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Analysis On Manifolds Calculus on Manifolds Introduction to Topological Manifolds Topology Basic Category Theory Multivariable Mathematics Topology from the Differentiable Viewpoint Advanced Calculus Introduction to Smooth Manifolds An Introduction to Manifolds Elementary Differential Topology Differential Topology Foundational Essays on Topological Manifolds, Smoothings, and Triangulations Advanced Calculus Topology Through Inquiry Elementary Linear Algebra Advanced Calculus Introduction to Topology From Differential Geometry to Non-commutative Geometry and Topology From Calculus to Cohomology Computational Topology for Data Analysis Advanced Calculus of Several Variables An Introduction to Riemannian Geometry Embeddings in Manifolds Elementary Topology A Visual Introduction to Differential Forms and Calculus on Manifolds Differential Geometry, Lie Groups, and Symmetric Spaces Elements of Differential Topology Introduction to Topology Introduction to Differential Topology Beginning Topology Manifolds and Differential Geometry Complex Analysis Elements Of Algebraic Topology Hamilton's Ricci Flow Characteristic Classes Exotic Smoothness and Physics All the Mathematics You Missed Foundations of Analysis Problems and Solutions in Differential Geometry, Lie Series, Differential Forms, Relativity and Applications

This text explains nontrivial applications of metric space topology to analysis. Covers metric space, point-set topology, and algebraic topology. Includes exercises, selected answers, and 51 illustrations. 1983 edition. This book uses elementary versions of modern methods found in sophisticated mathematics to discuss portions of "advanced calculus" in which the subtlety of the concepts and methods makes rigor difficult to attain at an elementary level. Exercises in the text, especially in the first part of the book. Author states, that they have to be solved, without the solutions, the text is incomplete. Includes also problems after each chapter This book is intended as an elementary introduction to differential manifolds. The authors concentrate on the intuitive geometric aspects and explain not only the basic properties but also teach how to do the basic geometrical constructions. An integral part of the work are the many diagrams which illustrate the proofs. The text is liberally supplied with exercises and will be welcomed by students with some basic knowledge of analysis and topology. Derived from the author's course on the subject, Elements of Differential Topology explores the vast and elegant theories in topology developed by Morse, Thom, Smale, Whitney, Milnor, and others. It begins with differential and integral calculus, leads you through the intricacies of manifold theory, and concludes with discussions on algebraic topol Beginning Topology is designed to give undergraduate students a broad notion of the scope of topology in areas of point-set, geometric, combinatorial, differential, and algebraic topology, including an introduction to knot theory. A primary goal is to expose students to some recent research and to get them actively involved in learning. Exercises and open-ended projects are placed throughout the text, making it adaptable to seminar-style classes. The book starts with a chapter introducing the basic concepts of point-set topology, with examples chosen to captivate students' imaginations while illustrating the need for rigor. Most of the material in this and the next two chapters is essential for the remainder of the book. One can then choose from chapters on map coloring, vector fields on surfaces, the fundamental group, and knot theory. A solid foundation in calculus is necessary, with some differential equations and basic group theory helpful in a couple of chapters. Topics are chosen to appeal to a wide variety of students: primarily upper-level math majors, but also a few freshmen and sophomores as well as graduate students from physics, economics, and computer science. All students will benefit from seeing the interaction of topology with other fields of mathematics and science; some will be motivated to continue with a more in-depth, rigorous study of topology. Multivariable Mathematics combines linear algebra and multivariable mathematics in a rigorous approach. The material is integrated to emphasize the recurring theme of implicit versus explicit that persists in linear algebra and analysis. In the text, the author includes all of the standard computational material found in the usual linear algebra and multivariable calculus courses, and more, interweaving the material as effectively as possible, and also includes complete proofs. * Contains plenty of examples, clear proofs, and significant motivation for the crucial concepts. * Numerous exercises of varying levels of difficulty, both computational and more proof-oriented. * Exercises are arranged in order of increasing difficulty. An introductory textbook on cohomology and curvature with emphasis on applications. Elements of Algebraic Topology provides the most concrete approach to the subject. With coverage of homology and cohomology theory, universal coefficient theorems, Kunneth theorem, duality in manifolds, and applications to classical theorems of point-set topology, this book is perfect for comunicating complex topics and the fun nature of algebraic topology for beginners. For a senior undergraduate or first year graduate-level course in Introduction to Topology. Appropriate for a one-semester course on both general and algebraic topology or separate courses treating each topic separately. This title is part of the Pearson Modern Classics series. Pearson Modern Classics are acclaimed titles at a value