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Pierre Albin

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MONROE HARRIS Van Kampen's Theorem Problem 1.

Suppose  $G$  and  $H$  are nontrivial groups. Suppose  $x = g_1 h_1 \dots g_n h_n$  lies in the center of  $G \times H$ , where  $g_i \in G$  and  $h_i \in H$ . For any

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$g^{-1}g^{-1}H$ , we have  $g^{-1}h^{-1} \dots g^{-1}nh^{-1}ng^{-1}h^{-1}n^{-1}g^{-1}n^{-1} \dots h^{-1}g^{-1}g^{-1}h^{-1} = 1$ . The only way for this to be true for all  $g$  is if  $h^{-1} = 1$  for all  $i$ .

## Van Kampen's Theorem

Algebraic Topology Homework 4 Solutions Here are a few solutions to some of the trickier problems... Recall: Let  $X$  be a topological space,  $A \subset X$  a subspace of  $X$ . Suppose  $f, g: X \rightarrow Y$  are maps restricting to the identity on  $A$ . Then a homotopy relative to  $A$  (or just: a homotopy rel.  $A$ ) from  $f$  to  $g$  is a map  $H: X \times I \rightarrow Y$  satisfying: (1)  $H(a; t) = a$  for all  $a \in A$  and all  $t \in I$ ,

## Algebraic Topology Homework 4 Solutions - boun.edu.tr

Allen Hatcher's Algebraic Topology, available for free

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download here. Our course will primarily use Chapters 0, 1, 2, and 3. Prerequisites. In addition to formal prerequisites, we will use a number of notions and concepts without much explanation.

## **Math 215A: Algebraic Topology**

Algebraic Topology Hatcher Solutions HATCHER'S

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HARRIS Van Kampen's Theorem Problem 1. Suppose  $G$  and  $H$  are nontrivial groups. Suppose  $x = g_1 h_1 \dots g_n h_n$  lies in the center of  $G \times H$ , where  $g_i \in G$  and  $h_i \in H$ . For any  $g \in G$ ,  $h \in H$ , we have  $g g_1 h_1 \dots g_n h_n g^{-1} h^{-1} = g_1 h_1 \dots g_n h_n$ .

## **Algebraic Topology Hatcher Solutions - Orris**

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Algebraic Topology Auxiliary Exercises Instructor: W. D. Gillam Due: At the discretion of the student Scholium. Let  $X$  be a topological space,  $\mathcal{U}$  a cover of  $X$ ,  $X_n = \text{Hom}(n; X)$  the set of singular  $n$ -simplices in  $X$ ,  $X_n^{\mathcal{U}}$  the subset of  $X_n$  consisting of those  $\sigma \in X_n$  for which there is some  $U \in \mathcal{U}$  with  $\sigma \in (n)U$ . Since the restriction of any  $\sigma \in X_n^{\mathcal{U}}$  to any face ...

## **Algebraic Topology Auxiliary Exercises**

Although we have in mind an audience with prior exposure to algebraic or differential topology, for the most part a good knowledge of linear algebra, advanced calculus, and point-set topology should suffice. Some acquaintance with manifolds, simplicial complexes, singular homology and cohomology, and homotopy groups is helpful, but not really ...

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## **Differential Forms in Algebraic Topology | Raoul Bott ...**

A downloadable textbook in algebraic topology. What's in the Book? To get an idea you can look at the Table of Contents and the Preface.. Printed Version: The book was published by Cambridge University Press in 2002 in both paperback and hardback editions, but only the paperback version is currently available (ISBN 0-521-79540-0). I have tried very hard to keep the price of the paperback ...

## **Algebraic Topology Book - Cornell University**

topology on  $X = \mathbb{R}/\mathbb{Z}$  so that  $\pi$  is continuous, viz,  $U \times \mathbb{R}/\mathbb{Z}$  is open  $\iff \pi^{-1}(U)$  is open. The resulting topological space is called the quotient space. E.g. Let  $I = [0;1] \times \mathbb{R}$  and  $X = I/\mathbb{Z}$ . We put the



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weakest equivalence relation on  $X$  s.t.  $(0;x) \sim (1;x); (x;0) \sim (x;1)$  for  $x \in I$ . We sometimes sum up this info in the following picture:  $\square \xrightarrow{\sim} \square \xrightarrow{\sim} \square$

## **MATH5665: Algebraic Topology- Course notes**

set topological nature that arise in algebraic topology. Since this is a textbook on algebraic topology, details involving point-set topology are often treated lightly or skipped entirely in the body of the text. Not included in this book is the important but somewhat more sophisticated topic of spectral sequences.

