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## VIEW?D=I5W5W4 - HARVEY HICKS

### **MEMBRANE COMPUTING**

#### **AN INTRODUCTION**

<u>Springer</u> 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**

#### **AN INTRODUCTION**

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### **APPLICATIONS OF MEMBRANE COMPUTING**

<u>Springer</u> 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.

### **MEMBRANE COMPUTING**

# 15TH INTERNATIONAL CONFERENCE, CMC 2014, PRAGUE, CZECH REPUBLIC, AUGUST 20-22, 2014, REVISED SELECTED PAPERS

Springer 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.

## 12TH INTERNATIONAL CONFERENCE, UCNC 2013, MILAN, ITALY, JULY 1-5, 2013, PROCEEDINGS

Springer This book constitutes the refereed proceedings of the 12th International Conference on Unconventional Computation and Natural Computation, UCNC 2013, held in Milan, Italy, in July 2013. The 30 papers (28 full papers, 8 poster papers, and 2 invited papers) were carefully reviewed and selected from 46 submissions. The topics of the volume include: quantum, cellular, molecular, neural, DNA, membrane, and evolutionary computing; cellular automata; computation based on chaos and dynamical systems; massive parallel computation; collective intelligence; computation based on physical principles such as relativistic, optical, spatial, collision-based computing; amorphous computing; physarum computing; hypercomputation; fuzzy and rough computing; swarm intelligence; artificial immune systems; physics of computation; chemical computation; evolving hardware; the computational nature of selfassembly, developmental processes, bacterial communication, and brain processes.

### **MEMBRANE COMPUTING**

# INTERNATIONAL WORKSHOP, WMC-CDEA 2002, CURTEA DE ARGES, ROMANIA, AUGUST 19-23, 2002, REVISED PAPERS

Springer Science & Business Media This book constitutes the thoroughly refereed post-proceedings of the International Workshop on Membrane Computing, WMC-CdeA 2002, held in Curtea de Arges, Romania, in August 2002. The 29 revised full papers presented were carefully selected during two rounds of reviewing and revision; some were especially solicited for inclusion in the book after the workshop. Most papers address membrane systems and membrane computing from the point of view of theoretical computer science; some papers solve open problems and present new approaches, and others provide mathematical and biological background. All in all, the book presents the state of the art in membrane computing.

### **MEMBRANE COMPUTING**

## INTERNATIONAL WORKSHOP, WMC-CDEA 2002, CURTEA DE ARGES, ROMANIA, AUGUST 19-23, 2002, REVISED PAPERS

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## **MEMBRANE COMPUTING**

# 14TH INTERNATIONAL CONFERENCE, CMC 2013, CHIŞINĂU, REPUBLIC OF MOLDOVA, AUGUST 20-23, 2013, REVISED SELECTED PAPERS

Springer This book constitutes the thoroughly refereed post-conference proceedings of the 14th International Conference on Membrane Computing, CMC 2013, held in Chişinău, Republic of Moldova, in August 2013. The 16 revised selected papers presented together with 6 invited lectures were carefully reviewed and selected from 26 papers presented at the conference. Membrane computing 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. It deals with membrane systems, also called P systems, which are distributed and parallel algebraic models processing multi sets of objects in a localized manner (evolution rules and evolving objects are encapsulated into compartments delimited by membranes), with an essential role played by the communication among compartments and with the environment.

### **MEMBRANE COMPUTING**

# 21ST INTERNATIONAL CONFERENCE, CMC 2020, VIRTUAL EVENT, SEPTEMBER 14-18, 2020, REVISED SELECTED PAPERS

Springer Nature This book constitutes the refereed post-conference proceedings of the 21st International Conference on

Membrane Computing, CMC 2020, held as a virtual event, in September 2020. The 10 full papers presented were selected from 31 submissions. The papers deal with all aspects on membrane computing and related areas.

#### **MEMBRANE COMPUTING MODELS: IMPLEMENTATIONS**

Springer Nature 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.

### LANGUAGE AND AUTOMATA THEORY AND APPLICATIONS

## **6TH INTERNATIONAL CONFERENCE, LATA 2012, A CORUÑA, SPAIN, MARCH 5-9, 2012, PROCEEDINGS**

Springer This book constitutes the refereed proceedings of the 6th International Conference on Language and Automata Theory and Applications, LATA 2012, held in A Coruña, 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.

