Formal Verification and Testing Based on P Systems

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Summary. In this paper it is surveyed the set of formal verification methods and testing approaches utilised for applications based on P systems.

P systems (also called membrane systems) represent a class of parallel and distributed computing devices which are inspired by the structure and the functioning of living cells [11], [12]. The model has been used for theoretical investigations as well as a vehicle to represent different problems from various domains [13]. A rich set of software tools have been produced to implement various simulators [7].

As a consequence of using membrane systems to specify, model and simulate various systems, certain methods and techniques have been employed to verify they work properly.

Formal methods have been used for various types of systems and using different formalisms. Petri nets based methods have been studied with respect to translating various classes of P systems into this formalism. Tools and techniques developed for Petri nets become available for the description, analysis, and verification of behavioral properties of membrane systems, and in particular for the investigation of the structure of the behavior of P systems [10]. It also allows to study causality and (a)synchrony, as basic properties of such systems.

Structural operational semantic allowing to systematically translate certain classes of P systems into a specific rewriting logic formalism called Maude [6], [2], has been provided. This approach allows to formally verify properties of the systems specified with these classes of P systems by using linear temporal logic model checking approaches [1].

For probabilistic and stochastic P systems special relationships with classes of stochastic process algebras and Petri nets have been investigated and a special purpose model checking approach based on Prism has been studied [3].

A complementary approach to formal verification is usually based on testing. More specifically, model based testing has been investigated for simple classes of P systems [8], [9] and ways to devise adequate test sets have been proposed. These techniques are somehow similar to studies investigating the role of the so called observers [4], [5] for certain classes of P systems.

This paper will present a survey on the main verification methods and testing tools applied to P systems and their advantages and limitations will be revealed.

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