MESA Rapid Problem #1

Let's make a typical carbon/oxygen core white dwarf. The simplest way to do this is to use one of the `test_suite` cases in `$MESA_DIR/star/test_suite/`: `make_co_wd`.

1. Either copy this entire directory to a new location and edit the new copy (so as not to mess up the test suite problem) or just edit the inlist in its original location. If you do the latter then subsequent MESA installations will overwrite your changes.

2. For now, the only changes we will make to the inlist file is setting `pgstar_flag=.true.` in the `&star_job` section, and changing the setting `log_L_lower_limit=-6` and `mesh_delta_coeff = 2.00` in the `&controls` section. This last change is simply to speed up the calculations.

3. Now run MESA. Almost immediately the star reaches the red giant branch. It will burn helium and then carbon. After a few minutes, it will begin to move to the left on the extended horizontal branch, heating up to over 100,000 K as it does so.

4. Let it continue in this phase until the temperature peaks and starts going down again. Note the peak temperature and stop MESA (`ctrl-C`). Now add the following line to the `&controls` section of `inlist_make_co_wd`: `Teff_upper_limit = your_temp`, where `your_temp` is the peak temperature you found (or *slightly* less than this temperature).

5. Now restart MESA (`re x???`), making sure that the model number you use still has a $T_{\rm eff}$ below the limit you have just set. The model will continue to contract and heat up rapidly, and when it reaches the given $T_{\rm eff}$ it will save a model called `wd1.mod`. We will use this model for calculations later in the long lab later today.

6. Comment out the $T_{\rm eff}$ limit line and set `log_L_lower_limit=-6`. Also comment out `save_model_filename = 'wd1.mod'` since we don't wish to overwrite this file when MESA exits the next time. Now Restart MESA with the `re x???` command and watch it go.

7. When MESA finishes, use your favorite graphing program to make a plot of the star's trip through the H-R diagram. Also try plotting log Age (yrs) versus log Luminosity for this model.

8. What was a) the maximum $T_{\rm eff}$ reached by your model, and b) what was its maximum age? c) What approximate fraction of its life did it spend on the white dwarf cooling track?