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While the development of information technology has been obvious to all, the underpinning computer science has been less apparent. Subrata Dasgupta provides a thought-provoking introduction to the field and its core principles, considering computer science as a science of symbol processing.

This book represents the most comprehensive and up-to-date collection of information on the topic of computational molecular biology. Bringing the most recent research into the forefront of discussion, *Algorithms in Computational Molecular Biology* studies the most important and useful algorithms currently being used in the field, and provides related problems. It also succeeds where other titles have failed, in offering a wide range of information from the introductory fundamentals right up to the latest, most advanced levels of study.

Python Algorithms, Second Edition explains the Python approach to algorithm analysis and design. Written by Magnus Lie Hetland, author of *Beginning Python*, this book is sharply focused on classical algorithms, but it also gives a solid understanding of fundamental algorithmic problem-solving techniques. The book deals with some of the most important and challenging areas of programming and computer science in a highly readable manner. It covers both algorithmic theory and programming practice, demonstrating how theory is reflected in real Python programs. Well-known algorithms and data structures that are built into the Python language are explained, and the user is shown how to implement and evaluate others.

Strengthen your understanding of data structures and their algorithms for the foundation you need to successfully design, implement and maintain virtually any software system. Theoretical, yet practical, *DATA STRUCTURES AND ALGORITHMS IN C++*, 4E by ex-

perienced author Adam Drozdek highlights the fundamental connection between data structures and their algorithms, giving equal weight to the practical implementation of data structures and the theoretical analysis of algorithms and their efficiency. This edition provides critical new coverage of treaps, k-d trees and k-d B-trees, generational garbage collection, and other advanced topics such as sorting methods and a new hashing technique. Abundant C++ code examples and a variety of case studies provide valuable insights into data structures implementation. *DATA STRUCTURES AND ALGORITHMS IN C++* provides the balance of theory and practice to prepare readers for a variety of applications in a modern, object-oriented paradigm. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version.

The guideline focuses specifically on evidence-based pharmacological treatments for AUD in outpatient settings and includes additional information on assessment and treatment planning, which are an integral part of using pharmacotherapy to treat AUD.

Integrating formal property verification (FPV) into an existing design process raises several interesting questions. This book develops the answers to these questions and fits them into a roadmap for formal property verification - a roadmap that shows how to glue FPV technology into the traditional validation flow. The book explores the key issues in this powerful technology through simple examples that mostly require no background on formal methods.

A comprehensive update of the leading algorithms text, with new material on matchings in bipartite graphs, online algorithms, machine learning, and other topics. Some books on algorithms are rigorous but incomplete; others cover masses of material but lack rigor. *Introduction to Algorithms* uniquely combines rigor and comprehensiveness. It covers a broad range of algorithms in depth,

yet makes their design and analysis accessible to all levels of readers, with self-contained chapters and algorithms in pseudocode. Since the publication of the first edition, *Introduction to Algorithms* has become the leading algorithms text in universities worldwide as well as the standard reference for professionals. This fourth edition has been updated throughout. New for the fourth edition: New chapters on matchings in bipartite graphs, online algorithms, and machine learning. New material on topics including solving recurrence equations, hash tables, potential functions, and suffix arrays. 140 new exercises and 22 new problems. Reader feedback-informed improvements to old problems. Clearer, more personal, and gender-neutral writing style. Color added to improve visual presentation. Notes, bibliography, and index updated to reflect developments in the field. Website with new supplementary material. Warning: Avoid counterfeit copies of *Introduction to Algorithms* by buying only from reputable retailers. Counterfeit and pirated copies are incomplete and contain errors.

Algorithms are the lifeblood of computer science. They are the machines that proofs build and the music that programs play. Their history is as old as mathematics itself. This textbook is a wide-ranging, idiosyncratic treatise on the design and analysis of algorithms, covering several fundamental techniques, with an emphasis on intuition and the problem-solving process. The book includes important classical examples, hundreds of battle-tested exercises, far too many historical digressions, and exactly four typos. Jeff Erickson is a computer science professor at the University of Illinois, Urbana-Champaign; this book is based on algorithms classes he has taught there since 1998.

