

# Dynamical Systems

## Homework One

### Due January 10, 2013

Please do these before class on Thursday. We will begin class by presenting/discussing the results of these exercises.

1. Let  $g(x) = -\frac{1}{2}x + 4$ .
  - (a) Using a calculator, determine the first five iterates of  $x_0 = 0$
  - (b) Using a calculator, determine the first five iterates of  $x_0 = 10$
  - (c) Modify the python code that I sent you to produce a time series plot for the iterates of  $g(x)$ . Plot enough iterates so that the long-term behavior of the orbit is clear. Does the long-term behavior depend on the initial condition that you choose?
2. Consider the differential equation:<sup>1</sup>

$$y' = \frac{y^2 - 1}{t^2 + 2t}. \quad (1)$$

Which of the following three functions, if any, are solutions to Eq. (1)?

$$y_1 = 1 + t, \quad (2)$$

$$y_2 = 1 + 2t, \quad (3)$$

$$y_3 = 1. \quad (4)$$

3. Modify the python code that I sent you so that it generates iterates of the function  $f(x) = 3.2x(1 - x)$ . Experiment with different initial conditions between 0 and 1. What is the long-term behavior?
4. Programming challenge. Modify the code that I sent you so that it plots two itineraries (for two different initial conditions) on the same axes. Have the itineraries plot in different colors.

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<sup>1</sup>Based on an example from pp. 21–22, Blanchard, Devaney, and Hall. *Differential Equations* (2nd ed.), Brooks/Cole, 2002.