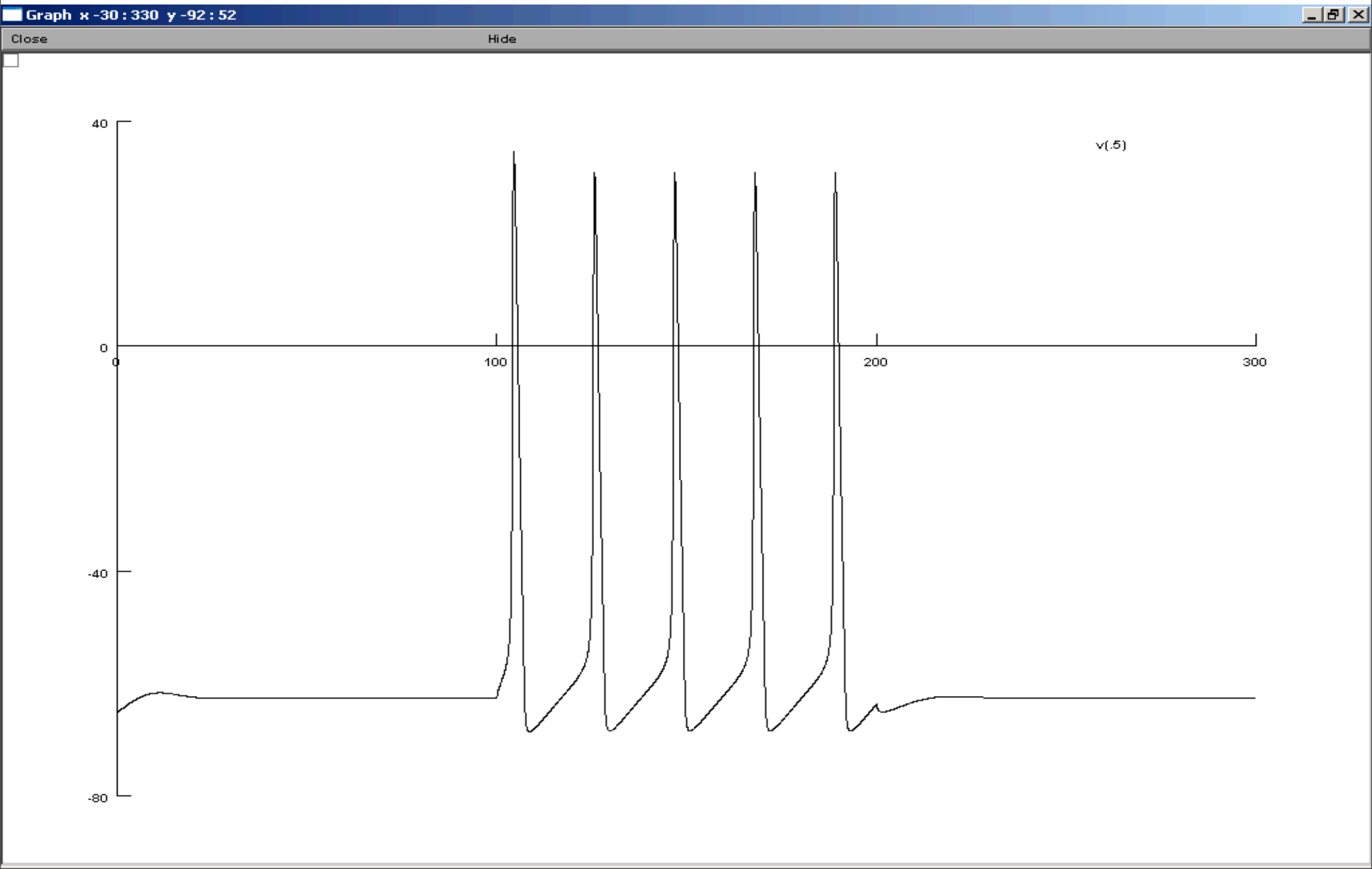
