Homework 2, PHY4410, Fall '19.
Due by 4:15pm Friday Sept 13

1. Change the binsearch.py file (at http://hedges.belmont.edu/~shawley/PHY4410/code/) to solve for lowest root of the polynomial f(x) = (x-4)*(x+2)*(x-10) using an initial bracket of x_lo = -5 and x_hi = 0. The exact solution should be x* = -2. Run it, and copy and paste the output from the script into an electronic document (e.g. Word) for which you will ultimately submit a PDF for this & other problems to Blackboard.

2. Similar to #1, use the newtons.py script in the same directory to solve for the same root as in #1. Use an initial guess of x = -4. Copy & paste the output. (Don't forget to update the derivative!)

3. Pendulum:
    a) Find Hamilton's equations of motion for a simple pendulum of length ℓ in a uniform gravitational field g, in terms of position θ (angle) and conjugate (angular) momentum p_θ.
    b) Write a finite-difference approximation to these equations, and solve for θ and p_θ at the 'advanced' time step, i.e. θ_{n+1} and $p_{\theta n+1}$.
    c) Write a Python program, called pendulum.py, which simulates the motion of the pendulum, and show different plots:
        i. an animation that shows the motion of the pendulum in normal x-y space
        ii. a plot which shows the path of the system in phase space

        Details: start the pendulum from rest, let $\ell = 1.0$ and $g = 9.8$, use a timestep of 0.01, and run for 100 time steps.
    d) Save the animation as a movie called "pendulum.mp4", and upload the movie to your phy4410/ directory on hedges, and upload your python source code there as well.