

Category Theory For The Sciences The Mit Press En

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Imagine Math 6 - Michele Emmer 2018-11-06

Imagine mathematics, imagine with the help of mathematics, imagine new worlds, new geometries, new forms. Imagine building mathematical models that make it possible to manage our world better, imagine combining music, art, poetry, literature, architecture and cinema with mathematics. Imagine the unpredictable and sometimes counterintuitive applications of mathematics in all areas of human endeavour.

Imagination and mathematics, imagination and culture, culture and mathematics. This sixth volume in the series begins with a homage to the architect Zaha Hadid, who died on March 31st, 2016, a few weeks before the opening of a large exhibition of her works in Palazzo Franchetti in Venice, where all the Mathematics and Culture conferences have taken place in the last years. A large section of the book is dedicated to literature, narrative and mathematics including a contribution from Simon Singh. It discusses the role of media in mathematics, including museums of science, journals and movies. Mathematics and applications, including blood circulation and preventing crimes using earthquakes, is also addressed, while a section on mathematics and art examines the role of math in design. A large selection presents photos of mathematicians and mathematical objects by Vincent Moncorge. Discussing all topics in a way that is rigorous but captivating, detailed but full of evocations, it offers an all-embracing look at the world of mathematics and culture.

Elements of ∞ -Category Theory - Emily Riehl 2022-02-10

This book develops the theory of infinite-dimensional categories by studying the universe, or ∞ -cosmos, in which they live.

Dendritic Spines - Rafael Yuste 2010-09-24

A leading neurobiologist explores the fundamental function of dendritic spines in neural circuits by analyzing different aspects of their biology, including structure, development, motility, and plasticity. Most neurons in the brain are covered by dendritic spines, small protrusions that arise from dendrites, covering them like leaves on a tree. But a hundred and twenty years after spines were first described by Ramón y Cajal, their function is still unclear. Dozens of different functions have been proposed, from Cajal's idea that they enhance neuronal interconnectivity to hypotheses that spines serve as plasticity machines, neuroprotective devices, or even digital logic elements. In *Dendritic Spines*, leading neurobiologist Rafael Yuste attempts to solve the "spine problem," searching for the fundamental function of spines. He does this by examining many aspects of spine biology that have fascinated him over the years, including their structure, development, motility, plasticity, biophysical properties, and calcium compartmentalization. Yuste argues that we may never understand how the brain works without understanding the specific function of spines. In this book, he offers a synthesis of the information that has been gathered on spines (much of which comes from his own studies of the mammalian cortex), linking their function with the computational logic of the neuronal circuits that use them. He argues that once viewed from the circuit perspective, all the pieces of the spine puzzle fit together nicely into a single, overarching function. Yuste connects these two topics, integrating current knowledge of spines with that of key features of the circuits in which they operate. He concludes with a speculative chapter on the computational function of spines, searching for the ultimate logic of their existence in the brain and offering a proposal that is sure to stimulate discussions and drive future research.

An Invitation to Applied Category Theory - Brendan Fong 2019-07-18

Category theory is unmatched in its ability to organize and layer abstractions and to find commonalities between structures of all sorts. No longer the exclusive preserve of pure mathematicians, it is now proving itself to be a powerful tool in science, informatics, and industry. By facilitating communication between communities and building

rigorous bridges between disparate worlds, applied category theory has the potential to be a major organizing force. This book offers a self-contained tour of applied category theory. Each chapter follows a single thread motivated by a real-world application and discussed with category-theoretic tools. We see data migration as an adjoint functor, electrical circuits in terms of monoidal categories and operads, and collaborative design via enriched profunctors. All the relevant category theory, from simple to sophisticated, is introduced in an accessible way with many examples and exercises, making this an ideal guide even for those without experience of university-level mathematics.

Sheaf Theory through Examples - Daniel Rosiak 2022-10-25

An approachable introduction to elementary sheaf theory and its applications beyond pure math. Sheaves are mathematical constructions concerned with passages from local properties to global ones. They have played a fundamental role in the development of many areas of modern mathematics, yet the broad conceptual power of sheaf theory and its wide applicability to areas beyond pure math have only recently begun to be appreciated. Taking an applied category theory perspective, *Sheaf Theory through Examples* provides an approachable introduction to elementary sheaf theory and examines applications including n-colorings of graphs, satellite data, chess problems, Bayesian networks, self-similar groups, musical performance, complexes, and much more. With an emphasis on developing the theory via a wealth of well-motivated and vividly illustrated examples, *Sheaf Theory through Examples* supplements the formal development of concepts with philosophical reflections on topology, category theory, and sheaf theory, alongside a selection of advanced topics and examples that illustrate ideas like cellular sheaf cohomology, toposes, and geometric morphisms. *Sheaf Theory through Examples* seeks to bridge the powerful results of sheaf theory as used by mathematicians and real-world applications, while also supplementing the technical matters with a unique philosophical perspective attuned to the broader development of ideas.

