Project 1: Integration Project Due 10/1/24
– Stephen Lepp

In this project you will calculate the time for an object starting at the velocity v_0, directed toward the sun, to fall to the surface of the sun(r_S).

An object starts at the earths radius, R_E, with an intial velocity v_0. We can calculate the velocity at any radius is given by energy conservation. The initial energy of the object is

$$E_0 = \frac{1}{2}mv_0^2 - \frac{GMm}{R_E}\,.$$

where G is the gravational constant, M is mass of sun, m in mass of object and R_E is radius of earths orbit. At later times energy conservation gives

$$\frac{1}{2}mv^2 - \frac{GMm}{R} = E_0\,.$$

which we can solve this for v to get a v as a function of r:

$$\frac{dr}{dt} = v(r)$$

or

$$\frac{dt}{dr} = \frac{1}{v(r)}$$

or

$$t = \int_{R_E}^{r_S} \frac{1}{v(r)} dR$$

write a program to evaluate this intergral and solve using out integration routines in class. Evaluate this integral for a $v_0 = 0m/s$, $v_0 = 10m/s$, and $v_0 = 1000m/s$.

Address the following questions in your report:
What trouble do you run into in trying to evaluate this intergral for $v_0 = 0$?
Our formulation of the problem assumed v_0 was directed toward the Sun, how would it change if it was directed away?
Using Newton's Laws, set up a differential equation for r(t) directly?

$R_E = 1.5 \times 10^{11}$ 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