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Prime Numbers A Computational Perspective

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Number theory is known as the queen of math, and prime numbers

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are her beautiful building blocks, which occurs highly irregularly and yet \square predictably \square , as spelt out by one of the most famous math breakthroughs, the PNT (Prime Number Theorem), which gives us an asymptotic estimate to the overall distribution of primes over a large interval!

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The number of digits of the numbers we can factor is about eight times as large as just 30 years ago, and the number of digits of the numbers we can routinely prove prime is about 500 times larger. It is important to observe that computational progress is two-pronged: There is progress in technology, but also progress in algorithm development.

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Prime Numbers: A Computational Perspective (Paperback ... In this volume we have endeavored to provide a middle ground-

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hopefully even a bridge-between "theory" and "experiment" in the matter of prime numbers. Of course, we speak of number theory and computer experiment. There are great books on the abstract properties of prime numbers. Each of us working in the field enjoys his or her favorite classics.

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This book bridges the gap between theoretical and computational aspects of prime numbers. It considers such matters as how to recognize primes, how to compute them, how to count them, and how to test conjectures about them; The book is clearly written and is a pleasure to read. It is largely self-contained.

Prime Numbers: A Computational Perspective / Edition 2 by ...

Prime numbers : a computational perspective. [Richard E Crandall; Carl Pomerance] -- Prime numbers beckon to the beginner, as the basic notion of primality is accessible even to children. Yet, some of the simplest questions about primes have confounded humankind for millennia.

Prime numbers : a computational perspective (eBook, 2005 ...

Prime Numbers: A Computational Perspective Hardcover □ Aug. 4 2005 by Richard Crandall (Author), Carl B. Pomerance (Author)

Prime Numbers: A Computational Perspective: Crandall ...

From the reviews: MATHEMATICAL REVIEWS "There are many books about the theory of prime numbers and a few about computations concerning primes. This book bridges the gap between theoretical and computational aspects of prime numbers. It considers such matters as how to recognize primes, how to compute them, how to count them, and how to test conjectures about them?The book is clearly written and is a pleasure to read.

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Bridges the gap between theoretical and computational aspects of prime numbers Exercise sections are a goldmine of interesting examples, pointers to the literature and potential research projects Authors are well-known and highly-regarded in the field

A description of 148 algorithms fundamental to number-theoretic computations, in particular for computations related to algebraic number theory, elliptic curves, primality testing and factoring. The first seven chapters guide readers to the heart of current research in computational algebraic number theory, including recent algorithms for computing class groups and units, as well as elliptic curve computations, while the last three chapters survey factoring and primality testing methods, including a detailed description of the number field sieve algorithm. The whole is rounded off with a description of available computer packages and some useful tables, backed by numerous exercises. Written by an authority in the field, and one with great practical and teaching experience, this is certain to become the standard and indispensable reference on the subject.

This introductory book emphasises algorithms and applications, such as cryptography and error correcting codes.

An introduction to computational complexity theory, its connections and interactions with mathematics, and its central role in the natural and social sciences, technology, and philosophy Mathematics and Computation provides a broad, conceptual overview of

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computational complexity theory—the mathematical study of efficient computation. With important practical applications to computer science and industry, computational complexity theory has evolved into a highly interdisciplinary field, with strong links to most mathematical areas and to a growing number of scientific endeavors. Avi Wigderson takes a sweeping survey of complexity theory, emphasizing the field's insights and challenges. He explains the ideas and motivations leading to key models, notions, and results. In particular, he looks at algorithms and complexity, computations and proofs, randomness and interaction, quantum and arithmetic computation, and cryptography and learning, all as parts of a cohesive whole with numerous cross-influences. Wigderson illustrates the immense breadth of the field, its beauty and richness, and its diverse and growing interactions with other areas of mathematics. He ends with a comprehensive look at the theory of computation, its methodology and aspirations, and the unique and fundamental ways in which it has shaped and will further shape science, technology, and society. For further reading, an extensive bibliography is provided for all topics covered. Mathematics and Computation is useful for undergraduate and graduate students in mathematics, computer science, and related fields, as well as researchers and teachers in these fields. Many parts require little background, and serve as an invitation to newcomers seeking an introduction to the theory of computation. Comprehensive coverage of computational complexity theory, and beyond High-level, intuitive exposition, which brings conceptual clarity to this central and dynamic scientific discipline Historical accounts of the evolution and motivations of central concepts and models A broad view of the theory of computation's influence on science, technology, and society Extensive bibliography

This book is about the theory and practice of integer factorisation presented in a historic perspective. It describes about twenty algorithms for factoring and a dozen other number theory

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algorithms that support the factoring algorithms. Most algorithms are described both in words and in pseudocode to satisfy both number theorists and computer scientists. Each of the ten chapters begins with a concise summary of its contents. The book starts with a general explanation of why factoring integers is important. The next two chapters present number theory results that are relevant to factoring. Further on there is a chapter discussing, in particular, mechanical and electronic devices for factoring, as well as factoring using quantum physics and DNA molecules. Another chapter applies factoring to breaking certain cryptographic algorithms. Yet another chapter is devoted to practical vs. theoretical aspects of factoring. The book contains more than 100 examples illustrating various algorithms and theorems. It also contains more than 100 interesting exercises to test the reader's understanding. Hints or answers are given for about a third of the exercises. The book concludes with a dozen suggestions of possible new methods for factoring integers. This book is written for readers who want to learn more about the best methods of factoring integers, many reasons for factoring, and some history of this fascinating subject. It can be read by anyone who has taken a first course in number theory.

