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EDITORIAL

Preface of the special issue on computational complexity and complex systems

Mario J. Pérez-Jiménez[1,2] · Claudio Zandron[3] · Petr Sosík[4] · David Orellana-Martín[1,2]

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This special issue of the Journal of Membrane Computing is devoted to complexity in two of its aspects. On the one hand, the study of computational complexity theory in the framework of membrane computing, giving efficient solutions to presumably intractable problems, and finding frontiers of efficiency. On the other hand, the area of complex systems is very important nowadays for all its applications from physics to social sciences, passing by a vast number of fields such as engineering, biology, chemistry and so on.

From the beginning, membrane systems have been demonstrated to be useful in several different tasks, both in theoretical fields such as computability theory, information theory and formal languages, among others, and in experimental duties, such as fault diagnosis, image segmentation, ecosystems modeling and so on. This special issue emphasizes in both sides by both giving solutions to presumably hard problems and describing the computational power of variants of P systems, and studying the role of membrane systems in pandemics situations and in medical image processing. These studies are part of the state-of-the-art results of their corresponding areas, showing the relevance of the edition of this type of special issue devoted to certain fields.

The editors would like to thank all the contributors, as well as the reviewers, for their effort in producing this special issue.

- The paper "Variants of derivation modes for which catalytic P systems with one catalyst are computationally complete" by Artiom Alhazov, Rudolf Freund, Sergiu Ivanov and Sergey Verlan, presents different derivation modes of catalytic P systems that are computationally complete, by their ability to simulate the behavior of register machines.
- In the paper "P systems in the time of COVID-19", the authors Fernando Baquero, Marcelino Campos, Carlos Llorens and José M. Sempere introduce LOIMOS, a epidemiological scenario simulator developed in the context of the fight against the pandemics caused by coronavirus SARS-CoV-2 on a global scale. Results concerning different scenarios are presented and compared with the real data with good estimations.
- Zsolt Gazdag, Károly Hajagos and Szabolcs Iván, in the paper "On the power of P systems with active membranes using weak non-elementary membrane division", present an efficient solution to QSAT, a well-known **PSPACE** -complete problem by using P systems with active membranes using weak non-elementary division rules instead of strong division rules, which difference lies in the entity that fires the rules: in the former, an object fires the rule, being transformed into a new object in each new created membrane; in the latter, one or more membranes are responsible of firing the rules, not removing any object from the system.
- The paper "Computational power of sequential spiking neural P systems with multiple channels", by Zeqiong Lv, Qian Yang, Hong Peng, Xiaoxiao Song and Jun

✉ Mario J. Pérez-Jiménez
marper@us.es

Claudio Zandron
claudio.zandron@unimib.it

Petr Sosík
petr.sosik@fpf.slu.cz

David Orellana-Martín
dorellana@us.es

[1] Research Group on Natural Computing, Department of Computer Science and Artificial Intelligence, Universidad de Sevilla, Avda. Reina Mercedes s/n, 41012 Sevilla, Spain

[2] SCORELab, I3US, Universidad de Sevilla, Avda. Reina Mercedes s/n, 41012 Sevilla, Spain

[3] Dipartimento di Informatica, Sistemistica e Comunicazione (DISCo), Università degli Studi di Milano-Bicocca, Viale Sarca 336, 20126 Milan, Italy

[4] Faculty of Philosophy and Science, Institute of Computer Science, Silesian University in Opava, Masarykova třída 343/37, 746 01 Opava, Czech Republic

Wang, is devoted to present new semantics for a variant of spiking neural P systems, called spiking neural P systems with multiple channels, where instead of having a global clock that synchronizes all the system to fire a rule in each neuron, a single rule is fired in each computational step. The computational power of this model with two sequential sub-modes and two strategies of rule application is studied.

