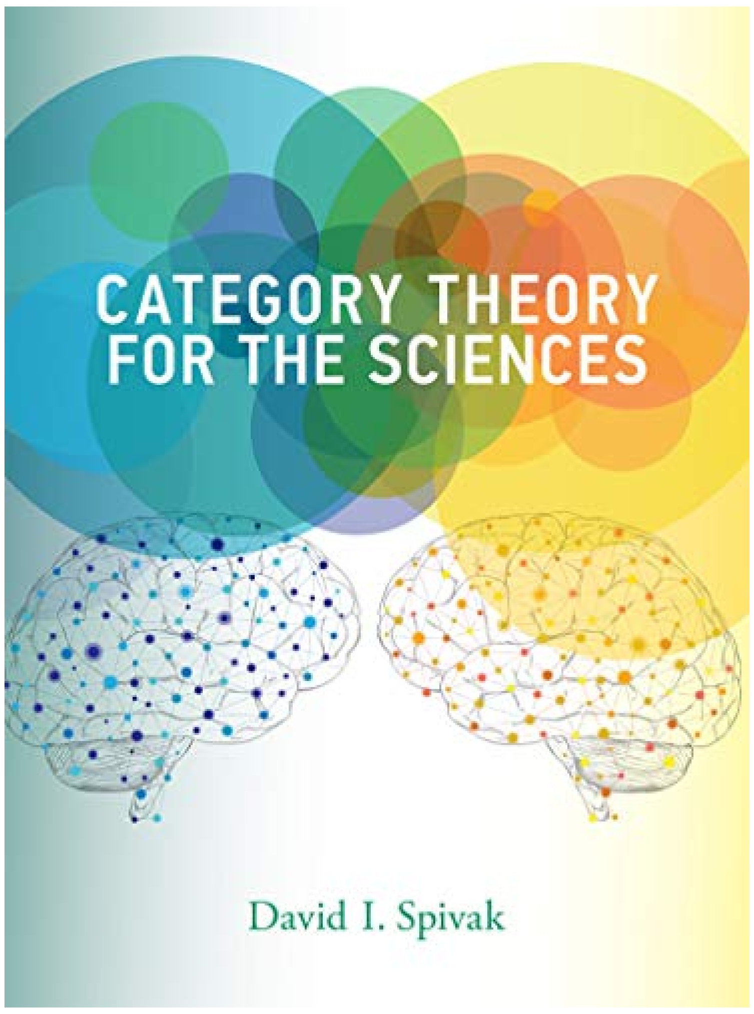
CATEGORY THEORY
FOR THE SCIENCES
David I. Spivak

[DOC] Category Theory For The Sciences (The MIT Press)

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Category Theory for the Sciences-David I. Spivak 2014-10-17 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.

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

Basic Category Theory-Tom Leinster 2014-07-24 A short introduction ideal for students learning category theory for the first time.

An Invitation to Applied Category Theory-Brendan Fong 2019-07-31 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.

Tool and Object-Ralph Krömer 2007-06-25 Category theory is a general mathematical theory of structures and of structures of structures. It occupied a central position in contemporary mathematics as well as computer science. This book describes the history of category theory whereby illuminating its symbiotic relationship to algebraic topology, homological algebra, algebraic geometry and mathematical logic and elaboratively develops the connections with the epistemological significance.

Category Theory in Physics, Mathematics, and Philosophy-Marek Kuś 2019-11-12 The contributions gathered here demonstrate how categorical ontology can provide a basis for linking three important basic sciences: mathematics, physics, and philosophy. Category theory is a new formal ontology that shifts the main focus from objects to processes. The book approaches formal ontology in the original sense put forward by the philosopher Edmund Husserl, namely as a science that deals with entities that can be exemplified in all spheres and domains of reality. It is a dynamic, processual, and non-substantial ontology in which all entities can be treated as transformations, and in which objects are merely the sources and aims of these transformations. Thus, in a rather surprising way, when employed as a formal ontology, category theory can unite seemingly disparate disciplines in contemporary science and the humanities, such as physics, mathematics and philosophy, but also computer and complex systems science.

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 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.

An Introduction to Category Theory-Harold Simmons 2011-09-22 Category theory provides a general conceptual framework that has proved fruitful in subjects as diverse as geometry, topology, theoretical computer science and foundational mathematics. Here is a friendly, easy-to-read textbook that explains the fundamentals at a level suitable for newcomers to the subject. Beginning postgraduate mathematicians will find this book an excellent introduction to all of the basics of category theory. It gives the basic definitions; goes through the various associated gadgetry, such as functors, natural transformations, limits and colimits; and then explains adjunctions. The material is slowly developed using many examples and illustrations to illuminate the concepts explained. Over 200 exercises, with solutions available online, help the reader to access the subject and make the book ideal for self-study. It can also be used as a recommended text for a taught introductory course.

