Mathematics and Digital Art

Instructor:	Dr. Vince Matsko
Office:	HSC 217, x5054
Office Hours:	T 10:40–12:40, W 2:15–3:15
Class Times:	1:00–2:15, CO 214
Email:	vjmatsko@usfca.edu
Website:	www.vincematsko.com
Blog:	www.cre8math.com
Text:	None required (all readings will be online)
Prerequisite:	Advanced algebra (or above)

Course Description: What is digital art? It is easy to make a digital *image,* but what gives it artistic value? This question will be explored in a practical, hands-on way by having students learn how to create their own digital images and movies in a laboratory-style classroom. We will focus on the Sage/Python environment, and learn to use Processing as well. There will be an emphasis on using the computer to create various types of fractal images. No previous programming experience is necessary.

Learning Outcomes for Mathematics:

1. Students should design a mathematical solution.
2. Students should implement the design or identify and correct problems with the design.
3. Students should evaluate the validity of a solution and its relevance to the original problem using reasoned discourse as the norm for decision making.

These outcomes will be addressed in the Final Project, where each student must design their own project and give a presentation on it at the end of the semester.

There are also specific learning outcomes for this course in particular:

1. Students should be able to create digital images by adapting Python scripts in the Sage environment.
2. Students should be able to create geometric animations by adapting scripts in the Processing platform.
3. Students should be able recognize and describe different types of fractal images.
4. Students should be able to build three-dimensional polyhedra models given the appropriate polyhedral net.

Core Learning Outcomes:

1. Students should be able to speak and write effectively.

   Students will be giving three presentations as a part of the course.

2. Students should be able to express ideas in an articulate and persuasive way.

   The students' final presentation will be about their own project work, where they will discuss the significance of their work in the context of the course.

3. Students should be able to understand a mathematical problem and design a solution.

   The students' project work must involve both a mathematical and an artistic component.

4. Students should be exposed to a wide breadth of disciplines, as a foundation for a general liberal arts education.

   Students will be exposed to mathematics, computer science, art, and design throughout the course.

5. Students should appreciate and be able to critically evaluate the arts.

   Throughout the course (and as a part of reading papers and making presentations), we will be addressing the issue of what makes a digital *image* digital *art.* Students will enlarge their vocabulary for articulating their aesthetic views.

6. Students should understand the nature of the physical world, the uses of the scientific method, and the implications of technology.

   In particular, students will engage in hands-on work which will demonstrate the implications of technology in creating works of art.

Student Mentoring: Adjusting to college life can be challenging. Issues such as newfound independence, time management, note taking, and living with a roommate or two aren't always easy to deal with.

We'll periodically talk about such issues. Please feel free to email me with a particular situation which is of concern to you. That way I can bring it up in class anonymously and we can see what suggestions others have to offer.

Schedule of Topics: Note: There are about 16 weeks this Spring semester. I outlined 15 weeks, as there will be 3–4 guest speakers during the course of the semester.

Topics broken down by week (approximate):

1. Color and the work of Josef Albers.
2. Color gradients, randomness, and basic conditional and looping constructs in Python.
3. Fractals, I: Linear and affine transformations.
4. Fractals, II: Linear and affine transformations, iterated function systems.
5. Fractals, III: Iterated function systems.
6. Presentation Week I.
7. L-systems I.
8. L-systems II.
9. Processing/Project Work I.
10. Processing/Project Work II.
11. Presentation Week II.
12. Processing/Project Work III.
13. Processing/Project Work IV.
14. Final Presentation Week.
15. Special topics week.

Course components:

1. Attendance: As there will be a significant amount of hands-on work in the course, attendance is required. Naturally things come up. Students will be allowed three absences over the course of the semester without penalty, beginning the second week of class. In order to avoid a penalty, you MUST email me in advance. Each missed class in excess of the three allowed is a 1% penalty.
2. Presentations: Students will give three presentations – two on course readings, and one on their Final Project. There is an archive from the Bridges conferences of over 1000 short (6–8 pages) papers on mathematics and art. These papers are searchable, so students can look for topics of their own interest for their presentations.

3. Homework assignments: As part of learning how to create digital images, various mathematical ideas are necessary. Students will have occasional problems sets on relevant areas in mathematics (such as number theory and discrete mathematics). Students will also occasionally submit final drafts, with commentary, of work done during laboratory time. Late homework will receive a penalty of 10% per calendar day.

4. Quizzes: We will occasionally have quizzes over the mathematical content of the course. These quizzes will be based largely on the assigned homework. In addition, you may use your notebook during the quizzes, so be sure to take good notes!

5. Final Project: A student-designed Final Project is a significant part of this course. Approximately mid-semester, students will design an original project of their own incorporating both mathematics and artistic design in a significant way. Some in-class time will be devoted to helping students with their projects.

There are no exams.

The course components are weighted as follows:

Course component	Percentage
Attendance	15%
Homework assignments	25%
Quizzes	10%
Presentation I	5%
Presentation II	5%
Final Project	30%
Final Project Presentation	10%

Grades will never be lower than the computed average. However, the instructor may raise a grade for exceptional class participation, significant improvement, or particularly brilliant performance within a particular course component.

Withdrawals and Incompletes: The last day to withdraw from the course is Monday, April 10. If you plan to withdraw from the course, it is your responsibility to complete the necessary paperwork by this date. You will not be allowed to withdraw after this date. An incomplete grade will be given only if you have a serious emergency, such as a medical condition, that prevents you from completing the course. You must produce proper documentation and must be passing the course with most of it complete. An incomplete grade will not be granted to avoid failing the course.

Academic Honesty: As a Jesuit institution committed to cura personalis – the care and education of the whole person – USF has an obligation to embody and foster the values of honesty and integrity. USF upholds the standards of honesty and integrity from all members of the academic community. All students are expected to know and adhere to the University's

Honor Code. You can find the full text of the code online at www.usfca.edu/fogcutter. You are encouraged to discuss the homework problems and course material with other students and with me during office hours. However, the homework that you hand in should reflect your own understanding of the material. You are NOT allowed to simply copy solutions from other students or other sources.