PHYS 220/MATH 220 Syllabus
Scientific Computing I (Fall 2020)
Chapman University

Course Information

Instructor: Dr. Justin Dressel
Email: dressel@chapman.edu

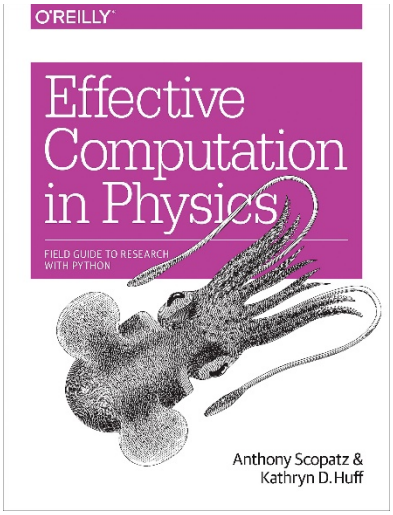
Course Time: MW 1:00 pm - 2:15 pm
Course Location: Leatherby Library B14 (if hyflex on-campus is allowed)
Zoom Link:
https://chapman.zoom.us/j/98185663871?pwd=RE1OL2hVVlFuZjRuQzFzTFZVVkVaUT09
Zoom Meeting ID: 981 8566 3871
Zoom Passcode: 220220

Office Hours: TTh 1:00 pm – 2:15 pm, or by appointment
Office Location: Keck Center 353 (if on-campus is allowed)
Zoom Link:
https://chapman.zoom.us/j/98846871039?pwd=cmFhdTZGNUhhSXBlTnJGWXY5cEhtUT09
Zoom Meeting ID: 988 4687 1039
Zoom Passcode: 220220

Course Site: **https://canvas.chapman.edu**

Course Description

(Same as MATH 220.) Prerequisite, CPSC 230. This example-driven course introduces computation as a tool for scientific exploration. Topics include manuscript preparation with LaTeX and Jupyter, test-driven development, numerical methods with arrays/data frames, and symbolic computation. Modern languages like Python and MATLAB are emphasized. Letter grade. (Offered fall semester.) **3 credits**



Required Textbook

- **Effective Computation in Physics**
  Scopatz & Huff, O'Reilly Media Inc., June 2015.
  ISBN: 9781491901533
  https://physics.codes

Required Equipment and Facilities

Non-mobile device that supports installing Anaconda Python (Mac, Windows, or Linux)
Non-mobile device that supports Zoom breakout rooms
High-speed internet connection with audio and video capabilities

Instructional Methods and Strategies

This course is intended to develop a professional skill set aimed at getting jobs related to physics, mathematics, and computer science after college. The tools we will use are not watered down—they are exactly the tools becoming increasingly used in industry and academia for scientific computing and data science, so are designed to be included on your resume after you graduate.

Practice is essential. The philosophy of the course is to learn by doing. You are expected to turn in professional-quality work that is documented and formatted according to industry standards. Your work should run correctly, have passing tests, and be clearly written. Half of your job is solving interesting problems; the other half of your job is working in teams and presenting your results to others.

Methods of Evaluation

Class time will consist of small lectures to introduce and review material, followed by breakout rooms in teams solving interesting physical problems with code. You will put into practice what you have read from the textbook and web resources, with guidance from the instructor and peers. Homework will be completed individually to provide additional practice and assess mastery, and will be peer-reviewed as a proxy for industry code-review. The Midterm and Final will be multi-week projects to be completed individually. They will require a synthesis of all topics learned in the course to complete successfully.

Student Assessment and Grading Scale

Assessment Category	Weighting
Classwork	20%
Homework	20%
Peer Review	10%
Midterm Project	20%
Final Project	30%

Grade	Minimum %	Maximum %
A	92	100
A-	88	92
B+	84	88
B	80	84
B-	76	80
C+	72	76
C	68	72
C-	64	68
D+	60	64
D	56	60
D-	52	56
F	0	52

Late Work and Accommodation Policy

To accommodate peer review of your work through Canvas, deadlines will be strict. A late assignment will be docked 5% each day after the due date. Projects may not be turned in late without exceptional justification since they span multiple weeks.

Collaboration Policy

Students are encouraged to discuss and study course material together. Physics and programming cannot be learned passively. Like any learned skill, it requires dedicated practice and patience to develop. Discussing ideas and solving problems together can greatly help the learning process. However, all work that is submitted for grading in this course must be your own. Any incidents of academic misconduct will be dealt with severely in accordance with the Chapman University Academic Integrity policy outlined below.