### UNCONVENTIONAL COMPUTATION AND NATURAL COMPUTATION

### 18TH INTERNATIONAL CONFERENCE, UCNC 2019, TOKYO, JAPAN, JUNE 3-7, 2019, PROCEEDINGS

<u>Springer</u> This book constitutes the proceedings of the 18th International Conference on Unconventional Computation and Natural Computation, UCNC 2019, held in Tokyo, Japan, in June 2019. The 19 full papers presented were carefully reviewed and selected from 32 submissions. The papers cover topics such as hypercomputation; chaos and dynamical systems based computing; granular, fuzzy and rough computing; mechanical computing; cellular, evolutionary, molecular, neural, and quantum computing; membrane computing; amorphous computing, swarm intelligence; artificial immune systems; physics of computation; chemical computation; evolving hardware; the computational nature of selfassembly, developmental processes, bacterial communication, and brain processes.

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## **REAL-LIFE APPLICATIONS WITH MEMBRANE COMPUTING**

<u>Springer</u> This book thoroughly investigates the underlying theoretical basis of membrane computing models, and reveals their latest applications. In addition, to date there have been no illustrative case studies or complex real-life applications that capitalize on the full potential of the sophisticated membrane systems computational apparatus; gaps that this book remedies. By studying various complex applications - including engineering optimization, power systems fault diagnosis, mobile robot controller design, and complex biological systems involving data modeling and process interactions - the book also extends the capabilities of membrane systems models with features such as formal verification techniques, evolutionary approaches, and fuzzy reasoning methods. As such, the book offers a comprehensive and up-to-date guide for all researchers, PhDs and undergraduate students in the fields of computer science, engineering and the bio-sciences who are interested in the applications of natural computing models.

### **MEMBRANE COMPUTING**

## 8TH INTERNATIONAL WORKSHOP, WMC 2007 THESSALONIKI, GREECE, JUNE 25-28, 2007 REVISED SELECTED AND INVITED PAPERS

<u>Springer</u> 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.

### LARGE-SCALE SCIENTIFIC COMPUTING

#### 7TH INTERNATIONAL CONFERENCE, LSSC 2009, SOZOPOL, BULGARIA, JUNE 4-8, 2009 REVISED PAPERS

Springer This book constitutes the thoroughly refereed post-conference proceedings of the 7th International Conference on Large-Scale Scientific Computations, LSSC 2009, held in Sozopol, Bulgaria, in June 2009. The 93 revised full papers presented together with 5 plenary and invited papers were carefully reviewed and selected from numerous submissions for inclusion in the book. The papers are organized in topical sections on multilevel and multiscale preconditioning methods multilevel and multiscale methods for industrial applications, environmental modeling, control and uncertain systems, application of metaheuristics to large scale problems, monte carlo: methods, applications, distributed computing, grid and scientific and engineering applications, reliable numerical methods for differential equations, novel applications of optimization ideas to the numerical Solution of PDEs, and contributed talks.

#### **ENJOYING NATURAL COMPUTING**

#### ESSAYS DEDICATED TO MARIO DE JESÚS PÉREZ-JIMÉNEZ ON THE OCCASION OF HIS 70TH BIRTHDAY

Springer This Festschrift is in honor of Mario de Jesús Pérez-Jiménez, Professor in the Department of Computer Science of University of Seville, Spain, on the occasion of his 70th birthday. The title of this volume reflects both his main research area, viz., Natural Computing, and the guiding principle of his functioning: "once you choose to do something, enjoy doing it". The respect that Professor Mario de Jesús Pérez-Jiménez enjoys in the scientific community was well demonstrated by the enthusiastic response received to the request to contribute to this book. The contributions by more than 70 authors from 15 countries cover a wide spectrum of research areas and reflect well the broad range of research interests of Professor Mario de Jesús Pérez-Jiménez. The research areas presented in this Festschrift include membrane computing, spiking neural networks, phylogenetic networks, ant colonies optimization, workbench for biocomputing, reaction systems, entropy of computation, rewriting systems, and insertion-deletion systems.

## **ROUGH SETS**

## INTERNATIONAL JOINT CONFERENCE, IJCRS 2019, DEBRECEN, HUNGARY, JUNE 17-21, 2019, PROCEEDINGS

<u>Springer</u> This LNAI 11499 constitutes the proceedings of the International Joint Conference on Rough Sets, IJCRS 2019, held in Debrecen, Hungary, in June 2019. The 41 full papers were carefully reviewed and selected from 71 submissions. The IJCRS conferences aim at bringing together experts from universities and research centers as well as the industry representing fields of research in which theoretical and applicational aspects of rough set theory already find or may potentially find usage. The papers are grouped in topical sections on core rough set models and methods; related methods and hybridization; areas of application.

