

Syllabus

Syllabus for CHBE 5838-004: Numerical Techniques in Python

Spring 2022

Lecture Times: Tuesday/Thursday 10:00 a.m.-11:15 a.m.

Location: While online remote, [Zoom link here](https://cuboulder.zoom.us/j/93667332412) [_\(https://cuboulder.zoom.us/j/93667332412\)_](https://cuboulder.zoom.us/j/93667332412), with passcode: **179330**. When in person, JSCBB B231.

Lecturer: Prof. Michael Shirts

Office: JSCBB C123, but I may or may not be there given this semester, please check first!

e-mail: michael.shirts@colorado.edu

Office hours: Friday 4:00 - 4:30, Monday 4-5:00. Same Zoom link as class!

Topics

This class is intended as an introduction to Python and using numerical computing with Python, including important computing and visualization libraries. Given that we have only 10 class periods over five weeks, we will not be able to get too far! The goal is to get you to a point that you feel confident in learning and going further afterwards. [A detailed course schedule](https://canvas.colorado.edu/courses/79233/pages/schedule-of-topics) [_\(https://canvas.colorado.edu/courses/79233/pages/schedule-of-topics\)_](https://canvas.colorado.edu/courses/79233/pages/schedule-of-topics) is posted on the course Canvas website, and will likely be updated over time, as I gauge the interests of the class and the progress we make.

Course Communication

Canvas will be used to communicate class information. You are responsible for all the information that is posted here! For most routine administrative questions you can email me, or send a question to the Slack workspace. Email is **not** a good way to clarify questions on the material; those questions should be answered in office hours or in-class discussion formats. If you have questions on any administrative topic (typos in materials, scheduling questions, etc.), email or Slack works very well. I will make every effort to return emails within 24 hours.

[_\(https://canvas.colorado.edu/courses/79233/files/41562421/download?wrap=1\)_](https://canvas.colorado.edu/courses/79233/files/41562421/download?wrap=1)

Slack Workspace

The course has a Slack workspace that you will be invited to after the first course, and is useful for asking questions and discussion.

Attendance policy

Attendance at the lecture sessions of class (whether remote or in-person) is required, and will be included in the grade. Lecture portions will be recorded for later viewing, but there is a significant amount of interactive programming during the class. Emergencies requiring missing the classes can be excused with by special arrangement, but the remote nature of the course should allow participation in most circumstances.

Course Materials

The class will be taught using Python. For Python, I recommend using with the free Miniconda or Anaconda packages, which can be used on Windows, Linux, and OS X. [See the Canvas web site on how to install Miniconda or Anaconda](https://canvas.colorado.edu/courses/79233/pages/important-for-first-day-software-for-the-course) (<https://canvas.colorado.edu/courses/79233/pages/important-for-first-day-software-for-the-course>), and [additional coding resources](https://canvas.colorado.edu/courses/79233/pages/readings-and-resources) (<https://canvas.colorado.edu/courses/79233/pages/readings-and-resources>).

We will be using a variety of resources for the course. All of the subjects in this class are covered in many different ways in a number of online resources, and it makes the most sense to point you to the best resource for each topic. Links to each of these will be posted as we go through the course usually a minimum of one week before lecture.

Learning Activities

This class will operate on a mix of learning modes. It will include lectures and in-class learning activities in the flipped classroom model, both alone and working together in breakout sessions, as well as weekly homework assignments.

I will solicit feedback regularly to make sure we are maximizing learning!

Assessment

Points will be given for course participation, weekly homework

- Course Participation: 60%
- Homework 40% (10% for each of 4 assignments)

There is no set curve in the class; I'm happy to give all A's if everyone demonstrates that they have mastery of the material.

Course Participation

As we will be using a student-directed learning and flipped classroom model to large extent, course participation becomes very important part of the course. It will be vital that you spend some time on the homework and play around with Python outside of class. Lectures will include short mini-lectures on difficult topics, working through Python notebooks to demonstrate concepts, and working on assignments in groups. Ways to demonstrate participation are:

- Asking and answering questions in class.