price. Please visit www.pearsonhighered.com/math-classics-series for a complete list of titles. This text is designed to provide instructors with a convenient single text resource for bridging between general and algebraic topology courses. Two separate, distinct sections (one on general, point set topology, the other on algebraic topology) are each suitable for a one-semester course and are based around the same set of basic, core topics. Optional, independent topics and applications can be studied and developed in depth depending on course needs and preferences. Author has written several excellent Springer books.; This book is a sequel to Introduction to Topological Manifolds; Careful and illuminating explanations, excellent diagrams and exemplary motivation; Includes short preliminary sections before each section explaining what is ahead and why An authorised reissue of the long out of print classic textbook, Advanced Calculus by the late Dr Lynn Loomis and Dr Shlomo Sternberg both of Harvard University has been a revered but hard to find textbook for the advanced calculus course for decades. This book is based on an honors course in advanced calculus that the authors gave in the 1960's. The foundational material, presented in the unstarred sections of Chapters 1 through 11, was normally covered, but different applications of this basic material were stressed from year to year, and the book therefore contains more material than was covered in any one year. It can accordingly be used (with omissions) as a text for a year's course in advanced calculus, or as a text for a three-semester introduction to analysis. The prerequisites are a good grounding in the calculus of one variable from a mathematically rigorous point of view, together with some acquaintance with linear algebra. The reader should be familiar with limit and continuity type arguments and have a certain amount of mathematical sophistication. As possible introductory texts, we mention Differential and Integral Calculus by R Courant, Calculus by T Apostol, Calculus by M Spivak, and Pure Mathematics by G Hardy. The reader should also have some experience with partial derivatives. In overall plan the book divides roughly into a first half which develops the calculus (principally the differential calculus) in the setting of normed vector spaces, and a second half which deals with the calculus of differentiable manifolds. This elegant book by distinguished mathematician John Milnor, provides a clear and succinct introduction to one of the most important subjects in modern mathematics. Beginning with basic concepts such as diffeomorphisms and smooth manifolds, he goes on to examine tangent spaces, oriented manifolds, and vector fields. Key concepts such as homotopy, the index number of a map, and the Pontryagin construction are discussed. The author presents proofs of Sard's theorem and the Hopf theorem. This volume presents a collection of problems and solutions in differential geometry with applications. Both introductory and advanced topics are introduced in an easy-to-digest manner, with the materials of the volume being self-contained. In particular, curves, surfaces, Riemannian and pseudo-Riemannian manifolds, Hodge duality operator, vector fields and Lie series, differential forms, matrix-valued differential forms, Maurer–Cartan form, and the Lie derivative are covered. Readers will find useful applications to special and general relativity, Yang–Mills theory, hydrodynamics and field theory. Besides the solved problems, each chapter contains stimulating supplementary problems and software implementations are also included. The volume will not only benefit students in mathematics, applied mathematics and theoretical physics, but also researchers in the field of differential geometry. Request Inspection Copy Differential geometry began as the study of curves and surfaces using the methods of calculus. In time, the notions of curve and surface were generalized along with associated notions such as length, volume, and curvature. At the same time the topic has become closely allied with developments in topology. The basic object is a smooth manifold, to which some extra structure has been attached, such as a Riemannian metric, a symplectic form, a distinguished group of symmetries, or a connection on the tangent bundle. This book is a graduate-level introduction to the tools and structures of modern differential geometry. Included are the topics usually found in a course on differentiable manifolds, such as vector bundles, tensors, differential forms, de Rham cohomology, the Frobenius theorem and basic Lie group theory. The book also contains material on the general theory of connections on vector bundles and an in-depth chapter on semi-Riemannian geometry that covers basic material about Riemannian manifolds and Lorentz manifolds. An unusual feature of the book is the inclusion of an early chapter on the differential geometry of hypersurfaces in Euclidean space. There is also a section that derives the exterior calculus version of Maxwell's equations. The first chapters of the book are suitable for a one-semester course on manifolds. There is more than enough material for a year-long course on manifolds and geometry. Topological data analysis (TDA) has emerged recently as a viable tool for analyzing complex data, and the area has grown substantially both in its methodologies and applicability. Providing a computational and algorithmic foundation for techniques in TDA, this comprehensive, self-contained text introduces students and researchers in mathematics and computer science to the current state of the field. The book features a description of mathematical objects and constructs behind recent advances, the