Computability An Introduction To Recursive Functio

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Recursively Enumerable Sets and Degrees Robert I. Soare 1999-11-01 ..."The book, written by one of the main researchers on the field, gives a complete account of the theory of r.e. degrees. .... The definitions, results and proofs are always clearly motivated and explained before the formal presentation; the proofs are described with remarkable clarity and conciseness. The book is highly recommended to everyone interested in logic. It also provides a useful background to computer scientists, in particular to theoretical computer scientists." Acta Scientiarum Mathematicarum, Ungarn 1988 ..."The main purpose of this book is to introduce the reader to the main results and to the intricacies of the current theory for the recurseively enumerable sets and degrees. The author has managed to give a coherent exposition of a rather complex and messy area of logic, and with this book degree-theory is far more accessible to students and logicians in other fields than it used to be." Zentralblatt für Mathematik, 623.1988

Computability, Complexity, and Languages Martin Davis 1994 This introductory text covers the key areas of computer science, including recursive function theory, formal languages, and automata. Additions to the second edition include: extended exercise sets, which vary in difficulty; expanded section on recursion theory; new chapters on program verification and logic programming; updated references and examples throughout.

Computability Theory, Semantics, and Logic Programming Melvin Fitting 1987 This book describes computability theory and provides an extensive treatment of data structures and program correctness. It makes accessible some of the author's work on generalized recursion theory, particularly the material on the logic programming language PROLOG, which is currently of great interest. Fitting considers the relation of PROLOG logic programming to the LISP type of language.

Theories of Computability Nicholas Pippenger 1997-05-28 A mathematically sophisticated introduction to Turing's theory, Boolean functions, automata, and formal languages.

Computability Nigel Cutland 1980-06-19 What can computers do in principle? What are their inherent theoretical limitations? The theoretical framework which

enables such questions to be answered has been developed over the last fifty years from the idea of a computable function – a function whose values can be calculated in an automatic way.

Computable Analysis Klaus Weihrauch 2012-12-06 Merging fundamental concepts of analysis and recursion theory to a new exciting theory, this book provides a solid fundament for studying various aspects of computability and complexity in analysis. It is the result of an introductory course given for several years and is written in a style suitable for graduate-level and senior students in computer science and mathematics. Many examples illustrate the new concepts while numerous exercises of varying difficulty extend the material and stimulate readers to work actively on the text.

Models of Computation Maribel Fernandez 2009-04-14 A Concise Introduction to Computation Models and Computability Theory provides an introduction to the essential concepts in computability, using several models of computation, from the standard Turing Machines and Recursive Functions, to the modern computation models inspired by quantum physics. An in-depth analysis of the basic concepts underlying each model of computation is provided. Divided into two parts, the first highlights the traditional computation models used in the first studies on computability: - Automata and Turing Machines; - Recursive functions and the Lambda-Calculus; - Logic-based computation models. and the second part covers object-oriented and interaction-based models. There is also a chapter on concurrency, and a final chapter on emergent computation models inspired by quantum mechanics. At the end of each chapter there is a discussion on the use of computation models in the design of programming languages.

An Introduction to Mathematical Logic Richard E. Hodel 2013 This comprehensive overview ofmathematical logic is designedprimarily for advanced undergraduatesand graduate studentsof mathematics. The treatmentalso contains much of interest toadvanced students in computerscience and philosophy. Topics include propositional logic;first-order languages and logic; incompleteness, undecidability,and indefinability; recursive functions; computability;and Hilbert's Tenth Problem.Reprint of the PWS Publishing Company, Boston, 1995edition.

Computational Complexity Sanjeev Arora 2009-04-20 New and classical results in computational complexity, including interactive proofs, PCP, derandomization, and quantum computation. Ideal for graduate students.