Inventive Minds - Marvin Minsky 2019-04-23

Six essays by artificial intelligence pioneer Marvin Minsky on how education can foster inventiveness, paired with commentary by Minsky's former colleagues and students. Marvin Minsky was a pioneering researcher in artificial intelligence whose work led to both theoretical and practical advances. His work was motivated not only by technological advancement but also by the desire to understand the workings of our own minds. Minsky's insights about the mind provide fresh perspectives on education and how children learn. This book collects for the first time six essays by Minsky on children, learning, and the potential of computers in school to enrich children's development. In these essays Minsky discusses the shortcomings of conventional education (particularly in mathematics) and considers alternative approaches; reflects on the role of mentors; describes higher-level strategies for thinking across domains; and suggests projects for children to pursue. Each essay is paired with commentary by one of Minsky's former colleagues or students, which identifies Minsky's key ideas and connects his writings to current research. Minsky once observed that in traditional teaching, "instead of promoting inventiveness, we focus on preventing mistakes." These essays offer Minsky's unique insights into how education can foster inventiveness. Commentary by Hal Abelson, Walter Bender, Alan Kay, Margaret Minsky, Brian Silverman, Gary Stager, Mike Travers, Patrick Henry Winston

The Optimal Implementation of Functional Programming Languages - Andrea Asperti 1998-12-03

First account of the subject by two of its leading exponents. Essentially self-contained.

The Sciences of the Artificial, third edition - Herbert A. Simon 1996-09-26

Continuing his exploration of the organization of complexity and the science of design, this new edition of Herbert Simon's classic work on artificial intelligence adds a chapter that sorts out the current themes and tools—chaos, adaptive systems, genetic algorithms—for analyzing complexity and complex systems. There are updates throughout the book as well. These take into account important advances in cognitive psychology and the science of design while confirming and extending the book's basic thesis: that a physical symbol system has the necessary and sufficient means for intelligent action. The chapter "Economic Reality" has also been revised to reflect a change in emphasis in Simon's thinking about the respective roles of organizations and markets in economic systems.

Basic Category Theory for Computer Scientists - Benjamin C. Pierce 1991-08-07

Basic Category Theory for Computer Scientists provides a straightforward presentation of the basic constructions and terminology of category theory, including limits, functors, natural transformations, adjoints, and cartesian closed categories. Category theory is a branch of pure mathematics that is becoming an increasingly important tool in theoretical computer science, especially in programming language semantics, domain theory, and concurrency, where it is already a standard language of discourse. Assuming a minimum of mathematical preparation, Basic Category Theory for Computer Scientists provides a straightforward presentation of the basic constructions and terminology of category theory, including limits, functors, natural transformations, adjoints, and cartesian closed categories. Four case studies illustrate applications of category theory to programming language design, semantics, and the solution of recursive domain equations. A brief literature survey offers suggestions for further study in more advanced texts. Contents Tutorial • Applications • Further Reading

Category Theory in Context - Emily Riehl 2017-03-09

Introduction to concepts of category theory — categories, functors, natural transformations, the Yoneda lemma, limits and colimits, adjunctions, monads — revisits a broad range of mathematical examples from the categorical perspective. 2016 edition.

Topology - Tai-Danae Bradley 2020-08-18

A graduate-level textbook that presents basic topology from the perspective of category theory. This graduate-level textbook on topology takes a unique approach: it reintroduces basic, point-set topology from a more modern, categorical perspective. Many graduate students are familiar with the ideas of point-set topology and they are ready to learn something new about them. Teaching the subject using category theory—a contemporary branch of mathematics that provides a way to represent abstract concepts—both deepens students' understanding of elementary topology and lays a solid foundation for future work in advanced topics. After presenting the basics of both category theory and topology, the book covers the universal properties of familiar constructions and three main topological properties—connectedness, Hausdorff, and compactness. It presents a fine-grained approach to convergence of sequences and filters; explores categorical limits and colimits, with examples; looks in detail at adjunctions in topology, particularly in mapping spaces; and examines additional adjunctions, presenting ideas from homotopy theory, the fundamental groupoid, and the Seifert van Kampen theorem. End-of-chapter exercises allow students to apply what they have learned. The book expertly guides students of topology through the important transition from undergraduate student with a solid background in analysis or point-set topology to graduate student preparing to work on contemporary problems in mathematics.