Categories for the Working Philosopher-Elaine Landry 2017-10-19 This is the first volume on category theory for a broad philosophical readership. It is designed to show the interest and significance of category theory for a range of philosophical interests: mathematics, proof theory, computation, cognition, scientific modelling, physics, ontology, the structure of the world. Each chapter is written by either a category-theorist or a philosopher working in one of the represented areas, in an accessible waythat builds on the concepts that are already familiar to philosophers working in these areas.

A New Foundation for Representation in Cognitive and Brain Science-Jaime Gómez-Ramirez 2013-11-22 The purpose of the book is to advance in the understanding of brain function by defining a general framework for representation based on category theory. The idea is to bring this mathematical formalism into the domain of neural representation of physical spaces, setting the basis for a theory of mental representation, able to relate empirical findings, uniting them into a sound theoretical corpus. The innovative approach presented in the book provides a horizon of interdisciplinary collaboration that aims to set up a common agenda that synthesizes mathematical formalization and empirical procedures in a systemic way. Category theory has been successfully applied to qualitative analysis, mainly in theoretical computer science to deal with programming language semantics. Nevertheless, the potential of category theoretic tools for quantitative analysis of networks has not been tackled so far. Statistical methods to investigate graph structure typically rely on network parameters. Category theory can be seen as an abstraction of graph theory. Thus, new categorical properties can be added into network analysis and graph theoretic constructs can be accordingly extended in more fundamental basis. By generalizing networks using category theory we can address questions and elaborate answers in a more fundamental way without waiving graph theoretic tools. The vital issue is to establish a new framework for quantitative analysis of networks using the theory of categories, in which computational neuroscientists and network theorists may tackle in more efficient ways the dynamics of brain cognitive networks. The intended audience of the book is researchers who wish to explore the validity of mathematical principles in the understanding of cognitive systems. All the actors in cognitive science: philosophers, engineers, neurobiologists, cognitive psychologists, computer scientists etc. are akin to discover along its pages new unforeseen connections through the development of concepts and formal theories described in the book. Practitioners of both pure and applied mathematics e.g., network theorists, will be delighted with the mapping of abstract mathematical concepts in the terra incognita of cognition.

Category Theory And Applications: A Textbook For Beginners (Second Edition)-Marco Grandis 2021-03-05 Category Theory now permeates most of Mathematics, large parts of theoretical Computer Science and parts of theoretical Physics. Its unifying power brings together different branches, and leads to a better understanding of their roots.This book is addressed to students and researchers of these fields and can be used as a text for a first course in Category Theory. It covers the basic tools, like universal properties, limits, adjoint functors and monads. These are presented in a concrete way, starting from examples and exercises taken from elementary Algebra, Lattice Theory and Topology, then developing the theory together with new exercises and applications.A reader should have some elementary knowledge of these three subjects, or at least two of them, in order to be able to follow the main examples, appreciate the unifying power of the categorical approach, and discover the subterranean links brought to light and formalised by this perspective.Applications of Category Theory form a vast and differentiated domain. This book wants to present the basic applications in Algebra and Topology, with a choice of more advanced ones, based on the interests of the author. References are given for applications in many other fields.In this second edition, the book has been entirely reviewed, adding many applications and exercises. All non-obvious exercises have now a solution (or a reference, in the case of an advanced topic); solutions are now collected in the last chapter.

Category Theory-Steve Awodey 2010-06-17 A comprehensive reference to category theory for students and researchers in mathematics, computer science, logic, cognitive science, linguistics, and philosophy. Useful for self-study and as a course text, the book includes all basic definitions and theorems (with full proofs), as well as numerous examples and exercises.

