Category Theory For The Sciences The Mit Press

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Basic Category

Theory for Computer Scientists Cambridge University Press 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.

Higher Topos Theory (AM-170) Springer Science & Business Media 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 undergradute computer scientists, and yet retains a level of mathematical correctness that will broaden its appeal to include students of mathematics new to category theory.

Categories for the Working Philosopher Springer Science & Business Media
A short introduction ideal for students learning category theory for the first time.

Sheaf Theory through Examples Springer Science & Business Media
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.

Categories for the Working Mathematician MIT Press
A brilliant mathematician examines the complexity of gender and society and forges a path out of inequality. Why are men in charge? After years in the male-dominated field of mathematics and in the female-dominated field of art, Eugenia Cheng has heard the question many times. In x + y, Cheng argues that her mathematical specialty -- category theory -- reveals why. Category theory deals more with context, relationships, and nuanced versions of equality than with intrinsic characteristics. Category theory also emphasizes dimensionality: much as a cube can cast a square or diamond shadow, depending on your perspective, so too do gender politics appear to change with how we examine them. Because society often rewards traits that it associates with males, such as

competitiveness, we treat the problems those traits can create as male. But putting competitive women in charge will leave many unjust relationships in place. If we want real change, we need to transform the contexts in which we all exist, and not simply who we think we are. Praise for Eugenia Cheng "[Eugenia Cheng's] tone is clear, clever and friendly . . . she is rigorous and insightful. . . . [She is] a lucid and nimble expositor." --- Alex Bellos, New York Times Book Review "Dr. Cheng . . . has a knack for brushing aside conventions and edicts, like so many pie crumbs from a cutting board." --- Natalie Angier, New York Times

Category Theory for Programmers (Scala Edition, Paperback) Oxford University Press

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 natur altransformations, 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.

2-Dimensional Categories Edinburgh University Press 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.

Diagrammatic Immanence Mit Press 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.

Category Theory for the Sciences Basic Books
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.
Category Theory for Computing Science Oxford University Press
This book has a fundamental relationship to the International Seminar on Fuzzy Set Theory held each September in Linz, Austria. First, this volume is an extended account of the eleventh Seminar of 1989. Second, and more importantly, it is the culmination of the tradition of the preceding ten Seminars. The purpose of the Linz Seminar, since its inception, was and is to foster the development of the mathematical aspects of fuzzy sets. In the earlier years, this was accomplished by bringing together for a week small grou ps of mathematicians in various fields in an intimate, focused environment which promoted much informal, critical discussion in addition to formal presentations. Beginning with the tenth Seminar, the intimate setting was retained, but each Seminar narrowed in theme; and participation was broadened to include both younger scholars within, and established mathematicians outside, the mathematical mainstream of

fuzzy sets theory. Most of the material of this book was developed over the years in close association with the Seminar or influenced by what transpired at Linz. For much of the content, it played a crucial role in either stimulating this material or in providing feedback and the necessary screening of ideas. Thus we may fairly say that the book, and the eleventh Seminar to which it is directly related, are in many respects a culmination of the previous Seminars.

Category Theory in Physics, Mathematics, and Philosophy
Springer Science & Business Media
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.

Category Theory
MIT Press
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
MIT Press

Using basic category theory, this Element describes all the central concepts and proves the main theorems of theoretical computer science. Category theory, which works with functions, processes, and structures, is uniquely qualified to present the fundamental results of theoretical computer science. In this Element, readers will meet some of the deepest ideas and theorems of modern computers and mathematics, such as Turing machines, unsolvable problems, the P=NP question, Kurt Gödel's incompleteness theorem, intractable problems, cryptographic protocols, Alan Turing's Halting problem, and much more. The concepts come alive with many examples and exercises.

From Categories to Homotopy Theory
Cambridge University Press

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.

Elementary

Categories, Elementary Toposes MIT Press A renewal of immanent metaphysics through diagrammatic methods and the tools of category theorySpinoza, Peirce and Deleuze are, in different ways, philosophers of immanence. Rocco Gangle addresses the methodological questions raised by a commitment to immanence in terms of how diagrams may be used both as tools and as objects of philosophical investigation. He integrates insights from Spinozist metaphysics, Peircean semiotics and Deleuzes philosophy of difference in conjunction with the formal operations of category theory. Category theory reveals deep structural connections among logic, topology and a variety of different areas of mathematics, and it provides constructive and rigorous concepts for investigating how diagrams work. Gangle introduces the methods of category theory from a philosophical and diagrammatic perspective, allowing philosophers with little or no mathematical training to come to grips with this important field. This coordination of immanent metaphysics, diagrammatic method and category theoretical mathematics opens a new horizon for contemporary thought.

Applications of Category Theory to Fuzzy Subsets Oxford University Press 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.

Categories for Quantum Theory
Birkhäuser
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.

Introduction to Infinity-Categories Oxford University Press

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.

Proof and the Art of Mathematics Gulf Professional Publishing

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

Axiomatic Method and Category Theory Cambridge University Press

This book develops the theory of infinite-

dimensional categories
by studying the
universe, or ?-cosmos,
in which they live.