Canvas and GitHub

This class will be managed with the Canvas course management system, with code repositories managed on GitHub and synchronized with the git distributed change control system. The latter two will be linked from Canvas and taught in the course. In addition to the main web interface for Canvas at https://canvas.chapman.edu there exist mobile apps for iOS and Android that support push notifications. Remember to configure your notifications for your account so you do not miss announcements or assignments. Remember to check Canvas daily.

Course Objectives and Learning Outcomes

After completing this course, students will be able to:

1. Create professional reports in LaTeX, including proper section structuring, figures, and references. Augment these static reports with dynamic Jupyter-lab notebooks that are targeted for interactive web publication as supplementary information.
2. Demonstrate industry-standard software engineering principles, including modular design, test-driven development, change control (git), and the efficient use of console editors (nano/vim) for code development.
3. Write simulation code involving precision numerical methods, array-based numerical processing, data file manipulation, data visualization, and symbolic computation.
4. Demonstrate the use of vectorized code and precompiled libraries to increase code efficiency, as well as a familiarity with just-in-time compilation.
5. Produce accurate simulations of challenging physical systems, with the explicit goal of using those simulations to answer interesting scientific questions.

Physics Program Learning Outcomes

Students will:

1. Recall and use mathematics to precisely formulate and solve physical problems.
2. Recall and use core principles of classical mechanics, electromagnetism, quantum mechanics, thermal physics, and statistical mechanics to model and analyze a variety of physical phenomena.
3. Use both laboratory and computational skills to take measurements, numerically simulate physical models, and analyze data to draw valid conclusions.
4. Effectively communicate scientific results to both technical and general audiences.
5. Demonstrate that they can think critically and work both independently and in collaborative teams.

Recording in Class

In this class, software may be used to record live class discussions on rare occasions. As a student in this class, your participation in live class discussions will be recorded to assist those who cannot attend the live session, or to serve as a resource for those who would like to review content that was presented. These recordings will be made available only to students who are enrolled in the class, and only during the period in which the course is offered. All recordings will become unavailable to students in the class shortly after the course ends. Students who prefer to participate via audio only will be allowed to disable their video camera so only audio will be captured. Please discuss this option with your instructor.

Safety Protocols for On-Campus Instruction

In response to the current COVID-19 pandemic, Chapman University has developed the CU Safely Back program (CUSBP) and mandatory safety measures (https://news.chapman.edu/coronavirus/). The University's mandatory safety measures may be stricter than local, state or federal guidelines and may be subject to change at any time. Students are expected to adhere to the University's safety measures while attending classes, including when entering and exiting classrooms, laboratories, or other instructional areas. Individual faculty may choose to have requirements for their courses that are stricter than the University's. Safety precautions and procedures may change in response to emerging findings and the recommendations of scientific experts and authorities. Refusal to abide by the University's mandatory safety measures or to the safety requirements specific to this course will result in your being asked to leave the area immediately, and may result in an administrative dismissal from this course.

The COVID-19 pandemic requires all of us to accept the possibility that changes in how this course is taught may be required and that some changes may occur with little or no notice. For example, after the return to campus some or all of the in-person aspects of a course may be shifted back to remote instruction. If this occurs, you will be given clear instructions as to how to proceed. The uncertainty of the situation is not ideal for any of us. We must all try to approach this situation with good-will, flexibility, and mutual understanding.

Religious Accommodation at Chapman University

Consistent with our commitment of creating an academic community that is respectful of and welcoming to persons of differing backgrounds, we believe that every reasonable effort should be made to allow members of the university community to fulfill their obligations to the university without jeopardizing the fulfillment of their sincerely held religious obligations. Please review the syllabus early in the semester and consult with your faculty member promptly regarding any possible conflicts with major religious holidays, being as specific as possible regarding when those holidays are scheduled in advance and where those holidays constitute the fulfillment of your sincerely held religious beliefs.

Chapman University Academic Integrity Policy

Chapman University is a community of scholars that emphasizes the mutual responsibility of all members to seek knowledge honestly and in good faith. Students are responsible for doing their own work and academic dishonesty of any kind will be subject to sanction by the instructor/administrator and referral to the university Academic Integrity Committee, which may

impose additional sanctions including expulsion. Please see the full description of Chapman University's policy on Academic Integrity at http://www.chapman.edu/academics/academicintegrity/index.aspx.

