A&S 100-006
Visualizing Mathematics
Spring 2014
TR 9:30–10:45 am — Room 1 KWH

Instructors:

Carl Lee
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Phone: 859-257-1405 (or 859-257-3336 to leave a message).
Office Hours: TR 11:00–12:00, and also by appointment, since I realize that this time may not be convenient for everyone.

Derek Eggers
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Phone: 859-312-8789
Office Hours: As above.

Course Web Page: We will use the Canvas learning management system—more information on this later. We will also post materials here: `http://www.ms.uky.edu/~lee/visualsp14/visualsp14.html`. Links will be set up to these locations from the standard course Blackboard site.

Course Description: This course will be an opportunity to explore how various aspects of mathematics can be visualized by physical and virtual models, often in quite beautiful ways, and conversely how mathematics can be used as a tool in designing beautiful physical and virtual models. Here are some examples that we may look at, but some choice of topics will be guided by the interests of the class members.

- Polyhedra: What are they, and what role do they play in art, chemistry, etc.?

- Symmetry: What does it mean to be symmetrical in two and three dimensions? How can we make and recognize symmetrical patterns and objects?

- The fourth dimension: How can we visualize it?

- Fractals: What are they, and how are some fractal images generated?

- Tensegrity structures: How can non-touching bars be suspended in space with cables?

- Three-dimensional dissection puzzles: How can we make and solve them?

- Animations: What is some mathematics underlying the modeling of motion?

We will construct both physical and virtual models, using some free (but incredibly powerful) software, such as SketchUp, OpenSCAD, and POV-Ray, and devices such as 3D printers. The prerequisite for the course is a willingness to try to work with algebra and geometry, and to learn more as needed. Calculus is not a prerequisite (but if you know it, you can find use for it!). Knowledge of a particular computer programming language is not a prerequisite, but we will be learning how to use some computer programs that require some attention to logic and detail, so patience in this regard is needed. For some examples from a previous version of this course, see `http://www.ms.uky.edu/~lee/visual05/visual05.html`.

Student Learning Outcomes: Students will use mathematics as a tool to create physical and virtual models, and conversely will create physical and virtual models to visualize mathematical concepts.

Required Materials:

- *Mathematical Snapshots* by Hugo Steinhaus, Dover, third edition (but it does not have to be this particular edition), 2011, ISBN-10: 0486409147, ISBN-13: 978-0486409146. There is also a Kindle edition.

- *Shapes, Space, and Symmetry* by Alan Holden, Dover, 2012 (but it does not have to be this particular edition), ISBN-19: 0486268519 ISBN-13: 978-0486268514.

Also, if you have your own computer, it is strongly recommended that you install the following free software if you are able:

- SketchUp, `http://www.sketchup.com`.

- OpenSCAD, `http://www.openscad.org`.

- POV-Ray, `http://www.povray.org` (This might not install on all computers; I have had some trouble with some Macs.)

- GeoGebra, `http://www.geogebra.org/cms/en`.

From time to time it may also be necessary to purchase some supplies to build some models.

Attendance and Participation: The success of this course is directly enhanced by everyone's experience and active participation. You will be actively supporting each other as you gain experience and understanding. Multiple ideas and points of view are important. You will benefit from hearing others' approaches to proving and problem solving, and they will benefit from you.

We expect all activities in class to be related to the course. In particular, cellphones should be silenced, and any use of laptops and other electronic devices should be devoted to the course activities.

If you miss a class for any reason, please let us know the reason immediately—an email message will suffice. We will give you an opportunity to make up graded work missed if it is due to an excused absence.

S.R. 5.2.4.2, `http://www.uky.edu/StudentAffairs/Code/part2.html`), defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit "reasonable cause for nonattendance" by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding dates of major religious holidays may be obtained through the religious liaison, Mr. Jake Karnes (859-257-2754).

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused or unexcused) per university policy.

Students may be asked to verify their absences in order for them to be considered excused.

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Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness or death in the family. Appropriate notification of absences due to university-related trips is required prior to the absence.

Assignments and Grading: The course will consist of a sequence of modules, each approximately one to two weeks in duration depending upon the flow of the course. Each module will focus on a particular theme. Associated with this theme will be some *tasks* to engage with the particular mathematical and modeling tools and content, culminating in a *product* for that module. The graded tasks and the final product will contribute to a score of 100 points for each module. The course score will be the sum of the module scores. Your letter grade will be determined according to the 10% scale, rounded to the nearest percent:

90–100%	A
80–89%	B
70–79%	C
60–69%	D
0–59%	E

Academic Integrity: Per university policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the university may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: `http://www.uky.edu/Ombud`. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Part II of Student Rights and Responsibilities (available online `http://www.uky.edu/StudentAffairs/Code/part2.html`) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about the question of plagiarism involving their own work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording or anything else from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism. Plagiarism includes reproducing someone else's work, whether it be a published article, chapter of a book, a paper from a friend or some file, or something similar to this. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work which a student submits as his/her own, whoever that other person may be.

Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone. When a student's assignment involves research in outside sources of information, the student must carefully acknowledge exactly what, where and how he/she employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas which are so generally and freely circulated as to be a part of the public domain (Section 6.3.1).

Please note: Any assignment you turn in may be submitted to an electronic database to check for plagiarism.

Accommodations Due to Disability: If you have a documented disability that requires academic accommodations, please see us as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide us with a Letter of Accommodation from the Disability Resource Center (Room 2, Alumni Gym, 257-2754, email address: jkarnes@email.uky.edu) for coordination of campus disability services available to students with disabilities.

Suggestions and Other Course Issues: Suggestions for improvement are welcome at any time. Any concern about the course should be brought first to our attention. Further recourse is available through the Mathematics Director of Undergraduate Studies and the Department Chair, both accessible from the Main Office in 715 Patterson Office Tower.

Important Dates:

January 14 — Tuesday — Last day a student may officially drop a course or cancel registration with the University Registrar for a full refund of fees
January 15 — Wednesday — First day of classes

January 20 — Monday — Martin Luther King, Jr., Birthday Academic Holiday

January 22 — Wednesday — Last day to add a class for the 2010 Fall Semester

January 22 — Tuesday — Last day to officially withdraw from the University or reduce course load and receive an 80 percent refund

February 5 — Wednesday — Last day to drop a course without it appearing on the students transcript

February 12 — Wednesday — Last day to officially withdraw from the University or reduce course load and receive a 50 percent refund

March 10 — Monday — Midpoint of 2010 Fall Semester

March 17–22 — Monday–Saturday — Spring Vacation — Academic Holiday

April 3 — Thursday — Last day of our class

April 11 — Friday — Last day to withdraw from the University or reduce course load. Students can withdraw or reduce course load after this date only for urgent nonacademic reasons.

May 10 — Saturday — Commencement