algorithms involved, computational considerations, as well as examples of topological structures or ideas that can be used in applications. It provides a thorough treatment of persistent homology together with various extensions – like zigzag persistence and multiparameter persistence – and their applications to different types of data, like point clouds, triangulations, or graph data. Other important topics covered include discrete Morse theory, the Mapper structure, optimal generating cycles, as well as recent advances in embedding TDA within machine learning frameworks. Many Christians have an easier time being saved by grace than they do living in grace every day. But grace is at the center of the life God calls us to--and reflects the heart of the One who calls.These studies in Grace will help you make the connection between grace as a remote biblical concept and grace as a lifestyle--a reality you experience day in, day out. Through an unfolding study of Psalm 23, you'll learn how God--our Good Shepherd--is for you, how he longs to walk with you through temptation, sorrow, and even deep regret. You'll discover God's desire to make his joy your joy. Throughout, you'll learn how enduring, powerful, and life-affirming God's work in your life can be---and rediscover why it's called amazing grace.Leader's guide included!Grace group sessions are:Living in GraceGrace for RegretsSustaining GraceDelighting in GraceA Legacy of GraceGrace ForeverGrace to Share A great book ... a necessary item in any mathematical library. --S. S. Chern, University of California A brilliant book: rigorous, tightly organized, and covering a vast amount of good mathematics. --Barrett O'Neill, University of California This is obviously a very valuable and well thought-out book on an important subject. --Andre Weil, Institute for

Advanced Study The study of homogeneous spaces provides excellent insights into both differential geometry and Lie groups. In geometry, for instance, general theorems and properties will also hold for homogeneous spaces, and will usually be easier to understand and to prove in this setting. For Lie groups, a significant amount of analysis either begins with or reduces to analysis on homogeneous spaces, frequently on symmetric spaces. For many years and for many mathematicians, Sigurdur Helgason's classic Differential Geometry, Lie Groups, and Symmetric Spaces has been--and continues to be--the standard source for this material. Helgason begins with a concise, self-contained introduction to differential geometry. Next is a careful treatment of the foundations of the theory of Lie groups, presented in a manner that since 1962 has served as a model to a number of subsequent authors. This sets the stage for the introduction and study of symmetric spaces, which form the central part of the book. The text concludes with the classification of symmetric spaces by means of the Killing-Cartan classification of simple Lie algebras over $\mathbb{C}$ and Cartan's classification of simple Lie algebras over $\mathbb{R}$, following a method of Victor Kac. The excellent exposition is supplemented by extensive collections of useful exercises at the end of each chapter. All of the problems have either solutions or substantial hints, found at the back of the book. For this edition, the author has made corrections and added helpful notes and useful references. Sigurdur Helgason was awarded the Steele Prize for Differential Geometry, Lie Groups, and Symmetric Spaces and Groups and Geometric Analysis. Topology Through Inquiry is a comprehensive introduction to point-set, algebraic, and geometric topology, designed to support inquiry-based learning (IBL) courses for upper-division undergraduate or beginning graduate students. The book presents an enormous amount of topology, allowing an instructor to choose which topics to treat. The point-set material contains many interesting topics well beyond the basic core, including continua and metrizability. Geometric and algebraic topology topics include the classification of 2-manifolds, the fundamental group, covering spaces, and homology (simplicial and singular). A unique feature of the introduction to homology is to convey a clear geometric motivation by starting with mod 2 coefficients. The authors are acknowledged masters of IBL-style teaching. This book gives students joy-filled, manageable challenges that incrementally develop their knowledge and skills. The exposition includes insightful framing of fruitful points of view as well as advice on effective thinking and learning. The text presumes only a modest level of mathematical maturity to begin, but students who work their way through this text will grow from mathematics students into mathematicians. Michael Starbird is a University of Texas Distinguished Teaching Professor of Mathematics. Among his works are two other co-authored books in the Mathematical Association of America's (MAA) Textbook series. Francis Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College and a past president of the MAA. Both authors are award-winning teachers, including each having received the MAA's Haimo Award for distinguished teaching. Starbird and Su are, jointly and individually, on lifelong missions to make learning—of mathematics and beyond—joyful, effective, and available to everyone. This book invites topology students and teachers to join in the adventure. This book aims to provide a friendly introduction to non-commutative geometry. It studies index theory from a classical differential geometry perspective up to the point where classical differential geometry methods become insufficient. It then presents non-commutative geometry as a natural continuation of classical differential geometry. It