Acta Cybernetica **19** (2009) 537–552.

On Pure Multi-Pushdown Automata that Perform Complete Pushdown Pops

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Abstract

This paper introduces and discusses pure multi-pushdown automata that remove symbols from their pushdowns only by performing complete pushdown pops. This means that during a pop operation, the entire pushdown is compared with a prefix of the input, and if they match, the whole contents of the pushdown is erased and the input is advanced by the prefix. The paper proves that these automata define an infinite hierarchy of language families identical with the infinite hierarchy of language families resulting from right linear simple matrix grammars. In addition, this paper discusses some other extensions of these automata with respect to operations they can perform with their pushdowns. More specifically, it discusses pure multi-pushdown automata that perform complete pushdown pops that are allowed to join two pushdowns and/or create a new pushdown.

Keywords: pure multi-pushdown automaton, complete pushdown pop, infinite hierarchy.

1 Introduction

Indisputably, *pushdown automata* fulfill a crucial role in formal language theory. Therefore, it comes as no surprise that this theory has introduced many variants of these automata (consult, for example, [1, 5, 6, 7, 8, 11, 12, 14, 17, 18] for more details).

It is well-known that the family of languages accepted by pushdown automata (with only one pushdown) coincides with the family of context-free languages and that adding any more pushdown makes these automata as powerful as Turing machines. Considering the pushdown alphabet, it is not hard to see that any number of pushdown symbols can be encoded by two different pushdown symbols. However, if the pushdown alphabet is a singleton (more precisely, we have one pushdown symbol A, and a bottom-of-pushdown symbol Z, $Z \neq A$, Z appears only on the bottom of the pushdown), we obtain so-called *counter automata* or *counter machines*. It is known that these automata accept languages from a proper subfamily of the family of context-free languages if they are equipped with only one counter, or the family of recursively enumerable languages if they are equipped

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