LSU OCS 4001 Fall 2024 Syllabus

Scientific Computing for Ocean, Coastal and Environmental Science
AKA **Science Hacking for Dummies**
OCS 4001 001 (lecture, 3 credit hours) and OCS 4001 003 (lab, 1 credit hour)

Note you should be enrolled in three units of lecture in OCS 4001 001 and one unit of lab in OCS 4001 003

Class meets Tue/Th 3-5:20 I ECS 1070 with the following tentative schedule:

3:00-3:20 coding practice and warmups
3:25-4:00 Lecture
10 min break
4:10-**5:20** Lab (if you need to leave earlier, okay) **NOTE updated end time!**

We will work together to figure out the best schedule. We will also be using slack and github to chat and share material.

Instructor:
Dr. Cheryl Harrison
cherylharrison@lsu.edu (but please send me a slack message)
Office hours after class by appointment, or just send me a message on slack

Mission Statement

Data analytics and scientific programming are critical, marketable research skills in science and industry. In this class we will be developing proficiency in scientific programming in the python programming language from the basics up, empowering you as a researcher to make the tools you need. Students will learn how to write programs, modify others' programs, analyze and visualize data. By the end of the semester, students will complete a research project relevant to their research or field of study.

Learning Goals

- Develop proficiency writing code in python for scientific applications using scripts and notebooks
- Python packages and how to get them
- Logical controls: for, while and do loops, etc.
- Data types, data files, input/output including netcdf files
- Visualization: scientific plotting, movies, maps
- Data analysis: statistics, machine learning…
- Other subjects as dictated by student interest
- Develop expertise related to the students' research culminating in a research project
- Project management skills
- Scientific writing and presentation skills: proposal writing, manuscript writing, bibliography management, scientific formatting in LaTeX, research presentations

Pedagogical Style

The basic format is a period of warmup and coding practice in groups, then a period of lecture/demonstrations, followed by lab time where we will hack away together. For lab, the expectation is that you will help one another, steal code from the internet, and generally hack things together until they work. Code commenting is strongly recommended.

This is the first time this class is being offered here at LSU, though it was taught previously at UTRGV three times. The goal is that we will explore together the best way to develop proficiency and have fun learning scientific python. Deviations from the class schedule are to be expected, and all suggestions and requests for material to be covered will be considered. We will push ourselves, but we will enjoy the process and the rewards.

LSU OCS 4001 Fall 2024 Syllabus

It is expected that students will make progress at different rates based on their background and abilities, and that the level of difficulty in the final project will reflect this. However, effort, showing up and putting time in is required for all students. Graduate students will be asked to do more research for their final project, with a more detailed proposal, additional analysis and figures, a longer final report, and a more refined final presentation.

There is no textbook for this course (see resources below). All materials are free and online. You will need to bring a computer to class, though we do have a couple of laptops you can check out. You should also bring headphones for video tutorials.

Final Research Project

The big goal of this class is to learn programming for scientific applications. To this end, a good chunk of the semester will be spent working on an individual research project using scientific data analysis. Students are encouraged to do a project related to their academic research in progress, or topics they wish to explore in the future. In previous classes students have used the final project to work on methods for their theses, but basically you can do whatever you are into.

For this project, we are doing the scientific process in miniature. Thus, you will write a research proposal on what you plan to do, do the research, then write a report in the style of an academic journal article on your results, and give a presentation to the class on your results. Previous semesters' projects are available on the respective github sites for inspiration.

Research project proposal:
Write a short (1-3 pages for undergrads, 2-4 pages for grad students) research proposal, including: abstract, background, why it's important, what your hypothesis is, what analysis you plan to do, what the broader impacts are, and a timeline for completion. (Broader impacts: How can this information be used? Why do we care? Impact for society...) At least one figure and three references are required for undergrads, and two figures and five references for grad students. You will also give a short class presentation to get feedback on your proposed research.

Research report:
5-10 pages for undergrads, 8-12 pages for grads. Should take the form of a scientific article with the following sections: Abstract, Introduction, Methods, Results, Discussion, Bibliography. 2-5 figures or tables and bibliography are required.

Final presentation using powerpoint or your favorite presentation software.

Detailed rubrics with a checklist of expectations for satisfactory performance will be provided for each component.