thereby aims to provide a natural link between classical differential geometry and non-commutative geometry. The book shows that the index formula is a topological statement, and ends with non-commutative topology. A readable introduction to the subject of calculus on arbitrary surfaces or manifolds. Accessible to readers with knowledge of basic calculus and linear algebra. Sections include series of problems to reinforce concepts. Manifolds, the higher-dimensional analogs of smooth curves and surfaces, are fundamental objects in modern mathematics. Combining aspects of algebra, topology, and analysis, manifolds have also been applied to classical mechanics, general relativity, and quantum field theory. In this streamlined introduction to the subject, the theory of manifolds is presented with the aim of helping the reader achieve a rapid mastery of the essential topics. By the end of the book the reader should be able to compute, at least for simple spaces, one of the most basic topological invariants of a manifold, its de Rham cohomology. Along the way, the reader acquires the knowledge and skills necessary for further study of geometry and topology. The requisite point-set topology is included in an appendix of twenty pages; other appendices review facts from real analysis and linear algebra. Hints and solutions are provided to many of the exercises and problems. This work may be used as the text for a one-semester graduate or advanced undergraduate course, as well as by students engaged in self-study. Requiring only minimal undergraduate prerequisites, 'Introduction to Manifolds' is also an excellent foundation for Springer's GTM 82, 'Differential Forms in Algebraic Topology'. A short introduction ideal for students learning category theory for the first time. This text contains a detailed introduction to general topology and an introduction to algebraic topology via its most classical and elementary segment. Proofs of theorems are separated from their formulations and are gathered at the end of each chapter, making this book appear like a problem book and also giving it appeal to the expert as a handbook. The book includes about 1,000 exercises. With this second volume, we enter the intriguing world of complex analysis. From the first theorems on, the elegance and sweep of the results is evident. The starting point is the simple idea of extending a function initially given for real values of the argument to one that is defined when the argument is complex. From there, one proceeds to the main properties of holomorphic functions, whose proofs are generally short and quite illuminating: the Cauchy theorems, residues, analytic continuation, the argument principle. With this background, the reader is ready to learn a wealth of additional material connecting the subject with other areas of mathematics: the Fourier transform treated by contour integration, the zeta function and the prime number theorem, and an introduction to elliptic functions culminating in their application to combinatorics and number theory. Thoroughly developing a subject with many ramifications, while striking a careful balance between conceptual insights and the technical underpinnings of rigorous analysis, Complex Analysis will be welcomed by students of mathematics, physics, engineering and other sciences. The Princeton Lectures in Analysis represents a sustained effort to introduce the core areas of mathematical analysis while also illustrating the organic unity between them. Numerous examples and applications throughout its four planned volumes, of which Complex Analysis is the second, highlight the far-reaching consequences of certain ideas in analysis to other fields of mathematics and a variety of sciences. Stein and Shakarchi move from an introduction addressing Fourier series and integrals to in-depth considerations of complex analysis; measure and integration theory, and Hilbert spaces; and, finally, further topics such as functional analysis, distributions and elements of probability theory. The theory of characteristic classes provides a meeting ground for the various disciplines of differential topology, differential and algebraic geometry, cohomology, and fiber bundle theory. As such, it is a fundamental and an essential tool in the study of differentiable manifolds. In this volume, the authors provide a thorough introduction to characteristic classes, with detailed studies of Stiefel-Whitney classes, Chern classes, Pontrjagin classes, and the Euler class. Three appendices cover the basics of cohomology theory and the differential forms approach to characteristic classes, and provide an account of Bernoulli numbers. Based on lecture notes of John Milnor, which first appeared at Princeton University in 1957 and have been widely studied by graduate students of topology ever since, this published version has been completely revised and corrected. Learn the basics of point-set topology with the understanding of its real-world application to a variety of other subjects including science, economics, engineering, and other areas of mathematics. Introduces topology as an important and fascinating mathematics discipline to retain the readers interest in the subject. Is written in an accessible way for readers to understand the usefulness and importance of the application of topology to other fields. Introduces topology concepts combined with their real-world application to subjects such DNA, heart stimulation, population modeling, cosmology, and computer graphics. Covers topics including knot theory, degree theory, dynamical systems and chaos, graph theory, metric spaces, connectedness, and compactness. A useful reference for readers wanting an intuitive introduction to topology.

