UCF Physics: AST 5765/4762: (Advanced) Astronomical Data Analysis

Fall 2019 Final Project

Due Thursday 5 December 2019 13:00

Your final assignment is to analyze a dataset and report the results. Per the syllabus, 20% of the final grade in the course is based on the correctness and completeness of the result (also the presence of tests and sanity checks), 10% is based on the quality of the analysis (organization, separation of generic and project-specific code, sensible variable naming, etc.), and 10% is based on the quality of your written report, **including the derivation of the error expression**.

See `WebCourses/Files/data` for data and `WebCourses/Files/hw/projtran.pdf` or `.../projspec.pdf` for descriptions. The projects:

AST 5765: Radial velocity curve of a galaxy. This project uses long-slit optical spectra from the Palomar 5 meter telescope in California. The data provide spatially-resolved velocity information, from which you will derive a radial velocity curve. From your curve you will measure the dark-matter content of the galaxy.

AST 4762: Radius of an exoplanet. This project uses infrared photometry from the Spitzer Space Telescope. The data provide a time-dependent lightcurve, from which you will derive the event depth (fraction of star's light blocked by the planet). From the depth and some other factors, you will determine the radius of the planet.

Your analysis code should follow the same organization as the homework assignments. Project-specific items (names of files, values of parameters, etc.) should be separate from routines that implement general methods. Routines should be documented following the standard template. The file of project-specific routines should record in comments why you chose particular parameters or methods. Code should be indented and spaced for easy readability and variables should be sensibly named. Your code should save and/or print all plots, tables, and numbers that you will use in your report. Print step numbers and give a few words (and units, where applicable) to explain each printed item. If you use additional plots or tables to help you choose or verify methods and parameters, including those plots in your electronic output will help justify your choices. You can refer to these in your code comments where you make those choices.

Evaluation will begin by changing directories to your `project_<username>` directory and typing `./project_<username>.py > out 2>&1` . The *entire* analysis, including the creation of figures, must run to completion from this point. Be certain that you include under your project directory all the routines that it needs, as any personal Python directories will not be available to us. Test this by unsetting any Python path additions and running your file as a Unix program. It will be difficult to pass this assignment if the project file does not run to completion and produce the same plots as you included in your paper.

Some of the datasets are large and you may encounter problems with memory if you make many copies of the data in your Python session.

The final report should be a paper (PDF file only) in the format of the *Astrophysical Journal*. Examples and format guidelines can be found on the journal's web site. You may use any text formatter you like, but templates are available for the LaTeX document preparation system. Produce a PDF file of your paper and include it in your project directory. The paper should be as short as possible (probably $\sim$4–7 journal pages, which are much longer than normal typed pages). You must use formal English. Spelling, grammar, and punctuation all count, as does a clear and logical flow of information. Use the active voice where possible. We suggest the following sections (modify as appropriate for your case):

1. Title (usually generic, serious, not flashy)
2. Author, affiliation (you, University of Central Florida)
3. Abstract
4. Introduction, including at least one background fact with a reference to a paper in a reviewed journal (search on ADS and/or Simbad)
5. Observations (include a table that summarizes the data)
6. Data Analysis
   (a) Frame Corrections (include a figure with raw and processed data)
   (b) Measurement (name after actual measurement, e.g., "Photometry")
7. Results (tables and figures as needed)
8. Conclusions
9. References (at least 1 on topic, 1 for methods, follow *ApJ* style)

Unlike a regular research article, your paper must include a derivation of the expression(s) used to calculate the uncertainties you report. Be sure to derive a single expression that has your observables as variables, and then apply the error propagation equation to it.

You may create your paper using any word processor or typesetting language you like. Many journals prefer submissions in LaTeX format, which is good at typesetting mathematics, handling citations and cross-references, etc. There is a LaTeX template with the data, and good resources for learning online. However, LaTeX has a steep learning curve, so start early if you choose this route.

We encourage you to discuss your projects. However, you must obey the following rules: First, you may not discuss, compare, or allow others to see any of your numbers, plots, code, etc., nor may you use code written by anyone other than you, except for code distributed to the class by course staff or in standard Python packages. Discussions about what methods are appropriate or how best to implement them are acceptable. This is equivalent to the final exam for the course, so dishonesty carries a high price. We are putting a great deal of faith in your integrity by encouraging your interaction, so we hope you will honor these guidelines. One topic where essentially unlimited interaction is allowed/encouraged (including sharing code that does not include text to appear in the paper) is how to do things in LaTeX.

There will be time in class to discuss projects, as well as the usual office hours. Good luck, and we look forward to seeing your results!