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Enumerative Geometry and String Theory

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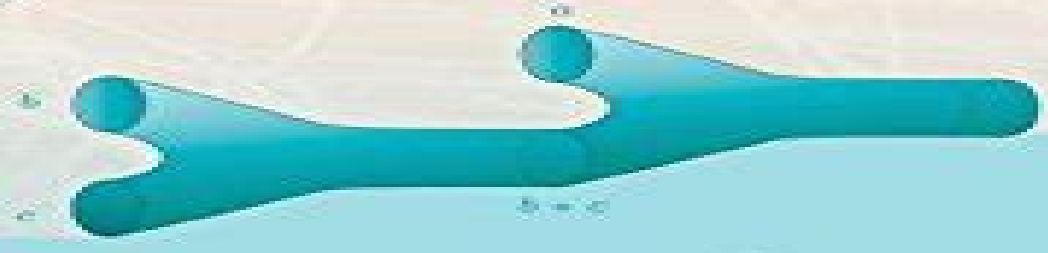

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Enumerative Geometry And String Theory

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Enumerative Geometry And String Theory:

Enumerative Geometry and String Theory Sheldon Katz,2006 Perhaps the most famous example of how ideas from modern physics have revolutionized mathematics is the way string theory has led to an overhaul of enumerative geometry an area of mathematics that started in the eighteen hundreds Century old problems of enumerating geometric configurations have now been solved using new and deep mathematical techniques inspired by physics The book begins with an insightful introduction to enumerative geometry From there the goal becomes explaining the more advanced elements of enumerative algebraic geometry Along the way there are some crash courses on intermediate topics which are essential tools for the student of modern mathematics such as cohomology and other topics in geometry The physics content assumes nothing beyond a first undergraduate course The focus is on explaining the action principle in physics the idea of string theory and how these directly lead to questions in geometry Once these topics are in place the connection between physics and enumerative geometry is made with the introduction of topological quantum field theory and quantum cohomology

Enumerative Invariants in Algebraic Geometry and String Theory Marcos Marino,Michael Thaddeus,Ravi Vakil,2008-08-15 Starting in the middle of the 80s there has been a growing and fruitful interaction between algebraic geometry and certain areas of theoretical high energy physics especially the various versions of string theory Physical heuristics have provided inspiration for new mathematical definitions such as that of Gromov Witten invariants leading in turn to the solution of problems in enumerative geometry Conversely the availability of mathematically rigorous definitions and theorems has benefited the physics research by providing the required evidence in fields where experimental testing seems problematic The aim of this volume a result of the CIME Summer School held in Cetraro Italy in 2005 is to cover part of the most recent and interesting findings in this subject Enumerative Invariants in Algebraic Geometry and String Theory Marcos Marino,Michael Thaddeus,Ravi Vakil,2009-08-29 Starting in the middle of the 80s there has been a growing and fruitful interaction between algebraic geometry and certain areas of theoretical high energy physics especially the various versions of string theory Physical heuristics have provided inspiration for new mathematical definitions such as that of Gromov Witten invariants leading in turn to the solution of problems in enumerative geometry Conversely the availability of mathematically rigorous definitions and theorems has benefited the physics research by providing the required evidence in fields where experimental testing seems problematic The aim of this volume a result of the CIME Summer School held in Cetraro Italy in 2005 is to cover part of the most recent and interesting findings in this subject **Topological String Theory and Enumerative Geometry** Yun S. Song,2001 *Quantum Field Theory, Supersymmetry, and Enumerative Geometry* Daniel S. Freed,David R. Morrison,Isadore Manuel Singer,2006 This volume presents three weeks of lectures given at the Summer School on Quantum Field Theory Supersymmetry and Enumerative Geometry With this volume the Park City Mathematics Institute returns to the general topic of the first institute the interplay between quantum field theory and

