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ON THE GENERATIVE POWER OF GRAPH-CONTROLLED INSERTION-DELETION SYSTEMS WITH SMALL SIZES

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ABSTRACT

A graph-controlled insertion-deletion (GCID) system is a regulated extension of an insertion-deletion system. Such a system has several components and each component has some insertion-deletion rules. A rule is applied to a string in a component and the resultant string is moved to the target component specified in the rule. We discuss the generative power of the GCID systems of size $(k; n, i', i''; m, j', j'')$ for all values of $n, m \in \{1, 2\}$ and $i', i'', j', j'' \in \{0, 1\}$, where the parameters in the size denote (from left to right) the maximum number of components, the maximal length of the insertion string, the maximal length of the left context for insertion, the maximal length of the right context for insertion; the last three parameters follow a similar representation with respect to deletion. We prove that GCID systems with sizes $(3; 2, 0, 0; 1, 1, 0)$, $(3; 2, 0, 0; 1, 0, 1)$, $(3; 1, 1, 0; 2, 0, 0)$ and $(3; 1, 0, 1; 2, 0, 0)$ describe the family of recursively enumerable languages (RE). We then show that for all $i', i'', j', j'' \in \{0, 1\}$ with $i' + i'' + j' + j'' \neq 0$, ins-del systems of size $(1; 2, i', i''; 2, j', j'')$ describe RE. Further for GCID systems of certain sizes that are not known to describe RE, we describe the linear languages and as well some closure classes of them.

Keywords: insertion-deletion systems, graph-controlled systems, descriptional complexity measures, computational completeness, metalinear languages

1. Introduction

The action of inserting some strands or deleting some strands do occur often in RNA editing and in DNA processing. In particular, in RNA editing, some fragments of messenger RNA can be either inserted or deleted [2, 3]. Likewise, in the theoretical process of mismatched annealing of DNA sequences, certain segments of the strands