

## **AST 376R – A Practical introduction to Research Methods**

Fall 2023 – Unique No. 48365

TTh 2:00 PM – 3:30 PM



**Instructor:** Prof. Danielle A. Berg

**Email:** [daberg@austin.utexas.edu](mailto:daberg@austin.utexas.edu)

**Student Help Hour:** W 11:00 AM – 12:00 PM

**Location:** PMA 17.220

**Teaching Assistant:** Malia Kao

**Email:** [mlkao@utexas.edu](mailto:mlkao@utexas.edu)

**Student Help Hour:** TBD

## **COURSE DETAILS**

**Summary:** Astronomy 376R is a course intended to prepare you to perform astronomy research. We will work with astronomy data, databases, and tools. The class is oriented around practical exercises including the analysis of imaging and spectral data, data visualization, Python programming, statistical analyses, reading, writing, and presenting papers, and oral presentations.

**Prerequisites:** Mathematics 305G or the equivalent is required. An introductory astronomy course is highly recommended. Prior computing experience is recommended but not required. This course may be counted toward the quantitative reasoning flag requirement and/or toward the independent inquiry flag requirement: be prepared to carry out simple calculations and think independently!

This course is restricted to science and engineering majors. See the "Memo for Undergraduate Astronomy Students Regarding Astronomy Courses":

<http://www.as.utexas.edu/astronomy/education/memo.html>.

**Course Meetings:** We will be meeting in person Tuesdays and Thursdays 2:00 PM – 3:30 PM in PMA 15.201.

**Course Webpage:** Your main source of information will be the course webpage on Canvas. This is where you will find announcements, homework and reading assignments, grades, deadlines, be able to ask questions, and more. It is your responsibility to check the Canvas course page on a regular basis. Please come to class prepared, having done the assigned pre-class readings and assignments, and be ready to participate in discussions and activities.

**Course Materials:** In this class we will use both textbook and software digital content. To get started, you will need:

**1. Textbooks:**

1. *Beginners Guide to Working with Astronomical Data* (BG)  
by Marcus Possel
2. *Astronomy*  
by Franknoi, Morrison & Wolff.

All readings, resources and data used in this class are publicly available and free to access. The references listed above are available for you to download from Canvas. *Astronomy* is an introductory astronomy textbook. It covers a wide variety of material and is intended as a general resource (other introductory textbooks are fine too).

2. **Software:** You will need a variety of `Python` packages and software installed on your computer to do the in class activities and homeworks. All necessary software will be readily available on the classroom computers. If you wish to use your laptop, you are responsible for determining how to install the necessary tools

**Lecture Notes:** All lecture pdfs (and notes) will be available to you after class via the Files tab on the left-hand side of our class Canvas page.

## COURSE DESCRIPTION

This course is intended to provide you with the research and professional development skills necessary to jump into STEM research projects, especially astronomy. This may include individual research projects in astronomy, research projects across departments in the College of Natural Sciences (CNS), the CNS Freshman Research Initiative (FRI), and external summer Research Experiences for Undergraduates (REU)s funded by the National Science Foundation (NSF), the Department of Defense, NASA, and other agencies/institutions across the country. The skills and research experience acquired in this class will also be useful for graduate school and jobs in industry, national laboratories, observatories, space science centers, etc.

**Course Objectives:** By the end of this course, you should successfully be able to:

### **Navigate the Research Landscape:**

- Explain the different **types of research**
- Know the components of the **scientific method**
- Know where to apply for **research funding**
- Evaluate the **ethics** of research
- Determine which **STEM careers** interest you

### **1. Operate your computer from the command line**

### **2. Effectively program in `Python` using Jupyter Notebooks**

- Perform basic functions
- Write your own functions

- Read and write files
- Plot research data
- Perform statistical analyses

### 3. Communicate science effectively:

- Perform literature searches
- Make posters
- Give different types of talks
- Write papers in LaTeX

### 4. Establish yourself as a researcher

- Determine which projects interest you
- Organized your publications
- Create a CV
- Develop your brand

## COURSE STRUCTURE

Each week during our scheduled course times (T & Th 2:00 PM – 3:30 PM), there will be 2 x 90-min meetings that will include lectures, discussions, and group activities. You are expected to complete assigned readings and homeworks prior to class; they are designed to aid your comprehension and explore some of the course topics in greater depth. There will be no exams but there will be a midterm project and a final project.

**Course Communication:** Here are some guidelines to help make sure we keep up good communication and that our interactions are enjoyable during our in-person learning:

- **Questions:** I'm always happy to take questions during lectures; please raise your hand so that I can see that you have a question. For questions outside of class, please post to the Canvas discussion board for our class, discuss with classmates, visit the help hours, or email me or Malia.
- **Announcements:** I will make relevant announcements at the beginning of each class. I also reserve the right to email the class or post information

using the announcements page on Canvas. Please check your notifications settings in Canvas to ensure that you are receiving the email versions of those announcements frequently.