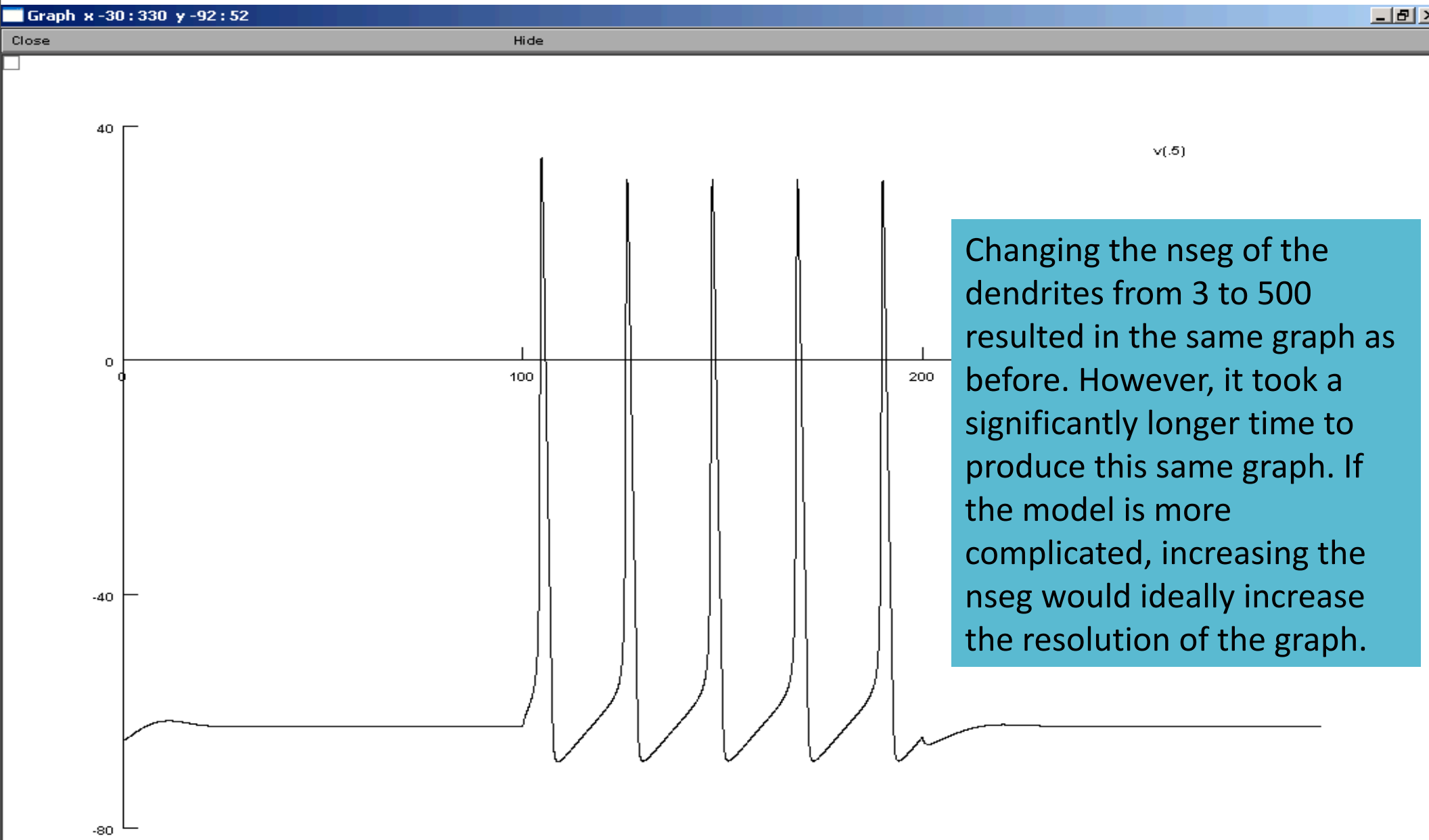
Lab M

