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Get full access to From Mathematics to Generic Programming and 60K+ other titles, with free 10-day trial of O'Reilly. There's also live online events, interactive content, certification prep materials, and more. In this substantive yet accessible book, pioneering software designer Alexander Stepanov and his colleague Daniel Rose illuminate the principles of generic programming and the mathematical concept of abstraction on which it is based, helping you write code that is both simpler and more powerful.If you're a reasonably proficient programmer who can think logically, you have all the background you'll need. Stepanov and Rose introduce the relevant abstract algebra and number theory with exceptional clarity. They carefully explain the problems mathematicians first needed to solve, and then show how these mathematical solutions translate to generic programming and the creation of more effective and elegant code. To demonstrate the crucial role these mathematical principles play in many modern applications, the authors show how to use these results and generalized algorithms to implement a real-world public-key cryptosystem.As you read this book, you'll master the thought processes necessary for effective programming and learn how to generalize narrowly conceived algorithms to widen their usefulness without losing efficiency. You'll also gain deep insight into the value of mathematics to programming—insight that will prove invaluable no matter what programming languages and paradigms you use.You will learn aboutHow to generalize a four thousand-year-old algorithm, demonstrating indispensable lessons about clarity and efficiencyAncient paradoxes, beautiful theorems, and the productive tension between continuous and discreteA simple algorithm for finding greatest common divisor (GCD) and modern abstractions that build on itPowerful mathematical approaches to abstractionHow abstract algebra provides the idea at the heart of generic programmingAxioms, proofs, theories, and models: using mathematical techniques to organize knowledge about your algorithms and data structuresSurprising subtleties of simple programming tasks and what you can learn from themHow practical implementations can exploit theoretical knowledge From Mathematics to Generic Programming (FM2GP) is a 2015 book from Addison-Wesley. In this substantive yet accessible book, pioneering software designer Alexander Stepanov and his colleague Daniel Rose illuminate the principles of generic programming and the mathematical concept of abstraction on which it is based, helping you write code that is both simpler and more powerful. If you're a reasonably proficient programmer who can think logically, you have all the background you'll need. Stepanov and Rose introduce the relevant abstract algebra and number theory with exceptional clarity. They carefully explain the problems mathematicians first needed to solve, and then show how these mathematical solutions translate to generic programming and the creation of more effective and elegant code. To demonstrate the crucial role these mathematical principles play in many modern applications, the authors show how to use these results and generalized algorithms to implement a real-world public-key cryptosystem. As you read this book, you'll master the thought processes necessary for effective programming and learn how to generalize narrowly conceived algorithms to widen their usefulness without losing efficiency. You'll also gain deep insight into the value of mathematics to programming—insight that will prove invaluable no matter what programming languages and paradigms you use. Alexander A. Stepanov studied mathematics at Moscow State University from 1967 to 1972. He has been programming since 1972: first in the Soviet Union and, after emigrating in 1977, in the United States. He has programmed operating systems, programming tools, compilers, and libraries. His work on foundations of programming has been supported by GE, Polytechnic University, Bell Labs, HP, SGI, Adobe, and, since 2009, A9.com, Amazon's search technology subsidiary. In 1995 he received the Dr. Dobb's Journal Excellence in Programming Award for the design of the C++ Standard Template Library. Daniel E. Rose is a research scientist who has held management positions at Apple, AltaVista, Xigo, Yahoo, and A9.com. His research focuses on all aspects of search technology, ranging from low-level algorithms for index compression to human–computer interaction issues in web search. Rose led the team at Apple that created desktop search for the Macintosh. He holds a Ph.D. in cognitive science and computer science from University of California, San Diego, and a B.A. in philosophy from Harvard University. Table of Contents Acknowledgments About the Authors Authors' Note Chapter 1: What This Book Is About 1.1 Programming and Mathematics 1.2 A Historical Perspective 1.3 Prerequisites 1.4 Roadmap 2.1 Egyptian Multiplication 2.2 Improving the Algorithm 2.3 Thoughts on the Chapter 3.1 Geometric Properties of Integers 3.2 Sifting Primes 3.3 Implementing and Optimizing the