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POWER AND EFFICIENCY OF MINIMAL PARALLELISM IN POLARIZATIONLESS P SYSTEMS

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ABSTRACT

Minimal parallelism was recently introduced [3] as a way of using the rules of a P system: from each set of applicable rules associated to a membrane, *at least* one rule must be applied. In this paper, we consider the minimal parallelism for P systems with active membranes without polarizations, using additional features, such as separation operations, changing membrane labels, catalytic or cooperative rules, etc. With several combinations of such features we obtain computational completeness. In cases where membrane division (of elementary or non-elementary membranes) is allowed, we show how SAT can be solved in polynomial time.

Keywords: Membrane systems, minimal parallelism, computational completeness, computational complexity

1. Introduction

Membrane systems (referred also as P systems) are a class of distributed parallel computing devices of a biochemical type, which can be seen as a general computing architecture where various types of objects can be processed in parallel by various operations. A key structural notion is that of a *membrane* by which a system is divided into compartments where chemical reactions can take place. These reactions transform multisets of objects present in the compartments into new objects, possibly transferring objects to neighboring compartments, including the environment.

For a comprehensive introduction to membrane computing we refer to [11].

As membrane systems are inspired by living cell behavior, a continuous research topic in the area was looking for as bio-realistic computing models as possible. In this framework, the application of developmental rules under different constraints is an interesting problem to study. An idea concerning the rule application that has recently attracted the attention is the *minimal parallelism*, introduced and investigated in [3]. Minimal parallelism relaxes the condition of using the rules in a maximally parallel way. More precisely, the rules are used in the *non-deterministic minimally parallel*