Project 2: Differential Equations Project — Due 10/17/24

In this project you will calculate the time and trajectry for an object starting at earths orbital radius to orbit the Sun The force from the sun on the object is

$$md^2R/dt^2 = F = -GM_s m/R^2 \quad .$$

Take the initial position to be R_E from the Sun and the initial velocity v to be 33. km/s perpendicular to the direction to the sun.

Set up the to coupled first order equations and write a program to solve the differential equation as it orbits the sun. (Note: You should use 2 dimensions to get the orbit in a plane, so you will have 4 coupled differential equations.) You can use the RungaKutta program RungaKutta.solve, that we developed in class. You may want to vary the step size to see if you can improve your orbit. Plot the position vs time and estimate the farthest distance to the Sun.

- What is the closest and the furthest distance from the Sun for your orbit? (Is the closest Distance one of your points? Is the furthest?)
- How well does your orbit conserve energy? How well does it conserve Angular Momentum?
- Explore other orbits with initial velocities from 0 and 40 km/s. Do the 0 km/s, reproduce your integration time from Proj 1? Which orbits do you have the most difficulty conserving Energy?

$R_E = 1.5 \times 10^{11}$ m
$r_S = 7 \times 10^8$ m
$M_S = 2 \times 10^{30}$ kg
$G = 6.67 \times 10^{-11}$ N m^2/kg^2