial intelligence alike with an authoritative snapshot of the latest theories and applications of model based reasoning Model-Based Reasoning in Science, Technology, and Medicine Lorenzo Magnani, Ping Li, 2007-06-30 The volume is based on papers presented at the international conference on Model Based Reasoning in Science and Medicine held in China in 2006 The presentations explore how scientific thinking uses models and explanatory reasoning to produce creative changes in theories and concepts The contributions to the book are written by researchers active in the area of creative reasoning in science and technology They include the subject area s most recent results and achievements

Advancements in the Philosophy of Design Pieter E. Vermaas, Stéphane Vial, 2018-03-02 This volume presents 25 essays on the philosophy of design With contributions originating from philosophy and design research and from product design to architecture it gives a rich spectrum of state of the art research and brings together studies on philosophical topics in which design plays a key role and design research to which philosophy contributes Coverage zooms in on specific and more well known design disciplines but also includes less studied disciplines such as graphic design interior architecture and exhibition design In addition contributors take up traditional philosophical issues such as epistemology politics phenomenology and philosophy of science Some essays cover philosophical issues that emerge in design for instance what design can do in addressing societal problems while other essays analyze main stream philosophical issues in which design is part of the argument as for instance abduction and aesthetics Readers will discover new research with insightful analyses of design research design thinking and the specificity of design Overall this comprehensive overview of an emerging topic in philosophy will be of great interest to researchers and students

Designing for Science Kevin Crowley, Christian D. Schunn, Takeshi Okada, 2001-03-01 This volume explores the integration of recent research on everyday classroom and professional scientific thinking It brings together an international group of researchers to present core findings from each context discuss connections between contexts and explore structures technologies and environments to facilitate the development and practice of scientific thinking The chapters focus on situations from young children visiting museums middle school students collaborating in classrooms undergraduates learning about research methods and professional scientists engaged in cutting edge research A diverse set of approaches are represented including sociocultural description of situated cognition cognitive ethnography educational design experiments laboratory studies and artificial intelligence This unique mix of work from the three contexts deepens our understanding of each subfield while at the same time broadening our understanding of how each subfield articulates with

broader issues of scientific thinking To provide a common focus for exploring connections between everyday instructional and professional scientific thinking the book uses a practical implications subtheme In particular each chapter has direct implications for the design of learning environments to facilitate scientific thinking *Exploration and Meaning Making in the Learning of Science* Bernard Zubrowski, 2009-08-14 Mountaineers Rock Climbers and Science Educators Around the 1920s rock climbing separated from mountaineering to become a separate sport At that time European climbers developed new equipment and techniques enabling them to ascend mountain faces and to climb rocks which were considered unassailable up to that time American climbers went further by expanding and improving on the equipment They even developed a system of quantification where points were given for the degree of difficulty of an ascent This system focused primarily on the pitch of the mountain and it even calculated up to de mals to give a high degree of quantification Rock climbing became a technical system Csikszentmihaly 1976 observed that the sole interest of rock climbers at that time was to climb the rock Rock climbers were known to reach the top and not even glance around at the scenery The focus was on reaching the top of the rock In contrast mountaineers saw the whole mountain as a single unit of perc tion The ascent to them is a gestalt including the aesthetic historical personal and physical sensations Csikszentmihaly 1976 p 486 This is an example of two contrasting approaches to the same kind of landscape and of two different groups of people Interestingly in the US Europe and Japan a large segment of the early rock climbers were young mathematicians and theoretical physicists while the mountaineers were a more varied lot **Scientific and Technological Thinking** Michael E. Gorman, Ryan D. Tweney, David C. Gooding, Alexandra P. Kincannon, 2004-09-22 At the turn of the 21st century the most valuable commodity in society is knowledge particularly new knowledge that may give a culture company or laboratory an adaptive advantage Knowledge about the cognitive processes that lead to discovery and invention can enhance the probability of making valuable new discoveries and inventions Such knowledge needs to be made widely available to ensure that no particular interest group corners the market on techno scientific creativity Knowledge can also facilitate the development of business strategies and social policies based on a genuine understanding of the creative process Furthermore through an understanding of principles underlying the cognitive processes related to discovery educators can utilize these principles to teach students effective problem solving strategies as part of their education as future scientists This book takes the reader out onto the cutting edge of research in scientific and technological thinking The editors advocate a multiple method approach chapters include detailed case studies of contemporary and historical practices experiments computational simulations and innovative theoretical analyses The editors attempt a provocative synthesis of this work at the end In order to achieve true scientific and technological progress an understanding of the process by which species are transforming the world is needed This book makes an important step in that direction by leading to breakthroughs in the understanding of discovery and invention

Scientific Cognition, Semiotics, and Computational Agents: Essays in Honor of Lorenzo Magnani - Volume 2

