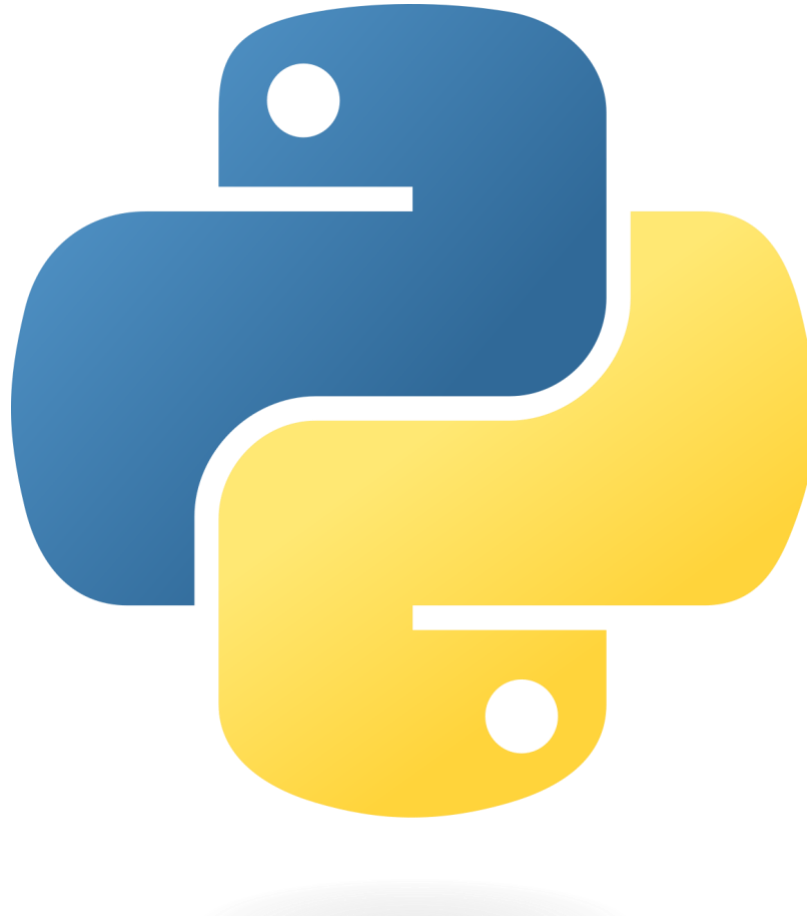


# Python for Scientific Data Analysis

**Note: SYLLABUS IS SUBJECT TO CHANGE!!!**



**Instructor:** Thayne Curries

**Department:** Physics and Astronomy

**Location:** Business Building, 3.03.20

**Modality:** In person, Tuesdays, Thursdays, 1pm-2:15pm

**Office Hours:** Tuesday – 2:45-3:45pm

**Email:** [thayne.currie@utsa.edu](mailto:thayne.currie@utsa.edu)

**Office Location:** AET 3.388

**Course Github Page:** [github.com/thaynecurrie/phys7903\\_fall2025](https://github.com/thaynecurrie/phys7903_fall2025)

# Course Syllabus Fall 2025

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# Course Syllabus – Fall 2025

## Public Health Considerations

The health and safety of our campus community is a shared responsibility of all Roadrunners. It is important to note that none of us can guarantee a COVID-19 free environment. We all must, however, follow the guidelines outlined in the [UTSA Public Health Task Force Report](#) (“Report”) and any other applicable policies as may be communicated by the University from time to time. This will include regulating behaviors outlined in the Report that mitigate risk, including:

- Encouraging the use [of face coverings](#),
- Self-monitoring for symptoms before coming to campus,
- [Getting tested](#) for COVID-19 if showing symptoms or after a close contact with a COVID-19 positive individual (if you are not already fully vaccinated and are not symptomatic),
- Following proper hygiene practices, including frequent hand sanitization, using cleansing wipes to disinfect surfaces, and minimizing the use of shared devices, tools and equipment,
- Avoid congregating (i.e. bottlenecking) near the entrances and exits before and after class – keeping your distance to reduce possible transmission from symptomatic or asymptomatic individuals.
- Communicating any COVID-19 related health concern to your supervisor or professor, and
- [Submitting a self-report](#) to report your positive test results or exposure (if not fully vaccinated and are also symptomatic for COVID-19 infection).

In turn, faculty members or supervisors will submit a COVID Case Referral to alert the COVID Response Team about positive COVID-19 cases for operational action. Failure to abide by these guidelines and requirements may result in disciplinary action in accordance with the [Student Code of Conduct](#) or applicable employment policies and procedures. Violations should be reported to the Office of Institutional Compliance via the [UTSA Hotline](#) for appropriate action.