Grading

Letter grades will be assigned based on attendance, labs, the final project and course feedback. Assignments will be submitted on the class github and the class Moodle site. Labs are due before the next class.

We are using specification grading, which means all assignments will be graded satisfactory or unsatisfactory, and specified groups of assignments need to be completed to receive a certain grade. Rubrics for satisfactory completion of assignments will be outlined when the assignment is given, but in general the assignment must be complete and of appropriate length and sufficient content. Assignments will be graded as satisfactory or unsatisfactory, and you will need to resubmit unsatisfactory labs in a timely manner.

LSU OCS 4001 Fall 2024 Syllabus

Since programming, like mathematics, builds on previous lessons, skipping assignments will be problematic and will result in a very poor grade in the course. Note if you miss a class meeting you are still responsible for all the material. Specified assignments for receiving a D grade cannot be skipped, and their satisfactory and timely completion is required to pass the course. The first two labs are not considered late if turned in the first two weeks. Course feedback is through weekly assessments on the class and on student's performance, and a class and self-assessment at the end of the term. The design philosophy of this course is that it will adapt to students' needs throughout the course.

To receive an A grade, students must

- Meet the specifications for receiving a B grade
- Satisfactorily complete **all three** advanced labs (Labs 12.2-13.2)

To receive a B grade, students must

- Meet the specifications for receiving a C grade
- Satisfactorily complete **one out of three** advanced labs (Labs 12.2-13.2)

To pass the course with a C, students must

- Meet the specifications for receiving a D grade
- Satisfactorily complete the Linear Regression, Timeseries Analysis, and Student Choice labs (Labs 10.1-12.1)
- Provide satisfactory course feedback

To pass the course with a D, students must

- Satisfactorily complete all assigned chapters in datacamp and the associated labs, as well as Cartopy and Movies lab (Labs 1.1-10.1)
- Satisfactorily complete all components of the final project

Failure to deliver a satisfactory final project will result in an F, regardless of other assignments done. For +/- modifications on the specified grades, performance on the final project will be considered, along with attendance and submission of weekly assessment forms.

If you have an issue come up, i.e. you get sick or have some other unfortunate circumstance, have fieldwork, etc., please communicate with me sooner rather than later and I will do everything in my power to give you reasonable accommodation and help you out. Life is inevitably complicated, and we all need to work together to support one another.

LSU OCS 4001 Fall 2024 Syllabus

Resources
All resources for this class are free and online

AN – Anaconda python/R platform
https://www.anaconda.com/download

C – Cartopy, Python mapping plotting package
https://scitools.org.uk/cartopy/docs/latest/

DC- datacamp, see assignments for class datacamp login info
Datacamp has interactive python (and other language) lessons. We get free access to this for our course.

O – Overleaf, Scientific formatting software using the LaTeX markup language
https://www.overleaf.com/
Introduction to LaTeX:
https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes

P – PANDAS (Python Data Analysis Library)
https://pandas.pydata.org/

R – The R programming language
https://swirlstats.com/ is a great intro tutorial, and tells you how to install R
https://r4ds.hadley.nz/ data science in R (more advanced)

SP – Scientific Python
Robert Johansson's scientific python lectures:
https://github.com/jrjohansson/scientific-python-lectures
Scipy lecture notes
http://scipy-lectures.org/
Matplotlib (plotting package)
https://matplotlib.org/
Scipy documentation (more advanced)
https://docs.scipy.org/doc/scipy/tutorial/index.html

W - On Scientific Writing:
https://cbc.arizona.edu/sites/default/files/2023-08/Scientific_Writing.pdf
https://writingcenter.unc.edu/tips-and-tools/sciences/
https://advice.writing.utoronto.ca/types-of-writing/science/
https://github.com/quanghuy0497/Writing-in-the-Sciences

