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"A mathematician named Klein Thought the Moebius band was divine. Said he: 'If you glue The edges of two, You'll get a weird bottle like mine.' " — Stephen Barr In this lively book, the classic in its field, a master of recreational topology invites readers to venture into such tantalizing topological realms as continuity and connectedness via the Klein bottle and the Moebius strip. Beginning with a definition of topology and a discussion of Euler's theorem, Mr. Barr brings wit and clarity to these topics: New Surfaces (Orientability, Dimension, The Klein Bottle, etc.) The Shortest Moebius Strip The Conical Moebius Strip The Klein Bottle The Projective Plane (Symmetry) Map Coloring Networks (Koenigsberg Bridges, Betti Numbers, Knots) The Trial of the Punctured Torus Continuity and Discreteness ("Next Number," Continuity, Neighborhoods, Limit Points) Sets (Valid or Merely True? Venn Diagrams, Open and Closed Sets, Transformations, Mapping, Homotopy) With this book and a square sheet of paper, the reader can make paper Klein bottles, step by step; then, by intersecting or cutting the bottle, make Moebius strips. Conical Moebius strips, projective planes, the principle of map coloring, the classic problem of the Koenigsberg bridges, and many more aspects of topology are carefully and concisely illuminated by the author's informal and entertaining approach. Now in this inexpensive paperback edition, Experiments in Topology belongs in the library of any math enthusiast with a taste for brainteasing adventures

Provides 19 experiments that illustrate topological problems.

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Contemporary Physics Since its birth in Poincaré's seminal 1894 'Analysis Situs', topology has become a cornerstone of mathematics. As with all beautiful mathematical concepts, topology inevitably — resonating with that Wignerian principle of the effectiveness of mathematics in the natural sciences — finds its prominent role in physics. From Chern-Simons theory to topological quantum field theory, from knot invariants to Calabi-Yau compactification in string theory, from spacetime topology in cosmology to the recent Nobel Prize winning work on topological insulators, the interactions between topology and physics have been a triumph over the past few decades. In this eponymous volume, we are honoured to have contributions from an assembly of grand masters of the field, guiding us with their world-renowned expertise on the subject of the interplay between 'Topology' and 'Physics'. Beginning with a preface by Chen Ning Yang on his recollections of the early days, we proceed to a novel view of nuclei from the perspective of complex geometry by Sir Michael Atiyah and Nick Manton, followed by an entrée toward recent developments in two-dimensional gravity and intersection theory on the moduli space of Riemann surfaces by

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Robbert Dijkgraaf and Edward Witten; a study of Majorana fermions and relations to the Braid group by Louis H Kauffman; a pioneering investigation on arithmetic gauge theory by Minhyong Kim; an anecdote-enriched review of singularity theorems in black-hole physics by Sir Roger Penrose; an adventure beyond anyons by Zhenghan Wang; an aperçu on topological insulators from first-principle calculations by Haijun Zhang and Shou-Cheng Zhang; finishing with synopsis on quantum information theory as one of the four revolutions in physics and the second quantum revolution by Xiao-Gang Wen. We hope that this book will serve to inspire the research community.

Visual shape analysis plays a fundamental role in perception by man and by computer, allowing for inferences about properties of objects and scenes in the physical world. Mathematical approaches to describing visual form can benefit from the use of representations that simultaneously capture properties of an object's outline as well as its interior. Motivated by the success of medial models, this doctoral thesis revisits a quantity related to medial axis computations, the average outward flux of the gradient of the Euclidean distance function from a boundary, and then addresses three distinct problems using this measure. First, I consider the problem of view sphere partitioning for view-based object recognition from sparse views. View-based 3D object recognition requires a selection of model object views against which to match a query view. Ideally, for this to be computationally efficient, such a selection should be sparse. To address this problem, I introduce a novel hierarchical partitioning of the view sphere into regions within which the silhouette of a model object is qualitatively unchanged. To achieve this, I propose a part-

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based abstraction of a skeleton, as a graph, dubbed the Flux Graph, which allows for views to be grouped. Next, I consider the problem of mapping an initially-unknown 2D environment from possibly noisy sensed samples via an on-line procedure which robustly computes a retraction of its boundaries to obtain a topological representation. Here I motto an algorithm that allows for online map construction with loop closure. I demonstrate that the proposed method allows the robot to localize itself on a partially constructed map to calculate a path to unexplored parts of the environment (frontiers), to compute a robust terminating condition when the robot has fully explored the environment, and finally to achieve loop closure detection. I also show that the resulting map is stable under disturbances to the sensed boundary, and to variations in starting locations for exploration. Finally, I consider the problem of scene categorization from complex line drawings. In the context of human vision, we show that local ribbon symmetry between neighboring pairs of contours facilitates the categorization of complex real-world environments by human observers. In the context of computer vision, I demonstrate a high level of performance in the problem of convolutional neural network-based recognition of natural scenes from line drawings, even in the absence of color, texture and shading information.

The eld of wireless sensor networks continues to evolve and grow in both practical and research domains. More and more wireless sensor networks are being used to gather information in real life applications. It is common to see how this technology is being applied in irrigation systems, intelligent buildings, bridges, security mechanisms, military operations, transportation-related applications, etc. At the same time, new

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developments in hardware, software, and communication technologies are expanding these possibilities. As in any other technology, research brings new developments and refinements and continuous improvements of current approaches that push the technology even further. Looking toward the future, the technology seems even more promising in two directions. First, a few years from now more powerful wireless sensor devices will be available, and wireless sensor networks will have applicability in an endless number of scenarios, as they will be able to handle traffic loads not possible today, make more computations, store more data, and live longer because of better energy sources. Second, a few years from now, the opposite scenario might also be possible. The availability of very constrained, nanotechnology-made wireless sensor devices will bring a whole new world of applications, as they will be able to operate in environments and places unimaginable today. These two scenarios, at the same time, will both bring new research challenges that are always welcome to researchers.

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