

(Imprecise Topics about) Handling Imprecision in P Systems

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1 (A Sort of) Introduction

The standard P systems are beautiful mathematical toys (maybe of interest for computer scientists, linguists, etc) which can easily get a smile from Palma-de-Mallorca-of-biologists. Working with multisets, hence precisely counting the objects from the compartments of a system (a cell), assuming a universal clock, which ticks uniformly for all compartments, and using the rules (reactions) in the maximal parallel manner, or, the other extreme case, in the sequential manner, are three features which make the life of mathematician easier and nicer, but which are science fiction for today biologists. The specification *today* suggests that *tomorrow* can change the things. However, waiting for tomorrow is not always a good strategy (for sure, not for our employers...), so that a sort of obsession wanders the science in general and membrane computing in particular: to become more and more realistic! Many papers are motivated in these terms, most of them succeeding to move (at most? at least?) from the southern building of Sevilla university to the central one (we do not mention them in the bibliography which closes this note, but only those which succeed – or at least promise – bigger steps; for the general bibliography of the area, the reader can consult the known web address <http://psystems.disco.unimib.it>), and only part of them already wawing towards the biologist, from the Valencia beaches...

The problem (difficulty) is not that numbers are no longer sure things, thus contradicting Galileo, but that *reality is imprecision* (and complexity, but this is a related but different topic). Even if God does not play dice (how could Einstein know it?!), for us, the humans, dices are indispensable. And not only dices (probabilities), but also many other sources/forms of uncertainty, in most cases originating in the partial knowledge we have about processes, phenomena, systems we want to understand. Probability, partial information, fuzzyness, randomness, stochasticity, ambiguity, noise (not to mention incompleteness, undecidability, intractability) are only a few of the main terms related to this issue.

Coping with uncertainty is not only a challenge coming from “reality”, from practitioners – in our case, mainly from biology. Biology is invoked here (in general, in membrane computing) mainly because this is the field from where the membrane computing is inspired and where it promises to return in the near future tools and applications relevant for biologists. However, membrane computing started as a branch of (theoretical) computer science, with the aim of learning something useful, or at least intellectually interesting, for computer science from the study of the (structure and functioning of the) living cell. The initial goal had nothing related to any promise to biologists. And yet at this theoretical level the challenge to deal with various forms of uncertainty appears. Because mathematics has developed several tools (theories) for handling uncertainty – probability theory, with many branches, fuzzy set theory, rough set theory, approximate reasoning and approximate algorithmics, etc – it is a natural task for the mathematician to bring such tools in membrane computing, with or without having in mind (and motivating the papers by) how realistic the models are, from a biological or non-biological point of view.

This long (and, admittedly, imprecise) discussion is intended to stress the fact that the topics/suggestions mentioned below are not necessarily meant to “bring P systems closer to biology” (sometimes, one even writes “back to biology”), although such a goal is implicate and it would be a nice “by-product” of the possible results obtained in the study of these topics/suggestions. The questions formulated below are just natural from a mathematical point of view (although in their formulation we will use biological motivation/metaphora).

Then, an important point we want to make is the fact that this note is explicitly meant to foster discussions, researches, collaborations during the Brainstorming Workshop on Uncertainty in P Systems, Palma de Mallorca, November 2004. This is not a research paper, is only a positional paper, a provocation to the participants in the meeting. The choice of issues is subjective, their ordering has no significance (of importance), the list is not meant to be exhaustive, the classification below is approximate. And, of course, many formulations are imprecise enough; already formulating in a rigorous manner such topics would be a matter of investigation.

Finally, a warning/precaution related to the bibliography: we have mentioned many titles at the end, all we know in this moment in membrane computing area related to the topic of this discussion, but we will cite very few of them in the text, although many of them are directly related to the issues we discuss. Also, we do not mention any book or paper related to the mathematical approaches to uncertainty/imprecision, for instance, about fuzzy or rough set theories; there are huge bibliographies (on the web) about these topics and the reader can easily find such an information.

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