CS-0290: Programming for Science

COURSE INFORMATION

Instructor(s):

Lee Spector
lasCCS@hampshire.edu
Office Extension: x5352
Office Hours:
Regular office hours: Tuesdays 10:00-11:30, Wednesdays 1:00-2:30, and Thursdays 10:00-11:30. Other times can be set up by arrangement (in person or via email). Sign up for regular office hours, advising day meetings, and occasionally other signup times on Moodle here.

TA(s):

Mitchel Fields
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Noah Marcus
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Roksi Cooper-Courville
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Office Hours:

Term:

2015F

Meeting Info:

Tuesday 12:30 PM - 01:50 PM Adele Simmons Hall (ASH) 126
Thursday 12:30 PM - 01:50 PM Adele Simmons Hall (ASH) 126

Description:

This course is an inquiry-based introduction to programming and computational concepts for students intending to concentrate in cognitive science, natural science, or computer science. Students will learn to write programs for data manipulation and scientific modeling in a general purpose programming language, and they will also have the opportunity to work in special-purpose science programming environments. Several of the core concepts of computer science that underlie computational approaches across the sciences will be introduced. No previous experience with programming is required. Prerequisite: One course in cognitive or natural science.

Course Objectives:

- To become comfortable using programming as part of your scientific work.
- To learn general purpose programming and computer science concepts and skills.

- To conduct independent programming-based project work.
- To engage in collaborative learning processes.
- To develop project presentation skills.
- To work collaboratively with classmates.

Evaluation Criteria:

You will be evaluated on the basis of attendance, participation, programming assignments and in-class “demo” presentations on assignment due dates. You should demonstrate through your participation, your code, and your text that you have read and thought about the course readings. Demos will be strictly limited to 3 minutes, with 1 minute set-up time. You should be certain before each demo session that you can get all of the necessary files in place and begin your demo within 1 minute of the start of your demo time. You should also be certain that you can complete your demo within 3 minutes after setup. Your portfolio should demonstrate facility with the code environment used in the class and engagement with several of the class topics at the implementation level.

Hampshire Students (who get narrative evaluations)

Any missed, late, or inadequate assignments or demos will be noted in your evaluation. If you fail to submit 2 or more assignments, or to present 2 or more of the demos, then you should not expect to receive an evaluation.

Five College Students (who get grades)

Each assignment will be graded on a scale from 0-100. Each demo will also be graded on a scale from 0-100. Attendance and participation will also be graded on a scale from 0-100. For your final grade I will calculate:

score = (0.4 * assignment average) + (0.4 * demo average) + (0.2 * attendance and participation)

I will then assign grades as follows:

score	grade
>=97	A+
>=93	A
>=90	A-
>=87	B+
>=83	B
>=80	B-
>=77	C+
>=73	C
>=70	C-
>=67	D+
>=63	D
>=60	D-
<60	F

There will be no curve. Plusses and minuses will be given only if your home institution allows them. Note that missed demos will be scored as zero and will have a dramatic negative impact on your grade. A clearly inadequate demo may also be scored as a zero or nearly zero.

Additional Info:

Division I Distribution Credit

Successful completion of this course satisfies the Divison I distribution requirement in Mind, Brain, and Information. This course provides opportunities for satisfaction of Division I cumulative skills requirements in Quantitative Skills and Independent Work.

Texts

There is no textbook for this course. All readings will be available for free online. Many of the readings are linked to the schedule below, while others may be posted as the course proceeds.

Software

We will be using Python 3, in iPython notebooks, in the environment provided by the Anaconda Python distribution.

Additional Resources

Interpreters:

- Cloud-hosted iPython notebook
- Online Python 3 interpreter
- Python program execution visualizer

Tutorials:

- Python 3.4.3 documentation (including a tutorial)
- Non-programmers Tutorial for Python 3
- Tutorialspoint Python tutorial
- python-course.eu Python 3 tutorial
- LearnPython.org interactive Python tutorial
- Hands-on Python tutorial
- Many more tutorials and resources for beginning Python programmers

Cheatsheets:

- Python cheatsheet
- Another Python cheatsheet

Style Guides:

- Style guide for Python code
- Python Guide Code Style
- Code Like a Pythonista: Idiomatic Python

Facilities

Students may use their own computers and/or the Macs in ASH 126, which will be available at various posted hours. Students should **not** expect files left on the Macs in ASH 126 to persist; **the discs on those machines may be erased without notice at any time**. Students may find it convenient to use a thumb drive to transport files to and from class.

