Current developments on computational modeling using P systems

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Abstract. A P systems based general framework for modeling ecosystems dynamics will be described. Roughly speaking, the idea is to use several regions (environments) that can be connected, each of them containing a probabilistic P system with active membranes (having identical skeleton for every environment).

Some real case studies will be displayed, discussing the usefulness of this tool in simulating complex ecosystems dynamics to aid managers, conservationists and policy-makers in making appropriate decisions for the improvement of management and conservation programs.

Keywords: Modeling, Multienvironment probabilistic P systems, P Systems simulators

1 Introduction

Membrane Computing is a quite active research field, initiated by Gh. Păun in 1998 [6, 8]. It is a theoretical machine-oriented model, where the computational devices (known as *P systems*) are in some sense an abstraction of a living cell. There exist a large number of different definitions of P systems models, but most of them share some common features: a *membrane structure* (defining in a natural way a number of regions or compartments), and an alphabet of *objects* that are able to evolve and/or move within the membrane structure according to a *set of rules* (emulating the way substances undergo biochemical reactions in a cell).

Recently, P systems are being used as tools for modeling purposes, adapting their semantics in an appropriate way. Indeed, interesting achievements are being obtained, which show that membrane computing can be an alternative to classical modeling frameworks (e.g. those based on differential equations). Works on this direction rely on the development of associated simulation software, since P systems have not yet been implemented neither in hardware nor in biological means.

The talk will try to provide a general overview of modeling frameworks for systems biology and population dynamics based on P systems (see e.g. [1, 7]),

displaying some real case studies [2, 3]. It is interesting to note that some biological parameters of the modeled processes can be obtained experimentally by Biologists or Ecologists (and therefore they can be taken into account when designing the model), while some other relevant constants may be unknown. Software tools are thus necessary to enable virtual experimentation, as well as for the process of model validation [4, 5].

References

1. Cardona, M., Colomer, M.A., Margalida, A., Palau, A., Pérez-Hurtado, I., Pérez-Jiménez, M.J., Sanuy, D.: A computational modeling for real ecosystems based on P systems. Natural Computing, online version (DOI: 10.1007/s11047-010-9191-3).
2. Cardona, M., Colomer, M.A., Margalida, A., Pérez-Hurtado, I., Pérez-Jiménez, M.J., Sanuy, D.: A P system based model of an ecosystem of some scavenger birds. In: Păun, Gh., Pérez-Jiménez, M.J., Riscos-Núñez, A., Rozenberg, Gr., Salomaa, A. (eds.) WMC 2009. LNCS, vol. 5957, pp. 182–195. Springer, Heidelberg (2010)
3. Colomer, M.A., Margalida, A., Sanuy, D., Pérez-Jiménez, M.J.: A bio-inspired computing model as a new tool for modeling ecosystems: The avian scavengers as a case study. Ecological modelling 222(1), 33–47 (2011)
4. García-Quismondo, M., Gutiérrez-Escudero, R., Pérez-Hurtado, I., Pérez-Jiménez, M.J., Riscos-Núñez, A.: An overview of P-Lingua 2.0. In: Păun, Gh., Pérez-Jiménez, M.J., Riscos-Núñez, A., Rozenberg, Gr., Salomaa, A. (eds.) WMC 2009. LNCS, vol. 5957, pp. 264–288. Springer, Heidelberg (2010)
5. Martínez-del-Amor, M.A., Pérez-Hurtado, I., Pérez-Jiménez, M.J., Riscos-Núñez, A., Sancho-Caparrini, F.: A simulation algorithm for multienvironment probabilistic P systems: A formal verification. Int. J. Foundations of Computer Science 22(1), 107–118 (2011)
6. Păun, Gh.: Computing with membranes. Journal of Computer and System Sciences, 61, 1 (2000), pp. 108–143, and Turku Center for Computer Science-TUCS Report No 208.
7. Păun, Gh., Romero-Campero, F.J.: Membrane Computing as a Modeling Framework. Cellular Systems Case Studies. In: Bernardo, M., Degano, P., Zavattaro, G. (eds.) SFM 2008. LNCS, vol. 5016, pp. 168–214. Springer, Heidelberg (2008)
8. The P systems Web Page, http://ppage.psystems.eu