- Posting questions to ask before class in the "Discussion" tool (must be asked by 10:00 pm the night before for credit).
- Identifying additional resources to share with the class.
- Pointing out typos in materials I distribute.
- Providing feedback on how the class could be better.
- Coming to office hours or other meeting with the professor at least once in the first couple of weeks.
- Working collaboratively on the labs/assignments given during class.
- Continuing to explore the material if you finish early.

Homework

There will be regular homework assignments in this class, due on Mondays at 9:00 p.m. Homework should be submitted via the course's Canvas web site. No late homework will be accepted without prior arrangement (if there's some technical difficulties with the website and it gets submitted a few minutes late, I don't care). However, I am fairly understanding of conflicts if you inform me ahead of time, or if there is something entirely outside of your control. Not all homework problems can be solved solely by information presented in class, and will often require spending time on the reading.

Homework will be graded on a check-plus / check / check-minus basis.

- 0: no effort made, any problems not attempted, or no homework turned in.
- check-minus: all problems attempted, some progress made, lack of basic understanding
- check: perhaps some conceptual problems, but most of the problems solved mostly correctly.
- check-plus: all problems basically correct, no major conceptual issues, but there may be some minor issues or math errors.

In general, a student with more check-pluses than checks and almost no check-minuses would be on target to get an A in the class. More checks than check-pluses, and not too many check minuses, would be more like an A-. Once during the semester, you may resubmit a homework after grading for an improved score, if it is submitted within a week of being returned. All problems that are incorrect/incomplete must be substantially improved to get regrade credit.

Unfortunately, because of limitations to the Canvas grading system, I can't currently use "check", "check-plus", "check- minus". I will instead use numbers to indicate which grade it is: 0=0, check-minus=1, check=2, check-plus=3. HOWEVER, these are not the weightings of the grades themselves!

Pair Programming

In class, we will use pair programming in break out sessions. In these sessions, you will go into a break out room and work through the problems together. Pair programming means one person writes, while the other person comments and provides suggestions, rather than just two people working through simultaneously. [The wikipedia page on "Pair Programming"](#)

https://en.wikipedia.org/wiki/Pair_programming) has a good description of the principles. You should take turns being the "driver" and the "observer" - take turns on each exercise or every 15 min or so on homework.

You can work on your homework either alone, or with a pair-programming partner. In pair-programming. **If you choose to submit using pair-programming, you must submit the same file, and indicate at the top of the file that you pair-programmed, meaning you worked on the program together, with both people present.** You may turn in only one pair programming assignment, as long as it is clearly labeled at the top the two people it belongs to. **You should actually use pair programming, so should be working on the homework at the same time, not dividing up tasks.** Cheating would be copying or using someone else's code other than in pair-programming. You may discuss homework with anyone, as long as you do not look at what they are typing or copy their files.

How to Succeed in the Course

- One could learn almost everything in this course on one's own. There are no lack of Python tutorials out there! I am assuming you are in this class because you want a moderate push and an excuse to pick up these skills. So to provide this, I will be expecting people to put in a moderate amount of effort (8-10 hrs/week, including the time class) during the 5 weeks we have together. If people are putting in the work, then I expect to give essentially all A's and A-'s.
- So you are expected to take responsibility for learning! You should read the suggested materials, work through the problems in detail, and seek out other resources as necessary to aid your understanding.
- Learn to use online resources. Virtually any question you can think of in this course has been thought of before and asked online. By the end of the course, you should be able to find those answers, and will be set for continuing to do so afterwards!
- Be an independent learner. Work on problems by yourself first. Try to resolve difficulties by taking different approaches, working on different but related examples, or reading other texts. Then, consult your peers for discussion of the best approach. Working jointly on homework from the get-go tends to let things you don't understand slip by unnoticed.
- Don't worry about struggling. Some people take easily to programming, some don't. And a very common problem is to get stuck on a bug in a program for quite some time. There's always an answer, and the key is to figure out what the program is actually doing at any point - we'll talk about this some more over the course of the module.

