CIS6930/4930 Intro to Computational Neuroscience Spring 2005
Home Work Assignment 4:
Due Tuesday 04/19/05 before class

This project is about constructing a Linear Time-Invariant system and another with a static non-lineartity and seeing how well you can learn these systems thru a simple gradient descent rule, given just the input and the output signal.

Begin by constructing an input signal $x(t)$ that is a gaussian white noise signal. You may want to check on the web as to how to construct such a signal.

Now consider the kernel $h(t) = A * e^{-t/\gamma}$. Choose values for A and γ. Produce the output $y(t) = \int_0^T x(t-\tau)h(\tau)d\tau$ for a large enough value of T.

1. (50 points) You are now set to learn this kernel. Hand the input and the output signal to a new program that attempts to learn the kernel $h(t)$ via a simple gradient descent rule. Quantify how well your program learns the kernel by plotting the square-error on the output signal as time progresses.

2. (50 points) Now assume that the output signal passes thru the static nonlinearity $\tilde{y}(t) = (y(t))^3$. Ask your program to learn a kernel for this pair of input and output, i.e., $x(t)$ and $\tilde{y}(t)$. Quantify how well your system performs on this case.