Mathematics 1180
MATHEMATICS FOR LIFE SCIENTISTS
Computer Assignment IV
Due February 10, 2004

In class we developed the Fitzhugh-Nagumo equations that describe the transmembrane potential of a neuron and the generation of action potentials. The Fitzhugh-Nagamo equations are:

$$\frac{dv}{dt} = -v(v-a)(v-1) - w \tag{1}$$

$$\frac{dw}{dt} = .1(v - \gamma w) \tag{2}$$

We will explore these equations with DEplot as in the last lab.

- **1.** Set $a = 3$, $\gamma = 2.5$ Graph the phase portrait using DEtools. Draw the null-clines onto this graph. Also sketch the solution v(t) and w(t). Does this system recreate the action potential?

- **2.** Now increase γ to $\gamma = 10$ and repeat question 1. What happened? Why? Give both a mathematical and biological explanation.

- **3.** Now we will apply a current to the cell and make the sodium inactivation even slower. Thus our new system is:

$$\frac{dv}{dt} = -v * (v-a) * (v-1) - w + I_a \tag{3}$$

$$\frac{dw}{dt} = 0.01(v - \gamma w) \tag{4}$$

set $\gamma = 2$ and $I_a = .15$ and repeat the first question only now, let the system run for a longer time. What has happened?