

IAM 550, Fall 2019
Self test 03, 11/15/2019

Test your understanding of the lecture sand labs

The equations of motion of a mass around a heavy central mass M due to gravitation alone are given by Newton's second law and Newton's law of gravitation:

$$\frac{d^2 \vec{x}}{dt^2} = -\frac{GM\vec{x}}{(x^2 + y^2)^{3/2}}$$

Rewrite the second order differential equations as a system of first order differential equations (there should be 4 of them). Then write the MATLAB code for a RHS function like we did in class for the pendulum.

For added enjoyment you can plug this function into the predictor-corrector ODE solver we developed in class. If you set $G = M = x_0 = y_0 = 1$ the mass will make a nice ellipse. Plot x versus y to see this and make sure the axes have the same scale. Higher v_{y0} will make a more extended ellipse, and if v_{y0} is too large the mass will go on a hyperbolic trajectory and escape.