Project for Scientific Computing Course.

The goal of this project is to learn how to read, plot and compare synthetic stellar spectra. Learning these skills will help with the broader project of understanding if the accretion of planets by host stars is detectable in spectra. There are four synthetic spectra attached as part of this project, though you will learn to compute your own later, and these spectra represent massive stars.

Each file contains a header with information about the model stellar atmosphere and then five columns: line number, wavelength (nm), the flux at that wavelength, the continuum flux at that wavelength, and the residual flux.

1) Using Python, you will write a code to read a spectra from a model spectra file and plot the spectra with wavelength on the x-axis and one of the spectra data (either column 3 or 5) along the y-axis.
2) You will learn to create those plots as an image (preferably a pdf file).
3) The next step is to begin to compare two different spectra. You will construct a program to read multiple synthetic spectra and plot them together on the same image, and to compute and plot the *difference* between two spectra as a function of wavelength. When you compute the differences you should be able to determine which absorption lines differ the most. This will require being able to compute the difference as well as tracking which lines have the greatest differences for specific wavelengths. When you determine which lines vary the most, you will identify which element or molecule that generates those spectral features.
4) Our theoretical synthetic stellar spectra are a good representation of a star, but real observations are noisy and have uncertainties. The next step is to include “noise” in the synthetic models and output observational-like synthetic spectra. To do this, you will read in a synthetic spectra, and compute a random error for each point, assuming some maximum error. You should research various techniques for adding random noise to a data set and develop a code for computing this.
5) (Extra) Once you have a code for adding random noise to the synthetic spectra, you will write a code to compare two noisy spectra and testing whether they are distinguishable based on statistical tests.
6) Beyond this work, you will learn to use the Atlas_ODF stellar atmospheres code suite and compute model stellar atmospheres and synthetic spectra for F stars that you will use as input for your codes.