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Refereed Article

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Approaches for Simulating and Modeling Cell Regulation: Search for a Unified View Using Constraints

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Abstract: *We investigate a few approaches that have been considered in the simulation and modeling of networks describing cell behavior. By simulation it is meant the direct problem of determining cell behavior when given a graph (network) specifying the interaction among genes. By cell behavior we mean determining the amount of byproducts (mRNA or protein) that each gene generates with time as it interacts with other genes. We refer to modeling as the inverse problem namely, inferring the network graph when given the data describing the cell's behavior. The modeling problem has acquired significant importance in view of the present high volume of cell data available from micro-array experiments. The emphasis of the paper is in using the constraint logic programming paradigm to describe the simulation of cell behavior. In that paradigm the same program describes both a problem and its inverse. Basically one defines multi-dimensional regions, transitions (specifying how control is transferred from one region to the other), and trajectories (sequences of transitions describing cell behavior). The paradigm is applied to several approaches that have been proposed to study simulation and modeling. Several logic programs have been developed to prototype those approaches under the same proposed paradigm. They include considering Boolean and discrete domains. In each case the potential of obtaining practical solutions to the inverse problem are discussed. The proposed paradigm is related to machine learning and to the synthesis of finite-state automata.*

Publication and review history

This work was first presented at the Machine Intelligence 18 Workshop, held on September 19-21, 2001 at the University of York, UK. Attendance at this workshop was based on invitations. Speakers at the workshop were invited to submit their articles for consideration in the forthcoming workshop volume. The subsequent publication and review history for the present article was as follows.

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5. Revised version appears in Electronic Transactions on Artificial Intellligence, Volume 5 (2001), section B, pages 161–188. The section and the annual volume are made permanently available at
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