Presented in a tutorial style, this comprehensive treatment unifies, simplifies, and explains most of the techniques for designing and analyzing adaptive control systems. Numerous examples clarify procedures and methods. 1995 edition.

Rapid developments in the field of genetic algorithms along with the popularity of the first edition precipitated this completely revised, thoroughly updated second edition of *The Practical Handbook of Genetic Algorithms*. Like its predecessor, this edition helps practitioners stay up to date on recent developments in the field and provides material

Data Structures & Theory of Computation

This textbook, for second- or third-year students of computer science, presents insights, notations, and analogies to help them describe and think about algorithms like an expert, without grinding through lots of formal proof. Solutions to many problems are provided to let students check their progress, while class-tested PowerPoint slides are on the web for anyone running the course. By looking at both the big picture and easy step-by-step methods for developing algorithms, the author guides students around the common pitfalls. He stresses paradigms such as loop invariants and recursion to unify a huge range of algorithms into a few meta-algorithms. The book fosters a deeper understanding of how and why each algorithm works. These insights are presented in a careful and clear way, helping students to think abstractly and preparing them for creating their own innovative ways to solve problems.

Due to the popularity of knowledge discovery and data mining, in practice as well as among academic and corporate R&D professionals, association rule mining is receiving increasing attention. The authors present the recent progress achieved in mining quantitative association rules, causal rules, exceptional rules, negative association rules, association rules in multi-databases, and association rules in small databases. This book is written for researchers, professionals, and students working in the fields of data mining, data analysis, machine learning, knowledge discovery in databases, and anyone who is interested in association rule mining.

An intuitive, yet precise introduction to probability theory, stochastic processes, statistical inference, and probabilistic models used in science, engineering, economics, and related fields. This is the currently used textbook for an introductory probability course at the Massachusetts Institute of Technology, attended by a large number of undergraduate and graduate students, and for a leading online class on the subject. The book covers the fundamentals of probability theory (probabilistic models, discrete and continuous random variables, multiple random variables, and limit theo-

rems), which are typically part of a first course on the subject. It also contains a number of more advanced topics, including transforms, sums of random variables, a fairly detailed introduction to Bernoulli, Poisson, and Markov processes, Bayesian inference, and an introduction to classical statistics. The book strikes a balance between simplicity in exposition and sophistication in analytical reasoning. Some of the more mathematically rigorous analysis is explained intuitively in the main text, and then developed in detail (at the level of advanced calculus) in the numerous solved theoretical problems.

An extensively revised edition of a mathematically rigorous yet accessible introduction to algorithms.

This open access book presents the first comprehensive overview of general methods in Automated Machine Learning (AutoML), collects descriptions of existing systems based on these methods, and discusses the first series of international challenges of AutoML systems. The recent success of commercial ML applications and the rapid growth of the field has created a high demand for off-the-shelf ML methods that can be used easily and without expert knowledge. However, many of the recent machine learning successes crucially rely on human experts, who manually select appropriate ML architectures (deep learning architectures or more traditional ML workflows) and their hyperparameters. To overcome this problem, the field of AutoML targets a progressive automation of machine learning, based on principles from optimization and machine learning itself. This book serves as a point of entry into this quickly-developing field for researchers and advanced students alike, as well as providing a reference for practitioners aiming to use AutoML in their work.

The first complete overview of evolutionary computing, the collective name for a range of problem-solving techniques based on principles of biological evolution, such as natural selection and genetic inheritance. The text is aimed directly at lecturers and graduate and undergraduate students. It is also meant for those who wish to apply evolutionary computing to a particular problem or within a given application area. The book contains quick-reference information on the current state-of-the-art in a wide range of related topics, so it is of interest not just to evolutionary computing specialists but to researchers working in other fields.

A laboratory study that investigates how algorithms come into existence. Algorithms--often associated with the terms big data, ma-

chine learning, or artificial intelligence--underlie the technologies we use every day, and disputes over the consequences, actual or potential, of new algorithms arise regularly. In this book, Florian Jaton offers a new way to study computerized methods, providing an account of where algorithms come from and how they are constituted, investigating the practical activities by which algorithms are progressively assembled rather than what they may suggest or require once they are assembled.

