

Biosystems Analytics 434/534 (3 units)

Asynchronous Online Format; Weekly modules completed at your own pace.

Description of Course

This course provides a comprehensive introduction to Python for data analytics. This course teaches students Python's basic data types and structures like strings, numbers, lists, tuples, dictionaries, and sets. In addition, the course focuses on testing code by writing small functions to develop larger, testable programs. As programs become complex, this "test-driven development strategy" ensures that code is robust and can be delivered to the community as cutting-edge open source packages. The course focuses on hands-on coding exercises to develop practical coding skills for interpreting and analyzing high-dimensional biological data. Students work independently and collaboratively online via Slack to gain skills in:

- basic Python data structures
- writing and testing functions and programs,
- using Python to read/write/parse files, and
- using regular expressions.

These skills are taught by implementing real-world coding examples to manipulate and process data in Python and test out your new skills through writing games in Python.

Course Prerequisites or Corequisites

An Apple or Windows computer. Some experience programming Python is useful but not required.

Instructor and Contact Information

- Instructor: Bonnie Hurwitz, Associate Professor, Biosystems Engineering
- Office: Bio5 Keating, Room 223
- E-mail: bhurwitz@arizona.edu
- Office Hours: 9:30-10:30 AM Wednesday on Zoom (<https://arizona.zoom.us/my/bonniehurwitz>)
- Course Websites: <https://github.com/bhurwitz33/be434-spring-2023>

Course Objectives

The course objective is to teach formal, structured methods to write Python well. This course introduces techniques seasoned programmers use daily, from how to start writing a new program, to how to verify that it actually works. This course teaches students basic python data structures, loops, functions, and regular expressions using simple puzzles and games. Once students have mastered these coding concepts and practices, they can be applied broadly to advanced concepts in scientific computing and biological data.

Expected Learning Outcomes This course is designed to provide students with a foundational understanding of manipulating data in Python. Upon completing this course students will be able to:

- Write command-line Python programs;
- Process a variety of command-line arguments, options, and flags;

- Write and run tests for your programs and functions;
- Manipulate of Python data structures including strings, lists, tuples, sets, dictionaries;
- Use higher-order functions like map and filter;
- Write and use regular expressions;
- Read, parse, and write various text formats;
- Use and control randomness;
- Use these skills to write challenging games in Python.

All students will complete a class project at the end of the semester, however, Graduate students will be required to complete a more detailed and complicated project than Undergraduates.

Course Format and Teaching Methods

The course is taught using an asynchronous online format, that allows students to work at their own pace through online videos with live-coding examples that demonstrate core concepts, an interactive group discussion (via slack) to get help from other students and the instructor, and weekly quizzes and homework assignments that reinforce concepts. Importantly, because the development of scripting skills is essential to this class, programming homework and quizzes must be completed weekly.

Absence and Class Participation Policy

Watching weekly videos and completing quizzes and assignments is vital to the class. As such, all assignments are due at the end of the week (Sunday at 11:59 pm). Students who miss assignments due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in missing/ungraded assignments for the week.

The UA's policy concerning Class Attendance, Participation, and Administrative Drops is available at <http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop>

The UA policy regarding absences for any sincerely held religious belief, observance or practice will be accommodated where reasonable, <http://policy.arizona.edu/human-resources/religious-accommodation-policy>.

Absences pre-approved by the UA Dean of Students (or Dean Designee) will be honored. See: <https://deanofstudents.arizona.edu/absences>

Makeup Policy for Students Who Register Late Students who register after the first class meeting may make up missed assignments/quizzes within the first two weeks of class.

Course Communications

Online communication, quizzes, and grading will be conducted through D2L and Slack. Course materials (video lectures, readings, homework assignments, and quizzes) will be available on D2L and the course GitHub site (<https://github.com/bhurwitz33/be434-spring-2023>). The GitHub privacy statement is located here: <https://help.github.com/articles/github-privacy-statement>. Slack (<https://slack.com/>) will be used for online class discussion forums, and each student will be invited to the slack channel at the beginning of the semester.

Required Texts or Readings

Tiny Python Projects (<http://tinypythonprojects.com/>), Ken Youens-Clark, Manning, 2020 All texts are available free of charge through the University of Arizona online catalog, required sections are listed on the course schedule in D2L.

Optional Texts or Readings

- The Python Quick Book (3rd ed), Manning, 2018.
- Beyond the Basic Stuff with Python, Sweigart, No Starch, 2021
- Mastering Python for Bioinformatics, Youens-Clark, O'Reilly, 2021
- Beginning Python, Hetland, Apress, 2017.
- Python for Data Analysis 2nd edition, O'Reilly, 2017.
- Additional required readings will be listed weekly on the course schedule and D2L.

Required or Special Materials

Students will be required to create a (free) account on GitHub to download and turn in assignments. Students must install Github Desktop (<https://desktop.github.com/>) on their laptops. Students must also install Python on their laptops for completing and turning in assignments. Students will also need to install Visual Studio Code (<https://code.visualstudio.com/>), an code editor. Information on accessing these resources and detailed installation instructions can be found under "Start here" in D2L. Detailed informaton on how to use and install all of these resources is available in the docs folder on the course Github site (<https://github.com/bhurwitz33/be434-spring-2023>) and via D2L.

