

MULTI-DIMENSIONAL DESCRIPTIONAL COMPLEXITY OF P SYSTEMS¹

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ABSTRACT

Membrane Computing is a branch of Natural Computing which starts from the assumption that the processes taking place in the compartmental structure of a living cell can be interpreted as computations. The description of the complexity of the computations of the membrane devices (P systems) is a hard task which goes beyond the usual parameters of time and space. This is especially hard in the case of P systems where the number of membranes increases along the computation, via division or creation of membranes. In this paper we show that a four-dimensional carpet can be a useful tool to describe and compare evolutions of P systems, even in such cases.

Keywords: Descriptive complexity, membrane computing, recognizer P systems, Sevilla carpets

1. Introduction

Membrane Computing, introduced by Gh. Păun in [11], is a cross-disciplinary field where computer scientists, biologists, formal linguists and complexity theoreticians are getting involved, enriching each others with results, open problems and promising new research lines. Indeed, Membrane Computing has been selected in February 2003 by the Institute for Scientific Information, USA, as a *Fast Emerging Research Front* in Computer Science, and [10] was mentioned in the ISI web page (<http://esi-topics.com/erf/october2003.html>) as a highly cited paper in October 2003.

This new non-deterministic model of computation abstracts the processes taking place in the compartmental structure of a living cell, interpreting them as computing operations. The computational devices of this model are called *membrane systems* or *P systems*. Roughly speaking, a P system consists of a cell-like membrane structure,

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