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A regular viewpoint on processes and algebra*

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Abstract

While different algebraic structures have been proposed for the treatment of concurrency, finding solutions for equations over these structures needs to be worked on further. This article is a survey of process algebra from a very narrow viewpoint, that of finite automata and regular languages. What have automata theorists learnt from process algebra about finite state concurrency? The title is stolen from [31]. There is a recent survey article [7] on finite state processes which deals extensively with rational expressions. The aim of the present article is different. How do standard notions such as Petri nets, Mazurkiewicz trace languages and Zielonka automata fare in the world of process algebra? This article has no original results, and the attempt is to raise questions rather than answer them.[1]

1 Formal languages

Formal language theory begins with the monoid of words $(\Sigma^*, \cdot, 1)$ over a finite alphabet Σ. A language is a set of words, and the algebraic structure of a set can be added to form an idempotent semiring $(\wp(\Sigma^*), \cdot, 1, +, 0)$. The identification of the semiring as a relevant algebraic structure is due to Conway [14] and Eilenberg [18].

Definition 1. *A **semiring** is a set S with an associative, commutative binary operation $+$ on S with identity 0; an associative binary operation $\cdot$ on S with identity 1 and absorbing element 0; and $\cdot$ distributing over $+$. The semiring is said to be **idempotent** if $+$ is idempotent.*

If we restrict ourselves to a regular language, recognized by a finite automaton, this amounts to saying that some equations hold in addition to those derived from the axioms of an idempotent semiring. Myhill and Nerode showed that recognizable languages, those saturated by finite-index congruences over the word monoid, are exactly the regular languages.

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[1]For some related questions in the world of process calculi, see [2].