XR – XARRAY, the array package for python
http://xarray.pydata.org/en/stable/

Z – Zotero, Bibliography software
https://www.zotero.org/

LSU OCS 4001 Fall 2024 Syllabus

Tentative Class Schedule. Advanced labs are highlighted

Dates	Week	Topic	Resources (defined above)	Assignments
8/27-29	1	Introductions: class, python	**DC** Intro to Python Ch 1-2	Lab 1.1, Lab 1.2, Weekly assessment (WA), Student Introductions
9/3-5	2	Functions, Numpy	**DC** Intro to Python Ch 3-4	Lab 2.1, Lab 2.2, WA
9/10-12	3	Matplotlib, Pandas	**DC** Intermediate Python Ch 1-2	Lab 3.1, Lab 3.2, WA
9/17-19	4	Logical control, Loops, Show us your plots	**DC** Intermediate python Ch 3-4	Lab 4.1, Lab 4.2, WA
9/24-26	5	Case Study, Functions	**DC** Intermediate python Ch 5, **DC** Intro to Functions Ch 1	Lab 5.1, Lab 5.2, WA
10/1-3	6	Plotting: More matplotlib, Xarray, Cartopy	**DC** Introduction to Data Visualization with Matplotlib	Lab 6.1, Lab 6.2, WA
10/8-10	7	More Pandas, Movies	**DC** Data Manipulation with Pandas	Final Research topics due 10/13 Lab 7.1, Lab 7.2, WA
10/15, Fall Holiday	8	Effective use of AI, Movie share	**O, Z, R, S**	Lab 8.1 WA
10/22-24	9	Pseudocode, Introduction to LaTeX and Zotero, LSU HPC, Research projects		Final project proposals due 10/28 Lab 9.1, Lab 9.2, WA
10/29-31	10	Research topics presentations, Proposal peer review		Research topics feedback, Lab 10.2, WA
11/5-7	11	Linear Regression, Timeseries Analysis		Lab 11.1, Lab 11.2, WA
11/12-14	12	Student choice, Predator Prey Modeling		Lab 12.1, Lab 12.2, WA
11/19-21	13	Intro to Machine Learning	**DC?**	Lab 13.1, Lab 13.2, WA
11/26, Thanksgiving	14	Research projects		Weekly research notebook, WA
12/3-5	15	Research projects		Weekly research notebook, WA
12/10	16	Research presentations	During Final Period: 7:30 – 9:30 AM	Final paper due Sun 12/8

LSU OCS 4001 Fall 2024 Syllabus

Important Dates

September 4	4:30pm	Final date for dropping courses without receiving a grade of a "W"
September 5	4:30pm	Final date for adding courses for credit and making section changes
November 8	4:30pm	Final date for dropping courses

Expectations

LSU's general policy states that for each credit hour, you (the student) should plan to spend at least two hours working on course related activities outside of class. **Visit the LSU Catalog** for more information regarding general information for courses.

LSU Student Code of Conduct

The LSU student code of conduct explains student rights and what is expected of student behavior. Students are expected to understand this code as described on the **Code of Conduct page**. Any violations of the LSU student code will be duly reported to the Dean of Students.

Permissible Use of Generative AI

As a partner in your learning, it is important to both of us that any assignment submission is a pure reflection of your work and understanding. In this course, using AI programs such as ChatGPT is permitted for the purposes of enhancing your understanding of course materials, encouraging creative exploration and supporting academic growth. These programs should not be used to produce work that misrepresents your abilities or deceives as to the conditions under which the work was completed.

If you choose to utilize AI programs to generate content, you must clearly acknowledge the use of AI generated material. Proper attribution of AI program use should include an explanation of how the program contributed to the assignment and/or your academic growth. Failing to give proper attribution to the use of AI programs in academic work will be reported to Student Advocacy & Accountability for review under the Code of Student Conduct and may result in impacts to your assignment and/or course grades.

Wellbeing

Your sense of wellbeing is influenced by many parts of your life. The extent to which you feel happy, healthy and otherwise fulfilled matters to us at LSU. Should you need direction to address any number of problems you may have that is directly influencing your sense of wellbeing, please visit **lsu.edu/lsucares** or complete the **LSU wellbeing resources and support form** to inquire as to specific offices to address your concerns. Please note the form is for non-emergency matters. For those matters requiring immediate attention, call the LSU police at 225-578-3231 or LSU Cares at 225-578-4307. For free, confidential, 24/7 emotional support and crisis management, call or text The Phone at 225-924-5781 (LSU1) or the Lifeline at 988.