Temporal Type Theory - Patrick Schultz 2019-01-29

This innovative monograph explores a new mathematical formalism in higher-order temporal logic for proving properties about the behavior of systems. Developed by the authors, the goal of this novel approach is to explain what occurs when multiple, distinct system components interact by using a category-theoretic description of behavior types based on sheaves. The authors demonstrate how to analyze the behaviors of elements in continuous and discrete dynamical systems so that each can be translated and compared to one another. Their temporal logic is also flexible enough that it can serve as a framework for other logics that work with similar models. The book begins with a discussion of behavior types, interval domains, and translation invariance, which serves as the groundwork for temporal type theory. From there, the authors lay out the logical preliminaries they need for their temporal modalities and explain the soundness of those logical semantics. These results are then applied to hybrid dynamical systems, differential equations, and labeled transition systems. A case study involving aircraft separation within the

National Airspace System is provided to illustrate temporal type theory in action. Researchers in computer science, logic, and mathematics interested in topos-theoretic and category-theory-friendly approaches to system behavior will find this monograph to be an important resource. It can also serve as a supplemental text for a specialized graduate topics course.

Mathematics of Big Data - Jeremy Kepner 2018-08-07

The first book to present the common mathematical foundations of big data analysis across a range of applications and technologies. Today, the volume, velocity, and variety of data are increasing rapidly across a range of fields, including Internet search, healthcare, finance, social media, wireless devices, and cybersecurity. Indeed, these data are growing at a rate beyond our capacity to analyze them. The tools—including spreadsheets, databases, matrices, and graphs—developed to address this challenge all reflect the need to store and operate on data as whole sets rather than as individual elements. This book presents the common mathematical foundations of these data sets that apply across many applications and technologies. Associative arrays unify and simplify data, allowing readers to look past the differences among the various tools and leverage their mathematical similarities in order to solve the hardest big data challenges. The book first introduces the concept of the associative array in practical terms, presents the associative array manipulation system D4M (Dynamic Distributed Dimensional Data Model), and describes the application of associative arrays to graph analysis and machine learning. It provides a mathematically rigorous definition of associative arrays and describes the properties of associative arrays that arise from this definition. Finally, the book shows how concepts of linearity can be extended to encompass associative arrays. Mathematics of Big Data can be used as a textbook or reference by engineers, scientists, mathematicians, computer scientists, and software engineers who analyze big data.

Tensor Categories - Pavel Etingof 2016-08-05

Is there a vector space whose dimension is the golden ratio? Of course not—the golden ratio is not an integer! But this can happen for generalizations of vector spaces—objects of a tensor category. The theory of tensor categories is a relatively new field of mathematics that generalizes the theory of group representations. It has deep connections with many other fields, including representation theory, Hopf algebras, operator algebras, low-dimensional topology (in particular, knot theory), homotopy theory, quantum mechanics and field theory, quantum computation, theory of motives, etc. This book gives a systematic introduction to this theory and a review of its applications. While giving a detailed overview of general tensor categories, it focuses especially on the theory of finite tensor categories and fusion categories (in particular, braided and modular ones), and discusses the main results about them with proofs. In particular, it shows how the main properties of finite-dimensional Hopf algebras may be derived from the theory of tensor categories. Many important results are presented as a sequence of exercises, which makes the book valuable for students and suitable for graduate courses. Many applications, connections to other areas, additional results, and references are discussed at the end of each chapter.

Semantics of Programming Languages - Carl A. Gunter 1992

Semantics of Programming Languages exposes the basic motivations and philosophy underlying the applications of semantic techniques in computer science. It introduces the mathematical theory of programming languages with an emphasis on higher-order functions and type systems. Designed as a text for upper-level and graduate-level students, the mathematically sophisticated approach will also prove useful to professionals who want an easily referenced description of fundamental results and calculi. Basic connections between computational behavior, denotational semantics, and the equational logic of functional programs are thoroughly and rigorously developed. Topics covered include models of types, operational semantics, category theory, domain theory, fixed point (denotational). semantics, full abstraction and other semantic correspondence criteria, types and evaluation, type checking and inference, parametric polymorphism, and subtyping. All topics are treated clearly and in depth, with complete proofs for the major results and numerous exercises.

