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Conceptual Mathematics

KEAGAN KENNEDI

Categories, Types, and Structures Courier Corporation
"This accessible approach to set theory for upper-level undergraduates poses rigorous but simple arguments. Each definition is accompanied by commentary that motivates and explains new concepts. A historical introduction is followed by discussions of classes and sets, functions, natural and cardinal numbers, the arithmetic of ordinal numbers, and related topics. 1971 edition with new material by the author"--
Abstract and Concrete Categories MIT Press

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.

An Invitation to Model Theory Springer Science & Business Media

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.

The Structure of Models of Peano Arithmetic Springer Nature

Science need not be dull and bogged down by jargon, as Richard Dawkins proves in this entertaining look at evolution. The themes he takes up are the concepts of altruistic and selfish behaviour; the genetical definition of selfish interest; the evolution of aggressive behaviour; kinshiptheory; sex ratio theory; reciprocal altruism; deceit; and the natural selection of sex differences. 'Should be read, can be read by almost anyone. It describes with great skill a new face of the theory of evolution.' W.D. Hamilton, Science

Godel's Incompleteness Theorems Oxford University Press

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

Axiomatic Method and Category Theory Cambridge University Press

This truly elementary book on categories introduces retracts, graphs, and adjoints to students and scientists.

Fibring Logics Oxford University Press, USA

This book develops a theory of enriched

meanings for natural language interpretation that uses the concept of monads and related ideas from category theory, a branch of mathematics that has been influential in theoretical computer science and elsewhere. Certain expressions that exhibit complex effects at the semantics/pragmatics boundary live in an enriched meaning space, while others live in a more basic meaning space. These basic meanings are mapped to enriched meanings only when required compositionally, which avoids generalizing meanings to the worst case. Ash Asudeh and Gianluca Giorgolo show that the monadic theory of enriched meanings offers a formally and computationally well-defined way to tackle important challenges at the semantics/pragmatics boundary. In particular, they develop innovative monadic analyses of three phenomena - conventional implicature, substitution puzzles, and conjunction fallacies - and demonstrate that the compositional properties of monads model linguistic intuitions about these cases particularly well. The analyses are accompanied by exercises to aid understanding, and the computational tools used are available on the book's companion website. The book also contains background chapters on enriched meanings and category

theory. The volume is interdisciplinary in nature, with insights from semantics, pragmatics, philosophy of language, psychology, and computer science, and will appeal to graduate students and researchers from a wide range of disciplines with an interest in natural language understanding and representation.

Sketches of an Elephant: A Topos Theory Compendium

Oxford University Press

The interplay between computability and randomness has been an active area of research in recent years, reflected by ample funding in the USA, numerous workshops, and publications on the subject. The complexity and the randomness aspect of a set of natural numbers are closely related. Traditionally, computability theory is concerned with the complexity aspect. However, computability theoretic tools can also be used to introduce mathematical counterparts for the intuitive notion of randomness of a set. Recent research shows that, conversely, concepts and methods originating from randomness enrich computability theory. The book covers topics such as lowness and highness properties, Kolmogorov complexity, betting strategies and higher computability. Both the basics and recent research results are desribed, providing a

very readable introduction to the exciting interface of computability and randomness for graduates and researchers in computability theory, theoretical computer science, and measure theory.

An Introduction to Category Theory Oxford University Press Aimed at graduate students, research logicians and mathematicians, this much-awaited text covers over 40 years of work on relative classification theory for nonstandard models of arithmetic. The book covers basic isomorphism invariants: families of type realized in a model, lattices of elementary substructures and automorphism groups.

Category Theory in Physics, Mathematics, and Philosophy Oxford University Press According to Grothendieck, the notion of topos is "the bed or deep river where come to be married geometry and algebra, topology and arithmetic, mathematical logic and category theory, the world of the continuous and that of discontinuous or discrete structures". It is what he had "conceived of most broad to perceive with finesse, by the same language rich of geometric resonances, an "essence" which is common to situations most distant from each other, coming from one region or another of the vast universe of mathematical things". The aim of this book is

to present a theory and a number of techniques which allow to give substance to Grothendieck's vision by building on the notion of classifying topos educed by categorical logicians. Mathematical theories (formalized within first-order logic) give rise to geometric objects called sites; the passage from sites to their associated toposes embodies the passage from the logical presentation of theories to their mathematical content, i.e. from syntax to semantics. The essential ambiguity given by the fact that any topos is associated in general with an infinite number of theories or different sites allows to study the relations between different theories, and hence the theories themselves, by using toposes as 'bridges' between these different presentations. The expression or calculation of invariants of toposes in terms of the theories associated with them or their sites of definition generates a great number of results and notions varying according to the different types of presentation, giving rise to a veritable mathematical morphogenesis.

Category Theory
Clarendon Press
This up-to-date introductory treatment employs category theory to explore the theory of structures. Its unique approach stresses concrete categories and presents a systematic view of factorization

structures, offering a unifying perspective on earlier work and summarizing recent developments. Numerous examples, ranging from general to specific, illuminate the text. 1990 edition, updated 2004.

Categories for the Working Philosopher

Oxford Studies in Semantics an

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.

Sets for Mathematics

Oxford University Press

Modern applications of logic, in mathematics, theoretical computer science, and linguistics, require combined systems involving many different logics working together. In this book the author offers a basic methodology for combining-or fibring-systems. This means that many existing complex systems can be broken down into simpler components, hence making them much easier to manipulate. Using this methodology the book discusses ways of obtaining a wide variety of multimodal, modal intuitionistic, modal substructural and fuzzy systems in a uniform way. It also covers self-fibred languages which allow formulae to apply to

themselves. The book also studies sufficient conditions for transferring properties of the component logics into properties of the combined system.

An Invitation to Applied Category Theory MIT Press (MA) 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.

Computability and Randomness Polimetrica s.a.s. 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.

Basic Category Theory for Computer Scientists Cambridge University Press

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.

What is Category Theory? Cambridge University Press

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.

Introduction to Higher-Order Categorical Logic Oxford University Press

Assuming no previous study in logic, this informal yet rigorous text covers the material of a standard undergraduate first course in mathematical logic, using natural deduction and leading up to the completeness theorem for first-order logic. At each stage of the text, the reader is given an intuition based on standard

mathematical practice, which is subsequently developed with clean formal mathematics. Alongside the practical examples, readers learn what can and can't be calculated; for example the correctness of a derivation proving a given sequent can be tested mechanically, but there is no general mechanical test for the existence of a derivation proving the given sequent. The undecidability results are proved rigorously in an optional final chapter, assuming Matiyasevich's theorem characterising the computably enumerable relations. Rigorous proofs of the adequacy and completeness proofs of the relevant logics are provided, with careful attention to the languages involved. Optional sections discuss the classification of mathematical structures by first-order theories; the required theory of cardinality is developed from scratch. Throughout the book there are notes on historical aspects of the material, and connections with linguistics and computer science, and the discussion of syntax and semantics is influenced by modern linguistic approaches. Two basic themes in recent cognitive science studies of actual human reasoning are also introduced. Including extensive exercises and selected solutions, this text is ideal for students in

Logic, Mathematics, Philosophy, and Computer Science.

Categories for Quantum Theory
Clarendon Press
A unique new book exploring Bernard Bolzano's Wissenschaftslehre (Theory of Science) and introducing a formal system to examine the logic presented in Bolzano's work.

Cardinal Arithmetic
Oxford University Press on Demand
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.