Axiomatic Method and Category Theory-Andrei Rodin 2013-10-14 This volume explores the many different meanings of the notion of the axiomatic method, offering an insightful historical and philosophical discussion about how these notions changed over the millennia. The author, a well-known philosopher and historian of mathematics, first examines Euclid, who is considered the father of the axiomatic method, before moving onto Hilbert and Lawvere. He then presents a deep textual analysis of each writer and describes how their ideas are different and even how their ideas progressed over time. Next, the book explores category theory and details how it has revolutionized the notion of the axiomatic method. It considers the question of identity/equality in mathematics as well as examines the received theories of mathematical structuralism. In the end, Rodin presents a hypothetical New Axiomatic Method, which establishes closer relationships between mathematics and physics. Lawvere's axiomatization of topos theory and Voevodsky's axiomatization of higher homotopy theory exemplify a new way of axiomatic theory building, which goes beyond the classical Hilbert-style Axiomatic Method. The new notion of Axiomatic Method that emerges in categorical logic opens new possibilities for using this method in physics and other natural sciences. This volume offers readers a coherent look at the past, present and anticipated future of the Axiomatic Method.

Topology-Tai-Danae Bradley 2020 "This book presents a modern, category-theory-based approach to topology to supplement the more traditional algebraic topology graduate course"--

Categories for Quantum Theory-Chris Heunen 2019-11-14 Monoidal category theory serves as a powerful framework for describing logical aspects of quantum theory, giving an abstract language for parallel and sequential composition, and a conceptual way to understand many high-level quantum phenomena. This text lays the foundation for this categorical quantum mechanics, with an emphasis on the graphical calculus which makes computation intuitive. Biproducts and dual objects are introduced and used to model superposition and entanglement, with quantum teleportation studied abstractly using these structures. Monoids, Frobenius structures and Hopf algebras are described, and it is shown how they can be used to model classical information and complementary observables. The CP construction, a categorical tool to describe probabilistic quantum systems, is also investigated. The last chapter introduces higher categories, surface diagrams and 2-Hilbert spaces, and shows how the language of duality in monoidal 2-categories can be used to reason about quantum protocols, including quantum teleportation and dense coding. Prior knowledge of linear algebra, quantum information or category theory would give an ideal background for studying this text, but it is not assumed, with essential background material given in a self-contained introductory chapter. Throughout the text links with many other areas are highlighted, such as representation theory, topology, quantum algebra, knot theory, and probability theory, and nonstandard models are presented, such as sets and relations. All results are stated rigorously, and full proofs are given as far as possible, making this book an invaluable reference for modern techniques in quantum logic, with much of the material not available in any other textbook.

An Introduction to Groups, Groupoids and Their Representations-Alberto Ibort 2019-11-06 This book offers an introduction to the theory of groupoids and their representations encompassing the standard theory of groups. Using a categorical language, developed from simple examples, the theory of finite groupoids is shown to knit neatly with that of groups and their structure as well as that of their representations is described. The book comprises numerous examples and applications, including well-known games and puzzles, databases and physics applications. Key concepts have been presented using only basic notions so that it can be used both by students and researchers interested in the subject. Category theory is the natural language that is being used to develop the theory of groupoids. However, categorical presentations of mathematical subjects tend to become highly abstract very fast and out of reach of many potential users. To avoid this, foundations of the theory, starting with simple examples, have been developed and used to study the structure of finite groups and groupoids. The appropriate language and notions from category theory have been developed for students of mathematics and theoretical physics. The book presents the theory on the same level as the ordinary and elementary theories of finite groups and their representations, and provides a unified picture of the same. The structure of the algebra of finite groupoids is analysed, along with the classical theory of characters of their representations. Unnecessary complications in the formal presentation of the subject are avoided. The book offers an introduction to the language of category theory in the concrete setting of finite sets. It also shows how this perspective provides a common ground for various problems and applications, ranging from combinatorics, the topology of graphs, structure of databases and quantum physics.

Introduction to Coalgebra-

Categories for the Working Mathematician-Saunders Mac Lane 2013-04-17 An array of general ideas useful in a wide variety of fields. Starting from the foundations, this book illuminates the concepts of category, functor, natural transformation, and duality. It then turns to adjoint functors, which provide a description of universal constructions, an analysis of the representations of functors by sets of morphisms, and a means of manipulating direct and inverse limits. These categorical concepts are extensively illustrated in the remaining chapters, which include many applications of the basic existence theorem for adjoint functors. The categories of algebraic systems are constructed from certain adjoint-like data and characterised by Beck's theorem. After considering a variety of applications, the book continues with the construction and exploitation of Kan extensions. This second edition includes a number of revisions and additions, including new chapters on topics of active interest: symmetric monoidal categories and braided monoidal categories, and the coherence theorems for them, as well as 2-categories and the higher dimensional categories which have recently come into prominence.