With Bonus

Problem M.1.

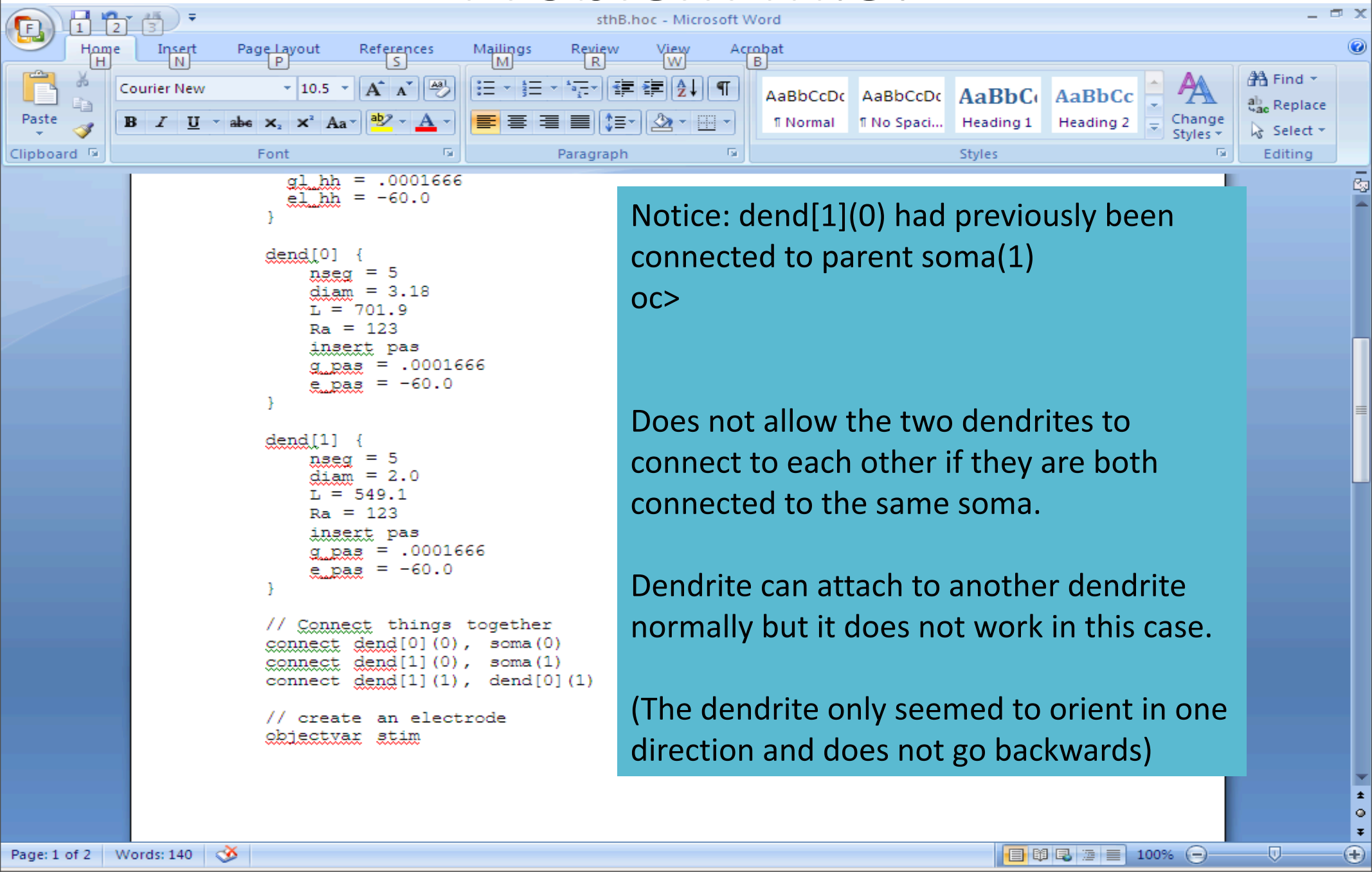


Problem M.2.



Changing the nseg of the dendrites from 3 to 500 resulted in the same graph as before. However, it took a significantly longer time to produce this same graph. If the model is more complicated, increasing the nseg would ideally increase the resolution of the graph.

Problem M.3.

