On a Contribution of Membrane Computing to a Cultural Synthesis of Computer Science, Mathematics, and Biological Sciences

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Summary. Some topic contribution of membrane computing to a cultural synthesis of computer science, mathematics and biological sciences is presented.

1 Introduction

After a more than decade of the researches in the area of membrane computing, cf. [19], initiated by Gheorghe Păun it is worth to propose a discussion about a contribution of these researches to a cultural synthesis of computer science, mathematics, and biological sciences.

An aim of the present paper is to initiate the discussion focusing on these its aspects which are familiar to the author whose research area comprises mathematical foundations of computer science and foundations of mathematics itself.

The theme of the discussion was inspired by [11] and [2], where the goal of [11] is to propose a framework that should allow a healthy and positive role for speculations in mathematics although traditional mathematical norms discourage speculation whereas it is the fabric of theoretical physics. Thus a cultural synthesis of mathematics and theoretical physics is understood in [11] more or less explicitly as a mutual inspiration between the discussed areas.

We point out here that speculation in mathematics can be reinforced by computer experiments, cf. provocative article [10], which could extend the discussion in [11] to computer science with a regard to the relations between mathematical thinking and algorithmic thinking, cf. [12].

The responses in [2] contain various opinions about a role of speculation in mathematics from a defense of an importance of proofs, see S. Mac Lane's response continued in [14], to an acceptance of speculation as possessing equal rights to proofs. The response due to R. Thom in [2] suggests also a cultural synthesis of mathematics and biology.

We propose a looking forward approach to a cultural synthesis of the areas mentioned in the title of the present paper, where a cultural synthesis is also understood as mutual inspiration.

In the next section we outline some topic contribution of membrane computing to this cultural synthesis.

2 Topic contribution

We point out the following topics as a contribution of membrane computing to the discussed synthesis:

A) biologically inspired self-assembly (randomized, cf. [15] and [16]) P systems (with membrane division and creation) for solving NP complete problems, cf. [17] and [21], which extend algorithmic thinking by a new idea of a (randomized) algorithm for a construction of a self-assembly distributed system realizing massively parallel computation,

B) spiking neural P systems, cf. [18], with learning problem solution, cf. [9], which are a step towards digitalization[1] of neural networks within mathematical neuroscience, cf. e.g. [3],

C) fractal constructs generated by P systems, cf. [8], with P systems for obtaining homology groups, cf. [5], and a possibility to experiment with them (to predict some mathematical results like in [10] to be proved with mathematical precision like in [14]) via P-lingua programming environment designed in Seville, cf. [4] and [20].

Concerning A) one can ask for a relation of randomized P systems in [15] and randomized Gandy–Păun–Rozenberg machines [16] with probabilistic computing devices discussed in [1].

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[1] in a similar way as cellular automata digitalize physics according to E. Fredkin, S. Wolfram, cf. [6], [7], [13]

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