

STATE COMPLEXITY OF FINITE TREE WIDTH NFAs ¹

ALEXANDROS PALIOUDAKIS, KAI SALOMAA, SELIM G. AKL

*School of Computing, Queen's University,
Kingston, Ontario K7L 3N6, Canada
e-mail: {alex, ksalomaa, akl}@cs.queensu.ca*

ABSTRACT

We consider nondeterministic finite automata having finite tree width (ftw-NFA) where the computation on any input string has a constant number of branches. We give effective characterizations of ftw-NFAs and a tight worst-case state size bound for determinizing an ftw-NFA A as a function of the tree width and the number of states of A . We also introduce a lower bound technique for ftw-NFAs.

Keywords: finite automata, limited nondeterminism, state complexity

1. Introduction

The descriptonal complexity of finite automata has been studied for over half a century, and there has been particularly much work done over the last two decades. Various ways of quantifying the nondeterminism of finite automata have been considered since the 70's. The ambiguity of a nondeterministic finite automaton (NFA) refers to the number of accepting computations, and other nondeterminism measures count, roughly speaking, the amount of guessing in both accepting and non-accepting computations. General references on descriptonal complexity include the surveys by Goldstine et al. [8], by Holzer and Kutrib [14, 15] and the handbook article by Yu [32].

Schmidt [29] first established an exponential trade-off between the size of unambiguous finite automata and general NFAs, and the bound was later refined in [24, 31]. The relationship between the degree of ambiguity and succinctness of finite automata was considered in [17, 18, 23, 28] and the state complexity of unambiguous finite automata over a unary alphabet has been recently studied in [26].

The branching measure of an NFA is the product of the degrees of nondeterministic choices on the best accepting computation [9] and other related nondeterminism measures have been considered in [21, 22]. The guessing measure [9] counts the minimum (or maximum [18]) number of advice bits used on a computation on a given input. The reader is referred to [8] for more details on the different notions of limited nondeterminism.

¹A preliminary version of this paper was presented at DCFS 2012 and appeared in the conference proceedings [27].