

ON MINIMAL CONTEXT-FREE INSERTION-DELETION SYSTEMS¹

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ABSTRACT

We investigate the class of context-free insertion-deletion systems. It is known that such systems are universal if the length of the inserted/deleted string is at least three. We show that if this length is bounded to two, then the obtained systems are not universal. We characterise the obtained class and we introduce a new complexity measure for insertion-deletion systems, which permits a better explanation of the obtained results.

Keywords: Formal languages, insertion-deletion systems, decidability

1. Introduction

The operations of insertion and deletion are fundamental in formal language theory, and generative mechanisms based on them have been considered (with linguistic motivation) since a long time ago, see [6] and [2]. Related formal language investigations can be found in several places; we mention only [3], [5], [8], [9]. In the last years, the study of these operations has received a new motivation from molecular computing, see [1], [4], [10], [12].

In general form, an insertion operation means adding a substring to a given string in a specified context, while a deletion operation means removing a substring of a given string from a specified context. A finite set of insertion-deletion rules, together with a set of axioms provide a language generating device (an InsDel system): starting from the set of initial strings and iterating insertion-deletion operations as defined by the given rules we obtain a language. The number of axioms, the length of the inserted or deleted strings, as well as the length of the contexts where these operations take place are natural descriptive complexity measures in this framework. As expected, insertion and deletion operations with context dependence are very powerful, leading to characterizations of recursively enumerable languages. Most of the papers mentioned above contain such results, in many cases improving the complexity of insertion-deletion systems previously available in the literature.

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