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Parallel Communicating Watson-Crick Automata Systems

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Abstract

Watson-Crick automata are finite state automata working on double-stranded tapes, introduced to investigate the potential of DNA molecules for computing. In this paper we introduce the concept of parallel communicating Watson-Crick automata systems. It consists of several Watson-Crick finite automata parsing independently the same input and exchanging information on request, by communicating states to each other. We investigate the computational power of these systems and prove that they are more powerful than classical Watson-Crick finite automata, but still accepting at most context-sensitive languages. Moreover, if the complementarity relation is injective, then we obtain that this inclusion is strict. For the general case, we also give some closure properties, as well as a characterization of recursively enumerable languages based on these systems.

1 Introduction

Watson-Crick finite automata, introduced in [5], are a counterpart of finite automata working on double stranded sequences. As suggested by the name, these automata are mainly inspired from molecular computing and are intended as a formalization of DNA manipulation. The two strands of the input are separately scanned from left to right by read only heads controlled by a common state. The characters on the corresponding positions from the two strands are linked by a complementarity relation, inspired from the Watson-Crick complementarity of DNA nucleotides. Several variants of these automata were investigated in [11, 12, 13, 15], see also [14] for a comprehensive presentation.

Distributed computations play a major role in modern computer science; multiprocessor computers, distributed data bases, computer networks, etc., introduced notions such as distribution, parallelism, and communication. The theory of grammar and automata systems was developed as a mathematical model for distributed and parallel computations.

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