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A self-contained introduction to logarithmic geometry, a key tool for analyzing compactification and degeneration in algebraic geometry. Rational homotopy theory is a subfield of algebraic topology. Written by three authorities in the field, this book contains all the main theorems of the field with complete proofs. As both notation and techniques of rational homotopy theory have been considerably simplified, the book presents modern elementary proofs for many results that were proven ten or fifteen years ago. Differential Forms on Singular Varieties: De Rham and Hodge Theory Simplified uses complexes of differential forms to give a complete treatment of the Deligne theory of mixed Hodge structures on the cohomology of singular spaces. This book features an approach that employs recursive arguments on dimension and does not introduce spaces of hig The notion of a motive is an elusive one, like its namesake "the motif" of Cezanne's impressionist method of painting. Its existence was first suggested by Grothendieck in 1964 as the underlying structure behind the myriad cohomology theories in Algebraic Geometry. We now know that there is a triangulated theory of motives, discovered by Vladimir Voevodsky, which suffices for the development of a satisfactory Motivic Cohomology theory. However, the existence of motives themselves remains conjectural. This book provides an account of the triangulated theory of motives. Its purpose is to introduce Motivic Cohomology, to develop its main properties, and finally to relate it to other known invariants of algebraic varieties and rings such as Milnor K-theory, etale cohomology, and Chow groups. The book is divided into lectures, grouped in six parts. The first part presents the definition of Motivic Cohomology, based upon the notion of presheaves with transfers. Some elementary comparison theorems are given in this part. The theory of (etale, Nisnevich, and Zariski) sheaves with transfers is developed in parts two, three, and six, respectively. The theoretical core of the book is the fourth part, presenting the triangulated category of motives. Finally, the comparison with higher Chow groups is developed in part five. The lecture notes format is designed for the book to be read by an advanced graduate student or an expert in a related field. The lectures roughly correspond to one-hour lectures given by Voevodsky during the course he gave at the Institute for Advanced Study in Princeton on this subject in 1999-2000. In addition, many of the original proofs have been simplified and improved so that this book will also be a useful tool for research mathematicians. Information for our distributors: Titles in this series are copublished with the Clay Mathematics Institute (Cambridge, MA). Differential Geometry is a wide field. We have chosen to concentrate upon certain aspects that are appropriate for an introduction to the subject; we have not attempted an encyclopedic treatment. In Book I, we focus on preliminaries. Chapter 1 provides an introduction to multivariable calculus and treats the Inverse Function Theorem, Implicit Function Theorem, the theory of the Riemann Integral, and the Change of Variable Theorem. Chapter 2 treats smooth manifolds, the tangent and cotangent bundles, and Stokes' Theorem. Chapter 3 is an introduction to Riemannian geometry. The Levi-Civita connection is presented, geodesics introduced, the Jacobi operator is discussed, and the Gauss-Bonnet Theorem is proved. The material is appropriate for an undergraduate course in the subject. We have given some different proofs than those that are classically given and there is some new material in these volumes. For example, the treatment of the Chern-Gauss-Bonnet Theorem for pseudo-Riemannian manifolds with boundary is new. This two-part volume contains numerous examples and insights on various topics. The authors have taken pains to present the material rigorously and coherently. This book will be immensely useful to mathematicians and graduate students working in algebraic geometry, arithmetic algebraic geometry, complex analysis and related fields. Written by Arthur Ogus on the basis of notes from Pierre Berthelot's seminar on crystalline cohomology at Princeton University in the spring of 1974, this book constitutes an informal introduction to a significant branch of algebraic geometry. Specifically, it provides the basic tools used in the study of crystalline cohomology of algebraic varieties in positive characteristic. Originally published in 1978. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. Connections, Curvature, and Cohomology V1 "...A nice feature of the book [is] that at various points the authors provide examples, or rather counterexamples, that clearly show what can go wrong...This is a nicely-written book [that] studies algebraic differential modules in several variables." --Mathematical Reviews This text presents a graduate-level introduction to differential geometry for mathematics and physics students. The exposition follows the historical development of the concepts of connection and curvature with the goal of explaining the Chern–Weil theory of characteristic classes on a principal bundle. Along the way we encounter some of the high points in the history of differential geometry, for example, Gauss' Theorema Egregium and the Gauss–Bonnet theorem. Exercises throughout the book test the reader’s understanding of the material and sometimes illustrate extensions of the theory. Initially, the prerequisites for the reader include a passing familiarity with manifolds. After