Required Extracurricular, Activities

Optional software carpentry workshops and events related to Python data analytics will be announced in D2L.

Grading Scale and Policies

The final letter grades for the class are based on the TOTAL NUMBER OF POINTS that each student accumulates for the following assessments (see details for each section below):

Point Breakdown per Category:

| Category | # Assessments | Points per assessment | Points total |
|----------------|---------------|-----------------------|--------------|
| Homework (48%) | 12 | 40 | 480 |
| Quizzes (36%) | 12 | 30 | 360 |
| Project (16%) | 1 | 160 | 160 |
| Total | | | 1000 |

Grading Scale:

| Grade | A | B | C | D | F |
|--------|-------------|---------|---------|---------|---------------|
| Points | 900 or more | 800-899 | 700-799 | 600-699 | less than 600 |

University policy regarding grades and grading systems is available at <http://catalog.arizona.edu/policy/grades-and-grading-system>.

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at <http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete> and <http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal> respectively.

Dispute of Grade Policy: Disputes on a grade for an assignment, quiz, or exam must be made within three days of when the grade is posted.

Weekly Learning Modules

Each week's learning module consists of: reading assignments, instructional videos, a practice quiz, and a homework assignment. All homework assignments are on the course GitHub site <https://github.com/bhurwitz33/be434-spring-2023> and linked in D2L. All readings, videos, and quizzes are on D2L.

Homework

The homework provides you with practice in scripting and analytics. Homework is turned in by committing your code to your GitHub repository that is shared with the instructor. Each week's homework is due that on Sunday at 11:59pm that week. On the following Monday, the instructor will download your code from GitHub. Your grade will be based on the percentage of tests you pass in the provided test suite. We encourage group work (via Slack) but be sure the code you turn in has been independently written (see Code of Academic Integrity below).

Quizzes

Each week, you will be tested on the videos and reading for that week (see the schedule) through a Practice Quiz on D2L. Students can take the quiz as many times as they would like to learn the material and improve their scores.

Final Project

At the end of the semester, each student will implement a program in Python via the class project that demonstrates the core programming concepts for the class. Students can select from several programming projects, wherein Graduate students will select from more difficult problems than Undergraduates. The final project should include documentation (a README), a program, a test suite, and any required input/data to run the program.

Scheduled Topics/Activities

Week 1: Course Introduction and Setup

Week 2: Writing your first python program

Week 3: Hello (Strings), HW1: 01_salutations, Practice Quiz 1

Week 4: Picnic (Lists), HW2: 02_sum, Practice Quiz 2

Week 5: Jump the Five (Dictionaries), HW3: 03_solfege, Practice Quiz 3

Week 6: Howler (Files), HW4: 04_cat, Practice Quiz 4

Week 7: Words Count (Files, algorithms), HW5: 05_proteins, Practice Quiz 5

Week 8: Apples and Bananas (Regular expressions, refactoring), HW6: 06_common, Practice Quiz 6

Week 9: Spring Break!

Week 10: Dial-a-Curse/Telephone/Ransom (Randomness), HW7: 07_iupac, Practice Quiz 7

Week 11: Bottles of Beer/Twelve Days of Christmas (Algorithms), HW8: 08_kmers, Practice Quiz 8

Week 12: WOD (Parsing CVS files), HW9: 09_fasta, Practice Quiz 9

Week 13: Password (Randomness), HW10: 10_conserved, Practice Quiz 10

Week 14: Tic-Tac-Toe (State), HW11: 11_run_length, Practice Quiz 11

Week 15: Tic-Tac-Toe (Types), HW12: 12_grep, Practice Quiz 12

Week 16–17 (4/24–5/3): Coding Projects

Honors Credit

Students wishing to contract this course for Honors Credit should email me to set up an appointment to discuss the terms of the contract. Typically undergraduate honors students implement a simplified project for the final project. Information on Honors Contracts can be found at <http://www.honors.arizona.edu/faculty-and-advisors/contracts>.

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.). Threatening Behavior Policy The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See <http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students>.

Accessibility and Accommodations

At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to

let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520) 621-3268 to explore reasonable accommodation.

If our class meets at a campus location: Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Code of Academic Integrity

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See <http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity>.

The University Libraries have some excellent tips for avoiding plagiarism, available at <http://new.library.arizona.edu/research/citing/plagiarism>. Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-harassment Policy

The University is committed to creating and maintaining an environment free of discrimination; see <http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy> Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Additional Resources for Students

UA Academic policies and procedures are available at <http://catalog.arizona.edu/policies> Student Assistance and Advocacy information is available at <http://deanofstudents.arizona.edu/student-assistance/students/student-assistance>

Confidentiality of Student Records

<http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa>

Subject to Change Statement

The information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.