PHYS 305
Computational Physics II

Assignment # 1
Due: Friday, January 22, 2016

Purpose: Practice to write codes in *C* or *C++*.

In this assignment you will write a program to calculate the *bifurcation diagram* for the very simple *logistic map*,

$$x_{i+1} = ax_i(1.0 - x_i)$$

where a is a real constant and x the 1-dimension variable that is to be iterated via the map. This map is described in the course notes and numerous references found via Google.

Bifurcation diagrams describe the smooth changes in the map iterates as well as the suden ones induced by parameter changes. For example, a period-1 trajectory (x maps onto itself) could vary smoothly with a, until a sharp change occurs in the solution by which a period-2 occurs, the period-1 trajectory becoming unstable.

- Modify the code in the course notes, or write a new code from scratch, to generate the data for the graphic in x amd a, to pipe this data in gnuplot and to plot the final figure.
- The parameter a is scanned in a range [a1,a2] via an equally spaced grid.
- The 1-dimension domain for x is the interval $[x1, x2]$ in x. It can be proved that a trajectory that leaves this domain $[x1, x2]$ will eventually escape to infinity.
- The initial values of x should be generated from a uniformly distributed pseudo random sequence. Such random numbers sequences are generated via calls like

$$x[i + 1] = rand()/RAND\_MAX$$

- The iterates that stay bounded in x after THRESH iterations are counted via a histogram. The first THRESH iterate values are considered as part of a transient period and therefore not counted.

- The trajectories are counted via a histogram. That is, the x-domain is covered by xRES bins. Then you need to write a function BINx to find the bin corresponding to a given x value.

- Write a function *norm()* to normalize the bin contents, with the largest number being set to 1.0. This way of counting the iterates gives the density of iterates around the various bifurcations in $x - a$ space.

[***Constants]***

Use the following values for the constants: $a1 = 2.8$, $a2 = 4.0$, $aRES = 1000$, $x1 = 0.0$, $x2 = 1.0$, $xRES = 800$, $THRESH = 5600$, **and** $MAXITER = 2500$**.**

Note: *Submission of solution*

A single tar file per assignment should be submitted by each student. The syntax of the command is

$$tar - cvf directory.tar directory$$

It should be sent to *phys305@physics.drexel.edu* as an attachement to a mail message.

The tar file should expand into one directory, and possibly subdirectories of it, through the command

$$tar - xvf filename.tar$$

Makefile and script codes should be provided with the source codes so as to expand all source files, generate data and plot the results via simple commands.