BEBI5009 Homework6
(Chapter 7 & 8)

Due 12/29/2016: before class (9:10am)

1. **7.8.5 The lac operon: effect of leak.**
Consider the model of the lac operon presented in Section 7.2.1, with parameter values as in Figure 7.7. The dose-response curve in Figure 7.7B indicates that the system shows little response to external lactose levels below 55 μM. Modify the model by adding a small 'leak' rate of transcription from the operon: add a constant term a0 to the mRNA production rate in equation (7.11). Set a0 = 0.01 molecules/min. Run simulations to determine how this change affects the triggering threshold. Explain your result in terms of the system behavior. How does the system behave when a0 = 0.1?

2. **8.6.2 Morris-Lecar model: refractory period.** Consider the Morris-Lecar model (equations (8.12) and (8.13)). Using the parameter values in Figure 8.6, simulate the system to steady state. Run a second simulation that starts at steady state, and introduces a ten millisecond (msec) pulse of Iapplied = 150 picoamperes/cm2, thus triggering an action potential. Next, augment your simulation by introducing a second, identical 10 milliseconds burst of Iapplied that begins 100 milliseconds after the end of the first pulse. Verify that this triggers a second action potential that is identical to the first. Next, explore what happens when less time elapses between the two triggering events. What is the response if the 10-msec pulses are separated by only 60 msec? 30 msec? For each case, plot the gating variable w(t) as well as the voltage V (t). Verify that even after the voltage has returned to near-rest levels, a second action potential cannot be triggered until the gating variable w(t) has returned to its resting value. Provide an interpretation of this behaviour.