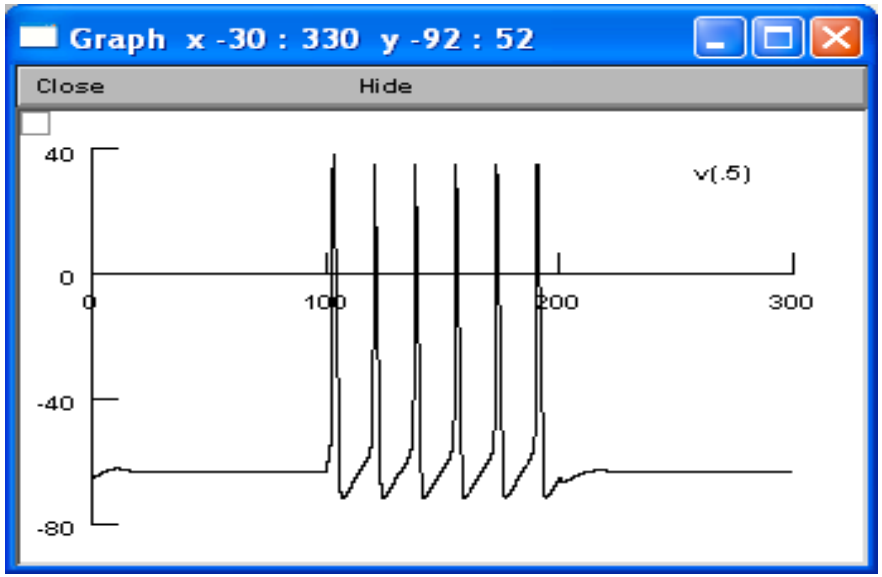


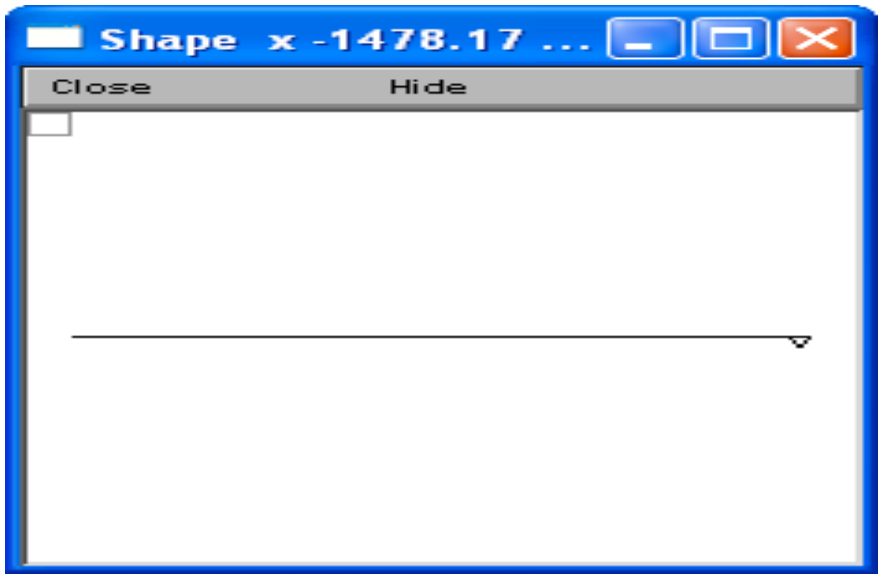
Notice: dend[1](0) had previously been connected to parent soma(1)
oc>

Does not allow the two dendrites to connect to each other if they are both connected to the same soma.

Dendrite can attach to another dendrite normally but it does not work in this case.

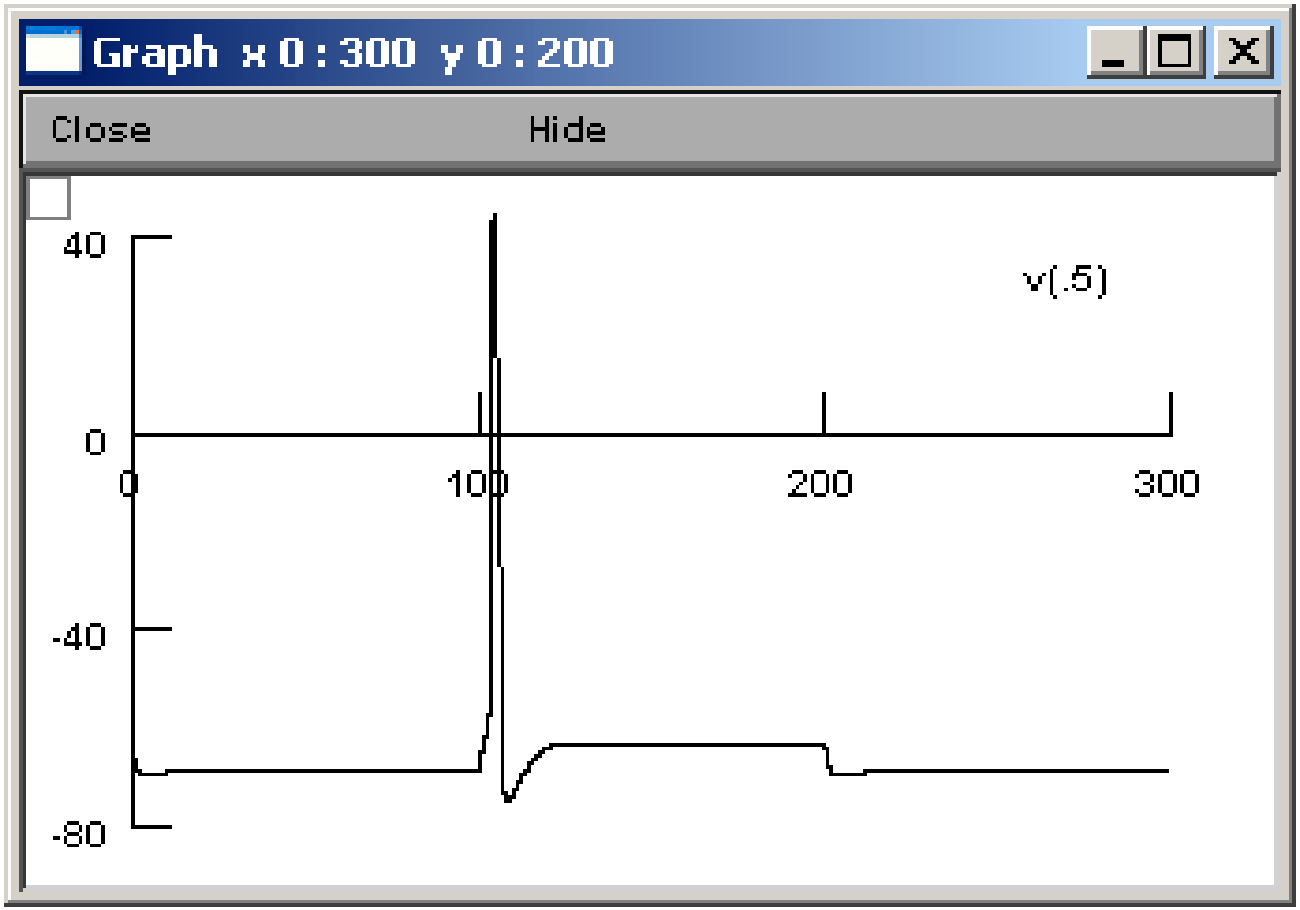
(The dendrite only seemed to orient in one direction and does not go backwards)