**For Face-to-Face Classroom and Other Academic Sessions:** Face coverings/masks are recommended in indoor public and common spaces, especially for those individuals who are high risk and/or not vaccinated. **Due to my personal circumstances, I will strongly request students to wear masks during any in-person interactions (e.g. in-person office hours).** For the latest information, please review [the Roadrunner Roadmap](#).

## **COURSE DESCRIPTION**

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Phys 4953/7903. Data Analysis Methods in Physics and Astronomy: Python for Scientific Data Analysis. (3-0) 3 Credit Hours. This course focuses on data analysis methods useful for physics and astronomy research in the Python programming language. Course coverage is split between learning pure methods and widely-used Python packages.

**Credit hours: 3**

**Prerequisites/co-requisites:** Prior instructor approval and basic familiarity with the fundamentals of coding.

**Course Objectives:** At the end of the course students will:

1. Understand the basics of Python relevant to scientific research, including core syntax and data structures.
2. Understand core Scientific Python functions in the NumPy and SciPy packages, including array indexing and slicing, conditional statements, numerical linear algebra, and statistical tests
3. Master reading in and plotting/displaying scientific data with Matplotlib
4. Understand key functionality of the AstroPy and AstroQuery packages for professional astrophysics research
5. Understand key modeling techniques as coded in Python; understand the basics of concepts like Markov Chain Monte Carlo simulations and principal component analysis
6. Better write original Python code for scientific research incorporating concepts described in 1-6.

Time permitting, my goal also is to cover other topics.

**Course Format:** This course will be taught in person.

**In-Person Requirements:**

1. a laptop computer;
2. Python-3.8 or later installed on your laptop under the Anaconda Python distribution with the following packages installed: NumPy, SciPy, Matplotlib, Pandas, Seaborn, AstroPy, Astroquery, and other packages as announced. **DO NOT PROCRASTINATE WITH THIS INSTALLATION!**
3. Zoom installed on your laptop. My recommendation: create a separate Anaconda Python environment for this class to avoid clashes with your normal codes.

## COMMUNICATION PLAN

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1. **Email** - I respond best to email – [thayne.currie@utsa.edu](mailto:thayne.currie@utsa.edu) -- and will make every attempt to send you a reply within 24 hours (usually much faster).

If more than 24 hours has elapsed without a response, I likely never received your email: please resend. University policy requires me to communicate with you from your utsa email address.

2. **Office Hours** – Office Hours are Tuesday – 2:45-3:45pm

## INSTRUCTOR BIO

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**Thayne Currie:** I am happy to be your instructor. I earned my PhD from UCLA, doing most my thesis work at the Harvard-Smithsonian Center for Astrophysics. Prior to joining UTSA in August 2022, I was an astrophysicist at NASA Ames Research Center. I have a separate affiliated position with the Subaru Telescope on Maunakea in Hawai'i. My research focuses on studying extrasolar planets by direct imaging using Subaru and other optical/infrared telescopes on the Earth and in space.

Like many (all?) of you, Python is a second language for me: I started coding in Fortran (!!!) and for over a decade used IDL as my primary language before becoming bilingual in Python. However, I hope that this fact will be an advantage for the class: I still remember what it was like to learn Python, what made sense, what didn't, and how existing literature could be improved.

## COURSE MATERIALS

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### Required Textbook

There are no required textbooks for this course. However, my notes will draw heavily from a few sources. All of these are available on Amazon for reasonable prices: the third one has a free online version on Github. I would strongly suggest that you purchase at least one of these books:

- 1) *Python for Data Analysis*, 3<sup>rd</sup> edition (2022)– Wes McKinney [a good general overview]
- 2) *Scientific Computing with Python*, 2<sup>nd</sup> edition (2021) – Claus Fuhrer [can be rigorous]
- 3) *Python Data Science Handbook*, (2017) – Jake van der Plas [excellent in spots, online and free]

I am also evaluating other textbooks on statistics and linear algebra in Python. I may also recommend some of these.

## THIS COURSE ON CANVAS

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There should be a Canvas page for this course. As this is not a large class like AST 1013, I will try to rely on Canvas as little as possible: basically just to turn in assignments..

## ASSIGNMENTS AND ASSESSMENTS

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**Readings and Lectures** – Reading assignments are optional – as the lectures will cover this material – but they will likely be beneficial. I will try to provide lecture notes in PDF form before each class. Lectures may include files, separate Python

scripts/modules, etc. I will also try to provide these ahead of time.

