**Physics 488, Fall 2019, Project #2**
**Planets in Binary Star Systems**

A significant fraction of stars are in binary systems, and astronomers have begun to find exoplanets in binary star systems. It is natural to wonder whether such planets could be habitable. The answer is not obvious since there is no general solution to the gravitational 3-body problem.

A key dynamical questions is whether the planet's orbit is stable or quasi-stable such that the amount of light that it receives from the stars does not vary too much. Astronomers have identified two classes of promising orbits:

- An "S-type" orbit stays close to *one* of the stars. See `http://exoplanet.eu/planets_binary` for a list of planets on S-type orbits in binary systems.
- A "circumbinary" orbit goes around *both* stars. See `https://en.wikipedia.org/wiki/Circumbinary_planet` for a list of circumbinary planets.

Your goal here is to use numerical simulations to explore planetary orbits in binary systems. You should simulate some of the orbits from the lists above. You should then examine intermediate cases: for example, how large can an S-type orbit be and remain reasonably stable? How small can a circumbinary orbit be and remain reasonably stable?

You will need to make some choices, such as the specific masses and their separations, the softening length, the elapsed time and number of time steps, and perhaps more. At minimum, you should discuss the choices and explain why you think they are reasonable; ideally, you would also explore how those choices affect your results.

This is an aside, but `http://three-body.ipb.ac.rs` lists a bunch of cool equal-mass 3-body systems. I encourage you to explore these, partly to test your code, and partly to make some fun plots/animations.