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LOWER BOUND FOR CONVERTING AN NFA WITH FINITE NONDETERMINISM INTO AN MDFA [1]

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ABSTRACT

It is known that a nondeterministic finite automaton (NFA) with n states and branching k can be simulated by a deterministic finite automaton with multiple initial states (MDFA) having $k \cdot n$ states (M. Kappes, *J. Automata, Languages and Combinatorics* 5, 2000). We give a lower bound $\frac{k}{1+\log k} \cdot n$ for the worst case size blow-up of this transformation. We consider also upper and lower bounds for the number of states an MDFA needs to simulate a given NFA of finite tree width.

Keywords: finite automata, limited nondeterminism, deterministic automata with multiple initial states, state complexity

1. Introduction

A deterministic finite automaton with multiple initial states (MDFA) can use only a constant amount of nondeterminism at the beginning of the computation to select the initial state [5, 9, 11]. Other models of nondeterministic finite automata (NFA) employing a finite amount of nondeterminism that have been considered in the literature include the following. A nondeterministic finite automaton (NFA) with finite *branching* [7, 11] is required to have, for each accepted string, a computation with a constant number of nondeterministic choices. The *tree width* of an NFA A (a.k.a. leaf-size, a.k.a. "computations(A)") [1, 10, 15] counts the maximum number of leaves of computation trees of A. Finite branching or finite tree width NFAs can use only a constant amount of nondeterminism, however, the nondeterministic choices need not occur at the start of the computation. For a given input w, the branching measure limits the amount of nondeterminism of the "best" accepting computation on w, that is, the computation that uses the least amount of nondeterminism whereas tree width measures the size of the entire computation tree on w. Other related models of limited nondeterminism have been considered e. g. in [13, 18].

Converting a general NFA to an NFA with finite branching results, in the worst case, in an exponential size blow-up [7] and the exponential size blow-up extends

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