When we created a loop by connecting two dendrites, did NEURON simply detach one of the dendrites from the soma?

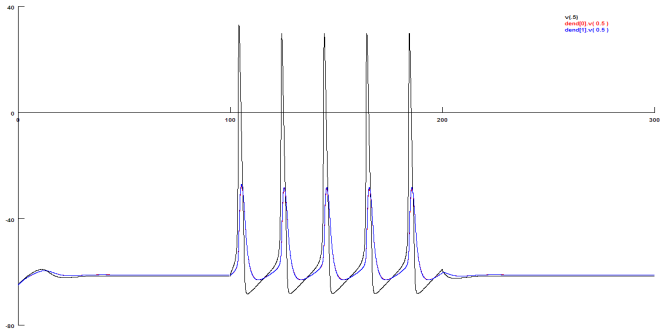
It seems not. I created a neuron with one dendrite that's twice the original length. If my suspicion was correct, this should give the exact same plot. However, the plots didn't look similar. The number of AP fired decreased from 7 to 6. The shape plot shows that the length of dendrite is 1478 instead of 74.5.



- Was the loop working? Did it change anything?

  - I guess it worked. I got a totally different graph from the original.

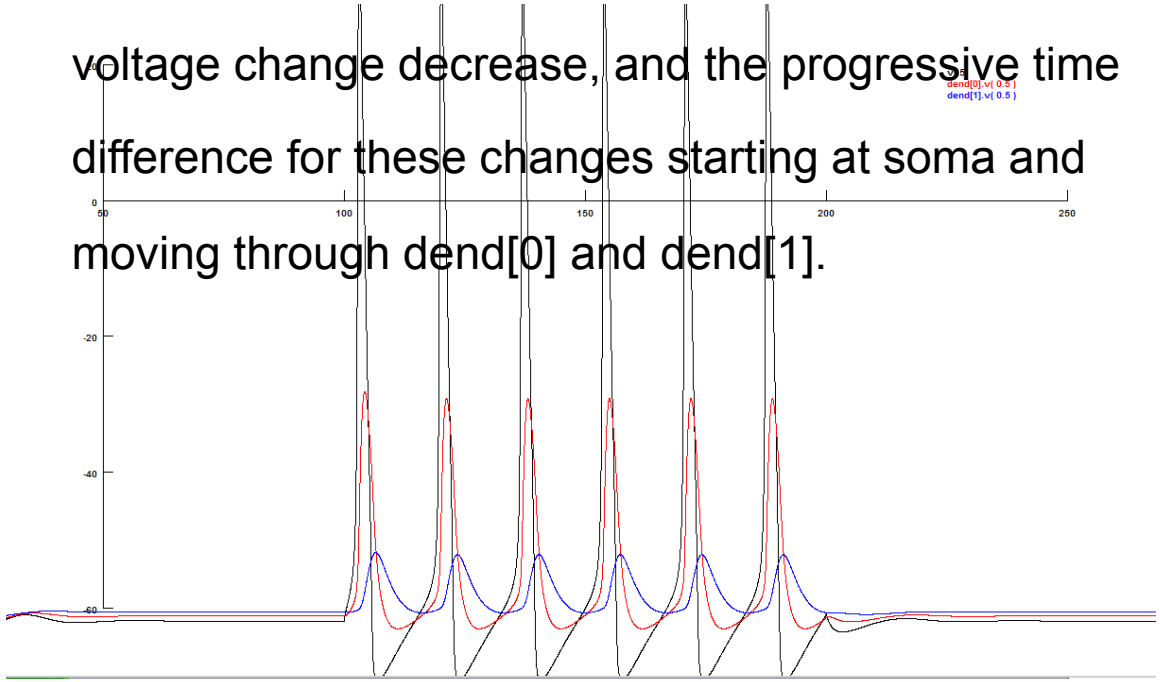
Attempted Loop



>> Connect dend[1](1), dend [0](1)

