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DESCRIPTIONAL COMPLEXITY OF CHOP OPERATIONS ON UNARY AND FINITE LANGUAGES

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ABSTRACT

We continue our research on the descriptional complexity of chop operations. Informally, the chop of two words is like their concatenation with the touching letters merged if they are equal, otherwise their chop is undefined. The iterated variants chop-star and chop-plus are defined similar as the classical operations Kleene star and plus. We investigate the state complexity of chop operations on unary and/or finite languages, and obtain similar bounds as for the classical operations. Further, we also show that any chop expression, describing a unary language, can be converted into an equivalent regular expression of linear size, which nicely contrasts the general case.

Keywords: descriptional complexity, state complexity, chop operations, chop expressions, unary languages, finite languages

1. Introduction

An interesting field of descriptional complexity of formal languages is the state complexity of regular languages. Given a regular language L, its state complexity is the minimum number of states that is sufficient and necessary for a finite automaton to accept L. This can be adopted to operations on languages. Given a (regularity preserving) k-nary operation $\circ$ and regular languages $L_1, L_2, \ldots, L_k$, the state complexity of $\circ$ is the minimum number of states that is sufficient and necessary for a finite automaton to accept $\circ(L_1, L_2, \ldots, L_k)$, as a function depending on the state complexities of the input languages. First results on the state complexity of operations on regular languages were obtained about more than three decades ago in [11] and [12]. Later in [15], besides some other operations, the state complexity of concatenation and Kleene star, which are basic operations for describing regular languages, was studied. Also the special case of unary input languages was investigated there, for which significantly different bounds than in the general case were obtained. Similarly, research on these operation problems on finite languages was done in [3]. All these results concentrated on deterministic finite automata, but one can study the same problems on nondeterministic finite automata. Research on the nondeterministic state complexity of concatenation, Kleene star and Kleene plus was undertaken