

Math 101 Finite Mathematics
Symmetry and Fractals Project

You will work in groups of three to five people to turn in a project, consisting of a paper and an in-class presentation. The paper is due in class on **Wednesday, Nov. 12**; the presentations will be **Monday, Nov. 10 and Wednesday, Nov. 12**. The list of possible topics is given below.

By **4:00 pm Monday, Oct. 27**, send me an email with the following information.

- (1) The names of the people in your group.
- (2) A ranking of the projects, from favorite (first) to least favorite (last). I will assign you a project based on the rankings.

The presentation: Each presentation should last 10 minutes. All group members are responsible for presenting. Your presentation can be as high- or low-tech as you'd like. Feel free to use the chalkboard, the overhead projector, the internet, Powerpoint, physical demonstrations, etc. You have a lot of freedom. Be sure to practice before you give your talk; you may find it more difficult than you expect!

Your presentation will be graded on the following criteria:

- (1) *Overview:* What is the context of the problem? Was the background of the topic explained? What assumptions are you making?
- (2) *Mathematics:* How is mathematics used in your project? Have you clearly explained how the ideas of this course are used? Since you only have 10 minutes you do not have time to do every detail, but you should at least outline the development of the necessary mathematical theory.
- (3) *Clarity:* Is all new terminology and notation defined? Do you make your points clearly?
- (4) *Style and organization:* Is the talk polished? Does it look like you have practiced it? Is the talk well organized and well planned? Did all group members participate in the presentation?

Hint #1: It's a very good idea to visit the Speaking Center while you're planning your presentation.

Hint #2: One of the most common mistakes that students make in presentations is rushing through the introduction. Make sure to spend plenty of time setting up the problem. Remember, the audience won't care about the answers you're giving if they don't understand the questions.

The paper: There is no page limit (maximum or minimum) for your write-up. You are required to use at least two outside sources. (Websites and your textbook don't count toward this minimum, although I encourage you to use them.) It should be typed. For many of you the write-up will include more information than you will be able to present (those 10 minutes will fly by!). The paper should be written in complete sentences, with correct grammar and punctuation. It should read like a research paper, not like a homework assignment. You are free to use any word processing software that you like, but Microsoft Word has an equation editor that may help with the writing. *It's a good idea to visit the Writing Center while you're working on your paper.* Lastly, it is very important to cite any outside sources and to include a bibliography. Be aware of Agnes Scott's strict policy on plagiarism!

Your paper will be graded on the following criteria:

- (1) Do you address all of the issues in the assignment?
- (2) Can the paper stand on its own? That is, can the paper be understood by someone who didn't see the presentation?
- (3) Is the paper well written (including punctuation and grammar)?

- (4) Did you use at least two outside sources? (Remember, your textbook and websites don't count toward this minimum.) Are all outside sources cited appropriately? Is there a bibliography?

Timeline:

- (1) Monday, October 27 - submit project requests by 4:00
- (2) Monday, November 10 and Wednesday, November 12 - project presentations in class
- (3) Wednesday, November 12 - papers due in class

List of projects:

- A. Three-dimensional rigid motions:** This is project 11.B on p. 471 of the textbook.
- B. Penrose tilings of the plane:** This is project 11.C on p. 471 of the textbook.
- C. Symmetry and beauty:** This is project 11.D on p. 471 of the textbook.
- D. Fractal dimension:** This is project 12.A on p. 511 of the textbook.
- E. Fractals and music:** This is project 12.B on pp. 511-512 of the textbook.
- F. Symmetry in crystals:** The molecules of a crystal are arranged in a three-dimensional symmetric lattice. Different kinds of symmetries produce different crystal structures. Discuss how this works and how crystals are classified.
- G. Fractals in the human body:** Many parts of the human body display fractal properties: blood vessels, the lungs, the brain, nerve endings, and others. Discuss some examples, and explain what biological purposes the fractal structures serve.
- H. Symmetry types of plants and animals:** Most living things exhibit symmetry. Discuss the different kinds of symmetry found in plants and animals, and explain what biological purposes the symmetries serve.
- I. Fractals in painting and poetry:** Some critics have argued that fractal patterns appear in painting and poetry, and that these patterns are pleasing to the human mind. Discuss this argument and give some examples. You may want to analyze fractal patterns in other works yourself, or even create your own works that include fractals.

Some suggested reading:

- Taylor, R.P., A.P. Micolich, and D. Jones. "Fractal analysis of Pollock's drip paintings." *Nature* 399 (1999), p. 422.
- Pollard-Gott, Lucy. "Fractal repetition structure in the poetry of Wallace Stevens." *Language and Style* 19:3 (1986), pp. 233-249.