Solving the Subset-Sum problem by active membranes

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Abstract We present the first cellular solution to the Subset-Sum problem using a family of deterministic P systems with active membranes. We do not use priority among rules, membrane dissolution nor cooperation; it suffices to control the electrical charges of the membranes and to introduce some counters. The number of steps of any computation is of linear order.

Keywords Membrane Computing, Complexity Classes, Active Membranes, Subset-Sum Problem.

§1 Introduction

In [2] an unconventional model of computation is presented as a kind of distributed parallel computing model and it comes from the observation that the processes which take place in the complex structure of a living cell can be considered as computations. The devices of this model are called P systems.

Up to now, P systems dealing with numerical problems have been rarely considered in the literature. The present paper is a first approach in this direction. Our claim is that, once we have seen the construction and verification of families of P systems solving a few numerical NP–complete problems, maybe we will be able to extract a common scheme that could be the basis for attacking new numerical problems.

We present here a cellular solution to the Subset-Sum problem, and we will analyze it 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 ([3], 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: in the next section we define the P systems with input (with and without external output) which will be the models considered to study the complexity classes; in section 3 the polynomial complexity class $\mathbf{PMC}_{\mathcal{F}}$, associated with a collection of P systems $\mathcal{F}$, is introduced; in sections 4 and 5 a cellular solution to the Subset-Sum problem is presented; section 6 is devoted to study the computational complexity of such solution; and the main results and conclusions are given in sections 7 and 8, respectively.

We work in this paper with membrane systems using symbol–objects.

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