Computability Theory S. Barry Cooper 2017-09-06 Computability theory originated with the seminal work of Gödel, Church, Turing, Kleene and Post in the 1930s. This theory includes a wide spectrum of topics, such as the theory of reducibilities and their degree structures, computably enumerable sets and their automorphisms, and subrecursive hierarchy classifications. Recent work in computability theory has focused on Turing definability and promises to have far-reaching mathematical, scientific, and philosophical consequences. Written by a leading researcher, Computability Theory provides a concise, comprehensive, and authoritative introduction to contemporary computability theory, techniques, and results. The basic concepts and techniques of computability theory are placed in their historical, philosophical and logical context. This presentation is characterized by an unusual breadth of coverage and the inclusion of advanced topics not to be found elsewhere in the literature at this level. The book includes both the standard material for a first course in computability and more advanced looks at degree structures,

forcing, priority methods, and determinacy. The final chapter explores a variety of computability applications to mathematics and science. Computability Theory is an invaluable text, reference, and guide to the direction of current research in the field. Nowhere else will you find the techniques and results of this beautiful and basic subject brought alive in such an approachable and lively way.

Mathematical Logic J.D. Monk 2012-12-06 From the Introduction: "We shall base our discussion on a set-theoretical foundation like that used in developing analysis, or algebra, or topology. We may consider our task as that of giving a mathematical analysis of the basic concepts of logic and mathematics themselves. Thus we treat mathematical and logical practice as given empirical data and attempt to develop a purely mathematical theory of logic abstracted from these data." There are 31 chapters in 5 parts and approximately 320 exercises marked by difficulty and whether or not they are necessary for further work in the book.

Computability Theory Herbert B. Enderton 2010-12-30 Computability Theory: An Introduction to Recursion Theory provides a concise, comprehensive, and authoritative introduction to contemporary computability theory, techniques, and results. The basic concepts and techniques of computability theory are placed in their historical, philosophical and logical context. This presentation is characterized by an unusual breadth of coverage and the inclusion of advanced topics not to be found elsewhere in the literature at this level. The text includes both the standard material for a first course in computability and more advanced looks at degree structures, forcing, priority methods, and determinacy. The final chapter explores a variety of computability applications to mathematics and science. Computability Theory is an invaluable text, reference, and guide to the direction of current research in the field. Nowhere else will you find the techniques and results of this beautiful and basic subject brought alive in such an approachable way. Frequent historical information presented throughout More extensive motivation for each of the topics than other texts currently available Connects with topics not included in other textbooks, such as complexity theory

Logic, Logic, and Logic George Boolos 1999 George Boolos was one of the most prominent and influential logician-philosophers of recent times. This collection, nearly all chosen by Boolos himself shortly before his death, includes thirty papers on set theory, second-order logic, and plural quantifiers; on Frege, Dedekind, Cantor, and Russell; and on miscellaneous topics in logic and proof theory, including three papers on various aspects of the Gödel theorems. Boolos is universally recognized as the leader in the renewed interest in studies of Frege's work on logic and the philosophy of mathematics. John Burgess has provided introductions to each of the three parts of the volume, and also an afterword on Boolos's technical work in provability logic, which is beyond the scope of this volume.

Computability Nigel J. Cutland 1980

Super-Recursive Algorithms Mark Burgin 2006-12-22 * The first exposition on super-recursive algorithms, systematizing all main classes and providing an accessible, focused examination of the theory and its ramifications * Demonstrates how these algorithms are more appropriate as mathematical models for modern computers and how they present a better framework for computing methods * Develops a new practically-oriented perspective on the theory of

algorithms, computation, and automata, as a whole

Theory of Recursive Functions and Effective Computability Hartley Rogers 1967

Recursive Functions and Metamathematics Roman Murawski 2013-03-14 Recursive Functions and Metamathematics deals with problems of the completeness and decidability of theories, using as its main tool the theory of recursive functions. This theory is first introduced and discussed. Then Gödel's incompleteness theorems are presented, together with generalizations, strengthenings, and the decidability theory. The book also considers the historical and philosophical context of these issues and their philosophical and methodological consequences. Recent results and trends have been included, such as undecidable sentences of mathematical content, reverse mathematics. All the main results are presented in detail. The book is self-contained and presupposes only some knowledge of elementary mathematical logic. There is an extensive bibliography. Readership: Scholars and advanced students of logic, mathematics, philosophy of science.

