A Modelling Language and Tool for P Systems

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Abstract. P Systems are a new unconventional computing paradigm inspired by the processes taking place in membrane structures of living cells. Each cell is an individual computing unit producing objects. Interaction between cells is achieved by the exchange of objects through the membrane structure. A Population P System is a class of P Systems, in which membranes form an arbitrary graph of individuals rather than a hierarchy of cells. Various kinds of rules allow: (a) the transformation of objects within cells, (b) modification of links between cells, (c) cell division and (d) cell death, as systems evolve. So far, all attempts to simulate the computation of P systems have been ad hoc. In contrast, this paper presents the syntax and semantics of PPSDL, a description language for expressing Population P System models as well as a tool which can be used to animate the computations of models described in PPSDL. An example of a Population P system will act as a vehicle of study for the presentation of the language and the developed tool.

Key words: Membrane Computing, Tools, Unconventional computing paradigms, Formal Methods.

1 Introduction

The increasing complexity of software systems has led to the search for new computing and modelling paradigms in order to find alternative means for achieving computational power. Nature has been an immense source of inspiration and has challenged the investigation into processes it uses for solving various complex problems. A number of new computational paradigms has arisen, abstracting from processes taking place in a variety of biological systems.

In the field of concurrent programming, new computational paradigms have been introduced, such as Gamma [1] and Cham [2], for the modelling of such systems' behaviour. Experiments on how DNA strands may be used as a massive parallel computer for solving well-known hard problems [3] gave rise to a whole new area of research. Inspiring from real ant colonies, Ant Colony Optimisation is used to solve hard combinatorial problems [4, 5]. In the last years, effort has been