Fall 2015 * Math 430 * Math 635 * Prof. Victor Matveev
Homework 8 * Due date: November 5

1. Consider the Morris-Lecar model (see the hand-out, lecture notes, and section 4.1), and assume that *I*=0. For each of the three sets of model parameters given in the hand-out, pick any *V*(0) above the threshold (assume *n*(0)=0), obtaining a single spike. Then, within the same figure, plot the following panels using command "subplot" (make a separate figure for each of the three parameter sets):

   - Phase plane with the nullclines, the flow field, and the single-spike trajectory
   - Plot of *V*(*t*) as a function of time, showing a single spike
   - Plot of $n(t)$ and $m(t) = m_\infty\left(V(t)\right)$ as functions of time
   - Plot of $I_{Ca}(t) = g_{Ca} m_\infty\left(V(t)\right)\left(V(t) - V_{Ca}\right)$ as a function of time
   - Plot of $I_K(t) = g_K n(t)\left(V(t) - V_K\right)$ as a function of time

   You can use any subplot layout that you like, but I recommend the following 3×2 layout:

```
subplot(3, 2, [3, 5]);    % Phase plane plot goes here
subplot(3, 2, 1);         % V(t) plot
subplot(3, 2, 2);         % m(t) and n(t) plot
subplot(3, 2, 4);         % ICa(t) plot
subplot(3, 2, 6);         % IK(t) plot
```

2. Determine which of the three parameter sets lead(s) to a more pronounced all-or-none threshold behavior.

3. Pick any one of three parameter sets. On the same figure panel, plot the equilibrium "I-V' curves for the leak, K^+ and the Ca^{2+} currents, which are steady state current vs. potential relationships given by $I_{Ca}(V) = g_{Ca} m_\infty\left(V\right)\left(V - V_{Ca}\right)$, $I_K(V) = g_K n_\infty\left(V\right)\left(V - V_K\right)$ and $I_L(V) = g_L\left(V - V_L\right)$. Finally, plot also the sum of all these ionic currents as a function of voltage, within the same panel.

4. For each of the three parameter sets, find the critical value of current producing a transition from rest to tonic spiking, with precision of two decimal digits. Make sure to keep a small step size *h* when you use the Euler method.