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INSERTION-DELETION WITH SUBSTITUTIONS II: ABOUT THE ROLE OF ONE-SIDED CONTEXT

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ABSTRACT

We discuss substitution as a further type of operation, added to (in particular, one-sided) insertion-deletion systems and investigate the effect of such an addition. Does this operation increase the computational power of a given class of insertion-deletion systems and if so, by what extent does the computational power increase? With the help of substitutions, we obtain new characterizations of the classes of context-sensitive and recursively enumerable languages. We present new normal forms for type-0 grammars that could be of independent interest. Moreover, insertion-deletion-substitution systems can describe new families of languages that contain all regular languages or that are contained in the class of context-free languages.

Keywords: computational completeness, context-sensitive, insertions, deletions, substitutions

1. Introduction

Insertion-deletion systems, or ins-del systems for short, are well established as computational devices and as a research topic within Formal Languages throughout the past decades, starting with the works of Haussler and Kari [4, 5].

Aside from having certain linguistic motivation [3], these systems take inspiration from the field of molecular biology, corresponding to the mismatched annealing of DNA sequences. Informally, the two operations of ins-del systems, the insertion and deletion operations, can insert or remove a substring of a given string, respecting specific contexts. This context-dependency is subject to many studies revolving around ins-del systems. In particular the main research question is: how much context is (in-)sufficient for an ins-del system to reach computational completeness. From the

[(A)] A large part of this work is also contained in the Master Thesis [15] of the first author, written at the University of Trier.

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