Computability Theory Rebecca Weber 2012 What can we compute--even with unlimited resources? Is everything within reach? Or are computations necessarily drastically limited, not just in practice, but theoretically? These questions are at the heart of computability theory. The goal of this book is to give the reader a firm grounding in the fundamentals of computability theory and an overview of currently active areas of research, such as reverse mathematics and algorithmic randomness. Turing machines and partial recursive functions are explored in detail, and vital tools and concepts including coding, uniformity, and diagonalization are described explicitly. From there the material continues with universal machines, the halting problem, parametrization and the recursion theorem, and thence to computability for sets, enumerability, and Turing reduction and degrees. A few more advanced topics round out the book before the chapter on areas of research. The text is designed to be self-contained, with an entire chapter of preliminary material including relations, recursion, induction, and logical and set notation and operators. That background, along with ample explanation, examples, exercises, and suggestions for further reading, make this book ideal for independent study or courses with few prerequisites.

Reflexive Structures Luis E. Sanchis 2012-12-06 Reflexive Structures: An Introduction to Computability Theory is concerned with the foundations of the theory of recursive functions. The approach taken presents the fundamental structures in a fairly general setting, but avoiding the introduction of abstract axiomatic domains. Natural numbers and numerical functions are considered exclusively, which results in a concrete theory conceptually organized around Church's thesis. The book develops the important structures in recursive function theory: closure properties, reflexivity, enumeration, and hyperenumeration. Of particular interest is the treatment of recursion, which is considered from two different points of view: via the minimal fixed point theory of continuous transformations, and via the well known stack algorithm. Reflexive Structures is intended as an introduction to the general theory of computability. It can be used as a text or reference in senior undergraduate and first year graduate level classes in computer science or mathematics.

Turing Computability Robert I. Soare 2016-06-20 Turing's famous 1936 paper introduced a formal definition of a computing machine, a Turing machine. This model led to both the development of actual computers and to computability

theory, the study of what machines can and cannot compute. This book presents classical computability theory from Turing and Post to current results and methods, and their use in studying the information content of algebraic structures, models, and their relation to Peano arithmetic. The author presents the subject as an art to be practiced, and an art in the aesthetic sense of inherent beauty which all mathematicians recognize in their subject. Part I gives a thorough development of the foundations of computability, from the definition of Turing machines up to finite injury priority arguments. Key topics include relative computability, and computably enumerable sets, those which can be effectively listed but not necessarily effectively decided, such as the theorems of Peano arithmetic. Part II includes the study of computably open and closed sets of reals and basis and nonbasis theorems for effectively closed sets. Part III covers minimal Turing degrees. Part IV is an introduction to games and their use in proving theorems. Finally, Part V offers a short history of computability theory. The author has honed the content over decades according to feedback from students, lecturers, and researchers around the world. Most chapters include exercises, and the material is carefully structured according to importance and difficulty. The book is suitable for advanced undergraduate and graduate students in computer science and mathematics and researchers engaged with computability and mathematical logic.

Enumerability, Decidability, Computability Hans Hermes 2013-03-14 The task of developing algorithms to solve problems has always been considered by mathematicians to be an especially interesting and im portant one. Normally an algorithm is applicable only to a narrowly limited group of problems. Such is for instance the Euclidean algorithm, which determines the greatest common divisor of two numbers, or the well-known procedure which is used to obtain the square root of a natural number in decimal notation. The more important these special algorithms are, all the more desirable it seems to have algorithms of a greater range of applicability at one's disposal. Throughout the centuries, attempts to provide algorithms applicable as widely as possible were rather unsuc cessful. It was only in the second half of the last century that the first appreciable advance took place. Namely, an important group of the inferences of the logic of predicates was given in the form of a calculus. (Here the Boolean algebra played an essential pioneer role.) One could now perhaps have conjectured that all mathematical problems are solvable by algorithms. However, well-known, yet unsolved problems (problems like the word problem of group theory or Hilbert's tenth problem, which considers the question of solvability of Diophantine equations) were warnings to be careful. Nevertheless, the impulse had been given to search for the essence of algorithms. Leibniz already had inquired into this problem, but without success.

