Astronomy 98

Introduction to Python for Astronomers DeCal

Spring 2023

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Faculty Sponsor: Eugene Chiang

Time & Place: Mondays & Fridays 4PM - 5PM in 131 Campbell Hall

Office Hours: Megan Joseph: TBD
Charlie Tolley: TBD
Mahum Khan: TBD
Pranathi Kolla: TBD
Jonah Han: TBD

Course Number: 98

Units: 2 units, P/NP

Prerequisites: Physics 7A and Math 1B (or equivalent) recommended but not required

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Course Description

This course provides an introduction to the Python programming language with a focus on data analysis and research in astronomy, physics, and other sciences. Primary emphasis is placed on astronomy and physics in preparation for upper division laboratory courses and research. Students will be exposed to the command line, Git version control, and Python software development. More advanced skills, such as image manipulation and data analysis techniques may also be explored. This course also briefly covers the essentials of the typesetting system LaTeX which are often useful in academic settings.

The primary audience for this course are those who have no prior experience with programming. As such, if you are already well versed in software development, this may not be the class for you. However, in order to learn the wide variety of technical material we cover in the short amount of time we have, it will take time and practice. As a consequence, some—especially those new to programming—may find the workload heavier than most DeCals.

This is not intended to be an easy course. Learning to code is easier to some than it is to others. What you put in is what you will receive from the course. Facilitators and interns are always ready to help you succeed and be confident in the skills you will gain.

Learning Objectives

Students will be introduced to basic programming concepts with the goal of becoming comfortable and proficient using the Python programming language in research settings. Using Python, students will demonstrate understanding of software structure and control flow by creating a project of their choosing. Given a set of data, students will be able to manipulate, process, analyze, and create data visualizations using Python and associated libraries such as AstroPy, NumPy, and Matplotlib, etc. Additionally, students will be able to use LaTeX to typeset simple documents.

Materials

Students are expected to bring and use their own computers. If you are unable, please let us know and we can try to arrange accommodations. Additionally, there is an optional course text written by the previous facilitators, Imad Pasha and Christopher Agostino, available at prappleizer.github.io/textbook.pdf. While it covers the basic priniciples needed in Python, it also does not include the harder parts of the course.

Course Resources

Class related files and notifications will be posted on bCourses unless otherwise specified. Additionally, we will have an **EdStem** where you can ask questions and receive answers from both the course staff and your peers. We encourage you to use EdStem rather than email, as it allows us to provide a more expedient response, and may also benefit classmates with similar questions.

Course Expectations & Grading

Participation	10%
Homework	60%
Final Project	30%

A grade of 70% or above AND an attempt on the final project is required to pass the class.

Attendance

Class will meet twice a week, **Mondays and Fridays from 4:00 PM to 5:00 PM**. On Mondays and Fridays we will have lecture to introduce new material and have hands-on examples for you to learn through practice. There may be weeks where we finish the lectures on Mondays, in those cases we will provide workshops for you to work on Friday's class time.

If you are unable to attend lecture, you may watch the lecture from a previous semester. These videos are linked on the bCourses home page. While these are available to you, we highly recommend you attend lecture in person. You will earn the 10% participation grade by coming to class. Other forms of participation such as posting/answering questions on Ed could also contribute to the participation grade.

Homework

Homework will be assigned weekly covering the topics we discuss in lectures. Homework will be released on Friday after class and will be due before class (4pm) on the next Friday unless otherwise noted, so you will have a week to work on it. All homeworks are to be submitted on bCourses. It is highly recommended that you make an honest effort at the homework. We grade based on effort AND accuracy. This means that points are mainly taken off based on how much effort was put into the answer. For example, if you did not get the answer right but you were on the right track, we will give you most of the points. The homework is intended to solidify knowledge as this is a P/NP course. You are encouraged to work with other students, but everyone must submit their own individual work. Late homework will be accepted until three weeks after the homework was due.

Projects

There will only be one final project over the semester and it is intended for you to demonstrate your ability in understanding the class material. The final project is required to pass the course, and it will involve a brief presentation as well. Further information will be disseminated closer to when the project is assigned.

Academic Misconduct

As with all classes, cheating, plagiarism, and other forms of academic dishonesty will not be tolerated. First violations will result in a zero on the assignment, and any subsequent violations may result in administrative action in accordance with the UC Berkeley Astronomy Department Policy on Academic Misconduct.

Department Resources

- Diversity and Climate: astro.berkeley.edu/about/diversity-and-climate
- Reporting Harassment or Discrimination: astro.berkeley.edu/department-resources/reporting-harassment

- Astronomy Undergraduate Wiki: kartp.astro.berkeley.edu
- Undergraduate Climate Advisor: Rav Kaur, Cooper Jacobus (ravkaur@berkeley.edu , (cjacobus@berkeley.edu)
- Undergraduate Representative: Fira Fatmasiefa, Kingsley Ehrich (firafsiefa@*berkeley.edu*, kingsley.ehrich@berkeley.edu)
- Undergraduate Faculty Advisor: Professor Eugene Chiang (echiang@berkeley.edu, 317 Campbell Hall)
- Academic Advisor: Brianna Franklin (bfranklin@berkeley.edu, 501E Campbell Hall)

Schedule

Below is a schedule of class meetings along with a (tentative) curriculum.

First lecture starts on January 20th, 2023.

Week	Lecture	Lecture/Lab	Topics Resources
1		1/20	• Syllabus overview and logistics • Installing Python on Computer • Text editors, the command line
2	1/23	1/27	• Data types • Functions
3	1/30	2/3	• Conditional statement • While-loops and for-loops • Dictionaries • Recursion
4	2/6	2/10	• Data manipulation (e.g. NumPy)
5	2/13	2/17	• Plotting Fundamentals • Pandas • Review
6	2/20	2/24	• Advanced Plotting • Curve Fitting • Root Finding
7	2/27	3/3	• Numerical Differentiation • Numerical Integration • Differential Equations
8	3/6	3/10	• Astropy • LaTeX • Final project proposal
9	3/13	3/17	• Review • Google Colab/GitHub • Proposal Due
10	3/20	3/24	• Animation • Object Oriented Programming
11	3/27	3/31	• Spring Break
12	4/3	4/7	• Numerical Simulations & Video Games • CV Development Workshop
13	4/10	4/14	• Final Project Check-Ins
14	4/17	4/21	• Intro to Research Workshop • Introduction to Machine Learning
15	4/24	4/28	• Final project presentations