- In the paper "Medical image fusion based on DTNP systems and Laplacian pyramid", by Siheng Mi, Li Zhang, Hong Peng and Jun Wang, Dynamic threshold neural P systems are used in the field of medical image fusion. In particular, a pipeline of different methods is designed by a pyramid decomposition using the Laplace pyramid approach for the two input images followed by DTNP systems, finally mixing the two results into a single image. The results are impressive, ensuring the fact that this novel method can compete with the state-of-the-art methods.
- The paper "From SAT to SAT-UNSAT using P systems with dissolution rules, by Agustín Riscos-Núñez and Luis Valencia-Cabrera, is devoted to apply an automatized protocol to transform a solution of an **NP**-complete problem, such as SAT, by means of a family of P systems, into a solution to a **DP**-complete problem. The objective is to obtain a family of P systems capable of, given two propositional logic formulas, return yes if and only if the first formula is satisfiable and the second formula is not satisfiable.
- Bosheng Song and Xiangxiang Zeng present in their paper "Solving a PSPACE-complete problem by symport/antiport P systems with promoters and membrane division" a solution to the problem QSAT by using cell-like membrane systems using communication and division rules while promoters are present. These special objects improve the previous results in the sense that, while without using promoters the number of objects that have to be used in symport/antiport rules is 3 to obtain efficient solutions to **PSPACE**-complete problems, promoters reduce the number of objects to 2. An overview of the computation is presented in the paper to understand the flow of the computation.

We think that this special issue is really interesting for the P community itself, since it gives visibility to an area that is really relevant in the framework of Membrane Computing, but it is also interesting for people from outside of the area, as it can introduce the field of Membrane Computing to people in the area of Computational Complexity Theory.

Mario J. Pérez-Jiménez was Full Professor at the Department of Computer Science and Artificial Intelligence at Universidad de Sevilla, Spain, since 2009, and currently Emeritus Professor. From 2005 to 2007, he was a Guest Professor of the Huazhong University of Science and Technology, Wuhan, China. He is a numerary member of the Academia Europaea (The Academy of Europe) in the Section of Informatics. His main research interests include theory of computation, computational complexity theory, natural computing (DNA computing and membrane computing), bioinformatics, and computational modelling for complex systems. He has published 20 books in computer science and mathematics, and over 300 scientific papers in international journals (collaborating with researchers worldwide), and he is a member of the Editorial Board of six ISI journals. He has been the first scientist awarded with "Important Contributions to Membrane Computing" under the auspices of the European Molecular Computing Consortium, Edinburgh, 2008. In 2014, he received the University of Sevilla's FAMA Award for his outstanding research career. He has been the main researcher in various European, Asian, Spanish and Andalusian research grants. From 2003, he was an expert reviewer of the Prospective and Evaluation National Agency of Spain. From May 2006, he was a European Science Foundation peer reviewer; from July 2008, he was an expert reviewer from the Romanian National University Research Council, and from October 2015, he is an international expert from the Russian Science Foundation, invited by the Russian International Affairs Council.

Claudio Zandron got the Ph.D. degree in computer science from the University of Milan in 2002. Since 2006, he is an associate professor at the Department of Informatics, Systems and Communication of the University of Milano-Bicocca, Italy. His research interests concern the areas of formal languages, molecular computing models, DNA computing, membrane computing, and computational complexity.

Petr Sosík is an associate professor of computer science at the Faculty of Philosophy and Science, Silesian University in Opava, Czech Republic. His professional experience includes research stays at Canadian and European universities, as well as commercial software projects. His scientific interests include molecular and natural computing and artificial intelligence.

David Orellana-Martín received his B.Sc. degree in 2014, his M.Sc. degree in 2016, and his Ph.D. degree in 2019 at the University of Seville. He received the best Ph.D. thesis of 2019 Award from the International Membrane Computing Society. He was an ERCIM fellow at NTNU (Norway) from 2019 to 2021, and currently, he is a postdoctoral fellow at the University of Seville. His main research interests are computational complexity theory, unconventional computing (specially membrane computing), as well as machine learning and high-performance computing. He is member of the Website Committee of the International Membrane Computing Society.