

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:

$$\begin{aligned} A &\rightarrow \alpha B, \text{ and} \\ A &\rightarrow \alpha \end{aligned}$$

where A and B are generic variables and α 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 . $V = \{A_i : i = 0, 1, \dots, |Q| - 1\}$.
- (b) The set of terminals T is precisely Σ .
- (c) $S = A_{q_0}$.
- (d) The productions P of G are defined as follows: For each transition, $\delta(q_i, \alpha) = q_j$, add the production $A_i \rightarrow \alpha A_j$. If q_j is also a final state, then add the production $A_i \rightarrow \alpha$.

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

2. Consider the language $L = \{a^n : n \text{ is not a perfect square}\}$. 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 $G = \{a^{p^2+i} : i = 1, 2, \dots, 2p\}$; 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.

Automata Theory Homework Ii Solutions

Viktor Kuncak, Andrey Rybalchenko



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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 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

Cellular Learning Automata: Theory and Applications Reza Vafashoar, Hossein Morshedlou, Alireza Rezvanian, Mohammad Reza Meybodi, 2020-07-24 This book highlights both theoretical and applied advances in cellular learning automata CLA a type of hybrid computational model that has been successfully employed in various areas to solve complex problems and to model learn or simulate complicated patterns of behavior Owing to CLA s parallel and learning abilities it has proven to be quite effective in uncertain time varying decentralized and distributed environments The book begins with a brief introduction to various CLA models before focusing on recently developed CLA variants In turn the research areas related to CLA are addressed as bibliometric network analysis perspectives The next part of the book presents CLA based solutions to several computer science problems in e g static optimization dynamic optimization wireless networks mesh networks and cloud computing Given its scope the book is well suited for all researchers in the fields of artificial intelligence and reinforcement learning

Language and Automata Theory and Applications Carlos Martín-Vide, Friedrich Otto, Henning Fernau, 2008-10-08 This book constitutes the refereed proceedings of the Second International Conference on Language and Automata Theory and Applications LATA 2008 held in Tarragona Spain in March 2008 The 40 revised full papers presented were carefully reviewed and selected from 134 submissions The papers deal with the various issues related to automata theory and formal languages

Programming-Based Formal Languages and Automata Theory Marco T. Morazán, 2023-12-18 This textbook introduces formal languages and automata theory for upper level undergraduate or beginning graduate students While it contains the traditional mathematical development usually employed in computational theory courses it is also quite different from many of them Machines grammars and algorithms developed as part of a constructive proof are intended to be rendered as programs The book is divided into four parts that build on each other Part I reviews fundamental concepts It introduces programming in FSM and reviews program design In addition it reviews essential mathematical background on sets relations and reasoning about infinite sets Part II starts the study of formal languages and automata theory in earnest with regular

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Solutions to Selected Problems to Accompany Switching and Finite Automata Theory Zvi Kohavi,1970 *Language and Automata Theory and Applications* Carlos Martín-Vide,Alexander Okhotin,Dana Shapira,2019-03-12 This book constitutes the refereed proceedings of the 13th International Conference on Language and Automata Theory and Applications LATA 2019 held in St Petersburg Russia in March 2019 The 31 revised full papers presented together with 5 invited talks were carefully reviewed and selected from 98 submissions The papers cover the following topics Automata Complexity Grammars Languages Graphs trees and rewriting and Words and codes *Theory of Computation* Dexter C. Kozen,2006-05-08 This textbook is uniquely written with dual purpose It covers core 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

Computer Aided Verification Ahmed Bouajjani,Oded Maler,2009-06-19 This book constitutes the refereed proceedings of the 21st International Conference on Computer Aided Verification CAV 2009 held in Grenoble France in June July 2009 The 36 revised full papers presented together with 16 tool papers and 4 invited talks and 4 invited tutorials were carefully reviewed and selected from 135 regular paper and 34 tool paper submissions The papers are dedicated to the advancement of the theory and practice of computer aided formal analysis methods for hardware and software systems their scope ranges from theoretical results to concrete applications with an emphasis on practical verification tools and the underlying algorithms and techniques

Verification, Model Checking, and Abstract Interpretation Viktor Kuncak,Andrey Rybalchenko,2012-01-21 This book constitutes the refereed proceedings of the 13th International Conference on Verification Model Checking and Abstract Interpretation VMCAI 2012 held in Philadelphia PA

USA in January 2012 co located with the Symposium on Principles of Programming Languages POPL 2012 The 26 revised full papers presented were carefully reviewed and selected from 70 submissions The papers cover a wide range of topics including program verification model checking abstract interpretation static analysis deductive methods program certification debugging techniques abstract domains type systems and optimization Integer Programming and Related Areas A Classified Bibliography 1976-1978 D. Hausmann,2012-12-06 *Constraints in Computational Logics: Theory and Applications* Hubert Comon,Claude Marche,Ralf Treinen,2003-08-06 Constraints provide a declarative way of representing infinite sets of data They are well suited for combining different logical or programming paradigms as has been known for constraint logic programming since the 1980s and more recently for functional programming The use of constraints in automated deduction is more recent and has proved to be very successful moving the control from the meta level to the constraints which are now first class objects This monograph like book presents six thoroughly reviewed and revised lectures given by leading researchers at the summer school organized by the ESPRIT CCL Working Group in Gif sur Yvette France in September 1999 The book offers coherently written chapters on constraints and constraint solving constraint solving on terms combining constraint solving constraints and theorem proving functional and constraint logic programming and building industrial applications **Computer Aided Systems Theory -- EUROCAST 2011** Roberto Moreno-Díaz,Franz Pichler,Alexis Quesada-Arencibia,2012-01-26 The two volume proceedings LNCS 6927 and LNCS 6928 constitute the papers presented at the 13th International Conference on Computer Aided Systems Theory EUROCAST 2011 held in February 2011 in Las Palmas de Gran Canaria Spain The total of 160 papers presented were carefully reviewed and selected for inclusion in the books The contributions are organized in topical sections on concepts and formal tools software applications computation and simulation in modelling biological systems intelligent information processing heuristic problem solving computer aided systems optimization model based system design simulation and verification computer vision and image processing modelling and control of mechatronic systems biomimetic software systems computer based methods for clinical and academic medicine modeling and design of complex digital systems mobile and autonomous transportation systems traffic behaviour modelling and optimization mobile computing platforms and technologies and engineering systems applications *Discrete and Computational Geometry, 2nd Edition* Satyan L. Devadoss,Joseph O'Rourke,2025-07-08 The essential introduction to discrete and computational geometry now fully updated and expanded Discrete and Computational Geometry bridges the theoretical world of discrete geometry with the applications driven realm of computational geometry offering a comprehensive yet accessible introduction to this cutting edge frontier of mathematics and computer science Beginning with polygons and ending with polyhedra it explains how to capture the shape of data given by a set of points from convex hulls and triangulations to Voronoi diagrams geometric duality chains linkages and alpha complexes Connections to real world applications are made throughout and algorithms are presented independent of any programming language Now fully

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STACS 96 Claude Puech,Rüdiger Reischuk,1996-02-14 This book constitutes the refereed proceedings of the 13th Symposium on Theoretical Aspects of Computer Science STACS 96 held in Grenoble France in February 1996 The 52 revised papers presented were selected from a total of 185 submissions also included are three invited papers The volume addresses all current aspects of theoretical computer science and is organized in sections on complexity theory automata theory parallel algorithms learning parallel and distributed systems cryptography logic and database theory algorithms semantics and program verification and communication complexity

Computer Literature Bibliography: 1964-1967 W. Youden,1965 **NBS Special Publication** ,1968

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