The Basics

Instructor: Dr. Christy Hazel (she/her)¹ Email: hazelchristy@grinnell.edu

Office: Noyce 2248

Drop-in Office Hours: Mondays 2:20-3:50PM, Fridays 10:30-11:30AM

Appointments: Use Calendly link on Canvas to schedule an appointment

Class Meetings: 2:30-3:50PM TTh in Noyce 2245

Textbook: Topology through Inquiry by Michael Starbird and Francis Su

Course Website: We are piloting the new Grinnell Learning Management System, Canvas. All course assignments will be on our Canvas page. Visit https://grinnell.instructure.com/ to access the page.

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Important Days and Dates at a Glance

- Homework due: Mondays at 11:59PM on Canvas
- Midterm 1: Thursday, February 27th in class
- Midterm 2: Thursday, April 24th in class
- Final presentations: Tuesday, May 6th and Thursday May 8th in class
- Written final project due: Wednesday, May 14th at 11:59PM



¹Feel free to call me Christy, or if you prefer something more formal, Professor Christy, Professor Hazel, Dr. Christy, Dr. Hazel are all fine!

Course Description and Goals

In calculus and analysis, we learn that continuous functions on the real line are, roughly speaking, functions that send inputs that are close together to outputs that are close together. But what does it mean for a function defined on a more complex geometric object to be continuous? How do we make sense of "closeness" and "connectedness" in general? Topology gives us a framework to answer these questions. The first part of this course will establish the basics of point-set topology. Then, once we've made precise the ideas of topological space and continuity, we'll turn to studying properties of spaces. Algebraic topology studies spaces using "algebraic invariants", which are ways to assign to each space a group or a ring in such a way that the "same" (i.e. *homotopic*) spaces are assigned the "same" (i.e. *isomorphic*) algebraic gadgets. We can then use tools from abstract algebra to answer geometric questions.

By the end of this course, a successful student will be proficient in the basics of point-set and algebraic topology. In particular, you will...

- Become fluent in the basic terminology used in point-set topology (spaces, subspaces, quotient spaces, continuous maps, metric spaces) and be able to prove statements about these objects.
- Become fluent in the basic terminology of homotopies and the fundamental group and be able to prove statements and do computations.
- Improve your mathematical writing and reasoning skills, building on and expanding techniques you learned in your foundations courses.
- Learn to give "chalk talks" (mathematical presentations on the board) through regular proof presentations.

Grading Scheme: How your learning will be assessed

Course grades will be weighted according to the following scheme:

• Pre-Class Work 4%

• Weekly Homework 25%

• Two Midterm Exams 32% (16% each)

• In-Class Engagement 4%

• Final Project 25%

- Presentations 10%
- More information about these categories is given later on in the syllabus. I will compute your weighted average using the breakdown above and then assign letter grades based on which interval your percentage falls in according to the following scale²: [93, 100] A, [90, 93) A-, [87, 90) B+, [83, 87) B, [80, 83) B-, [77, 80) C+, [70, 77) C, [60, 70) D, [0, 60) F.

²I reserve the right to modify this scale at the end of the semester. Any modifications would happen after everything has been graded, would apply to all students, and would only benefit students (I would never increase the cut-off for a letter grade). But this is unlikely, and you should not expect any grade scale modifications.

A Day in our Class

Our textbook is structured in an inquiry-based learning format. Each section has definitions and examples with theorems in between, but you'll notice the theorems are missing proofs! Rather than giving you proofs to read, the book gives you the tools you need to come up with the proofs on your own. We will be filling in the proofs as a group as we move through the text.

Before class you will read the book and come up with outlines for an assigned proof(s). During class you will share and listen to solutions. After class you will revisit these ideas and carefully write them into formal proofs. Here is the rough schedule for each of our class meetings:

- (*Before class*) Read the assigned section, take notes on the assigned definitions/examples, come up with a proof for your assigned theorem.
- (*First 10 or so minutes of class*) Open time for questions about definitions/examples. Then Christy will present our first proof of the day.
- (*Next 10 or so minutes*) Meet with one or two students who had the same theorem(s) assigned. Discuss your solutions and ask each other questions. One person will be assigned as the presenter before class, and you should make sure they are ready to present.
- (*Next 30 or so minutes*) Each of the three groups will present their theorem and proof. The other two groups will take notes and ask questions at the end.
- (*Remainder of class, about 10 minutes*) Christy will give some concluding/summarizing remarks and/or prove remaining theorem(s) from the section.
- (*After class*) Use your notes from the presentations and discussions to type up proofs of the theorems.

