Homework Assignment 5

Due: Sunday October 18, 11:59 pm, UBlearns Digitial Dropbox

PHY 410: choose any two problems. **PHY 505: work all three problems**

1. Modify the program halley.cpp to measure the period of the orbit. Compare this with the prediction from Kepler's third law to determine the accuracy of the simulation, and hence determine the number of steps reuqired to achieve a given accuracy with the Euler and Euler-Cromer algorithms. Apply the more accurate algorithm to simulate the orbits of some of the comets in NASA's comet fact sheet.

   `http://www.physics.buffalo.edu/phy410-505/topic3/lec-3-1.pdf`

2. Choose a program whose accuracy you think you can trust and use it to explore changing the inverse square law of gravity to

$$F(r) = \frac{\text{constant}}{r^{\beta}} \ ,$$

   where β is some positive parameter. For example, you can choose initial conditions for $\beta = 2$ to give a perfectly circular orbit, or an eccentric Kepler ellipse. Then explore how the orbit changes when you start with same initial position and velocity, but change β to $2.1, 2.5, 3.0, \ldots$. Your classical mechanics textbook may suggest other interesting values of β to try.

   `http://www.physics.buffalo.edu/phy410-505/topic3/lec-3-2.pdf`

3. Modify the force function to include the effects of general relativity. Assuming that the Sun is a point mass, so mercury get arbitrarily close to its Schwarzschild radius, generate 3 different types of Schwarzschild orbits, choosing the ones you find most interesting from a relativity textbook or `http://en.wikipedia.org/wiki/Kepler_problem_in_general_relativity`.

   `http://www.physics.buffalo.edu/phy410-505/topic3/lec-3-3.pdf`