- **Environment & Etiquette:** I am committed to providing you with a friendly, productive, and effective learning environment. There are things that you can do to help with this:
  1. Make the class environment safe and respectful for all: employ language and conduct that is honest, civil, courteous, and responsible.
  2. Participate in class and assignments and work with whomever you are assigned.
  3. Show respect for the dignity and diversity of individuals, and work on building constructive relationships with instructors and your fellow peers.
  4. Refrain from behaviors that are sexually harassing, culturally insensitive, or interpersonally inappropriate.
  5. Respect the value of other individuals' time – show up to class and group meetings on time, turn in work on time, etc.
  6. Use professional language: use standard English, appropriate grammar, and critical thinking and analysis in your writing and verbal communications in order to demonstrate academic proficiency. Refrain from profanity and improper language by developing higher levels of language usage in order to better represent yourself. Refrain from malicious gossip, slander, or defamation of character against others, including faculty, staff, professionals in the academic and surrounding communities, and their fellow students.
  7. Use professional judgment: Learn and utilize decision-making and problem-solving skills that allow for self-monitoring and improved behavioral and emotional control. Refrain from loud, abusive, negative, demeaning, sarcastic, inappropriate, combative language in interpersonal interactions with others. Refrain from emotional outbursts that intimidate or endanger the welfare of others. Be aware of your own physical, mental, or emotional problems and seek assistance for problems that reach the level of impairment.

8. Practice professional behavior: Properly prepare for coursework, meet deadlines consistently, report to class on time, and remain for the entire class period, honor faculty requests for classroom decorum. Accept and use constructive feedback non-defensively and practice giving feedback that is thoughtful and constructive.

**Course Participation:** In-person class participation is required and is part of your grade.

## COURSE GRADING

Course grade will be evaluated on three components:

1. Homework – constitutes 50%.
2. Midterm project / Collaboration grade – constitutes 10 %.
3. In-class participation – constitutes 30%.
4. Final proposal – constitutes 10%.

**Grading Scale:** The grading scale is below. Note that this course will *not* be graded on a curve. Your grade is calculated to the nearest 1/100<sup>th</sup> of a percentage point.

<b>A:</b> 94.00 – 100%	<b>B-:</b> 79.00 – 82.99%	<b>D+:</b> 67.00 – 70.99%
<b>A-:</b> 91.00 – 93.99%	<b>C+:</b> 76.00 – 78.99%	<b>D:</b> 63.00 – 66.99%
<b>B+:</b> 87.00 – 90.99%	<b>C:</b> 73.00 – 75.99%	<b>D-:</b> 60.00 – 62.99%
<b>B:</b> 83.00 – 86.99%	<b>C-:</b> 70.00 – 72.99%	<b>F:</b> 0.00 – 59.99%

**Homework:** There will be regular readings and homework assignments (most weeks), which all together will make up **50%** of your grade. Homework must be handed in by the start (2:00 PM) of each class that they are due (see schedule below or on CANVAS). Homework solutions will be posted after class, so no late work will be accepted. To reiterate: Late homework will not be accepted.

**Exams:** There are no exams for this course.

**Midterm Project:** The midterm project is due **October 10th** and is worth **10%** of your grade. It will consist of making a research poster of a project of your choosing.

- Acceptable projects: Selected from the Project Descriptions sheet.
- Group size: Individual
- Format: Must use the poster format given in class.

**In-class Participation:** One of the primary goals of this class is to develop relevant skills for your future career, whether that be in academia, industry, outreach, etc., and this is best done by active practice. Therefore, you will earn your in-class participation grade through (1) your engagement in class discussions / activities and (2) your journal club presentations and your engagement during other presentations.

- **Journal Club Presentation:** Each student must give at least one journal club presentation throughout the course. You will choose a paper of interest and read it for scientific understanding (we will learn how to do this). You will then prepare a short (10-min) presentation of the primary points of the article. There will then be 5 min for questions, which will help you practice thinking and answering questions on your feet. This skill is critical for research and for any future presentations you give, no matter the venue.
  - Topic: You can choose any peer-reviewed astronomy publication that has not been presented previously. Note, however, that some articles are very long and difficult to present in just 10 minutes. For example, it is best not to choose an Annual Review article.
  - Length: You are responsible for preparing a 10-min presentation + 5-min for questions.
  - Level: Your presentation should be *teaching* the material to your peers. It is important to practice breaking down ideas and our presentation of them.

