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WATSON-CRICK ω-AUTOMATA

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ABSTRACT

Watson-Crick ω-automata are finite automata working with infinite double-stranded words, where the two strands relate to each other through a complementary relation inspired by the DNA complementarity. There are several natural possibilities to define such automata, in particular to define the acceptance condition for such infinite double-stranded words. We present here several results on the equivalence of Büchi, Rabin, Streett, and Muller-like acceptance conditions. We prove that these acceptance conditions are equivalent for nondeterministic Watson-Crick ω-automata. For deterministic automata, we prove that the four conditions are equivalent for non-empty stateless automata, while the general case remains open. We also investigate the relationship between the classes of languages accepted by several types of Watson-Crick ω-automata.

Keywords: Watson-Crick, finite automata, ω-automata, decidability

1. Introduction

Adleman's celebrated experiment [1] on the potential use of biomolecules for computations gave rise and motivation to a large number of studies dealing with DNA computing. Among many others, several models based on Automata Theory and Formal Languages were introduced in this area, see [10]. An important type of automata, inspired by the work on DNA computing is the Watson-Crick finite automata introduced in [4] and then investigated in [6, 8, 9, 12], see also [3] and [5] for surveys. They work on double stranded sequences of letters related by a complementary relation – such a data structure is called a *Watson-Crick tape*. The automata scan separately each of the two strands, in a correlated manner. They may have a finite number of states controlling the moves and they may have an auxiliary memory which is also a Watson-Crick tape, used in a FIFO-like manner. Combining these possibilities, several types of Watson-Crick automata can be obtained, see [10, Chapter 5].

The notion of ω-automata, i. e., automata working on infinite words, was introduced in the sixties by Büchi [2], McNaughton [7], and Rabin [11]. They made some connections between Automata Theory and other fields, such as Logics and set-theoretical Topology; for some surveys see [13, 14, 15].