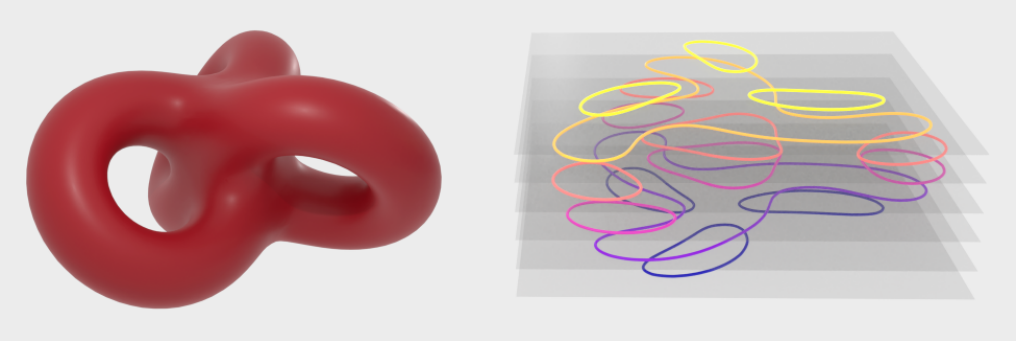
Math 549 – Differentiable Manifolds I – Fall 2022

Emily Dumas



1. The basics

Course web page	On UIC's Blackboard LMS https://uic.blackboard.com/ultra/courses/_225995_1/cl/outline
Lectures	MWF 2:00-2:50pm in Lincoln Hall 100 (CRN 40616)
Instructor	Emily Dumas (she/her) <edumas@uic.edu>
Office hours	10am Monday and 1pm Wednesday
Office location	722 SEO
Online office	*Link available in UIC's online LMS.*
Instructor home page	https://dumas.io/

2. Welcome statement

Welcome to Math 549.

As your instructor, my main goals are to:

(1) **Treat everyone with dignity and respect**, to create a positive and welcoming learning environment.
(2) **Make sure everyone understands the course rules** so that there are no surprises.
(3) **Give clear and comprehensible lectures** that, along with self-study, allow you to learn the material thoroughly.

In general I try to minimize the use of high-stakes assessments in my courses. In this course, where one of the goals is to prepare you for a preliminary exam, I do think some exam-taking practice is helpful. Therefore, we will have midterm and final exams, but each is worth just 20% of the course grade.

I look forward to working with you this semester.

3. Course content

This is a first course on smooth manifolds. We will introduce and study manifolds, smooth maps, tangent spaces, vector fields, flows, and differential forms. We will also cover some introductory material on related topics such as Lie groups, Riemannian metrics, and de Rham cohomology, though these topics are explored more fully in other courses.

The definition of a smooth manifold is itself quite complicated, and developing familiarity with it and constructing some examples will be a major focus early in the course. Our rate of progress through the material may therefore seem slow at first, with a gradual increase in pace later in the semester.

4. Prerequisites

According to the UIC course catalog, Math 445 (topology) and Math 310 or Math 320 (linear algebra) or equivalent background in these topics are required. I teach a course that is compatible with these prerequisites.

In practice, we do not use much material from UIC's Math 445 (topology) beyond the basics of topological spaces, continuity, and compactness. In cases where deeper results from topology are used, they typically appear in a way that would allow the results to be accepted without immediate recollection of the proofs.

In contrast, a strong background in linear algebra is very important for this course.

Furthermore, while real analysis is not among the catalog prerequisites for Math 549, some background in this area—or any other course covering differentiability of multivariate functions—would be quite helpful.

Experience writing rigorous mathematical proofs is also essential for success in Math 549.

5. Texts

There are no required textbooks. You need to have access to the primary text, but since it is available for free to current UIC students in ebook form, I do not recommend purchasing any textbook unless you prefer having a physical copy.

Primary text:

- J. M. Lee, *Introduction to Smooth Manifolds*, 2ed, Springer GTM, 2012.
  - Physical book: ISBN 9780387954486 (paperback), 9781441999818 (hardcover)
  - Ebook: https://link-springer-com.proxy.cc.uic.edu/book/10.1007/978-1-4419-9982-5

The following secondary texts are recommended for students seeking other expositions of the material.

