Physics Assignment 3

PHY410: Do problems 1 and 2
PHY 505: Do all three problems.

Accept the assignment from github classroom: https://classroom.github.com/a/zkYAai37. You will then get a link to your own github area.
You should submit your code through github classroom. Submit your writeup, and a link to your github classroom area where your code is, on UBLearns.

Problem 1

Compare the accuracies (how many digits are correct) and efficiencies (how many steps does it take to reach a given accuracy) of any two quadrature algorithms on the definite integral:

$$\int_0^1 \exp(3x)dx$$

And any two root-finding algorithms on the two functions

$$y(x) = \tan(x)$$

and

$$y(x) = \tanh(x).$$

Name your code “PhysicsAssignment3/Problem1.ipynb” (worth 5 points).

Problem 2

Using the tools from Lecture, study classical scattering from a hard sphere and from the Lennard-Jones potential. Plot typical trajectories, and compute and plot the differential scattering cross section for the hard-sphere and Lennard-Jones cases.

$$\frac{d\sigma}{d\Omega} = \frac{b}{\sin\theta_s}\left|\frac{d\theta_s}{db}\right|^{-1}$$

Do this for two or three different values of the energy that you find most interesting. Study the phenomenon of orbiting in the Lennard-Jones case: what is the maximum number of orbits you can generate by carefully tuning the energy and impact parameter?

Name your code “PhysicsAssignment3/Problem2.ipynb”. You should be able to modify the swig files to get the C++ code working within your notebook at this point! (worth 5 points).

Problem 3

Modify the scattering program to plot trajectories and differential cross sections for the screened Coulomb (aka Yukawa) potential

$$V(r) = V_0 \frac{e^{-r/r_0}}{r}$$

for various values of r_0. Compare your results in the limit of large r_0 with analytic formulas for Rutherford scattering derived in class.

Name your code “PhysicsAssignment3/Problem3.ipynb”. You should be able to modify the swig files to get the C++ code working within your notebook at this point! (worth 5 points).