Communication: How to get help and how to contact me

- Drop-in Office Hours. These sessions are dedicated time for my students to ask me questions about homework and course material. These will be held in my office (Noyce 2248).
 - Come by any time during the scheduled times.
 - Students should come in one at a time or in groups to ask questions (if you do come in as group, just make sure everyone in the group is comfortable with that).
 - If there is a line, these questions will be limited to 5ish minutes to allow the next students to come in to ask questions. You are welcome to get back in line if you have more questions.
- Appointments. In addition to office hours, I also budget time for about 2 hours of appointments each week. If you would like to schedule a 15-minute appointment with me, please use the Calendly link on Canvas. Each student is allowed to schedule at most one appointment per week. Please do not select multiple appointments.

- Email. You are welcome to email me any time with any questions or comments about mathematics or about the course (hazelchristy@grinnell.edu).
 - Note I usually do not check my email between 6PM and 8AM on weekdays, and I only occasionally check email on the weekends. You are welcome to email me whenever is most convenient for you, but I usually won't respond until normal working hours.
 - I will try to always respond within one business day (note if you email Friday afternoon, there's a chance I won't get back to you until Monday).

More About Assessments

Homework (25% of final grade)

Pre-Class Work (4% of final grade)

You'll be asked to come up with a proof to one theorem before each class. You don't need to type up a proof, but you should have a complete argument worked out (it can be handwritten in bullet points in your notebook, for example). You'll use these notes to discuss with your partner(s) and possibly present. You'll be asked to take a picture and upload these notes to Canvas by 2PM on the relevant class day.

In-Class Engagement (4% of final grade)

An essential component of learning mathematics is regularly and thoughtfully engaging with the material. Our class meetings give us scheduled time to engage with content as a group. This part of your grade will be based on your engagement in class. If you do all of the things listed below, then you will get full points in this category:

- show up on time to class with your pre-class work completed;
- pay attention when someone is presenting, whether this is the professor, one of your groupmates, or a different group;
- productively engage with your assigned group to discuss your theorem and provide support to your groups' presenter;
- stay in the classroom during class time (it's okay to step out of a class every once-in-a-while to run to the bathroom, but you shouldn't be regularly leaving unless you have accommodations);
- refrain from taking out your phone, laptop, outside work, or anything else that would distract you or others during our class time.

You can harm your engagement score by skipping class, showing up late, or being on your cell phone or laptop during class. **Cell phones and laptops should not be used during class**. If you like to use a tablet to take notes, then that's fine, but you should have the tablet in note-taking mode for the duration of class.

I do understand life happens, and you might need to occasionally miss class. If you miss <u>two or less</u> classes during the semester, then your score won't be affected. **If possible, please let me know ahead of time if you are missing class.** Our class has structured group work with pre-assigned groups, and if you unexpectedly miss class, then this can cause issues for your group.

If you miss more than two classes, then you should expect your engagement score to decline. Documented illnesses/emergencies and university-approved travel are exceptions to this rule. If you are missing more than a week of classes because of illness or travel, then please reach out to me so we can come up with a plan.

Presentations (10% of final grade)

Three students will present each class period for the first 12 weeks of class. See A Day in our Class for how this will be structured. Each student should expect to do 6–8 presentations over the course of the semester. This portion of your grade will be based on how often and how well you present.

I will email each student feedback after their presentation. I will also meet with each student halfway through the semester and again at the end of the semester to discuss how you are doing in this category.

Note: I do not expect you to be a great presenter at the start of the semester. But I do expect you to reflect on feedback and to improve your boardwork and presentation skills. As long as you consistently reflect on and improve your presentations, then you will do well in this category. More details about presentation expectations will be given on Canvas.

Midterm Exams (32% of final grade)

We will have two in-class midterm exams:

- Exam 1: Thursday, February 27th
- Exam 2: Thursday, April 24th

I will post information about each exam on Canvas the week before the exam. Each exam score will count for 16% of your final grade. It is important that you are present for the exams. Please see "Make-up Exam Policy" below for more information.