This is a book about prime numbers, congruences, secret messages, and elliptic curves that you can read cover to cover. It grew out of undergraduate courses that the author taught at Harvard, UC San Diego, and the University of Washington. The systematic study of number theory was initiated around 300B. C. when Euclid proved that there are infinitely many prime numbers, and also cleverly deduced the fundamental theorem of arithmetic, which asserts that every positive integer factors uniquely as a product of primes. Over a thousand years later (around 972A. D.) Arab mathematicians formulated the congruent number problem that asks for a way to decide whether or not a given positive integer n is the area of a right triangle, all three of whose sides are rational numbers. Then another

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thousand years later (in 1976), Diffie and Hellman introduced the first ever public-key cryptosystem, which enabled two people to communicate secretly over a public communications channel with no predetermined secret; this invention and the ones that followed it revolutionized the world of digital communication. In the 1980s and 1990s, elliptic curves revolutionized number theory, providing striking new insights into the congruent number problem, primality testing, public-key cryptography, attacks on public-key systems, and playing a central role in Andrew Wiles's resolution of Fermat's Last Theorem.

This book presents material suitable for an undergraduate course in elementary number theory from a computational perspective. It seeks to not only introduce students to the standard topics in elementary number theory, such as prime factorization and modular arithmetic, but also to develop their ability to formulate and test precise conjectures from experimental data. Each topic is motivated by a question to be answered, followed by some experimental data, and, finally, the statement and proof of a theorem. There are numerous opportunities throughout the chapters and exercises for the students to engage in (guided) open-ended exploration. At the end of a course using this book, the students will understand how mathematics is developed from asking questions to gathering data to formulating and proving theorems. The mathematical prerequisites for this book are few. Early chapters contain topics such as integer divisibility, modular arithmetic, and applications to cryptography, while later chapters contain more specialized topics, such as Diophantine approximation, number theory of dynamical systems, and number theory with polynomials. Students of all levels will be drawn in by the patterns and relationships of number theory uncovered through data driven exploration.

In August 1859 Bernhard Riemann, a little-known 32-year old mathematician, presented a paper to the Berlin Academy titled: "On

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the Number of Prime Numbers Less Than a Given Quantity." In the middle of that paper, Riemann made an incidental remark "a guess, a hypothesis. What he tossed out to the assembled mathematicians that day has proven to be almost cruelly compelling to countless scholars in the ensuing years. Today, after 150 years of careful research and exhaustive study, the question remains. Is the hypothesis true or false? Riemann's basic inquiry, the primary topic of his paper, concerned a straightforward but nevertheless important matter of arithmetic "defining a precise formula to track and identify the occurrence of prime numbers. But it is that incidental remark "the Riemann Hypothesis" that is the truly astonishing legacy of his 1859 paper. Because Riemann was able to see beyond the pattern of the primes to discern traces of something mysterious and mathematically elegant shrouded in the shadows "subtle variations in the distribution of those prime numbers. Brilliant for its clarity, astounding for its potential consequences, the Hypothesis took on enormous importance in mathematics. Indeed, the successful solution to this puzzle would herald a revolution in prime number theory. Proving or disproving it became the greatest challenge of the age. It has become clear that the Riemann Hypothesis, whose resolution seems to hang tantalizingly just beyond our grasp, holds the key to a variety of scientific and mathematical investigations. The making and breaking of modern codes, which depend on the properties of the prime numbers, have roots in the Hypothesis. In a series of extraordinary developments during the 1970s, it emerged that even the physics of the atomic nucleus is connected in ways not yet fully understood to this strange conundrum. Hunting down the solution to the Riemann Hypothesis has become an obsession for many "the veritable "great white whale" of mathematical research. Yet despite determined efforts by generations of mathematicians, the Riemann Hypothesis defies resolution. Alternating passages of extraordinarily lucid mathematical exposition with chapters of elegantly composed biography and history, *Prime Obsession* is a fascinating and fluent

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account of an epic mathematical mystery that continues to challenge and excite the world. Posited a century and a half ago, the Riemann Hypothesis is an intellectual feast for the cognoscenti and the curious alike. Not just a story of numbers and calculations, Prime Obsession is the engrossing tale of a relentless hunt for an elusive proof " and those who have been consumed by it.

This book presents a theory of learning that starts with the assumption that engagement in social practice is the fundamental process by which we get to know what we know and by which we become who we are. The primary unit of analysis of this process is neither the individual nor social institutions, but the informal 'communities of practice' that people form as they pursue shared enterprises over time. To give a social account of learning, the theory explores in a systematic way the intersection of issues of community, social practice, meaning, and identity. The result is a broad framework for thinking about learning as a process of social participation. This ambitious but thoroughly accessible framework has relevance for the practitioner as well as the theoretician, presented with all the breadth, depth, and rigor necessary to address such a complex and yet profoundly human topic.

Bridges the gap between theoretical and computational aspects of prime numbers Exercise sections are a goldmine of interesting examples, pointers to the literature and potential research projects Authors are well-known and highly-regarded in the field

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