

Duality in automata

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Abstract

In the history of automata theory, there have been several attempts to define an idea of an automaton that is “reverse” or “dual” or “complementary” to a given automaton. This presentation describes our generalization of these ideas to form a comprehensive theory of duality which applies to deterministic and nondeterministic automata as well as, to a limited degree, stochastic automata. The theory is in the form of a dualization operator that creates from an automaton its dual automaton. The word “dual” is chosen because, when the operator is applied twice, the resulting system is essentially equivalent to the original system, reduced to a minimum number of states.

We also show that this duality is closely related to previous ideas of the linear dimension of a system, in that the dual automaton has the same linear dimension as the original.

The primary result of this research is a greater understanding of dynamical systems at a deep level, one which enables us to relate many previous results.