Final Project (25% of final grade)

In lieu of a final exam there will be a final project. In this project, you will explore one of the sections from our text that we did not cover during the first 12 weeks of the semester. You will give a presentation on this section and then submit a written report with proofs of theorems from

that section. More details will be given about the final project once it gets closer, and you will have support and guidance leading up to the presentation. The 25% grade portion will be comprised of the written report, presentation, practice presentation feedback, and some scaffolded draft work. More details about the breakdown will be given on Canvas later.

MASSS (extra credit up to 0.5%)

The math and stats departments have a joint student seminar series that meets many Thursdays 12-1PM (lunch will be provided!). You can earn 0.1% towards your course grade if you attend a seminar and then **email me a paragraph by 5PM the Friday immediately after** describing what the talk was about. You can earn up to 0.5% extra credit to your course grade doing this. If you email me after 5PM on Friday, then you will not receive any extra credit.

Late Homework Policy

Each student will be allowed to take one 48-hour homework extension for one homework assignment. Please send me a short email letting me know you are taking your extension, and I will give you instructions for how to submit the late assignment. You do not need to provide a reason why. There is no penalty for taking your one extension.

After this first extension, each student will be allowed to take one more 48-hour extension, but this will result in a 10% grade deduction on that assignment. Again, please send me a short email letting me know you would like a second extension. You do not need to provide a reason why.

No extensions will be given after these two extensions except in extreme, documented situations.

If you are struggling to meet deadlines in this course, then I encourage you to meet with me so we can come up with a plan to help you through the semester.

Make-up Exam Policy

If you have university-approved travel (such as for athletics) that conflicts with an exam, then please let me know and provide documentation as soon as possible. Documentation must be provided **at least one week** in advance. In that case, we will schedule a make-up exam for before you leave.

If you are sick or experience a medical emergency on an exam date, then a make-up exam will be provided if you email me a signed doctor's note that states you are/were unable to attend classes on that date. It is unlikely that I will offer a make-up without any documentation. If you have some other emergency that is preventing you from attending an exam, then please reach out as soon as possible to see if a make-up is possible. In any case, please **do not expect a make-up exam if you do not provide documentation stating you had to miss the exam**.

Classroom Culture and Expectations

We will be spending a lot of time discussing mathematics together this term. We should all recognize that different people will have different mathematical and personal backgrounds. To foster and

maintain a productive and inclusive learning environment, it is essential that we create a space where people feel comfortable asking questions and discussing material. Here are a few concrete things we can do to build our learning community:

- **Be present and engaged.** We have a limited amount of time together in the classroom, so let's use this time productively. For all of us, this means showing up on time, being ready to start at the beginning of class, and not engaging in distracting behavior such as using phones, looking at non-course related materials, chatting about unrelated topics during class, leaving during class, etc.
- Recognize that learning is a process and be open to making mistakes. I do not expect you to be able to do every proof on your first try. Be open to trying new problems and making mistakes. Recognize that mistakes are a natural part of learning, and find something to learn from your mistakes.
- Listen to understand, not to judge. You will often be discussing mathematics with your classmates. Make sure everyone gets a chance to share ideas, and listen to understand and learn from your classmates' ideas, not to judge their abilities. If you disagree with something, share your disagreement respectfully and make sure you are critiquing the ideas and not the person.
- Take space and give space. "Take space" by participating in discussions. Ask questions and share ideas. We all benefit from hearing different ideas and thought processes. Also make sure you "give space". If you find that you are dominating a conversation or are the only person in class answering questions, then ask others what they think or wait for someone else to raise their hand. Take time to listen (and actually listen-don't just wait to share your own ideas). Creating an inclusive and productive classroom requires all of us to be mindful of the space we occupy.

Grinnell Resources for Support and Learning

Below are some of the resources offered by Grinnell that could be helpful for you. Grinnell has a lot of resources available for students, so it can be hard to stay informed about all of them. The link https://www.grinnell.edu/students has more information on resources.

Academic Accommodations Based on a Disability

Everyone in this class deserves an equitable opportunity to learn and engage with the material. Students with documented disabilities that are working with the Office of Disability Resources should have accommodation letters available to faculty via the accommodation portal. To help ensure that your access needs are met, I encourage individual students to approach me so we can have a discussion about your distinctive learning needs and accommodations within the context of this course. If you have not already worked with the Office of Disability Resources and believe you may require academic accommodations for this course, Disability Resources staff can be reached via email at access@grinnell.edu, by phone 641-269-3089, or by stopping by their offices on the first floor of Steiner Hall. If you have any other questions about accommodations in this course, please feel free to reach out to me.

