

Preface

This volume is a collection of selected papers that were presented at the international conference *Model-Based Reasoning in Science and Technology. Models and Inferences: Logical, Epistemological, and Cognitive Issues* (MBR015_ITALY), held at the Centro Congressi Mediaterraneo, Sestri Levante, Italy, June 25–27, 2015, chaired by Lorenzo Magnani.

A previous volume, *Model-Based Reasoning in Scientific Discovery*, edited by L. Magnani, N.J. Nersessian, and P. Thagard (Kluwer Academic/Plenum Publishers, New York, 1999; Chinese edition, China Science and Technology Press, Beijing, 2000), was based on the papers presented at the first “model-based reasoning” international conference, held at the University of Pavia, Pavia, Italy, in December 1998. Other two volumes were based on the papers presented at the second “model-based reasoning” international conference, held at the same place in May 2001: *Model-Based Reasoning. Scientific Discovery, Technological Innovation, Values*, edited by L. Magnani and N.J. Nersessian (Kluwer Academic/Plenum Publishers, New York, 2002), and *Logical and Computational Aspects of Model-Based Reasoning*, edited by L. Magnani, N.J. Nersessian, and C. Pizzi (Kluwer Academic, Dordrecht, 2002). Another volume, *Model-Based Reasoning in Science and Engineering*, edited by L. Magnani (College Publications, London, 2006), was based on the papers presented at the third “model-based reasoning” international conference, held at the same place in December 2004. The volume *Model-Based Reasoning in Science and Medicine*, edited by L. Magnani and P. Li (Springer, Heidelberg/Berlin 2006), was based on the papers presented at the fourth “model-based reasoning” conference, held at Sun Yat-sen University, Guangzhou, P.R. China. The volume *Model-Based Reasoning in Science and Technology. Abduction, Logic, and Computational Discovery*, edited by L. Magnani, W. Carnielli and C. Pizzi (Springer, Heidelberg/Berlin 2010), was based on the papers presented at the fifth “model-based reasoning” conference, held at the University of Campinas, Campinas, Brazil, in December 2009. Finally, the volume *Model-Based Reasoning in Science and Technology. Theoretical and Cognitive Issues*, edited by L. Magnani, (Springer,

Heidelberg/Berlin 2013), was based on the papers presented at the sixth “model-based reasoning” conference, held at Fondazione Mediaterraneo, Sestri Levante, Italy, June 2012.

The presentations given at the Sestri Levante conference explored how scientific thinking uses models and explanatory reasoning to produce creative changes in theories and concepts. Some speakers addressed the problem of model-based reasoning in technology and stressed issues such as the relationship between science and technological innovation. 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. Understanding the contribution of modeling practices to discovery and conceptual change in science and in other disciplines requires expanding the concept of reasoning to include complex forms of creativity 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. The term “model” comprises both internal and external representations. 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. Moreover, in the modeling process, various forms of abstraction are used. Evaluation and adaptation take place in light of structural, causal, and/or functional constraints. Model simulation can be used to produce new states and enable evaluation of behaviors and other factors. The various contributions of the book are written by interdisciplinary researchers who are active in the area of modeling reasoning and creative reasoning in logic, cognitive science, science and technology: the most recent results and achievements about the topics above are illustrated in detail in the papers.

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Several papers concerning model-based reasoning deriving from the previous conferences MBR98 and MBR01 can be found in special issues of Journals: in *Philosophica: Abduction and Scientific Discovery*, 61(1), 1998, and *Analogy and Mental Modeling in Scientific Discovery*, 61(2) 1998; in *Foundations of Science: Model-Based Reasoning in Science: Learning and Discovery*, 5(2) 2000, all edited by L. Magnani, N.J. Nersessian, and P. Thagard; in *Foundations of Science: Abductive Reasoning in Science*, 9, 2004, and *Model-Based Reasoning: Visual, Analogical, Simulative*, 10, 2005; in *Mind and Society: Scientific Discovery: Model-Based Reasoning*, 5(3), 2002, and *Commonsense and Scientific Reasoning*, 4(2), 2001, all edited by L. Magnani and N.J. Nersessian. Finally, other related philosophical, epistemological, and cognitive-oriented papers deriving from the presentations given at the conference MBR04 have been published in a special issue of the *Logic Journal of the IGPL: Abduction, Practical Reasoning, and Creative Inferences in Science*, 14(1) (2006), and have been published in two special issues of *Foundations of Science: Tracking Irrational Sets: Science, Technology, Ethics, and Model-Based Reasoning in Science and Engineering*, 13 (1) and 13(2) (2008), all edited by L. Magnani. Other technical logical papers presented at MBR09_BRAZIL have been published in a special issue of the *Logic Journal of the IGPL: Formal Representations in Model-Based Reasoning and Abduction*, 20(2) (2012), edited by L. Magnani, W. Carnielli, and C. Pizzi. Finally, technical logical papers presented at MBR12_ITALY have been published in a special issue of the *Logic Journal of the IGPL: Formal Representations in Model-Based Reasoning and Abduction*, 21(6) (2013), edited by L. Magnani.

Other more technical formal papers presented at (MBR015_ITALY) will be published in a special issue of the *Logic Journal of the IGPL*, edited by L. Magnani and C. Casadio.

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