- W. M. Boothby, *An Introduction to Differentiable Manifolds and Riemannian Geometry*, 2ed, Academic Press, 1986.
- F. W. Warner, *Foundations of Differentiable Manifolds and Lie Groups*, Springer GTM, 1983.

6. How the course is delivered

This a synchronous in-person class. This means that unless the university requires a change in teaching modality, the course will be held at the scheduled time in Lincoln Hall 100. Any change in teaching modality will be announced on the course web page.

At present there is no plan to offer any hybrid participation option, nor to record the course lectures.

(In case of student or instructor absence from campus, some contingency plans are described below in Section 12.)

7. Important dates and deadlines

Fixed dates. Some of these dates are taken directly from the UIC academic calendar.

22 Aug	Mon	First day of class
2 Sep	Fri	Add/drop deadline
5 Sep	Mon	No class (Labor day)
10 Oct	Mon	Take-home midterm exam posted
17 Oct	Mon	Take-home midterm exam due
24-25 Nov	Thu-Fri	No class (Thanksgiving)
2 Dec	Fri	Last day of class
7 Dec, 1-3pm	Wed	Final exam
13 Dec	Tue	Departmental deadline for instructor to submit grades
19 Dec	Mon	Course grades become available on my.uic.edu

Recurring.

- **Homework will be due once a week** in most cases, usually on Mondays. The exact deadline for assignments that have been posted can be found on Gradescope.

8. HOMEWORK

Problems sets will be posted on the course web page, with each problem set indicating the date when it is due. Homework will be collected and graded online using *Gradescope*, a tool accessible through the course page on Blackboard. Homework will **not** be accepted in any physical form (e.g. please do not give paper to the instructor).

Typesetting solutions to problem sets is encouraged but not required. Online collection means that homework written on paper will need to be scanned or photographed for upload. Hand-written solutions (whether scanned from paper or prepared with a tablet) must be legible to the course staff to receive credit, and should not contain an excessive amount of irrelevant material or scratch work.

Many problems will be taken from the textbook, but some will be written by the instructor or taken from other sources. The usual schedule will be one problem set per week, due on Monday.

Homework dropping: At the end of the semester, the **three** lowest homework grades will be dropped.

Homework collaboration and resource policy: Collaborating on homework with other students in the course is acceptable, but you must write and understand the work you ultimately submit. Write your collaborators' names on the first page of the assignment.

9. MIDTERM

There will be a take-home midterm exam posted on or before Monday October 10 and due Monday October 17. Like the homework, midterm exams will be collected on Gradescope.

Midterm collaboration and resource policy: No collaboration is permitted on the take-home midterm exam. Course notes and the official textbooks listed on the syllabus are the only references that students are allowed to consult when solving these problems.

10. FINAL EXAM

The final exam will be held at the time set by the registrar, which is 1-3pm on Wednesday, December 7, 2022. It is important that students avoid making plans (e.g. travel) that conflict with the exam.

The final exam location will be announced at a later date (when it is set by the registrar).

Unlike the midterm exam, the final exam will be held in person, with solutions written on paper booklets and collected for grading.

11. ATTENDANCE POLICY

It is important to attend the lectures whenever possible. However, following public health guidance, students who are sick (or experiencing symptoms) should never participate in in-person activities.

Attendance in lectures will not be checked or recorded.

12. ABSENCE CONTINGENCY PLANS

12.1. **Student absent from lecture.** Any student who misses a lecture should ask another student in the course for notes from the lecture and review the associated material from the textbook.

12.2. **Instructor absent from lecture.** If the instructor cannot lead a course lecture in person, one of these things will happen:

(1) Online synchronous lecture: Class will be held on Zoom using the meeting link on the course web page.

(2) In-person substitute: Another instructor will lead the meeting as usual.

(3) Cancellation: The course meeting will be cancelled, with the next lecture containing the content planned for the cancelled one.

(4) Asynchronous lecture delivery: A lecture video will be recorded and provided to all students.

These options are roughly ordered from most likely to least likely. In any case, an announcement of the specific plan will be made with as much advance notice as possible. It is expected that instructor absences will be rare.

13. Policy on missed or late work

For homework, the three lowest scores are dropped at the end of the semester. This dropping policy exists to handle occasional workload variations or other events that might affect your ability to complete an assignment on time.

