Problem set 1: Python programming

Due Friday Jan. 18. Submit on Canvas, including commented .py or .ipynb code in addition to document showing code execution.

   1) Exercise 2.6 and 2.12 in Newman (see attached scans, in case you don't have book handy).

   2) Use the python package matplotlib.pyplot or pylab (the latter is used in Newman) to make a scatter plot of stars in HR diagram using the file stars.txt on the website `http://www-personal.umich.edu/~mejn/cp/programs.html`. The two columns in this file are the star's temperature in Kelvin and apparent magnitude (related to the radiation flux from each star). Make sure to label each axis and make the figure look professional. Find a way to (roughly) indicate where the stellar main sequence lies (how you do this is up to you), and the masses of main sequence stars. In particular, indicate which main sequence stars have mass $0.75 M_\odot$, $1 M_\odot$, and $1.5 M_\odot$ (Hint: you should search online [or beginning astronomy textbooks] for how to do this.)

Make sure all code is commented and clear. A significant fraction of grade will be on code clarity:

- variable names make logical sense (but they do not have to be overly descriptive). For the four quantities out put in Exercise 2.6b, a, b, T, e can be labeled a, b, T, e.

- that comments are provided for ease of reading ('#' in python starts a comment). However, comments should not overburden code with unnecessary description, so there is a balance. For example, this could be a line of your code for Exercise 2.6
  a = (l1 + l2)/2. # semi-major axis

- that the code structure is as simple as possible. There aren't unneeded loops; variables that appear but are unneeded in the calculation; circuitous ways of coding up an algorithm. (Note that you do not have to vectorize your Python [i.e. avoid loops in favor of linear algebra], which generally results in amazing speed improvements.)

   If you don't have experience with Python, work through Ch 2 in computational astrophysics in more detail then this assignment. Also, if you forget/don't know syntax needed to execute some command, google it. We will devote 30 min next Monday and Wednesday to programming in class.