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DESCRIPTIONAL COMPLEXITY OF DETERMINISTIC FINITE AUTOMATA WITH MULTIPLE INITIAL STATES [1]

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ABSTRACT

We study the descriptional complexity of finite automata with multiple initial states and a deterministic transition function. The model is compared to ordinary deterministic and nondeterministic finite automata. It allows to use nondeterminism in practical applications and still provides in some cases exponential savings in the number of states compared to the smallest deterministic finite automaton. Using another acceptance criterion, even exponential savings over nondeterministic finite automata are achievable while the implementation remains easy.

Keywords: Finite automata, nondeterminism.

1. Introduction

It is well known that the description of a regular language by a nondeterministic finite automaton (NFA) can be exponentially more concise than its description by a deterministic finite automaton (DFA) [9]. In this paper, we will study the descriptional complexity of deterministic finite automata with multiple initial states (MDFA). These automata are only allowed to use a limited amount of nondeterminism in a very restricted way, namely only to guess in which initial state to begin. The benefit of this restriction is that an MDFA with k initial states can be implemented by building k DFA identical up to their initial states and summing up their yes/no acceptance results by an OR-gate (see Figure 1). Therefore, this model is interesting from a practical point of view.

2. Definitions

We assume the reader is familiar with the common notions of formal language theory as presented in [6]. A finite automaton (FA) is a quintuple $M = (Q, \Sigma, \delta, Q_0, F)$,

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