Recursion Theory for Metamathematics Raymond M. Smullyan 1993-01-28 This work is a sequel to the author's Gödel's Incompleteness Theorems, though it can be read independently by anyone familiar with Gödel's incompleteness theorem for Peano arithmetic. The book deals mainly with those aspects of recursion theory that have applications to the metamathematics of incompleteness, undecidability, and related topics. It is both an introduction to the theory and a presentation of new results in the field.

An Introduction to Functional Programming Through Lambda Calculus Greg Michaelson 2013-04-10 Well-respected text for computer science students provides an accessible introduction to functional programming. Cogent examples illuminate the central ideas, and numerous exercises offer reinforcement.

Includes solutions. 1989 edition.

An Early History of Recursive Functions and Computability Rod Adams 2011 Traces the development of recursive functions from their origins in the late nineteenth century to the mid-1930s, with particular emphasis on the work and influence of Kurt Gödel.

Computability and Logic George S. Boolos 2007-09-17 Computability and Logic has become a classic because of its accessibility to students without a mathematical background and because it covers not simply the staple topics of an intermediate logic course, such as Godel's incompleteness theorems, but also a large number of optional topics, from Turing's theory of computability to Ramsey's theorem. This 2007 fifth edition has been thoroughly revised by John Burgess. Including a selection of exercises, adjusted for this edition, at the end of each chapter, it offers a simpler treatment of the representability of recursive functions, a traditional stumbling block for students on the way to the Godel incompleteness theorems. This updated edition is also accompanied by a website as well as an instructor's manual.

Recursion Theory Joseph R. Shoenfield 2018-04-27 This volume, which ten years ago appeared as the first in the acclaimed series Lecture Notes in Logic, serves as an introduction to recursion theory. The fundamental concept of recursion makes the idea of computability accessible to a mathematical analysis, thus forming one of the pillars on which modern computer science rests. The clarity and focus of this text have established it as a classic instrument for teaching and self-study that prepares its readers for the study of advanced monographs and the current literature on recursion theory.

Computability B. Jack Copeland 2013-06-07 Computer scientists, mathematicians, and philosophers discuss the conceptual foundations of the notion of computability as well as recent theoretical developments.

Hilbert's Tenth Problem: An Introduction to Logic, Number Theory, and Computability M. Ram Murty 2019-05-09 Hilbert's tenth problem is one of 23 problems proposed by David Hilbert in 1900 at the International Congress of Mathematicians in Paris. These problems gave focus for the exponential development of mathematical thought over the following century. The tenth problem asked for a general algorithm to determine if a given Diophantine equation has a solution in integers. It was finally resolved in a series of papers written by Julia Robinson, Martin Davis, Hilary Putnam, and finally Yuri Matiyasevich in 1970. They showed that no such algorithm exists. This book is an exposition of this remarkable achievement. Often, the solution to a famous problem involves formidable background. Surprisingly, the solution of Hilbert's tenth problem does not. What is needed is only some elementary number theory and rudimentary logic. In this book, the authors present the complete proof along with the romantic history that goes with it. Along the way, the reader is introduced to Cantor's transfinite numbers, axiomatic set theory, Turing machines, and Gödel's incompleteness theorems. Copious exercises are included at the end of each chapter to guide the student gently on this ascent. For the advanced student, the final chapter highlights recent developments and suggests future directions. The book is suitable for undergraduates and graduate students. It is essentially self-contained.

Proofs and Algorithms Gilles Dowek 2011-01-11 Logic is a branch of philosophy, mathematics and computer science. It studies the required methods to determine

whether a statement is true, such as reasoning and computation. Proofs and Algorithms: Introduction to Logic and Computability is an introduction to the fundamental concepts of contemporary logic – those of a proof, a computable function, a model and a set. It presents a series of results, both positive and negative, – Church's undecidability theorem, Gödel's incompleteness theorem, the theorem asserting the semi-decidability of provability – that have profoundly changed our vision of reasoning, computation, and finally truth itself. Designed for undergraduate students, this book presents all that philosophers, mathematicians and computer scientists should know about logic.