Annotation The Description for this book, Elementary Differential Topology. (AM-54), will be forthcoming. A topological embedding is a homeomorphism of one space onto a subspace of another. The book analyzes how and when objects like polyhedra or manifolds embed in a given higher-dimensional manifold. The main problem is to determine when two topological embeddings of the same object are equivalent in the sense of differing only by a homeomorphism of the ambient manifold. Knot theory is the special case of spheres smoothly embedded in spheres; in this book, much more general spaces and much more general embeddings are considered. A key aspect of the main problem is taming: when is a topological embedding of a polyhedron equivalent to a piecewise linear embedding? A central theme of the book is the fundamental role played by local homotopy properties of the complement in answering this taming question. The book begins with a fresh description of the various classic examples of wild embeddings (i.e., embeddings inequivalent to piecewise linear embeddings). Engulfing, the fundamental tool of the subject, is developed next. After that, the study of embeddings is organized by codimension (the difference between the ambient dimension and the dimension of the embedded space). In all codimensions greater than two, topological embeddings of compacta are approximated by nicer embeddings, nice embeddings of polyhedra are tamed, topological embeddings of polyhedra are approximated by piecewise linear embeddings, and piecewise linear embeddings are locally unknotted. Complete details of the codimension-three proofs, including the requisite piecewise linear tools, are provided. The treatment of codimension-two embeddings includes a self-contained, elementary exposition of the algebraic invariants needed to construct counterexamples to the approximation and existence of embeddings. The treatment of codimension-one embeddings includes the locally flat approximation theorem for manifolds as well as the characterization of local flatness in terms of local homotopy properties. This book is a high-level introduction to vector calculus based solidly on differential forms. Informal but sophisticated, it is geometrically and physically intuitive yet mathematically rigorous. It offers remarkably diverse applications, physical and mathematical, and provides a firm foundation for further studies. Differential Topology provides an elementary and intuitive introduction to the study of smooth manifolds. In the years since its first publication, Guillemin and Pollack's book has become a standard text on the subject. It is a jewel of mathematical exposition, judiciously picking exactly the right mixture of detail and generality to display the richness within. The text is mostly self-contained, requiring only undergraduate analysis and linear algebra. By relying on a unifying idea--transversality--the authors are able to avoid the use of big machinery or ad hoc techniques to establish the main results. In this way, they present intelligent treatments of important theorems, such as the Lefschetz fixed-point theorem, the Poincaré-Hopf index theorem, and Stokes theorem. The book has a wealth of exercises of various types. Some are routine explorations of the main material. In others, the students are guided step-by-step through proofs of fundamental results, such as the Jordan-Brouwer separation theorem. An exercise section in Chapter 4 leads the student through a construction of de Rham cohomology and a proof of its homotopy invariance. The book is suitable for either an introductory graduate course or an advanced undergraduate course. Unlike many other texts on differential geometry, this textbook also offers interesting applications to geometric mechanics and general relativity. The first part is a concise and self-contained introduction to the basics of manifolds, differential forms, metrics and curvature. The second part studies applications to mechanics and relativity including the proofs of the Hawking and Penrose singularity theorems. It can be independently used for one-semester courses in either of these subjects. The main ideas are illustrated and further developed by numerous examples and over 300 exercises. Detailed solutions are provided for many of these exercises, making An Introduction to Riemannian Geometry ideal for self-study. With a fresh geometric approach that incorporates more than 250 illustrations, this textbook sets itself apart from all others in advanced calculus. Besides the classical capstones--the change of variables formula, implicit and inverse function theorems, the integral theorems of Gauss and Stokes--the text treats other important topics in differential analysis, such as Morse's lemma and the Poincaré lemma. The ideas behind most topics can be understood with just two or three variables. The book incorporates modern computational tools to give visualization real power. Using 2D and 3D graphics, the book offers new insights into fundamental elements of the calculus of differentiable maps. The geometric theme continues with an analysis of the physical meaning of the divergence and the curl at a level of detail not found in other advanced calculus books. This is a textbook for undergraduates and graduate students in mathematics, the physical sciences, and economics. Prerequisites are an introduction to linear algebra and multivariable calculus. There is enough material for a year-long course on advanced calculus and for a variety of semester courses--including topics in geometry. The measured pace of the book, with its