

AUTOMATIC SEQUENCES

Theory, Applications, Generalizations

JEAN-PAUL ALLOUCHE & JEFFREY SHALLIT

AUTOMATIC SEQUENCES

ALLOUCHE
& SHALLIT

Uniting dozens of seemingly disparate results from different fields, this book combines concepts from mathematics and computer science to present the first integrated treatment of sequences generated by "finite automata."

The authors apply the theory to the study of automatic sequences and their generalizations, such as Sierpinski words and k-regular sequences. And further, they provide applications to number theory (particularly to formal power series and transcendence in finite characteristics), physics, computer graphics, and music.

Starting from first principles whenever feasible, basic results from combinatorics on words, numeration systems, and models of computation are discussed. Thus this book is suitable for graduate students or advanced undergraduates, as well as for mature researchers wishing to know more about this fascinating subject.

Jean-Paul Allouche is Directeur de Recherche at CNRS, UJL, Cnrs. He has written some 40 papers in number theory and combinatorics on words. He is on the editorial board of *Advances in Applied Mathematics* and on the scientific committee of the *Journal de Théorie des Nombres de Bordeaux*.

Jeffrey Shallit is Professor of Computer Science at the University of Waterloo. He has written 80 articles on number theory, algorithms, formal languages, combinatorics on words, computer graphics, history of mathematics, algebra and automata theory. He is the editor-in-chief of the *Journal of Integer Sequences* and co-author of *Algorithmic Number Theory*.

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Automatic Sequences Jean-Paul Allouche, Jeffrey Shallit, 2003-07-21 Uniting dozens of seemingly disparate results from different fields this book combines concepts from mathematics and computer science to present the first integrated treatment of sequences generated by finite automata The authors apply the theory to the study of automatic sequences and their generalizations such as Sturmian words and k regular sequences And further they provide applications to number theory particularly to formal power series and transcendence in finite characteristic physics computer graphics and music Starting from first principles wherever feasible basic results from combinatorics on words numeration systems and models of computation are discussed Thus this book is suitable for graduate students or advanced undergraduates as well as for mature researchers wishing to know more about this fascinating subject Results are presented from first principles wherever feasible and the book is supplemented by a collection of 460 exercises 85 open problems and over 1600 citations to the literature

Automatic Sequences Friedrich von Haeseler, 2003 Automatic sequences are sequences which are produced by a finite automaton Although they are not random they may look as being random This text deals with different aspects of automatic sequences including a general introduction and the algebraic approach to automatic sequences *The Logical Approach to Automatic Sequences* Jeffrey Shallit, 2022-09-29 Automatic sequences are sequences over a finite alphabet generated by a finite state machine This book presents a novel viewpoint on automatic sequences and more generally on combinatorics on words by introducing a decision method through which many new results in combinatorics and number theory can be automatically proved or disproved with little or no human intervention This approach to proving theorems is extremely powerful allowing long and error prone case based arguments to be replaced by simple computations Readers will learn how to phrase their desired results in first order logic using free software to automate the computation process Results that normally require multipage proofs can emerge in milliseconds allowing users to engage with mathematical questions that would otherwise be difficult to solve With more than 150 exercises included this text is an ideal resource for researchers graduate students and advanced undergraduates studying combinatorics sequences and number theory Automatic Sequences von Friedrich Haeseler, 2008-08-22 Automatic sequences are sequences which are produced by a finite automaton Although they are not random they may look as being random They are complicated in the sense of not being not ultimately periodic they may look rather complicated in the sense that it may not be easy to name the rule by which the sequence is generated however there exists a rule which generates the sequence The concept automatic sequences has special applications in algebra number theory finite automata and formal languages combinatorics on words The text deals with different aspects of automatic sequences in particular a general introduction to automatic sequences the basic combinatorial properties of automatic sequences the algebraic approach to automatic sequences geometric objects related to automatic sequences **The Logical Approach to Automatic Sequences** Jeffrey Shallit, 2022-09-29 Learn how to automatically

prove mathematical statements in combinatorics sequences and number theory **A Functional Description of the Edvac**
[an Automatically-sequence Serial Binary Electronic Digital Computer] Moore School of Electrical Engineering,1949

