

Differential Geometry Final Project

You may work alone or in a group of up to 2 people and turn in one per group, although each person conducts peer review and a self-evaluation. Choose a topic related to differential geometry as evidenced by its inclusion in a differential geometry text and connection to one or more topics we covered. This final project connects to our course goals and the four general education goals for ASU as you

1. **extend course content**
2. **make connections to differential geometry**
3. **write and speak**
4. **reflect on classmates presentations and your own**

Your project will be graded on your differential geometry connections and the clarity and creativity of:

extension of course content	material presented orally and in writing extends class content in some creative way by explaining new material, visualizing existing material in creative ways (GeoGebra, Maple, or another programming language), examining connections to your field or other classes, describing historical connections, or other new connections
alphabetized bullet point list of related class topics near the beginning of your presentation	orally and in writing presents an alphabetized list of topics we covered that relate to your topic—at least one item is on it. The list is near the beginning of your presentation. Say your extension incorporates Christoffel symbols in some way. Then include. If not, then do not
differential geometry connections	rich differential geometry connections, presented orally with correct mathematics connecting to the language of our class when possible
if needed, consistent scholarly reference list that is professional	if applicable, cites credible, relevant sources and/or evidence that are situated within the context and purpose of the presentation
if applicable, cites image refs	image references, if any are needed, are listed professionally and cited appropriately
video and forum posting	by Friday April 29th at 2pm, post in the final project forum <ul style="list-style-type: none"> • your preferred name • your final project title/topic • a link to your video that we can access (you can have it be a Screencast-o-matic shared link, a Kaltura link, “unlisted” on YouTube, or have it shared only with people at ASU who have the link on Google Drive, for example), which satisfies the final project criteria. You should take as long or short as you need to meet these rubric items although staying on point is important and part of a professional presentation. If you find that your video is longer than 20 minutes, please consider whether you can trim it
4 peer reviews	in-depth peer review of 4 classmates’ presentations with some topics different than yours (if possible) and detailing strengths, suggestions and what you learned (see below for questions)
self-reflection	in-depth self reflection (see below for questions)
overall writing and speaking	contains writing and speaking that is clear, organized and professionally presented (it is OK to have some imperfect flow in your speech). Your video includes balanced voice narration from each member of your group, if you work in a group of 2, or includes your voice narration otherwise
own words/self creation	Aside from external images, all components are products that you create yourself in your own words. If you are showing any mathematics symbols or notation professionally type it yourself

Sample Topics

Here are some final project ideas, just to name a few possibilities—there are many others!

- Topic from class: You could expand on a topic from class such as a curve, a surface, a metric form, tensors, or other topics
- Visualization: You could work to create a differential geometry visualization in GeoGebra, Maple, or another programming language to visualize in a creative way something we covered or something new that connects. For instance, as part of an independent study, Matt Hefner coded <http://matthefner.com/jsgeometryofcurves.html>. You could work on a new visualization or program and report back on how that went or find one we didn't cover, like Rudy Rucker's Software related to "How Flies Fly," to explore and report on.
- Textbook: You could explore a theorem, topic, or visualization in the textbook we didn't cover, or expand on one we did, such as one of the following, and summarize what you learned:
 - pp. 453–454 lists some final project ideas, including a Mylar Balloon
 - 1.6 has Green's Theorem and the Isoperimetric Inequality
 - 3.6 has Surfaces of Delaunay
 - Chapter 4 has Minimal Surfaces
 - 5.2 has the Clairaut Relation for geodesics
 - 5.7 in our textbook has an industrial application of wrapping and unwrapping
 - Chapter 7 has Calculus of Variations and Geometry
 - The index lists various pages on the Gauss map
- Article: You could read an article or part of a book and summarize what you learned, like
 - "The Center of Population of the United States" by David Austin
 - "Curvature and Uniqueness of Equilibrium" [Mathematical Economics] by Andrea Loi and Stefano Matta
 - "Designing a Baseball Cover" by Richard B. Thompson
 - *Differential Geometry For Physicists And Mathematicians: Moving Frames And Differential Forms: From Euclid Past Riemann* by Jose G Vargas
 - "How a 19th Century Math Genius Taught Us the Best Way to Hold a Pizza Slice" by Aatish Bhatia
 - "Hyperbolic Basketball" by Bernadette Boyle, Andrew Lazowski and Michael Watt
 - "The Klein Bottle as an Eggbeater" by Richard L. W. Brown
 - *Subdivision Surfaces (Geometry and Computing)* by Jorg Peters and Ulrich Reif

There are lots of possibilities to extend content—I encourage creativity!

For 4040 Capstone Students

Students in MAT 4040, the Mathematics Capstone, should create a video presentation that relates to their capstone project.

For 5530 Students

In addition, 5530 students will research the literature (mathematics and/or physics and/or cs journals) and discuss some recent work, and if possible an open problem, that relates to your topic. Summarize what you found in your own words and be sure to list the journal article(s).

Conduct 4 Peer Reviews

After you post in the final project forum there is typically a delay, like 15 minutes, and then your classmates' postings will open to you so that you can work on 4 peer reviews and a self evaluation. You submit a PDF of that in the (separate) hand in assignment link (not this forum), which goes just to me. Try to select classmates' videos who selected a different topic than you did.

1. Name of the person/people
2. List the project title
3. List the topics from class that relate
4. List one or more strengths of the project
5. Give one or more suggestions for the project
6. How much time and effort does it look like they put into their work, as compared to your own effort? [2 = more than me, 1 = about the same as me, 0 = less than me]
7. What did you learn OR What is your favorite part of their project?

and a Self-Evaluation

1. Your name and topic
2. What would you have improved about your project with more time and/or resources?
3. What did you feel went well?
4. If you worked alone, discuss what you learned about yourself through this project.
If you worked with a partner discuss how you worked together or divided up the work. Do you deserve the same grade as your partner? Why or why not?

Resources

You have many options to record your video project, including:

1. You can use your Zoom pro account <https://appstate.zoom.us/>. The video found at <https://youtu.be/c9K1r9Lefxw> gives an introduction to using Zoom to record and share your work (phrased in terms of faculty recording a lecture, but the steps will be the same). Zoom lets you share your screen and video of yourself at the same time. <https://confluence.appstate.edu/display/public/ATKB/Zoom%3A+Using+for+Lecture+Capture> says Recordings in the Zoom Cloud are retained for 30 days. You can download recordings from the Zoom Cloud, and post them on your YouTube channel to retain indefinitely should you wish. The videos are also automatically copied over to your Kaltura account and can be shared from there.
2. You can use your Screencast-o-matic pro account <http://screencast-o-matic.com/appstate>. The video found at <https://youtu.be/K3wqlKDnWv0> gives a quick introduction to using Screencast-o-matic to record and share your work. This video reviews the free version while highlighting many great features available with a *deluxe upgrade*. You already have the *deluxe upgrade* when you sign in with your appstate credentials at <http://screencast-o-matic.com/appstate>. This means you have access to all of the features that are advertised in the video!
3. You can use YouTube or Google Drive to host and share your work. Review <https://youtu.be/9dLI002DeTo> to see a quick introduction to sharing your work on YouTube. You can read detailed instructions about how to share your video file on Google Drive at <https://www.businessinsider.com/how-to-share-a-video-on-google-drive>. I think using the share link option (step 6) with permissions set to "anyone at appstate" is the easiest way to share.