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Methods of Solving Number Theory Problems - Ellina Grigorieva
2018-07-06

Through its engaging and unusual problems, this book demonstrates methods of reasoning necessary for learning number theory. Every technique is followed by problems (as well as detailed hints and solutions) that apply theorems immediately, so readers can solve a variety of abstract problems in a systematic, creative manner. New solutions often require the ingenious use of earlier mathematical concepts - not the memorization of formulas and facts. Questions also often permit experimental numeric validation or visual interpretation to encourage the combined use of deductive and intuitive thinking. The first chapter starts with simple topics like even and odd numbers, divisibility, and prime numbers and helps the reader to solve quite complex, Olympiad-type problems right away. It also covers properties of the perfect, amicable, and figurate numbers and introduces congruence. The next chapter begins with the Euclidean algorithm, explores the representations of integer numbers in different bases, and examines continued fractions, quadratic irrationalities, and the Lagrange Theorem.

The last section of Chapter Two is an exploration of different methods of proofs. The third chapter is dedicated to solving Diophantine linear and nonlinear equations and includes different methods of solving Fermat's (Pell's) equations. It also covers Fermat's factorization techniques and methods of solving challenging problems involving exponent and factorials. Chapter Four reviews the Pythagorean triple and quadruple and emphasizes their connection with geometry, trigonometry, algebraic geometry, and stereographic projection. A special case of Waring's problem as a representation of a number by the sum of the squares or cubes of other numbers is covered, as well as quadratic residuals, Legendre and Jacobi symbols, and interesting word problems related to the properties of numbers. Appendices provide a historic overview of number theory and its main developments from the ancient cultures in Greece, Babylon, and Egypt to the modern day. Drawing from cases collected by an accomplished female mathematician, *Methods in Solving Number Theory Problems* is designed as a self-study guide or supplementary textbook for a one-semester course in introductory number theory. It can also be used to prepare for mathematical

Olympiads. Elementary algebra, arithmetic and some calculus knowledge are the only prerequisites. Number theory gives precise proofs and theorems of an irreproachable rigor and sharpens analytical thinking, which makes this book perfect for anyone looking to build their mathematical confidence.

Elementary Number Theory - V.K. Krishnan 2012

Solved and Unsolved Problems in Number Theory - Daniel Shanks
2020-12-29

Much of elementary number theory arose out of the investigation of three problems; that of perfect numbers, that of periodic decimals, and that of Pythagorean numbers. We have accordingly organized the book into three long chapters. The result of such an organization is that motivation is stressed to a rather unusual degree. Theorems arise in response to previously posed problems, and their proof is sometimes delayed until an appropriate analysis can be developed. These theorems, then, or most of them, are "solved problems." Historical discussion is, of course, natural in such a presentation. However, our primary interest is in the theorems, and their logical interrelations, and not in the history per se. The aspect of the historical approach which mainly concerns us is the determination of the problems which suggested the theorems, and the study of which provided the concepts and the techniques which were later used in their proof. In most number theory books residue classes are introduced prior to Fermat's Theorem and the Reciprocity Law. But this is not at all the correct historical order. We have here restored these topics to their historical order, and it seems to us that this restoration presents matters in a more natural light. The "unsolved problems" are the conjectures and the open questions- we distinguish these two categories-and these problems are treated more fully than is usually the case. The conjectures, like the theorems, are introduced at the point at which they arise naturally, are numbered and stated formally. Their significance, their interrelations, and the heuristic evidence supporting them are often discussed. It is well-known that some unsolved problems, such as Fermat's Last Theorem and Riemann's Hypothesis, have been

enormously fruitful in suggesting new mathematical fields, and for this reason alone it is not desirable to dismiss conjectures without an adequate discussion. Further, number theory is very much a live subject, and it seems desirable to emphasize this.

Number Theory - John J. Watkins 2013-12-26

An introductory textbook with a unique historical approach to teaching number theory The natural numbers have been studied for thousands of years, yet most undergraduate textbooks present number theory as a long list of theorems with little mention of how these results were discovered or why they are important. This book emphasizes the historical development of number theory, describing methods, theorems, and proofs in the contexts in which they originated, and providing an accessible introduction to one of the most fascinating subjects in mathematics. Written in an informal style by an award-winning teacher, Number Theory covers prime numbers, Fibonacci numbers, and a host of other essential topics in number theory, while also telling the stories of the great mathematicians behind these developments, including Euclid, Carl Friedrich Gauss, and Sophie Germain. This one-of-a-kind introductory textbook features an extensive set of problems that enable students to actively reinforce and extend their understanding of the material, as well as fully worked solutions for many of these problems. It also includes helpful hints for when students are unsure of how to get started on a given problem. Uses a unique historical approach to teaching number theory Features numerous problems, helpful hints, and fully worked solutions Discusses fun topics like Pythagorean tuning in music, Sudoku puzzles, and arithmetic progressions of primes Includes an introduction to Sage, an easy-to-learn yet powerful open-source mathematics software package Ideal for undergraduate mathematics majors as well as non-math majors Digital solutions manual (available only to professors)

Elementary Number Theory - Underwood Dudley 1978

"With almost a thousand imaginative exercises and problems, this book stimulates curiosity about numbers and their properties."

