

Categories, Symmetry and Manifolds, Math 4800

University of Utah, Fall 2020

Aaron Bertram

Class Monday and Wednesday, 3:00–4:20 pm, Online Synchronous.

Contact bertram@math.utah.edu.

Web-page Via Canvas; official announcements and homework assignments will be posted there. Check in on Canvas at least twice a week for announcements and updates.

Format The class will be delivered *synchronously*, i.e., live at the time listed, via the Zoom video conferencing software. It is strongly suggested that you have a webcam and microphone to fully participate. Zoom meeting details will be made available on the Canvas page.

While I will present course material during the class period, I also hope to make the class as interactive as possible. I strongly encourage your questions, and am happy to go over problems or do more examples to illustrate the topics at hand.

During class time, I suggest that everyone keep their microphones muted so as to eliminate background noise, but feel completely free to unmute yourself and interrupt with questions/clarifications. When speaking, please turn on your video if possible, if it wasn't already on.

Classes will be recorded and made available on Canvas, so if you miss a lecture you can watch it later. Class recordings will not be made available to the general public and will be deleted at the end of the semester, but be aware that a recording will exist for a few months. Because of this, please refrain from giving out any sensitive personal information during class time.

Laptops The Marriott library has a limited number of laptops for loan to students, and information about wifi options: <https://lib.utah.edu/coronavirus/checkout-equipment.php>

Text We will use lecture notes and material that can be downloaded from the internet.

Prerequisites Instructor approval.

Office hours Office hours will be via Zoom, with details forthcoming on the Canvas page.

Goals Thinking categorically is a good vehicle for looking back at many of your undergraduate mathematics courses and looking ahead to graduate-level topics. Categories are the environment in which symmetry is a well-defined notion, and the “representations” of symmetries (as groups of matrices) is one of the most fascinating subjects in mathematics. The representations of finite symmetry groups (e.g. the symmetries of a Euclidean solid) can be classified at the undergraduate mathematics level, and we will go through this, constructing character tables for many of these groups. Passing from finite to compact symmetry groups requires some graduate-level mathematics, which we will explore in the second half of the course. In particular, we will discuss topological, differentiable, complex analytic and algebraic manifolds as well as Lie Groups and Lie Algebras, and get a taste of some Algebraic Geometry.

Homework There will be weekly homework assignments in which we work out some theory and many examples. I encourage you to discuss homework problems in groups as a way to learn from each other. That being said, it is important to write up one's own solutions. Late homework will not be accepted except in extenuating circumstances such as illness. In such cases, please let me know as soon as possible that you need to submit late.

Grading There will be no exams in this class. The grade will be based on homework and an end-of-semester project, which we will be crafting together starting at the midpoint of the semester (i.e. the week formerly known as Fall break). The grade will be 50% homework and 50% project.

Other dates Classes begin: Monday, August 24
Last day to add, drop (delete), elect CR/NC, or audit classes: Friday, September 4
Last day to withdraw from classes: Friday, October 16
Last class (for this course): Wednesday, December 2

Tech issues You may submit your homework and project via Canvas. If you have a tablet or a similar computerized writing surface, the simplest method is usually to download the homework pdf, write directly on that, and then upload the pdf to Canvas. If you do not have a printer, you can simply write your solutions on a blank piece of paper, clearly indicating which problem you are solving, and then scan to pdf. If you do not have a scanner there are many apps that convert a smartphone into a scanner. Please make sure that you have an app that can convert the files into pdf format. Please only upload one file per homework. All files should be converted into pdf format so that I can mark them up online for you to receive comments.

Communication Class announcements will be via e-mail, through the Canvas server. Students should check Canvas regularly, and set up notifications that are directly forwarded to their e-mail inbox. You should also regularly check your UMail or forward it to an address that you monitor.

COVID Specific *In the Case of a Stay-at-Home Order:* Should another stay at home order go into place, the class will continue as synchronous on-line. In this situation, I intend to keep teaching following the same format and schedule. However, I realize that for some students a stay-at-home order may come with additional burdens; if you are in this category, please e-mail me and I will work with you individually to come up with solutions.

Protocol in the Case of Sickness: If I happen to get sick, I will arrange an alternative instructor. Should one of you happen to get sick, let me know via e-mail, and we will work out an arrangement for future assignments. A reminder that all students, faculty, and staff who are given a positive COVID diagnosis must self-report at <https://coronavirus.utah.edu>.

Resources and Policies

ADA Statement: The University of Utah seeks to provide equal access to its programs, services, and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability & Access, 162 Olpin Union Building, (801) 581-5020. CDA will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability & Access.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status, or genetic information. If you or someone you know has been harassed or assaulted on the basis of your sex, including sexual orientation or gender identity/expression, you are encouraged to report it to the University's Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, (801) 581-8365, or to the Office of the Dean of Students, 270 Union Building, (801) 581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 Student Services Building, (801) 581-7776. To report to police, contact the Department of Public Safety, (801) 585-2677.

Campus Safety: The University of Utah values the safety of all campus community members. To report suspicious activity or to request a courtesy escort, call campus police at (801) 585-2677. You will receive important emergency alerts and safety messages regarding campus safety via text message. For more information regarding safety and to view available training resources, including helpful videos, visit <https://safeu.utah.edu>.

Student Names and Personal Pronouns: Class rosters are provided to the instructor with the student's legal name as well as *preferred first name*, if previously entered by you in the Student Profile section of your CIS account; this can be managed online by you at any time. I will refer to you with the name and the pronoun that you prefer, in class or on assignments: please advise me of any changes or preferences. For assistance or support, please reach out to the LGBT Resource Center, <https://lgbt.utah.edu>.

Diversity and Inclusivity: It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally, or for others. In addition, if any of our class meetings conflict with your religious events, please let me know so that I can make alternative arrangements for you.

Undocumented Student Support Statement: Immigration is a complex phenomenon with broad impact on those who are directly affected by it, as well as those who are indirectly affected by their relationships with family members, friends, and loved ones. If your immigration status presents obstacles to engaging in specific activities or fulfilling specific course criteria, confidential arrangements may be requested from the Dream Center. Arrangements with the Dream Center will not jeopardize your student status, your financial aid, or any other part of your residence. The Dream Center offers a wide range of resources to support undocumented students (with and without DACA) as well as students from mixed-status families. To learn more, please contact the Dream Center at (801) 213-3697 or <https://dream.utah.edu>.

Wellness Statement: Personal concerns such as stress, anxiety, relationship difficulties, depression, cross-cultural differences, etc., can interfere with a student's ability to succeed and thrive at the University. For helpful resources, contact the Center for Student Wellness at (801) 581-7776 or <https://www.wellness.utah.edu>.