We live in a highly connected world with multiple self-interested agents interacting and myriad opportunities for conflict and cooperation. The goal of game theory is to understand these opportunities. This book presents a rigorous introduction to the mathematics of game theory without losing sight of the joy of the subject. This is done by focusing on theoretical highlights (e.g., at least six Nobel Prize winning results are developed from scratch) and by presenting exciting connections of game theory to other fields such as computer science (algorithmic game theory), economics (auctions and matching markets), social choice (voting theory), biology (signaling and evolutionary stability), and learning theory. Both classical topics, such as zero-sum games, and modern topics, such as sponsored search auctions, are covered. Along the way, beautiful mathematical tools used in game theory are introduced, including convexity, fixed-point theorems, and probabilistic arguments. The book is appropriate for a first course in game theory at either the undergraduate or graduate level, whether in mathematics, economics, computer science, or statistics. The importance of game-theoretic thinking transcends the academic setting—for every action we take, we must consider not only its direct effects, but also how it influences the incentives of others.

Covering the basic techniques used in the latest research work, the author consolidates progress made so far, including some very recent and promising results, and conveys the beauty and excitement of work in the field. He gives clear, lucid explanations of key results and ideas, with intuitive proofs, and provides critical examples and numerous illustrations to help elucidate the algorithms. Many of the results presented have been simplified and new insights provided. Of interest to theoretical computer scientists, operations researchers, and discrete mathematicians.

"This book does the impossible: it makes math fun and easy!" - Sander Rossel, COAS Software Systems *Grokking Algorithms* is a fully illustrated, friendly guide that teaches you how to apply com-

mon algorithms to the practical problems you face every day as a programmer. You'll start with sorting and searching and, as you build up your skills in thinking algorithmically, you'll tackle more complex concerns such as data compression and artificial intelligence. Each carefully presented example includes helpful diagrams and fully annotated code samples in Python. Learning about algorithms doesn't have to be boring! Get a sneak peek at the fun, illustrated, and friendly examples you'll find in *Grokking Algorithms* on Manning Publications' YouTube channel. Continue your journey into the world of algorithms with *Algorithms in Motion*, a practical, hands-on video course available exclusively at Manning.com (www.manning.com/livevideo/algorithms-?in-motion). Purchase of the print book includes a free eBook in PDF, Kindle, and ePub formats from Manning Publications. About the Technology An algorithm is nothing more than a step-by-step procedure for solving a problem. The algorithms you'll use most often as a programmer have already been discovered, tested, and proven. If you want to understand them but refuse to slog through dense multipage proofs, this is the book for you. This fully illustrated and engaging guide makes it easy to learn how to use the most important algorithms effectively in your own programs. About the Book *Grokking Algorithms* is a friendly take on this core computer science topic. In it, you'll learn how to apply common algorithms to the practical programming problems you face every day. You'll start with tasks like sorting and searching. As you build up your skills, you'll tackle more complex problems like data compression and artificial intelligence. Each carefully presented example includes helpful diagrams and fully annotated code samples in Python. By the end of this book, you will have mastered widely applicable algorithms as well as how and when to use them. What's Inside Covers search, sort, and graph algorithms Over 400 pictures with detailed walkthroughs Performance trade-offs between algorithms Python-based code samples About the Reader This easy-to-read, picture-heavy introduction is suitable for self-taught programmers, engineers, or anyone who wants to brush up on algorithms. About the Author Aditya Bhargava is a Software Engineer with a dual background in Computer Science and Fine Arts. He blogs on programming at adit.io. Table of Contents Introduction to algorithms Selection sort Recursion Quicksort Hash tables Breadth-first search Dijkstra's algorithm Greedy algorithms Dynamic programming K-nearest neighbors

Based on the authors' market leading data structures books in Java and C++, this textbook offers a comprehensive, definitive introduction to data structures in Python by authoritative authors. *Data Structures and Algorithms in Python* is the first authoritative object-oriented book available for the Python data structures course. Designed to provide a comprehensive introduction to data structures and algorithms, including their design, analysis, and implementation, the text will maintain the same general structure as *Data Structures and Algorithms in Java* and *Data Structures and Algorithms in C++*.