Steps into Analytic Number Theory - Paul Pollack 2021-02-08

This problem book gathers together 15 problem sets on analytic number theory that can be profitably approached by anyone from advanced high school students to those pursuing graduate studies. It emerged from a 5-week course taught by the first author as part of the 2019 Ross/Asia Mathematics Program held from July 7 to August 9 in Zhenjiang, China. While it is recommended that the reader has a solid background in mathematical problem solving (as from training for mathematical contests), no possession of advanced subject-matter knowledge is assumed. Most of the solutions require nothing more than elementary number theory and a good grasp of calculus. Problems touch at key topics like the value-distribution of arithmetic functions, the distribution of prime numbers, the distribution of squares and nonsquares modulo a prime number, Dirichlet's theorem on primes in arithmetic progressions, and more. This book is suitable for any student with a special interest in developing problem-solving skills in analytic number theory. It will be an invaluable aid to lecturers and students as a supplementary text for introductory Analytic Number Theory courses at both the undergraduate and graduate level.

Number Theory - 1986-05-05

This book is written for the student in mathematics. Its goal is to give a view of the theory of numbers, of the problems with which this theory deals, and of the methods that are used. We have avoided that style which gives a systematic development of the apparatus and have used instead a freer style, in which the problems and the methods of solution are closely interwoven. We start from concrete problems in number theory. General theories arise as tools for solving these problems. As a rule, these theories are developed sufficiently far so that the reader can see for himself their strength and beauty, and so that he learns to apply them. Most of the questions that are examined in this book are connected with the theory of diophantine equations - that is, with the theory of the solutions in integers of equations in several variables. However, we also consider questions of other types; for example, we derive the theorem of Dirichlet on prime numbers in arithmetic progressions and investigate the growth of the number of solutions of

congruences.

Elementary Number Theory - Underwood Dudley 2008-09-25

Minimal prerequisites make this text ideal for a first course in number theory. Written in a lively, engaging style by the author of popular mathematics books, it features nearly 1,000 imaginative exercises and problems. Solutions to many of the problems are included, and a teacher's guide is available. 1978 edition.

Elementary Number Theory - David M. Burton 2002

This text provides a simple account of classical number theory, as well as some of the historical background in which the subject evolved. It is intended for use in a one-semester, undergraduate number theory course taken primarily by mathematics majors and students preparing to be secondary school teachers. Although the text was written with this readership in mind, very few formal prerequisites are required. Much of the text can be read by students with a sound background in high school mathematics.

Number Theory - Titu Andreescu 2009-06-12

This introductory textbook takes a problem-solving approach to number theory, situating each concept within the framework of an example or a problem for solving. Starting with the essentials, the text covers divisibility, unique factorization, modular arithmetic and the Chinese Remainder Theorem, Diophantine equations, binomial coefficients, Fermat and Mersenne primes and other special numbers, and special sequences. Included are sections on mathematical induction and the pigeonhole principle, as well as a discussion of other number systems. By emphasizing examples and applications the authors motivate and engage readers.

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.

Problems in Analytic Number Theory - U.S.R. Murty 2007-12-18

This informative and exhaustive study gives a problem-solving approach to the difficult subject of analytic number theory. It is primarily aimed at graduate students and senior undergraduates. The goal is to provide a rapid introduction to analytic methods and the ways in which they are used to study the distribution of prime numbers. The book also includes an introduction to p -adic analytic methods. It is ideal for a first course in analytic number theory. The new edition has been completely rewritten, errors have been corrected, and there is a new chapter on the arithmetic progression of primes.

104 Number Theory Problems - Titu Andreescu 2007-04-05

This challenging problem book by renowned US Olympiad coaches, mathematics teachers, and researchers develops a multitude of problem-solving skills needed to excel in mathematical contests and in mathematical research in number theory. Offering inspiration and intellectual delight, the problems throughout the book encourage students to express their ideas in writing to explain how they conceive problems, what conjectures they make, and what conclusions they reach. Applying specific techniques and strategies, readers will acquire a solid

understanding of the fundamental concepts and ideas of number theory.