mathematics **Calabi-Yau Varieties: Arithmetic, Geometry and Physics** Radu Laza,Matthias Schütt,Noriko Yui,2015-08-27 This volume presents a lively introduction to the rapidly developing and vast research areas surrounding Calabi Yau varieties and string theory With its coverage of the various perspectives of a wide area of topics such as Hodge theory Gross Siebert program moduli problems toric approach and arithmetic aspects the book gives a comprehensive overview of the current streams of mathematical research in the area The contributions in this book are based on lectures that took place during workshops with the following thematic titles Modular Forms Around String Theory Enumerative Geometry and Calabi Yau Varieties Physics Around Mirror Symmetry Hodge Theory in String Theory The book is ideal for graduate students and researchers learning about Calabi Yau varieties as well as physics students and string theorists who wish to learn the mathematics behind these varieties **Chern-Simons Theory, Matrix Models, and Topological Strings** Marcos Marino,2005-09-22 In recent years the old idea that gauge theories and string theories are equivalent has been implemented and developed in various ways and there are by now various models where the string theory gauge theory correspondence is at work One of the most important examples of this correspondence relates Chern Simons theory a topological gauge theory in three dimensions which describes knot and three manifold invariants to topological string theory which is deeply related to Gromov Witten invariants This has led to some surprising relations between three manifold geometry and enumerative geometry This book gives the first coherent presentation of this and other related topics After an introduction to matrix models and Chern Simons theory the book describes in detail the topological string theories that correspond to these gauge theories and develops the mathematical implications of this duality for the enumerative geometry of Calabi Yau manifolds and knot theory It is written in a pedagogical style and will be useful reading for graduate students and researchers in both mathematics and physics willing to learn about these developments Topological String Theory and Enumerative Geometry ,2003 In this thesis we investigate several problems which have their roots in both topological string theory and enumerative geometry In the former case underlying theories are topological field theories whereas the latter case is concerned with intersection theories on moduli spaces A permeating theme in this thesis is to examine the close interplay between these two complementary fields of study The main problems addressed are as follows In considering the Hurwitz enumeration problem of branched covers of compact connected Riemann surfaces we completely solve the problem in the case of simple Hurwitz numbers In addition utilizing the connection between Hurwitz numbers and Hodge integrals we derive a generating function for the latter on the moduli space bar M sub g 2 of 2 pointed genus g Deligne Mumford stable curves We also investigate Givental s recent conjecture regarding semisimple Frobenius structures and Gromov Witten invariants both of which are closely related to topological field theories we consider the case of a complex projective line P1 as a specific example and verify his conjecture at low genera In the last chapter we demonstrate that certain topological open string amplitudes can be computed via relative stable morphisms in the algebraic category **Lectures on Fractal**

Geometry and Dynamical Systems Ya. B. Pesin,Vaughn Climenhaga,2009 Both fractal geometry and dynamical systems have a long history of development and have provided fertile ground for many great mathematicians and much deep and important mathematics These two areas interact with each other and with the theory of chaos in a fundamental way many dynamical systems even some very simple ones produce fractal sets which are in turn a source of irregular chaotic motions in the system This book is an introduction to these two fields with an emphasis on the relationship between them The first half of the book introduces some of the key ideas in fractal geometry and dimension theory Cantor sets Hausdorff dimension box dimension using dynamical notions whenever possible particularly one dimensional Markov maps and symbolic dynamics Various techniques for computing Hausdorff dimension are shown leading to a discussion of Bernoulli and Markov measures and of the relationship between dimension entropy and Lyapunov exponents In the second half of the book some examples of dynamical systems are considered and various phenomena of chaotic behaviour are discussed including bifurcations hyperbolicity attractors horseshoes and intermittent and persistent chaos These phenomena are naturally revealed in the course of our study of two real models from science the FitzHugh Nagumo model and the Lorenz system of differential equations This book is accessible to undergraduate students and requires only standard knowledge in calculus linear algebra and differential equations Elements of point set topology and measure theory are introduced as needed This book is a result of the MASS course in analysis at Penn State University in the fall semester of 2008 Recent Progress in Mathematics Nam-Gyu Kang,Jaigyoung Choe,Kyeongsu Choi,Sang-hyun Kim,2022-09-30 This book consists of five chapters presenting problems of current research in mathematics with its history and development current state and possible future direction Four of the chapters are expository in nature while one is based more directly on research All deal with important areas of mathematics however such as algebraic geometry topology partial differential equations Riemannian geometry and harmonic analysis This book is addressed to researchers who are interested in those subject areas Young Hoon Kiem discusses classical enumerative geometry before string theory and improvements after string theory as well as some recent advances in quantum singularity theory Donaldson Thomas theory for Calabi Yau 4 folds and Vafa Witten invariants Dongho Chae discusses the finite time singularity problem for three dimensional incompressible Euler equations He presents Kato s classical local well posedness results Beale Kato Majda s blow up criterion and recent studies on the singularity problem for the 2D Boussinesq equations Simon Brendle discusses recent developments that have led to a complete classification of all the singularity models in a three dimensional Riemannian manifold He gives an alternative proof of the classification of noncollapsed steady gradient Ricci solitons in dimension 3 Hyeonbae Kang reviews some of the developments in the Neumann Poincare operator NPO His topics include visibility and invisibility via polarization tensors the decay rate of eigenvalues and surface localization of plasmon singular geometry and the essential spectrum analysis of stress and the structure of the elastic NPO Danny Calegari provides an explicit description of the shift locus as a complex of spaces over a