## NATURAL COMPUTING AND BEYOND

# WINTER SCHOOL HAKODATE 2011, HAKODATE, JAPAN, MARCH 2011 AND 6TH INTERNATIONAL WORKSHOP ON NATURAL COMPUTING, TOKYO, JAPAN, MARCH 2012, PROCEEDINGS

Springer Science & Business Media This book contains the joint proceedings of the Winter School of Hakodate (WSH) 2011 held in Hakodate, Japan, March 15-16, 2011, and the 6th International Workshop on Natural Computing (6th IWNC) held in Tokyo, Japan, March 28-30, 2012, organized by the Special Interest Group of Natural Computing (SIG-NAC), the Japanese Society for Artificial Intelligence (JSAI). This volume compiles refereed contributions to various aspects of natural computing, ranging from computing with slime mold, artificial chemistry, eco-physics, and synthetic biology, to computational aesthetics.

## **MEMBRANE COMPUTING**

## 17TH INTERNATIONAL CONFERENCE, CMC 2016, MILAN, ITALY, JULY 25-29, 2016, REVISED SELECTED PAPERS

<u>Springer</u> 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 fullpaper length.

### **MEMBRANE COMPUTING**

# 7TH INTERNATIONAL WORKSHOP, WMC 2006, LEIDEN, NETHERLANDS, JULY 17-21, 2006, REVISED, SELECTED, AND INVITED PAPERS

<u>Springer</u> 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.

## **DEVELOPMENTS IN LANGUAGE THEORY**

## 6TH INTERNATIONAL CONFERENCE, DLT 2002, KYOTO, JAPAN, SEPTEMBER 18-21, 2002, REVISED PAPERS

<u>Springer Science & Business Media</u> The refereed proceedings of the 6th International Conference on Developments in Language Theory, DLT 2002, held in Kyoto, Japan in September 2002. The 28 revised full papers presented together with 8 invited papers were carefully reviewed and selected from 63 submissions. Among the topics addressed are grammars and acceptors for strings, graphs, arrays, etc; efficient algorithms for languages; combinatorial and algebraic properties of languages; decision problems; relations to complexity theory, logic picture description and analysis, DNA computing, cryptography, concurrency, quantum computing, and algebraic systems.

#### **PROCEEDINGS OF THE 2005 WORKSHOP ON UNCONVENTIONAL COMPUTING**

#### FROM CELLULAR AUTOMATA TO WETWARE

Luniver Press THE BOOK BRINGS TOGETHER WORK FROM A MULTIDISCIPLINARY CORE OF SCIENTISTS WHO ARE WORKING IN THE FIELD OF UNCONVENTIONAL COMPUTING. THE GOAL WAS TO PROVIDE A COMMON GROUND FOR DIALOG AND INTERACTION, TO HIGHLIGHT THE LATEST ADVANCES, AND TO DISCUSS THE MAIN DIRECTIONS FOR THE FUTURE. TOPICS INCLUDE PROGRAMMING OF CHEMICAL SYSTEMS, EVOLVING LOGICAL GATES IN LIQUID CRYSTAL, IMAGE

PROCESSING IN CHEMICAL MEDIA, REACTION-DIFFUSION ELECTRONIC CIRCUITS FOR COMPUTATION AND PATTERN GENERATION, RULE MIGRATION IN CELLULAR AUTOMATA, MULTI-STATE QUANTUM AUTOMATA, DNA COMPUTING OF SHORTEST PATH PROBLEMS, AND ARTIFICIAL CHEMISTRIES. THE PAPERS COLLECTED IN THIS BOOK PROVIDE A GOOD OVERVIEW OF HOT RESEARCH TOPICS IN THE VIBRANT FIELD OF UNCONVENTIONAL COMPUTING.

