# A linear-time solution for the Knapsack problem using active membranes

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**Abstract.** Up to now, P systems dealing with numerical problems have been rarely considered in the literature. In this paper we present an effective solution to the Knapsack Problem using a family of deterministic P systems with active membranes using 2-division. We show that the number of steps of any computation is of linear order, but polynomial time is required for pre-computing resources.

## 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 idea is inspired in the solution presented in [6] for the Subset-Sum problem.

The analysis of the solution presented here will be done from the point of view of the complexity classes. A *complexity class* for a model of computation is a collection of problems that can be solved (or languages that can be decided) by some devices of this model with *similar* computational resources.

In this paper we present a *polynomial complexity class* in cellular computing with membranes inspired in some ideas of Gh. Păun ([2], section 7.1) discussed with some members of the Research Group on Natural Computing from the University of Seville. This class allows us to detect some intrinsic difficulties of the resolution of a problem in the model above mentioned.

The paper is organized as follows: first a formal definition of recognizer P systems is given in the next section; then, in section 3 the polynomial complexity class $\mathbf{PMC}_{\mathcal{AM}}$ is introduced; in sections 4 and 5 a cellular solution for the Knapsack problem is presented, together with some comments; a computational study of such solution is developed in section 6; and the consequences of this study together with the conclusions are given in sections 7 and 8.

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