# Homework 1

This first assignment is meant to be a review of concepts from previous courses (primarily ASTR 322). We will be looking at Gaia observations and a theoretical model of the color-magnitude diagram (CMD) for the benchmark open cluster, M67, and making a few basic measurements.

1. Read the datafile from Table 3 of Gao (2018), which as been crossmatched to Gaia EDR3 via the CDS XMATCH tool. (`Gao2018_GaiaEDR3.csv`). Each row of this file corresponds to a real star from the Gaia EDR3 catalog, which Gao (2018) determined was a likely member of M67.

How many stars are included in this data?

2. Read the MIST Isochrone, which has been chosen to roughly corresponds to the published age and metallicity of M67 (`MIST_iso_61ca3125bac7d.iso.cmd`)

3. Plot the Gaia EDR3 color-magnitude diagram (CMD) for M67, using both the data from (1) and the model from (2). Use the BP-RP color (x-axis) and the apparent G-band magnitude (y-axis).

Remember which way the y-axis should be oriented! Label your axes correctly and clearly.

You will need to estimate the "distance modulus" to put the isochrone on top of the cluster data, or use information from the Gao (2018) crossmatch (e.g. the Gaia parallax…).

Label the M67 CMD w/ all major phases of stellar evolution, including:
- Main Sequence
- Turn off
- Blue stragglers
- Sub-giants
- Red giant branch
- Horizontal branch
- White dwarfs

4. Explain how you would answer these basic questions about M67, given such measurements and isochrone models:
   A. How old is this cluster?
   B. How far away is it?
   C. How massive is it? (If it's easier, you can consider just the main sequence stars here)

Estimate the value for each of these properties as well. (Note: we're not worried about super precise measurements here, well-explained order of magnitude estimates are OK!)

5. Above the main sequence is a smaller, parallel track of stars. What is it? How far above the main sequence is it (in magnitudes), and why?

Turn in your write-up, including the labeled plot, as a PDF. Remember to include an attribution for any group work! Also turn in your code or Jupyter Notebook used to solve the assignment. Use the Dropbox upload link. **DUE: Jan 10, 11PM PST**