

CS 19000: Introduction to Computational Thinking

Spring 2009

Computer Science has become indispensable to scientific inquiry and is permeating science in a transformative manner. The course introduces science majors to computational thinking via basic programming concepts, data and data management concepts, simulation, and visual interaction. The course will use Python and various Python libraries including VPython, Matplotlib, and NetworkX. The course satisfies the computing requirement for science majors.

Course Syllabus

Basic Tools (6 weeks)

- Introduction to Python. Elementary values and data types.
- Straight line programs, assignments to variables, type conversion, math library.
- Strings, lists, and tuples. Vectors and arrays. Conditionals and loop structures.
- Plotting using Matplotlib and 3D visualization in VPython.
- Functions, parameters, and scope. Recursion.

Computational Tools and Methods (6 weeks)

- Arithmetic and random numbers. Using NumPy. Numerical and problem stability.
- Computational Physics: Applications of Monte Carlo Simulation
- Introduction to trees and graphs, using NetworkX, graphs in science applications.
- Bioinformatics: Analyzing biological structures and their visualization using Cytoscape.
- Grand challenges in scientific computing.

Looking under the Hood at Computer Science (3 weeks)

- Object-oriented design. Use and design of classes, OO concepts.
- History of computer science.
- Limits of computing, intractability, computability.
- Future models of computation: DNA computing, quantum computing.

Prerequisites

General interest in science. No prior programming experience is expected.
Calculus background is required (Math 161 or equivalent).

Course Details

- One-hour class periods Monday and Wednesday 11:30-12:20, two-hour lab on Friday
- 4-5 problem sets and 5 projects focused on science applications; group work in the lab
- Two midterm exams and one comprehensive final exam

Course Material

- Python Programming: An Introduction to Computer Science, J. Zelle, Franklin, Beedle & Associates, 2004.
- Learning Python, M. Lutz, O'Reilly, 2007
- Python Tutorial, Guido van Rossum, Release 2.5.2, 2008; <http://docs.python.org/tut/>

The course was developed as part an NSF funded project on “Science Education in Computational Thinking (SECANT)” described at <http://secant.cs.purdue.edu/>

For information on the Spring 2008 offering of 190C see <http://secant.cs.purdue.edu/cs190c:start>

For questions, please contact Professor Susanne Hambruch, seh@cs.purdue.edu.