PHYS 410/510: Scientific Computation
Ben Farr
Spring 2022

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Office Hours: see below
Office: Willamette 470

Web: canvas.uoregon.edu/courses/202315
Class Hours: TR 10:00-11:50 a.m.
Class Room: Price Science Commons B042

Instructor Office Hours

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Office Hours</th>
<th>Location</th>
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<tbody>
<tr>
<td>Farr</td>
<td>T 3:00-4:00PM</td>
<td>WIL 470</td>
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<tr>
<td>Godfrey</td>
<td>W 1:00-2:00PM</td>
<td>WIL 315</td>
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You can also make use of the Physics Drop-In Help Center, where you can get help from Physics PhD students!

Course Description

The goal of this course is to build a strong foundation for scientific computation. With a particular emphasis on drawing physical insight from data, we will cover tools and techniques useful for conducting computationally demanding science.

Course Objectives

The course will begin by establishing proficiency with the core tools for working with numbers and data in Python (e.g., numpy, pandas). From there we will explore a range of data science concepts (e.g., model development, regression, optimization, Bayesian inference, machine learning) and their application to real-world data. The exact topics we cover will depend on the interest of the class.

Course Modality

Unless otherwise required by the university, this will be a primarily in-person class. I will try to provide a remote connection option when I’m notified in advance of the need to connect remotely due to isolation.

Course Policies

Communication

I’ll use Canvas as our primary mode of communication. Please make sure that your notifications are setup appropriately so that you see classroom announcements.
Classroom Community Expectations

I want this course to be engaging, with lively discussion. Never hesitate to interrupt with a question or to contribute to a discussion.

Laptops and tablets are strongly encouraged. Most class sessions will involve live coding demonstration coupled with small group hands-on activities.

Textbook

We will not be using any particular textbook exclusively. We will be leveraging a wide range of material, all of it freely available, which I will link to in Canvas as needed.

Grading

Your grade will be determined by your performance in the class. The components of your final grade will be

- Homework — 25%
- Midterm Project — 35%
- Final Project — 40%

Here are important notes about the grading:

- There will be no exams, only homework and projects.
- On most assignments, additional prompts will push 510 students to go deeper into the material.
- Problem sets exist to aid you in understanding and reasoning. The point of the homework is to demonstrate that you have a sound understanding of basic principles and that you are able to clearly articulate it. All submissions should include clear narratives for the motivation of your approach and interpretation of any results, in addition to working code.
- Each homework will be graded out of 15 points, 10 points for scientific correctness and 5 points for the clarity and quality of your writing. This means that I expect a well developed logical argument and explanation of your approach and interpretation of results.
- Homework will typically be collected electronically as Jupyter notebooks uploaded to Canvas.
- No late assignments will be accepted, unless prearranged under extenuating circumstances.
- The final homework will be assigned during dead week.
- It is highly recommended that you work on the homework together in groups (but you must turn in your own work unless otherwise stated).

Course Outline

Below is an example outline of what the course will look like. This will change based on your prior experience and interests, so stay tuned and provide feedback!

Week 1, March 29:

- Intro to Docker
- Get comfortable handling data in Python
Week 2, April 5:
- Intro to sampling
- Application: Explore Gaia data
- Linear regression

Week 3, April 12:
- Application: Boltzmann distribution & Ising Model
- The Metropolis algorithm
- Application: Observational HR diagram

Week 4, April 19:
- Intro to PyMC
- Application: Modeling outliers

Week 5, April 26:
- Application: Modeling CO2 concentrations
- Intro to machine learning

Week 6, May 3:
- Intro to Logistic Regression

Week 7, May 10:
- Application: Logistic regression w/ Gaia
- Intro to neural networks

Week 8, May 17:
- Densely connected classifiers

Week 9, May 24:
- Intro to convolutional neural networks

Week 10, May 31:
- Intro to time series analysis
- Application: LIGO data

University Policies

Academic Disruption
In the event of a campus emergency that disrupts academic activities, course requirements, deadlines, and grading percentages are subject to change. Information about changes in this course will be communicated as soon as possible by email, and on Canvas. If we are not able to meet face-to-face, students should immediately log onto Canvas and read any announcements and/or access alternative assignments. Students are also expected to continue coursework as outlined in this syllabus or other instructions on Canvas.
In the event that the instructor of this course has to quarantine, this course may be taught online during that time.