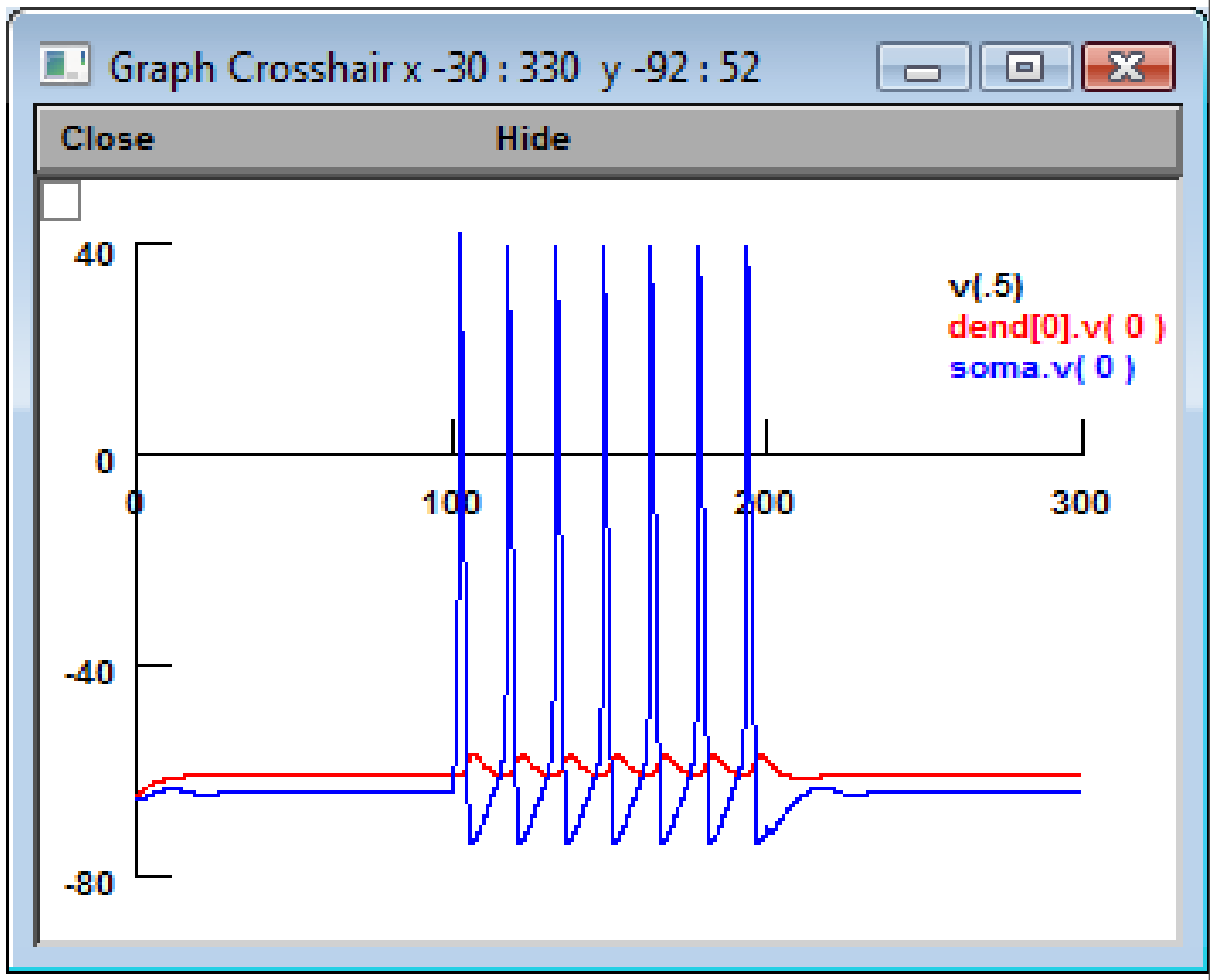
Notice: dend[1](0) had been previously connected to soma (1)

As can be seen from the default graphs to the left, the voltage change in these dendrites is equal under default conditions. However, when a loop is attempted, dend[1] becomes disconnected from the soma. This is demonstrated by the increase in the dend[0] voltage change, the substantial dend[1] voltage change decrease, and the progressive time difference for these changes starting at soma and moving through dend[0] and dend[1].



