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 publication and connection to one or more topics we covered.

Contents

1.1 Rubric and Your Tasks

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. This could be 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
depth of differential geometry connections	rich differential geometry connections, presented orally with correct mathematics connecting to the language of our class when possible and aimed at a peer who needs a refresher. depth can be achieved by reviewing related differential geometry we already covered and connecting it to your extension, or it can be achieved with the differential geometry extensions themselves, if the topic is one we haven't covered.
overall writing and speaking	contains writing and speaking that is clear, organized and professionally presented in the language of our class (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 then professionally type it yourself
if applicable, professional scholarly reference list with author names at the end of your slides	if applicable, cites credible, relevant sources and/or evidence that are listed professionally and cited appropriately, including authors at the end of your slides
if applicable, cites image references at the end of your slides	images are referenced by their original source but do not need authors. place these and any other citations at the end of your slides

share final project ideas during class	on our last day together before finals, you will briefly present your name and final project plans to classmates and hear theirs. If you are unsure, you can present more than one idea and decide later.
video and forum posting	by Monday May 6th at 2pm, post in the final project forum • your preferred name • your final project title/topic • a link to your video that we can access which satisfies the final project criteria unless you work with a partner in which case one of you posts that and the other posts a message naming your partner. 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)

1.2 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/geometryofcurves.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!

1.3 For 4040 Capstone Students

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

1.4 For 5530 Students

5530 students will additionally 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).

1.5 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?

1.6 Conduct 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?

1.7 Resources: ASU Options to Record and Share Your Video

1. The library offers help via
   https://library.appstate.edu/services-search/digital-media-studio.
   The university has Zoom as well as Kaltura pro accounts. Access your Zoom pro account at
   https://appstate.zoom.us/. Zoom cloud recordings are automatically copied to your private Kaltura My Media directory, so you can use your Zoom pro account and embed it using the Kaltura button  . During finals this could be slow, so you might want to download to your computer and then upload to Google Drive or YouTube and then change the permissions to share it with us (see below). For Kaltura, see
   https://confluence.appstate.edu/display/ATKB/Kaltura+in+AsULearn
   and install Kaltura from My Media/Kaltura Capture to record you and your screen. This page also shows how to embed a Kaltura video to a forum post using the same Kaltura button

2. You can use your ScreenPal pro account
   https://screenpal.com/appstate

3. You could create a recording with your phone or some other recording software and then use YouTube or Google Drive to host and share your work. Review
   https://www.youtube.com/embed/9dLI0O2DeTo 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.