Introduction to Scientific Computing

EART/ASTR 119

MWF 10:00AM-11:45AM, Soc Sci 1 135 (Mac Lab)

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Course Description: Introduction to solving scientific problems using computers. A series of simple problems from Earth sciences, physics, and astronomy are solved using a user-friendly scientific programming language (Python/SciPy).

Prerequisite(s): Mathematics 11A or 19A or 20A or Applied Mathematics or Statistics 15A.
Units: 5

Text(s): There is no textbook for this course. For the numerical algorithms I will be probably developing some of the lectures based on *"Numerical Recipies: The art of scientific computing"*. This text has a Fortran, C, and C++ version. I use the Fortran version but I believe that only affects the examples.
The main reason there is no primary text is there are many great online resources that you will be using regularly. Assigning a textbook would probably be redundant and less useful than the sources below

- `http://www.python.org/doc/` - Core python language documentation
- `http://docs.scipy.org/doc/numpy/reference/` - Documentation for numpy
- `http://docs.scipy.org/doc/scipy/reference/` - Documentation for scipy
- `http://matplotlib.org/` - Documentation for matplotlib
- `https://linuxjourney.com/` - A great resource for learning to use a unix shell
- `https://sites.google.com/a/ucsc.edu/krumholz/teaching-and-courses/ast119_w15` Class notes from Winter 2015

- `http://stackoverflow.com/` - The programmers go-to place to ask questions
- `http://google.com/` - Probably the best resource for answering you questions related to programming

Course Objectives:
At the completion of this course, students will be able to:

1. Create python scripts and use libraries
2. Solve basic programming problems like sort and search in python
3. Plot and perform simple fits to data
4. Solve simple ordinary and partial differential equation

Grade Distribution:

Class Questions	5%
Homework	45%
Midterm Exam	25%
Final Project	25%

Course Policies:

- **General**
  - **All code must have comments or will receive a 0.**
  - Grades will be maintained on `https://canvas.ucsc.edu/`. Students are responsible for tracking their progress by referring to the online gradebook.
- **Attendance**
  - Attendance is expected for each lecture. At the start of each class there will be a question to be answered and turned in. These will be used to track attendance.
- **Homework**
  - Homeworks will be posted and turned in via Canvas
  - There will be roughly 1 homework per week
  - After being graded, you will have 1 week to resubmit an assignment. Up to half the missed point may be given back on the resubmitted work
    - example: A grade of 60/100 was given on a homework. The work was resubmitted and done perfectly (100/100). The final grade for that homework will be 80/100.
  - Late assignments will receive a 0
  - You are encouraged to collaborate on homework but what you turn in must be your own work. This means you may not copy-paste anyone else's work. For more on this see Academic Honesty in Programming.

Academic Honesty in Programming:
Taken from Mark Krumholz's Winter 2015 syllabus.

Plagiarism is defined as copying the work of another and presenting it as your own, and is no more acceptable in computer programming classes than in other contexts. Here are a few guidelines that apply to computer programming in particular:

- It is unacceptable to copy and submit as your own all or substantial portions of anothers work, with or without attribution. It is acceptable to copy a few lines of code, or even a small subroutine, and incorporate those into your own, more complex program, provided that you acknowledge your source. This need not be a formal footnote; a short comment in the source code is fine, for example

  ```
  # This line is taken from http://www.url.com/neat/programming/idea
  ```

- In the same vein, it is unacceptable to post the entirety of a homework question on a message board like `http://stackoverflow.com/` and request assistance with it. However, it is acceptable to ask general questions regarding specific tasks that you must accomplish as part of the assignment.

- For more on academic integrity in computer programming classes, please see the very thorough discussion at `http://www.cs.cornell.edu/courses/CS1133/2014fa/about/integrity.php`.

- If in doubt about whether something is acceptable, please ask. You will never be penalized for asking.

Session Deadlines: 8-Week:
Drop: Monday, July 10
Withdraw: Friday, July 28
Summer Session does not drop students for non-attendance or non-payment. Students must drop themselves.

DRC Accommodations:
The DRC reduces barriers to inclusion and full participation for students with disabilities by providing support to individually determine reasonable academic accommodations. If you have questions or concerns about exam accommodations, or any other disability-related matter, please contact the DRC office, located in Hahn 125 or at 831-459-2089 or drc@ucsc.edu.

Academic Dishonesty:
Academic integrity is the cornerstone of a university education. Academic dishonesty diminishes the university as an institution and all members of the university community. It tarnishes the value of a UCSC degree. All members of the UCSC community have an explicit responsibility to foster an environment of trust, honesty, fairness, respect, and responsibility. All members of the university community are expected to present as their original work only that which is truly their own. All members of the community are expected to report observed instances of cheating, plagiarism, and other forms of academic dishonesty in order to ensure that the integrity of scholarship is valued and preserved at UCSC. In the event a student is found in violation of the UCSC Academic Integrity policy, he or she may face both academic sanctions imposed by the instructor of record and disciplinary sanctions imposed either by the provost of his or her college or the Academic Tribunal convened to hear the case. Violations of the Academic Integrity policy can result in dismissal from the university and a permanent notation on a students transcript. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the Academic Integrity page at the Division of Undergraduate Education.

Title IX:
The university cherishes the free and open exchange of ideas and enlargement of knowledge. To maintain this freedom and openness requires objectivity, mutual trust, and confidence; it requires the absence of coercion, intimidation, or exploitation. The principal responsibility for maintaining these conditions must rest upon those members of the university community who exercise most authority and leadership: faculty, managers, and supervisors.
The university has therefore instituted a number of measures designed to protect its community from sex discrimination, sexual harassment, sexual violence, and other related prohibited conduct. Information, advice, referrals, and/or copies of the UC Policy on Sexual Violence and Sexual Harassment and the UC Santa Cruz Procedures for Reporting and Responding to Reports of Sexual Violence and Sexual Harassment are available to all students, faculty, and staff by contacting Tracey Tsugawa, Title IX/Sexual Harassment Officer, 105 Kerr Hall, 459-2462, or ttsugawa@ucsc.edu.

Tentative Course Outline:
The weekly coverage might change as it depends on the progress of the class.

Week	Content
Week 1	• Introduction to python • Python as a calculator • Scripts, functions, code flow
Week 2	• Data input and output • Plotting and figures
Week 3	• Advanced plotting and movies • Basic Statistics, model fitting
Week 4	• Random numbers • Root finding
Week 5	• Integrals and ordinary differential equations • Mass on a spring
Week 6	• Partial differential equations • Heat diffusion
Week 7	• Simulating orbits
Week 8	• Final Projects

Other topics time permitting: FFT, Monte-Carlo methods, image analysis, basic fluid dynamics