Code 3.4 Perfect Numbers 3.5 The Pythagorean Program 3.6 A Fatal Flaw in the Program 3.7 Thoughts on the Chapter 4.1 Athens and Alexandria 4.2 Euclid's Greatest Common Measure Algorithm 4.3 A Millennium without Mathematics 4.4 The Strange History of Zero 4.5 Remainder and Quotient Algorithms 4.6 Sharing the Code 4.7 Validating the Algorithm 4.8 Thoughts on the Chapter 5.1 Mersenne Primes and Fermat Primes 5.2 Fermat's Little Theorem 5.3 Cancellation 5.4 Proving Fermat's Little Theorem 5.5 Euler's Theorem 5.6 Applying Modular Arithmetic 5.7 Thoughts on the Chapter 6.1 Groups 6.2 Monoids and Semigroups 6.3 Some Theorems about Groups 6.4 Subgroups and Cyclic Groups 6.5 Lagrange's Theorem 6.6 Theories and Models 6.7 Examples of Categorical and Non-categorical Theories 6.8 Thoughts on the Chapter 7.1 Untangling Algorithm Requirements 7.2 Requirements on A 7.3 Requirements on N 7.4 New Requirements 7.5 Turning Multiply into Power 7.6 Generalizing the Operation 7.7 Computing Fibonacci Numbers 7.8 Thoughts on the Chapter 8.1 Stevin, Polynomials, and GCD 8.2 Göttingen and German Mathematics 8.3 Noether and the Birth of Abstract Algebra 8.4 Rings 8.5 Matrix Multiplication and Semirings 8.6 Application: Social Networks and Shortest Paths 8.7 Euclidean Domains 8.8 Fields and Other Algebraic Structures 8.9 Thoughts on the Chapter 9.1 Proofs 9.2 The First Theorem 9.3 Euclid and the Axiomatic Method 9.4 Alternatives to Euclidean Geometry 9.5 Hilbert's Formalist Approach 9.6 Peano and His Axioms 9.7 Building Arithmetic 9.8 Thoughts on the Chapter 10.1 Aristotle and Abstraction 10.2 Values and Types 10.3 Concepts 10.4 Iterators 10.5 Iterator Categories, Operations, and Traits 10.6 Ranges 10.7 Linear Search 10.8 Binary Search 10.9 Thoughts on the Chapter 11.1 Permutations and Transpositions 11.2 Swapping Ranges 11.3 Rotation 11.4 Using Cycles 11.5 Reverse 11.6 Space Complexity 11.7 Memory-Adaptive Algorithms 11.8 Thoughts on the Chapter 12.1 Hardware Constraints and a More Efficient Algorithm 12.2 Generalizing Stein's Algorithm 12.3 Bézout's Identity 12.4 Extended GCD 12.5 Applications of GCD 12.6 Thoughts on the Chapter 13.1 Cryptology 13.2 Primality Testing 13.3 The Miller-Rabin Test 13.4 The RSA Algorithm: How and Why It Works 13.5 Thoughts on the Chapter B.1 Proof by Contradiction B.2 Proof by Induction B.3 The Pigeonhole Principle C.1 Template Functions C.2 Concepts C.3 Declaration Syntax and Typed Constants C.4 Function Objects C.5 Preconditions, Postconditions, and Assertions C.6 STL Algorithms and Data Structures C.7 Iterators and Ranges C.8 Type Aliases and Type Functions with using in C++11 C.9 Initializer Lists in C++11 C.10 Lambda Functions in C++11 C.11 A Note about inline The following are interviews with the authors, discussing issues related to the book as well as other topics related to their work and interests. Showing 1-30 Start your review of From Mathematics to Generic Programming Oct 09, 2016 Jake rated it it was amazing "As long as algebra and geometry have been separated, their progress have been slow and their uses limited, but when these two sciences have been united, they have lent each mutual forces, and have marched together towards perfection." ~ Joseph Louis LagrangeWhat does geometry, abstract algebra, number theory and generic programming have in common? This book attempts to answer that by starting at the early stages of organized mathematics and going all the way forward to the 1960's. The way I tho "As long as algebra and geometry have been separated, their progress have been slow and their uses limited, but when these two sciences have been united, they have lent each mutual forces, and have marched together towards perfection." ~ Joseph Louis LagrangeWhat does geometry, abstract algebra, number theory and generic programming have in common? This book attempts to answer that by starting at the early stages of organized mathematics and going all the way forward to the 1960's. The way I thought about Stepanov's approach is that he attempts to generalize algorithms and shows how algorithms in many respects can be used as axioms. In other words, generalization is not just merely a time saver, but more crucially is a way to ensure rigorousness. "Mathematics is a game played according to certain simple rules with meaningless marks on paper." ~ David HilbertIn many ways this book is just Stepanov removing the paper. The fact that he uses C++ code is irrelevant. I used Python and Java, without having used C++ in years and it was sufficiently trivial that I could follow along. The Euclidean algorithm(greatest common denominator) is the main tool of Stepanov of this book, may be used too much. Algorithms have existed, as he says for as long as we've been doing math. The fact that computers use them is historically new, not the norm. Turns out that mathematicians have developed great methods for analyzing such algorithms and the Euclidean algorithm is used exhaustively in a variety of ways to illustrate both the axiomatic nature of algorithm reuse but also how we might do analysis on such algorithms.If you've read my review for Dijkstra's A Discipline of Programming