Difficulty/Level

This course is primarily intended to serve students without prior programming experience, but with some prior college-level experience in science.

Demonic Coding

Many class sessions will be dedicated in part or entirely to "demonic coding." Each student must have access to his/her current work files every day -- on a laptop computer, or a thumb drive, or a networked server, etc. -- and always be ready to participate as a coder in a demonic coding session.

Policies in Regards to Illness, Epidemic, or Pandemic

If you have a fever, please stay home, take good care of yourself, and contact me by email or phone. When you are able to work at home you should be able to participate in classes and to submit work electronically. If your illness makes it impossible for you to meet the course deadlines then contact me and we will negotiate an accommodation.

Adaptations and Accommodations

If you need course adaptations or accommodations because of a disability, or if you have a medical condition that may impact your performance or participation in this course, then please let me know. If you have approved accommodations then please go to Accessibility Services in CASA/Lemelson Center to pick up Letters of Accommodation to facilitate a proactive discussion about reasonable accommodations for this course. If you have documented disabilities but have not already already contacted Accessibility Services are encouraged to so. Accessibility Services can be contacted via email: Accessibility@hampshire.edu, via phone: 413-559-5498, or in person: Lemelson Center (CASA entrance).

Plagiarism Policy

Official policy text:

> All Hampshire College students and faculty, whether at Hampshire or at other institutions, are bound by the ethics of academic integrity. The entire description and college policy can be found in Non Satis Non Scire at handbook.hampshire.edu under Academic Policies/Ethics of Scholarship. Plagiarism is the representation of someone else's work as one's own. Both deliberate and inadvertent misrepresentations of another's work as your own are considered plagiarism and are serious breaches of academic honesty and integrity. All sources used or consulted in the process of writing papers, examinations, preparing oral presentations, course assignments, artistic productions, and so on, must be cited. Sources include material from books, journals or any other printed source, the work of other students, faculty, or staff, information from the Internet, software programs and other electronic material, designs and ideas.
>
> All cases of suspected plagiarism or academic dishonesty will be referred to the Dean of Advising who will review documentation and meet with student and faculty member. Individual faculty, in consultation with the Dean of Advising, will decide the most appropriate consequence in the context of the class. This can range from revising and resubmitting an assignment to failing the course. Beyond the consequence in the course, CASA considers first offenses as opportunities for education and official

warning. Multiple or egregious offenses will have more serious consequences. Suspected instances of other breaches of the ethics of academic integrity, such as the falsification of data, will be treated with the same seriousness as plagiarism and will follow the same process.

In this course we will often be sharing and borrowing code. This is an important aspect of the course and an important aspect of modern programming practice. This does not mean, however, that it is acceptable to submit code that is not your own without acknowledging sources. Sources should be clearly and explicitly provided in everything that you produce.

Schedule

The following is only an approximate schedule and it is subject to change. Adjustments will be announced in class. Assigned readings should be read *prior* to the indicated classes.

Tuesday 2:00-3:20 PM	Thursday 2:00-3:20 PM
	September 10 **Introduction to CS290** In class: introductions, syllabus, overview

September 15
Installfest
 	
Before class:
• Read:
  ◦ Optional: Non-programmers Tutorial for Python 3, Hello, World
  ◦ The Python Tutorial, Chapter 1 and Chapter 3
 	
In class:
• Install iPython
• Experiment with iPython notebooks
	September 17
	Introduction to Python
	
	Before class:
	• Read: The Python Tutorial, Chapter 4
	
	In class:
	• Python fundamentals
	• Demonic Coding

September 22 **Demonic Coding** In class: • Python fundamentals • Demonic Coding	**September 24** **Demos** Due: Assignment #1: • Submit an iPython notebook containing original Python code for any purpose. In class: • Demos
September 29 **Scraping and Wrangling Data** Before class: • Read: The Python Tutorial, Chapter 5 and Chapter 7 In class: • Finding your data • http://www.data.gov • Demonic Coding	**October 1** **Data Science** Before class: • Read: “Data Science and Prediction” by Vasant Dhar, *Communications of the ACM*, Vol. 56 No. 12, Pages 64-73 In class: • Data science