Basic Category Theory for Computer Scientists - Benjamin C. Pierce 1991-08-07

Basic Category Theory for Computer Scientists provides a straightforward presentation of the basic constructions and terminology of category theory, including limits, functors, natural transformations, adjoints, and cartesian closed categories. Category theory is a branch of

pure mathematics that is becoming an increasingly important tool in theoretical computer science, especially in programming language semantics, domain theory, and concurrency, where it is already a standard language of discourse. Assuming a minimum of mathematical preparation, *Basic Category Theory for Computer Scientists* provides a straightforward presentation of the basic constructions and terminology of category theory, including limits, functors, natural transformations, adjoints, and cartesian closed categories. Four case studies illustrate applications of category theory to programming language design, semantics, and the solution of recursive domain equations. A brief literature survey offers suggestions for further study in more advanced texts. Contents Tutorial • Applications • Further Reading

Categories and Computer Science - R. F. C. Walters 1991

Category theory has become increasingly important and popular in computer science, and many universities now have introductions to category theory as part of their courses for undergraduate computer scientists. The author is a respected category theorist and has based this textbook on a course given over the last few years at the University of Sydney. The theory is developed in a straightforward way, and is enriched with many examples from computer science. Thus this book meets the needs of undergraduate computer scientists, and yet retains a level of mathematical correctness that will broaden its appeal to include students of mathematics new to category theory.

Category Theory - Steve Awodey 2010-06-18

Category theory is a branch of abstract algebra with incredibly diverse applications. This text and reference book is aimed not only at mathematicians, but also researchers and students of computer science, logic, linguistics, cognitive science, philosophy, and any of the other fields in which the ideas are being applied. Containing clear definitions of the essential concepts, illuminated with numerous accessible examples, and providing full proofs of all important propositions and theorems, this book aims to make the basic ideas, theorems, and methods of category theory understandable to this broad readership. Although assuming few mathematical pre-requisites, the standard of mathematical rigour is not compromised. The material covered includes the standard core of categories; functors; natural transformations; equivalence; limits and colimits; functor categories; representables; Yoneda's lemma; adjoints; monads. An extra topic of cartesian closed categories and the lambda-calculus is also provided - a must for computer scientists, logicians and linguists! This Second Edition contains numerous revisions to the original text, including expanding the exposition, revising and elaborating the proofs, providing additional diagrams, correcting typographical errors and, finally, adding an entirely new section on monoidal categories. Nearly a hundred new exercises have also been added, many with solutions, to make the book more useful as a course text and for self-study.

Category Theory - Steve Awodey 2006-05

Containing example exercises, this reference to category theory is suitable for researchers and graduates in philosophy, mathematics, and computer science. With definitions of concepts, and proofs of propositions and theorems, the text makes the ideas of this topic understandable to the broad readership.

Philosophical Introduction to Set Theory - Stephen Pollard 2015-07-20

This unique approach maintains that set theory is the primary mechanism for ideological and theoretical unification in modern mathematics, and its technically informed discussion covers a variety of philosophical issues. 1990 edition.

Category Theory for Programmers (Scala Edition, Paperback) -

Bartosz Milewski 2019-08-12

This is the Scala edition of *Category Theory for Programmers* by Bartosz Milewski. This book contains code snippets in both Haskell and Scala.

Proof and the Art of Mathematics - Joel David Hamkins 2021-02-23

How to write mathematical proofs, shown in fully-worked out examples. This is a companion volume Joel Hamkins's *Proof and the Art of Mathematics*, providing fully worked-out solutions to all of the odd-numbered exercises as well as a few of the even-numbered exercises. In many cases, the solutions go beyond the exercise question itself to the natural extensions of the ideas, helping readers learn how to approach a mathematical investigation. As Hamkins asks, "Once you have solved a problem, why not push the ideas harder to see what further you can prove with them?" These solutions offer readers examples of how to write a mathematical proofs. The mathematical development of this text follows the main book, with the same chapter topics in the same order, and all theorem and exercise numbers in this text refer to the corresponding statements of the main text.

Introduction to Representation Theory - Pavel I. Etingof 2011

Very roughly speaking, representation theory studies symmetry in linear spaces. It is a beautiful mathematical subject which has many applications, ranging from number theory and combinatorics to geometry, probability theory, quantum mechanics, and quantum field theory. The goal of this book is to give a "holistic" introduction to representation theory, presenting it as a unified subject which studies representations of associative algebras and treating the representation theories of groups, Lie algebras, and quivers as special cases. Using this approach, the book covers a number of standard topics in the representation theories of these structures. Theoretical material in the book is supplemented by many problems and exercises which touch upon a lot of additional topics; the more difficult exercises are provided with hints. The book is designed as a textbook for advanced undergraduate and beginning graduate students. It should be accessible to students with a strong background in linear algebra and a basic knowledge of abstract algebra.