**Final Projects:** The final component of the class will be to perform a short research project and write it up as a research article. Articles will be due by the

**5 PM CT on Monday, Dec 4<sup>th</sup>** and is worth **10%** of your grade. You will present your findings in a short presentation during the last two days of class.

- Topic: Choose from the project list or propose your own.
- Group size: 1-2. Each student must turn in their own, individual paper.
- Format: Following the standard ApJ letter format.
- Evaluation: Your grade will be determined based on are three components:
  1. My assessment of your project – 50%
  2. My assessment of your paper – 40%
  3. Your participation on the presentations – attendance, questions, discussion – 10%

## **COURSE POLICIES**

**Communication Policy:** Please email me or visit me in my office at any time for questions or discussions of a personal nature. For questions about class content or logistics you **must** post the question to the canvas discussion board, ask others in your class, or ask me during student help hours. If your question is still unanswered, you may then email me.

**Homework:** No late or makeup work / projects will be accepted.

**Exceptions:** Late and makeup work will not be accepted. However, I understand that unpredictable life events happen, so exceptions may be made for special circumstances. If you are unable to submit homework on time or attend a class, you must contact me in advance of the due date for your exception to be considered. If you experience a personal or family emergency (death in the family, protracted sickness, serious mental health issues) that prevents you from attending class, you should contact me, your other professors, and the graduate advisor. If you need help finding additional resources, please do not hesitate to contact me.

**Accommodations for Religious/Cultural Holidays:** A student who is absent from a class for the observance of a religious/cultural holiday will be permitted to make



up the missed work, if notice is given at least fourteen days prior to such an absence.

**Accommodations for disabilities:** The university is committed to creating an accessible and inclusive learning environment consistent with university policy and federal and state law. Please let me know if you experience any barriers to learning so I can work with you to ensure you have equal opportunity to participate fully in this course. If you are a student with a disability, or think you may have a disability, and need accommodations please contact Disability and Access (D&A). Please refer to D&A's website for contact and more information: <http://diversity.utexas.edu/disability/>. If you are already registered with D&A , please deliver your Accommodation Letter to me as early as possible in the semester so we can discuss your approved accommodations and needs in this course.

**Zero-tolerance of harassment/assault:** Harassment of any sort will not be tolerated in this class or related workspaces. Title IX and Title VII makes clear that violence and harassment based on sex, gender, race, or national origin are Civil Rights violations subject to investigation and disciplinary action on behalf of the University. The same kinds of accountability and support will be applied to offenses against other categories such as sexual orientation and gender identity. If you or someone you know has been harassed or assaulted, either in the classroom or outside of the classroom space, you can find the appropriate resources through the University Title IX Coordinator (512-232-3992), UT Austin Campus Police (512-471-4441), the Student Ombuds Services (which can provide *confidential* advice, resources and help; 512-471-3825), and the UT Counseling and Mental Health Center (512-471-3515).

**Mental Health Services:** College is challenging and stressful; **Your first priority should be taking care of yourself and your own health, and those around you. If you experience diminished mental health, please seek help.** Diminished mental health, including significant stress, mood changes, excessive worry, or problems with eating and/or sleeping can interfere with optimal academic performance.

Similarly, problems with relationships, family worries, loss, or a personal struggle or crisis can also contribute to decreased academic performance. [UT Austin's Counseling and Mental Health Center](#) (512-471-3515) provides mental health services to support the academic success of students. This includes counseling services, wellness workshops, free and confidential therapy groups, and general information. I encourage you to browse their website and actively seek support if you're experiencing any of these difficulties.

**Expectations regarding mutual respect:** Astronomy belongs to all people, independent of race, religion, gender, gender identity, gender expression, or sexual orientation. Incidents of discrimination, assault, harassment, threats, intimidation, profiling, or coercion based on membership or perceived membership will not be tolerated. Show each other respect no matter perceived knowledge or performance in this class, or any other.

**Sharing of Course Materials is Prohibited:** No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials diminishes the ability of others to learn. It is a violation of the University's Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

# COURSE SCHEDULE

Month	Day /Class	Topic	Pre-Class Reading	Homework	
<b>Part I: Intro to Research</b>					
August	22nd (1)	Types of Research The Scientific Method Types of Astronomy Data Types of Tools Software / Languages	S1.1-1.4		
	24th (2)	Research Journey How to look up/cite papers	"Choose Your Own Adventure" "Astronomy Paper Seminar Guide"		
	29th (3)	How to read and present a paper		HW #1 Using ADS & arXiv	
	<b>Part II: Intro to Research Computers / Programming</b>				
	31st (4)	Intro to Linux/Mac OSX		HW #2 Reading a Scientific Article	
September	5th	Intro to Python #1	S5.1-5.3		
	7th	Intro to Python #2	S6.1-6.7	HW #3 Python #1	
	12th	Intro to Python #3	S7.1-7.7 S8.1-8.9		
	<b>Part III: Intro to Imaging</b>				
	14th	Astronomy Images DS9	S2.1-2.4 S3.1-3.8	HW #4 Python #2	

