Computational-Physics

Homework for Week 5

Due on that midnight that falls between Sunday, 28 September and Monday, 29 September, 2003

1. Reproduce something like figure 3.7. To do so accurately with Euler-Cromer, if it is possible, may require a fairly long run with a very small time step. Whatever method is used, you'll need to suppress transients. I see two strategies. (a) If you choose to employ your pendulum function from last week, you'll need to write a subroutine poincare that takes the output of pendulum and picks out only those times that are multiples of the driving period. Since these times almost always fall between times sampled by pendulum, I found it helpful to write a short subroutine called interpolate that interpolates data between sampled points. (b) If you prefer, the Matlab adaptive ODE integrator ode113 or the Octave adaptive ODE integrator lsode will take a list of times, which you may set to be integer multiples of the period. This will give you practice using a black-box subroutine. In research, it would be important to understand and control the algorithm; both ode113 and (through lsode_options) lsode take a large number of options that change their behavior. Both would work badly if this were what's called a "stiff" problem, but it isn't.

2. The logistic map is a very simple model of chaos. Giordano’s problem 4 on page 60 finds a bifurcation diagram and estimates the Feigenbaum parameter for the logistic map. We'll do most of this in class in the second half of the week. This is a warm-up for problem 3.

3. See if you can reproduce the bifurcation diagram for the non-linear pendulum, figure 3.9. This is Giordano problem 1 on page 59.