Group Theory in Physics - Michael Aivazis 1991-06-25

This solutions booklet is a supplement to the text book 'Group Theory in Physics' by Wu-Ki Tung. It will be useful to lecturers and students taking the subject as detailed solutions are given.

A Gateway to Number Theory: Applying the Power of Algebraic Curves - Keith Kendig 2021-04-23

Challenge: Can you find all the integers a, b, c satisfying $2a^2+3b^2=5c^2$? Looks simple, and there are in fact a number of easy solutions. But most of them turn out to be anything but obvious! There are infinitely many possibilities, and as any computer will tell you, each of a, b, c will usually be large. So the challenge remains ... Find all integers a, b, c satisfying $2a^2+3b^2=5c^2$ A major advance in number theory means this book can give an easy answer to this and countless similar questions. The idea behind the approach is transforming a degree-two equation in integer variables a, b, c into a plane curve defined by a polynomial. Working with the curve makes obtaining solutions far easier, and the geometric solutions then get translated back into integers. This method morphs hard problems into routine ones and typically requires no more than high school math. (The complete solution to $2a^2+3b^2=5c^2$ is included in the book.) In addition to equations of degree two, the book addresses degree-three equations—a branch of number theory that is today something of a cottage industry, and these problems translate into “elliptic curves”. This important part of the book includes many pictures along with the exposition, making the material meaningful and easy to grasp. This book will fit nicely into an introductory course on number theory. In addition, the many solved examples, illustrations, and exercises make self-studying the book an option for students, thus becoming a natural candidate for a capstone course.

Elementary Number Theory and Its Applications - Kenneth H. Rosen 2005

Elementary Number Theory and Its Applications is noted for its outstanding exercise sets, including basic exercises, exercises designed to help students explore key concepts, and challenging exercises.

Computational exercises and computer projects are also provided. In addition to years of use and professor feedback, the fifth edition of this text has been thoroughly checked to ensure the quality and accuracy of the mathematical content and the exercises. The blending of classical theory with modern applications is a hallmark feature of the text. The Fifth Edition builds on this strength with new examples and exercises, additional applications and increased cryptology coverage. The author devotes a great deal of attention to making this new edition up-to-date, incorporating new results and discoveries in number theory made in the past few years.

A Mathematical Orchard - Mark I. Krusemeyer 2012-10-11

Here is a collection of 208 challenging, original problems, with carefully worked, detailed solutions. In addition to problems from The Wohascum County Problem Book, there are about 80 new problems, many of which involve experimentation and pattern finding. The problems are intended for undergraduates; although some knowledge of linear or abstract algebra is needed for a few of the problems, most require nothing beyond calculus. In fact, many of the problems should be accessible to high school students. On the other hand, some of the problems require considerable mathematical maturity, and most students will find few of the problems routine. Over four-fifths of the book is devoted to presenting instructive, clear, and often elegant solutions. For many problems, multiple solutions are given. Appendices list the prerequisites for individual problems and arrange them by topic. This should be helpful to classes on problem solving and to individuals or teams preparing for contests such as the Putnam. The index can help, as well, in finding problems with a specific theme, or in recovering a half-remembered problem.

Exercises in Number Theory - D.P. Parent 2013-03-09

After an eclipse of some 50 years, Number Theory, that is to say the study of the properties of the integers, has regained in France a vitality worthy of its distinguished past. More and more researchers have been attracted by problems which, though it is possible to express in simple statements, whose solutions require all their ingenuity and talent. In so

doing, their work enriches the whole of mathematics with new and fertile methods. To be in a position to tackle these problems, it is necessary to be familiar with many specific aspects of number theory. These are very different from those encountered in analysis or geometry. The necessary know-how can only be acquired by studying and solving numerous problems. Now it is very easy to formulate problems whose solutions, while sometimes obvious, more often go beyond current methods. Moreover, there is no doubt that, even more than in other disciplines, in mathematics one must have exercises available whose solutions are accessible. This is the objective realised by this work. It is the collaborative work of several successful young number theorists. They have drawn these exercises from their own work, from the work of their associated research groups as well as from published work.

Lectures on Number Theory - Peter Gustav Lejeune Dirichlet 1999
Lectures on Number Theory is the first of its kind on the subject matter. It covers most of the topics that are standard in a modern first course on number theory, but also includes Dirichlet's famous results on class numbers and primes in arithmetic progressions.

Number Theory - George E. Andrews 1994-10-12

Written by a distinguished mathematician and teacher, this undergraduate text uses a combinatorial approach to accommodate both math majors and liberal arts students. In addition to covering the basics of number theory, it offers an outstanding introduction to partitions, plus chapters on multiplicativity-divisibility, quadratic congruences, additivity, and more.

