Teaching AI for Astronomy Research

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ABSTRACT

Experiences teaching two AI classes for advanced astronomy **undergraduates** are reported.

In the first example (ASTR320, Theoretical Astrophysics) students were programming problems using Claude, but the focus of the class was astrophysics.

In the second example (ASTR498, Special Problems in Astronomy) we take a different approach and let students learn to solve computing problems purely by prompting, no direct coding. Planning was a priority before coding could commence.

320: Course Philosophy and Methodology Summary

The course teaches students to use generative AI responsibly as a modern research tool in astronomy. AI is presented as the latest step in a long evolution of computational methods, but students are expected to treat it as an assistant — not an authority — by verifying outputs through physical reasoning, limiting cases, and independent checks.

The guiding principle is **“Don’t trust. Verify!”**

Methodologically, the class uses active learning with hands-on prompt writing, evaluation of AI outputs, and integration of astronomy archives, catalogs, and software tools. Students develop a small research project that documents AI use, validation steps, and scientific reasoning. Grading emphasizes participation, critical evaluation, and transparent research practices rather than novelty of results.

Take Aways

- Use AI as an assistant
- Plan the research before coding starts
- Take small steps
- Verify each step (i.e. come up with check points)
- AI should be introduced earlier in the undergraduate curriculum

An Astronomer with an LLM is way more powerful than an LLM

498 project-1: Mike

In this project Mike studied whether automated light-curve classifiers introduce a selection bias when their efficiency is not measured against relevant parameters, testing SN Ia classification on real and synthetic Rubin LSST data. At first, I let Claude take whole tasks and it worked to finish the project rather than teach me. I then limited it to small, bounded jobs and kept my own notes instead of project memory.

Lessons learned:

- **Cross-discipline integration.** Supernovae, LSST operations, classifier design, and statistics.
- **Speed and cost.** Months of coding become hours, at a fraction of a percent of a team's time.
- **Literature review**. Focused questions on the reading, and critiques of plans on request.

While learning how not to use AI:

- **Handing it whole tasks**. It completes the project rather than aiding the student.
- **Leaving project memory on**. Tangential facts become research priorities.
- **Trusting its focus.** It misleads less by false statements than by mistaken focus.

498 project-2: Ryan

In this project Ryan studied whether exoplanet transits could reveal atmospheric composition, using Claude Opus and Fable via Perplexity to speed up literature review, answer questions, and build code. At first, I let it run its own course with broad prompts and soon fell into the trap I had feared. I then broke the project into simpler parts and worked with Perplexity instead of handing it the work.

Lessons learned:

- **Sources**. Finding relevant research and sources.
- **Feedback**. Providing comments given sources.
- **Coding**. Much faster than human input.
- **Application**. Inspecting and recalling information for application.
- **Synthesis**. Condensing and aggregating sources and research.
- **Small steps**. Giving small, discrete steps to work with.

While learning how not to use AI:

- **Large, vague goals.** It becomes extraneous with its methods.
- **Full trust in its outputs.** They can be misguided or not relevant to your goals.
- **Letting it decide your knowledge.** It leads to actions or recommendations you cannot verify.

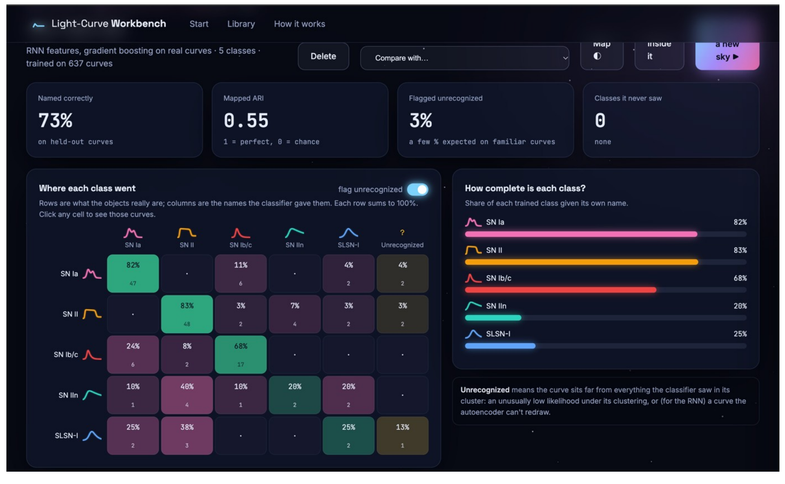


Figure 1: A workbench displaying a confusion matrix for a test of real ZTF curves against a real+simulated-trained classifier.

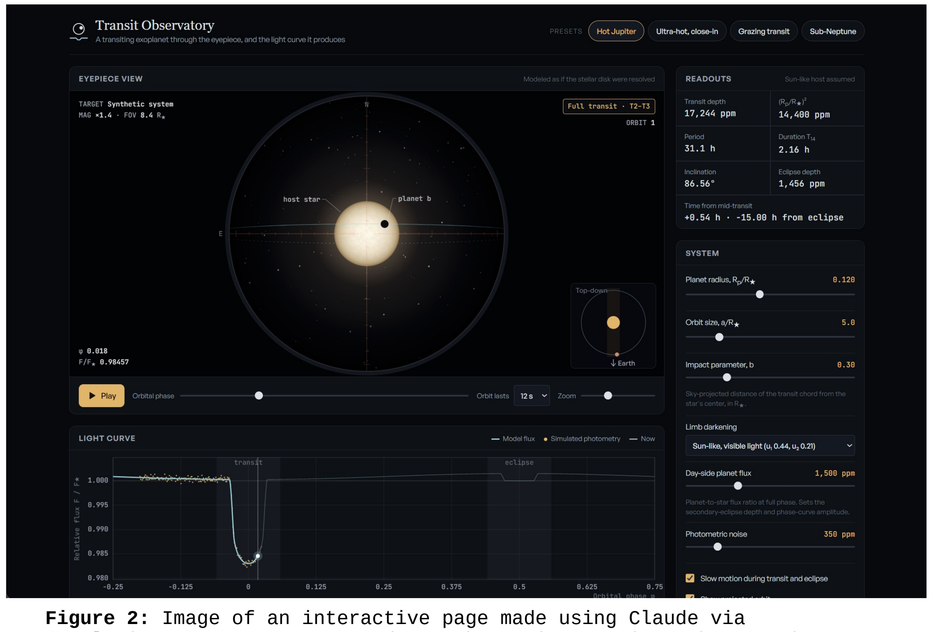


Figure 2: Image of an interactive page made using Claude via Perplexity AI. AI was prompted to make an interactive web page that gives a view and adjustable parameters to visualize exoplanet transits. No instructions on how to code or make the page were given.