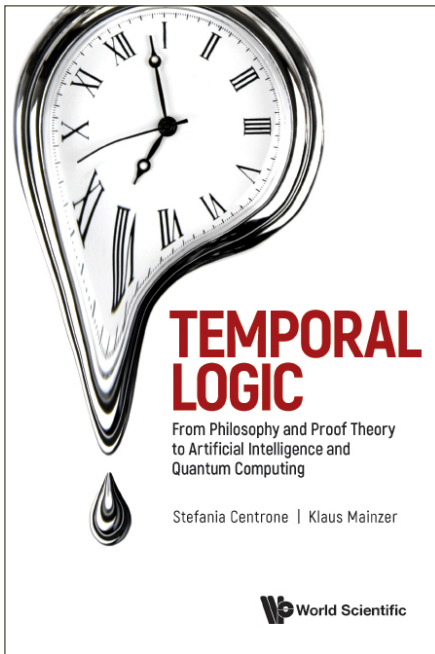


Temporal Logic

From Philosophy and Proof Theory to Artificial Intelligence and Quantum Computing



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ABOUT THE BOOK

Calculi of temporal logic are widely used in modern computer science. The temporal organization of information flows in the different architectures of laptops, the Internet, or supercomputers would not be possible without appropriate temporal calculi. In the age of digitalization and High-Tech applications, people are often not aware that temporal logic is deeply rooted in the philosophy of modalities. A deep understanding of these roots opens avenues to the modern calculi of temporal logic which have emerged by extension of modal logic with temporal operators.

Computationally, temporal operators can be introduced in different formalisms with increasing complexity such as Basic Modal Logic (BML), Linear-Time Temporal Logic (LTL), Computation Tree Logic (CTL), and Full Computation Tree Logic (CTL*). Proof-theoretically, these formalisms of temporal logic can be interpreted by the sequent calculus of Gentzen, the tableau-based calculus, automata-based calculus, game-based calculus, and dialogue-based calculus with different advantages for different purposes, especially in computer science.

The book culminates in an outlook on trendsetting applications of temporal logics in future technologies such as artificial intelligence and quantum technology. However, it will not be sufficient, as in traditional temporal logic, to start from the everyday understanding of time. Since the 20th century, physics has fundamentally changed the modern understanding of time, which now also determines technology. In temporal logic, we are only just beginning to grasp these differences in proof theory which needs interdisciplinary cooperation of proof theory, computer science, physics, technology, and philosophy.

READERSHIP

Researchers and students of mathematical logic and foundations, theoretical computer science, and philosophy. The level is graduate with introductions on the undergraduate level. The book can be used for courses on temporal logic in mathematical logic as well as in computer science. It is also of general interest for the general reader in philosophy, social science (e.g., security issues), and history of science.

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ABOUT THE AUTHORS

Klaus Mainzer is Emeritus of Excellence at the Technical University of Munich (TUM) and senior professor at the University of Tübingen. After studies of mathematics, physics, and philosophy at the University of Münster, he was Professor for the Foundations and History of Exact Sciences and Vice-President at the University of Constance, Professor for Philosophy of Science and founding director of the Institute of Interdisciplinary Informatics at the University of Augsburg, and Professor for Philosophy of Science, director of the Carl von Linde Academy and founding director of the Munich Center for Technology in Society (MCTS) at TUM.

His principal research interests are about constructive and computational foundations of mathematics, science, and philosophy with a special focus on complex systems and AI-technology and its societal impact. Book publications in World Scientific Singapore are *The Digital and the Real World* (2018), *Proof and Computation I-II* (with P Schuster and H Schwichtenberg (2018, 2022), *Local Activity Principle. The Cause of Complexity* (with L Chua) (2013), *Symmetry and Complexity. The Spirit and Beauty of Nonlinear Science* (2005).

Stefania Centrone is Privatdozentin at the University of Hamburg and holds a Heisenberg-Stelle from October 2018 (TU-Berlin: 2019–2021; FernUniversität Hagen: 2022 –). In 2012 she was awarded a DFG-Eigene Stelle for the project “olzanos und Husserls Weiterentwicklung von Leibnizens Ideen zur Mathesis Universalis” at the University of Oldenburg, where she was research assistant until 30 September 2018. In 2016 she was deputy professor of Theoretical Philosophy at the University of Göttingen. She is author, among others, of the monographs *Logic and Philosophy of Mathematics in the Early Husserl* (Springer 2010), *Studien zu Bolzano* (Academia Verlag 2015), *Oskar Becker, On the Logic of Modalities (1930): Translation, Commentary and Analysis, with P Minari* (Springer 2022), and editor of the volumes *Versuche über Husserl* (Meiner 2013), *Essays on Husserl’s Logic and Philosophy of Mathematics* (Springer 2017), *Mathesis Universalis, Computability and Proof*, with D Sarikaya, P Schuster and S Negri (Springer 2019) and *Reflections on the Foundations of Mathematics*, with D Kant and D Sarikaya (Springer 2019).

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