Gheorghe Păun

Membrane Computing

An Introduction

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   Membrane Computing Gheorghe Paun,2014-03-12 Membrane computing is an unconventional model of computation associated with a new computing paradigm The field of membrane computing was initiated in 1998 by the author of this book it is a branch of natural computing inspired by the structure and functioning of the living cell and devises distributed parallel computing models in the form of membrane systems This book is the first monograph surveying the new field in a systematic and coherent way It presents the central notions and results the main classes of P systems the main results about their computational power and efficiency a complete bibliography and a series of open problems and research topics

   Membrane Computing Marian Gheorghe,Grzegorz Rozenberg,Arto Salomaa,Petr Sosík,Claudio Zandron,2014-12-16 This book constitutes the thoroughly refereed post conference proceedings of the 15th International Conference on Membrane Computing CMC 2014 held in Prague Czech Republic in August 2014 The 19 revised selected papers presented together with 5 invited lectures were carefully reviewed and selected from 24 papers presented at the conference In addition two papers selected from the 22 papers presented at the regional version of CMC the Asian Conference on Membrane Computing ACMC 2014 held in Coimbatore India are included The papers cover a wide range of topics in the area of membrane computing which is an area of computer science aiming to abstract computing ideas and models from the structure and the functioning of living cells as well as from the way the cells are organized in tissues or higher order structures   **Membrane Computing** Hendrik Jan Hoogeboom,Gheorghe Paun,Grzegorz Rozenberg,Arto Salomaa,2007-01-25 This book constitutes the thoroughly refereed extended post proceedings of the 7th International Workshop on Membrane Computing WMC 2006 held in Leiden Netherlands in July 2006 The papers in this volume cover all the main directions of research in membrane computing ranging from theoretical topics in mathematics and computer science to application issues Special attention was paid to the interaction of membrane computing with biology   Membrane Computing George Eleftherakis,Petros Kefalas,Gheorghe Paun,Grzegorz Rozenberg,Arto Salomaa,2007-11-25 For anyone needing to keep up to date with all the latest research in the field of membrane computing this book will come as a breath of fresh air It is the extended post proceedings of the 8th International Workshop on Membrane Computing held in June 2007 A total of 27 revised papers are presented All of them have been through two rounds of reviewing Special attention has been paid to the interaction of

membrane computing with biology and computer science **Membrane Computing** Alberto Leporati,Grzegorz Rozenberg,Arto Salomaa,Claudio Zandron,2017-02-21 This book contains revised selected papers from the 17th International Conference on Membrane Computing CMC 2017 held in Milan Italy in July 2016 The 19 full papers presented in this volume were carefully reviewed and selected from 28 submissions They deal with membrane computing P systems theory an area of copmputer science aiming to abstract computing ideas and models from the structure and the functioning of living cells as well as from the way the cells are organized in tissues or higher order structures The volume also contains 3 invited talks in full paper length **Descriptional Complexity of Formal Systems** Andreas Malcher,Luca Prigioniero,2025-08-01 This book constitutes the refereed proceedings of the 26th IFIP WG 1 02 International Conference on Descriptional Complexity of Formal Systems DCFS 2025 held in Loughborough UK during July 22 24 2025 This book includes 15 full papers carefully reviewed and selected from 20 submissions as well as 4 abstracts of the invited talks The conference focus on all aspects of descriptional complexity including automata grammars languages and other formal systems various modes of operations and complexity measures **Applications of Membrane Computing in Systems and Synthetic Biology** Pierluigi Frisco,Marian Gheorghe,Mario J. Pérez-Jiménez,2013-12-17 Membrane Computing was introduced as a computational paradigm in Natural Computing The models introduced called Membrane or P Systems provide a coherent platform to describe and study living cells as computational systems Membrane Systems have been investigated for their computational aspects and employed to model problems in other fields like Computer Science Linguistics Biology Economy Computer Graphics Robotics etc Their inherent parallelism heterogeneity and intrinsic versatility allow them to model a broad range of processes and phenomena being also an efficient means to solve and analyze problems in a novel way Membrane Computing has been used to model biological systems becoming with time a thorough modeling paradigm comparable in its modeling and predicting capabilities to more established models in this area This book is the result of the need to collect in an organic way different facets of this paradigm The chapters of this book together with the web pages accompanying them present different applications of Membrane Systems to Biology Deterministic non deterministic and stochastic systems paired with different algorithms and methodologies show the full potential of this framework The book is addressed to researchers interested in applications of discrete biological models and the interplay between Membrane Systems and other approaches to analyze complex systems *Language and Automata Theory and Applications* Adrian-Horia Dediu,Carlos Martín-Vide,2012-02-29 This book constitutes the refereed proceedings of the 6th International Conference on Language and Automata Theory and Applications LATA 2012 held in A Coru a Spain in March 2012 The 41 revised full papers presented together with 3 invited talks and 2 invited tutorials were carefully reviewed and selected from 114 initial submissions The volume features contributions from both classical theory fields and application areas e g innformatics systems biology language technology artificial intelligence etc Among the topics covered are algebraic language theory automata and logic

