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

Fall 2019 Homework 11

Due Tuesday 19 November 2019

Work:
Become sufficiently familiar with aperture photometry to:

1. Measure the relative fluxes of stars in an image.

Resources:

1. Review SNR and aperture photometry sections of Howell. Think how they would be modified if you subtracted a background image first.

2. Optional, not needed for this assignment. Recommend you read this over the next few weeks. MCMC is becoming very common, and we will have a demo next week or so.
Hogg, D. W., and Forman-Mackey, D. 2019. Data Analysis Recipes: Using Markov Chain Monte Carlo. *The Astrophysical Journal Supplement Series* **236**, 1.
`https://doi.org/10.3847/1538-4365/aab76e`

Hand in:

This assignment concludes the measurement of stellar fluxes from the data in `WebCourses/Files/data/hw7`. Be careful to follow the instructions above the questions in HW7. Follow the convention that the center of a pixel has the integer position of the pixel and that the lower-left corner has position (-0.5, -0.5).

1. (10 points) Copy the routines and homework files from the previous homework (including any inclusions of prior assignments) into the directory for this assignment. Correct any errors you may have had, making a comment that says "`# FIXED:` " and giving the date. You may refer to the posted solution, but if you do so you must state what you used from it. The only non-comment for this problem should be the prior homework file run as a batch job (e.g., `from hw10_sol import *`). This will run all the homework files as batch files, each calling the prior one as its first thing, back to HW7. Of course, make sure they all still run without errors. It is a good idea to compare your results to those in the solutions.

2. (20 points) Write a routine called `apphot` that does aperture photometry as described in class:

   (a) Cut out a sub-image around the approximate center of a star. Be sure it is big enough to contain the sky annulus centered on the real center.

   (b) Use `disk` twice to make a mask for the sky annulus.

   (c) Calculate the average sky pixel in the annulus.

   (d) Subtract this value from each pixel in the sub-image.

(e) Use `disk` to make a mask for the photometry aperture.

(f) Calculate the total flux in the aperture.

(g) Return a tuple containing the stellar flux and the average sky.

3. (10 points) Test `apphot`. Make a noiseless array containing a 2D Gaussian of $\sigma = 2$ pixels at the center of a 21×21 image. Run `apphot` on it with a 6-pixel aperture and a 7–10 pixel sky annulus. Print the result. What should it be?

4. (10 points) Write a routine called `dophot` that accepts the table from HW10 and your 3D data array, runs `apphot` once per row of the table, and returns the table with the entries from `apphot` added. You will need to pass additional values (box size if you use one, aperture sizes, etc.) in order not to hard-code anything specific to the analysis.

5. (10 points) Run the `dophot` routine and print the resulting table to an ASCII text file, appropriately named.

6. (10 points) Include a copy of your class log file in your handin. Print the Git log for your main homework file.