Math 2030 C-I: Discrete Dynamical Systems, a.k.a. "Proofs Bootcamp"
A Communication-Intensive (CxC) course
Fall 2013
Louisiana State University
Monday, Wednesday, and Friday from 11:30 to 12:20
Room 232 of Lockett Hall

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Course web site: `http://www.math.lsu.edu/~shipman/courses_13B-2030.html`

Textbook: A First Course in Chaotic Dynamical Systems, by Robert L. Devaney

Basic Course Description:

Dynamical systems with discrete time and in one spatial dimension; complex dynamics; quadratic maps; chaos; structural stability; bifurcation theory.

The prerequisite for this course is Math 1552, the second semester of calculus.

Course Content:

The subject of dynamical systems lends it self very well to a fruitful interplay between computational experiment and mathematical theory. This makes the subject an ideal medium for learning to read and write rigorous mathematics. Learning the rigorous definitions of concepts and proving of theorems is the main objective of the course. The emphasis throughout is on communicating mathematical proofs in a logically coherent way, both in writing and speaking. Computer experiments may be assigned for the purpose of thoughtful exploration of ideas in discrete dynamics.

A Communication-Intensive Course:

[1]This is a certified Communication-Intensive (C-I) course which meets all of the requirements set forth by LSU's Communication across the Curriculum program, including

- instruction and assignments emphasizing informal and formal *writing* and *speaking*;
- teaching of discipline-specific communication techniques;
- use of draft-feedback-revision process for learning;
- practice of ethical and professional work standards;
- 40% of the course grade rooted in communication-based work; and

[1]Statement from http://sites01.lsu.edu/wp/cxc/CISyllabusStmt/.

- a student/faculty ratio no greater than 35:1.

Students interested in pursuing the LSU Distinguished Communicators certification may use this C-I course for credit. For more information about this student recognition program, visit www.cxc.lsu.edu.

Assignments:

There are four types of Communication-Intensive activities in this course:

Type 1 (writing) 3-part mathematical exposition. Proving a mathematical statement involves a *creative process*, in which one explores and creates structures with the aim of elucidating why a statement is true or not, and an *organizational process*, in which one unravels the creative process to produce a step-by-step logically coherent argument that starts with certain axioms and ends with the desired statement. When communicating a proof to another person, one wants to retain elements of the creative process that highlight the essential ideas behind the truth of a statement without sacrificing mathematical rigor. This activity involves (1) explaining the creative process an a clear but mathematically informal way; (2) extracting from the creative process a formal step-by-step proof, in which each step consists of a well-defined statement and its justification based on previous statements and axioms in the proof; and (3) a prose version of the proof meant to convey to a human being both the underlying ideas and the full logically coherent argument.

Type 2 (writing) 4-part mathematical invention. The mathematical statements that serve as the starting point of a Type-1 activity have their genesis in a more primitive creative process. We observe general patterns or phenomena that seem interesting and worth investigating further. Careful mathematical investigations require precise definitions, statements, and justifications. This activity involves (1) identifying and explaining a mathematical phenomenon in clear but mathematically informal language, providing examples and non-examples; (2) defining the ideas, objects, and phenomena in a mathematically rigorous way; (3) making a mathematical statement; and (4) proving the statement.

Type 3 (writing) Peer review. When communicating an idea, it is not always easy to imagine your audience's state of mind, especially when the idea seems clear to you. Feedback from a peer has many benefits: (1) it is an excellent means of ascertaining how effective your communication is; (2) it motivates the writer to higher standards; and (3) it helps the reviewer to read mathematical ideas and arguments critically and learn how to improve her or his own writing. In this activity, a student writes a detailed and serious review of another student's mathematical exposition, the expositor writes a rebuttal, and there is a final discussion.

Type 4 (speaking) Oral mathematical exposition. Whether at a technical level or at the level of general exposition, oral communication of mathematics requires carefully identifying ideas and their logical connections. (1) When explicating a technical proof orally, careful choice of words and well formed sentences are of utmost importance. The live nature of oral communication requires an even firmer understanding of the arguments

than does written communication, and it requires more practice than one might imagine. (2) In a typical conference presentation, one needs to find a way to communicate the underlying ideas behind why a statement is true or why a method works, and know which details are important and which are not. In this activity, both aspects of communicating mathematics are practiced by presenting orally an activity of Type 1 or Type 2.

This is the tentative plan; it is subject to change.

C-I activities. There will be nine assignments of the types described above.

- Four assignments of Type 1.
- One assignment of Type 2.
- One assignment of Type 3.
- Three assignments of Type 4.

Routine problems will be assigned periodically. These will be held to high standards of mathematical logic but will not be subject to the structure of the C-I assignment types discussed above.

In-class participation. Periodically, some problems from an assignment will be discussed in class before the due date of the assignment. These problems will be submitted at the beginning of class and students' work will be shared with the rest of the class for constructive criticism.

Final Exam:

The written final examination is on Saturday, December 14, from 3:00 to 5:00 PM.

Evaluation:

Assignments of Types 1–4 will be graded in feedback-improvement loop. Each assignment will be submitted multiple times (ideally thrice). Each submission will receive two scores. The green score is an evaluation of the work based on my expectations up to that point in the course, and the red grade indicates the score the assignment would receive if it were the final submission. The green score is permanent, but the red one is replaced by the new red score on the next submission of the same assignment. The final submission receives only a red score, which is permanent. The red grade provides feedback about the quality of the work and indicates how much improvement is needed. The green score motivates students to submit the assignment, while not penalizing them for going through the learning process.

The activities are weighted toward the course grade as follows:

Eight Communication-Intensive activities: 50%
Other problems: 30%
Final exam: 20%

Grading scale: A—at least 90%; B—at least 80%; C—at least 70%; D—at least 60%.

Ethical Conduct:

Students are encouraged to discuss problems with each other and other people and consult other literature; however, all work that is turned in must ultimately be that of the submitter alone. If a student receives aid on an assigned problem from discussions with people or other sources, he or she must begin from scratch in writing the solution so that the result is the product of his or her own understanding alone. Students must abide by the LSU Code of Student Conduct:
`http://appl003.lsu.edu/slas/dos.nsf/$Content/Code+of+Conduct?OpenDocument`