

Abstract

We continue the research aimed at formalization of various aspects of the notion of information initiated at our department. The question of usefulness of supplementary information (an advice) is examined for the class of problems represented by regular languages. An advice is considered useful if it helps to solve a given problem easier. A problem and an advice are formalized via regular languages. We take a minimal finite automaton accepting a language formalizing a problem to be a solution of the problem. We take the state complexity for a complexity measure. Our question is formalized via the notion of the decomposability of a finite automaton. A finite automaton A_{prob} is considered decomposable if there exist two smaller finite automata A_{new} and A_{adv} such that $L(A_{prob}) = L(A_{new}) \cap L(A_{adv})$. The automaton A_{new} represents a simpler solution to the given problem utilizing a supplementary information (advice), that an input is accepted by A_{adv} . We define and examine the notion of decomposability for deterministic and nondeterministic finite automata. We also define the notions of deterministic and nondeterministic decomposability of regular languages.

We give the characterization upon deterministic decomposability for the class of unary regular languages. An infinite class of nondeterministically undecomposable unary regular languages is identified. We also define and examine the notion of partial decomposability of a finite automaton and a regular language. In this setting it is sufficient if an advice allows a simpler solution of an original problem only for some subset of all inputs, i.e., $L(A_{new}) \cap L(A_{adv}) = L(A_{prob}) \cap L(A_{adv})$.

Keywords: finite automaton, regular language, unary language, decomposability of regular languages, supplementary information, advice, usefulness of information, descriptive complexity, state complexity