Mathematical Logic and Theoretical Computer Science-David Kueker 2020-12-18 Mathematical Logic and Theoretical Computer Science covers various topics ranging from recursion theory to Zariski topoi. Leading international authorities discuss selected topics in a number of areas, including denotational semanitcs, reccuriosn theoretic aspects fo computer science, model theory and algebra, Automath and automated reasoning, stability theory, topoi and mathematics, and topoi and logic. The most up-to-date review available in its field, Mathematical Logic and Theoretical Computer Science will be of interest to mathematical logicians, computer scientists, algebraists, algebraic geometers, differential geometers, differential topologists, and graduate students in mathematics and computer science.

Categories and Computer Science-R. F. C. Walters 1991 Provides an introduction to category theory whilst retaining a level of mathematical correctness, thus appealing to students of both computer science and mathematics.

Categorical Logic and Type Theory-B. Jacobs 2001-05-24 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.

Category Theory for Computing Science-Michael Barr 1995 A wide coverage of topics in category theory and computer science is developed in this text, including introductory treatments of cartesian closed categories, sketches and elementary categorical model theory, and triples. Over 300 exercises are included.

Computational Category Theory-David E. Rydeheard 1988

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.

Basic Notions of Algebra-Igor R. Shafarevich 2006-03-30 Wholeheartedly recommended to every student and user of mathematics, this is an extremely original and highly informative essay on algebra and its place in modern mathematics and science. From the fields studied in every university maths course, through Lie groups to cohomology and category theory, the author shows how the origins of each concept can be related to attempts to model phenomena in physics or in other branches of mathematics. Required reading for mathematicians, from beginners to experts.

Abstract and Concrete Categories-Jiri Adamek 2009-01-01 This up-to-date introductory treatment employs the language of category theory to explore the theory of structures. Its unique approach stresses concrete categories, and each categorical notion features several examples that clearly illustrate specific and general cases. A systematic view of factorization structures, this volume contains seven chapters. The first five focus on basic theory, and the final two explore more recent research results in the realm of concrete categories, cartesian closed categories, and quasitopoi. Suitable for advanced undergraduate and graduate students, it requires an elementary knowledge of set theory and can be used as a reference as well as a text. Updated by the authors in 2004, it offers a unifying perspective on earlier work and summarizes recent developments.

Linear Algebra Problem Book-Paul R. Halmos 1995-12-31 Linear Algebra Problem Book can be either the main course or the dessert for someone who needs linear algebraand today that means every user of mathematics. It can be used as the basis of either an official course or a program of private study. If used as a course, the book can stand by itself, or if so desired, it can be stirred in with a standard linear algebra course as the seasoning that provides the interest, the challenge, and the motivation that is needed by experienced scholars as much as by beginning students. The best way to learn is to do, and the purpose of this book is to get the reader to DO linear algebra. The approach is Socratic: first ask a question, then give a hint (if necessary), then, finally, for security and completeness, provide the detailed answer.

Conceptual Mathematics-F. William Lawvere 2009-07-30 In the last 60 years, the use of the notion of category has led to a remarkable unification and simplification of mathematics. Conceptual Mathematics introduces this tool for the learning, development, and use of mathematics, to beginning students and also to practising mathematical scientists. This book provides a skeleton key that makes explicit some concepts and procedures that are common to all branches of pure and applied mathematics. The treatment does not presuppose knowledge of specific fields, but rather develops, from basic definitions, such elementary categories as discrete dynamical systems and directed graphs; the fundamental ideas are then illuminated by examples in these categories. This second edition provides links with more advanced topics of possible study. In the new appendices and annotated bibliography the reader will find concise introductions to adjoint functors and geometrical structures, as well as sketches of relevant historical developments.

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 naturaltransformations, 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.

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.

Categories for Types-Roy L. Crole 1993 This textbook explains the basic principles of categorical type theory and the techniques used to derive categorical semantics for specific type theories. It introduces the reader to ordered set theory, lattices and domains, and this material provides plenty of examples for an introduction to category theory, which covers categories, functors, natural transformations, the Yoneda lemma, cartesian closed categories, limits, adjunctions and indexed categories. Four kinds of formal system are considered in detail, namely algebraic, functional, polymorphic functional, and higher order polymorphic functional type theory. For each of these the categorical semantics are derived and results about the type systems are proved categorically. Issues of soundness and completeness are also considered. Aimed at advanced undergraduates and beginning graduates, this book will be of interest to theoretical computer scientists, logicians and mathematicians specializing in category theory.