COVID Containment Plan
As the University of Oregon returns to in-person instruction, the key to keeping our community healthy and safe involves prevention, containment, and support. Here is information critical to how the UO is responding to COVID-19.

• **Prevention**: To prevent or reduce the spread of COVID-19 in classrooms and on campus, all students and employees:
  1. Must comply with vaccination policy
  2. Must wear face coverings in all indoor spaces on UO campus
  3. Complete weekly testing if not fully vaccinated or exempted
  4. Wash hands frequently and practice social distancing when possible
  5. Complete daily self-checks
  6. Stay home/do not come to campus if feeling symptomatic
  7. Complete the UO COVID-19 case and contact reporting form if you test positive or have been in close contact with a confirmed or presumptive case.

• **Containment**: If a student in class tests positive for COVID-19, all relevant classes will be notified via an email by the Corona Corps Care Team with instructions for students and staff based on their vaccination status. Specifically:
  - **Vaccinated and Asymptomatic students**: Quarantine not required, but daily self-monitoring before coming on campus is advised; sign up for testing through MAP 3-5 days after exposure if advised you are a contact."
  - **Unvaccinated or partially vaccinated students**: 14-day quarantine advised - do not come to class - and sign up for testing 3-5 days after notification through MAP, if asymptomatic, or through University Health Services (541-346-2770) or your primary care provider, if symptomatic.
  - **Symptomatic students**: stay home (do not come to class/campus), complete the online case and contact form, and contact University Health Services (541-346-2770) or your primary care provider to arrange for immediate COVID-19 testing.

Students identified as a close contacts of a positive case will be contacted by the Corona Corps Care Team (541-346-2292).

• **Support**: The following resources are available to you as a student.
  - University Health Services or call (541) 346-2770
  - University Counseling Center or call (541) 346-3277 or (541) 346-3227 (after hrs.)
  - MAP COVID-19 Testing
  - Corona Corps or call (541) 346-2292
  - Academic Advising or call (541) 346-3211
  - Dean of Students or call (541)-346-3216

Good Classroom Citizenship
• Wear your **mask** and make sure it fits you well
• **Stay home** if you’re sick
• **Get to know your neighbors** in class, and let them know if you test positive
• **Get tested** regularly
• Watch for **signs and symptoms** with the daily symptom self-check
• **Wash your hands** frequently or use hand sanitizer

Complete the UO COVID-19 **case and contact reporting form** if you test positive or are a close contact of someone who tests positive.

### Other Policies

#### Accessibility

The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center in 360 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu.

#### Your Well-Being

Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you’re facing such challenges, you don’t need to handle them on your own—there’s help and support on campus.

As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground floor) and get help from one of the specially trained Peer Wellness Advocates. Find out more at health.uoregon.edu/ducknest.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

#### Basic Needs

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course is urged to contact the Dean of Students Office (346-3216, 164 Oregon Hall) for support.

This UO webpage includes resources for food, housing, healthcare, childcare, transportation, technology, finances, and legal support: [https://blogs.uoregon.edu/basicneeds/food/](https://blogs.uoregon.edu/basicneeds/food/)
**Academic Integrity**

The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students’ obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at [https://researchguides.uoregon.edu/citing-plagiarism](https://researchguides.uoregon.edu/citing-plagiarism).

**Student Experience Surveys**

Please, please, please fill these out! I read through all of your feedback to improve the course!

**Mandatory Reporter Status**

I am an assisting employee. For information about my reporting obligations as an employee, please see Employee Reporting Obligations on the Office of Investigations and Civil Rights Compliance (OICRC) website. Students experiencing sex or gender-based discrimination, harassment or violence should call the 24-7 hotline 541-346-SAFE [7244] or visit safe.uoregon.edu for help. Students experiencing all forms of prohibited discrimination or harassment may contact the Dean of Students Office at 5411-346-3216 or the non-confidential Title IX Coordinator/OICRC at 541-346-3123. Additional resources are available at investigations.uoregon.edu/how-get-support. I am also a mandatory reporter of child abuse. Please find more information at Mandatory Reporting of Child Abuse and Neglect.