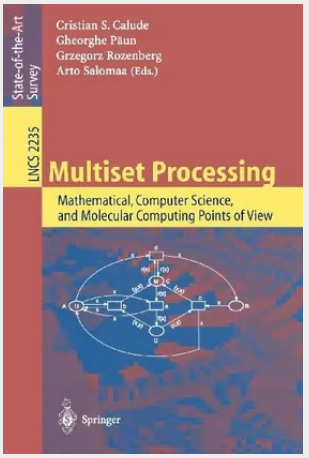
Calude / Paun / Rozenberg

Multiset Processing

Mathematical, Computer Science, and Molecular Computing Points of View



Themultiset (a set with multiplicities associated with its elements, in the form of natural numbers) is a notion which has appeared again and again in many areas of mathematics and computer science, sometimes called abag (some h- torical information appears in the enclosed paper by A. Syropoulos). As a data structure, this notion stands “in-between”strings/lists, where a linear ordering of symbols/items is present, andsets, where no ordering and no multiplicity is considered;inamultiset,onlythemultiplicityofelementsmatters,nottheir ordering. Actually, in between lists and multisets we also havepomsets, partially ordered multisets. Con?ning ourselves to computer science, we may mention many areas where multisets are used: formal power series, Petri nets, data bases, logics, formal language theory (in relation with Parikh mapping, commutative grammars, etc), concurrency, and so on. In the last few years, the notion has occurred in a rather natural way in the molecular computing area. An aqueous solution of chemical compounds, swimming together in a given space, without any given spatial relation between individual elements, is just a multiset. Actually, this chemical metaphor was used several years before the occurrence of what is now called molecular computing, as the basic ingredient of the Gamma language and the Chemical Abstract Machine (a comprehensive survey of these ideas is provided by J. -P. Banˆ atre, P. Fradet, D. Le Metayer).

Structures and Bio-language to Simulate Transition P Systems on Digital Computers.- Gamma and the Chemical Reaction Model: Fifteen Years After.- Visual Multiset Rewriting: Applications to Diagram Parsing and Reasoning.- Multiset Automata.- Parikh Mapping and Iteration.- Multiset Constraints and P Systems.- Toward a Formal Macroset Theory.- Normal Forms of Grammars, Finite Automata, Abstract Families, and Closure Properties of Multiset Languages.- On Multisets in Database Systems.- Tolerance Multisets.- Fuzzy Multisets and Their Generalizations.- Universality Results for Some Variants of P Systems.- Multiset and K-Subset Transforming Systems.- On P Systems with Active Membranes Solving the Integer Factorization Problem in a Polynomial Time.- The Linear Theory of Multiset Based Dynamic Systems.- Artificial Life Applications of a Class of P Systems: Abstract Rewriting Systems on Multisets.- Mathematics of Multisets.

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