Homework #1
Nonlinear dynamics and chaos

1. (Strogatz 2.4)

   Use linearized stability, to classify the fixed points of the following systems. if linearized stability fails, use graphical/ geometric approach:

$$\dot{x} = 1 - e^{-x^2} \tag{1}$$
$$\dot{x} = ax - x^3 \text{for all possible values of } a \tag{2}$$
$$\dot{x} = x(1-x)(2-x) \tag{3}$$
$$\dot{x} = x^2(6-x) \tag{4}$$
$$\dot{x} = \ln x \tag{5}$$

2. Consider the quadratic map:

$$x_{n+1} = rx_n(1-x_n). \qquad x \in [0,1], \quad r \in \mathrm{R} \tag{6}$$

   (a) For which values of r is this a contracting (dissipative) map?

   (b) For these values, what is the asymptotic behavior for large n?

   (c) Find analytically and graphically the fixed points and their stability.

   (d) Using Matlab find, plot and describe the behavior for large n, for: $r =$ 0.4, 2., 2.9, 3.2, 2.8, 4. (Can use the sample Matlab program for the logistic map on the course home page for this purpose).