Membrane computing and programming

Membrane computing is a branch of natural computing aiming to abstract computing models from the structure and the functioning of the biological cell and from the organization and cooperation of cells in tissues, neural nets, populations, etc. The obtained models, called *P systems*, were vividly investigated, mainly from the computability point of view (power and efficiency), but also as models of biological processes, in relation to computer science, and in other contexts. This research area was initiated in 1998 [2], and now its bibliography is huge – already in 2003, ISI considered membrane computing as an "emerging research area of computer science", with the initial paper qualified as "fast breaking". A monograph [3] was published in 2002, and a comprehensive handbook was recently published [4]. Details can be found at the domain website from [5].

Very shortly, the obtained models are distributed and parallel computing devices, processing multisets of objects (symbols or strings) in compartments defined by membranes (intuitively understood as 3D vesicles); the rules for evolving the objects (also the membranes can evolve) are inspired from the biochemistry. Many classes of P systems were defined, most of them equivalent in power to Turing machines, certain of them able to solve computationally hard problems in a feasible time (by means of a time-space trade-off); numerous applications, especially in modeling biological or biomedical processes, or ecosystems. Many software simulators are available and also attempts towards implementations on a dedicated hardware were reported.

Starting with 2000, each year a workshop on membrane computing (WMC) takes place – from 2010 the series will be continued in the form of a conference on membrane computing (CMC). The tenth edition of WMC took place in August 2009, in Curtea de Argeş, Romania, while CMC11 will take place in August 2010, in Jena, Germany. The present volume is based on papers presented at this tenth workshop, with several other invited papers, aiming to cover an important research topic in this area, namely the connection between membrane computing (more general, cellular computing) and programming, understood in a general sense. Various issues are dealt with, starting with theoretical questions (semantics, algebraic approaches, extensions of P systems with practical computing motivations, model checking and verification), going to existing software packages for handling P systems and to attempts to implement P systems on existing parallel hardware (Nvidia, for instance) or on dedicated hardware, and ending with papers devoted to possible implications of membrane computing ideas and results in designing new programming languages, new software or computer architectures. Further (preliminary) discussions about the connections between membrane computing and programming can be found in the volumes of previous editions of WMC (see the website at [5] for details), in [1], etc.

The papers are written by researchers active in membrane computing and an intoductory/survey style is adopted by most contributions, with unpublished material in each case, obtained by authors in their current research. The introductory paper provides a quick presentation of membrane computing (basic notions, research topics, types of results and of applications, relevant references), thus making easier the understanding of this volume for the reader coming from other areas of computer science.

References

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Guest editors
Gheorghe Păun
Institute of Mathematics of the Romanian Academy, Bucharest, Romania

Mario J. Pérez-Jiménez
University of Seville, Spain

Gheorghe Ştefănescu
University of Bucharest, Romania
E-mail address: gpaun@us.es (G. Păun)

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