Computability, Enumerability, Unsolvability S. B. Cooper 1996-01-11 The fundamental ideas concerning computation and recursion naturally find their place at the interface between logic and theoretical computer science. The contributions in this book, by leaders in the field, provide a picture of current ideas and methods in the ongoing investigations into the pure mathematical foundations of computability theory. The topics range over computable functions, enumerable sets, degree structures, complexity, subrecursiveness, domains and inductive inference. A number of the articles contain introductory and background material which it is hoped will make this volume an invaluable resource.

Logical Number Theory I Craig Smorynski 2012-12-06 Number theory as studied by the logician is the subject matter of the book. This first volume can stand on its own as a somewhat unorthodox introduction to mathematical logic for undergraduates, dealing with the usual introductory material: recursion theory, first-order logic, completeness, incompleteness, and undecidability. In addition, its second chapter contains the most complete logical discussion of Diophantine Decision Problems available anywhere, taking the reader right up to the frontiers of research (yet remaining accessible to the undergraduate). The first and third chapters also offer greater depth and breadth in logico-arithmetical matters than can be found in existing logic texts. Each chapter contains numerous exercises, historical and other comments aimed at developing the student's perspective on the subject, and a partially annotated bibliography.

An Introduction to Gödel's Theorems Peter Smith 2007-07-26 Peter Smith examines Gödel's Theorems, how they were established and why they matter.

Computability and Unsolvability Martin Davis 2013-04-16 Classic graduate-level introduction to theory of computability. Discusses general theory of computability, computable functions, operations on computable functions, Turing machines self-applied, unsolvable decision problems, applications of general theory, mathematical logic, Kleene hierarchy, more.

Computability Theory Neil D. Jones 2014-06-20 Computability Theory: An Introduction provides information pertinent to the major concepts, constructions, and theorems of the elementary theory of computability of recursive functions. This book provides mathematical evidence for the validity of the Church-Turing thesis. Organized into six chapters, this book begins with an overview of the concept of effective process so that a clear understanding of the effective computability of partial and total functions is obtained. This text then introduces a formal development of the equivalence of Turing machine computability, enumerability, and decidability with other formulations. Other chapters consider the formulas of the predicate calculus, systems of recursion equations, and Post's production systems. This book discusses as well the

fundamental properties of the partial recursive functions and the recursively enumerable sets. The final chapter deals with different formulations of the basic ideas of computability that are equivalent to Turing-computability. This book is a valuable resource for undergraduate or graduate students.

A Recursive Introduction to the Theory of Computation Carl Smith 2012-12-06 The aim of this textbook is to present an account of the theory of computation. After introducing the concept of a model of computation and presenting various examples, the author explores the limitations of effective computation via basic recursion theory. Self-reference and other methods are introduced as fundamental and basic tools for constructing and manipulating algorithms. From there the book considers the complexity of computations and the notion of a complexity measure is introduced. Finally, the book culminates in considering time and space measures and in classifying computable functions as being either feasible or not. The author assumes only a basic familiarity with discrete mathematics and computing, making this textbook ideal for a graduate-level introductory course. It is based on many such courses presented by the author and so numerous exercises are included. In addition, the solutions to most of these exercises are provided.