Classroom Behavior

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially

important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](http://www.colorado.edu/policies/student-classroom-and-course-related-behavior) [_ \(http://www.colorado.edu/policies/student-classroom-and-course-related-behavior\)_](http://www.colorado.edu/policies/student-classroom-and-course-related-behavior) and the [Student Conduct & Conflict Resolution policies](https://www.colorado.edu/sccr/student-conduct) [_ \(https://www.colorado.edu/sccr/student-conduct\)_](https://www.colorado.edu/sccr/student-conduct).

Requirements for COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](https://www.colorado.edu/sccr/) [_ \(https://www.colorado.edu/sccr/\)_](https://www.colorado.edu/sccr/). For more information, see the policy on [classroom behavior](http://www.colorado.edu/policies/student-classroom-and-course-related-behavior) [_ \(http://www.colorado.edu/policies/student-classroom-and-course-related-behavior\)_](http://www.colorado.edu/policies/student-classroom-and-course-related-behavior) and the [Student Code of Conduct](http://www.colorado.edu/osccr/) [_ \(http://www.colorado.edu/osccr/\)_](http://www.colorado.edu/osccr/). If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

CU Boulder currently requires masks in classrooms and laboratories regardless of vaccination status. This requirement is a precaution to supplement CU Boulder’s COVID-19 vaccine requirement. Exemptions include individuals who cannot medically tolerate a face covering, as well as those who are hearing-impaired or otherwise disabled or who are communicating with someone who is hearing-impaired or otherwise disabled and where the ability to see the mouth is essential to communication. If you qualify for a mask-related accommodation, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus. In addition, vaccinated instructional faculty who are engaged in an indoor instructional activity and are separated by at least 6 feet from the nearest person are exempt from wearing masks if they so choose.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the [Public Health Office](https://www.colorado.edu/health/public-health/quarantine-and-isolation) [_ \(https://www.colorado.edu/health/public-health/quarantine-and-isolation\)](https://www.colorado.edu/health/public-health/quarantine-and-isolation) [_ \(contacttracing@colorado.edu \(mailto:contacttracing@colorado.edu\)\)_](mailto:contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the [Public Health Office](https://www.colorado.edu/health/public-health/quarantine-and-isolation) [_ \(https://www.colorado.edu/health/public-health/quarantine-and-isolation\)](https://www.colorado.edu/health/public-health/quarantine-and-isolation) [_ \(contacttracing@colorado.edu \(mailto:contacttracing@colorado.edu\)\)_](mailto:contacttracing@colorado.edu).

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code academic integrity policy. Violations of the Honor Code may include, but are not limited to: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu (<mailto:honor@colorado.edu>)); 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](https://www.colorado.edu/osccr/honor-code) (<https://www.colorado.edu/osccr/honor-code>).

Any discovered incidents of academic dishonesty will be reported to the departmental disciplinary committee who will recommend an academic sanction. Sanctions can range from an F for the particular assignment and a lowering of your grade at least a full letter grade to an F for the course. In addition, all confirmed incidents will be reported to the University Honor Code where further nonacademic disciplinary action can be taken. The following list includes some of the examples of dishonest acts (not all of them) for which a hearing will result:

1. Talking to each other during a class individual exam or bringing any information into the exam.
2. Any alteration, forgery, or falsification of official records (such as modification of graded homework problems or exams for which you are seeking additional credit).
3. Allowing another person to take an exam for you (false identification).
4. Knowingly providing material of your own or of others to a fellow student.
5. Possession of or observation of examinations or solutions to examinations prior to the date and time of the exam.
6. Allowing another person to answer clicker questions for you, or answering clicker questions for someone else.

Religious Holidays:

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance.

See the [campus policy regarding religious observances](http://www.colorado.edu/policies/observance-religious-holidays-and-absences-classes-andor-exams) (<http://www.colorado.edu/policies/observance-religious-holidays-and-absences-classes-andor-exams>)

for full details.

