

Course Project

Overview The main purpose for this project is to give you experience in learning a topic independently to the point where you can teach others about it. You will give a fifteen-minute presentation in class and write a report. Your presentation will focus on the main ideas and your report will fill in the details. For both, your audience will be students at the end of this partial differential equations course who have not studied your topic.

Topic and source material The choice of topic is yours, subject to my approval. You should look for something equivalent in scope to what is covered in a typical sections of a textbook. You can study your topic from a single source. That is, you do not have to do an exhaustive literature search. For a source, you can use our textbook, some other textbook, or a journal article. It is unlikely an internet source will be suitable, but you can check with me if you find something that you think might be reasonable. Get my approval of your topic and source by Friday November 20.

Presentation You will give a fifteen-minute presentation to the class on your topic. In this presentation, you should convey the main ideas; you will probably not have time to cover many specific details. For example, if your topic involves a significant computation, you should be able to outline the main steps but will probably not have time to do the computation live and in person.

You can support your presentation with chalkboard, overhead projector, or computer projection system. You will need to let me know several days in advance of your presentation if you will need specific technology.

Presentations will be during the last week of the course or at a time we all agree to during finals week.

Written report Your written report should be a self-contained exposition of your topic. You should strive to explain things in your own terms.

Your report must be printed. Use 1.5 or double spacing. Figures should be inserted into your document electronically. You can put all of the figures following the text or you can embed each figure at a relevant point within the text.

The written report will be due on Wednesday, December 16 by 2 pm.

Evaluation I will evaluate your presentation and report in terms of

- the accuracy, precision, clarity, and completeness of the mathematical content;
- the level of understanding and insight you display; and
- the mechanics of your presentation and writing (e.g., articulation, spelling, grammar, neatness)

I'll assign a score to your course project with the presentation weighted at 30% and the written report weighted at 70%.

Potential topics

- detailed derivation of the wave equation as a model for a vibrating string
- random walk derivation of the heat equation
- Schrodinger equation as a PDE
- Duhamel's principle
- energy methods
- maximum principles
- proof of the Fourier series convergence theorem
- McKenna model of the first Tacoma Narrows Bridge
- Black-Scholes model of financial derivatives
- method of characteristics
- modeling traffic flow
- role of Fourier series and partial differential equations in the development of the function concept
- Navier-Stokes equations of fluid mechanics
- wavelets (see Problem 7 in Section 3.2)
- age-structured models in ecology
- a particular orthogonal set of functions (Legendre polynomials, Laguerre polynomials, Bessel functions, . . .)
- Green's functions
- generalized functions and distributions