## **Preface - Cornell University**

NOTES ON THE COURSE "ALGEBRAIC TOPOLOGY" 3

8.3. Relative homotopy groups 61 9. Fiber bundles 65 9.1.

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First steps toward fiber bundles 65 9.2. Constructions of new fiber bundles 67 9.3. Serre fiber bundles 70 9.4. Homotopy exact sequence of a fiber bundle 73 9.5. More on the groups  $\pi_n(X, A; x_0)$  75 10. Suspension Theorem and Whitehead ...

## **NOTES ON THE COURSE “ALGEBRAIC TOPOLOGY”**

Algebraic topology I. Title 514'.2 QA6!2 79—41610 ISBN 0 521 23161 2 hard covers ISBN 0 521 29840 7 paperback.

INTRODUCTION Most of this book is based on lectures to third-year undergraduate and postgraduate students. It aims to provide a thorough grounding in the more elementary parts of algebraic topology, although

## **ALGEBRAIC TOPOLOGY - School of Mathematics**

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MTH 869 Algebraic Topology Joshua Ruiter February 12, 2018 Proposition 0.1 (Exercise 1.1.10). Let  $(X; x_0)$  and  $(Y; y_0)$  be pointed, path-connected spaces. Let  $f: I \rightarrow X$  and  $g: I \rightarrow Y$  both be loops based at  $(x_0; y_0)$ . Via inclusions, we can think of  $f; g$  as loops  $I \rightarrow X \times Y$  based at  $(x_0; y_0)$ . Let  $p_X: X \times Y \rightarrow X$  and  $p_Y: X \times Y \rightarrow Y$  be the standard projections. Then we have  $f \simeq p_X \circ g$  via the homotopy

## Homework 3 MTH 869 Algebraic Topology

Algebraic Topology Final Exam Solutions 1) Let  $X$  be the connected sum of two tori, let  $a_1$  and  $b_1$  be the meridian and longitude of the first torus, and let  $a_2$  and  $b_2$  be the meridian and longitude of the second torus. There is a simple closed curve  $\gamma$  that is homotopic to  $a_1 b_1 a_2^{-1} b_2^{-1}$ . Let  $Y$  be the

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union of  $X$  with a 2-disk  $D$ , where the boundary of

## **Algebraic Topology Final Exam Solutions**

INTRODUCTION TO ALGEBRAIC TOPOLOGY 5 Exercise

1.34. Formulate a universal property for the  $\times$  product. The product of topological spaces allows the introduction of the notion of a topological group. Definition 1.35. A topological group is a group  $G$  equipped with a topology such

## **INTRODUCTION TO ALGEBRAIC TOPOLOGY**

Solutions to Homework # 2 Hatcher, Chap. 0, Problem 16.1

Let  $R_1 := M_{n,1}(\mathbb{R}) = \{x = (x_k)_{k=1}^n \mid x_n = 0\}$ . We define a topology on  $R_1$  by declaring a set  $S \subseteq R_1$  closed if and only if, for  $n > 0$ , the intersection  $S \cap R_1^n$  is finite.

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dimensional subspace  $R^n = \{(x_k)_{k=1}^n; x_k = 0; \forall k > n\}$  is closed in the Euclidean topology of  $R^n$ . For each  $x \in R^1$  set  $j \sim x_j$

## **Solutions to Homework # 1 Hatcher, Chap. 0, Problem 4.**

This book is designed to introduce a student to some of the important ideas of algebraic topology by emphasizing the relations of these ideas with other areas of mathematics. Rather than choosing one point of view of modern topology (homotopy theory, simplicial complexes, singular theory, axiomatic homology, differential topology, etc ...

## **Algebraic Topology - A First Course | William Fulton ...**

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## **Algebraic topology : Lefschetz, Solomon, 1884-1972 : Free ...**

Course Goals First and foremost, this course is an excursion into the realm of algebraic topology. Please take a few hours to review point-set topology; for the most part, chapters 1-5 of Lee (or 4-7 of Sieradski or 2-3 of Munkres or 3-6 of Kahn), contain the prerequisite information. Be sure you understand quotient and adjunction spaces.

## **Algebraic Topology Course Information**

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ALLEN HATCHER: ALGEBRAIC TOPOLOGY MORTEN  
POULSEN All references are to the 2002 printed edition.

Chapter 0 Ex. 0.2. Define  $H: (R^n \setminus \{0\}) \times I \rightarrow R^n \setminus \{0\}$  by  $H(x,t) = (1-t)x + t|x|x$ ,  $x \in R^n \setminus \{0\}$ ,  $t \in I$ . It is easily verified that  $H$  is a homotopy between the identity map and a retraction onto  $S^{n-1}$ , i.e. a deformation retraction. Ex. 0.3.

