Journal of Automata, Languages and Combinatorics **9** (2004) 4, 387–397

P SYSTEMS WITH CONDITIONAL COMMUNICATION RULES ASSIGNED TO MEMBRANES

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ABSTRACT

We introduce a variant of purely communicating membrane systems where the rules are directly assigned to the membranes and not to the regions as this is usually observed in the area of membrane systems. Multisets of promotors and inhibitors inside and outside the membrane control the application of rules assigned to a membrane. For the application of rules leading from one configuration of the system to the succeeding configuration we consider a sequential model and do not use the model of maximal parallelism. We will show that for such systems with only one membrane and using only singleton promoting and/or inhibiting multisets, we already obtain universal computational power.

Keywords: Antiport/symport, membrane computing, P systems, rules assigned to membranes, universality

1. Introduction

When in 1998 Gheorghe Păun introduced membrane systems (in [14]) as computing devices that were abstracted from the biological functioning of living cells, the rules responsible for the evolution of the systems were placed inside the region surrounded by a membrane and had to be applied in a maximally parallel way. Sequential variants of membrane systems (we shall mostly use the term P systems in the following) were introduced in [6] (also see [7]). The most important features considered in the various models of P systems investigated in further papers (e. g., see [4, 14, 15]; for a comprehensive overview see [16]; for actual developments in the area of P systems see [20]) are the membrane structure and specific features of the membranes (labelled by natural numbers), especially for the transfer of objects through the membranes. A *membrane structure* consists of membranes hierarchically embedded in the outermost *skin membrane*; every membrane encloses a *region* possibly containing other membranes. In the membranes, multisets of objects can be placed, which evolve according to given evolution rules. Applying these evolution rules (assigned to the regions) in a nondeterministic, maximally parallel way, the system passes from one configuration to another one, thereby performing a computation. Only halting computations produce a result, which consists of the objects present in a specified output membrane. In [17],