Automata Theory – Homework II (Solutions)

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1 Problems

1. Let L be a regular language not containing λ. Argue that there exists a right-linear grammar for L, whose productions are restricted to the forms:

$$A \rightarrow aB, \text{ and}$$
$$A \rightarrow a$$

where A and B are generic variables and a is a generic terminal.

Solution: In class, we showed that every regular language can be represented as a DFA $M = (Q, \Sigma, \delta, q_0, F)$, where the symbols should be interpreted using the standard convention. Since, L is λ-free, it must be the case that $q_0 \notin F$. We construct the following Right-Linear Grammar $G = (V, T, S, P)$ for L:

(a) We use symbol A_i to denote state q_i. $V = \{A_i : i = 0, 1, \ldots, |Q| - 1\}$.

(b) The set of terminals T is precisely Σ.

(c) $S = A_0$.

(d) The productions P of G are defined as follows: For each transition, $\delta(q_i, a) = q_j$, add the production $A_i \rightarrow a A_j$. If q_j is also a final state, then add the production $A_i \rightarrow a$.

We use induction on the number of transition steps to show that if $\delta(q_0, w) \in F$, then $A_0 \Rightarrow^* w$. Likewise, we use induction on the number of steps in a leftmost derivation to establish that if $A_0 \Rightarrow^* w$, then $\delta(q_0, w) \in F$. (The induction proofs are straightforward exercises). $\square$

2. Consider the language $L = \{a^n : n$ is not a perfect square$\}$. Prove that L is not regular, *by using the Pumping Lemma*. You may not use complement properties of regular languages.

Solution: One way of showing that L is not regular is through the following argument: If L is regular, then so is L^c; however, we showed in class that L^c is not regular and hence L cannot be regular. Since you were expressly forbidden from using the complement properties of regular languages, let us proceed to prove the non-regularity of L, using first principles.

Assume that L is regular and let $M = (Q, \Sigma, \delta, q_0, F)$ denote the unique minimal state DFA for L, where the symbols in the tuple have their usual meaning. Let p denote the number associated by the Pumping Lemma with L; we know that $p = |Q|$. Let $G = \{a^{p^2+i} : i = 1, 2, \ldots, 2p\}$; we can think of the strings in G as being indexed by their length after subtracting the offset p^2. Using w_i to refer to the string a^{p^2+i}, we have that $|w_i| + 1 = |w_{i+1}|$. Let $R = \{\delta(q_0, w_i) : w_i \in G\}$; we use r_i to denote $\delta(q_0, w_i)$, $w_i \in G$.

The following observations are in order:

(i) All the states in R are final states.

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[Introduction to Formal Languages, Automata Theory and Computation](#) Kamala Krithivasan,2009-09 Introduction to Formal Languages Automata Theory and Computation presents the theoretical concepts in a concise and clear manner with an in depth coverage of formal grammar and basic automata types The book also examines the underlying theory and principles of computation and is highly suitable to the undergraduate courses in computer science and information technology An overview of the recent trends in the field and applications are introduced at the appropriate places to stimulate the interest of active learners   **Language and Automata Theory and Applications** Shmuel Tomi Klein,Carlos Martín-Vide,Dana Shapira,2018-04-03 This book constitutes the refereed proceedings of the 12th International Conference on Language and Automata Theory and Applications LATA 2018 held in Ramat Gan Israel in April 2018 The 20 revised full papers presented together with 3 invited papers were carefully reviewed and selected from 58 submissions The papers cover fields like algebraic language theory algorithms for semi structured data mining algorithms on automata and words automata and logic automata for system analysis and programme verification automata networks automatic structures codes combinatorics on words computational complexity concurrency and Petri nets data and image compression descriptional complexity foundations of finite state technology foundations of XML grammars Chomsky hierarchy contextual unification categorial etc grammatical inference and algorithmic learning graphs and graph transformation language varieties and semigroups language based cryptography mathematical and logical foundations of programming methodologies parallel and regulated rewriting parsing patterns power series string processing algorithms symbolic dynamics term rewriting transducers trees tree languages and tree automata and weighted automata   **Solutions to Selected Problems to Accompany Switching and Finite Automata Theory** Zvi Kohavi,1970   [Language and Automata Theory and Applications](#) Alberto Leporati,Carlos Martín-Vide,Dana Shapira,Claudio Zandron,2021-02-22 This book constitutes the proceedings of the 15th International Conference on Language and Automata Theory and Applications LATA 2021 held in Milan Italy in March 2021 The 26 full papers presented in this volume were carefully reviewed and selected from 52 submissions They were organized in topical sections named algebraic structures automata complexity learning logics and languages trees and graphs and words and strings   [Theory of Computation](#) Dexter C. Kozen,2006-05-08 This textbook is uniquely written with dual purpose It cover cores material in the foundations of computing for graduate students in computer science and also provides an introduction to some more advanced topics for those intending further study in the area This innovative text focuses primarily on computational complexity theory the classification of computational problems in terms of their inherent complexity The book contains an invaluable collection of lectures for first year graduates on the theory of computation Topics and features include more than 40 lectures for first year graduate students and a dozen homework sets and exercises   **Integer Programming and Related Areas A Classified Bibliography 1976–1978** D.

Hausmann,2012-12-06   *I.E.E.E. Conference Record of ... Annual Symposium on Switching and Automata Theory* ,1961

   Hawaii International Conference on System Sciences, 23rd IEEE Computer Society Press,1990 This annual meeting held in Kailua Kona Hawaii in January 1990 provides a forum for the interchange of ideas advances and applications among academics and practitioners in the information computing and system sciences and an opportunity to get a winter suntan Papers deal with architecture   **IEEE Conference Record of 1968 Ninth Annual Symposium on Switching and Automata Theory** ,1968   **Fundamentals of Computation Theory** Lothar Budach,1979   Automatic Control and Computer Sciences ,1982   **Finite Orthogonal Series in the Design of Digital Devices** Mark G. Karpovsky,1976

   Cybernetics Abstracts ,1969   **Theory of games, astrophysics, hydrodynamics and meteorology** John Von Neumann,1963   Logic, theory of sets and quantum mechanics John Von Neumann,1961   Digest of Technical Papers ,1984   **Scientific American** ,1900   **Continuous geometry and other topics** John Von Neumann,1961   Computer Literature Bibliography: 1946-1963 W. W. Youden,1965   **CIPS Magazine** Canadian Information Processing Society,1971

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