Final Exam

The final exam is a take-home project (i.e. an expanded homework). It will *not* be assessed "objectively" using benchmarks, rather I will assess your code in each of the 5 usual categories (*accuracy, speed, compactness/optimization, structure, comments*) as outlined in the syllabus for homeworks. For the final exam, each category will be worth 35 points except for *accuracy*, which will be worth 60 points. So, take care when reading the project description below, and make sure that you provide code to conduct every calculation and produce every plot.

You are free to include FITS files[1] in your submission directory if it facilitates the running of your code. If you do store FITS files in Git to help your code run, make sure you include documented code in Git that you wrote to create the FITS files.

As usual, be sure to provide a README file documenting your final exam submission. For this assignment, please work on your own. Graded work in the repository is still fair game and I will answer questions related to clarity.

Project

Use the `Mangle` format to create a bright star mask for the Sloan Digital Sky Survey (SDSS). Obtain the positions of all the `PRIMARY` stars[2] in the sweeps that are in the Right Ascension and Declination ranges $10^h < \alpha < 14^h$ and $30^\circ < \delta < 60^\circ$ and that have magnitudes of $r_{observed} < 10$. The subscript "observed" means that the magnitude has *not* been corrected for extinction due to dust in our Galaxy. Create circular `Mangle` polygons that extend to a radius of $5''$ around each $r_{observed} < 10$ star and combine these polygons into a single mask. Write this mask out to your submission directory in a text file in `Mangle` format.

Determine how many $r_{true} < 19$ `PRIMARY` galaxies[3] in the sweeps lie in the bright star mask that you have created where the subscript "true" means that the magnitude *has* been corrected for extinction due to dust in our Galaxy[4]. Plot the $r_{true} < 19$ galaxy sample in Aitoff projection, highlighting the galaxies that lie in the bright star mask.

Calculate the *total area* that your bright star mask would remove from a sky survey. Demonstrate how the bright stars would therefore affect measurements of the number density of the $r_{true} < 19$ galaxies by calculating the number density of $r_{true} < 19$ galaxies using the entire $10^h < \alpha < 14^h$ and $30^\circ < \delta < 60^\circ$ region and using the $10^h < \alpha < 14^h$ and $30^\circ < \delta < 60^\circ$ region with areas (and galaxies) in the bright star mask removed.

[1] as always, files uploaded to Git should be small so make sure to trim any rec arrays to only the needed columns

[2] i.e. objects of type "star" that are point sources in SDSS imaging

[3] i.e. objects of type "galaxy" that are extended sources in SDSS imaging

[4] If you choose to store the $r_{true} < 19$ galaxies in a FITS file in Git, limit the file to no more than the `RA`, `DEC`, r-band `PSFFLUX` and r-band `EXTINCTION` columns to save space