Since the beginning of the Internet age and the increased use of ubiquitous computing devices, the large volume and continuous flow of distributed data have imposed new constraints on the design of learning algorithms. Exploring how to extract knowledge structures from evolving and time-changing data, *Knowledge Discovery from Data Streams* presents a coherent overview of state-of-the-art research in learning from data streams. The book covers the fundamentals that are imperative to understanding data streams and describes important applications, such as TCP/IP traffic, GPS data, sensor networks, and customer click streams. It also addresses several challenges of data mining in the future, when stream mining will be at the core of many applications. These challenges involve designing useful and efficient data mining solutions applicable to real-world problems. In the appendix, the author includes examples of publicly available software and online data sets. This practical, up-to-date book focuses on the new requirements of the next generation of data mining. Although the concepts presented in the text are mainly about data streams, they also are valid for different areas of machine learning and data mining.

The latest edition of the essential text and professional reference, with substantial new material on such topics as vEB trees, multithreaded algorithms, dynamic programming, and edge-based flow. Some books on algorithms are rigorous but incomplete; others cover masses of material but lack rigor. *Introduction to Algorithms* uniquely combines rigor and comprehensiveness. The book covers a broad range of algorithms in depth, yet makes their design and analysis accessible to all levels of readers. Each chapter is relatively self-contained and can be used as a unit of study. The algorithms are described in English and in a pseudo-code designed to be readable by anyone who has done a little pro-

gramming. The explanations have been kept elementary without sacrificing depth of coverage or mathematical rigor. The first edition became a widely used text in universities worldwide as well as the standard reference for professionals. The second edition featured new chapters on the role of algorithms, probabilistic analysis and randomized algorithms, and linear programming. The third edition has been revised and updated throughout. It includes two completely new chapters, on van Emde Boas trees and multithreaded algorithms, substantial additions to the chapter on recurrence (now called "Divide-and-Conquer"), and an appendix on matrices. It features improved treatment of dynamic programming and greedy algorithms and a new notion of edge-based flow in the material on flow networks. Many exercises and problems have been added for this edition. The international paperback edition is no longer available; the hardcover is available worldwide.

Focuses on the interplay between algorithm design and the underlying computational models.

Feature engineering is a crucial step in the machine-learning pipeline, yet this topic is rarely examined on its own. With this practical book, you'll learn techniques for extracting and transforming features—the numeric representations of raw data—into formats for machine-learning models. Each chapter guides you through a single data problem, such as how to represent text or image data. Together, these examples illustrate the main principles of feature engineering. Rather than simply teach these principles, authors Alice Zheng and Amanda Casari focus on practical application with exercises throughout the book. The closing chapter brings everything together by tackling a real-world, structured dataset with several feature-engineering techniques. Python packages including numpy, Pandas, Scikit-learn, and Matplotlib are used in code examples. You'll examine: Feature engineering for numeric data: filtering, binning, scaling, log transforms, and power transforms Natural text techniques: bag-of-words, n-grams, and phrase detection Frequency-based filtering and feature scaling for eliminating uninformative features Encoding techniques of categorical variables, including feature hashing and bin-counting Model-based feature engineering with principal component analysis The concept of model stacking, using k-means as a featurization technique Image feature extraction with manual and deep-learning techniques

Wireless localization techniques are an area that has attracted in-

terest from both industry and academia, with self-localization capability providing a highly desirable characteristic of wireless sensor networks. *Localization Algorithms and Strategies for Wireless Sensor Networks* encompasses the significant and fast growing area of wireless localization techniques. This book provides comprehensive and up-to-date coverage of topics and fundamental theories underpinning measurement techniques and localization algorithms. A useful compilation for academicians, researchers, and practitioners, this Premier Reference Source contains relevant references and the latest studies emerging out of the wireless sensor network field.

