Math 100 — Assignment 12 (Matlab), due Nov. 15, 2012

You may again submit a diary file of your work session. However, if you write or use any M-files, please submit them as well so that I can reproduce your work.

1. Verify the change of orientation of the circular orbit problem, i.e., provide Matlab code that plots the orbit described by

$$\begin{aligned} y_1'(t) &= y_2(t), & y_1(0) &= 1 \\ y_2'(t) &= -y_1(t), & y_2(0) &= 0. \end{aligned}$$

2. Plot the spiral-shaped orbit, i.e.,

$$\begin{aligned} x'(t) &= -x(t) + y(t), & x(0) &= 1 \\ y'(t) &= -x(t) - y(t), & y(0) &= 1. \end{aligned}$$

3. Illustrate that the following orbit always acts as an attracting circular orbit.

$$\begin{aligned} x'(t) &= x(t) + y(t) - x^3(t) - x(t)y^2(t) \\ y'(t) &= -x(t) + y(t) - x^2(t)y(t) - y^3(t). \end{aligned}$$

   Use at least 5 different starting points, both inside and outside the circle.

4. Do Exercise 15.3 (Orbit generator) in *Experiments in* Matlab.

5. Use Matlab to show how the van der Pol oscillator

$$\begin{aligned} x'(t) &= v(t), & x(0) &= 2 \\ v'(t) &= \mu(1 - x(t)^2)v(t) - x(t), & v(0) &= 0 \end{aligned}$$

   behaves for the different damping constants $\mu = 0.01, 0.1, 1, 10, 100$.