**RELATIONS AND KLEENE ALGEBRA IN COMPUTER SCIENCE** 

9TH INTERNATIONAL CONFERENCE ON RELATIONAL METHODS IN COMPUTER SCIENCE AND 4TH INTERNATIONAL WORKSHOP ON APPLICATIONS OF KLEENE ALGEBRA, RELMICS/AKA 2006, MANCHESTER, UK, AUGUST 29 - SEPTEMBER2, 2006, PROCEEDINGS

<u>Springer Science & Business Media</u> The book constitutes the joint refereed proceedings of the 9th International Conference on Relational Methods in Computer Science, RelMiCS 2006, and the 4th International Workshop on Applications of Kleene Algebras, AKA 2006, held in Manchester, UK in August/September 2006. The 25 revised full papers presented together with two invited papers and the abstract of an invited talk were carefully reviewed and selected from 44 submissions.

## **SWARM INTELLIGENCE**

## **INTRODUCTION AND APPLICATIONS**

<u>Springer Science & Business Media</u> The book's contributing authors are among the top researchers in swarm intelligence. The book is intended to provide an overview of the subject to novices, and to offer researchers an update on interesting recent developments. Introductory chapters deal with the biological foundations, optimization, swarm robotics, and applications in new-generation telecommunication networks, while the second part contains chapters on more specific topics of swarm intelligence research.

## THE OXFORD HANDBOOK OF MEMBRANE COMPUTING

<u>OUP Oxford</u> 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.

## MULTIOBJECTIVE PROBLEM SOLVING FROM NATURE

### FROM CONCEPTS TO APPLICATIONS

<u>Springer Science & Business Media</u> This text examines how multiobjective evolutionary algorithms and related techniques can be used to solve problems, particularly in the disciplines of science and engineering. Contributions by leading researchers show how the concept of multiobjective optimization can be used to reformulate and resolve problems in areas such as constrained optimization, co-evolution, classification, inverse modeling, and design.

### **APPLICATIONS OF MEMBRANE COMPUTING**

<u>Springer Science & Business Media</u> 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 higherorder 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.

### **COMPUTATION, COOPERATION, AND LIFE**

### ESSAYS DEDICATED TO GHEORGHE PAUN ON THE OCCASION OF HIS 60TH BIRTHDAY

<u>Springer</u> Gheorghe Păun has played an important role within a wide range of disciplines, from the foundations of traditional computation theory and formal language theory to research gaining its inspiration from living nature. He has significantly contributed to the development of these diverse fields, initiating and pioneering some of them with remarkable imaginativeness and enthusiasm. Gheorghe Păun's research focusses on systems inspired by structures and processes found in living systems, with the field of membrane computing or P systems being the most important of his initiatives. This Festschrift volume, published to honor Gheorghe Păun on the occasion of his 60th birthday,

includes 16 contributions by his students and collaborators. The research presented aims to gain a better understanding of what computation is, to find better models of computation, and to look for new computing devices inspired by the structure and/or functioning of natural or societal systems. The papers are preceded by an introduction by Solomon Marcus, Gheorghe Păun's lifelong teacher and mentor, and are organized in topical sections on general computing, grammar systems, membrane systems, and inspirations from natural computing.

## **EVOLVABLE COMPONENTS**

## FROM THEORY TO HARDWARE IMPLEMENTATIONS

Springer Science & Business Media At the beginning of the 1990s research started in how to combine soft comput ing with reconfigurable hardware in a quite unique way. One of the methods that was developed has been called evolvable hardware. Thanks to evolution ary algorithms researchers have started to evolve electronic circuits routinely. A number of interesting circuits - with features unreachable by means of con ventional techniques - have been developed. Evolvable hardware is quite pop ular right now; more than fifty research groups are spread out over the world. Evolvable hardware has become a part of the curriculum at some universi ties. Evolvable hardware is being commercialized and there are specialized conferences devoted to evolvable hardware. On the other hand, surprisingly, we can feel the lack of a theoretical background and consistent design methodology in the area. Furthermore, it is quite difficult to implement really innovative and practically successful evolvable systems using contemporary digital reconfigurable technology.

