**ME 599 Software Development for Engineering Research, Spring 2020**
**Oregon State University**
**T/Th 10:00–11:50 am, Zoom (https://oregonstate.zoom.us/j/476702331)**

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**Instructor:** Dr. Kyle Niemeyer, kyle.niemeyer@oregonstate.edu
**Office Hours:** Rogers 320; by appointment.
Also via Slack as `@niemeyek` (https://class-me599-002-sp20.slack.com/)

**Course Content:** This course will advance students' understanding of topics related to computational science and engineering, and advance their skills in applying techniques to solve research problems using high-level programming languages. The course will build on existing abilities in computer programming to cover topics related to computational modeling and scientific software development. Students will gain experience in applying available packages and libraries, as well as developing software to solve problems related to their own research interests. Students will also gain experience in working collaboratively and openly on scientific computing projects.

**Required Textbook:** *Effective Computation in Physics*, by Scopatz & Huff, O'Reilly. http://physics.codes
**Prerequisites:** ME 499/599 "ST/Computer Programming for Mechanical Systems" (Future number: ME 435/535), or equivalent. Graduate standing or instructor approval.
**Grading:** Project (100%)

## Learning Objectives

At the end of this course, students will be able to:

1. use high-level programming language to analyze and/or solve practical research problems;
2. apply principles of modern computational science and engineering, reproducibility, and open science to their research;
3. evaluate, visualize, write about, and publish computational research results; and
4. develop and share an open-source research software package that solves a problem in their research area.

# Course Policies

## 1 Academic Honesty

It is the expectation of the instructor that any work submitted for this course is a fair and accurate representation of the student's own abilities and efforts, or in the case of team work, those of the team. Evidence to the contrary will prompt investigation and any dishonest acts will be dealt with accordingly.

**Academic or Scholarly Dishonesty** is defined as an act of deception in which a Student seeks to claim credit for the work or effort of another person, or uses unauthorized materials or fabricated information in any academic work or research, either through the Student's own efforts or the efforts of another.

For more information about academic integrity and relevant University policies/procedures, please refer to the Student Conduct web site and the section on Academic Regulations in the OSU Schedule of Classes. If you have **any questions or concerns** about this policy, **don't hesitate** to contact me.

## 2 General and attendance

I look at this class as an exchange: I expect you to be in class on time, fully present for all lectures, and prepared to contribute by asking insightful questions (or giving informed answers); you can expect me to be well-prepared to give a useful and (hopefully) interesting lecture.

## 3 Project

The main focus of the course will be a project that involves developing a new software package targeted at your own research area, and ideally something you would use towards your thesis research. All of the concepts discussed in the class, including testing, documentation, and open sharing of the software will be applied to the project.

## 4 Grading

Grading of your project will be done via self- and peer-assessment. More details will be shared later.

## 5 Universal Learning

I am committed to the principle of universal learning. This mean that our classroom, virtual spaces, practices, and interactions should be as inclusive as possible. Mutual respect, civility, and the ability to listen and observe others carefully are crucial to universal learning. Students are expected to follow the Code of Student Conduct: https://beav.es/codeofconduct

For any student with particular needs: "Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations."

**Culture of respect** I believe in the creation and maintenance of a more inclusive, welcoming university that is safe for all students, faculty, and staff. I will provide care and support to community members who may be negatively affected by bias incidents through our Bias Incident Response Process, which is supported by the OSU Office of Institutional Diversity (OID).

**Reach Out for Success** University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at oregonstate.edu/ReachOut. If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255).

**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 OSU Human Services Resource Center (HSRC) for support (541-737-3747, hsrc@oregonstate.edu).

**Mental health** Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance. The source of symptoms might be strictly related to your course work; if so, please speak with me. However, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance. OSU Counseling and Psychological Services (CAPS) offers free, confidential psychological services to help you manage personal challenges that may threaten your well-being.

## 6 Important Dates

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| Add deadline (without approval) | 5 April |
| Drop deadline (100% refund) | 5 April |
| Add deadline (with department approval) | 12 April |
| Withdraw deadline (50% refund) | 19 April |
| Withdraw deadline (no refund) | 15 May |
| Change grading basis | 15 May |

## Course Schedule (tentative):

| TUESDAY | THURSDAY |
|---|---|
| Mar 31st **1**<br>Intro. to computational modeling and analysis | Apr 2nd **2**<br>Structuring Python programs, modular/functional programming |
| 7th **3**<br>Classes, objects, NumPy arrays | 9th **4**<br>Storing & manipulating data in files, HDF5 |
| 14th **5**<br>Version control, working collaboratively & peer code review | 16th **6**<br>Software testing & continuous integration |
| 21st **7**<br>Analysis; plotting & visualization | 23rd **8**<br>Analysis; plotting & visualization (contd. |
| 28th **9**<br>Numerical methods (Interpolation, curve fitting, optimization, etc.) | 30th **10**<br>Interfacing with other languages |
| May 5th **11**<br>Intro. to parallel computing | 7th **12**<br>Intro. to parallel computing (contd.) |
| 12th **13**<br>Measuring and improving performance | 14th **14**<br>Reproducible research |
| 19th **15**<br>Software documentation | 21st **16**<br>Writing & publishing computational research |
| 26th **17**<br>Deploying & sharing software; licenses & copyright | 28th **18**<br>Open science |
| June 2nd **19**<br>Project presentations | 4th **20**<br>Project presentations |