Journal of Automata, Languages and Combinatorics 8 (2003) 3, 465–476

ON THE COMPLEXITY OF SIMON AUTOMATA OVER THE DYCK LANGUAGE[1]

FLAVIO D'ALESSANDRO
Dipartimento di Matematica "Guido Castelnuovo", Università di Roma "La Sapienza"
piazzale Aldo Moro 2, I-00185 Roma, Italy
e-mail: dalessan@mat.uniroma1.it

ABSTRACT

In this paper the following problem is studied. Let $\tilde{\Sigma} = \Sigma \cup \bar{\Sigma}$ be a finite alphabet where Σ and $\bar{\Sigma}$ are disjoint and equipotent sets. Let L be a rational language over $\tilde{\Sigma}$ and let $\mathcal{S}_L$ be the *Simon distance automaton* of L. Let C be the square matrix with entries in the extended set of natural numbers given by the formula: for every pair (p, q) of states of $\mathcal{S}_L$, C_{pq} is the minimum weight of a computation in $\mathcal{S}_L$ from p to q labelled by a *Dyck word* if such a computation exists, otherwise it is ∞. We exhibit a polynomial time algorithm which allows us to compute the matrix C in the case Σ is the unary alphabet. This result partially solves an open question raised in [4].

Keywords: Formal languages, distance automata, free groups

1. Introduction

This paper mainly concerns the study of a complexity problem on distance automata. A finite nondeterministic automaton with a distance function is called distance automaton. The distance function assigns zero or one to every transition and assigns to every accepted word a natural number called its distance: this number is the minimum weight – computed by using distances assigned to transitions – of a successful computation spelling the word. Distance automata play a crucial role as basic computing machines in the solution of several important problems of formal language theory: for instance determining of the star-height and the finite power property of rational languages of the free monoid (see [13] for an excellent survey on the subject). We recall that a subset L of the free monoid satisfies the finite power property if L^* is equal to a finite union of powers of L.

The latter property was shown to be decidable for the rational sets of the free monoid independently by K. Hashiguchi and I. Simon in 1979 ([12, 7]).

[1]This work was partially supported by the Istituto Nazionale di Alta Matematica "F. Severi", Gruppo Nazionale delle Strutture Algebriche and MIUR project "Linguaggi formali e automi: teoria e applicazioni".