Describing Computations of Membrane Systems with Petri Nets

György Vaszil

Faclty of Informatics, University of Debrecen, Kassai út 26, 4028 Debrecen, Hungary

Abstract

Membrane systems [5] are biologically inspired models of computation: their operation attempts to imitate the functioning of living cells. The computation in a membrane system proceeds in distinct regions called membranes or compartments. The compartments allow computation with multisets: they accomplish transformations of their contained multisets by various evolution rules. In the original symbol object model, the compartments are organized in a tree like structure and the rules account for the computational processes in the compartments in a parallel and distributed manner. Multisets of objects on the left hand sides of rules are transformed to multisets on the right hand sides and these might also be placed to other regions of the system before the next computational step begins. The computation proceeds until no more rule can further be applied in any of the regions, and the result is usually given by the objects of one or more designated output regions. In short, membrane systems consume, produce, and move objects around in the regions of their membrane structure.

The functioning membrane systems, described above, might remind us of the behavior of place transition Petri nets, since Petri net transitions also consume tokens from their input places and produce new tokens at their output places. If we establish a correspondence between token distributions on the places of the net (markings) and object distributions in the different regions of the P system (configurations), see [4], then the transitions of place/transition nets can naturally be described by multiset transformations in the membrane system. This is also true the other way around, the functioning of the membrane system based on the different kinds of objects and object evolution rules in different compartments can be described by the evolution of Petri net configurations (markings). See the handbook chapter [3] for more information.

In the presentation we look at these structural links between the two models in more detail. This approach might motivate the examination of membrane systems from the point of view of the concurrent nature of their behavior, and also inspire the study of Petri net variants suitable for the modeling of membrane system computations, [1, 2]

References

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vaszil.gyorgy@inf.unideb.hu (G. Vaszil)
0000-0003-1213-8616 (G. Vaszil)