the first chapter, it becomes necessary to understand and manipulate differential forms. A knowledge of de Rham cohomology is required for the last third of the text. Prerequisite material is contained in author's text An Introduction to Manifolds, and can be learned in one semester. For the benefit of the reader and to establish common notations, Appendix A recalls the basics of manifold theory. Additionally, in an attempt to make the exposition more self-contained, sections on algebraic constructions such as the tensor product and the exterior power are included. Differential geometry, as its name implies, is the study of geometry using differential calculus. It dates back to Newton and Leibniz in the seventeenth century, but it was not until the nineteenth century, with the work of Gauss on surfaces and Riemann on the curvature tensor, that differential geometry flourished and its modern foundation was laid. Over the past one hundred years, differential geometry has proven indispensable to an understanding of the physical world, in Einstein's general theory of relativity, in the theory of gravitation, in gauge theory, and now in string theory. Differential geometry is also useful in topology, several complex variables, algebraic geometry, complex manifolds, and dynamical systems, among other fields. The field has even found applications to group theory as in Gromov's work and to probability theory as in Diaconis's work. It is not too far-fetched to argue that differential geometry should be in every mathematician's arsenal. Self-contained development of cohomological theory of manifolds with various sheaves and its application to differential geometry covers categories and functions, sheaves and cohomology, fiber and vector bundles, and cohomology classes and differential forms. 1973 edition. This book is aimed to provide an introduction to local cohomology which takes cognizance of the breadth of its interactions with other areas of mathematics. It covers topics such as the number of defining equations of algebraic sets, connectedness properties of algebraic sets, connections to sheaf cohomology and to de Rham cohomology, Grobner bases in the commutative setting as well as for D-modules, the Frobenius morphism and characteristic p methods, finiteness properties of local cohomology modules, semigroup rings and polyhedral geometry, and hypergeometric systems arising from semigroups. The book begins with basic notions in geometry, sheaf theory, and homological algebra leading to the definition and basic properties of local cohomology. Then it develops the theory in a number of different directions, and draws connections with topology, geometry, combinatorics, and algorithmic aspects of the subject. This book gives a clear introductory account of equivariant cohomology, a central topic in algebraic topology. Equivariant cohomology is concerned with the algebraic topology of spaces with a group action, or in other words, with symmetries of spaces. First defined in the 1950s, it has been introduced into K-theory and algebraic geometry, but it is in algebraic topology that the concepts are the most transparent and the proofs are the simplest. One of the most useful applications of equivariant cohomology is the equivariant localization theorem of Atiyah-Bott and Berline-Vergne, which converts the integral of an equivariant differential form into a finite sum over the fixed point set of the group action, providing a powerful tool for computing integrals over a manifold. Because integrals and symmetries are ubiquitous, equivariant cohomology has found applications in diverse areas of mathematics and physics. Assuming readers have taken one semester of manifold theory and a year of algebraic topology, Loring Tu begins with the topological construction of equivariant cohomology, then develops the theory for smooth manifolds with the aid of differential forms. To keep the exposition simple, the equivariant localization theorem is proven only for a circle action. An appendix gives a proof of the equivariant de Rham theorem, demonstrating that equivariant cohomology can be computed using equivariant differential forms. Examples and calculations illustrate new concepts. Exercises include hints or solutions, making this book suitable for self-study. This book discusses the equivariant cohomology theory of differentiable manifolds. Although this subject has gained great popularity since the early 1980's, it has not before been the subject of a monograph. It covers almost all important aspects of the subject The authors are key authorities in this field. This volume is based on the proceedings of the Hopf-Algebras and Quantum Groups conference at the Free University of Brussels, Belgium. It presents state-of-the-art papers - selected from over 65 participants representing nearly 20 countries and more than 45 lectures - on the theory of Hopf algebras, including multiplier Hopf algebras and quantum g Differential geometry and topology have become essential tools for many theoretical physicists. In particular, they are indispensable in theoretical studies of condensed matter physics, gravity, and particle physics. Geometry, Topology and Physics, Second Edition introduces the ideas and techniques of differential geometry and topology at a level suitable for postgraduate students and researchers in these fields. The second edition of this popular and established text incorporates a number of changes designed to meet the needs of the reader and reflect the development of the subject. The book features a considerably expanded first chapter, reviewing aspects of path integral