LSU OCS 4001 Fall 2024 Syllabus

Disabilities

Louisiana State University is committed to providing reasonable accommodations for all persons with disabilities. The syllabus is available in alternate formats upon request.

Any student with a documented disability needing academic adjustments is requested to speak with Disability Services and the instructor, as early in the semester as possible. All discussions will remain confidential. This publication/material is available in alternative formats upon request. Please contact Disability Services in 124 Johnston Hall, 225-578-5919 or **www.lsu.edu/disability**.

LSU Collegiate Recovery Program

Louisiana State University is committed to being inclusive to students in recovery, and to assisting students who are exploring recovery resources. LSU's Collegiate Recovery Program is geared toward helping students remain in recovery while at LSU and seeks to advocate for students' recovery when applicable. If you have questions about LSU's Collegiate Recovery Program or available resources, please call 225-578-4826 or email **asinge6@lsu.edu**.

Academic Success

The primary ingredients of your academic success are attending class, managing your time efficiently, taking good notes, and developing good critical thinking and communication abilities. LSU has a number of excellent resources that will assist you in developing these skills. The place to begin is the **Center for Academic Success** (CAS). The CAS offers guidance on what learning strategies are best suited to your talents, tutoring in the basic subjects, and workshops on a variety of topics, from note taking to time management. **Communication Across the Curriculum** assist students in developing the communication skills necessary for academic and professional success. Finally, with respect to professional success, the **LSU Olinde Career Center** can assist you in choosing a major and a profession that best suits your talents and passions and help you develop a four year career plan to ensure success when you graduate from LSU.

Remote Learning

In the event of a campus-wide closure, this course may transition to an alternative form of instruction. I will notify you by Moodle and slack as soon as possible of the format our course will take. For example, the class may be held via Zoom and recorded for those unable to attend, or I will provide a lesson online that you can do asynchronously, or we may cover content at a different pace or schedule. If the emergency closure impacts scheduled tests, I will make alternative arrangements as soon as possible. If alternative formats are not available due to widespread loss of power and/or internet or other extenuating circumstances, the University may schedule makeup days per **Policy Statement 117**.

Nondiscrimination, Sexual Harassment, & Title IX

LSU provides equal opportunity for all qualified persons in admission to, participation in, or employment in the programs and activities which the university operates without regard to race, creed, color, marital status, sexual orientation, gender identity, gender expression, religion, sex, national origin, age, mental or physical disability, or veteran's status. LSU has implemented a procedure to address complaints for those who believe they have been subjected to discrimination and/or harassment in violation of this policy. Please know that your instructors are

here to support you and listen to your experience. We also want you to know that we are mandatory reporters and must report what we know to the Office of Civil Rights and Title IX. All LSU employees, with few exceptions, are required to report instances of sex- or gender-based harassment and discrimination, including sexual misconduct and power-based violence (e.g., sexual assault, stalking, dating violence, domestic violence, sexual exploitation, retaliation, etc.) for which they may not be the victim, but of which they are aware. The Office of Civil Rights & Title IX is the LSU office responsible for investigating complaints regarding any type of discrimination, sexual harassment, or power-based violence. The Office of Civil Rights & Title IX is located in 118 Himes Hall and the phone number is 225-578-9000. If you are aware of an individual who has been victimized, you are encouraged to contact the Office of Civil Rights & Title IX or file an online report by visiting **LSU's Title IX** website and clicking the **Report an Incident** box. If you have been assaulted, harassed, or a victim of violence, we encourage you to contact the Office of Civil Rights & Title IX. Please reach out for help immediately. Some excellent resources available to Baton Rouge residents include:

- STAR (Sexual Trauma Awareness and Response; 24/7 hotline: 855-435-STAR (7827)
- IRIS Domestic Violence Center; 24/7 hotline: 800-541-9706
- The Lighthouse Program; 225-578-5718
- VIA LINK; 800-273-TALK (8255) [national line but answered from New Orleans]

National resources include:

- RAINN (Rape, Abuse & Incest National Network); 24/7 hotline: 800-656-4673
- National Sexual Violence Resource Center

For additional information, visit www.lsu.edu/civil-rights the **Office of Civil Rights & Title IX** and review **PM-73** (Prohibiting Power-based Violence, including Sex- and Gender-based Harassment and Discrimination, and Sexual Misconduct).