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TWO-WAY FINITE AUTOMATA WITH A WRITE-ONCE TRACK [1]

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ABSTRACT

The basic finite automata model has been extended over the years with different acceptance modes (nondeterminism, alternation), new or improved devices (two-way heads, pebbles, nested pebbles) and with cooperation. None of these additions permits recognition of non-regular languages. The purpose of this work is to investigate a new kind of automata which is inspired by an extension of 2DPDAs. Mogensen enhanced these with what he called a WORM (write once, read many) track and showed that Cook's linear-time simulation result still holds. Here we trade the pushdown store for nondeterminism or a pebble and show that the languages of these new types of finite automata are still regular. The conjunction of alternation, or of nondeterminism and a pebble permits the recognition of non-regular languages. We give examples of languages that are easy to recognize and of operations that are easy to perform using these WORM tracks under nondeterminism. While somewhat similar to Hennie machines, our models do not require an explicit time bound on their computations.

Keywords: Automata models, WORM tracks, regularity

1. Introduction

Two-way deterministic pushdown automata (2DPDAs) have played an important role in the development of formal language theory [6]. It is a well-known fact [4, 15] that the class of languages recognizable by multihead (or single-head with polynomial padding) 2DPDAs is strongly equal to P in the sense that the polynomial exponent is closely related to the number of heads. By Cook's result [5], a k-head 2DPDA can be simulated on a random-access machine with unit cost in time $O(m^k)$ where m is the length of the input. This has inspired some interesting algorithms such as the Knuth-Morris-Pratt [12] algorithm or a linear-time algorithm for recognizing "PALSTAR" [7].

In [14] the idea of extending 2DPDAs with a special kind of track, called a write-once read-many (WORM) track was introduced. This was done with the hope of increasing their power while retaining their linear-time simulation property. WORM

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