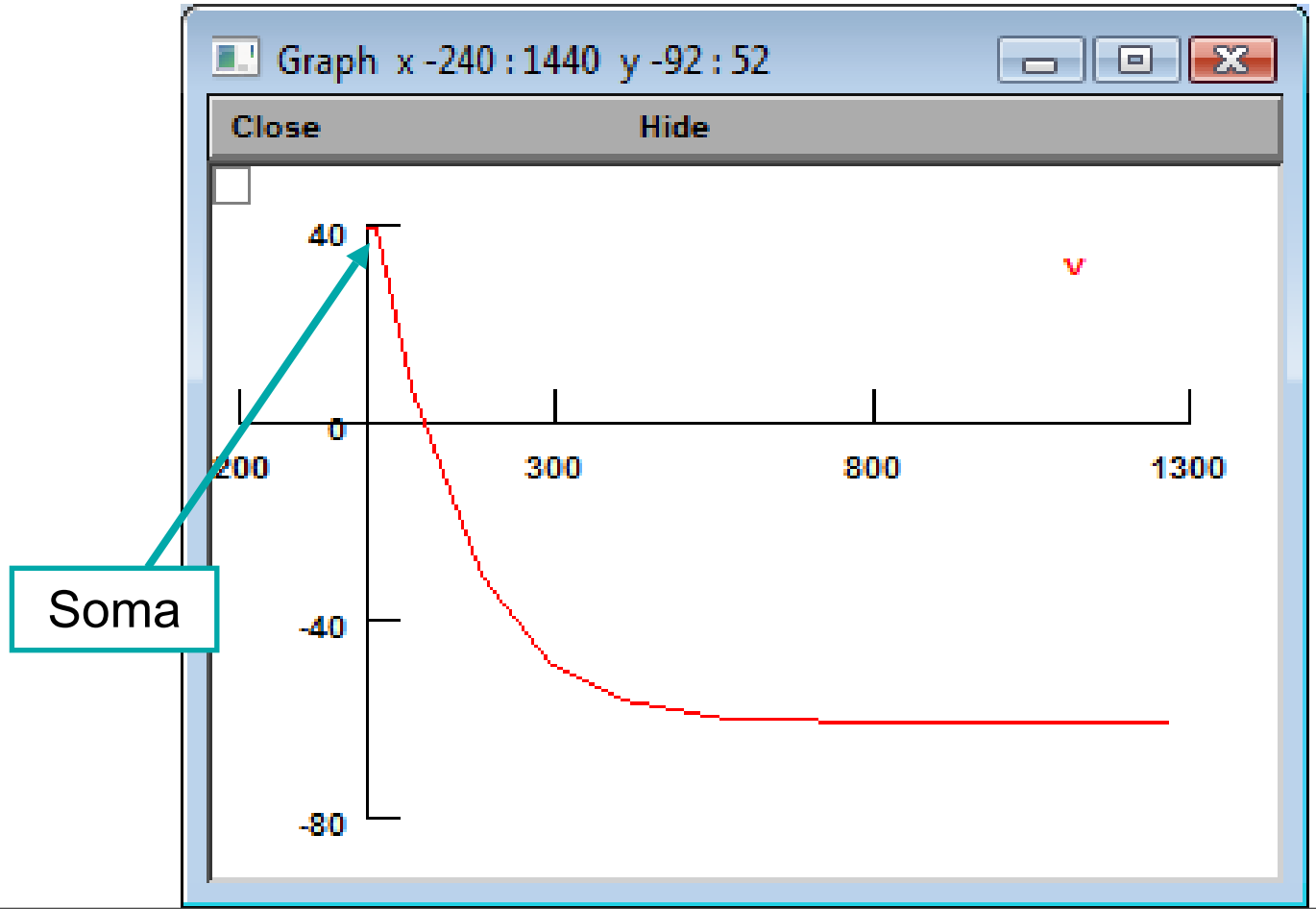
Verifying My Hypothesis

- If dend[0] is still connected to the soma, the voltage read from dend[0](0) will be the same as read from soma(0).
- If they are disconnected, they will show very different graphs because they will be at opposite ends of the system.

