

P SYSTEMS WITH REPLICATED REWRITING

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ABSTRACT

P Systems are computing models, where objects can evolve in parallel within a hierarchical membrane structure. Recent results show that this model is a promising framework for solving NP-Complete problems in polynomial time. (Of course “solving” NP-Complete problems in this framework means trading space for time and using an exponential space. The interest for P systems in this respect lies in the fact that we can generate this space in a very natural, easy and systematic manner, inherent to P systems). The present paper considers P systems using strings as the data structure and replicated rewriting as the control structure. This is a variant of P systems which can attack NP-Complete problems: here we exemplify this with SAT and HPP, which can be solved in linear time. We also prove that this variant is computationally complete, it characterizes the family of recursively languages.

Keywords: natural computing, P systems, replicated rewriting.

1. Introduction

In the area of natural computing, P systems are new computing models based on way nature organizes cellular level in living organisms. Different processes developed at this level can be thought of as computations. In his seminal paper [4], GH. PĂUN considers systems based on a hierarchically arranged finite cell structure consisting of several cell membranes embedded in a main membrane called skin membrane. The membranes delimit regions where objects are placed. In [4], two basic classes of P systems are considered, with symbol-objects and string-objects. Starting from these main variants, several further variants were considered [1, 3, 5, 7, 8].

Here we consider a variant of P systems with string-objects with the object evolution rules based on rewriting. It is known that certain variants of P systems, such as P systems with active membranes [6] and P systems with worm objects [1], are capable of solving NP-Complete problems in polynomial time. For solving hard problems with P systems which use rewriting rules, we need to replicate strings, in order to get exponential space in a linear time. This is the starting idea of our paper: to consider rules which replicate strings at the same time when rewriting them. Such P systems with replicated rewriting are introduced in the following section. Then we give an