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Class Projects

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 me, 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 discuss the project with me at least once early in the process, and continue discussing with me as you progress. 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

You must turn in something written. You will give a 20 minute presentation to the class (on the day of the final). There must also be a bibliography following the style specified in the SDSU thesis manual.

Assessment Rubric

Points will be awarded as follows

10 Attendance: Show up, be attentive, ask questions.

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 LaTeX.) 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 14
- Presentation: May 9
- Written Project: May 19

Some Topics to Consider

There are a variety of resources, many available on the web, so you can find a lot by searching. I give a few suggestions below.
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 (Lecture Notes by David Cox)

Applications

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

Computation

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