My plan right now is to have class sessions consist of two blocks of lectures separated by a period where you have time to work on a subset of problems.

Your grade will be based on the following:

- **Homework Problem Sets** – The problems will be cover material discussed in lectures. Problem sets will usually be due the following Monday before class.

A completed assignment will consist of i) source code showing how you solved each problem, ii) the result (including any figures, output data, or printed statements), and iii) responses to questions (where applicable).

It is possible – though not guaranteed – that I will reserve some problems for graduate students only.

During each class, I will set aside time to work on a subset of homework problems. I will be available to help in case you get stuck on coding issues.

The required format for homework submissions will be Jupyter Notebooks or Python scripts (i.e. \*.py) with clear and easy instructions for execution. Unless otherwise specifically noted, Jupyter Notebooks are preferred.

- **Class Project** – You will devise and work on a focused Python coding project relevant to your own interests that goes beyond material covered in this class. This could be original code you write yourself or analysis of data with a sophisticated pipeline/analysis package not covered in the class. The subject matter will be approved by me. You are allowed to work in groups of up to 3 for this assignment, provided that each member directly contributes an equal amount to the project. (continued below ...)

Due at the end of the course, you will submit a write-up of your project: describing its motivation and coding skills tested and instructions for executing code to replicate your results. If you write original code, this code should be submitted; if you use existing code, you will be required to provide a copy/link to the source code. Whether you write original code or utilize existing code, you will be expected to explain what the code is doing at each step

### Working in Groups is Acceptable

You are encouraged to work in groups on problem set assignments and for your class project PROVIDED THAT the work you submit is your own. E.g. you write down your own answers to problem sets yourself: do not copy and paste others' work.

## GRADING INFORMATION

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Final grades will be based on earning the following percentage breakdown.

Activity	Percentage
Problem Sets	80%
Class Project	20%

### Grade Distribution and Letter Grade

Percentage	Grade
97-100%	A+
93-96%	A
90-92%	A-
87-89%	B+
83-86%	B
80-82%	B-
77-79%	C+
73-76%	C
70-72%	C-
67-69%	D+
63-66%	D
60-62%	D-
<60%	F

## ESSENTIAL STUDENT INFORMATION

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- **Important:** Bookmark and visit the [Common Syllabus Information webpage](#) to find important and valuable resources about counseling services, transitory/minor medical issues, supplemental instruction, tutoring services, academic success coaching, sexual harassment and sexual misconduct, campus safety and emergency preparedness, inclusivity statement, and the Roadrunner Creed.
- For technical requirements, support, and academic resources, visit the [Student Support Gateway](#), where you can find all your tech and academic support resources in one place.
- Follow [Online Learning Netiquette](#) standards for your online communication activities. Please be mindful of the communication tools available in your course and use them for learning purposes. Class discussions take place in a respectful

and safe environment, whether online or in person. UTSA encourages everyone to openly share their ideas and opinions without penalty or judgment, but learning should always be based on facts and research. It is possible to disagree without being disagreeable.

- UTSA provides reasonable accommodations to students via the [Student Disability Services](#). For more details on eligibility, policies, and requirements, please visit [www.utsa.edu/disability](http://www.utsa.edu/disability) or call (210) 458-4157.
- **UTSA Wellbeing Resources:** your wellbeing is a priority for us. UTSA is proud to partner with [Wellness 360](#) and [MySSP](#) to provide students with access to quality health and mental health care. Visit the [UTSA Students Wellbeing Resources](#) to explore the services available.

## My Statement on Academic Freedom

Academic freedom<sup>1</sup> is a cornerstone of the University. Academic freedom in its teaching aspect is fundamental for the protection of the rights of the teacher in teaching and of the student to freedom in learning<sup>2</sup>. Each faculty member is entitled to full freedom in the classroom discussing the subject that the faculty member teaches<sup>3</sup>. The University of Texas at San Antonio will not penalize or discipline members of the faculty because of their exercise of academic freedom.

Along with this freedom comes responsibility. It is the responsibility of faculty members to ensure that topics taught are related to the classroom subject. Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled<sup>4</sup>. It is not the proper role of the university or any outside agency to attempt to shield individuals from ideas and opinions they find unwelcome, disagreeable, or even deeply offensive<sup>5</sup>. Engaging with new ideas and perspectives helps students grow intellectually and is beneficial to the educational process.

