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# P Systems with Membrane Creation and Rule Input

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**Summary.** 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, called with *rule input*, where the data of the instance is provided via a set of rules which are introduced in the system at the beginning of the computation. We also discuss a new semantic for P systems with membrane creation and, as an 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 candidate solutions.

The way in which this exponential number of membranes is created in polynomial time is based on biological processes inspired in living cells. Basically, two processes are used in order to produce new membranes: *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 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 [10], Subset Sum [7], Knapsack [8], Bin Packing [9] and Partition [1], but as Gh. Păun pointed in [6] “*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 by means of P systems using membrane creation have arisen (see [2, 3, 4]).

In these solutions, 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 semantics for P systems with membrane creation and, as an example, a uniform family of recognizer P systems with *rule input* which solves the Subset Sum problem is provided.

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