Problem Set 5
Due: Fri Feb 27

Reading Assignment: Moler: Sections 1.1, 1.7, 11.2, 6.1, 6.2, 6.4, 3.1–3.5, 7.1, 7.2, 7.4, 7.8, 7.13

(1) For the linear problem $\frac{du}{dt} = au$, prove that the fourth-order Runge-Kutta method is in fact fourth-order accurate, using the definition of the local truncation error.

(2) Solve $\frac{du}{dt} = -u, \ u(t = 0) = 1$ using both the backward Euler and TR methods (use ivp1.m). Choose a timestep $\Delta t$ that illustrates L-stability of backward Euler and non-L-stability of TR—i.e., $u_{TR}$ should go negative. Plot the exact, backward Euler, and TR solutions for this timestep size.

(3) Modify LorenzEqs.m to solve the Shaw oscillator IVP

$$u' = 0.7v + 10u(0.1 - v^2)$$
$$v' = -u + 0.25 \sin(1.57w)$$
$$w' = 1$$

$u(0) = -0.73, \ v(0) = 0, \ w(0) = 0$ ($w$ is time $t$). Turn in plots of the solution and the attractor for $t_f = 100$.  