## **UNCONVENTIONAL COMPUTATION**

## 9TH INTERNATIONAL CONFERENCE, UC 2010, TOKYO, JAPAN, JUNE 21-25, 2010, PROCEEDINGS

<u>Springer</u> The 9th International Conference on Unconventional Computation, UC 2010, was organized under the auspices of EATCS and Academia Europaea, by the University of Tokyo (Tokyo, Japan), and the Center for Discrete Mathematics and Theoretical Computer Science (Auckland, New Zealand). It was held in Tokyoduring June 21-25,2010(seehttp://arn.local.frs.riken.jp/UC10/). The venue was the Sanjo (Hilltop) Conference Hall at Hongo Campus of the University of Tokyo. Hongo Campus was formerly the residence of the Maeda family, one of the richest feudal lords in the Edo period of Japan. The Japanese garden in the residence is partially preserved, including the pond and the hill on which the conference hall is located. Within walking distance from Hongo Campus are Ueno park with many museums, the Akihabara area, which is now the center of Japanesepop culture, and the Korakuenamusement park/baseball stadium. The International Conference on Unconventional Computation (UC) series (seehttp://www.cs.auckland.ac.nz/CDMTCS/conferences/uc/)isdevotedto all aspects of unconventional computation — theory as well as experiments and applications. Typical, but not exclusive, topics are: natural computing including quantum, cellular, molecular, membrane, neural, and evolutionary computing, as well as chaos and dynamical systembased computing, and various proposals for computational mechanisms that go beyond the Turing model.

### **MEMBRANE COMPUTING**

# **19TH INTERNATIONAL CONFERENCE, CMC 2018, DRESDEN, GERMANY, SEPTEMBER 4-7, 2018, REVISED SELECTED PAPERS**

<u>Springer</u> This book constitutes revised selected papers from the 19th International Conference on Membrane Computing (CMC19), CMC 2018, which was held in Dresden, Germany, in September 2018. The 15 papers presented in this volume were carefully reviewed and selected from 20 submissions. The contributions aim 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.

### FORMAL AND NATURAL COMPUTING

### **ESSAYS DEDICATED TO GRZEGORZ ROZENBERG**

<u>Springer</u> This book presents state of the art research in theoretical computer science and related ?elds. In particular, the following areas are discussed: automata theory, formal languages and combinatorics of words, graph transformations, Petri nets, concurrency, as well as natural and molecular computing. The articles are written by leading researchers in these areas. The writers were originally invited to contribute to this book but then the normal refereeing procedure was applied as well. All of the articles deal with some issue that has been under vigorous study during recent years. Still, the topics range from very classical ones to issues raised only two or three years ago. Both survey articles and papers attacking speci?c research problems are included. The book highlights some key issues of theoretical computer science, as they seem to us now at the beginning of the new millennium. Being a comprehensive

overview of some of the most active current research in theoretical computer science, it should be of de?nite interest for all researchers in the areas covered. The topics range from basic decidability and the notion of information to graph grammars and graph transformations, and from trees and traces to aqueous algorithms, DNA encoding and selfassembly. Special e?ort has been given to lucid presentation. Therefore, the book should be of interest also for advanced students.

### COMBINATORIAL IMAGE ANALYSIS

# 13TH INTERNATIONAL WORKSHOP, IWCIA 2009, PLAYA DEL CARMEN, MEXICO, NOVEMBER 24-27, 2009, PROCEEDINGS

<u>Springer</u> This volume constitutes the refereed proceedings of the 13th International Workshop on Combinatorial Image Analysis, IWCIA 2009, held in Playa del Carmen, Mexico, in November 2009. The 32 revised full papers and one invited paper presented were carefully reviewed and selected from 70 initial submissions. The papers are organized in topical sections on digital geometry: curves, straightness, convexity, geometric transformations, metrics, distance transforms and skeletons, segmentation, thinning, skeletonization, image representation, processing, analysis, reconstruction and recognition, digital tomography, image models based on geometry, combinatorics, arithmetics, algebra, mathematical morphology, topology and grammars, as well as digital topology and its applications to image modeling and analysis.

## HANDBOOK OF RESEARCH ON NATURAL COMPUTING FOR OPTIMIZATION PROBLEMS

IGI Global Nature-inspired computation is an interdisciplinary topic area that connects the natural sciences to computer science. Since natural computing is utilized in a variety of disciplines, it is imperative to research its capabilities in solving optimization issues. The Handbook of Research on Natural Computing for Optimization Problems discusses nascent optimization procedures in nature-inspired computation and the innovative tools and techniques being utilized in the field. Highlighting empirical research and best practices concerning various optimization issues, this publication is a comprehensive reference for researchers, academicians, students, scientists, and technology developers interested in a multidisciplinary perspective on natural computational systems.