contractible building He describes the pieces in terms of dynamically extended laminations and of certain explicit discriminant like affine algebraic varieties **The Calabi–Yau Landscape** Yang-Hui He,2021-07-31 Can artificial intelligence learn mathematics The question is at the heart of this original monograph bringing together theoretical physics modern geometry and data science The study of Calabi Yau manifolds lies at an exciting intersection between physics and mathematics Recently there has been much activity in applying machine learning to solve otherwise intractable problems to conjecture new formulae or to understand the underlying structure of mathematics In this book insights from string and quantum field theory are combined with powerful techniques from complex and algebraic geometry then translated into algorithms with the ultimate aim of deriving new information about Calabi Yau manifolds While the motivation comes from mathematical physics the techniques are purely mathematical and the theme is that of explicit calculations The reader is guided through the theory and provided with explicit computer code in standard software such as SageMath Python and Mathematica to gain hands on experience in applications of artificial intelligence to geometry Driven by data and written in an informal style The Calabi Yau Landscape makes cutting edge topics in mathematical physics geometry and machine learning readily accessible to graduate students and beyond The overriding ambition is to introduce some modern mathematics to the physicist some modern physics to the mathematician and machine learning to both *Handbook of Teichmüller Theory* Athanase Papadopoulos,2007 The subject of this handbook is Teichmuller theory in a wide sense namely the theory of geometric structures on surfaces and their moduli spaces This includes the study of vector bundles on these moduli spaces the study of mapping class groups the relation with 3 manifolds the relation with symmetric spaces and arithmetic groups the representation theory of fundamental groups and applications to physics Thus the handbook is a place where several fields of mathematics interact Riemann surfaces hyperbolic geometry partial differential equations several complex variables algebraic geometry algebraic topology combinatorial topology low dimensional topology theoretical physics and others This confluence of ideas toward a unique subject is a manifestation of the unity and harmony of mathematics This volume contains surveys on the fundamental theory as well as surveys on applications to and relations with the fields mentioned above It is written by leading experts in these fields Some of the surveys contain classical material while others present the latest developments of the theory as well as open problems This volume is divided into the following four sections The metric and the analytic theory The group theory The algebraic topology of mapping class groups and moduli spaces Teichmuller theory and mathematical physics This handbook is addressed to graduate students and researchers in all the fields mentioned **Introduction to String Theory** Sergio Cecotti,2023-10-06 Graduate students typically enter into courses on string theory having little to no familiarity with the mathematical background so crucial to the discipline As such this book based on lecture notes edited and expanded from the graduate course taught by the author at SISSA and BIMSA places particular emphasis on said mathematical background The target audience for the book includes students of both

theoretical physics and mathematics This explains the book s strange style on the one hand it is highly didactic and explicit with a host of examples for the physicists but in addition there are also almost 100 separate technical boxes appendices and starred sections in which matters discussed in the main text are put into a broader mathematical perspective while deeper and more rigorous points of view particularly those from the modern era are presented The boxes also serve to further shore up the reader s understanding of the underlying math In writing this book the author s goal was not to achieve any sort of definitive conciseness opting instead for clarity and completeness To this end several arguments are presented more than once from different viewpoints and in varying contexts Algebraic Aspects of Digital Communications Tanush Shaska,Engjell Hasimaj,2009 Proceedings of the NATO Advanced Study Institute on New Challenges in Digital Communications Vlora Albania 27 April 9 May 2008 T p verso **Calabi-yau Manifolds: A Bestiary For Physicists (2nd Edition)** Tristan Hubsch,2024-12-17 Calabi Yau spaces are complex spaces with a vanishing first Chern class or equivalently with a trivial canonical bundle sheaf so they admit a Ricci flat K hler metric that satisfies the vacuum Einstein equations Used to construct possibly realistic super string models they are being studied vigorously by physicists and mathematicians alike Calabi Yau spaces have also turned up in computations of probability amplitudes in quantum field theory This book collects and reviews relevant results on several major techniques of 1 constructing such spaces and 2 computing physically relevant quantities such as spectra of massless fields and their Yukawa interactions These are amended by 3 stringy corrections and 4 results about the moduli space and its geometry including a preliminary discussion of the still conjectural universal deformation space It also contains a lexicon of assorted terms and important results and theorems which can be used independently The first edition of Calabi Yau Manifolds A Bestiary for Physicists was the first systematic book covering Calabi Yau spaces related mathematics and their application in physics Thirty years on this new edition explores the intense development in the field since 1992 providing an additional 400 references It also addresses advances in machine learning and other computer aided methods that have recently made physically relevant computations feasible opened new avenues in the field and begun to deliver concretely on the now 40 year old promise of string theory The presentation of ideas results and computational methods is complemented by detailed models and sample computations throughout This second edition also contains a new closing section outlining the staggering advances of the past three decades and providing suggestions for future reading *A Primer on the Calculus of Variations and Optimal Control Theory* Mike Mesterton-Gibbons,2009 The calculus of variations is used to find functions that optimize quantities expressed in terms of integrals Optimal control theory seeks to find functions that minimize cost integrals for systems described by differential equations This book is an introduction to both the classical theory of the calculus of variations and the more modern developments of optimal control theory from the perspective of an applied mathematician It focuses on understanding concepts and how to apply them The range of potential applications is broad the calculus of variations and optimal control theory have been widely used in