Frontiers of Game Theory - Emeritus Professor of Economics Ken Binmore 1993

These seventeen contributions take up the most recent research in game theory, reflecting the many diverse approaches in the field today. They are classified in five general tactical categories - prediction, explanation, investigation, description, and prescription - and with in these along applied and theoretical divisions. The introduction clearly lays out this framework. Ken Binmore is Professor of Economics at the University of Michigan, Alan Kirman is Professor of Economics at European University Institute, and Piero Tani is Dean of the Faculty at the University of Florence. Contents: Famous Gamesters, Ken Binmore, Alan Kirman, and Piero Tani. Cognition and Framing in Sequential Bargaining for Gains and Losses, Cohn F. Camerer, Eric J. Johnson, Talia Rymon, Sankar Sen. Explaining the Vote: Constituency Constraints on Sophisticated Voting, David Austen Smith. The Dynamics of Learning in N-Person Games with the Wrong N, Vincent Brousseau and Alan Kirman. Stationary Equilibria for Deterministic Graphical Games, Steve Alpern. Stable Coalition Structures in Consecutive Games, Joseph Greenberg and Shlomo Weber. The General Nucleolus and the Reduced Game Property, Michael Maschler, Jos Potters, Stef Tijs. Some Thoughts on Efficiency and Information, Françoise Forges. On the Fair and Coalition Strategy Proof Allocation of Private Goods, Hervé Moulin. From Repeated to Differential Games: How Time and Uncertainty Pervade the Theory of Games, Alain Haurie. Unraveling in Games of Sharing and Exchange, Steven J. Brams, D. Marc Kilgour, Morton D. Davis. Does Evolution Eliminate Dominated Strategies? Larry Samuelson. Equilibrium Selection in Stag Hunt Games, Hans Carlsson and Eric van Damme. Variable Universe Games, Michael Bacharach. Aspects of Rationalizable Behavior, Peter J. Hammond. Normative Validity and Meaning of von Neumann-Morgenstern Utilities, John C. Harsanyi. DeBayesian Game Theory, Ken Binmore.

Categories, Types, and Structures - Andrea Asperti 1991

Category theory is a mathematical subject whose importance in several areas of computer science, most notably the semantics of programming languages and the design of programmes using abstract data types, is widely acknowledged. This book introduces category theory at a level appropriate for computer scientists and provides practical examples in the context of programming language design.

Categorical Logic and Type Theory - B. Jacobs 2001-05-10

This book is an attempt to give a systematic presentation of both logic and type theory from a categorical perspective, using the unifying concept of fibred category. Its intended audience consists of logicians, type theorists, category theorists and (theoretical) computer scientists.

The Wim Hof Method - Wim Hof 2020-10-20

INSTANT NEW YORK TIMES BESTSELLER The only definitive book authored by Wim Hof on his powerful method for realizing our physical and spiritual potential. "This method is very simple, very accessible, and endorsed by science. Anybody can do it, and there is no dogma, only acceptance. Only freedom." —Wim Hof Wim Hof has a message for each of us: "You can literally do the impossible. You can overcome disease, improve your mental health and physical performance, and even control your physiology so you can thrive in any stressful situation." With *The Wim Hof Method*, this trailblazer of human potential shares a method that anyone can use—young or old, sick or healthy—to supercharge their capacity for strength, vitality, and happiness. Wim has become known as "The Iceman" for his astounding physical feats, such as spending hours in freezing water and running barefoot marathons over deserts and ice fields. Yet his most remarkable achievement is not any record-breaking

performance—it is the creation of a method that thousands of people have used to transform their lives. In his gripping and passionate style, Wim shares his method and his story, including:

- **Breath**—Wim’s unique practices to change your body chemistry, infuse yourself with energy, and focus your mind
- **Cold**—Safe, controlled, shock-free practices for using cold exposure to enhance your cardiovascular system and awaken your body’s untapped strength
- **Mindset**—Build your willpower, inner clarity, sensory awareness, and innate joyfulness in the miracle of living
- **Science**—How users of this method have redefined what is medically possible in study after study
- **Health**—True stories and testimonials from people using the method to overcome disease and chronic illness
- **Performance**—Increase your endurance, improve recovery time, up your mental game, and more
- **Wim’s Story**—Follow Wim’s inspiring personal journey of discovery, tragedy, and triumph
- **Spiritual Awakening**—How breath, cold, and mindset can reveal the beauty of your soul

Wim Hof is a man on a mission: to transform the way we live by reminding us of our true power and purpose. “This is how we will change the world, one soul at a time,” Wim says. “We alter the collective consciousness by awakening to our own boundless potential. We are limited only by the depth of our imagination and the strength of our conviction.” If you’re ready to explore and exceed the limits of your own potential, The Wim Hof Method is waiting for you.

