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

Some experience programming Python is useful but not required.

Tools needed

An Apple or Windows computer. A free account on Replit. A free account on GitHub.

Instructor and Contact Information

- Instructor: Bonnie Hurwitz, Associate Professor, Biosystems Engineering
- Office: Bio5 Keating, Room 223
- E-mail: bhurwitz@arizona.edu
- Office Hours: 12:00 PM Friday on Zoom (https://arizona.zoom.us/my/bonniehurwitz)
- Course Website: https://github.com/hurwitzlab/be434-Spring2025

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/hurwitzlab/be434-Spring2025). Students are required to have their own

GitHub account and can sign up for a free account here: https://github.com/. 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. Replit will be used as the required coding platform and students can get a free account here: https://replit.com/signup

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 recommended readings will be listed on D2L.

Required or Special Materials

Students will be required to create a free account on GitHub to download and turn in assignments. Students will use Replit to write and test code (https://replit.com/signup), and then submit this code to GitHub for grading. Information on accessing these resources and detailed instructions are documented in week1 in 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 (52%)	13	40	520
Quizzes (36%)	12	30	360
Project (12%)	1	120	120
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 quiz, and a homework assignment. All practice exercises and homework assignments are on the course GitHub site https://github.com/hurwitzlab/be434-Spring2025 and linked in D2L. All readings, videos, and quizzes are on D2L.

Homework

The homework provides you with practice in scripting in Python. Homework is turned in by committing your code to your GitHub repository that is shared with the instructor. Each week's homework is assigned on Monday at 8:00am and due on Sunday at 11:59pm. 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 with each homework assignment. I encourage group work (via Slack) but be sure the code you turn in has been independently written (see Code of Academic Integrity below). In addition, code should not be written using generative AI resources like ChatGPT, however, you are welcome to use the limited AI recommendations in Replit for correct syntax.

Quizzes

Each week, you will be tested on the exercises, videos and reading for that week (see the schedule) through a Quiz on D2L. Students can take the quiz up to two times 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 progamming projects, wherein Graduate students will select from more difficult problems than Undergraduates.

Scheduled Topics/Activities

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Week 1    : Course Introduction and Setup, TPP: Getting Started

Week 2    : Writing your first python program, TPP: Ch1, HW0:
00_getting_started
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Week 3    : Hello (Strings), HW1: 01_howdy, Quiz 1, TPP: Ch2

Week 4    : Picnic (Lists), HW2: 02_divide, Quiz 2, TPP: Ch3

Week 5    : Jump the Five (Dictionaries), HW3: 03_dna, Quiz 3, TPP: Ch4

Week 6    : Howler (Files), HW4: 04_revc, Quiz 4, TPP: Ch5

Week 7    : Words Count (Files, algorithms), HW5: 05_gc, Quiz 5, TPP: Ch6

Week 8    : Apples and Bananas (Regular expressions, refactoring), HW6:
06_rna, Quiz 6, TPP: Ch8

Week 9    : Spring Break!

Week 10   : Dial-a-Curse/Telephone/Ransom (Randomness), HW7: 07_syndna,
Quiz 7, TPP: Ch9,10,12

Week 11   : Bottles of Beer/Twelve Days of Christmas (Algorithms), HW8:
08_common, Quiz 8, TPP: Ch11,13

Week 12   : WOD (Parsing CVS files), HW9: 09_blastomatic, Quiz 9, TPP:
Ch19

Week 13   : Password (Randomness), HW10: 10_conserved, Quiz 10, TPP: Ch20

Week 14   : Tic-Tac-Toe (State), HW11: 11_run_length, Quiz 11, TPP: Ch21

Week 15   : Tic-Tac-Toe (Types), HW12: 12_seqmagique, Quiz 12, TPP: Ch22

Week 16-17: Coding Projects

No Final!
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Honors Credit

Students wishing to use 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 an additional 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.

Statement on the use of Generative AI

In this course any and all uses of generative artificial intelligence (AI)/large language model tools such as ChatGPT, Dall-e, Google Bard, Microsoft Bing, etc. will be considered a violation of the Code of Academic Integrity, specifically the prohibition against submitting work that is not your own. This applies to all assessments in the course, including coding assignments, discussions, quizzes, and exercises. This course policy is driven by the learning goals and desired learning outcomes for the course (see above).

The following actions are prohibited:

- entering all or any part of an assignment statement or test questions as part of a prompt to a large language model AI tool;
- incorporating any part of an AI-written response in an assignment;
- using AI to summarize or contextualize reading assignments or source materials; and
- submitting your own work for this class to a large language model AI tool for iteration or improvement.

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.