Accommodations for Disabilities:

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](https://www.colorado.edu/disabilityservices/) [\(https://www.colorado.edu/disabilityservices/\)](https://www.colorado.edu/disabilityservices/). Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu [\(mailto:dsinfo@colorado.edu\)](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition, see [Temporary Medical Conditions](http://www.colorado.edu/disabilityservices/students/temporary-medical-conditions) [\(http://www.colorado.edu/disabilityservices/students/temporary-medical-conditions\)](http://www.colorado.edu/disabilityservices/students/temporary-medical-conditions) on the Disability Services website.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. The university will not tolerate acts of sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, or protected-class discrimination or harassment by or against members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or email cureport@colorado.edu [\(mailto:cureport@colorado.edu\)](mailto:cureport@colorado.edu). Information about university policies, [reporting options](https://www.colorado.edu/oiec/reporting-resolutions/making-report) [\(https://www.colorado.edu/oiec/reporting-resolutions/making-report\)](https://www.colorado.edu/oiec/reporting-resolutions/making-report), and the support resources can be found on the [OIEC website](http://www.colorado.edu/institutionalequity/) [\(http://www.colorado.edu/institutionalequity/\)](http://www.colorado.edu/institutionalequity/).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents of sexual misconduct, dating and domestic violence, stalking, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about their rights, support resources, and reporting options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](https://www.colorado.edu/dontignoreit/) [\(https://www.colorado.edu/dontignoreit/\)](https://www.colorado.edu/dontignoreit/).

Schedule of Topics

Below is the preliminary schedule of topics for the course; it will be updated throughout the course, but will be correct for upcoming 3-4 lectures. Specific readings for each topic can be found in the Modules section.

PCSE [_ \(http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf\)](http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf) is "Python for Computational Scientists and Engineers"

SL [_ \(http://scipy-lectures.org/\)](http://scipy-lectures.org/) is Scipy-lectures.org

Date	Topic	Some readings
Jan 11th	Class 1: Class Introduction, Jupyter Notebooks, and Python	PCSE _ (http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf) , Chapters 1, 2
Jan 13th	Class 2: Lists, Dictionaries and Flow Control	PCSE _ (http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf) , Chapters 3, 4, 6
Jan 18th	Class 3: Functional Programming	PCSE _ (http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf) , 5, 7, 8, SL: Python Language _ (http://scipy-lectures.org/intro/language/python_language.html) , All Code Academy lessons
Jan 20th	Class 4: Numpy, Arrays, Matrices, and Linear Algebra	PCSE _ (http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf) , chapters 13,14, (chapter 10 "From MATLAB to Python" may be interesting if you have MatLab background)
Jan 25th	Class 5: Making it Pretty and Fast: Data Formatting and Code Vectorization	pyformat.info _ (https://pyformat.info/)
Jan 27th	Class 6: A Picture is worth	PCSE _ (http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf)

	1000 words: Matplotlib	for-Computational-Science-and-Engineering.pdf), chapter 15.1, SL: Plotting in Python _(http://scipy-lectures.org/intro/matplotlib/index.html) , SL: 3D plotting in Python _(http://scipy-lectures.org/packages/3d_plotting/index.html)
Feb 1st	Class 7: Pandas, Statistical Tools and More Plotting	SL: Pandas in statistics _(http://scipy-lectures.org/packages/statistics/index.html)
Feb 3rd	Class 8: SciPy and solving differential equations	SL: SciPy, _(http://scipy-lectures.org/intro/scipy.html) PCSE _(http://www.southampton.ac.uk/~fangohr/training/python/pdfs/Python-for-Computational-Science-and-Engineering.pdf)), chapter 16
Feb 8th	Class 9: Optimization and nonlinear systems of equations problems	SL: Optimization _(https://scipy-lectures.org/advanced/mathematical_optimization/)
Feb 10th	Class 10: Image Analysis	SL: Scikit-image _(http://scipy-lectures.org/packages/scikit-image/index.html) , Scikit-image tutorials _(https://github.com/scikit-image/skimage-tutorials)