Python 3: Plotting in Python
Due: November 2nd by 5pm

For the assignment below you will use the data file you generated from the last programming assignment (Python 2), as well as the original BrightStars.dat. You will need to read from both files to make the plots below. The IPython notebook on plotting will be very helpful. Note that it is possible to complete this assignment in IPython without writing a complete program, but you should write a program for practice.

Turn in to me: **one page** that contains the plots listed below. The plots should be in two columns and two rows. Plot 1 should be in the top left corner, plot 2 in the top right corner, plot 3 in the bottom left corner, and plot 4 in the bottom right corner. For each plot, type up a brief caption to explain what the plot shows; these can be on a separate page from the plots themselves. Please also email me the program you have written to create this plots.

1) RA vs Dec scatterplot of bright stars (in decimal degrees)

- Right Ascension should be on the horizontal axis.
- Declination should be on the vertical axis.
- Label both axes and include the units in parentheses.

2) A "color magnitude diagram" of the brightest stars (scatterplot)

- B-V color should be on the horizontal axis.
- Absolute magnitude should be on the vertical axis, but in reverse order so that brighter stars will be toward the top of the plot – meaning lower magnitudes at the top of the plot.
- Remove the edge color on the plotting symbols and change their size to 2.
- Label both axes.
- In your caption describe what the two main "clumps" in this plot are. Hint: Refer to the Hertzsprung-Russell diagram introduced in class.

3) Histogram of Star Distances

- The horizontal axis consists of bins of distances (in light years) in log space. Hint: you can do plt.hist(dist_lyr, bins=np.logspace(np.log10(dist_lyr.min()), np.log10(dist_lyr.max())) to get nicely formatted bins in log space on your x-axis.
- The vertical axis should be a fraction—i.e. the fraction of the total that is in that bin. Hint: use the "weights" argument.
- Label the axes.

4) Kepler's Third Law for the Galactic Center

- Use the semi-major axes of stars around the galactic center as your x-axis values: [4.95186221e+16, 1.47129169e+16, 3.95629182e+16, 3.43643449e+16, 2.60961919e+16, 2.70539822e+16]. This list is in cm.

- Use the periods of stars around the galactic center for your y-axis values: [94.1, 15.24, 67.2, 54.4,36, 38]. This list is in years, but you should plot in seconds.
- Make a log-log plot of these values with labeled axes.
- Write a function that uses Kepler's Third Law to return the orbital period in seconds. The function should take semi-major axis and mass as arguments.
- Plot Kepler's Third Law with an appropriate choice of M so that you get a line that falls on top of your data. You can start with M=1.99e+33 g (1 solar mass) to see what you get.
- Create a label for your plotted line that is the mass you have chosen, i.e. "M=1 solar mass," and display that label on your plot.
- Label the axes and include units.
- In your caption for this figure state what your value of M represents.