This self-contained introduction to algebraic topology is suitable for a number of topology courses. It consists of about one quarter 'general topology' (without its usual pathologies) and three quarters 'algebraic topology' (centred around the fundamental group, a readily grasped topic which gives a

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good idea of what algebraic topology is). The book has emerged from courses given at the University of Newcastle-upon-Tyne to senior undergraduates and beginning postgraduates. It has been written at a level which will enable the reader to use it for self-study as well as a course book. The approach is leisurely and a geometric flavour is evident throughout. The many illustrations and over 350 exercises will prove invaluable as a teaching aid. This account will be welcomed by advanced students of pure mathematics at colleges and universities.

This text explains nontrivial applications of metric space topology to analysis. Covers metric space, point-set topology, and algebraic topology. Includes exercises, selected answers,



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and 51 illustrations. 1983 edition.

A short introduction ideal for students learning category theory for the first time.

In most mathematics departments at major universities one of the three or four basic first-year graduate courses is in the subject of algebraic topology. This introductory textbook in algebraic topology is suitable for use in a course or for self-study, featuring broad coverage of the subject and a readable exposition, with many examples and exercises. The four main chapters present the basic material of the subject: fundamental group and covering spaces, homology and cohomology, higher homotopy groups, and homotopy theory

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generally. The author emphasizes the geometric aspects of the subject, which helps students gain intuition. A unique feature of the book is the inclusion of many optional topics which are not usually part of a first course due to time constraints, and for which elementary expositions are sometimes hard to find. Among these are: Bockstein and transfer homomorphisms, direct and inverse limits, H-spaces and Hopf algebras, the Brown representability theorem, the James reduced product, the Dold-Thom theorem, and a full exposition of Steenrod squares and powers. Researchers will also welcome this aspect of the book.

This text contains a detailed introduction to general topology and an introduction to algebraic topology via its most classical

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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.

This textbook is intended for a course in algebraic topology at the beginning graduate level. The main topics covered are the classification of compact 2-manifolds, the fundamental group, covering spaces, singular homology theory, and singular cohomology theory. These topics are developed systematically, avoiding all unnecessary definitions, terminology, and technical machinery. The text consists of material from the first five chapters of the author's earlier

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book, Algebraic Topology; an Introduction (GTM 56) together with almost all of his book, Singular Homology Theory (GTM 70). The material from the two earlier books has been substantially revised, corrected, and brought up to date.

Algebraic topology is a basic part of modern mathematics, and some knowledge of this area is indispensable for any advanced work relating to geometry, including topology itself, differential geometry, algebraic geometry, and Lie groups. This book provides a detailed treatment of algebraic topology both for teachers of the subject and for advanced graduate students in mathematics either specializing in this area or continuing on to other fields. J. Peter May's approach reflects the enormous internal developments within algebraic topology

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over the past several decades, most of which are largely unknown to mathematicians in other fields. But he also retains the classical presentations of various topics where appropriate. Most chapters end with problems that further explore and refine the concepts presented. The final four chapters provide sketches of substantial areas of algebraic topology that are normally omitted from introductory texts, and the book concludes with a list of suggested readings for those interested in delving further into the field.

Manifolds play an important role in topology, geometry, complex analysis, algebra, and classical mechanics. Learning manifolds differs from most other introductory mathematics in that the subject matter is often completely unfamiliar. This

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introduction guides readers by explaining the roles manifolds play in diverse branches of mathematics and physics. The book begins with the basics of general topology and gently moves to manifolds, the fundamental group, and covering spaces.

Starting with the first principles of topology, this volume advances to general analysis. Three levels of examples and problems make it appropriate for students and professionals. Abundant exercises, ordered and numbered by degree of difficulty, illustrate important concepts, and a 40-page appendix includes tables of theorems and counterexamples. 1970 edition.

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Algebraic Topology is a system and strategy of partial translations, aiming to reduce difficult topological problems to algebraic facts that can be more easily solved. The main subject of this book is singular homology, the simplest of these translations. Studying this theory and its applications, we also investigate its underlying structural layout - the topics of Homological Algebra, Homotopy Theory and Category Theory which occur in its foundation. This book is an introduction to a complex domain, with references to its advanced parts and ramifications. It is written with a moderate amount of prerequisites — basic general topology and little else — and a moderate progression starting from a very elementary beginning. A consistent part of the exposition is organised in the form of exercises, with suitable hints and

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solutions. It can be used as a textbook for a semester course or self-study, and a guidebook for further study.

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