Syllabus PTYS595B – Spring 2025

Artificial Intelligence and Machine Learning Techniques in Planetary Science

Instructor: Michael Phillips
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Times and Location:

One 50 min Lecture per week: Wednesday 10am
Room 330 in Kuiper Space Sciences Building

I will be available for questions and discussions after lecture or by appointment. I have an open-door policy, but my availability isn't guaranteed without scheduling a time in advance.

Shane Byrne will be sitting in on most lectures and will be available throughout the class for additional assistance as needed.

Course Website:

Lectures and general information for the course will be posted on D2L at:
https://d2l.arizona.edu/d2l/home/1541342

A GitHub Repository with Jupyter Notebooks and other code for the class is here:
https://github.com/Michael-S-Phillips/PTYS_AI.git

Course Description:

This course will explore Artificial Intelligence and Machine Learning techniques for planetary science research. Designed for scientists and researchers, this course offers a practical introduction to AI/ML techniques applied to planetary data analysis. Students will learn to leverage neural networks and ML algorithms for tasks such as image processing, classification, curve fitting, and filtering. Additionally, we will cover the use of large language models in planetary research and software development tasks. Through hands-on projects and case studies, participants will gain experience using AI/ML tools to analyze and interpret data from planetary missions, enhancing their ability to conduct state of the art research in planetary science. No prior AI/ML experience required; basic programming skills and knowledge of Python are recommended.

Course Objectives:

Students will:

- Learn how to manage Python environments with Conda, use GitHub repositories, and run Python scripts and Jupyter Notebooks
- Learn basic machine learning and artificial intelligence methods applied with Python, including curve fitting, classification, image analysis and feature extraction, LLM-assisted coding, and more.

- Gain practical experience using real-world data and replicating results from peer-reviewed publications.

Expected Learning Outcomes:
Upon completion of this course students will have in hand a repository of coding examples and will be able to:

- Address scientific problems using AI/ML techniques
- Classify image datasets using Convolutional Neural Networks and Vision Transformer models
- Remove noise from data with ML techniques
- Apply curve fitting routines to non-linear datasets
- Augment their code writing with built-in LLM assistants
- Serve local LLMs for use in scientific analysis or other tasks

Course Credit:
There will be no final or mid-term exams in this course. Students earn credit for class participation and completing the assigned notebooks in class. You are encouraged to work together.

Prerequisites:
This class relies almost entirely on Python. While no background in Python is necessary for participation in the class, it would be valuable.

Accessibility and Accommodations:
At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu/) to establish reasonable accommodations.

Subject to Change Statement:
Information contained in the course syllabus (including this statement), other than the grade and absence policies, may be subject to change with advance notice, as deemed appropriate by the instructor.

University Policies:
Other University policies are listed at:
https://academicaffairs.arizona.edu/syllabus-policies

Draft Schedule
(Subject to change)

Index	Date	Wednesday 10am	Notes
0	15-Jan	Introduction	
1	22-Jan	LLMs (as coding assistants)	
2	29-Jan	LLMs (local serving)	
3	5-Feb	Curve fitting	
4	12-Feb	Curve fitting	
5	19-Feb	Classification	
6	26-Feb	Classification	
7	5-Mar	Image Classification (CNNs and ViTs)	
8	12-Mar	No Class	Spring Break and LPSC
9	19-Mar	Image Classification (Data Prep.)	
10	26-Mar	Image Classification (Transfer learning)	
11	2-Apr	Image Classification (Hyperparameters)	
12	9-Apr	Case Studies	
13	16-Apr	Case Studies and Practical Applications	
14	23-Apr	Practical Applications	
15	30-Apr	Working Session	
16	7-May	Flex day	