

ON THE NUMBER OF DISTINCT LANGUAGES ACCEPTED BY FINITE AUTOMATA WITH n STATES¹

MICHAEL DOMARATZKI

*School of Computer Science, Queen's University
Kingston, ON K7L 3N6, Canada
e-mail: domaratz@cs.queensu.ca*

DEREK KISMAN

*5760 Buckboard Rd. NW
Calgary, AB T3A 4R6, Canada
e-mail: dkisman@acm.org*

and

JEFFREY SHALLIT²

*School of Computer Science, University of Waterloo
Waterloo, ON N2L 3G1, Canada
e-mail: shallit@uwaterloo.ca*

ABSTRACT

We give asymptotic estimates and some explicit computations for both the number of distinct languages and the number of distinct finite languages over a k -letter alphabet that are accepted by deterministic finite automata (resp. nondeterministic finite automata) with n states.

Keywords: Enumeration, finite automata, minimal automaton, nondeterministic finite automaton

1. Introduction

The problem of enumeration of finite automata according to various criteria (with or without distinguished initial state, initially connected³, strongly connected, non-isomorphic, etc.) was considered as early as 1959, when V. A. Vyssotsky apparently wrote a Bell Laboratories memorandum on this subject [35]. (We have not been able to obtain a copy.) Counting finite automata was problem 19 in Harary's 1960 list

¹Full version of a submission presented at the Third International Workshop on *Descriptive Complexity of Automata, Grammars and Related Structures* (Vienna, Austria, July 20–22, 2001).

²Research supported in part by a grant from NSERC.

³That means, for each state q there exists a directed path from the distinguished start state to q .