Astronomy 320 Spring 2020
Homework #1
Due Sunday, 9 February 2020 at midnight

The Gaia database is publicly available online and contains a huge dataset of precision astrometry and parallaxes. In this assignment you will use the Gaia DR2 database to study stars in a nearby open cluster, the Pleiades.

A note on Python: I like to use Jupyter notebooks for my Python code, but you can use whatever flavor of Python you like to complete this assignment. You can also use another plotting package but Python has many packages that should make this assignment easier to complete.

1. Access the Gaia catalog online at https://gea.esac.esa.int/archive/. Query the database around the position of the Pleiades (you can look up the coordinates of the Pleiades in the SIMBAD database (http://simbad.harvard.edu/ or you can just tell Gaia to look up the coordinates in SIMBAD for you). Add an "extra condition" to select only stars brighter than G=13 mag (i.e. set phot_g_mean_mag <= 13) to limit the number of stars you are working with. I searched a region of radius 1 degree, in which Gaia found 489 stars brighter than G=13 mag. The default query settings produce a table that includes position, parallax, "G" band photometry (a special white light filter used only by Gaia), Gaia blue minus red photometry (BP-RP), radial velocities for the brightest stars, and errors on each of these quantities (we'll talk more about what these errors mean later in the course). The table also includes a photometric variability flag and a stellar temperature and extinction value if available; we won't use these data for now. Save the table in a convenient place.
2. Transform the positions (which are in decimal degrees) into a coordinate system that is more useful to an observer: Right Ascension and Declination in H:M:S D:M:S format. You can use a built-in Python task to do this or you can code the transformation equations yourself. Don't forget about the equinox!
3. Make a figure showing the position on the sky of stars in the region of the Pleiades. Color-code the stars by their distance. To do this, you will need to take the Gaia parallax and convert it to a distance in parsecs. Label your axes! Astronomers generally make these plots so that North is up and East is to the left (because we're looking up at the sky, E-W is reversed from a map of the Earth).
4. Use the Gaia G and BP-RP magnitudes to make a color-magnitude (observational Hertzsprung-Russell) diagram. Use G as the "magnitude" on the Y axis and BP-RP as the "color" on the X axis. Label your axes, and note that astronomers generally plot the Y axis in reverse numerical order so that brighter stars appear at the top of the diagram. Color-code the points by distance again in this diagram as you did previously.
5. Looking at your color-magnitude diagram, estimate the distance in parsecs to the Pleiades open cluster. Add a label to your figure indicating the distance to the cluster. You will notice that there are stars in your figure at other distances as well; think about where those stars are located and why they appear on your figure.

To turn in your assignment, create a github account at https://github.tamu.edu (you probably already have one associated with your NetID). In github, create a repo for ASTR320. We have created some instructions for how to do this here: https://github.tamu.edu/kstringer/astr320_example/blob/master/README.md (these instructions were made by a former TA for this course; you should share your files with our current TA Silvana Delgado). Make a directory called HW1. In this directory, upload your python notebook and your data table (i.e. the Gaia data with additional columns for your calculated RA, Dec, distance, and the B, V magnitudes) along with the two figures you made (of the positions of the stars and the color-magnitude diagram). Submit your homework (before midnight on Sunday for full credit) by sharing your github repository for this assignment with both me (https://github.tamu.edu/jlm076) and your TA Silvana Delgado (https://github.com/sdelgadoandr).