On the Implementation of Multiset Relations and Operations

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A membrane system Π of degree $m \geq 1$ (or P system for short) [3] is a construct $\Pi = \langle U, \mu, w_1, \ldots, w_m, R_1, \ldots, R_m \rangle$. Membranes delimit regions $w_1, \ldots, w_m$ separating "inside" from "outside". Regions are arranged in a hierarchical structure μ, and represented by multisets over a finite alphabet U. Regions are endowed with two sets of rules, evolution rules $R_1, \ldots, R_i$ and communication rules $R_{i+1}, \ldots, R_m$.

Computation in membrane systems means the executions of these rules in maximal parallel manner. In [1], boundaries of regions as multisets were proposed. Membrane calculations can be controlled by the help of these boundaries [2].

Let U be a nonempty finite set of objects. A multiset or mset M over U is represented by a total function $M : U \to \mathbb{N} \cup \{\infty\}$. After defined usual generalizations of basic set–theoretical relations and operations for multisets, additional multiset relations and operations will be defined concerning membrane calculations.

Calculations with multisets have large computation needs. There are software packages, programming languages and computer algebra systems, which encourage basic multiset operations. However, they do not give any means for calculating in membrane systems. The goal of this study is to outline an abstract model for managing multisets mainly keeping membrane system calculations in view.

References

[1] Mihálydeák, T., Csajbók, Z.E., Membranes with boundaries. In: Csuhaj-Varjú, E., et al. (eds.), CMC 2012. LNCS, vol. 7762, Springer, (2013), 277–294.

[2] Mihálydeák, T., Vaszil, Gy., Regulating rule application with membrane boundaries in P systems. In: Rozenberg, G., et al. (eds.), CMC 2015, Revised Selected Papers. LNCS, vol. 9504, Springer, (2015), 304–320.

[3] Păun, Gh., Computing with membranes. J Comput Syst Sci 61(1), (2000), 108–143.