Chaotic Dynamics: Final Projects

Chaotic Dynamics

Final Projects

General Information

- Can take many forms -- need not be a paper. We will discuss as a class whether or not we want to have a set of presentations open to the coa community, or if we just want to present to the class.
- Should be on some topic that's interesting to you.
- You and I share responsibility for the project. I will try to meet with you all individually and discuss possible projects. But you also need to take some initiative; if you're feeling lost or confused, be assertive and find me sooner rather than later.
- I strongly encourage you to work on projects in groups. Perhaps you'll end up doing separate projects, but maybe a few of you have broadly similar interests. If this is the case, I suggest doing some common background readings and meeting to discuss as a group.

Preliminary Project Guidelines

Here are some properties of an excellent final project:

1. Most importantly, you should learn something in the course of doing your project. Ideally, you'll find one or two ideas that you'll want to explore thoroughly.
2. You should meet all deadlines.

3. Whatever medium you choose -- talk, paper, etc -- your project should be well presented. You should have a clear audience in mind.
4. Your project should be more than a "book" report. You should do something. This might entail building something, writing or experimenting with computer programs, or doing a bunch of problems.
5. Your project should be something you work on over several weeks. It should not be hastily completed during week 9.
6. In most cases, you should consult several references, not just one. It is also desirable (although in many cases this won't be feasible) for you to consult a primary reference or two in addition to texts.

Possible Project Ideas

- Further exploration of the logistic map.
  - Detailed proof/demonstration of chaos,
  - Examination of universality
  - Sarkovski's theorem on the ordering of periodic orbits.
- Measures of randomness and complexity. How can we quantify how random or unpredictable a system is? How can we quantify how "complex" or "structured" or "complicated" or "intricate" a system is?
- Cellular Automata
- Develop lesson plans for a high school or elementary class. Or, develop materials for the introductory chaos and fractals course to be taught in the winter.
- Fractals
  - Detailed exploration of the Mandelbrot and Julia sets. This could involve doing some graphical experiments and/or proving some stuff.
  - Applications of fractals in the geosciences. Looking at the type of networks formed by river basins might be especially timely, given that there's a "monster" course in rivers coming up.
- Evolution and Adaptation
  - Dynamical models of of evolution.
  - Genetic algorithms.
  - Evolving cellular automata. (Our book has a section on this.)
  - Population Dynamics. Effects of finite size populations.
- Models of Ecosystems
  - Predator-Prey
  - Agent-based models
- Focus on a particular application. Dynamics arises in tons of scientific (and unscientific) situations.
- Do an experiment. Collect some data. Or, work with some data sets that are publicly available. Build and analyze a chaotic system.
- Scaling in biological systems. Why does metabolism rate depend on the

mass of a creature in the way that it does?

- Differential Equations. There are tons of systems that are modeled via differential equations.
  - Population dynamics
  - Mechanical systems (pendulums and springs and stuff)
  - Chemical reactions
- Agent-based simulations
- Game theory

[Dave] [Chaotic Dynamics] [COA]

Web page maintained by dave@hornacek.coa.edu.