Math 155. Homework 3. Section 1.9 and preview to Section 1.11.

Do the following problems from the Adler text:

1.9: 6, 25-26, 38-40, 50

Also do the following problems.

1. Three seals splash into their salt water pool at Sea World, spilling 20 gallons of water. Their pool usually holds 350 gallons of water. If one replaces the 20 gallons of water with pure water without adding salt, the concentration of salt will decrease.

(a) Fill in the four blank boxes below to model the situation above. Let s_t represent the concentration of salt in the pool after the seals have splashed t times, measured in mol/gal.

Step	Volume (gal)	Total Salt (mol)	Salt Concentration (mol/gal)
H_20 in pool before seals jump in	350	$350s_t$	s_t
Water lost	20	$20s_t$	s_t
H_20 in pool after seals jump in	330		s_t
Pure water replaced	20		0
H_20 in pool after adding pure water			

(b) Write the DTDS: $s_{t+1} =$

For problem 2, you will need a computer with the *Wolfram Mathematica Player* installed so that you can make use of Mathematica Demonstrations. Instructions for downloading the free Mathematica Player are at the course website under the "Study Resources" tab; `www.math.colostate.edu/~shipman/math155/Study-Resources.html`. The Mathematica Demonstrations, which plot iterations and cobweb diagrams of DTDS's as you actively change parameters, are also available at this site. The Mathematica Player is also installed on the computers on the first floor of the Morgan Library. To use the player in the Morgan Library, you just download any of the Mathematica Demonstrations, and then double click on the demonstration you have downloaded (no Mathematica Player icon appears in the library computers and Mathematica Player is not in the list of programs on those computers, but the player is installed!).

2. For this exercise, we will use the Wolfram Mathematica Player Demonstration for the Heart Model from the Study Resources page of the course website. Set the player for the parameters $\tau = 0.4$, $\alpha = 0.9$, $u = 16$, $V_c = 47$ and initial condition $V_0 = 3$.

(a) What is the long-term behavior of a heart under such conditions?

(b) Now decrease τ to 0.3. What long-term behavior do you observe?

(c) Now decrease τ to 0.2. What long-term behavior do you observe?

Here are some additional questions for you to mull over: (No need to give answers here).

(i) What is the biological interpretation of a decrease in τ?

(ii) Using the parameters $\tau = 0.2$, $\alpha = 0.9$, $V_c = 47$, can you find a value for u that makes the heart healthy?

(iii) A pacemaker monitors the heart to see if the heart beat is too slow. If the heart is beating too slowly, the pacemaker sends a signal to tell the heart to beat (i.e. sends a signal like the SA node sends to the AV node). What parameter or parameters in our model would be affected by a pacemaker?