quantization and gauge theories. Chapter 2 introduces the mathematical concepts of maps, vector spaces, and topology. The following chapters focus on more elaborate concepts in geometry and topology and discuss the application of these concepts to liquid crystals, superfluid helium, general relativity, and bosonic string theory. Later chapters unify geometry and topology, exploring fiber bundles, characteristic classes, and index theorems. New to this second edition is the proof of the index theorem in terms of supersymmetric quantum mechanics. The final two chapters are devoted to the most fascinating applications of geometry and topology in contemporary physics, namely the study of anomalies in gauge field theories and the analysis of Polakov's bosonic string theory from the geometrical point of view. Geometry, Topology and Physics, Second Edition is an ideal introduction to differential geometry and topology for postgraduate students and researchers in theoretical and mathematical physics. There is a well-known correspondence between the objects of algebra and geometry: a space gives rise to a function algebra; a vector bundle over the space corresponds to a projective module over this algebra; cohomology can be read off the de Rham complex; and so on. In this book Yuri Manin addresses a variety of instances in which the application of commutative algebra cannot be used to describe geometric objects, emphasizing the recent upsurge of activity in studying noncommutative rings as if they were function rings on "noncommutative spaces." Manin begins by summarizing and giving examples of some of the ideas that led to the new concepts of noncommutative geometry, such as Connes' noncommutative de Rham complex, supergeometry, and quantum groups. He then discusses supersymmetric algebraic curves that arose in connection with superstring theory; examines superhomogeneous spaces, their Schubert cells, and superanalogues of Weyl groups; and provides an introduction to quantum groups. This book is intended for mathematicians and physicists with some background in Lie groups and complex geometry. Originally published in 1991. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. Since the times of Gauss, Riemann, and Poincare, one of the principal goals of the study of manifolds has been to relate local analytic properties of a manifold with its global topological properties. Among the high points on this route are the Gauss-Bonnet formula, the de Rham complex, and the Hodge theorem; these results show, in particular, that the central tool in reaching the main goal of global analysis is the theory of differential forms. The book by Morita is a comprehensive introduction to differential forms. It begins with a quick introduction to the notion of differentiable manifolds and then develops basic properties of differential forms as well as fundamental results concerning them, such as the de Rham and Frobenius theorems. The second half of the book is devoted to more advanced material, including Laplacians and harmonic forms on manifolds, the concepts of vector bundles and fiber bundles, and the theory of characteristic classes. Among the less traditional topics treated is a detailed description of the Chern-Weil theory. The book can serve as a textbook for undergraduate students and for graduate students in geometry. This book is an easy-to-read reference providing a link between partial differential equations (pde), stochastic analysis, and index theory. Most mathematicians working in pde are only vaguely familiar with the powerful ideas of stochastic analysis. On the other hand, the additional intuition which Taira?s book conveys might provide better insight and be helpful for their work. In addition, the book provides a nice compendium for a large variety of facts from differential geometry, functional analysis, pseudodifferential operators, and Markov processes - for quickly looking up a theorem. To the Teacher. This book is designed to introduce a student to some of the important ideas of algebraic topology by emphasizing the re lations of these ideas with other areas of mathematics. Rather than choosing one point of view of modem topology (homotopy theory, simplicial complexes, singular theory, axiomatic homology, differ ential topology, etc.), we concentrate our attention on concrete prob lems in low dimensions, introducing only as much algebraic machin ery as necessary for the problems we meet. This makes it possible to see a wider variety of important features of the subject than is usual in a beginning text. The book is designed for students of mathematics or science who are not aiming to become practicing algebraic topol ogists-without, we hope, discouraging budding topologists. We also feel that this approach is in better harmony with the historical devel opment of the subject. What would we like a student to know after a first course in to pology (assuming we reject the answer: half of what one would like the student to know after a second course in topology)? Our answers to this have guided the choice of material, which includes: under standing the relation between homology and integration, first on plane domains, later on Riemann surfaces and in higher dimensions; wind ing numbers and degrees of mappings, fixed-point theorems; appli cations such as the Jordan curve theorem, invariance of domain; in dices of vector fields and Euler characteristics; fundamental groups This book provides an advanced introduction to extended theories of quantum field theory and algebraic topology, including Hamiltonian quantization associated with some geometrical