Tissue P Systems with Cell Division

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Abstract. In tissue P systems several cells (elementary membranes) communicate through symport/antiport rules, thus carrying out a computation. We add to such systems the basic feature of (cell) P systems with active membranes – the possibility to divide cells. As expected (as it is the case for P systems with active membranes), in this way we get the possibility to solve computationally hard problems in polynomial time; we illustrate this possibility with SAT problem.

1 Introduction

In membrane computing, there are two main classes of P systems: with the membranes arranged hierarchically, inspired from the structure of the cell, and with the membranes placed in the nodes of a graph, all of them at the same level, inspired from the cell inter-communication in tissues. A particularly interesting sub-class of the first class are the systems with active membranes, where the membrane division can be used in order to solve hard problems, e.g., **NP**-complete problems, in polynomial or even linear time, by a space-time trade-off. In the tissue P systems, the communication among cells is performed by means of symport/antiport rules, well-known in biology. Details can be found in [2], [3], as well as in the comprehensive page from the web address http://psystems.disco.unimib.it).

In this paper we combine the two definitions, and consider tissue P systems (with the communication done through symport/antiport rules) with cell division rules of the same form as in P systems with active membranes, but without using polarizations. The rules are used in the non-deterministic maximally parallel way, with the restriction that if a division rule is used for dividing a cell, then this cell does not participate in any other rule, for division or communication (when dividing, the interaction of the cell with other cells or with the environment is blocked); the cells obtained by division have the same labels as the mother cell, hence the rules to be used for evolving them or their objects are inherited (the label precisely identify the available rules).

This natural extension of tissue P systems provides the possibility of solving `SAT` in polynomial time, in a confluent way: at precise times, one of the objects `yes, no` are sent to the environment, giving the answer to the question whether the input propositional formula is satisfiable. The construction is uniform: in a polynomial time, a family of recognizing tissue P systems with cell division is constructed, which, receiving as inputs encodings of instances of `SAT`, tells us whether or not these instances are satisfiable.

References

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