Selene Arfini,2025-09-19 This book the second of two volumes focuses on scientific cognition computationalism and scholars reception of what Lorenzo Magnani named eco cognitive views on the mind The authors of these chapters address complex questions which regard in part Magnani s contributions in the field of model based science the role of inferential models in mathematics the transformations and possible applicability of Charles Sanders Peirce s and Immanuel Kant s concepts and insight into current understanding of scientific progress and the still unsolved questions regarding the methodological steps that take researchers to scientific discoveries Some contributions also address the problematic understanding of artificial agents as intelligent how cognition can be discussed within the limits of computationalism and how the eco cognitive perspective on the mind also affects the conception of scientific reasoning and socially constructed phenomena The book is of great interest to those interested in epistemology philosophy of science mathematical logic and AI Towards a Competence-Based View on Models and Modeling in Science Education Annette Upmeyer zu Belzen,Dirk Krüger,Jan van Driel,2020-01-01 The book takes a closer look at the theoretical and empirical basis for a competence based view of models and modeling in science learning and science education research Current thinking about models and modeling is reflected The focus lies on the development of modeling competence in science education and on philosophical aspects including perspectives on nature of science The book explores interprets and discusses models and modeling from the perspective of different theoretical frameworks and empirical results The extent to which these frameworks can be integrated into a competence based approach for science education is discussed In addition the book provides practical guidance by outlining evidence based approaches to diagnosing and promoting modeling competence The aim is to convey a strong understanding of models and modeling for professions such as teacher educators science education researchers teachers and scientists Different methods for the diagnosis and assessment of modeling competence are presented and discussed with regard to their potential and limitations The book provides evidence based ideas about how teachers can be supported in teaching with models and modeling implementing a competence based approach and thus how students can develop their modeling competence Based on the findings research challenges for the future are identified **The Routledge Companion to Philosophy of Science** Martin Curd,Stathis Psillos,2013-07-24 The Routledge Companion to Philosophy of Science is an indispensable reference source and guide to the major themes debates problems and topics in philosophy of science It contains sixty two specially commissioned entries by a leading team of international contributors Organized into four parts it covers historical and philosophical context debates concepts the individual sciences The Routledge Companion to Philosophy of Science addresses all of the essential topics that students of philosophy of science need to know from empiricism explanation and experiment to causation observation prediction and more and contains many helpful features including chapters on individual sciences such as biology chemistry physics and psychology further reading and cross referencing at the end of each chapter Expanded and revised throughout this second edition includes new chapters on Conventionalism

Social Epistemology Computer Simulation Thought Experiments Pseudoscience Species and Taxonomy and Cosmology

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 **The**

Construction of Analogy-Based Research Programs Rebecca Mertens, 2019-03-20 When the German chemist Emil Fischer presented his lock and key hypothesis in 1899 his analogy to describe the molecular relationship between enzymes and substrates quickly gained vast influence and provided future generations of scientists with a tool to investigate the relation between chemical structure and biological specificity Rebecca Mertens explains the appeal of the lock and key analogy by its role in model building and in the construction of long term cross generational research programs She argues that a crucial feature of these research programs namely ascertaining the continuity of core ideas and concepts is provided by a certain way of analogy based modelling *Communications and Discoveries from Multidisciplinary Data* Shuichi Iwata, Yukio Ohsawa, Shusaku Tsumoto, Ning Zhong, Yong Shi, Lorenzo Magnani, 2008-08-17 This book collects selected papers by authors for CODATA 2006 which are relevant to the acquisition of knowledge and the assessment of risk and opportunity that comes from combining data from a number of different disciplines Inconsistency in Science Joke Meheus, 2013-03-09 For centuries inconsistencies were seen as a hindrance to good reasoning and their role in the sciences was ignored In recent years however logicians as well as philosophers and historians have showed a growing interest in the matter Central to this change were the advent of paraconsistent logics the shift in attention from finished theories to construction processes and the recognition that most scientific theories were at some point either internally inconsistent or incompatible with other accepted findings The new interest gave rise to important questions How is logical anarchy avoided Is it ever rational to

accept an inconsistent theory In what sense if any can inconsistent theories be considered as true The present collection of papers is the first to deal with this kind of questions It contains case studies as well as philosophical analyses and presents an excellent overview of the different approaches in the domain **Psychology of Science** Robert W. Proctor,E.J.

Capaldi,2012-07-12 The study of science sometimes referred to as metascience is a new and growing field that includes the philosophy of science history of science sociology of science and anthropology of science In the last ten years the formal study of the psychology of science has also emerged The psychology of science focuses on the individual scientist influenced by intelligence motivation personality and the development of scientific interest thought ability and achievement over a lifespan Science can be defined as explicitly and systematically testing hypotheses Defined more broadly science includes wider processes such as theory construction and the hypothesis testing seen in children and non scientific adults Most prior work in the study of science has emphasized the role of explicit reasoning however contemporary research in psychology emphasizes the importance of implicit processes in decision making and choice and assumes that the performance of many tasks involves a complex relationship between implicit and explicit processes Psychology of Science brings together contributions from leaders in the emerging discipline of the psychology of science with other experts on the roles of implicit and explicit processes in thinking Highlighting the role of implicit processes in the creation of scientific knowledge this volume links the psychology of science to many strands of psychology including cognitive social and developmental psychology as well as neuroscience Ultimately this volume raises awareness of the psychology of science among psychologists philosophers and sociologists of science and anyone interested in the metasciences **Philosophy and**

Cognitive Science II Lorenzo Magnani,Ping Li,Woosuk Park,2015-05-27 The book shows how eastern and western perspectives and conceptions can be used to addresses recent topics laying at the crossroad between philosophy and cognitive science It reports on new points of view and conceptions discussed during the International Conference on Philosophy and Cognitive Science PCS2013 held at the Sun Yat sen University in Guangzhou China and the 2013 Workshop on Abductive Visual Cognition which took place at KAIST in Deajeon South Korea The book emphasizes an ever growing cultural exchange between academics and intellectuals coming from different fields It juxtaposes research works investigating new facets on key issues between philosophy and cognitive science such as the role of models and causal representations in science the status of theoretical concepts and quantum principles abductive cognition vision and visualization in science from an eco cognitive perspective Further topics are ignorance immunization in reasoning moral cognition violence and epistemology and models and biomorphism The book which presents a unique and timely account of the current state of the art on various aspects in philosophy and cognitive science is expected to inspire philosophers cognitive scientists and social scientists and to generate fruitful exchanges and collaboration among them

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