	19th	Guest Lecturer: Ryan Endsley		
	21st	Imaging w/Python	S10.1-10.3	HW #5 DS9
<b>Part IV: Intro to Poster Presentations</b>				
	26th	How to create a poster Creating a QR code		
	28th	Data Visualization	"The Science of Visual Data Communication"	
October	<b>Part V: Intro to Spectra</b>			
	3rd	Basic spectra w/Python		
	5th	Spectral Cubes QFITSVIEW		HW #6 Spectra
	<b>Part VI: Intro to Datasets and Tables</b>			
	10th			Midterm Posters
	12th			
	<b>Part VII: Intro to Simulations</b>			
	17th			HW #7 Datasets
	19th			
	<b>Part VIII: Intro to Proposals</b>			
	24th	Observing proposals		HW #8 Simulations
	26th	Computing proposals		
	<b>Part IX: Intro to Research Publications &amp; Talks</b>			

	31st	Presenting yourself: CV, website, personality		
November	2nd	Intro to Latex Citations / Bibliography	<a href="#">"Elements of Style"</a>	
	7th	Giving talks	"How to give a great talk"	HW #9 CV
	9th	Astronomy Career Panel		
	14th	In class work		
	16th	In class work		HW #10 Latex
	28th	Presentations		
	30th	Presentations		
December	4th	No Class		Final Projects: ApJ Letter

## TECH SUPPORT

### What to do if you have computer issues

1. If you need help with one of the computer lab computers, please contact the CNS IT Help Desk and email [help@cns.utexas.edu](mailto:help@cns.utexas.edu) with the subject line "AST 376R Help Request – Please Direct to Lucas Lane" and cc the Professor and the TA on the email. Use the template email below and fill in the info for your case. You should receive an email back from them fixing your account promptly. If you do not get a reply back within 24 hours, please let the Professor and TA know. Below is the template email:

From: xxxxxxx

To: [help@cns.utexas.edu](mailto:help@cns.utexas.edu)

Cc: [daberg@astro.utexas.edu](mailto:daberg@astro.utexas.edu), [mlkao@utexas.edu](mailto:mlkao@utexas.edu)

Subject: AST 376R Help Request –Please Direct to Lucas Lane

Hello,

I am a student in the AST 376R class (A Practical Introduction to Research) taught by Prof. Berg. I am having trouble with my MacBook Pro laptop, and need to resolve the issue as soon as possible in order to complete an assignment for the class. I cc Prof. Berg and the TA and request that they be cced on the reply from IT, if at all possible. Below is some diagnostic info:

- My name = xxxxxxxx
- My UT ID = xxxxxxxx
- I attach screenshot (you can use command+shift+3 to make screenshot)
- Description of issue: (fill in details of what you did, reference screenshot, include error message)

I would appreciate it if you could fix the problem promptly and email me back. Thank you, Sign your name and include your cell phone

## **GUIDELINES FOR USING ChatGPT RESPONSIBLY:**

Incorporating ChatGPT into your academic journey can offer valuable insights, but it's crucial to exercise caution and responsibility. While ChatGPT can assist in brainstorming, generating ideas, and clarifying concepts, it should not replace rigorous research and critical thinking. Keep the following in mind when utilizing ChatGPT:

**Supplementary Tool:** ChatGPT should be treated as a supplementary resource rather than a primary source of information. It can provide a starting point for exploration, but your academic work should rely on verified and credible sources.

**Limited Contextual Understanding:** ChatGPT might lack a full understanding of the context or nuances specific to your coursework. Its responses are based on patterns in data and might not encompass the complexity of certain topics.

**Fact-Checking:** Always fact-check information generated by ChatGPT before using it in assignments or discussions. Relying solely on its responses without verification could result in inaccuracies.

**Critical Assessment:** Exercise critical thinking when evaluating ChatGPT's suggestions. Consider multiple perspectives and engage in deeper analysis beyond the immediate responses.

**Academic Integrity:** Properly attribute any ideas or content derived from ChatGPT that you use in your work. Plagiarism and misrepresentation of sources violate academic integrity standards.

**Learning Opportunity:** Viewing ChatGPT as a learning tool rather than an oracle will enhance your understanding of AI's capabilities and limitations.

By adhering to these guidelines, you'll harness the benefits of ChatGPT while upholding the academic rigor and integrity expected in your college-level studies. (Generated by ChatGPT, of course)