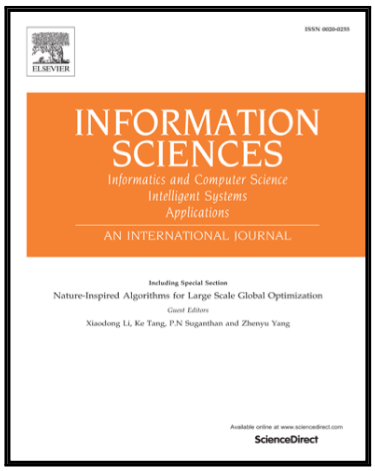

The relationships among several forms of weighted finite automata over strong bimonoids

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The relationships among several forms of weighted finite automata over strong bimonoids *

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Abstract

Given a strong bimonoid P, we introduce three different behaviors of a weighted finite automaton over P (called a $P-$valued finite automaton), named the initial object semantics, final object semantics and run semantics. We define four forms for a $P-$valued nondeterministic finite automaton ($P-$NFA) and three forms for a $P-$valued deterministic finite automaton ($P-$DFA). Under the above-mentioned semantics, the equivalence and differences among the four forms of $P-$NFAs are discussed and the equivalence among the three forms of $P-$DFAs are given. Moreover, we show that some equivalence depends on right distributivity or left distributivity, or even requires P to degenerate into a semiring.

Keywords: Semirings; Strong bimonoids; Weighted finite automata; Fuzzy finite automata; Equivalence

1 Introduction

Weighted finite automata are classical nondeterministic finite automata in which the transitions, initial and final states carry weights. The weights often form certain algebraic structures, called semirings [20]. Fuzzy finite automata was first studied by Wee [23] in 1969. In fact, Fuzzy finite automata can be viewed as weighted automata valued in semirings which are also certain ordered structures. For example, automata based on completed residuated lattice-valued logic [17, 18] can be viewed as weighted automata taking values in completed residuated lattices, and fuzzy finite automata with membership values in lattice-ordered monoids [10] can be viewed as a special kind of weighted finite automata valued in lattice-ordered monoids, etc. Weighted finite automata and fuzzy finite automata have both a well elaborated theory and practical applications, cf. [1, 3, 4, 8, 14, 15, 16, 24, 29].

Automata valued in a complete orthomodular lattice (automata based on quantum logic) was first introduced by Ying [26]. Since then, automata theory based on quantum logic has been developed

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