Despite growing interest, basic information on methods and models for mathematically analyzing algorithms has rarely been directly accessible to practitioners, researchers, or students. An Introduction to the Analysis of Algorithms, Second Edition, organizes and presents that knowledge, fully introducing primary techniques and results in the field. Robert Sedgewick and the late Philippe Flajolet have drawn from both classical mathematics and computer science, integrating discrete mathematics, elementary real analysis, combinatorics, algorithms, and data structures. They emphasize the mathematics needed to support scientific studies that can serve as the basis for predicting algorithm performance and for comparing different algorithms on the basis of performance. Techniques covered in the first half of the book include recurrences, generating functions, asymptotics, and analytic combinatorics. Structures studied in the second half of the book include permutations, trees, strings, tries, and mappings. Numerous examples are included throughout to illustrate applications to the analysis of algorithms that are playing a critical role in the evolution of our modern computational infrastructure. Improvements and additions in this new edition include Upgraded figures and code An all-new chapter introducing analytic combinatorics Simplified derivations via analytic combinatorics throughout The book's thorough, self-contained coverage will help readers appreciate the field's challenges, prepare them for advanced results—covered in their monograph *Analytic Combinatorics* and in Donald Knuth's *The Art of Computer Programming* books—and provide the background they need to keep abreast of new research. "[Sedgewick and Flajolet] are not only worldwide leaders of the field, they also are masters of exposition. I am sure that every serious computer scientist will find this book rewarding in many

ways." —From the Foreword by Donald E. Knuth

This book provides a comprehensive introduction to the latest advances in the mathematical theory and computational tools for modeling high-dimensional data drawn from one or multiple low-dimensional subspaces (or manifolds) and potentially corrupted by noise, gross errors, or outliers. This challenging task requires the development of new algebraic, geometric, statistical, and computational methods for efficient and robust estimation and segmentation of one or multiple subspaces. The book also presents interesting real-world applications of these new methods in image processing, image and video segmentation, face recognition and clustering, and hybrid system identification etc. This book is intended to serve as a textbook for graduate students and beginning researchers in data science, machine learning, computer vision, image and signal processing, and systems theory. It contains ample illustrations, examples, and exercises and is made largely self-contained with three Appendices which survey basic concepts and principles from statistics, optimization, and algebraic-geometry used in this book. René Vidal is a Professor of Biomedical Engineering and Director of the Vision Dynamics and Learning Lab at The Johns Hopkins University. Yi Ma is Executive Dean and Professor at the School of Information Science and Technology at ShanghaiTech University. S. Shankar Sastry is Dean of the College of Engineering, Professor of Electrical Engineering and Computer Science and Professor of Bioengineering at the University of California, Berkeley.

This edition of Robert Sedgewick's popular work provides current and comprehensive coverage of important algorithms for Java programmers. Michael Schidlowsky and Sedgewick have developed new Java implementations that both express the methods in a concise and direct manner and provide programmers with the practical means to test them on real applications. Many new algorithms are presented, and the explanations of each algorithm are much more detailed than in previous editions. A new text design and detailed, innovative figures, with accompanying commentary, greatly enhance the presentation. The third edition retains the successful blend of theory and practice that has made Sedgewick's work an invaluable resource for more than 400,000 programmers! This particular book, Parts 1-4, represents the essential first half of Sedgewick's complete work. It provides extensive coverage of fundamental data structures and algorithms for sorting, searching,

and related applications. Although the substance of the book applies to programming in any language, the implementations by Schidlowsky and Sedgewick also exploit the natural match between Java classes and abstract data type (ADT) implementations. Highlights Java class implementations of more than 100 important practical algorithms Emphasis on ADTs, modular programming, and object-oriented programming Extensive coverage of arrays, linked lists, trees, and other fundamental data structures Thorough treatment of algorithms for sorting, selection, priority queue ADT implementations, and symbol table ADT implementations (search algorithms) Complete implementations for binomial queues, multiway radix sorting, randomized BSTs, splay trees, skip lists, multiway tries, B trees, extendible hashing, and many other advanced methods Quantitative information about the algorithms that gives you a basis for comparing them More than 1,000 exercises and more than 250 detailed figures to help you learn properties of the algorithms Whether you are learning the algorithms for the first time or wish to have up-to-date reference material that incorporates new programming styles with classic and new algorithms, you will find a wealth of useful information in this book.