Design Justice - Sasha Costanza-Chock 2020-03-03

An exploration of how design might be led by marginalized communities, dismantle structural inequality, and advance collective liberation and ecological survival. What is the relationship between design, power, and social justice? “Design justice” is an approach to design that is led by marginalized communities and that aims explicitly to challenge, rather than reproduce, structural inequalities. It has emerged from a growing community of designers in various fields who work closely with social movements and community-based organizations around the world. This book explores the theory and practice of design justice, demonstrates how universalist design principles and practices erase certain groups of people—specifically, those who are intersectionally disadvantaged or multiply burdened under the matrix of domination (white supremacist heteropatriarchy, ableism, capitalism, and settler colonialism)—and invites readers to “build a better world, a world where many worlds fit; linked worlds of collective liberation and ecological sustainability.” Along the way, the book documents a multitude of real-world community-led design practices, each grounded in a particular social movement. Design Justice goes beyond recent calls for design for good, user-centered design, and employment diversity in the technology and design professions; it connects design to larger struggles for collective liberation and ecological survival.

Biomateriomics - Steven W. Cranford 2012-05-23

Biomateriomics is the holistic study of biological material systems. While such systems are undoubtedly complex, we frequently encounter similar components -- universal building blocks and hierarchical structure motifs -- which result in a diverse set of functionalities. Similar to the way music or language arises from a limited set of music notes and words, we exploit the relationships between form and function in a meaningful way by recognizing the similarities between Beethoven and bone, or Shakespeare and silk. Through the investigation of material properties, examining fundamental links between processes, structures, and properties at multiple scales and their interactions, materiomics explains system functionality from the level of building blocks. Biomateriomics specifically focuses the analysis of the role of materials in the context of biological processes, the transfer of biological material principles towards biomimetic and bioinspired applications, and the study of interfaces between living and non-living systems. The challenges of biological materials are vast, but the convergence of biology, mathematics and engineering as well as computational and experimental techniques have resulted in the toolset necessary to describe complex material systems, from nano to macro. Applying biomateriomics can unlock Nature’s secret to high performance materials such as spider silk, bone, and nacre, and elucidate the progression and diagnosis or the treatment of diseases. Similarly, it contributes to develop a de novo understanding of biological material processes and to the potential of exploiting novel concepts in innovation, material synthesis and design.

Democratizing Innovation - Eric Von Hippel 2006-02-17

The process of user-centered innovation: how it can benefit both users and manufacturers and how its emergence will bring changes in business models and in public policy. Innovation is rapidly becoming democratized. Users, aided by improvements in computer and communications technology, increasingly can develop their own new

products and services. These innovating users—both individuals and firms—often freely share their innovations with others, creating user-innovation communities and a rich intellectual commons. In *Democratizing Innovation*, Eric von Hippel looks closely at this emerging system of user-centered innovation. He explains why and when users find it profitable to develop new products and services for themselves, and why it often pays users to reveal their innovations freely for the use of all. The trend toward democratized innovation can be seen in software and information products—most notably in the free and open-source software movement—but also in physical products. Von Hippel’s many examples of user innovation in action range from surgical equipment to surfboards to software security features. He shows that product and service development is concentrated among “lead users,” who are ahead on marketplace trends and whose innovations are often commercially attractive. Von Hippel argues that manufacturers should redesign their innovation processes and that they should systematically seek out innovations developed by users. He points to businesses—the custom semiconductor industry is one example—that have learned to assist user-innovators by providing them with toolkits for developing new products. User innovation has a positive impact on social welfare, and von Hippel proposes that government policies, including R&D subsidies and tax credits, should be realigned to eliminate biases against it. The goal of a democratized user-centered innovation system, says von Hippel, is well worth striving for. An electronic version of this book is available under a Creative Commons license.

An Introduction to the Language of Category Theory - Steven Roman 2017-01-05

This textbook provides an introduction to elementary category theory, with the aim of making what can be a confusing and sometimes overwhelming subject more accessible. In writing about this challenging subject, the author has brought to bear all of the experience he has gained in authoring over 30 books in university-level mathematics. The goal of this book is to present the five major ideas of category theory: categories, functors, natural transformations, universality, and adjoints in as friendly and relaxed a manner as possible while at the same time not sacrificing rigor. These topics are developed in a straightforward, step-by-step manner and are accompanied by numerous examples and exercises, most of which are drawn from abstract algebra. The first chapter of the book introduces the definitions of category and functor and discusses diagrams, duality, initial and terminal objects, special types of morphisms, and some special types of categories, particularly comma categories and hom-set categories. Chapter 2 is devoted to functors and natural transformations, concluding with Yoneda’s lemma. Chapter 3 presents the concept of universality and Chapter 4 continues this discussion by exploring cones, limits, and the most common categorical constructions - products, equalizers, pullbacks and exponentials (along with their dual constructions). The chapter concludes with a theorem on the existence of limits. Finally, Chapter 5 covers adjoints and adjunctions. Graduate and advanced undergraduates students in mathematics, computer science, physics, or related fields who need to know or use category theory in their work will find *An Introduction to Category Theory* to be a concise and accessible resource. It will be particularly useful for those looking for a more elementary treatment of the topic before tackling more advanced texts.

