NAU NORTHERN ARIZONA UNIVERSITY

College of the Environment, Forestry, and Natural Sciences

AST 299 – Computing Analysis - Astronomy

Spring 2025

Course Information

- Location: Liberal Arts Rm 301
- Meeting time: M/W 12:45-2:00 pm
- Total Units of Course Credit: 3
- Prerequisites: none

Instructor Information

- Instructor: Prof. Jonathan Jackson
- Email: jonathan.jackson@nau.edu
- Office: Physical Sciences Rm 225A
- Student Hours: F 11am-12:30pm
- TA: Stefanie Storms
- TA Hours (Rm 218): T 3pm-4:30pm

Course Description

Computational analysis of data is one of the most fundamental skills necessary for modern research in any discipline of science. We will focus on astronomical examples in this class, but the techniques and methods covered will be broadly applicable to research science. The primary analysis platform used in this course will be Jupyter Notebook, which is a free open-source project that supports scientific computing over many programming languages. In this course, we will primarily use Python, which is an accessible computing language with an extensive suite of community-supported libraries, to work through tutorials, homework assignments, projects, and exams intended to prepare students to work in a research environment.

Student Learning Objectives

At the end of this course, students should be able to:
SLO1. Understand and use modules, data types, control flow, and functions in Python;
SLO2. Have familiarity with common astronomical packages such as astropy;
SLO3. Import and manipulate astronomical datasets;
SLO4. Perform scientific analysis of data at a level suitable for undergraduate research in astronomy and other related fields.

100% Career Ready

One of the primary goals of this course is to provide skills that are in-demand from STEM employees to help NAU CEFNS students pursue careers of confidence and lives or purpose. Below is a list of in-demand career-ready competencies (CRC) from the

National Association of Colleges and Employers (NACE) that students may be able to practice in this course:

CRC1. Career & Self-Development: Proactively develop oneself and one's career through continual personal and professional learning, awareness of one's strengths and weaknesses, navigation of career opportunities, and networking to build relationships within and without one's organization.
CRC2. Communication: Clearly and effectively exchange information, ideas, facts, and perspectives with persons inside and outside of an organization.
CRC3. Critical Thinking: Identify and respond to needs based upon an understanding of situational context and logical analysis of relevant information.
CRC4. Equity & Inclusion: Demonstrate the awareness, attitude, knowledge, and skills required to equitably engage and include people from different local and global cultures. Engage in anti-racist practices that actively challenge the systems, structures, and policies of racism.
CRC5. Leadership: Recognize and capitalize on personal and team strengths to achieve organizational goals.
CRC6. Professionalism: Knowing work environments differ greatly, understand and demonstrate effective work habits, and act in the interest of the larger community and workplace.
CRC7. Teamwork: Build and maintain collaborative relationships to work effectively toward common goals, while appreciating diverse viewpoints and shared responsibilities.
CRC8. Technology: Understand and leverage technologies ethically to enhance efficiencies, complete tasks, and accomplish goals.

The Career-Ready Competencies most directly covered in this class are: CRCs 1, 3, 7, and 8.

Textbook and Materials

There is no required textbook for this class, but *Python for Astronomers: An Introduction to Scientific Computing*, by Imad Pasha and Chris Agostino is recommended. It is available in PDF format for free online at: https://prappleizer.github.io/index.html.

Evaluation and Grading System

Students in this class will be assessed primarily through coding assignments completed in and outside of class. These will consist of four categories of assignments: (1) in-class tutorials, (2) homeworks, (3) exams, and (4) a final project. The tables below describe how each assignment will go into the grade book and the total points required to earn each letter grade:

Assessment	Points
In-class tutorials	150
Homeworks	180
Midterm Exam 1	40
Midterm Exam 2	40
Final Project	70
Total	**480**

Absences	Effect on grade
0 – 3	None
4 – 6	Lowered by 5%
7 or more	Lowered by 10%

Grade	Points
A	432 - 480
B	384 – 431
C	336 – 383
D	288 – 335
F	0 – 287

Attendance

- Science is a collaborative effort. We will emulate this process in our class through hands-on practice and group work. Moreover, the foundation for many of the skills we will develop throughout the semester will begin in class. For this reason, class attendance will contribute to your grade.
- If you need to miss a class, please reach out to Professor Jackson *in advance* so that an accommodation can be reached regarding any missed activities.

In-class Tutorials

- ~Once per week, we will complete a tutorial in class that will reinforce (or sometimes introduce) many of the topics we cover in class. These will be graded for completion. Note, however, that some portions may be difficult to complete without full comprehension of the material, so attending class and asking questions will be crucial for success.

Homeworks

- Homeworks will be completed in Jupyter Notebooks and will apply the material discussed in class to astronomical test cases. These will be submitted through Canvas and the lowest score from the semester will be dropped.
- **Late assignments will be accepted only with prior permission**. You may ask for a 2-extension with no questions asked! For longer extensions, please communicate the reason for the extension in your request.

Exams

- Exams will be similar to homework assignments (i.e., they will primarily be writing code), but will integrate several weeks of material into each assignment. The second exam will be cumulative, focusing on new material but building on material from the beginning of the semester.

Final Project

- More info coming soon!

