NONDETERMINISM VERSUS DETERMINISM OF FINITE AUTOMATA OVER DIRECTED ACYCLIC GRAPHS *

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Abstract

Three types of finite-state graph automata are compared over directed acyclic graphs (where vertices and edges are labelled). The automata are distinguished by the way how states are attached to an input graph ("vertex-marking", "edge-marking", and "1-sphere-marking"). We note the equivalence of these models, relate them to logical definability notions, and show that deterministic versions are strictly weaker (thus correcting an error of [9]).

1 Introduction

The question of an adequate notion of recognizability of graph properties has recently attracted much attention, and many competing approaches have been developed. The starting point in this research is the notion of (nondeterministic or deterministic) finite automaton over words. In a first step towards more general inputs than words, finite tree automata were introduced by Doner [5] and Thatcher and Wright [13]. It was shown that many characterizations of recognizable word languages, namely in terms of regular expressions, recognizability in finite algebras, and definability in monadic second-order logic, are all naturally preserved when passing from words to trees. An important point in this theory is the reduction of nondeterministic tree automata (in the "bottom-up" or "frontier to root" version) to deterministic ones. Some time later, a model of finite automaton over planar directed acyclic graphs was introduced by Kamimura and Slutzki [9]. Whereas tree automata attach states to the vertices of a given input, the automata of [9] generate state labels on the edges of a graph. Continuing this research, Bossut, Dauchet, and Warin [2, 3] characterized nondeterministic automata on planar directed acyclic graphs by a calculus of regular expressions. More recently, Thomas [11, 12] introduced a third and more expressive notion of finite-state acceptor (over arbitrary finite graphs of bounded degree) whose recognition power matches existential monadic second-order logic. In this paper we

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