Many of you indicated that you would prefer to do a final project than take a take-home final exam. The outline for the final projects is as follows:

1. You will investigate one of the topics below, in consultation with myself and Tim Goldberg, and possibly in coordination with one or two other students in the class;
2. you will give a 20-minute presentation to the class, during the last weeks of the semester; and
3. you will write a 3–5 page paper describing your research.

To get started, you need to choose one of the following topics, and consult with me to find some initial references that you can start reading.

Please think about the project topics over the weekend, and be prepared to choose a topic on Tuesday after class. We'll try to arrange things so that everyone is working on something they want to work on, but also the presentations will treat a variety of interesting topics.

Topics

I. **Global properties of curves.** There are probably two or three topics within this project. For a start, there are several interesting results in Chapter 3 of Pressley, including the Isoperimetric Inequality and the 4–Vertex Theorem. In addition, there are several sections about curvature of knots in do Carmo's book (on reserve in the Math Library).

II. **Minimal surfaces.** Students will read Chapter 9 of Pressley, and consult outside sources, regarding the theory of minimal surfaces (constant mean curvature $H \equiv 0$). Possible extra topics include soap bubbles and the Willmore Conjecture. I am hoping at least two students choose this topic, and then coordinate their presentations.

III. **Covariant derivatives, vector fields, Morse theory.** This could be a bigger or smaller project. For a start, one student could investigate covariant derivatives and vector fields. Another student might like to expand on this and study Morse theory. These projects start with material in Ethan Bloch's book, and with §§11.4–11.5 in Pressley. It might also be possible to learn a bit about differential forms and degree of a map to provide an alternative proof of the Gauss-Bonnet theorem.

IV. **Come up with your own!** Are you taking this course because you have some other reason to want to learn differential geometry? Perhaps you are a physics student, and you want to see the tie-in with **general relativity**. Or you are a computer science student and you want to explain why differential geometry comes into problems in **computer vision**. Whatever your motivation, why don't you give us a survey of why differential geometry comes up in your field, and how the theorems we have been studying are relevant.

Presentation

The presentations will take place during the last two to three class periods, and will be 20 minutes long. Before your presentation, you **must give a practice presentation** to a fellow student, and get feedback from him/her. After your presentation, your classmates, Tim and I will give you feedback about various aspects of your talk. I will provide more details about presentations in the near future.

Paper

The final component of your project is a written description of what you have learned. This should be 3–5 pages long, and should contain the statement of at least one theorem, its proof, a detailed example or two, and an exercise or two with hints or sketched solutions. The format may differ slightly depending on your choice of topic.

Revision is an important part of the writing process. For this reason, you will need to turn a rough draft of your paper one class period **before** your presentation. You will get feedback on the draft, and then the final version of the paper will be due on **Thursday, May 10, 2007 at 3pm**.

Take-Home Final

If you elect to take a take-home final exam instead of the final project, it will be handed out on **Thursday, April 26, 2007** in class, and will be due on **Thursday, May 10, 2007 at 3pm**.