

FORMAL LANGUAGES & AUTOMATA THEORY

- **Theory of Automata**

Theory of automata is a theoretical branch of computer science and mathematical. It is the study of abstract machines and the computation problems that can be solved using these machines. The abstract machine is called the automata. The main motivation behind developing the automata theory was to develop methods to describe and analyse the dynamic behaviour of discrete systems.

This automaton consists of states and transitions. The **State** is represented by **circles**, and the **Transitions** is represented by **arrows**.

Automata is the kind of machine which takes some string as input and this input goes through a finite number of states and may enter in the final state.

Formal language

In mathematics, computer science, and linguistics, a formal language is a set of strings of symbols that may be constrained by rules that are specific to it. The alphabet of a formal language is the set of symbols, letters, or tokens from which the strings of the language may be formed; frequently it is required to be finite

A formal language is often defined by means of a formal grammar such as a regular grammar or context-free grammar, also called its formation rule.

Alphabet

- **Definition** – An **alphabet** is any finite set of symbols.
- **Example** – $\Sigma = \{a, b, c, d\}$ is an **alphabet set** where 'a', 'b', 'c', and 'd' are symbols.

String

- **Definition** – A **string** is a finite sequence of symbols taken from Σ .
- **Example** – 'cabcad' is a valid string on the alphabet set $\Sigma = \{a, b, c, d\}$

Length of a String

- **Definition** – It is the number of symbols present in a string. (Denoted by $|S|$).
- **Examples** –
 - If $S = \text{'cabcad'}$, $|S| = 6$
 - If $|S| = 0$, it is called an **empty string** (Denoted by λ or ϵ)

Kleene Star

- **Definition** – The Kleene star, Σ^* , is a unary operator on a set of symbols or strings, Σ , that gives the infinite set of all possible strings of all possible lengths over Σ including λ .
- **Representation** – $\Sigma^* = \Sigma_0 \cup \Sigma_1 \cup \Sigma_2 \cup \dots$, where Σ_p is the set of all possible strings of length p .
- **Example** – If $\Sigma = \{a, b\}$, $\Sigma^* = \{\lambda, a, b, aa, ab, ba, bb, \dots\}$

Formal Languages Automata Theory Notes

Kathleen Armour



Formal Languages Automata Theory Notes:

Formal Languages, Automata and Numeration Systems 2 Michel Rigo, 2014-09-10 The interplay between words computability algebra and arithmetic has now proved its relevance and fruitfulness Indeed the cross fertilization between formal logic and finite automata such as that initiated by J R B chi or between combinatorics on words and number theory has paved the way to recent dramatic developments for example the transcendence results for the real numbers having a simple binary expansion by B Adamczewski and Y Bugeaud This book is at the heart of this interplay through a unified exposition Objects are considered with a perspective that comes both from theoretical computer science and mathematics Theoretical computer science offers here topics such as decision problems and recognizability issues whereas mathematics offers concepts such as discrete dynamical systems The main goal is to give a quick access for students and researchers in mathematics or computer science to actual research topics at the intersection between automata and formal language theory number theory and combinatorics on words The second of two volumes on this subject this book covers regular languages numeration systems formal methods applied to decidability issues about infinite words and sets of numbers

Elements of Automata Theory , Elements of Automata Theory Jacques Sakarovitch, 2009-10-01 Automata theory lies at the foundation of computer science and is vital to a theoretical understanding of how computers work and what constitutes formal methods This treatise gives a rigorous account of the topic and illuminates its real meaning by looking at the subject in a variety of ways The first part of the book is organised around notions of rationality and recognisability The second part deals with relations between words realised by finite automata which not only exemplifies the automata theory but also illustrates the variety of its methods and its fields of application Many exercises are included ranging from those that test the reader to those that are technical results to those that extend ideas presented in the text Solutions or answers to many of these are included in the book

Handbook of Formal Languages Grzegorz Rozenberg, 1997 This uniquely authoritative and comprehensive handbook is the first work to cover the vast field of formal languages as well as their applications to the divergent areas of linguistics developmental biology computer graphics cryptology molecular genetics and programming languages The work has been divided into three volumes