systems analysis systems verifications computational complexity decidability unification graph transformations language based cryptography and applications in data mining computational learning and pattern recognition   *Algorithmic Bioprocesses* Anne Condon,David Harel,Joost N. Kok,Arto Salomaa,Erik Winfree,2009-08-14 A fundamental understanding of algorithmic bioprocesses is key to learning how information processing occurs in nature at the cell level The field is concerned with the interactions between computer science on the one hand and biology chemistry and DNA oriented nanoscience on the other In particular this book offers a comprehensive overview of research into algorithmic self assembly RNA folding the algorithmic foundations for biochemical reactions and the algorithmic nature of developmental processes The editors of the book invited 36 chapters written by the leading researchers in this area and their contributions include detailed tutorials on the main topics surveys of the state of the art in research experimental results and discussions of specific research goals The main subjects addressed are sequence discovery generation and analysis nanoconstructions and self assembly membrane computing formal models and analysis process calculi and automata biochemical reactions and other topics from natural computing including molecular evolution regulation of gene expression light based computing cellular automata realistic modelling of biological systems and evolutionary computing This subject is inherently interdisciplinary and this book will be of value to researchers in computer science and biology who study the impact of the exciting mutual interaction between our understanding of bioprocesses and our understanding of computation

Applications of Membrane Computing Gabriel Ciobanu,Mario J. Pérez-Jiménez,Gheorghe Păun,2007-08-06 Membrane computing is a branch of natural computing which investigates computing models abstracted from the structure and functioning of living cells and from their interactions in tissues or higher order biological structures The models considered called membrane systems P systems are parallel distributed computing models processing multisets of symbols in cell like compartmental architectures In many applications membrane systems have considerable advantages among these are their inherently discrete nature parallelism transparency scalability and nondeterminism In dedicated chapters leading experts explain most of the applications of membrane computing reported so far in biology computer science computer graphics and linguistics The book also contains detailed reviews of the software tools used to simulate P systems   **Mathematical Reviews** ,2007   Biomolecular Computation for Bionanotechnology Jian-Qin Liu,Katsunori Shimohara,2007 The drive toward non silicon computing is underway and this first of its kind guide to molecular computation gives researchers a firm grasp of the technologies biochemical details and theoretical models at the cutting edge It explores advances in molecular biology and nanotechnology and illuminates how the convergence of various technologies is propelling computational capacity beyond the limitations of traditional hardware technology and into the realm of moleware   *Economic Computation and Economic Cybernetics Studies and Research* ,2006   *Membrane Computing Models: Implementations* Gexiang Zhang,Mario J. Pérez-Jiménez,Agustín Riscos-Núñez,Sergey Verlan,Savas Konur,Thomas Hinze,Marian

Gheorghe,2021-07-01 The theoretical basis of membrane computing was established in the early 2000s with fundamental research into the computational power complexity aspects and relationships with other un conventional computing paradigms Although this core theoretical research has continued to grow rapidly and vigorously another area of investigation has since been added focusing on the applications of this model in many areas most prominently in systems and synthetic biology engineering optimization power system fault diagnosis and mobile robot controller design The further development of these applications and their broad adoption by other researchers as well as the expansion of the membrane computing modelling paradigm to other applications call for a set of robust efficient reliable and easy to use tools supporting the most significant membrane computing models This work provides comprehensive descriptions of such tools making it a valuable resource for anyone interested in membrane computing models **Mobility in Process Calculi and Natural Computing** Bogdan Aman,Gabriel Ciobanu,2011-11-03 The design of formal calculi in which fundamental concepts underlying interactive systems can be described and studied has been a central theme of theoretical computer science in recent decades while membrane computing a rule based formalism inspired by biological cells is a more recent field that belongs to the general area of natural computing This is the first book to establish a link between these two research directions while treating mobility as the central topic In the first chapter the authors offer a formal description of mobility in process calculi noting the entities that move links calculus ambients ambient calculi and branes brane calculi In the second chapter they study mobility in the framework of natural computing The authors define several systems of mobile membranes in which the movement inside a spatial structure is provided by rules inspired by endocytosis and exocytosis They study their computational power in comparison with the classical notion of Turing computability and their efficiency in algorithmically solving hard problems in polynomial time The final chapter deals with encodings establishing links between process calculi and membrane computing so that researchers can share techniques between these fields The book is suitable for computer scientists working in concurrency and in biologically inspired formalisms and also for mathematically inclined scientists interested in formalizing moving agents and biological phenomena The text is supported with examples and exercises so it can also be used for courses on these topics *The Oxford Handbook of Membrane Computing* Gheorghe Paun,Grzegorz Rozenberg,Arto Salomaa,2009-12-24 Membrane Computing studies models of computation called P systems inspired by the structure and functioning of a living cell in particular by the role of membranes in compartmentalization of living cells This handbook provides the necessary biological and formal background in a state of the art review of current research Developments in Language Theory ,2004 American Book Publishing Record ,2006 **Membrane Computing** Carlos Martín-Vide,Giancarlo Mauri,Gheorghe Paun,Grzegorz Rozenberg,Arto Salomaa,2004-02-02 This book constitutes the thoroughly refereed post proceedings of the International Workshop on Membrane Computing WMC 2003 held in Tarragona Spain in July 2003 The 26 revised full papers presented were carefully selected during two rounds of reviewing and

improvement All current topics in the emerging area of membrane computing are addressed ranging from issues in mathematics and theoretical computer science to potential applications in biology bioinformatics sorting ranking linguistics and computer graphics several implementations and simulations on computers computer networks and reconfigurable hardware are presented too

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