constraints, symplectic embedding and Hamilton-Jacobi quantization and Becci-Rouet-Stora-Tyutin (BRST) symmetry, as well as de Rham cohomology. It offers a critical overview of the research in this area and unifies the existing literature, employing a consistent notation. Although the results presented apply in principle to all alternative quantization schemes, special emphasis is placed on the BRST quantization for constrained physical systems and its corresponding de Rham cohomology group structure. These were studied by theoretical physicists from the early 1960s and appeared in attempts to quantize rigorously some physical theories such as solitons and other models subject to geometrical constraints. In particular, phenomenological soliton theories such as Skyrmion and chiral bag models have seen a revival following experimental data from the SAMPLE and HAPPEX Collaborations and these are discussed. The book describes how these model predictions were shown to include rigorous treatments of geometrical constraints because these constraints affect the predictions themselves. The application of the BRST symmetry to the de Rham cohomology contributes to a deep understanding of Hilbert space of constrained physical theories. Aimed at graduate-level students in quantum field theory, the book will also serve as a useful reference for those working in the field. An extensive bibliography guides the reader towards the source literature on particular topics. "...A nice feature of the book [is] that at various points the authors provide examples, or rather counterexamples, that clearly show what can go wrong...This is a nicely-written book [that] studies algebraic differential modules in several variables." --Mathematical Reviews "...A nice feature of the book [is] that at various points the authors provide examples, or rather counterexamples, that clearly show what can go wrong...This is a nicely-written book [that] studies algebraic differential modules in several variables." --Mathematical Reviews An inviting, intuitive, and visual exploration of differential geometry and forms Visual Differential Geometry and Forms fulfills two principal goals. In the first four acts, Tristan Needham puts the geometry back into differential geometry. Using 235 hand-drawn diagrams, Needham deploys Newton’s geometrical methods to provide geometrical explanations of the classical results. In the fifth act, he offers the first undergraduate introduction to differential forms that treats advanced topics in an intuitive and geometrical manner. Unique features of the first four acts include: four distinct geometrical proofs of the fundamentally important Global Gauss-Bonnet theorem, providing a stunning link between local geometry and global topology; a simple, geometrical proof of Gauss’s famous Theorema Egregium; a complete geometrical treatment of the Riemann curvature tensor of an n-manifold; and a detailed geometrical treatment of Einstein’s field equation, describing gravity as curved spacetime (General Relativity), together with its implications for gravitational waves, black holes, and cosmology. The final act elucidates such topics as the unification of all the integral theorems of vector calculus; the elegant reformulation of Maxwell’s equations of electromagnetism in terms of 2-forms; de Rham cohomology; differential geometry via Cartan’s method of moving frames; and the calculation of the Riemann tensor using curvature 2-forms. Six of the seven chapters of Act V can be read completely independently from the rest of the book. Requiring only basic calculus and geometry, Visual Differential Geometry and Forms provocatively rethinks the way this important area of mathematics should be considered and taught. This concise and practical textbook presents the essence of the theory on smooth manifolds. A key concept in mathematics, smooth manifolds are ubiquitous: They appear as Riemannian manifolds in differential geometry; as space-times in general relativity; as phase spaces and energy levels in mechanics; as domains of definition of ODEs in dynamical systems; as Lie groups in algebra and geometry; and in many other areas. The book first presents the language of smooth manifolds, culminating with the Frobenius theorem, before discussing the language of tensors (which includes a presentation of the exterior derivative of differential forms). It then covers Lie groups and Lie algebras, briefly addressing homogeneous manifolds. Integration on manifolds, explanations of Stokes’ theorem and de Rham cohomology, and rudiments of differential topology complete this work. It also includes exercises throughout the text to help readers grasp the theory, as well as more advanced problems for challenge-oriented minds at the end of each chapter. Conceived for a one-semester course on Differentiable Manifolds and Lie Groups, which is offered by many graduate programs worldwide, it is a valuable resource for students and lecturers alike. Foundations of Differentiable Manifolds and Lie Groups gives a clear, detailed, and careful development of the basic facts on manifold theory and Lie Groups. Coverage includes differentiable manifolds, tensors and differentiable forms, Lie groups and homogenous spaces, and integration on manifolds. The book also provides a proof of the de Rham theorem via sheaf cohomology theory and develops the local theory of elliptic operators culminating in a proof of the Hodge theorem. 