Toward a Science of Consciousness - Stuart R. Hameroff 1996

This text originates from the second of two conferences discussing the concept of consciousness. In 15 sections, this book demonstrates the broad range of fields now focusing on consciousness.

Data Feminism - Catherine D’Ignazio 2020-03-31

A new way of thinking about data science and data ethics that is informed by the ideas of intersectional feminism. Today, data science is a form of power. It has been used to expose injustice, improve health outcomes, and topple governments. But it has also been used to discriminate, police, and surveil. This potential for good, on the one hand, and harm, on the other, makes it essential to ask: Data science by whom? Data science for whom? Data science with whose interests in mind? The narratives around big data and data science are overwhelmingly white, male, and techno-heroic. In *Data Feminism*, Catherine D’Ignazio and Lauren Klein present a new way of thinking about data science and data ethics—one that is informed by intersectional feminist thought. Illustrating data feminism in action, D’Ignazio and Klein show how challenges to the male/female binary can help challenge other hierarchical (and empirically wrong) classification systems. They explain how, for example, an understanding of emotion can expand our ideas about effective data visualization, and how the

concept of invisible labor can expose the significant human efforts required by our automated systems. And they show why the data never, ever “speak for themselves.” Data Feminism offers strategies for data scientists seeking to learn how feminism can help them work toward justice, and for feminists who want to focus their efforts on the growing field of data science. But Data Feminism is about much more than gender. It is about power, about who has it and who doesn't, and about how those differentials of power can be challenged and changed.

Basic Category Theory - Tom Leinster 2014-07-24

A short introduction ideal for students learning category theory for the first time.

Category Theory for the Sciences - David I. Spivak 2014-10-10

An introduction to category theory as a rigorous, flexible, and coherent modeling language that can be used across the sciences. Category theory was invented in the 1940s to unify and synthesize different areas in mathematics, and it has proven remarkably successful in enabling powerful communication between disparate fields and subfields within mathematics. This book shows that category theory can be useful outside of mathematics as a rigorous, flexible, and coherent modeling language throughout the sciences. Information is inherently dynamic; the same ideas can be organized and reorganized in countless ways, and the ability to translate between such organizational structures is becoming increasingly important in the sciences. Category theory offers a unifying framework for information modeling that can facilitate the translation of knowledge between disciplines. Written in an engaging and straightforward style, and assuming little background in mathematics, the book is rigorous but accessible to non-mathematicians. Using databases as an entry to category theory, it begins with sets and functions, then introduces the reader to notions that are fundamental in mathematics: monoids, groups, orders, and graphs—categories in disguise. After explaining the “big three” concepts of category theory—categories, functors, and natural transformations—the book covers other topics, including limits, colimits, functor categories, sheaves, monads, and operads. The book explains category theory by examples and exercises rather than focusing on theorems and proofs. It includes more than 300 exercises, with solutions. Category Theory for the Sciences is intended to create a bridge between the vast array of mathematical concepts used by mathematicians and the models and frameworks of such scientific disciplines as computation, neuroscience, and physics.

Sorting Things Out - Geoffrey C. Bowker 2000-08-25

A revealing and surprising look at how classification systems can shape both worldviews and social interactions. What do a seventeenth-century mortality table (whose causes of death include “fainted in a bath,” “frighted,” and “itch”); the identification of South Africans during apartheid as European, Asian, colored, or black; and the separation of machine- from hand-washables have in common? All are examples of classification—the scaffolding of information infrastructures. In *Sorting Things Out*, Geoffrey C. Bowker and Susan Leigh Star explore the role of categories and standards in shaping the modern world. In a clear and lively style, they investigate a variety of classification systems, including the International Classification of Diseases, the Nursing Interventions Classification, race classification under apartheid in South Africa, and the classification of viruses and of tuberculosis. The authors emphasize the role of invisibility in the process by which classification orders human interaction. They examine how categories are made and kept invisible, and how people can change this invisibility when necessary. They also explore systems of classification as part of the built information environment. Much as an urban historian would review highway permits and zoning decisions to tell a city's story, the authors review archives of classification design to understand how decisions have been made. *Sorting Things Out* has a moral agenda, for each standard and category valorizes some point of view and silences another. Standards and classifications produce advantage or suffering. Jobs are made and lost; some regions benefit at the expense of others. How these choices are made and how we think about that process are at the moral and political core of this work. The book is an important empirical source for understanding the building of information infrastructures.

