Computing a partial mapping by a P system: Design and Verification

Antonio Pérez-Jiménez, Mario J. Pérez-Jiménez and Fernando Sancho–Caparrini

Dpto. Ciencias de la Computación e Inteligencia Artificial
Universidad de Sevilla, España

{Antonio.Perez,Mario.Perez,Fernando.Sancho}@cs.us.es

Abstract. Computing with membranes is a new computability model and it is basically a non imperative and procedural model. For that reason it is very hard to establish the verification of the P systems. In this paper a computing P system (according to the definition given in section 2) such that just computing the set $\{1^2, 2^2, \ldots, n^2\}$ for a given $n \geq 1$, is presented. A formalization of its syntax is given and the verification of this computing P system is established through the characterization of its successful computations.

1 Introduction

In October 1998, Gheorghe Păun ([1]) introduces a new computability model, of a distributed parallel type, based on the notion of *membrane structure*. This model, called *transition P-systems*, start from the observation that the processes which take place in the complex structure of a living cell can be considered *computations*.

The *membrane structure* of a P system is a hierarchical arrangement of membranes (understood as vesicles in a space), embedded in a *skin membrane* that separates the system from the environment. When a membrane has not any membrane inside, it is called *elementary*. Each membrane encloses a space between it and the membranes directly included in it (if any). This space (the *region* of the membrane) can contain a multiset (a set where the elements can be repeated) of objects (represented by symbols of a given alphabet) and a set of (evolution) rules for them. Each membrane defines an unique region; that is, each region is delimited (*from the outside*) by an unique membrane.

En [1], Gh. Păun illustrates the way of working of this new model giving an example of a transition P system *generating* exactly all squares of natural numbers greater or equal to 1. In [4] a formal verification of that P system has been given. In this paper we present a computing P system Π (according to definition given in Section 2) such that for every natural number $n \geq 1$, the P system Π with input n returns the set of squares $\{1^2, 2^2, \ldots, n^2\}$. The paper is organized as follows: Section 2 briefly presents some basic concepts about computing transition P systems. Section 3 gives a computing P system

Π, formalizing its syntaxis according to [3]. In section 4 some properties of this P system are studied in order to characterize the successful computations of it. In Section 5, this P system is shown to be able to compute the partial function $f : \mathbf{N} - \rightarrow P(\mathbf{N})$ defined as follows:

$$f(n) = \begin{cases} \uparrow & \text{if } n = 0 \\ \{1^2, 2^2, \ldots, n^2\} & \text{if } n \neq 0 \end{cases}$$

References

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