CS290 - Introduction to Computational Science

Syllabus

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Description

This course is designed to provide an introduction to the tools and techniques of interdisciplinary computationally based research in the natural sciences. Computationally based research, or computational science, uses computers to simulate laboratory experiments, or, to perform experiments for which there is no laboratory analog yet. Lab exercises will come from a variety of disciplines. This course is designed for students majoring or intending to major in any of the natural sciences. Computational science is at the heart of a wide variety of current research areas, *e.g.* climate change, the origins of the universe, the human genome project, and the underlying cause of diseases such as Alzheimer's.

Textbook and Other Readings

The textbook we'll be using for this course is:

- Shiflet, Angela. *Introduction to Computational Science*, 1/E, Princeton University Press, 2006.

Additionally, we'll be reading a couple of papers and monographs on topics not covered in the text.

Organization

The basic components of the course are:

1. Class sessions
2. Exercises
3. Labs
4. Library research

See below, *Grading*, for a breakdown of the weights assigned to each of these components.

One prominent thread you will find in this course is how we as computer scientists work with people in other disciplines to understand and model a wide range of physical systems. Much of

the science done today is computational and multi-disciplinary in nature, this course will introduce you to a variety of current research problems from across the natural sciences.

Class Sessions

Class meets on Tuesday and Friday from 1:00-2:20p, in D220. In mid-November I'll be off-campus for about 10 days at the annual SuperComputing Conference. During this time some classes will be held with a video-teleconferencing system and some with a guest lecturer.

Class participation is showing-up to each class on-time and prepared, doing all the work, and actively engaging your fellow students and myself in the enterprise of learning.

Exercises

There will be one exercise set per week, most of them will come from the text and some of them from other sources. Periodically we'll have short quizzes, probably using Moodle, typically on terms and definitions, which will also count as exercises. Exercises are to be done individually.

Labs

The labs for this class will center around learning the principle techniques of computational science, included here are topics such as:

- Modeling
- Computational tools, *e.g.* Octave
- Agent simulations
- Cellular automata
- Systems dynamics
- Monte Carlo simulations
- Validation and verification

Typically labs will involve model development, software, possibly some real-world scientific hardware, data collection and analysis, and a write-up. Labs will be done with a lab partner, early in the semester we'll pair-off and barring catastrophe we'll stick with those through the semester. I'd like each group to use a wiki page to write-up their lab results.

Library Research

Towards the end of the semester we'll do a library research project. This will be an opportunity for you to familiarize yourself with the electronic and print (yes, paper!) resources available for computational science. For those of you that don't already know LaTeXthis assignment could serve as your introduction to it.

Each of you will choose a topic from a list developed by Sara Penhale, Mary Bogue, and me. The list will include specific types of computational science done in geoscience, physics, biology,

chemistry, environmental science, and mathematics. You will be responsible for preparing a summary of the underlying science, a description of the principle model(s), a description of commonly employed the simulation technique(s), available software, etc.

Grading

The course components are weighted as follows:

1. Exercises	40%
2. Labs	30%
3. Library Research	20%
4. Class participation	10%

Academic Honesty

Often you will find it useful to discuss specific problems, techniques, etc. with tutors and fellow students. The sharing of ideas is a helpful and normal part of learning, and is encouraged. In particular one of the best ways to really learn something is to teach it to other people.

However, it's also possible to abuse those resources and turn-in work that isn't your own, particularly in computer science classes. See the Academic Integrity Policy in the Curriculum Guide for the official Earlham College policy,
`http://www.earlham.edu/curriculumguide/academics/integrity.html`

Disabilities

Please let me know as early in the semester as possible if there are any adaptations or accommodations you require, if there is any emergency medical information I should know about, or if you might need special arrangements in the case the building needs to be evacuated. The Earlham policy is:

> *Any student with a documented disability (e.g., physical, learning, psychiatric, vision, hearing, etc.) who needs to arrange reasonable accommodations must contact Academic Support Services and the instructor at the beginning of each semester. Accommodation arrangements must be made during the first-two weeks of the semester.*

It is important to follow this procedure.

Mantra

"Work hard, learn lots, and have fun." Ray Ontko, *circa* 1999.