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On the Gap Between Separating Words and Separating Their Reversals

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Abstract

A deterministic finite automaton (DFA) separates two strings w and x if it accepts w and rejects x. The minimum number of states required for a DFA to separate w and x is denoted by $\text{sep}(w, x)$. The present paper shows that the difference $\left|\text{sep}(w, x) - \text{sep}(w^R, x^R)\right|$ is unbounded for a binary alphabet; here w^R stands for the mirror image of w. This solves an open problem stated in [Demaine, Eisenstat, Shallit, Wilson: Remarks on separating words. DCFS 2011. LNCS vol. 6808, pp. 147-157.]

Keywords: Words separation, Finite automata

1. Introduction

In 1986, Goralčík and Koubek [1] introduced the *separating words problem*. Given two distinct strings w and x, we define $\text{sep}(w, x)$ to be the number of states in the smallest deterministic finite automaton (DFA) that accepts w and rejects x [2]. This problem asks for good upper and lower bounds on

$$S(n) := \max_{w \neq x \wedge |w|,|x| \leq n} \text{sep}(w, x).$$

Goralčík and Koubek [1] proved $S(n) = o(n)$. Besides, the best known upper bound so far is $O(n^{2/5} (\log n)^{3/5})$, which was obtained by Robson [3, 4]. A recent paper by Demaine, Eisenstat, Shallit, and Wilson [2] surveys the latest results about this problem, and while proving several new theorems, it also introduces three new open problems, all of which have remained unsolved

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