Solving numerical NP-complete problems using P systems with active membranes: the Partition problem and beyond.

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1 Introduction

Cellular Computing is an emergent branch in the field of Natural Computing. Since Gh. Păun introduced it (see [2]) much work has been done, but not always with the same approach. Computer scientists, biologists, formal linguists and complexity theoreticians have contributed enriching the field with their different points of view.

The present paper is focused in the design of a family of P systems that solves a numerical NP-complete problem, and in the formal verification of this solution. The design is a sequel of several previous works on other problems, mainly the Subset-Sum and the Knapsack problems but also the VALIDITY and SAT problems. Also the similarities with the solutions presented in [4], [5], [7] and [8] will be highlighted and some conclusions will be extracted from them. We intend to show that the idea of a *cellular programming language* is possible, indicating some "subroutines" that can be used in a variety of situations.

Recall that a decision problem, X, is a pair (I_X, θ_X) such that I_X is a language over a finite alphabet (whose elements are called *instances*) and θ_X is a total boolean function over I_X.

We intend to design a family of P systems such that we can *solve* the Partition problem, in the following sense: given a concrete instance of the problem we should be able to pick a P system of the family, provide it with the appropriate input and the wait until an answer (either Yes or No) is sent out to the environment.

In this paper P systems within the active membrane model will be used. We refer to [2] (see chapter 7) for a detailed definition of evolution rules, transition steps and configurations in this model. We will use the variant of P systems with input and with external output (a brief review of these models and variants will be provided in the paper).

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