1. Statement adapted from Texas A&M University's Syllabus Statement Regarding Academic Freedom
2. 1940 Statement of Principles on Academic Freedom and Tenure
3. Board of Regents Rule 31004; HOP Policy 4.02
4. American Association of University Professors Joint Statement on Rights and Freedoms of Students
5. The Chicago Statement



## COURSE MANAGEMENT AND POLICIES

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**Student Code of Conduct and Scholastic Dishonesty/Copyright and Fair Use** The Student Code of Conduct is Section B of the Appendices in the Student Information Bulletin. Scholastic Dishonesty is listed in the Student Code of Conduct (Sec. B of the Appendices) under [Sec. 203](#). It is important to understand the issue of intellectual property rights. You may not use the images or thoughts of others for profit or gain without their written permission. The UTSA library has a [Copyright Laws and Public Performance Rights](#) (PPR) page.

**Clarification of the above for this class:** For this class, the following will also be considered as examples of academic dishonesty: using AI to write code, copy and pasting code from fellow classmates.

### **Students with Disabilities**

The University of Texas at San Antonio, in compliance with the Americans with Disabilities Act and Section 504 of the Rehabilitation Act, provides “reasonable accommodations” to students with disabilities. Only those students who have officially registered with Student Disability Services and requested accommodations for this course will be eligible for disability accommodations. Instructors at UTSA must be provided official notification of accommodation through Student Disability Services. Information regarding diagnostic criteria and policies for obtaining disability-based academic accommodations can be found at [www.utsa.edu/disability](http://www.utsa.edu/disability) or by calling Student Disability Services at (210) 458-4157. Accommodations are not retroactive.

### **Family Educational Rights and Privacy Act (FERPA)**

FERPA grants students the right to control certain disclosures of their educational records. For a full explanation of your rights and to grant access to FERPA educational records, go to [Student Catalog Annual FERPA Letter](#) and [One Stop Enrollment – FERPA Proxy Access](#). Without your consent or authorization of proxy access, UTSA may release [Directory Information](#), such as but not limited to your name, email, phone, place of birth, and photograph, unless you have opted out of the release of Directory Information. To opt out, go to [Restrict Directory Information Form](#). **Mandatory Reporting of Sexual Misconduct and Reporting of Health and Safety Information:** If a student discloses an incident of sexual misconduct to any UTSA employee (other than to a designated confidential employee such as mental health counselor or PEACE advocate, a UTSA police officer using a pseudonym form or at a public awareness event), that information is not confidential, and the UTSA employee must report all known information to the UTSA Office of Equal Opportunity Services. Employees may also report any concerns about the health and safety of students or others to other school officials and/or law enforcement. For a complete list of exceptions to FERPA, please see [Student Catalog Annual FERPA Letter](#) and [HOP 5.01](#).

### **Video and audio recording**

As the instructor of this course, I may record meetings and lessons. You are expected to follow appropriate University policies and maintain the security of passwords used to

access recorded lectures. Recordings may not be published, reproduced, or shared with those not in the class without consent. If the instructor or a UTSA office plans any other uses for the recordings, consent of the students identifiable in the recordings is required before such use unless an exception is allowed by law. For more information on your privacy and class recordings, review [Student Privacy \(FERPA\) in Virtual Classrooms and Other Educational Recordings](#) and the [Guide to Secure Video Conferencing Tools](#).

### **Firearm Exclusion Zone Notice**

I invoke my right to designate my office as an exclusion zone. Pursuant to HOP 9.48, Carrying of Concealed Handguns on Campus, my private office, AET 3.338, is a designated exclusion zone. As set out in Section 30.06, Penal Code (trespass by license holder with a concealed handgun), a person licensed to carry a Concealed Handgun under Subchapter H, Chapter 411 Government Code (handgun licensing law), may not enter this property/office with a concealed handgun. De conformidad con HOP 9.48, Llevar Armas de Fuego Encubiertas en el Campus, mi oficina privada, AET 3.338, es una zona designada de exclusin. Conforme a la seccin 30.06 del cdigo penal (trespasar portando armas de fuego) personas con licencia bajo del sub-capitulo H, capitulo 411, codigo de gobierno (ley de portar armas), no deben entrar a esta propiedad portando un arma de fuego.

**NOTE:** The syllabus is subject to change at the instructor's discretion. Any changes/corrections to the course materials, assignment dates, or other updates will be communicated to the students ahead of time on a best effort basis.

## **PROVISIONAL COURSE SCHEDULE (HIGHLY SUBJECT TO CHANGE!!!!!!)**

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Below is a rough outline of the course. I have the details defined for the first several weeks. The rest will be filled in later.

