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RANDOM GENERATION MODELS FOR NFA'S [1]

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ABSTRACT

The aim of this study is the random generation of non-deterministic automata. We focus our attention on the random generation processed with bitstreams for which we present a probabilistic analysis. Let m be the size of the alphabet. We show that the DFAs obtained by subset construction from n-state NFAs based on equiprobable bitstreams have a probability of being of size $m+2$ that tends to 1 when n tends to infinity. This property gives an asymptotical explanation to van Zijl's experimental results concerning the succinctness of NFAs. We also determine the probability that a state is reachable from an equiprobably chosen DFA state. We show that the distribution of the subsets that appear during the subset construction is an equiprobable one in the case of bitstreams generated with the probability $2-2^{\frac{n-1}{n}}$. This result is related to the conjecture of Leslie, Raymond and Wood, which says that the number of states of the DFA is maximum when the density of the NFA is approximately equal to $2/n$. Finally we extend this probabilistic study to the case of $\star$-NFAs defined by van Zijl.

Keywords: Random generation, non deterministic finite automaton, $\star$-NFA, subset construction

1. Introduction

Random generation of structures allows us to test algorithms' performance and to illustrate theoretical results. A good knowledge of the structures' space that we want to generate is indispensable to design a generation algorithm. Nicaud has studied the equiprobable random generation of deterministic n-state automata [7].

Our aim is to make a similar study concerning the random generation of NFAs. We consider in this paper the random NFA generation method based on random bitstreams. Van Zijl [8] has used this method with equiprobable bitstreams in order to compare the succinctness of various representations of regular languages. We develop a probabilistic analysis of nondeterministic transition tables produced by this method, which highlights some properties of the associated NFAs. We especially focus on the number of states of the DFAs obtained by subset construction.

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