A SURVEY ON OPERATIONAL STATE COMPLEXITY

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ABSTRACT

Descriptional complexity is the study of the conciseness of the various models representing formal languages. The state complexity of a regular language is the size, measured by the number of states of the smallest, either deterministic or nondeterministic, finite automaton that recognises it. Operational state complexity is the study of the state complexity of operations over languages. In this survey, we review the state complexities of individual regularity preserving language operations on regular and some subregular languages. Then we revisit the state complexities of the combination of individual operations. We also review methods of estimation and approximation of state complexity of more complex combined operations.

Keywords: descriptional complexity, automata theory, regular languages, state complexity, operational state complexity

1. Introduction

Automata theory is one of the oldest research areas in computer science. Much research has been done on automata theory since 1950's. Work in many subareas of automata theory is still ongoing these days due to its new applications in areas such as software engineering, programming languages, parallel programming, network security, formal verification and natural language and speech processing [163, 174, 165, 194, 150, 200].

Descriptional complexity and, in particular, state complexity is one of such active subareas. Generally speaking, the study of complexity mainly focuses on the following two kinds of issues: time and space complexity issues, i. e., time and space needed for the execution of the processes; or descriptional complexity issues, i. e., the succinctness of the model representations [202]. In general, having succinct objects will improve our control on software, which may become smaller, more efficient and easier to certify.

State complexity is a type of descriptional complexity based on the finite machine model, and, in the domain of regular languages, it is related to the basic question of