ASTR702 - HW6
October 9, 2024, Due October 18, 2024
2 pt each part

1) What is the maximum stellar mass? Compute the Eddington luminosity by assuming $\bar{\kappa} = \kappa_{\rm es}$ and $X = 0.7$, and use an appropriate mass-luminosity relation for high masses.

2) The maximum mass of a (non-rotating) white dwarf is 1.4 $M_\odot$.
a) How fast would it need to be rotating for the minimum mass to be 50% higher?
b) Assuming the Solar core is rotating at the same speed as the bulk of the Sun, what is the maximum mass for the white dwarf that will be formed from the Sun?

3) (10 pt) Compute the density profile for the $n = 0, 1, 1.5, 3$, and 5 polytropes. Although some of these can be solved analytically, you'll want to use the same computer code for all.

Start with the Lane-Emden equation. This is a second-order differential equation, but we can write second-order equations as two first-order equations, one of which is the derivative of the function that you are trying to solve. In other words, define a new function as the derivative $f(\xi) \equiv d\theta/d\xi$ and then solve for $df(\xi)/d\xi$. You can then compute $\theta(\xi)$ and $f(\xi)$ from the Euler method.

Please plot these density profiles on the same axes of ρ/ρ_c vs. ξ. Please turn in both the plot and the code.