

CS 346U: Exploring Complexity

Dynamics lab

Writeup due Monday, October 12, 2009

In this lab you will investigate the dynamics of the logistic map and, in particular, the degree of sensitive dependence on initial conditions at different values of the control parameter R . You will then extend your studies to the sine map.

1. Download “logistic.nlogo” from the class web page. Open it in the same directory in which you downloaded Netlogo.
2. Set the switch “plot x_0’?” to on, so you will have plots from two initial configurations.
3. For each of $R=3.6, 3.7, 3.8, 3.9, 4.0$ (five different values), create plots (x_t versus time) as follows:

set x_0 to .2

set x_0' to .20000001

click “setup”

repeatedly click “go” until you can see that the plots corresponding to the two initial conditions have clearly separated

Include each of these plots in your writeup.

4. For each of the five R values, record the time (number of times “go” pressed) at which the plots corresponding to the two initial conditions have clearly separated. Create a single graph that plots this value (“time to separation”) versus R for the five R values.
5. Make a copy of logistic.nlogo and rename it “sine.nlogo”. Modify the procedures so that the model implements the “sine map”, as discussed in class: $x_{t+1} = \frac{R}{4} \sin(\pi x_t)$, where x is between 0 and 1 and R is between 0 and 4. Redo steps 1–4 above using your sine map model.
6. For your writeup (to be done in Word or another word-processing program), include all your plots, each with captions saying what the plots are. At the end, write a paragraph summarizing your observations from your plots — that is, what happens to “sensitive dependence on initial conditions” as R is increased. Also include in your writeup your Netlogo code for the sine map model .