Automatic Sequences and Decidable Properties Daniel Goc,2013 In 1912 Axel Thue sparked the study of combinatorics on words when he showed that the Thue Morse sequence contains no overlaps that is factors of the form $ayaya$. Since then many interesting properties of sequences began to be discovered and studied. In this thesis we consider a class of infinite sequences generated by automata called the k automatic sequences. In particular we present a logical theory in which many properties of k automatic sequences can be expressed as predicates and we show that such predicates are decidable. Our main contribution is the implementation of a theorem prover capable of practically characterizing many commonly sought after properties of k automatic sequences. We showcase a panoply of results achieved using our method. We give new explicit descriptions of the recurrence and appearance functions of a list of well known k automatic sequences. We define a related function called the condensation function and give explicit descriptions for it as well. We reaffirm known results on the critical exponent of some sequences and determine it for others where it was previously unknown. On the more theoretical side we show that the subword complexity p_n of k automatic sequences is k synchronized i.e the language of pairs (n, p_n) expressed in base k is accepted by an automaton. Furthermore we prove that the Lyndon factorization of k automatic sequences is also k automatic and explicitly compute the factorization for several sequences. Finally we show that while the number of unbordered factors of length n is not k synchronized it is k regular.

A Manual of Operation for the Automatic Sequence Controlled Calculator Harvard University. Computation Laboratory,1946 [Automatic Sequences and Their Shuffles](#) Tomi Kärki,2006 *Sequences, Groups, and Number Theory* Valérie Berthé, Michel Rigo,2018-04-09 This collaborative book presents recent trends on the study of sequences including combinatorics on words and symbolic dynamics and new interdisciplinary links to group theory and number theory. Other chapters branch out from those areas into subfields of theoretical computer science such as complexity theory and theory of automata. The book is built around four general themes: number theory and sequences, word combinatorics, normal numbers and group theory. Those topics are rounded out by investigations into automatic and regular sequences, tilings and theory of computation, discrete dynamical systems, ergodic theory, numeration systems, automaton semigroups and amenable groups. This volume is intended for use by graduate students or research mathematicians as well as computer scientists who are working in automata theory and formal language theory. With its organization around unified themes it would also be appropriate as a supplemental text for graduate level courses.

A Solution of the Periodicity Problem for Automatic Sequences Friedrich von Haeseler,1997

Language and Automata Theory and Applications Adrian-Horia Dediu, Carlos Martín-Vide, Bianca Truthe,2013-03-15 This book constitutes the refereed proceedings of the 7th International Conference on Language and Automata Theory and Applications LATA 2013 held in Bilbao Spain in April 2013. The 45 revised full papers presented together with 5 invited talks

were carefully reviewed and selected from 97 initial submissions The volume features contributions from both classical theory fields and application areas bioinformatics systems biology language technology artificial intelligence etc Among the topics covered are algebraic language theory algorithms for semi structured data mining algorithms on automata and words automata and logic automata for system analysis and program verification automata concurrency and Petri nets automatic structures cellular automata combinatorics on words computability computational complexity computational linguistics data and image compression decidability questions on words and languages descriptonal complexity DNA and other models of bio inspired computing document engineering foundations of finite state technology foundations of XML fuzzy and rough languages grammars Chomsky hierarchy contextual multidimensional unification categorial etc grammars and automata architectures grammatical inference and algorithmic learning graphs and graph transformation language varieties and semigroups language based cryptography language theoretic foundations of artificial intelligence and artificial life parallel and regulated rewriting parsing pattern recognition patterns and codes power series quantum chemical and optical computing semantics string and combinatorial issues in computational biology and bioinformatics string processing algorithms symbolic dynamics symbolic neural networks term rewriting transducers trees tree languages and tree automata weighted automata

Weil Pump Company V. Chicago Pump Company ,1934 **Linear Cellular Automata and Automatic Sequences** Jean-Paul Allouche,1996 **The Electric Power Club Handbook of Standards** Electric Power Club,1925 Sequences and Their Applications T. Helleseth,P.V. Kumar,2002 Pseudorandom sequences have widespread applications for instance in spread spectrum code division multiple access optical and ultrawide band communication systems as well as in ranging systems global positioning systems circuit testing and stream ciphers Such sequences also have strong ties to error correcting codes This volume contains survey and research papers on sequences and their applications It brings together leading experts from discrete mathematics computer science and communications engineering and helps to bridge advances in these different areas Papers in this volume discuss the theory of sequences and their applications in cryptography coding theory communications systems numerical computation and computer simulation

Power Switchboard and Switching Equipment Handbook Electric Power Club,1925 *Annual Report of the Aetna-Standard Engineering Company, Youngstown, Ohio* Aetna-Standard Engineering Company,1936 *The Colorado School of Mines Magazine* ,1923 **Scientific Canadian Mechanics' Magazine and Patent Office Record** Canada. Patent Office,1910

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