

Class Projects

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The main purpose of the class project is to give students a chance to pursue their own interests and their creative impulses. The projects also add breadth to the course: exposing students to a variety of topics beyond the core material that I present. For myself, projects provide an opportunity to learn new things through the work of my students.

In order to clarify my expectations for the project, I will discuss below the content of the project, what you should deliver for assessment, and what my rubric is for grading.

To ensure that the projects meet my expectations, are well designed and are manageable within the time period allotted, you should briefly discuss the project with me early in the process. Following that, a written proposal (just a paragraph or two) should be submitted. I will return it with suggestions and discussion of how the project will be graded under the rubric below.

Content

Within the subject area of the course you have great latitude in choosing a topic. For example, your work may

- develop a theoretical topic with theorems and proofs,
- give interesting examples,
- discuss an application to science or engineering,
- implement and experiment with algorithms,
- create an educational module for use in high school/college.

Your work should have significant mathematical content, and the mathematics should be clearly explained.

Deliverables

Your work may consist of some combination of the following:

- a written report,
- a class presentation,
- a computer program,
- materials for an educational module.

You must turn in something written, even if your focus is not on the written report. There must also be a bibliography following the style specified in the SDSU thesis manual. I prefer that you give at least a 20 minute presentation to the class.

Assessment Rubric

Points will be awarded as follows

10 Attendance: A freebie.

10 Proposal: As long as it is clear, well-presented, and on time you get full marks.

20 Quality of presentation: Make my job easy! your work should be well organized and clear. Written work should be legible, and grammatical. (This would be a good opportunity to learn to use L^AT_EX.) Computer code should be well organized and commented. Boardwork or slides should be legible and clear. Etc.

20 Quality of the work: How well did you understand the material? Did you explain it well?

20 Quantity: Is the amount of work reasonable for the time allotted?

20 Challenge: How difficult was the material? How original was your work? This is my opportunity to reward creativity, originality, audacity.

Grading scale is A: 85 and above, B: 70-85, C: 60-75.

The main assessment items will be the last four, particularly the last three. In these categories, I award 15 points for something “good,” 20 points for something that “shows spark.” I may even award 25 points for something that is outstanding.

Due Dates

- Proposal: April 15
- Presentation: May 7 or May 9
- Written Project: May 17

Some Topics to Consider

IVA is *Ideals, Varieties and Algorithms*, Cox, Little, O'Shea.

UAG is *Using Algebraic Geometry*, Cox, Little, O'Shea.

Theory

- Dimension: How do we define dimension of a variety (algebraically)? (Ch. 9)
- Local geometry and local rings (UAG, Ch. 4)
- Power series rings, p -adic numbers (UAG, Ch. 4, Koblitz p -adic numbers)
- Invariant Theory: groups and algebraic geometry (IVA Ch. 7)
- Toric Varieties (UAG Ch. 7)
- Tropical Geometry (Sturmfels Math 274)

Applications

- Algebraic Statistics (Sturmfels' lectures or books, Pistone *Algebraic Statistics*)
 - design of experiments
 - models of independence
- Robotics (IVA Ch. 6)
- Coding theory and order domains (UAG Ch. 9,10)
- Cryptography (books by Koblitz)

Computation

- Groebner basis conversion (UAG Ch 2)
- integer programming (UAG Ch 8)
- linear programming
- Tropical mathematics algorithms