

Solving VALIDITY problem by active membranes with input

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Abstract. Given a class of membrane systems, \mathcal{F} , the complexity class $\mathbf{PMC}_{\mathcal{F}}$ of all problems solvable in polynomial time by a family of P systems of type \mathcal{F} is presented. We show that the problem of determining if a boolean formula in conjunctive normal form is a tautology, belongs to $\mathbf{PMC}_{\mathcal{AM}}$, being \mathcal{AM} the class of recognizers P systems with input and with active membranes using 2-division. We conclude that **co-NP** is contained in this complexity class.

1 Introduction

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 [1] an unconventional model of computation is presented as a kind of distributed parallel computing model. This model 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.

In this paper we present a *polynomial complexity class* in cellular computing with membranes inspired by some ideas that Gh. Păun ([4], section 7.1) discussed with the authors. This class allows us to detect some intrinsic difficulties of the resolution of a problem in the model above mentioned.

A precise definition of the parameters that specify a complexity class is required: the model and the mode of computation (cellular computing with membranes), the computational resource (the time), the bound for this resource (a recursive total function mapping natural numbers to natural numbers). Of course, we need to define what kind of problems will be considered (decision problems).

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 $\mathbf{PMC}_{\mathcal{AM}}$ is introduced. Section 4 is devoted to study the complexity of the **VALIDITY** problem.

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

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