

MATH 8803:

AN INVITATION TO CARTAN GEOMETRIES

Syllabus

Spring 2027

1 Course Information

Course Title: Special Topics

Lecture Meeting Times: TR 9:30am – 10:45am

Lecture Meeting Location: Skiles 368

1.1 Course Content

This course is meant as an invitation to the modern Erlangen program, with a heavy focus on intuition. Some topics I intend to touch upon in the course include:

- Intuition for working with and visualizing Lie groups
- Euclidean geometry
- General model geometries (hyperbolic geometry, projective geometry, etc.)
- Reinventing classical mechanics from first principles
- A brief primer on representations of Lie groups
- Cartan geometries in general
- Riemannian geometry
- The nonabelian fundamental theorem of calculus
- How to judiciously pretend that everything is homogeneous
- Intuition behind the Killing form
- A very brief overview of noncompact symmetric spaces
- Parabolic geometries
- Additional topics depending on class interests

1.2 Learning Outcomes

The primary goal of the course is to give students sufficient background and intuition for the ideas surrounding the modern Erlangen program that they are comfortable with exploring it further. Given how truly vast the modern Erlangen program extends across mathematics, we anticipate that students should be able to implement these ideas within their own work by the end of the semester.

1.3 Prerequisites

I won't be enforcing any hard prerequisites, but you should probably be at least passingly familiar with smooth manifolds and Lie groups. If you don't know what $SL_2\mathbb{R}$ is, for example, then this might not be a good course for you yet.

1.4 How to succeed in this course

Basically, attend the lectures, ask questions, and put a reasonable amount of effort into completing the final project in a satisfactory way.

2 Instructor information

Instructor: Dr. Jacob W. Erickson

Instructor Office: Skiles 218A

Instructor Email: jerickson41@gatech.edu

Instructor Office Hours:

- TBD (Clough 248)
- TBD (Zoom)

3 Textbooks and other resources

There's no required textbook for this course, but I'm basing the content of the lectures on notes I've written on the topic, which are available on my webpage under the heading "Parabolic Geometries for People that Like Pictures". Secretly, one motivation for doing this course is to strong-arm myself into completing said notes.

4 Course Requirements & Grading

4.1 Attendance

The nature of the course kind of necessitates some portion of the grade to be based on attendance. In our case, attendance to the lectures will count for 60% of the grade.

4.2 Final project

Toward the middle of the semester, I'll have you pitch a topic of interest to you that relates to the topics discussed in the lectures. Given the breadth of the subject, finding such a topic should not be particularly difficult. Once we agree on the topic, I'll have you either write a small paper on it or give a small presentation on it for the end of the semester. This will account for the remaining 40% of the grade.

4.3 Grade Breakdown

Your final grade in the class will be computed according to the table below.

Grading scheme:
60% Attendance
40% Final project

4.4 CIOs Incentive

I strongly value your feedback, and I'll inquire what incentive seems appropriate for encouraging you to complete the CIOs evaluation for the course.

4.5 Grade Assignment

After *all* grades are in and all overall percentage scores for students have been computed using the weights described above, grades are assigned. The standard cutoffs are as follows.

A: [90%, 100%] B: [80%, 90%) C: [70%, 80%) D: [60%, 70%) F: [0%, 60%)

Grades will not be rounded, but grade cutoffs may be adjusted at the end of the semester. So, to guarantee an A, get 90% or better overall. To guarantee at least a B grade, get 80% or better overall, etc.

5 Course Expectations & Guidelines

5.1 Missed work policy

If you have to miss a lecture due to illness, a religious holiday, a university-approved absence, or a personal emergency, then please let me know (preferably ahead of time) so that it doesn't count against your attendance!

5.2 Digital Learning Days

In cases where campus may be physically closed due to events such as inclement weather, a digital learning day may replace in-person classes. Should this event occur on a lecture day, then lectures will either be streamed live, or a recording will be posted for students to watch asynchronously. If a digital learning day occurs on a midterm exam date, then class lectures will meet online or asynchronously instead, and that exam will be rescheduled to the next lecture day.

5.3 Students with Disabilities and/or in need of Special Accommodations

Georgia Tech complies with the regulations of the Americans with Disabilities Act of 1990 and offers accommodations to students with disabilities. If you are in need of classroom or testing accommodations, please make an appointment with the Office of Disability Services to discuss the appropriate procedures. More information is available on their [website](#). Please also make an appointment with me to discuss your accommodation, if necessary.

5.4 Statement of Intent for Inclusivity

As members of the Georgia Tech community, we are committed to creating a learning environment in which all of our students feel safe and included. Because we are individuals with varying needs, we are reliant on your feedback to achieve this goal. To that end, we invite you to enter into dialogue with us about the things we can stop, start, and continue doing to make the classroom an environment in which every student feels valued and can engage actively in our learning community.

5.5 The Honor Code and Academic Dishonesty

Do not cheat! Abide by the [honor code](#) at all times. See <http://honor.gatech.edu> and [here](#).

Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Office of Student Integrity. Cheating includes, but is not limited to:

- Using a calculator, books, or any form of notes on checkpoint or celebration assessments.
- Copying directly from any source, including friends, classmates, tutors, internet sources, or a solutions manual.
- Allowing another person to copy your work.
- Taking a test or quiz in someone else's name, or having someone else take a test or quiz in your name.
- Asking for a regrade of a paper that has been altered from its original form.

Cheating does not include working together with your friends and classmates on your homework. You may use AI and other tools to help you get started on your homework, but relying heavily on these will likely result in poor performance on exams if you do not develop your own understanding of the material. AI tools may sometimes make mathematical errors, so be careful in applying them.

5.6 Student-Faculty Expectations Agreement

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulate some basic expectations that you can have of me and that I have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.