Computer science and economics have engaged in a lively interaction over the past fifteen years, resulting in the new field of algorithmic game theory. Many problems that are central to modern computer science, ranging from resource allocation in large networks to online advertising, involve interactions between multiple self-interested parties. Economics and game theory offer a host of useful models and definitions to reason about such problems. The flow of ideas also travels in the other direction, and concepts from computer science are increasingly important in economics. This book grew out of the author's Stanford University course on algorithmic game theory, and aims to give students and other newcomers a quick and accessible introduction to many of the most important concepts in the field. The book also includes case studies on online advertising, wireless spectrum auctions, kidney exchange, and network management.

This is the eBook of the printed book and may not include any media, website access codes, or print supplements that may come packaged with the bound book. *Algorithm Design* introduces algorithms by looking at the real-world problems that motivate them. The book teaches students a range of design and analysis tech-

niques for problems that arise in computing applications. The text encourages an understanding of the algorithm design process and an appreciation of the role of algorithms in the broader field of computer science. August 6, 2009 Author, Jon Kleinberg, was recently cited in the New York Times for his statistical analysis research in the Internet age.

This newly expanded and updated second edition of the best-selling classic continues to take the "mystery" out of designing algorithms, and analyzing their efficacy and efficiency. Expanding on the first edition, the book now serves as the primary textbook of choice for algorithm design courses while maintaining its status as the premier practical reference guide to algorithms for programmers, researchers, and students. The reader-friendly Algorithm Design Manual provides straightforward access to combinatorial algorithms technology, stressing design over analysis. The first part, Techniques, provides accessible instruction on methods for designing and analyzing computer algorithms. The second part, Resources, is intended for browsing and reference, and comprises the catalog of algorithmic resources, implementations and an extensive bibliography. NEW to the second edition: • Doubles the tutorial material and exercises over the first edition • Provides full online support for lecturers, and a completely updated and improved website component with lecture slides, audio and video • Contains a unique catalog identifying the 75 algorithmic problems that arise most often in practice, leading the reader down the right path to solve them • Includes several NEW "war stories" relating experiences from real-world applications • Provides up-to-date links leading to the very best algorithm implementations available in C, C++, and Java

This book provides an introduction to the mathematical and algorithmic foundations of data science, including machine learning, high-dimensional geometry, and analysis of large networks. Topics include the counterintuitive nature of data in high dimensions, important linear algebraic techniques such as singular value decomposition, the theory of random walks and Markov chains, the fundamentals of and important algorithms for machine learning, algorithms and analysis for clustering, probabilistic models for large networks, representation learning including topic modelling and non-negative matrix factorization, wavelets and compressed sensing. Important probabilistic techniques are developed including the law of large numbers, tail inequalities, analysis of random

projections, generalization guarantees in machine learning, and moment methods for analysis of phase transitions in large random graphs. Additionally, important structural and complexity measures are discussed such as matrix norms and VC-dimension. This book is suitable for both undergraduate and graduate courses in the design and analysis of algorithms for data.

This book provides a versatile and lucid treatment of classic as well as modern probability theory, while integrating them with core topics in statistical theory and also some key tools in machine learning. It is written in an extremely accessible style, with elaborate motivating discussions and numerous worked out examples and exercises. The book has 20 chapters on a wide range of topics, 423 worked out examples, and 808 exercises. It is unique in its unification of probability and statistics, its coverage and its superb exercise sets, detailed bibliography, and in its substantive treatment of many topics of current importance. This book can be used as a text for a year long graduate course in statistics, computer science, or mathematics, for self-study, and as an invaluable research reference on probability and its applications. Particularly worth mentioning are the treatments of distribution theory, asymptotics, simulation and Markov Chain Monte Carlo, Markov chains and martingales, Gaussian processes, VC theory, probability metrics, large deviations, bootstrap, the EM algorithm, confidence intervals, maximum likelihood and Bayes estimates, exponential families, kernels, and Hilbert spaces, and a self contained complete review of univariate probability.