extensive examples and illustrations, make it especially suitable for independent study. This book explains and helps readers to develop geometric intuition as it relates to differential forms. It includes over 250 figures to aid understanding and enable readers to visualize the concepts being discussed. The author gradually builds up to the basic ideas and concepts so that definitions, when made, do not appear out of nowhere, and both the importance and role that theorems play is evident as or before they are presented. With a clear writing style and easy-to- understand motivations for each topic, this book is primarily aimed at second- or third-year undergraduate math and physics students with a basic knowledge of vector calculus and linear algebra. Foundations of Analysis has two main goals. The first is to develop in students the mathematical maturity and sophistication they will need as they move through the upper division curriculum. The second is to present a rigorous development of both single and several variable calculus, beginning with a study of the properties of the real number system. The presentation is both thorough and concise, with simple, straightforward explanations. The exercises differ widely in level of abstraction and level of difficulty. They vary from the simple to the quite difficult and from the computational to the theoretical. Each section contains a number of examples designed to illustrate the material in the section and to teach students how to approach the exercises for that section. --Book cover. Ricci flow is a powerful analytic method for studying the geometry and topology of manifolds. This book is an introduction to Ricci flow for graduate students and mathematicians interested in working in the subject. To this end, the first chapter is a review of the relevant basics of Riemannian geometry. For the benefit of the student, the text includes a number of exercises of varying difficulty. The book also provides brief introductions to some general methods of geometric analysis and other geometric flows. Comparisons are made between the Ricci flow and the linear heat equation, mean curvature flow, and other geometric evolution equations whenever possible. Several topics of Hamilton's program are covered, such as short time existence, Harnack inequalities, Ricci solitons, Perelman's no local collapsing theorem, singularity analysis, and ancient solutions. A major direction in Ricci flow, via Hamilton's and Perelman's works, is the use of Ricci flow as an approach to solving the Poincaré conjecture and Thurston's geometrization conjecture. Since Poincaré's time, topologists have been most concerned with three species of manifold. The most primitive of these--the TOP manifolds--remained rather mysterious until 1968, when Kirby discovered his now famous torus unfurling device. A period of rapid progress with TOP manifolds ensued, including, in 1969, Siebenmann's refutation of the Hauptvermutung and the Triangulation Conjecture. Here is the first connected account of Kirby's and Siebenmann's basic research in this area. The five sections of this book are introduced by three articles by the authors that initially appeared between 1968 and 1970. Appendices provide a full discussion of the classification of homotopy tori, including Casson's unpublished work and a consideration of periodicity in topological surgery. Advanced Calculus of Several Variables provides a conceptual treatment of multivariable calculus. This book emphasizes the interplay of geometry, analysis through linear algebra, and approximation of nonlinear mappings by linear ones. The classical applications and computational methods that are responsible for much of the interest and importance of calculus are also considered. This text is organized into six chapters. Chapter I deals with linear algebra and geometry of Euclidean n-space Rn. The multivariable differential calculus is treated in Chapters II and III, while multivariable integral calculus is covered in Chapters IV and V. The last chapter is devoted to venerable problems of the calculus of variations. This publication is intended for students who have completed a standard introductory calculus sequence.

- Analysis On Manifolds
- Calculus On Manifolds
- Introduction To Topological Manifolds
- Topology
- Basic Category Theory
- Multivariable Mathematics
- Topology From The Differentiable Viewpoint
- Advanced Calculus
- Introduction To Smooth Manifolds
- An Introduction To Manifolds
- Elementary Differential Topology
- Differential Topology
- Foundational Essays On Topological Manifolds Smoothings And Triangulations
- Advanced Calculus
- Topology Through Inquiry
- Elementary Linear Algebra
- Advanced Calculus
- Introduction To Topology
- From Differential Geometry To Non commutative Geometry And Topology
- From Calculus To Cohomology
- Computational Topology For Data Analysis
- Advanced Calculus Of Several Variables
- An Introduction To Riemannian Geometry
- Embeddings In Manifolds
- Elementary Topology
- A Visual Introduction To Differential Forms And Calculus On Manifolds
- Differential Geometry Lie Groups And Symmetric Spaces
- Elements Of Differential Topology
- Introduction To Topology
- Introduction To Differential Topology
- Beginning Topology

- Manifolds And Differential Geometry
- Complex Analysis
- Elements Of Algebraic Topology
- Hamiltons Ricci Flow
- Characteristic Classes
- Exotic Smoothness And Physics
- All The Mathematics You Missed
- Foundations Of Analysis
- Problems And Solutions In Differential Geometry Lie Series Differential Forms Relativity And Applications