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 Developed from a first-year graduate course in algebraic topology, this text is an informal introduction to some of the main ideas of contemporary homotopy and cohomology theory. The materials are structured around four core areas: de Rham theory, the Cech-de Rham complex, spectral sequences, and characteristic classes. By using the de Rham theory of differential forms as a prototype of cohomology, the machineries of algebraic topology are made easier to assimilate. With its stress on concreteness, motivation, and readability, this book is equally suitable for self-study and as a one-semester course in topology. In this work, I have attempted to give a coherent exposition of the theory of differential forms on a manifold and harmonic forms on a Riemannian space. The concept of a current, a notion so general that it includes as special cases both differential forms and chains, is the key to understanding how the homology properties of a manifold are immediately evident in the study of differential forms and of chains. The notion of distribution, introduced by L. Schwartz, motivated the precise definition adopted here. In our terminology, distributions are currents of degree zero, and a current can be considered as a differential form for which the coefficients are distributions. The works of L. Schwartz, in particular his beautiful book on the Theory of Distributions, have been a very great asset in the elaboration of this work. The reader however will not need to be familiar with these. Leaving aside the applications of the theory, I have restricted myself to considering theorems which to me seem essential and I have tried to present simple and complete of these, accessible to each reader having a minimum of mathematical proofs background. Outside of topics contained in all degree programs, the knowledge of the most elementary notions of general topology and tensor calculus and also, for the final chapter, that of the Fredholm theorem, would in principle be adequate. This graduate-level textbook introduces the classical theory of complex tori and abelian varieties, while presenting in parallel more modern aspects of complex algebraic and analytic geometry. Beginning with complex elliptic curves, the book moves on to the higher-dimensional case, giving characterizations from different points of view of those complex tori which are abelian varieties, i.e., those that can be holomorphically embedded in a projective space. This allows, on the one hand, for illuminating the computations of nineteenth-century mathematicians, and on the other, familiarizing readers with more recent theories. Complex tori are ideal in this respect: One can perform "hands-on" computations without the theory being totally trivial. Standard theorems about abelian varieties are proved, and moduli spaces are discussed. Recent results on the geometry and topology of some subvarieties of a complex torus are also included. The book contains numerous examples and exercises. It is a very good starting point for studying algebraic geometry, suitable for graduate students and researchers interested in algebra and algebraic geometry. Information for our distributors: SMF members are entitled to AMS member discounts. 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'. The need for an axiomatic treatment of homology and cohomology theory has long been felt by topologists. Professors Eilenberg and Steenrod present here for the first time an axiomatization of the complete transition from topology to algebra. Originally published in 1952. The Princeton Legacy Library uses the latest print-on-demand technology to again make available previously out-of-print books from the distinguished backlist of Princeton University Press. These editions preserve the original texts of these important books while presenting them in durable paperback and hardcover editions. The goal of the Princeton Legacy Library is to vastly increase access to the rich scholarly heritage found in the thousands of books published by Princeton University Press since its founding in 1905. An introductory textbook on cohomology and curvature with emphasis on applications. In this volume the authors seek to illustrate how methods of differential geometry find application in the study of the topology of differential manifolds. Prerequisites are few since the authors take pains to set out the theory of differential forms and the algebra required. The reader is introduced to De Rham cohomology, and explicit and detailed calculations are present as examples. Topics covered include Mayer-Vietoris exact sequences, relative cohomology, Pioncare duality and Lefschetz's theorem. This book will be suitable for graduate students taking courses in algebraic topology and in differential topology. Mathematicians studying relativity and mathematical physics will find this an invaluable introduction to the techniques of differential geometry. This is a relatively fast paced graduate level introduction to complex algebraic geometry, from the basics to the frontier of the subject. It covers sheaf theory, cohomology, some Hodge theory, as well as some of the more algebraic aspects of algebraic geometry. The author frequently refers the reader if the treatment of a certain topic is readily available elsewhere but goes into considerable detail on topics for which his treatment puts a twist or a more transparent viewpoint. His cases of exploration and are chosen very carefully and deliberately. The textbook achieves its purpose of taking new students of complex algebraic geometry through this a deep yet broad introduction to a vast subject, eventually bringing them to the forefront of the topic via a non-intimidating style.

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