Elements of Number Theory - I. M. Vinogradov 2016-01-14

Clear, detailed exposition that can be understood by readers with no background in advanced mathematics. More than 200 problems and full solutions, plus 100 numerical exercises. 1949 edition.

111 Problems in Algebra and Number Theory - Adrian Andreescu 2016-04

Algebra plays a fundamental role not only in mathematics, but also in various other scientific fields. Without algebra there would be no uniform language to express concepts such as numbers' properties. Thus one

must be well-versed in this domain in order to improve in other mathematical disciplines. We cover algebra as its own branch of mathematics and discuss important techniques that are also applicable in many Olympiad problems. Number theory too relies heavily on algebraic machinery. Often times, the solutions to number theory problems involve several steps. Such a solution typically consists of solving smaller problems originating from a hypothesis and ending with a concrete statement that is directly equivalent to or implies the desired condition. In this book, we introduce a solid foundation in elementary number theory, focusing mainly on the strategies which come up frequently in junior-level Olympiad problems.

1001 Problems in Classical Number Theory - Arnel Mercier 2007

Introduction to Number Theory - Mathew Crawford 2008

Elementary Number Theory with Applications - Thomas Koshy 2002

The advent of modern technology has brought a new dimension to the power of number theory: constant practical use. Once considered the purest of pure mathematics, it is used increasingly now in the rapid development of technology in a number of areas, such as art, coding theory, cryptology, computer science, and other necessities of modern life. Elementary Number Theory with Applications is the fruit of years of dreams and the author's fascination with the subject, encapsulating the beauty, elegance, historical development, and opportunities provided for experimentation and application. This is the only number theory book to show how modular systems can be employed to create beautiful designs, thus linking number theory with both geometry and art. It is also the only number theory book to deal with bar codes, Zip codes, International Standard Book Numbers (ISBN), and European Article Numbers (EAN). Emphasis is on problem-solving strategies (doing experiments, collecting and organizing data, recognizing patterns, and making conjectures). Each section provides a wealth of carefully prepared, well-graded examples and exercises to enhance the readers' understanding and problem-solving skills. This is the only number theory book to: Show how

modular systems can be employed to create beautiful designs, thus linking number theory with both geometry and art Deal with bar codes, Zip codes, International Standard Book Numbers (ISBN), and European Article Numbers (EAN) Emphasize problem-solving strategies (doing experiments, collecting and organizing data, recognizing patterns, and making conjectures) Provide a wealth of carefully prepared, well-graded examples and exercises to enhance the readers' understanding and problem-solving skills

Equations and Inequalities - Jiri Herman 2012-12-06

A look at solving problems in three areas of classical elementary mathematics: equations and systems of equations of various kinds, algebraic inequalities, and elementary number theory, in particular divisibility and diophantine equations. In each topic, brief theoretical discussions are followed by carefully worked out examples of increasing difficulty, and by exercises which range from routine to rather more challenging problems. While it emphasizes some methods that are not usually covered in beginning university courses, the book nevertheless teaches techniques and skills which are useful beyond the specific topics covered here. With approximately 330 examples and 760 exercises.

Unsolved Problems in Number Theory - Richard Guy 2013-06-29

Second edition sold 2241 copies in N.A. and 1600 ROW. New edition contains 50 percent new material.

Introduction to Analytic Number Theory - Tom M. Apostol 2013-06-29

"This book is the first volume of a two-volume textbook for undergraduates and is indeed the crystallization of a course offered by the author at the California Institute of Technology to undergraduates without any previous knowledge of number theory. For this reason, the book starts with the most elementary properties of the natural integers. Nevertheless, the text succeeds in presenting an enormous amount of material in little more than 300 pages."—MATHEMATICAL REVIEWS

Problems in Algebraic Number Theory - M. Ram Murty 2006-03-30

The problems are systematically arranged to reveal the evolution of concepts and ideas of the subject Includes various levels of problems - some are easy and straightforward, while others are more challenging All

problems are elegantly solved

Problems and Solutions in Real Analysis - Masayoshi Hata 2007

This unique book provides a collection of more than 200 mathematical problems and their detailed solutions, which contain very useful tips and skills in real analysis. Each chapter has an introduction, in which some fundamental definitions and propositions are prepared. This also contains many brief historical comments on some significant mathematical results in real analysis together with useful references. *Problems and Solutions in Real Analysis* may be used as advanced exercises by undergraduate students during or after courses in calculus and linear algebra. It is also useful for graduate students who are interested in analytic number theory. Readers will also be able to completely grasp a simple and elementary proof of the prime number theorem through several exercises. The book is also suitable for non-experts who wish to understand mathematical analysis.

