Differential Geometry Final Project

You may work alone or in a group of up to 2 people and turn in one per group. 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. Your project will be graded based on your differential geometry connections and the clarity and creativity of:

- Create a video presentation (you can use your Zoom pro account `https://appstate.zoom.us/` or other software like Screencast-o-matic...):

  1. an extension of class work, which might be one of the following, just to give you some ideas:

     - summary of what you have learned (in your own words) after researching an extension of class is some way
     - summary of part of the book we didn't cover
     - computer program you work on and report back on how that went
     - historical timeline you create and present
     - classroom worksheet that you create and present
     - the beginnings of a more extensive research project...
       there are lots of possibilities to extend content—I encourage creativity!

  2. an alphabetized bullet point list of topics we covered that relates to your topic

     Make an alphabetized bullet point list of the topics we covered in class that connect to your topic. This is purely a list of topics we covered that connect. For example, say your extension incorporates Christoffel symbols in some way. Then include that in your list. However, if it doesn't, then do not include.

  3. a reference list. Any consistent style that is professional is fine.

- By Tuesday May 5th at 11am, post a message in the final project forum containing a link to your video that we can access (you can have it be "unlisted" on YouTube or have it shared only with people at ASU who have the link on Google Drive, for example.)

- Next, conduct three peer reviews (see below) of classmates' videos who selected a different topic than you did and a self-evaluation (see below) and turn that in (to me) as a PDF in the link on ASULearn.

Aside from some external images, all components must be products that you create yourself in your own words, and that look/sound reasonably professional and flow well (it is ok to have some imperfect bits in your video). If you are showing any mathematics symbols or notation professionally type it yourself.

Sample Topics
Here are some final project ideas, just to give you a sense of some possibilities!

- p. 453–454 of our textbook, which lists some final project ideas
- 5.7 in our textbook: an industrial application of wrapping and unwrapping
- Best Way to Hold a Pizza Slice
- Developable surfaces
- "Designing a Baseball Cover" - the article by Richard B. Thompson from *The College Mathematics Journal* Vol. 29, No. 1 (Jan., 1998), pp. 48–61. Published by: Mathematical Association of America
- Economics and curvature
- Gauss map

- Journal article exploration: Explore a related journal article, like *The Klein Bottle as an Eggbeater* by Richard L.W. Brown.
- Oddly shaped wheels for nonflat surfaces, like A Bicycle with Flower-Shaped Wheels
- Maple file exploration: Compute the Christoffel symbols and Ricci curvature for your metric from hw 7 by using commands similar to those found in Wormholes.mw file or explore a different Maple file related to differential geometry, such as Robert Jantzen's demo on geodesics on the torus
- Minimal surfaces
- Physics in differential geometry
- Poincare conjecture (no longer a conjecture)
- Rudy Rucker's Software related to "How Flies Fly"
- Spirograph parameterizations like Spirotechnics!
- *Subdivision Surfaces (Geometry and Computing)* by Jorg Peters and Ulrich Reif explores the connections between differential geometry and the popular technique for representing surfaces. For example in 2005, Tony DeRose won a Technical Achievement Academy Award (Oscar) for his work on subdivision surfaces at Pixar. DeRose said he was on "a mission to show kids how cool math and science can be...[and] this award will help get that message across."
- Textbook: explore a theorem or topic the textbook we didn't cover

- Tensors
- Topic from class: Expand on a topic from class such as a curve like the Brachistrone, a surface, or a metric form
- Visualization in differential geometry

These are just a few of many possibilities!

For 5531 Students

In addition, 5531 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 Three Peer Reviews

1. Name of the person and the topic.
2. List the topics from class that relate
3. List a few strengths of the project
4. Give suggestions for improvement
5. 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]
6. What did you learn?
7. 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?