Chapman University Students with Disabilities Policy

In compliance with ADA guidelines, students who have any condition, either permanent or temporary, that might affect their ability to perform in this class are encouraged to contact the Office of Disability Services. If you will need to utilize your approved accommodations in this class, please follow the proper notification procedure for informing your professor(s). This notification process must occur more than a week before any accommodation can be utilized. Please contact Disability Services at (714) 516-4520 if you have questions regarding this procedure, or for information and to make an appointment to discuss and/or request potential accommodations based on documentation of your disability. Once formal approval of your need for an accommodation has been granted, you are encouraged to talk with your professor(s) about your accommodation options. The granting of any accommodation will not be retroactive and cannot jeopardize the academic standards or integrity of the course.

Chapman University Equity and Diversity Policy

Chapman University is committed to ensuring equality and valuing diversity. Students and professors are reminded to show respect at all times as outlined in Chapman's Harassment and Discrimination Policy. Any violations of this policy should be discussed with the professor, the Dean of Students and/or otherwise reported in accordance with this policy.

Student Support at Chapman University

Over the course of the semester, you may experience a range of challenges that interfere with your learning, such as problems with friend, family, and or significant other relationships; substance use; concerns about personal adequacy; feeling overwhelmed; or feeling sad or anxious without knowing why. These mental health concerns or stressful events may diminish your academic performance and/or reduce your ability to participate in daily activities. You can learn more about the resources available through Chapman University's Student Psychological Counseling Services here: https://www.chapman.edu/students/health-and-safety/psychological-counseling/.

Fostering a community of care that supports the success of students is essential to the values of Chapman University. Occasionally, you may come across a student whose personal behavior concerns or worries you, either for the student's well-being or yours. In these instances, you are encouraged to contact the Chapman University Student Concern Intervention Team who can respond to these concerns and offer assistance: https://www.chapman.edu/students/health-and-safety/student-concern/index.aspx. While it is preferred that you include your contact information so this team can follow up with you, you can submit a report anonymously. 24-hour emergency help is also available through Public Safety at 714-997-6763

Physics, Imposter Syndrome, and Failure as the Best Teacher

Physics (and programming) tends to be challenging for people, especially those who have not yet practiced the style of thinking required for logical constraint-based problem solving. It is very common for students to feel lost, or to feel that everyone else in the room seems to be understanding the material but them. These feelings of *imposter syndrome* are almost always unwarranted, so instead focus on improving your own abilities from where you currently are. You are not competing with your peers—*you are only competing with yourself*. Usually, everyone is feeling similarly about new material and just trying to hide it. It will be crucial for you to communicate when you do not understand something (both to the instructor and to your peers) in order to destroy the illusion that imposter syndrome presents and help each other master the material.

It is also especially important to remember that *the best teacher is failure*—correcting your inevitable and numerous mistakes will lead to mastery and should be understood as an integral and unavoidable part of the learning process. Don't get discouraged and be persistent; mastery will come with time and effort. Many promising students give up prematurely when faced with early failure, rather than persisting to become accomplished scientists. The following two articles comment on this point further:

- https://www.scientificamerican.com/article/one-reason-young-people-dont-go-into-science-we-dont-fail-well1/
- https://www.nature.com/articles/nj7587-555a

Tentative Course Schedule

The schedule below indicates the corresponding book sections that should be read **prior** to coming to class, as well as a broad outline of the topics that will be covered. This tentative schedule will be updated by more specific assignments on Canvas as the semester proceeds.

Week	Monday	Wednesday	Topics
1 : 8/31	Orientation	Ch. 1	Setup, bash, remote shell, Jupyter-lab
2 : 9/7	(Labor Day: No Class)	Ch. 15,16	git, GitHub
3 : 9/14	Ch. 2	Ch. 3,4	Python: modules, types, logic
4 : 9/21	Ch. 5	Ch. 17	Python: functions, structure, debugging
5 : 9/28	Ch. 6	Ch. 18	Python: classes, testing
6 : 10/5	Ch. 7		Python: visualization
7 : 10/12	Ch. 9	(midterm assigned)	Efficient Python: arrays, numpy
8 : 10/19	Ch. 10		Efficient Python: managing data
9 : 10/26	Ch. 11		Efficient Python: data structures
10 : 11/2	Ch. 12	(midterm due)	Efficient Python: parallel code, numba
11 : 11/9	Ch. 20		LaTeX reports
12 : 11/16	Ch. 20	(final assigned)	Interactive notebook supplements
13 : 11/23	(Fall Break: No Class)	(Fall Break: No Class)	
14 : 11/30	Supplements	Supplements	From Python to MATLAB
15 : 12/7	Supplements	Supplements	From Python to Julia
16 : **12/17**	**1:30 pm – 4:00 pm**	(final due)	(Finals Week)