	• Demonic Coding
October 6 **Demonic Coding** In class: • Demonic Coding	**October 8** **Demos** Due: Assignment #2: • Submit an iPython notebook that reads and prints information about your data. In class: • Demos
October 13 ***OCTOBER BREAK - NO CLASS***	**October 15** **Analyzing and Visualizing Data** Before class: • Read: “How to make beautiful data visualizations in python with matplotlib” by Randal S. Olson • Optional: Watch Statistical Data Analysis in Python tutorial videos • Optional: Review “Variance and variability” lecture materials from Harvard's CS109: Data Science In class: • Analysis and visualization Demonic Coding
October 20 **Demonic Coding** In class: • Demonic Coding	**October 22** **Demos** Due: Assignment #3: • Submit an iPython notebook that produces meaningful analysis and/or visualizations of your data. In class: • Demos
October 27 **Simulating Coins, Dice and Cards** Before class: • Read: Python Module of the Week: random – Pseudorandom number generators In class: • Code for simulating coins, dice, and cards • Demonic Coding	**October 29** **Simulating Genomes** Before class: • Read “What, if anything, is a Wolf?” by R. Coppinger, L. Spector, and L. Miller. In *The World of Wolves: New Perspectives on Ecology, Behaviour and Management*, edited by M. Musiani, L. Boitani and P. Paquet. Calgary: The University of Calgary Press, 2010 In class: • Code for simulating genetic mutation

	• Demonic Coding
November 3 **Simulating Populations** Before class: • Read: ◦ "Group size, individual role differentiation and effectiveness of cooperation in a homogeneous group of hunters" by R. Escobedo, C. Muro, L. Spector, and R. P. Coppinger, In *Journal of the Royal Society Interface*, Vol. 11, No. 95, 20140204, pp. 1-10, 2014 ◦ "Emergence of Collective Behavior in Evolving Populations of Flying Agents" by L. Spector, J. Klein, C. Perry, and M. Feinstein, in *Genetic Programming and Evolvable Machines*, Vol. 6, No. 1, pp. 111-125, 2005 In class: • Packs and swarms Demonic Coding	**November 5** ***ADVISING DAY - NO CLASS***
November 10 **Demonic Coding** In class: • Demonic Coding	**November 12** **Demos** Due: Assignment #4: • Submit an iPython notebook that conducts a simulation and analyzes and/or visualizes the data produced by the simulation. In class: • Demos
November 17 **Other Tools and Applications** Matlab Guest lecturer: Sarah Hews	**November 19** **Other Tools and Applications** Before class: • Read: "Partial and total-order planning: evidence from normal and prefrontally damaged populations" by M.J. Rattermann, L. Spector, J. Grafman, H. Levin, and H. Harward. in *Cognitive Science*, Vol. 25, No. 6, 2001 In class: • The Chores experimental environment • Demonic Coding
November 24 **Project Discussion** Due: Assignment #5: • Submit a 1-page project proposal (details will be discussed in class).	**November 26** ***THANKSGIVING - No Class***

In class: • Project discussion	
December 1 **Demonic Coding** In class: • Demonic Coding	**December 3** **Demonic Coding** In class: • Demonic Coding
December 8 **Demos** Due: Assignment #6: • Submit: ◦ Final project In class: • Demos	**December 10** **Demos** In class: • Demos, continued

 Data Science and Prediction

 Assignment #1

Submit an iPython notebook containing original Python code for any purpose.

 Code from class for reading, accessing, and graphing data from a CSV file

You'll also need the data file if you want to run it (or substitute your own).

 The data file used in the code for reading data, etc.

 Assignment #2

Submit an iPython notebook that reads and prints information about your data.

 Code from class for computing and plotting averages and standard deviations

Also shows how to produce simple scatter plots.

 Assignment #3

Submit an iPython notebook that produces meaningful analysis and/or visualizations of your data.

 Code from class for simulating coins, dice, and cards

 Code from class for simulating mutation of genomes

 Assignment #4

Submit an iPython notebook that conducts a simulation and analyzes and/or visualizes the data produced by the simulation.

Assignment #5

Submit a 1-page project proposal, in a text or PDF file, describing what you plan to submit for your final project and what you plan to present in your final presentation. Your project should highlight your Python programming skills in a science-oriented application.

Final Project

Submit final project submissions here