Computability and Complexity Theory Steven Homer 2011-12-09 This revised and extensively expanded edition of Computability and Complexity Theory comprises essential materials that are core knowledge in the theory of computation. The book is self-contained, with a preliminary chapter describing key mathematical concepts and notations. Subsequent chapters move from the qualitative aspects of classical computability theory to the quantitative aspects of complexity theory. Dedicated chapters on undecidability, NP-completeness, and relative computability focus on the limitations of computability and the distinctions between feasible and intractable. Substantial new content in this edition includes: a chapter on nonuniformity studying Boolean circuits, advice classes and the important result of Karp—Lipton. a chapter studying properties of the fundamental probabilistic complexity classes a study of the alternating Turing machine and uniform circuit classes. an introduction of counting classes, proving the famous results of Valiant and Vazirani and of Toda a thorough treatment of the proof that IP is identical to PSPACE With its accessibility and well-devised organization, this text/reference is an excellent resource and guide for those looking to develop a solid grounding in the theory of computing. Beginning graduates, advanced undergraduates, and professionals involved in theoretical computer science, complexity theory, and computability will find the book an essential and practical learning tool. Topics and features: Concise, focused materials cover the most fundamental concepts and results in the field of modern complexity theory, including the theory of NP-completeness, NP-hardness, the polynomial hierarchy, and complete problems for other complexity classes Contains information that otherwise exists only in research literature and presents it in a unified, simplified manner Provides key mathematical background information, including sections on logic and number theory and algebra Supported by numerous exercises and supplementary problems for reinforcement and self-study purposes

A Programming Approach to Computability A.J. Kfoury 2012-12-06 Computability theory is at the heart of theoretical computer science. Yet, ironically, many of its basic results were discovered by mathematical logicians prior to the development of the first stored-program computer. As a result, many texts on computability theory strike today's computer science students as far removed from their concerns. To remedy this, we base our approach to computability on

the language of while-programs, a lean subset of PASCAL, and postpone consideration of such classic models as Turing machines, string-rewriting systems, and p. -recursive functions till the final chapter. Moreover, we balance the presentation of un solvability results such as the unsolvability of the Halting Problem with a presentation of the positive results of modern programming methodology, including the use of proof rules, and the denotational semantics of programs. Computer science seeks to provide a scientific basis for the study of information processing, the solution of problems by algorithms, and the design and programming of computers. The last 40 years have seen increasing sophistication in the science, in the microelectronics which has made machines of staggering complexity economically feasible, in the advances in programming methodology which allow immense programs to be designed with increasing speed and reduced error, and in the develop ment of mathematical techniques to allow the rigorous specification of program, process, and machine.

Computability Theory Herbert B. Enderton 2011 This textbook is designed to introduce undergraduate mathematics and computer science students to computability theory (recursion theory). It is based on teaching experience, and is designed to be accessible to junior and senior students without a previous background in the subject. Computability Theory: aAn Introduction to Recursion Theory, aprovides a concise, comprehensive, and authoritative introduction to contemporary computability theory, techniques, and results. The basic concepts and techniques of computability theory are placed in their historical, philosophical and logical context. This presentation is characterized by an unusual breadth of coverage and the inclusion of advanced topics not to be found elsewhere in the literature at this level. aThe text includes both the standard material for a first course in computability and more advanced looks at degree structures, forcing, priority methods, and determinacy. The final chapter explores a variety of computability applications to mathematics and science. aComputability Theory is an invaluable text, reference, and guide to the direction of current research in the field. Nowhere else will you find the techniques and results of this beautiful and basic subject brought alive in such an approachable way. Frequent historical information presented throughout More extensive motivation for each of the topics than other texts currently available Connects with topics not included in other textbooks, such as complexity theory a.

Incompleteness and Computability Richard Zach 2017-06-15 A textbook on recursive function theory and G﷿del's incompleteness theorems. Also covers models of arithmetic and second-order logic.

Automata and Computability Dexter C. Kozen 2013-11-11 These are my lecture notes from CS381/481: Automata and Computability Theory, a one-semester senior-level course I have taught at Cornell Uni versity for many years. I took this course myself in thc fall of 1974 as a first-year Ph.D. student at Cornell from Juris Hartmanis and have been in love with the subject ever sin,:e. The course is required for computer science majors at Cornell. It exists in two forms: CS481, an honors version; and CS381, a somewhat gentler paced version. The syllabus is roughly the same, but CS481 go es deeper into thc subject, covers more material, and is taught at a more abstract level. Students are encouraged to start off in one or the other, then switch within the first few weeks if they find the other version more suitaLle to their level of mathematical skill. The purpose of t.hc course is twofold: to introduce computer science students to the rieh heritage of models and abstractions that have arisen over the

years; and to dew!c'p the capacity to form abstractions of their own and reason in terms of them.