If you are going to miss any other deadline or graded course activity, or if something more serious comes up affecting multiple homework assignments, please contact the instructor as soon as possible to explain the situation so we can try to work out an equitable solution.

14. Academic honesty

Incidents of academic misconduct, while rare in graduate courses, will be reported to the Dean of Students office and handled under UIC's Student Disciplinary Policy (`https://go.uic.edu/DisciplinaryPolicy`).

15. Course grade computation

The course grade is computed as a weighted average of scores on the three types of work:

- 60% - **Homework**
  - The **three** lowest scores are dropped
  - The remaining homework scores are converted to percentages and averaged, so each assignment accounts for the same fraction of the course grade
- 20% - **Take-home midterm**
- 20% - **Final exam**

And just to be clear about the meaning of weighted average, this means your final course grade is equal to:

$$0.6 \times (\text{homework average}) + 0.2 \times (\text{midterm percentage score}) + 0.2 \times (\text{final exam percentage score})$$

When final course grade percentages are available, they will be converted to letter grades using thresholds to be determined by the instructor. The grading thresholds will be *at least as generous* as the following scale, and the instructor's intention in designing the assessments is to make it possible to apply this exact scale:

- A = 85% – 100%
- B = 70% – 84.9999%
- C = 60% – 69.9999%
- D = 50% – 59.9999%
- F = less than 55%

16. Communication with course staff

Instructor office hours will be held in person (whenever the university allows this). Students wishing to visit office hours using zoom on a certain day may do so if arranged with the instructor in advance. Students who cannot attend office hours but want to meet with the instructor can request an appointment.

Outside of course meetings, office hours, and scheduled appointments, email and Discord are the best ways to contact the instructor in most cases.

Keep in mind that questions received in the last few hours before a course deadline (for a homework assignment or exam) cannot necessarily be answered in time to help you with your work.

17. Communication with other students

In all class settings (meetings, office hours, online forums, etc.) students are required to treat everyone with respect. Harassment, bullying, discrimination, bigotry, and other behaviors that create a harmful or exclusionary environment will not be tolerated.

The course Discord server can be used to communicate with other students in the class (as a group, or through individual private messages).

18. University Policies

UIC requires that every syllabus mention the following university policies.

18.1. **Academic deadlines.** The UIC academic calendar can be found at:

http://catalog.uic.edu/ucat/academic-calendar/

In particular this calendar includes the deadlines for adding and dropping courses.

18.2. **Standards of conduct.** All UIC students are required to abide by the rules and standards of conduct described in the Student Disciplinary Policy (https://go.uic.edu/DisciplinaryPolicy).

18.3. **Disability accommodation.** The University of Illinois at Chicago UIC is committed to full inclusion and participation of people with disabilities in all aspects of university life. Students who face or anticipate disability-related barriers while at UIC should connect with the Disability Resource Center (DRC) by visiting drc.uic.edu, by emailing drc@uic.edu, or by calling (312) 413-2183 to create a plan for reasonable accommodations. In order to receive accommodations, students must disclose disability to the DRC, complete an interactive registration process with the DRC, and provide their course instructor with a Letter of Accommodation (LOA). Course instructors in receipt of an LOA will work with the student and the DRC to implement approved accommodations.

18.4. **Religious holidays.** The UIC Senate Policy on religious holidays (approved May 25, 1988) is as follows:

"The faculty of the University of Illinois at Chicago shall make every effort to avoid scheduling examinations or requiring that student projects be turned in or completed on religious holidays. Students who wish to observe their religious holidays shall notify the faculty member by the tenth day of the semester of the date when they will be absent unless the religious holiday is observed on or before the tenth day of the semester. In such cases, the students shall notify the faculty member at least five days in advance of the date when he/she will be absent. The faculty member shall make every reasonable effort to honor the request, not penalize the student for missing the class, and if an examination or project is due during the absence, give the student an exam or assignment equivalent to the one completed by those students in attendance. If the student feels aggrieved, he/she may request remedy through the campus grievance procedure."

The University Holidays and Religious Observances calendar can be found at:

http://oae.uic.edu/religious-calendar/

19. Revision history of this document

- 2022-08-17 Initial publication
- 2022-08-19 Added office hours
- 2026-08-20 Fix instructor name, pronouns