CHAPTER 9

CHARACTERIZING TRACTABILITY BY CELL–LIKE MEMBRANE SYSTEMS

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In this paper we present a polynomial complexity class in the framework of membrane computing. In this context, and using accepting transition P systems, we provide a characterization of the standard computational class **P** of problems solvable in polynomial time by deterministic Turing machines.

1. Introduction

The *Theory of Computation* deals with the *mechanical solvability* of problems, distinguishing clearly between problems for which there are algorithmic procedures solving them, and those for which there are none. But it is very important to clarify the difference between *solvability in theory* and *solvability in practice*; that is, studying procedures which can run using an amount of resources likely to be available. Rouhgly speaking, a problem is called *tractable* if it is mechanically solvable in practice.

Computational Complexity Theory tries to classify decision problems according to the amount of resources required for solving them in a *mechanical* way. A *complexity class* for a model of computation is a collection of problems that can be solved by some devices of this model with *similar* computational resources.

At the end of 1998, the area of *Membrane Computing* was initiated by Gh. Păun [7] coming from the observation that the processes which take place in the complex structure of a living cell can be considered as computations, and providing basic computing models consisting of distributed parallel devices processing multisets in the compartments defined by a cell–like hierarchy of membranes.

In this paper we present a *polynomial complexity class* in that framework, allowing us to detect some intrinsic difficulties of the resolution of a problem. In that context, a characterization of the standard computational class **P** of tractable problems (that is, problems solvable in polynomial time by deterministic Turing machines) is obtained.

The paper is organized as follows: in the next section some preliminary notions are given. In section 3 we define the cellular framework (accepting cell–like membrane systems) in which a computational complexity theory will be developed. Section 4 introduces a polynomial complexity class associated with P systems. Sections 5 and 6 are devoted to characterize the standard class **P** through cellular computing models.

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

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