This text, extensively class-tested over a decade at UC Berkeley and UC San Diego, explains the fundamentals of algorithms in a story line that makes the material enjoyable and easy to digest. Emphasis is placed on understanding the crisp mathematical idea behind each algorithm, in a manner that is intuitive and rigorous without being unduly formal. Features include: The use of boxes to strengthen the narrative: pieces that provide historical context, descriptions of how the algorithms are used in practice, and excursions for the mathematically sophisticated. Carefully chosen advanced topics that can be skipped in a standard one-semester course, but can be covered in an advanced algorithms course or in a more leisurely two-semester sequence. An accessible treatment of linear programming introduces students to one of the greatest achievements in algorithms. An optional chapter on the quantum algorithm for factoring provides a unique peephole into

this exciting topic. In addition to the text, DasGupta also offers a Solutions Manual, which is available on the Online Learning Center. "Algorithms is an outstanding undergraduate text, equally informed by the historical roots and contemporary applications of its subject. Like a captivating novel, it is a joy to read." Tim Roughgarden Stanford University

This easy-to-follow textbook provides a student-friendly introduction to programming and algorithms. Emphasis is placed on the threshold concepts that present barriers to learning, including the questions that students are often too embarrassed to ask. The book promotes an active learning style in which a deeper understanding is gained from evaluating, questioning, and discussing the material, and practised in hands-on exercises. Although R is used as the language of choice for all programs, strict assumptions are avoided in the explanations in order for these to remain applicable to other programming languages. Features: provides exercises at the end of each chapter; includes three mini projects in the final chapter; presents a list of titles for further reading at the end of the book; discusses the key aspects of loops, recursions, program and algorithm efficiency and accuracy, sorting, linear systems of equations, and file processing; requires no prior background knowledge in this area.

Cryptography is now ubiquitous – moving beyond the traditional environments, such as government communications and banking systems, we see cryptographic techniques realized in Web browsers, e-mail programs, cell phones, manufacturing systems, embedded software, smart buildings, cars, and even medical implants. Today's designers need a comprehensive understanding of applied cryptography. After an introduction to cryptography and data security, the authors explain the main techniques in modern cryptography, with chapters addressing stream ciphers, the Data Encryption Standard (DES) and 3DES, the Advanced Encryption Standard (AES), block ciphers, the RSA cryptosystem, public-key cryptosystems based on the discrete logarithm problem, elliptic-curve cryptography (ECC), digital signatures, hash functions, Message Authentication Codes (MACs), and methods for key establishment, including certificates and public-key infrastructure (PKI). Throughout the book, the authors focus on communicating the essentials and keeping the mathematics to a minimum, and they move quickly from explaining the foundations to describing practical implementations, including recent topics such as lightweight ci-

phers for RFIDs and mobile devices, and current key-length recommendations. The authors have considerable experience teaching applied cryptography to engineering and computer science students and to professionals, and they make extensive use of examples, problems, and chapter reviews, while the book's website offers slides, projects and links to further resources. This is a suitable textbook for graduate and advanced undergraduate courses and also for self-study by engineers.

The significantly expanded and updated new edition of a widely used text on reinforcement learning, one of the most active research areas in artificial intelligence. Reinforcement learning, one

of the most active research areas in artificial intelligence, is a computational approach to learning whereby an agent tries to maximize the total amount of reward it receives while interacting with a complex, uncertain environment. In Reinforcement Learning, Richard Sutton and Andrew Barto provide a clear and simple account of the field's key ideas and algorithms. This second edition has been significantly expanded and updated, presenting new topics and updating coverage of other topics. Like the first edition, this second edition focuses on core online learning algorithms, with the more mathematical material set off in shaded boxes. Part I covers as much of reinforcement learning as possible without going beyond the tabular case for which exact solutions can be

found. Many algorithms presented in this part are new to the second edition, including UCB, Expected Sarsa, and Double Learning. Part II extends these ideas to function approximation, with new sections on such topics as artificial neural networks and the Fourier basis, and offers expanded treatment of off-policy learning and policy-gradient methods. Part III has new chapters on reinforcement learning's relationships to psychology and neuroscience, as well as an updated case-studies chapter including AlphaGo and AlphaGo Zero, Atari game playing, and IBM Watson's wagering strategy. The final chapter discusses the future societal impacts of reinforcement learning.