Extragalactic Data Science

ASTR 343

Instructor Info

Prof. Karen Masters

Student Hours: find when I am free https://calbird.com/karen/1136

Observatory A or online

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Course Info

Prereq: ASTR204 or equiv.

Tue/Thu 1-2.30pm

TBD

Overview

Astro 343 is a 0.5 credit upper level astronomy/astrophysics elective, which can be taken in series with the other 0.5 credit upper level Astro elective offered this semester, or as a stand-alone course. We will cover the basics of modern extra-galactic science (a review of our knowledge of the Milky Way and external galaxies) alongside hands on projects involving data science/statistical techniques used to investigate them. Assessment will be highly project based, with regular coding assignments (in python) done during class time, and guided reading of both current, and classic astrophysical literature. Students will leave with an understanding of extragalactic astrophysics as a modern data focused science.

Material

Supplementary Texts:
Galaxies in the Universe, by Linda Sparke
There is no need to buy this book, but for students interested in further study/research in this topic area it will be a useful resource.

All required journal articles and other reading material/resources will be provided or linked to on Moodle.

Assessment in this Class

Each week we will do in class activities. You will also read a journal article on the weekly topic which we will discuss in class. You will turn in weekly reflections on the activity and the reading.

The final project should involve some data analysis on the topic (related to galaxies) of your choice. You will turn in a KNAC style report (5 pages including at least one figure you generate, an introduction, methods and conclusion.)

30%	Weekly Reflections
10%	In class presentation
10%	Participation
50%	Final Project

Honour Code

Collaboration is an important part of science. You are strongly encouraged to work together and/or consult one another for work in this class. You are encouraged to consult any books necessary as well as resources on the internet. You must, however, turn in your own individual homework, and this must be written on your own. Copying and pasting (even parts of sentences) is not permitted and is a violation of the Honour Code. Good collaboration involves everyone understanding what is going on in the assignments. Therefore even if the basic solution is shared you must explain it in your own words (including mathematical words). Please list any students that you collaborated with. Please pay attention to your classmates to make sure no one is being left out of collaborative work.

You may not obtain materials from students who have taken this course in previous years, nor may you distribute your current materials to students not currently enrolled in this class. Please consult me if you have any questions.

FAQs

Will I learn how to use a telescope in this class?

No. But we will use a lot of data from other telescopes.

What is astrophysics?

The use of physics to understand and learn about objects in the night sky. All areas of physics, as well as a lot of chemistry (and some biology) are important to the full understanding of astrophysical objects.

What's the difference between astronomy and astrophysics?

It's really just semantics in the modern useage. The most useful distinction is that there are lots of Amateur Astronomers (someone who as a hobby uses a telescope to view the skies), while it's much more unusual to be an Amateur Astrophysicist (someone who uses physics to interpret objects in the Universe). At Haverford the Astrophysics Major is basically the same as the Physics Major with an Astro emphasis, while the Astronomy Major has more astronomy and less core physics.

What is extragalactic data science?

Modern extragalactic research often uses large surveys which thousands, or millions of galaxies. So the field uses a lot of data science techniques, from statistics, to data visualization, and even machine learning.

Diversity and Inclusivity Statement

Our classroom should be a place where all members will be treated with respect. I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability - and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. If something was said in class (by anyone including myself) that made you feel uncomfortable, please talk to me about it (anonymous feedback is always an option). I appreciate any opportunity to continue my learning about diverse perspectives.

In an ideal world, science would be objective. However, science is done by people, and is historically built on a small subset of privileged voices. In this class, we will make an effort to read work from a diverse group of scientists, but limits still exist on this diversity. I believe that integrating a diverse set of experiences is important for a more comprehensive understanding of science. We may discuss issues of diversity in astrophysics as part of the course from time to time. Please contact me (in person or electronically) or submit anonymous feedback if you have any suggestions to improve the quality of the course materials.

Accommodation Statement

Your ability to thrive academically can be impacted by your personal well-being and a variety of stressors may impact you over the course of the semester. If the stressors are academic, I welcome the opportunity to discuss and address them with you in order to find solutions together. If you are experiencing challenges or questions related to emotional health, finances, physical health, relationships, learning strategies or differences, or other potential stressors, I hope you will consider reaching out to the many resources available on campus. These resources include CAPS (free and unlimited counseling is available) and many others. A full list can be found at https://www.haverford.edu/deans-office-student-life/offices-resources.

Haverford College is committed to creating a learning environment that meets the needs of its diverse student body and providing equal access to students with a disability. If you have (or may have) a learning difference or disability – including mental health, medical, or physical impairment – please contact the Office of Access and Disability Services at hc-ads@haverford.edu. The Director will confidentially discuss the process to establish reasonable accommodations. It is never too late.

Students who have already been approved to receive academic accommodations and want to use them in this course should share their accommodation letter, then meet with me as soon as possible to discuss how their accommodations can be implemented in this course. Please note that accommodations require advance notice in order to be successfully implement.

If, at any point in the semester, a disability or personal circumstances affect your learning in this course or if there are ways in which some aspect of the course could be adapted to facilitate full participation, please do not hesitate to reach out to me.

It is a state law in Pennsylvania that individuals must be given advance notice that they may be recorded. Therefore, any student who has a disability-related need to audio record this class must first be approved for this accommodation from the Director of Access and Disability Services and then must speak to me. Other class members need to be aware that this class may be recorded.

Class Schedule

Date	Topic/Plan	Activities/deadlines
Week 1 (Oct 26th, 28th)	The Milky Way as a galaxy	Getting started
Week 2 (Nov 2nd, 4th)	The Dynamics of galaxies	Gaia data project
Week 3 (No 9th, 11th)	Galaxies beyond the Milky Way	Sciserver Compute exercise to investigate colour-morphology
Week 4 (Nov 16th, 18th)	Scaling relations in galaxies	Fitting a line to data on luminosity-line width
Week 5 (Nov 23rd)	Measuring distances to galaxies	Presentations on a distance measurement
Week 6 (Nov 30th, Dec 2nd)	Black Holes in Galaxies	Images as data - how to overlay contours on images
Week 7 (Dec 7th, 9th)	Large scale structure	Measuring correlation functions
Dec 8th	Class Trip to UPenn to attend a Colloquium on galaxies	TBC
Finals (Dec 13-17th)	Final Project	