1. (12 Points) Consider the following variable in Matlab:

```
list=[12, -5, 8, 2, 13, -4, -3];
```

a) What does the following command output:

```
list(1:2:7)
```

b) What is a command (or set of commands) to determine the lowest value of the elements in `list`?

c) I have a 1000 element vector `fireRates` to capture the firing rates of a neuron, calculated every 100ms for 100 seconds.

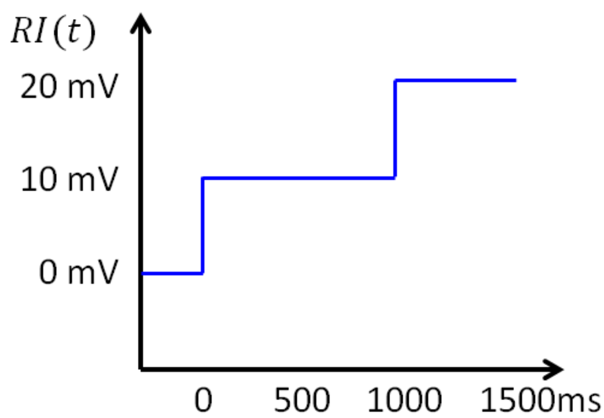
- What is the command to plot the firing rates for the neuron?

- How do we compute the average firing rate for the first second (the first 10 elements of `fireRates`, and place that result in a new variable `fireAve1`?

- Write a for loop to create `fireAveVec` so that `fireAveVec(1)` has the average rate for the 1st second, `fireAveVec(2)` has the average for the 2nd second, … `fireAveVec(100)` has the average for the 100th second?

Name

2. (6 Points) Assume we have a model neuron with v(0)=-65, E_L=-65, v_{reset}=-65, τ=0.01, and v_{thresh}=-50. We have the following input RI(t):

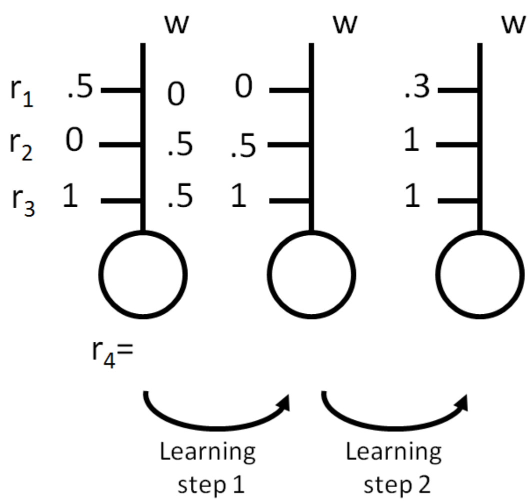


a) Draw the resulting v(t) shown below. (You can estimate RI(t) voltages to the nearest 5mV – if you think the input should plateau, to -42mV, you would label the input as -40mV.)

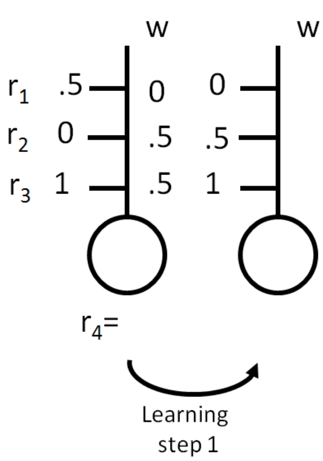
Name

9. (13 Points) We have a neuron, called neuron 4, that takes input from 3 pre-synaptic neurons. We define $h = \sum_j w_{4j} r_{4j}$ and establish the output of neuron 4, r_4 as simply h (the weighted sum).

a) Use the Hebbian learning rule *without normalization* discussed in class to determine the new weights and new outputs of neuron 4 after learning step 1 and learning step 2 below. Assume $\epsilon(w) = \begin{cases} .1 & w \geq 0 \\ -.1 & w < 0 \end{cases}$. (The inputs from each pre-synaptic neuron vary at each learning step, as depicted.)



b) Repeat learning step 1 using Hebbian learning **with normalization**. Again, assume $\epsilon(w) = \begin{cases} .1 & w \geq 0 \\ -.1 & w < 0 \end{cases}$



Name

5. (6 points) Presume we would like to model the axon voltage/spiking of a neuron using the differential equation and voltage reset rule we used in class.

Let us assume the variable values for the model neuron are:

v_{reset}=-60mV v_{thresh}=-30mV τ=0.1   RI(t)=35 mV (for all time)   v(0ms)=-50mV

E_L=-60mV   time step: Δt=10 ms

Compute v(30ms)

10. (5 Points) Compute the output of the following neurons, presuming the output is found by computing the weighted sum of the inputs ***h***, and applying the function g shown below, i.e., r_{out} = g(h).