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Physical Perspectives on Computation, Computational Perspectives on Physics

Edited by Michael E. Cuffaro

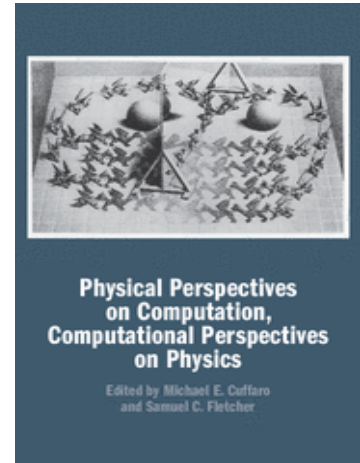
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Although computation and the science of physical systems would appear to be unrelated, there are a number of ways in which computational and physical concepts can be brought together in ways that illuminate both. This volume examines fundamental questions which connect scholars from both disciplines: is the universe a computer? Can a universal computing machine simulate every physical process? What is the source of the computational power of quantum computers? Are computational approaches to solving physical problems and paradoxes always fruitful? Contributors from multiple perspectives reflecting the diversity of thought regarding these interconnections address many of the most important developments and debates within this exciting area of research. Both a reference to the state of the art and a valuable and accessible entry to interdisciplinary work, the volume will interest researchers and students working in physics, computer science, and philosophy of science and mathematics.

List of figures; List of tables; Preface; Introduction; Part I. The Computability of Physical Systems and Physical Systems as Computers: 1. Ontic pancomputationalism; 2. Zuse's thesis, Gandy's thesis, and Penrose's thesis; 3. Church's thesis, Turing's limits, and Deutsch's principle; Part II. The Implementation of Computation in Physical Systems: 4. How to make orthogonal positions parallel: revisiting the quantum parallelism thesis; 5. How is there a physics of information? On characterizing physical evolution as information processing; 6. Abstraction/representation theory and the natural science of computation; Part III. Physical Perspectives on Computer Science: 7. Physics-like models of computation; 8. Feasible computation: methodological contributions from computational science; 9. Relativistic computation; Part IV. Computational Perspectives on Physical Theory: 10. Intension in the physics of computation: lessons from the debate about Landauer's principle; 11. Maxwell's demon does not compute; 12. Quantum theory as a principle theory: insights from an information-theoretic reconstruction; Bibliography; Index.



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