The Alchemy of Us - Ainissa Ramirez 2021-04-06

In the bestselling tradition of *Stuff Matters* and *The Disappearing Spoon*: a clever and engaging look at materials, the innovations they made possible, and how these technologies changed us. Finalist for the 41st Los Angeles Times Book Award in Science and Technology and selected as one of the Best Summer Science Books Of 2020 by Science Friday. In

The Alchemy of Us, scientist and science writer Ainissa Ramirez examines eight inventions—clocks, steel rails, copper communication cables, photographic film, light bulbs, hard disks, scientific labware, and silicon chips—and reveals how they shaped the human experience. Ramirez tells the stories of the woman who sold time, the inventor who inspired Edison, and the hotheaded undertaker whose invention pointed the way to the computer. She describes, among other things, how our pursuit of precision in timepieces changed how we sleep; how the railroad helped commercialize Christmas; how the necessary brevity of the telegram influenced Hemingway's writing style; and how a young chemist exposed the use of Polaroid's cameras to create passbooks to track Black citizens in apartheid South Africa. These fascinating and inspiring stories offer new perspectives on our relationships with technologies.

Why Only Us - Robert C. Berwick 2017-05-12

Berwick and Chomsky draw on recent developments in linguistic theory to offer an evolutionary account of language and humans' remarkable, species-specific ability to acquire it. “A loosely connected collection of four essays that will fascinate anyone interested in the extraordinary phenomenon of language.” —New York Review of Books We are born crying, but those cries signal the first stirring of language. Within a year or so, infants master the sound system of their language; a few years after that, they are engaging in conversations. This remarkable, species-specific ability to acquire any human language—“the language faculty”—raises important biological questions about language, including how it has evolved. This book by two distinguished scholars—a computer scientist and a linguist—addresses the enduring question of the evolution of language. Robert Berwick and Noam Chomsky explain that until recently the evolutionary question could not be properly posed, because we did not have a clear idea of how to define “language” and therefore what it was that had evolved. But since the Minimalist Program, developed by Chomsky and others, we know the key ingredients of language and can put together an account of the evolution of human language and what distinguishes us from all other animals. Berwick and Chomsky discuss the biolinguistic perspective on language, which views language as a particular object of the biological world; the computational efficiency of language as a system of thought and understanding; the tension between Darwin's idea of gradual change and our contemporary understanding about evolutionary change and language; and evidence from nonhuman animals, in particular vocal learning in songbirds.

Mathematics for Computer Science - Eric Lehman 2017-03-08

This book covers elementary discrete mathematics for computer science and engineering. It emphasizes mathematical definitions and proofs as well as applicable methods. Topics include formal logic notation, proof methods; induction, well-ordering; sets, relations; elementary graph theory; integer congruences; asymptotic notation and growth of functions; permutations and combinations, counting principles; discrete probability. Further selected topics may also be covered, such as recursive definition and structural induction; state machines and invariants; recurrences; generating functions.

Categories for the Working Mathematician - Saunders MacLane 2013-11-11

Category Theory has developed rapidly. This book aims to present those ideas and methods which can now be effectively used by Mathematicians working in a variety of other fields of Mathematical research. This occurs at several levels. On the first level, categories provide a convenient conceptual language, based on the notions of category, functor, natural transformation, contravariance, and functor category. These notions are presented, with appropriate examples, in Chapters I and II. Next comes the fundamental idea of an adjoint pair of functors. This appears in many substantially equivalent forms: That of universal construction, that of direct and inverse limit, and that of pairs of functors with a natural isomorphism between corresponding sets of arrows. All these forms, with their interrelations, are examined in Chapters III to V. The slogan is “Adjoint functors arise everywhere”. Alternatively, the fundamental notion of category theory is that of a monoid—a set with a binary operation of multiplication which is associative and which has a unit; a category itself can be regarded as a sort of generalized monoid. Chapters VI and VII explore this notion and its generalizations. Its close connection to pairs of adjoint functors illuminates the ideas of universal algebra and culminates in Beck's theorem characterizing categories of algebras; on the other hand, categories with a monoidal structure (given by a tensor product) lead *inter alia* to the study of more convenient categories of topological spaces.