numerous ways in biology criminology economics engineering finance management science and physics Applications described in this book include cancer chemotherapy navigational control and renewable resource harvesting The prerequisites for the book are modest the standard calculus sequence a first course on ordinary differential equations and some facility with the use of mathematical software It is suitable for an undergraduate or beginning graduate course or for self study It provides excellent preparation for more advanced books and courses on the calculus of variations and optimal control theory *Basics of Representation Theory* Udayan Bhattacharya,2025-02-20 Delve into the captivating world of Basics of Representation Theory a comprehensive guide designed for students researchers and enthusiasts eager to explore the intricate symmetries and structures that underpin modern mathematics Our book offers a detailed introduction to foundational concepts providing a solid understanding of group actions linear representations and character theory From there it explores the algebraic structures of irreducible representations breaking down the decomposition into irreducible components and examining the properties of characters Readers will journey through diverse topics including the representation theory of symmetric groups Lie groups and algebraic groups as well as advanced topics such as the representation theory of finite groups the Langlands program and applications in quantum mechanics and number theory With a wealth of examples illustrations and exercises Basics of Representation Theory ensures a hands on approach to learning encouraging practical exploration and problem solving The book also includes numerous references and further reading suggestions for those who wish to delve deeper into specific topics Written in a clear and accessible style this book caters to all levels from undergraduate students encountering representation theory for the first time to experienced researchers seeking fresh insights With its comprehensive coverage and diverse applications Basics of Representation Theory is an invaluable resource for anyone interested in the beauty and depth of this field *Geometry and Physics* H. Pedersen,2021-01-08 Based on the proceedings of the Special Session on Geometry and Physics held over a six month period at the University of Aarhus Denmark and on articles from the Summer school held at Odense University Denmark Offers new contributions on a host of topics that involve physics geometry and topology Written by more than 50 leading international experts Integral Geometry, Radon Transforms and Complex Analysis Carlos A. Berenstein,Peter F. Ebenfelt,Simon Gindikin,Sigurdur Helgason,Alexander Tumanov,2006-11-14 This book contains the notes of five short courses delivered at the Centro Internazionale Matematico Estivo session Integral Geometry Radon Transforms and Complex Analysis held in Venice Italy in June 1996 three of them deal with various aspects of integral geometry with a common emphasis on several kinds of Radon transforms their properties and applications the other two share a stress on CR manifolds and related problems All lectures are accessible to a wide audience and provide self contained introductions and short surveys on the subjects as well as detailed expositions of selected results **Riemann Surfaces and Algebraic Curves** Renzo Cavalieri,Eric Miles,2016-09-26 Hurwitz theory the study of analytic functions among Riemann surfaces is a classical field

and active research area in algebraic geometry The subject s interplay between algebra geometry topology and analysis is a beautiful example of the interconnectedness of mathematics This book introduces students to this increasingly important field covering key topics such as manifolds monodromy representations and the Hurwitz potential Designed for undergraduate study this classroom tested text includes over 100 exercises to provide motivation for the reader Also included are short essays by guest writers on how they use Hurwitz theory in their work which ranges from string theory to non Archimedean geometry Whether used in a course or as a self contained reference for graduate students this book will provide an exciting glimpse at mathematics beyond the standard university classes

The Enigmatic Realm of **Enumerative Geometry And String Theory**: Unleashing the Language is Inner Magic

In a fast-paced digital era where connections and knowledge intertwine, the enigmatic realm of language reveals its inherent magic. Its capacity to stir emotions, ignite contemplation, and catalyze profound transformations is nothing in short supply of extraordinary. Within the captivating pages of **Enumerative Geometry And String Theory** a literary masterpiece penned by a renowned author, readers set about a transformative journey, unlocking the secrets and untapped potential embedded within each word. In this evaluation, we shall explore the book is core themes, assess its distinct writing style, and delve into its lasting impact on the hearts and minds of those that partake in its reading experience.

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Enumerative Geometry And String Theory Introduction

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