University Policies

- **ACADEMIC INTEGRITY:** NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at https://www9.nau.edu/policies/Client/Details/1443?whoIsLooking=Students&pertainsTo=All
- **ARTIFICIAL INTELLIGENCE:** Artificial intelligence (AI) technologies bring both opportunities and challenges. Ensuring honesty in academic work creates a culture of integrity and expectations of ethical behavior. The use of these technologies can depend on the instructional setting, varying by faculty member, program, course, and assignment. Please refer to course policies, any additional course-specific guidelines in the syllabus, or communicate with the instructor to understand expectations. NAU recognizes the role that these technologies will play in the current and future careers of our graduates and expects students to practice responsible and ethical use of AI technologies to assist with learning within the confines of course policies.
- **COPYRIGHT INFRINGEMENT:** All lectures and course materials, including but not limited to exams, quizzes, study outlines, and similar materials are protected by copyright. These materials may not be shared, uploaded, distributed, reproduced, or publicly displayed without the express written permission of NAU. Sharing materials on websites such as Course Hero, Chegg, or related websites is considered copyright infringement subject to United States Copyright Law and a violation of NAU Student Code of Conduct. For additional information on ABOR policies relating to course materials, please refer to ABOR Policy 6-908 A(2)(5).
- **COURSE TIME COMMITMENT:** Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to

work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.

- **DISRUPTIVE BEHAVIOR:** Membership in NAU's academic community entails a special obligation to maintain class environments that are conductive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at https://nau.edu/university-policy-library/disruptive-behavior.
- **NONDISCRIMINATION AND ANTI-HARASSMENT:** NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, veteran status and genetic information. Certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual Relationships* policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti- Harassment* policy. To report a concern related to possible unlawful discrimination or harassment or to request a time to meet, please use the Report an Issue Form. To file a complaint, please submit the online Complaint Form. EAO also assists with religious accommodations. To request a religious accommodation, please use the Religious Accommodation Request Intake Form. EAO additionally provides access to lactation spaces, and please use to the Lactation Space Request Form to request use of a location. For additional information about nondiscrimination or anti-harassment, contact EAO at EquityandAccess@nau.edu, or visit the EAO website at https://nau.edu/equity-and-access. The EAO is located in Old Main on the first floor.
- **TITLE IX:** Title IX of the Education Amendments of 1972, as amended, protects individuals from discrimination based on sex in any educational program or activity operated by recipients of federal financial assistance. In accordance with Title IX, Northern Arizona University prohibits discrimination based on sex or gender in all its programs or activities. Sex discrimination includes sexual harassment, sexual assault, relationship violence, and stalking. NAU does not discriminate on the basis of sex in the education programs or activities that it operates, including in admission and employment. NAU is committed to providing an environment free from discrimination based on sex or gender and provides a number of supportive measures that assist students, faculty and staff employees, and covered guests. One may direct inquiries concerning the application of Title IX to either or both the university Title IX Coordinator or the U.S. Department of Education, Assistant Secretary, Office of Civil Rights. You may contact NAU's Title IX Coordinator at titleix@nau.edu or by phone at 928-523-5434 . In furtherance of its Title IX obligations, NAU promptly will

investigate or equitably resolve all reports of sex/gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. To submit a report, please use the File a Report Form. The Office for the Resolution of Sexual Misconduct (ORSM): Title IX Institutional Compliance, Prevention & Response addresses matters that fall under the university's Sexual Misconduct Policy. ORSM also facilitates reasonable modifications for pregnant or parenting individuals. Additional important information and related resources, including how to request help or confidential support following conduct covered by the Sexual Misconduct Policy, is available on the ORSM web site, and you also may contact the office at titleix@nau.edu. The ORSM is located in Gammage on the third floor.

- **ACCESSIBILITY:** Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), ,928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at https://nau.edu/disability-resources/student-eligibility-process or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.
- **RESPONSIBLE CONDUCT OF RESEARCH:** Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at https://nau.edu/research/compliance/research-integrity.
- **MISCONDUCT IN RESEARCH:** As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Scott Pryor, who can be reached at scott.pryor@nau.edu or 928-523-5927. More information about misconduct in research is available at https://nau.edu/university-policy-library/misconduct-in-research.
- **SENSITIVE COURSE MATERIALS:** University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies,

students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Tentative Course Schedule

Week	Dates	Topic	Assignment Due
1	1/13, 1/15	Syllabus overview, Unix Introduction	
2	1/22	Jupyter Introduction, Variables and data types, "Hello World!"	
3	1/27, 1/29	Array manipulation and NumPy	Homework 1
4	2/3, 2/5	Conditionals, Loops, Functions	Homework 2
5	2/10, 2/12	Commenting, Debugging	Homework 3
6	2/17, 2/19	Working with data, Plotting with Matplotlib and Seaborn	Homework 4
7	2/24, 2/26	Fitting, Handling uncertainty	**Midterm 1**
8	3/3, 3/5	Pandas, CSV, Excel	Homework 5
Spring Break – No Class			
9	3/17, 3/19	AstroPy, Image processing	Homework 6
10	3/24, 3/26	Database querying and creation	Homework 7
11	3/31, 4/2	LaTeX, Science writing and presentation	Homework 8
12	4/7, 4/9	Final project brainstorming/work time	**Midterm 2**
13	4/14, 4/16	Guest Lecture, Presentations	Homework 9
14	4/21, 4/23	Presentations	Homework 10
15	4/28, 4/30	Presentations	
16	5/7	**Exam Week - No Class**	**Final Project**