Counseling and Wellness

Student Health and Wellness (SHAW) provides a variety of services to support the physical, mental, and social well-being of Grinnell students. Find more information by visiting their website (https://www.grinnell.edu/about/leadership/offices-services/student-health/counseling), including information about counseling services that are available to Grinnell students. They also offer a Need-to-Talk 24/7 counseling hotline at 641-269-4404. These calls will offer a one-time session to work through a specific concern.

Religious Observance

I encourage students who plan to observe holy days that coincide with class meetings or assignment due dates to consult with me in the first three weeks of classes so that we may reach a mutual understanding of how you can meet the terms of your religious observance and also the requirements for this course.

Title IX and Pregnancy Related Conditions

Grinnell College is committed to compliance with Title IX and to supporting the academic success of pregnant and parenting students and students with pregnancy related conditions. If you are a pregnant student, have pregnancy related conditions, or are a parenting student (child under oneyear needs documented medical care) who wishes to request reasonable related supportive measures from the College under Title IX, please email the Title IX Coordinator at titleix@grinnell.edu. The Title IX Coordinator will work with Disability Resources and your professors to provide reasonable supportive measures in support of your education while pregnant or as a parent under Title IX.

Academic Advising Support

If you have other needs that aren't addressed through the above resources, please let me know soon so that we can work together for the best possible learning environment. In some cases, I will recommend consulting with the Academic Advising staff. They are an excellent resource for developing strategies for academic success and can connect you with other campus resources as well: http://www.grinnell.edu/about/offices-services/academic-advising. If I notice that you are encountering difficulty, in addition to communicating with you directly about it, I will also likely submit an academic alert via Academic Advising's SAL portal. This reminds you of my concern, and it notifies the Academic Advising team and your adviser(s) so that they can reach out to you with additional offers of support.

Academic Honesty

Please familiarize yourself with Grinnell's policies on academic honesty. Below are some specific policies for this course.

<u>You are allowed</u> (and strongly encouraged!) to ask me for clarification and hints and to work with your classmates on homework problems and pre-class work. But you must write your final solution on your own. You will be required to list anyone you worked with on your homework submissions.

If you find an alternative textbook, video, or any other resource that helps you with the material on a homework assignment, then you must mention that on your homework. I recommend checking with me before using any external resources to make sure they fit the level of our course.

<u>You are not allowed</u> to consult external resources for proofs. This includes other textbooks that provide solutions/proofs of the homework statements, online forums, any AI tools or large language models (LLMs) such as Chat GPT, or any other external resource that gives you a partial or complete solution to one of your assigned problems.

You should not be using AI tools or LLMs for any reason while coming up with the mathematical ideas or writing style in your assignments. The only exception is that you <u>can</u> consult these tools or online forums for help with IAT_EX commands and formatting.

Consulting any completed or partial solution is academically dishonest. A key goal in any math course is to learn how to navigate through being stuck. This is especially true in a 400level course. You should not expect to be able to solve most problems right away. Reading and understanding a math solution is much easier than figuring it out yourself, so it hurts your learning to find solutions instead of coming up with them on your own. If you're feeling stuck and really don't know how to proceed, then you should reach out to me and we can come up with a plan together.

Some clarifications on collaborating with other students

You are encouraged to work with your classmates on problems, but you should not share solutions or hints to problems you've already solved. To clarify, if you are brainstorming how to solve a problem with a group of students, and in the course of your conversation someone suggests a key piece of the solution, then everyone in your study group is welcome to use that key piece when you write up your own proofs later on. Additionally, you are allowed to discuss your written solutions for this problem with that group (since you already have an agreed-upon path through the proof that you discovered together).

On the other hand, if you or a classmate has already solved a problem (either on their own or with a different group), then it is not okay to share key pieces with other students in the class. Thus if someone asks for help or hints on a homework problem that you've already solved, then you should tell them that you already solved the problem and instead recommend they ask me if they are stuck.

You should never share your LATEX code for a solution with another student. Even if you worked together, you should not be sharing full or partial solutions in this way. If you or a classmate is struggling to learn LaTeX, then they should come chat with me to come up with a plan.