Cellular solutions to some numerical NP-complete problems: A Prolog implementation

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ABSTRACT

This chapter is devoted to the study of numerical **NP**-complete problems in the framework of cellular systems with membranes, also called *P systems* (Păun, 1998). We present *efficient* solutions to the Subset-Sum and the Knapsack problems. These solutions are obtained via families of P systems with the capability of generating an exponential amount of working space in polynomial time.

Besides, a simulation tool for P systems, written in Prolog, is described. As an illustrative example, a session in the Prolog simulator implementing one of the presented cellular solutions is included.

INTRODUCTION

The race towards the miniaturization of silicon microchips in order to get more and more powerful (smaller and faster) processors is expected to hit its own physical limits very soon. This is why it is necessary to look for new *unconventional models* of computation. One of the main research lines in this direction intends to obtain new paradigms of computation inspired from Nature. This approach is generically known as Natural Computing.

This chapter is included within the framework of one of these Nature inspired models, namely, *Cellular Computing with membranes*. This model abstracts the functioning of a living cell. At the moment it is just at the theoretical level, and it is not likely that it would be implemented *in vivo* in the next future. However, some simulations *in silico* (i.e. software implementations) have been recently presented, written in various programming languages (Java, C, Scheme, etc.), although they are not able to actually implement the massive parallelism inherent to the original model.

The simulator presented here is written in Prolog, and it was created with the purpose of being an assistant in theoretical research in Cellular Computing. That is, it is not intended to get an efficient implementation, but an intuitive tool, in order to provide faithful and detailed information about the computations of cellular systems. Indeed, during the development of the simulator, a feed-back process happened: the simulator

gave useful information that aided to fix the formal verification of cellular systems, and also some already verified systems that were used to test the simulator caused some bugs in the Prolog code to arise.

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