Problems and Solutions in Real Analysis - Masayoshi Hata 2016-12-12

This second edition introduces an additional set of new mathematical problems with their detailed solutions in real analysis. It also provides numerous improved solutions to the existing problems from the previous edition, and includes very useful tips and skills for the readers to master successfully. There are three more chapters that expand further on the topics of Bernoulli numbers, differential equations and metric spaces.

Each chapter has a summary of basic points, in which some fundamental definitions and results are prepared. This also contains many brief historical comments for some significant mathematical results in real analysis together with many references. *Problems and Solutions in Real Analysis* can be treated as a collection of advanced exercises by undergraduate students during or after their courses of calculus and linear algebra. It is also instructive for graduate students who are interested in analytic number theory. Readers will also be able to completely grasp a simple and elementary proof of the Prime Number Theorem through several exercises. This volume is also suitable for non-experts who wish to understand mathematical analysis. Request Inspection Copy Contents: Sequences and Limits Infinite

Series Continuous Functions Differentiation Integration Improper Integrals Series of Functions Approximation by Polynomials Convex Functions Various Proof $\zeta(2) = \pi^2/6$ Functions of Several Variables Uniform Distribution Rademacher Functions Legendre Polynomials Chebyshev Polynomials Gamma Function Prime Number Theorem Bernoulli Numbers Metric Spaces Differential Equations Readership: Undergraduates and graduate students in mathematical analysis.

An Introduction to Number Theory - G. Everest 2007-05-21

Includes up-to-date material on recent developments and topics of significant interest, such as elliptic functions and the new primality test. Selects material from both the algebraic and analytic disciplines, presenting several different proofs of a single result to illustrate the differing viewpoints and give good insight.

Unsolved Problems in Number Theory - Richard Guy 2004-07-13

Mathematics is kept alive by the appearance of new, unsolved problems. This book provides a steady supply of easily understood, if not easily solved, problems that can be considered in varying depths by mathematicians at all levels of mathematical maturity. This new edition features lists of references to OEIS, Neal Sloane's Online Encyclopedia of Integer Sequences, at the end of several of the sections.

Problems of Number Theory in Mathematical Competitions - Hong-Bing Yu 2010

Number theory is an important research field of mathematics. In mathematical competitions, problems of elementary number theory occur frequently. These problems use little knowledge and have many variations. They are flexible and diverse. In this book, the author introduces some basic concepts and methods in elementary number theory via problems in mathematical competitions. Readers are encouraged to try to solve the problems by themselves before they read the given solutions of examples. Only in this way can they truly appreciate the tricks of problem-solving.

Excursions in Number Theory - Charles Stanley Ogilvy 1988-01-01
Challenging, accessible mathematical adventures involving prime

numbers, number patterns, irrationals and iterations, calculating prodigies, and more. No special training is needed, just high school mathematics and an inquisitive mind. "A splendidly written, well selected and presented collection. I recommend the book unreservedly to all readers." — Martin Gardner.

Problems and Theorems in Classical Set Theory - Peter Komjath
2006-11-22

This volume contains a variety of problems from classical set theory and represents the first comprehensive collection of such problems. Many of these problems are also related to other fields of mathematics, including algebra, combinatorics, topology and real analysis. Rather than using drill exercises, most problems are challenging and require work, wit, and inspiration. They vary in difficulty, and are organized in such a way that earlier problems help in the solution of later ones. For many of the problems, the authors also trace the history of the problems and then provide proper reference at the end of the solution.

[The Theory of Numbers](#) - Andrew Adler 1995

Problem-Solving and Selected Topics in Number Theory - Michael

Th. Rassias 2010-11-16

The book provides a self-contained introduction to classical Number Theory. All the proofs of the individual theorems and the solutions of the exercises are being presented step by step. Some historical remarks are also presented. The book will be directed to advanced undergraduate, beginning graduate students as well as to students who prepare for mathematical competitions (ex. Mathematical Olympiads and Putnam Mathematical competition).

Introduction to Number Theory - Anthony Vazzana 2007-10-30

One of the oldest branches of mathematics, number theory is a vast field devoted to studying the properties of whole numbers. Offering a flexible format for a one- or two-semester course, Introduction to Number Theory uses worked examples, numerous exercises, and two popular software packages to describe a diverse array of number theory topics.

Problems in Group Theory - John D. Dixon 2007-01-01

265 challenging problems in all phases of group theory, gathered for the most part from papers published since 1950, although some classics are included.