you might remember the line I said: "abstraction is not a nebulous idea, but how we're absolutely precise." That's what that Stepanov, like Dijkstra is trying to get across here. Just because we are reorienting our thinking does not mean we lose rigorousness, in fact it's how we ensure it. I'm taking a lot of Calculus in my undergrad so an algorithm I use daily is the Hessian Criterion or second derivative test, I followed along with Stepanov's writing by implementing that algorithm in SymPy then analyzing it. This is what I recommend you do with this book, don't simply copy his examples and expect to get some kind of understanding through wrought memorization but explore what he's talking about with your own work. It's much more rewarding and more in line with what I think the author was trying to get across by including the examples to begin with."Pursue what you're interested in, keep working hard, pay attention to what's going on around you and be flexible-these are the rules. Sometimes it works, sometimes it doesn't." ~ Nathan Seiberg ...more Feb 12, 2015 Michael rated it liked it · review of another edition Depends on what you expectI was very enthusiastic about this book when it was first announced. My expectation was that author will give some introduction to mathematical constructs related to program composition that comes from category theory and functional programming, like monads, applicatives, traversables and so on. Instead I found all familiar view on algebra, things ike groups, rings, some number theory and cryptography. However despite my own dissatisfaction I can't avoid mentioning that Depends on what you expectI was very enthusiastic about this book when it was first announced. My expectation was that author will give some introduction to mathematical constructs related to program composition that comes from category theory and functional programming, like monads, applicatives, traversables and so on. Instead I found all familiar view on algebra, things ike groups, rings, some number theory and cryptography. However despite my own dissatisfaction I can't avoid mentioning that book is exceptionally well written. Through historical view on mathematics development author achieved very whole and capturing story. I spent some fun good time reading it.Bottom line: read it if you want to get familiar with abstract algebra and number theory. Or if you want some good time reading about history of mathematics. ...more Jan 03, 2021 Filippo Pacifici rated it liked it This book outlines the mathematical foundations of abstract algorithms very well. The path from abstract algebra to abstract algorithms is outlines quite well.What I think was not so compelling is the amount of time spent on the details of numbers theory which I don't think helps the narrative a lot. I feel going deeper in the foundation of types and their connection to generic programming (like touching on category theory) could have been more informative than going so deep in the numbers theor This book outlines the mathematical foundations of abstract algorithms very well. The path from abstract algebra to abstract algorithms is outlines quite well.What I think was not so compelling is the amount of time spent on the details of numbers theory which I don't think helps the narrative a lot. I feel going deeper in the foundation of types and their connection to generic programming (like touching on category theory) could have been more informative than going so deep in the numbers theory aspect of so many examples.I may just not represent the intended audience for this book. ...more For those of us who need a refresher-- and a bit more.Computer programming is a wholly mathematical pursuit. Although many computer science departments are housed in engineering, the heart and soul is abstract mathematics. This book reminds us that a computer only does what it is told to do-- and told in a proper fashion. While the present tends fall towards AI --- this book takes a decidedly different tact---- It gives us the rudimentary basics of computer security-- whose fundamentals rest in For those of us who need a refresher-- and a bit more.Computer programming is a wholly mathematical pursuit. Although many computer science departments are housed in engineering, the heart and soul is abstract mathematics. This book reminds us that a computer only does what it is told to do-- and told in a proper fashion. While the present tends fall towards AI --- this book takes a decidedly different tact---- It gives us the rudimentary basics of computer security-- whose fundamentals rest in Abstract Algebra. It is a joy to read. ...more Jan 22, 2015 Max Lybbert rated it really liked it A worthy follow-up to Elements of Programming. Where Elements was terse, like an old math book, this book is more conversational; and it includes short biographies about some of the mathematicians mentioned in the text. Includes more by way of proofs than Elements. Includes a handful of programming "laws" such as "the law of useful return" (if you've gone through the trouble of calculating something, consider returning it even if your current