#### **MEMBRANE COMPUTING**

#### INTERNATIONAL WORKSHOP, WMC 2003, TARRAGONA, SPAIN, JULY 17-22, 2003, REVISED PAPERS

Springer This volume is based on papers presented at the Workshop on Membrane Computing, WMC 2003, which took place in Tarragona, Spain, in the - riod July 17-July 22, 2003. This was the Fourth Annual Membrane Computing Workshop, and the?rst one held outside Romania. The?rst three meetings were organized in Curtea de Argei s, Romania - they took place in August 2000 (with the proceedings published in Lecture Notes in Computer Science, Vol. 2235), in August 2001 (with a selection of papers published as a special issue of F- damenta Informaticae, Vol. 49, Nos. 1-3, 2002), and in August 2002 (with the proceedings published in Lecture Notes in Computer Science, Vol. 2597). The 2003 workshop was the second workshop of the Molecular Computing Network (MolCoNet) funded by the EU Commission in the Fifth Framework Program Information Society Technologies (project number IST-2001-32008). The preproceedings of WMC 2003 were published as Technical Report 28/03 of theResearchGrouponMathematicalLinguisticsfromRoviraiVirgiliUniversity, Tarragona, and they were available during

the workshop.

### **MEMBRANE COMPUTING**

#### INTERNATIONAL WORKSHOP, WMC 2003, TARRAGONA, SPAIN, JULY 17-22, 2003, REVISED PAPERS

Springer Science & Business Media 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.

## **UNCONVENTIONAL COMPUTATION**

Springer Science & Business Media This book constitutes the refereed proceedings of the 10th International Conference on Unconventional Computation, UC 2011, held in Turku, Finland, in June 2011. The 17 revised full papers presented together with 6 extended abstracts of invited talks, and 3 extended abstracts of tutorials were carefully reviewed and selected from 33 initial submissions. The papers are devoted to all aspects of unconventional computation theory as well as experiments and applications. Typical topics are: natural computing including quantum, cellular, molecular, membrane, neural, and evolutionary computing, as well as chaos and dynamical system-based computing, and various proposals for computational mechanisms that go beyond the Turing model.

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## **MEMBRANE COMPUTING**

# 9TH INTERNATIONAL WORKSHOP, WMC 2008, EDINBURGH, UK, JULY 28-31, 2008, REVISED SELECTED AND INVITED PAPERS

<u>Springer</u> This volume contains a selection of papers presented at the 9th Workshop on Membrane Computing, WMC9, which took place in Edinburgh, UK, during July 28-31,2008. The ?rst three workshopson membrane computing were ornized in Curtea de Arge, s, Romania - they took place in August 2000 (with the proceedings published in Lecture Notes in Computer Science, volume 2235), in August 2001 (with a selection of papers published as a special issue of Funmenta Informaticae, volume 49, numbers 1-3, 2002), and in August 2002 (with the proceedings published in Lecture Notes in Computer Science, volume 2597). The next ?ve workshops were organized in Tarragona, Spain, in July 2003, in Milan, Italy, in June 2004, in Vienna, Austria, in July 2005, in Leiden, The Netherlands, in July 2006, and in Thessaloniki, Greece, in June 2007, with the proceedings published as volumes 2933, 3365, 3850, 4361, and 4860 of Lecture Notes in Computer Science.

## MODELS OF COMPUTATION IN CONTEXT

# 7TH CONFERENCE ON COMPUTABILITY IN EUROPE, CIE 2011, SOFIA, BULGARIA, JUNE 27 - JULY 2, 2011, PROCEEDINGS

Springer Science & Business Media This book constitutes the refereed proceedings of the 7th Conference on Computability

in Europe, CiE 2011, held in Sofia, Bulgaria, in June/July 2011. The 22 revised papers presented together with 11 invited lectures were carefully reviewed and selected with an acceptance rate of under 40%. The papers cover the topics computability in analysis, algebra, and geometry; classical computability theory; natural computing; relations between the physical world and formal models of computability; theory of transfinite computations; and computational linguistics.

#### MEMBRANE COMPUTING

# 5TH INTERNATIONAL WORKSHOP, WMC 2004, MILAN, ITALY, JUNE 14-16, 2004, REVISED SELECTED AND INVITED PAPERS

<u>Springer</u> This book constitutes the thoroughly refereed extended postproceedings of the 5th International Workshop on Membrane Computing, WMC 2004, held in Milan, Italy in June 2004. The 20 revised full papers presented together with 6 invited papers went through two rounds of reviewing and improvement. All current topics in the area of membrane computing are addressed, ranging from mathematics and theoretical computer science to applications in biology, linguistics, and computer graphics. Issues related to computational power and complexity classes, new classes of P systems, fuzzy approaches, and reversibility and energy consumption are dealt with as well.