Virtual Topology and Functor Geometry-Fred Van Oystaeyen 2007-11-15 Intrinsically noncommutative spaces today are considered from the perspective of several branches of modern physics, including quantum gravity, string theory, and statistical physics. From this point of view, it is ideal to devise a concept of space and its geometry that is fundamentally noncommutative. Providing a clear introduction to noncommutative topology, Virtual Topology and Functor Geometry explores new aspects of these areas as well as more established facets of noncommutative algebra. Presenting the material in an easy, colloquial style to facilitate understanding, the book begins with an introduction to category theory, followed by a chapter on noncommutative spaces. This chapter examines noncommutative lattices, noncommutative opens, sheaf theory, the generalized Stone space, and Grothendieck topology. The author then studies Grothendieck categorical representations to formulate an abstract notion of "affine open". The final chapter proposes a dynamical version of topology and sheaf theory, providing at least one solution of the problem of sheafification independent of generalizations of topos theory. By presenting new ideas for the development of an intrinsically noncommutative geometry, this book fosters the further unification of different kinds of noncommutative geometry and the expression of observations that involve natural phenomena.

A Functorial Model Theory-Cyrus F. Nourani 2016-04-19 This book is an introduction to a functorial model theory based on infinitary language categories. The author introduces the properties and foundation of these categories before developing a model theory for functors starting with a countable fragment of an infinitary language. He also presents a new technique for generating generic models with categories by inventing infinite language categories and functorial model theory. In addition, the book covers string models, limit models, and functorial models.

From Categories to Homotopy Theory-Birgit Richter 2020-04-16 Category theory provides structure for the mathematical world and is seen everywhere in modern mathematics. With this book, the author bridges the gap between pure category theory and its numerous applications in homotopy theory, providing the necessary background information to make the subject accessible to graduate students or researchers with a background in algebraic topology and algebra. The reader is first introduced to category theory, starting with basic definitions and concepts before progressing to more advanced themes. Concrete examples and exercises illustrate the topics, ranging from colimits to constructions such as the Day convolution product. Part II covers important applications of category theory, giving a thorough introduction to simplicial objects including an account of quasi-categories and Segal sets. Diagram categories play a central role throughout the book, giving rise to models of iterated loop spaces, and feature prominently in functor homology and homology of small categories.

Comprehensive Mathematics for Computer Scientists 1-Guerino Mazzola 2006-10-05 Contains all the mathematics that computer scientists need to know in one place.

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.

Introduction to Abelian Model Structures and Gorenstein Homological Dimensions-Marco A. P. Bullones 2016-08-19 Introduction to Abelian Model Structures and Gorenstein Homological Dimensions provides a starting point to study the relationship between homological and homotopical algebra, a very active branch of mathematics. The book shows how to obtain new model structures in homological algebra by constructing a pair of compatible complete cotorsion pairs related to a specific homological dimension and then applying the Hovey Correspondence to generate an abelian model structure. The first part of the book introduces the definitions and notations of the universal constructions most often used in category theory. The next part presents a proof of the Eklof and Trlifaj theorem in Grothedieck categories and covers M. Hovey’s work that connects the theories of cotorsion pairs and model categories. The final two parts study the relationship between model structures and classical and Gorenstein homological dimensions and explore special types of Grothendieck categories known as Gorenstein categories. As self-contained as possible, this book presents new results in relative homological algebra and model category theory. The author also re-proves some established results using different arguments or from a pedagogical point of view. In addition, he proves folklore results that are difficult to locate in the literature.

Algebra: Chapter 0-Paolo Aluffi 2009 Algebra: Chapter 0 is a self-contained introduction to the main topics of algebra, suitable for a first sequence on the subject at the beginning graduate or upper undergraduate level. The primary distinguishing feature of the book, compared to standard textbooks in algebra, is the early introduction of categories, used as a unifying theme in the presentation of the main topics. A second feature consists of an emphasis on homological algebra: basic notions on complexes are presented as soon as modules have been introduced, and an extensive last chapter on homological algebra can form the basis for a follow-up introductory course on the subject. Approximately 1,000 exercises both provide adequate practice to consolidate the understanding of the main body of the text and offer the opportunity to explore many other topics, including applications to number theory and algebraic geometry. This will allow instructors to adapt the textbook to their specific choice of topics and provide the independent reader with a richer exposure to algebra. Many exercises include substantial hints, and navigation of the topics is facilitated by an extensive index and by hundreds of cross-references.

Introduction to Higher-Order Categorical Logic-J. Lambek 1988-03-25 Part I indicates that typed-calculi are a formulation of higher-order logic, and cartesian closed categories are essentially the same. Part II demonstrates that another formulation of higher-order logic is closely related to topos theory.