P systems with membrane creation and rule input

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Abstract. When a uniform family of recognizer P systems is designed to solve a problem, the data of a concrete instance of the problem is usually provided via a multiset which is placed in the so-called *input membrane*. In this paper we present a new definition for recognizer P systems with *rule input*, where the data of the instance is provided via a new set of rules. We also discuss a new semantic for P systems with membrane creation and as example, a uniform family of recognizer P systems with *rule input* which solves the Subset Sum problem is provided.

1 Introduction

Solving **NP**-complete problems is done in the membrane computing framework by generating an exponential amount of workspace in polynomial time and using the parallelism to check simultaneously all the candidates to solution.

The way in which this exponential number of membranes is created in polynomial time is based on biological processes. Inspired in living cells, P systems abstract the way of obtaining new membranes. These process are basically two: *mitosis* (membrane division) and *autopoiesis* (membrane creation), see [5]. Both ways of generating new membranes have given rise to different variants of P systems: *P systems with active membranes*, where the new workspace is generated by membrane division and *P systems with membrane creation*, where the new membranes are created from objects.

Both models are universal from a computational point of view, but technically, they are pretty different. In fact, nowadays there does not exist any theoretical result which proves that these models can simulate each other in polynomial time.

P systems with active membranes have been successfully used to design solutions to well-known **NP**-complete problems, as SAT [9], Subset Sum [6], Knapsack [7], Bin Packing [8] and Partition [1], but as Gh. Păun pointed in [10] *"membrane division was much more carefully investigated than membrane creation as a way to obtain tractable solutions to hard problems"*. Recently, the first results related to the power and design of algorithms to solve NP problems in these model have arisen (see [2–4]).

In these solution, both in the model of P systems with active membranes and P systems with membrane creation, a uniform family of recognizer P systems is designed to solve the problem and the data of a concrete instance of the problem is usually provided via a multiset which is placed in the so-called *input membrane*.

In this paper we present a new definition for recognizer P systems with *rule input*, where the data of the instance is provided via a new set of rules. We also discuss a new semantic for P systems with membrane creation and as example, a uniform family of recognizer P systems with *rule input* which solves the Subset Sum problem is provided.

The paper is organized as follows: first P systems with membrane creation are remembered in the next section with a short disscusion about the semantics. In section 3 recognizer P systems with input rules are presented. As an example, a uniform family of recognizer P systems with *rule input* which solves the Subset Sum problem is presented in 4. Finally, some formal details and conclusions are given in the last sections.

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