### **Week 1: August 26-28**

**T** - Setting up Anaconda, Course Overview; Crash course in Python (printing);  
Basic Python: reading/writing/prompting

Notes: Basic, Pt. 1--2

Reading: Ch2 - McKinney, Ch2 - Fuhrer

Homework#1: Python interests survey

**R - Basic Python:** Functions, If-Then Statements; For-Loops; Attributes, Finding, Replacing, Sorting

Notes: Basic, Pt. 2-6

Reading: Ch2 - McKinney, Ch3 - Fuhrer

Homework#2: Basics 1-6

## **Week 2: September 2-4**

**T - Data Structures:** Lists, Tuples, Arrays, and Dictionaries; Slicing; Comprehensions; Sequence Functions, and Lambda Functions

Notes: Basic, Pt. 5—6 (if needed), Data Structures: 1-3

Reading: Ch 3, Ch 4.1- McKinney; Ch 3; 4.1, 4.3 - Fuhrer

Homework#2: Data Structures 1-3

Homework #1 Due

**R – Data Structures; Numpy - Numpy Arrays**

Notes: Data Structures 3; NumPy: 1

Reading: Ch 4.1, 4.3 - McKinney

Homework#2: Data Structures 1-3

## **Week 3: September 9-11**

**T – NumPy - Array Arithmetic and Universal Functions  
Slicing & Reshaping**

Notes: NumPy: 1-3

Reading: Ch 4.3, Appendix A2 – McKinney; Ch 4.6, 4.7, 4.8 - Fuhrer

Homework#3: NumPy 1-3

Homework #2 Due

**R – More Array Operations, and Broadcasting**

Notes: NumPy: 3-4

Reading: Appendix A2, A3 – McKinney; Ch 4.7, 4.8 - Fuhrer

Homework#3: NumPy 4

## **Week 4: September 16-18**

**T – Numpy/SciPy Basic Linear Algebra, Solving Linear Equations**

Notes: NumPy: 5

Reading: Ch 4.6 - McKinney; Ch 4.1.3, 4.2, 4.9 - Fuhrer

Homework#4: NumPy: 4-5

Homework #3 Due

**R – Numpy/Advanced linear algebra: singular value decomposition**

Notes: NumPy: 5-7;

Reading: Ch 4.6 - McKinney; Ch 4.2, 4.9 - Fuhrer

Homework #4: NumPy 6-7

## **Week 5: September 23-25**

**T – Numpy/Advanced linear algebra: PCA**

**R – PCA applications; SciPy/optimization**

Notes: NumPy: 8,9; Intro SciPy 1,2,3

Reading: van der Plas/Ch 5-09

Homework#4: NumPy 8-9

## **Week 6: September 30-October 2**

**T – SciPy/optimization, root finding, minimization**

Homework #4 Due

**R – SciPy/ minimization, interpolation; statistics**

Notes: SciPy 1--3

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework#5: SciPy 1,2,3

## **Week 7: October 7-9**

**T** – SciPy statistics

**R** – SciPy statistics

Notes: SciPy 3

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework #5: SciPy 3

## **Week 8: October 14-16**

**T** – Matplotlib – Basics

Homework #5 Due

**R** – Matplotlib – Simple Plot Customization

Notes: Matplotlib 1a,1b

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework #6: Matplotlib 1

## **Week 9: October 21-23**

**T** - Matplotlib - Subplots and axes configurations

**R** – Matplotlib - Subplots and axes configurations

Notes: Matplotlib 2a,2b

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework 6: Matplotlib 2

## **Week 10: October 28-30**

**T** – Matplotlib 2c - subplots and axes configurations

Homework #6 Due

**R** – Matplotlib 3 – shadings, histograms, and contour plots

Notes: Matplotlib 2c, 3

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework 7: Matplotlib 2

## **Week 11: November 4-6**

**T** – Matplotlib 3

Homework #7 Due

**R** – Matplotlib 4 (likely remote)

Notes: Matplotlib 4, AstroPy 1

Reading: vander Plas 4.00-4.10; McKinney, Ch 9; Fuhrer, Ch 6

Homework 8: Matplotlib 2--4

## **Week 12: November 11-13**

**T** - AstroPy 1 (possibly remote)

Homework #8 Due

**R** – AstroPy 1,2,3

## **Week 13: November 18-20**

**T** – AstroPy 3, 4

Homework #9 Due

**R** – AstroPy 5, 6/ Markov-Chain Monte Carlo Methods/Bayesian Inference

### **Week 14: November 25-27**

**T** – Markov-Chain Monte Carlo Methods

**R** - No class

### **Week 15: December 2-4**

**T** – Markov-Chain Monte Carlo Methods/Bayesian Inference

**R** – Markov-Chain Monte Carlo Methods/Bayesian Inference

Homework #10 Due

**Hand in Projects**