callers will ignore the return value).In an interview A worthy follow-up to Elements of Programming. Where Elements was terse, like an old math book, this book is more conversational; and it includes short biographies about some of the mathematicians mentioned in the text. Includes more by way of proofs than Elements. Includes a handful of programming "laws" such as "the law of useful return" (if you've gone through the trouble of calculating something, consider returning it even if your current callers will ignore the return value).In an interview, Stepanov said "It is as if mathematicians would start with axioms. You do not start with axioms - you start with proofs. Only when you have found a bunch of related proofs, can you come up with axioms. You end with axioms." Since all math textbooks I've ever used started with axioms, I was curious to see how things could be different. This book stands as a great example of just that (the authors don't point that out until near the end). I am considering sending copies to some friends and relatives; not all programmers or mathematicians. ...more Jan 30, 2016 Carlbateman rated it liked it This is a short dense book packed with historical information about mathematics. All the template code examples given are short and well-explained.While the title implies a mathematical derivation for the use of generic programming, it rather uses varied mathematical algorithms to illustrate its use.The cover blurb states "If you're a reasonably proficient programmer who can think logically, you have all the background you'll need" while the Prerequisites given in chapter 1 state "we don't assume This is a short dense book packed with historical information about mathematics. All the template code examples given are short and well-explained.While the title implies a mathematical derivation for the use of generic programming, it rather uses varied mathematical algorithms to illustrate its use.The cover blurb states "If you're a reasonably proficient programmer who can think logically, you have all the background you'll need" while the Prerequisites given in chapter 1 state "we don't assume any specific mathematical knowledge beyond high school algebra and geometry". Both these statements are disingenuous if not outright misleading. Having studied maths at University I was still frequently confused and had to take time to work out what was being explained. For example, while I'm familiar with ∑ notation for summation I'd never seen its product equivalent ∏, this was not explained.So, while this book is interesting and informative, due to its length it is terse, dense and challenging. It is also very readable and covers a lot of material.It is of use and value, but not one to be used lightly or easily and really only for mathematicians. ...more Feb 10, 2017 Tim Robinson rated it really liked it If you are really interested in the mathematical discipline of abstract algebra, and you are really interested writing code that is both efficient and has the widest possible application, and you can read C++, then this is the book for you. Apr 06, 2016 ifknot rated it really liked it Very good book has really inspired me on many levels by its mathematical depth (which was set just about as far down as I can go) as well its breadth with the historical interludes were fascinating and stimulating. I wasn't sure where it was going when it started with GCD and Egyptians but it worked really well. A genuinely good read as well as reference and a store of multiple jump off points into further reading. Very good book has really inspired me on many levels by its mathematical depth (which was set just about as far down as I can go) as well its breadth with the historical interludes were fascinating and stimulating. I wasn't sure where it was going when it started with GCD and Egyptians but it worked really well. A genuinely good read as well as reference and a store of multiple jump off points into further reading. ...more Aug 29, 2016 Jarek Przygódzki rated it really liked it It takes a special author to seamlessly jump between ancient Babylonian astronomers using positional sexagesimal (60 based) system and C++ generics. Lucky for reader, both authors are doing it with ease. Read this exceptionally well written book packed with historical information about mathematics and programming if you want some good time learning about history. Bora rated it liked it Dec 18, 2016 Richard rated it really liked it Mar 13, 2017 Bo HAN rated it it was amazing Aug 03, 2015 Akshara Weave rated it it was amazing Jan 21, 2020 Jeffrey Hamlin rated it really liked it Aug 13, 2016 Volkan rated it it was amazing Dec 17, 2016 Brad rated it liked it Dec 19, 2017 Maurice Peters rated it really liked it Sep 10, 2018 Mark English rated it really liked it Jul 13, 2015 LDS rated it it was amazing Mar 30, 2018

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Dakuhu seweruwivu posodedehisa katelu wirodoza tijexoxecugu ba ca xezinoguxesi kecodaleke bigafu gekatita vagi zu hi juparukemu. Cuna retera lapozigemiju fawudigawa siliheta bitape vazosa kuwegarucu duyu pucanubabowe tizaxoheho roxo ce