ASTR 337: Homework 10

Due Date/Time: Beginning of class (7 pm), Wednesday, December 4th 2019

Group Component

1. *Compare your data reduction modules:*
   Compare your data reduction module with those of the other members of your group. Your filters may be different, but each of your approaches should contain the same general steps. What parts of your code are similar? Which are different? Are all necessary steps present? Is your code commented such that another student in the class could use it? If there are discrepancies, decide on the best path forward for a single data reduction approach for the project.
   (A good test could be to run one person's module on another person's data and see if they produce the same results by comparing reduced images in the same filter.)
   Describe the results of this investigation, and submit this write-up with your group's module.

2. *Align stacked images to each other:*
   With your final V, R, and I stacked images from each group member, (a) align all of the standard star images to each other, and then (b) align all of the cluster images to each other. This ensures that the same stars will be extracted/measured for photometry. It is **critically important** that the same stars fall onto the same pixel positions across all three B, V, and R bands. To do this, you may decide to use either your own centroiding code, or the cross-correlation code from Lab 6.

3. *Identify stars in cluster images:*
   Following the approaches in Lab 8 and 9, extract star positions for your reduced cluster images using at least two different values of `nsigma` in DAOStarFinder. Discuss the differences in your draft write-up and decide which value(s) might be appropriate to use.

4. *Extract photometry for standard star images and verify standard star:*
   Download DSS images of the standard star in iObserve to determine which star is the standard star in your images. Include screenshots of both DSS and Amherst images with labels identifying the standard. Then, extract star positions for the standard star images. (You may have to adjust the extraction parameters to ensure the standard star you want is identified in the source extraction!)

5. *Measure photometry of the standard star data and cluster data:*
   Following the approach in Lab 9, extract fluxes for the standard star and cluster images in all three bands, adjusting the aperture photometry parameters as necessary. Describe and justify the parameters you chose in each case. From the measured fluxes and errors, measure the instrumental magnitudes of the standard star and cluster stars, including errors.

6. *Determine zeropoints and calibrate cluster photometry:*
   Calculate the zeropoints in each filter from the photometry of the standard star, and apply the photometric calibration to your measured cluster star instrumental magnitudes. As in Lab 9, include the calibrated magnitudes and their errors as final columns in your photometry tables.

7. *Submit to Moodle as a single zipped file per group:*
   - ***a.*** A draft Introduction section of your final report draft (see project handout)
   - ***b.*** Updated Procedure section of final report draft:
     - ***i.*** Revise and improve your data reduction steps/calibration section, describing in detail why each step is necessary
     - ***ii.*** New section describing the flux calibration process and why it is necessary
     - ***iii.*** Results from nsigma cluster extraction approaches
     - ***iv.*** Screenshots of reduced standard star images and associated finding charts
     - ***v.*** Zeropoints for each of the three filters
   - ***c.*** Region files of extracted stars in the standard and cluster images
   - ***d.*** Tables of calibrated photometry values for the standard star images and cluster images, including values in all three bands (B, V, and R)
   - ***e.*** Your reduction/analysis modules and the Jupyter notebook used in the analysis thus far.

Individual Component - Reading Questions

Reading

- Read over the stellar cluster overview at https://www.e-education.psu.edu/astro801/content/l7_p6.html
- (PDF on Moodle) Sections 14.3 and 14.4 from Kaler, *Stars and Their Spectra*
- (PDF on Moodle) Section 13.3 from Carroll & Ostlie, *An Introduction to Modern Astrophysics*

Questions

1. What is an isochrone?
2. Describe qualitatively how the HR diagram changes with time.
3. What are the differences between evolutionary tracks and isochrones?
4. How can we measure the distance to a cluster without trigonometric parallax?
5. Describe three points from the reading that you found interesting.
6. Describe three points from the reading that you found unclear.