Substitution and Tiling Dynamics: Introduction to Self-inducing Structures Shigeki Akiyama, Pierre Arnoux, 2020-12-05 This book presents a panorama of recent developments in the theory of tilings and related dynamical systems It contains an expanded version of courses given in 2017 at the research school associated with the Jean Morlet chair program Tilings have been designed used and studied for centuries in various contexts This field grew significantly after the discovery of aperiodic self similar tilings in the 60s linked to the proof of the undecidability of the Domino problem and was driven further by Dan Shechtman's discovery of quasicrystals in 1984 Tiling problems establish a bridge between the mutually influential fields of geometry dynamical systems aperiodic order computer science number theory algebra and logic The main properties of tiling dynamical systems

are covered with expositions on recent results in self similarity and its generalizations fusion rules and S adic systems algebraic developments connected to physics games and undecidability questions and the spectrum of substitution tilings

Automata Theory and Logic Martin Hofmann, Martin Lange, 2025-10-29 This book introduces the reader into the field of automata theory and logic It studies fundamental properties like complementation and determinisation of automata on infinite words and trees and presents their applications for logics used in program verification The presentation of such concepts some of which are 50 years old or more is given in a modern style and is accompanied by many exercises The book can be used for self study or as a basis for a graduate course on automata and logic presupposing knowledge on finite automata and regular languages of finite words only

A Guide to the Literature on Semirings and their Applications in Mathematics and Information Sciences K. Glazek, 2013-06-29 This volume presents a short guide to the extensive literature concerning semirings along with a complete bibliography The literature has been created over many years in variety of languages by authors representing different schools of mathematics and working in various related fields In many instances the terminology used is not universal which further compounds the difficulty of locating pertinent sources even in this age of the Internet and electronic dissemination of research results So far there has been no single reference that could guide the interested scholar or student to the relevant publications This book is an attempt to fill this gap My interest in the theory of semirings began in the early sixties when together with Bogdan W glorz I tried to investigate some algebraic aspects of compactifications of topological spaces semirings of semicontinuous functions and the general ideal theory for special semirings Unfortunately local algebraists in Poland told me at that time that there was nothing interesting in investigating semiring theory because ring theory was still being developed However some time later we became aware of some similar investigations having already been done The theory of semirings has remained my first love ever since and I have been interested in the results in this field that have been appearing in literature even though I have not been active in this area myself

Foundations of Software Science and Computation Structures Parosh Aziz Abdulla, Delia Kesner, 2025-04-30 This open access book constitutes the proceedings of the 28th International Conference on Foundations of Software Science and Computation Structures FOSSACS 2025 which took place in Hamilton Canada during May 2025 held as part of the International Joint Conferences on Theory and Practice of Software ETAPS 2025 The 19 papers included in these proceedings were carefully reviewed and selected from 58 submissions They focus on foundational research in software science on theories and methods to support the analysis integration synthesis transformation and verification of programs and software systems

Foundations of Software Science and Computational Structures Helmut Seidl, 2007-07-02 This book constitutes the refereed proceedings of the 10th International Conference on Foundations of Software Science and Computation Structures FOSSACS 2007 held in Braga Portugal in March April 2007 The 25 revised full papers presented together with the abstract of one invited talk cover a broad spectrum on theories and methods to support analysis synthesis

transformation and verification of programs and software systems Rewriting Techniques and Applications Paliath Narendran, Michael Rusinowitch, 2003-07-31 This book constitutes the refereed proceedings of the 10th International Conference on Rewriting Techniques and Applications RTA 99 held in Trento Italy in July 1999 as part of FLoC 99 The 23 revised full papers presented were carefully selected from a total of 53 submissions Also included are four system descriptions as well as three invited contributions Among the topics covered are constraint solving termination deduction and higher order rewriting graphs complexity tree automata context sensitive rewriting string rewriting and numeration systems etc

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