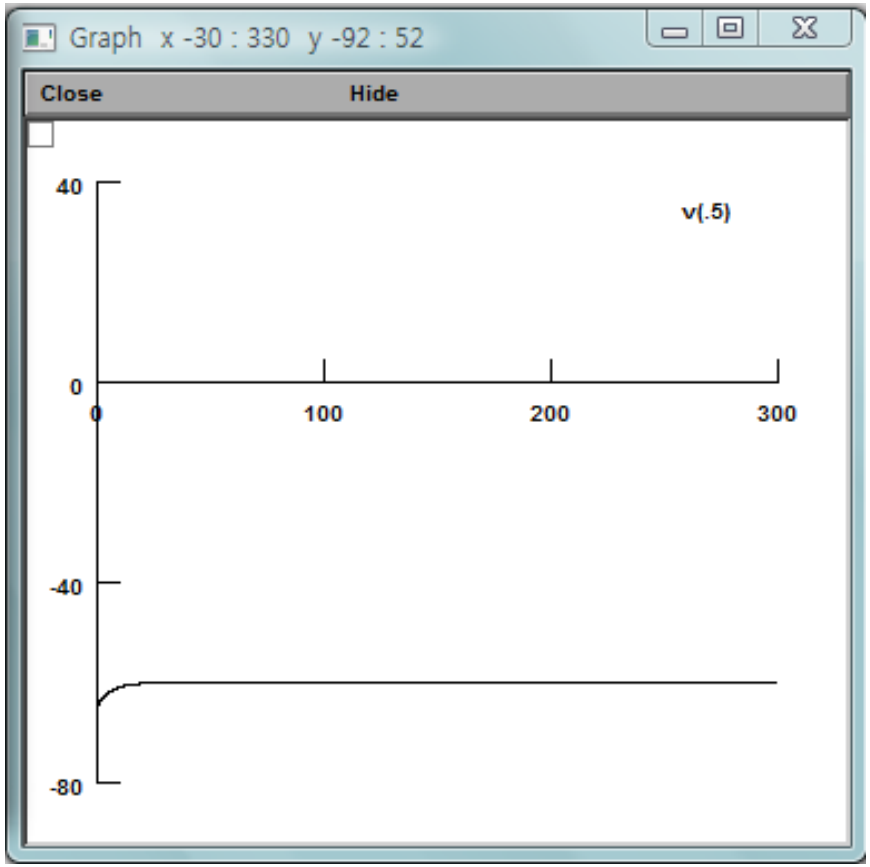


Further Verify

- Use a space plot to verify what the V vs. t plot showed us on the previous slide.



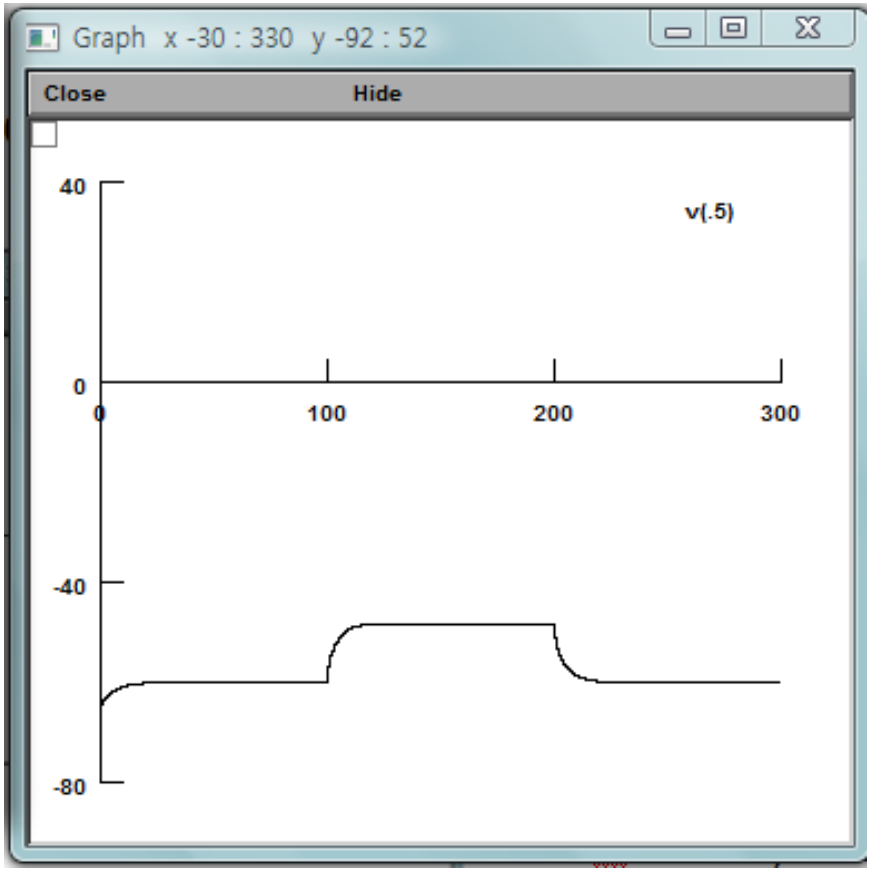
Homework M.*: Be creative with the bonus



- oc>for i=0, 99 dend[i] {
- > oc>nseg=5
- > oc>diam=3.18
- > oc>L=701.9
- > oc>Ra=123
- > oc>insert pas
- > oc>g_pas=0.0001667
- > oc>e_pas=-60.0
- > oc>}
- oc>for i=0, 99 connect dend[i](0), soma (i/100)

Using the loop, I added the same 100 dendrites to the soma, however, it did not show any action potentials.

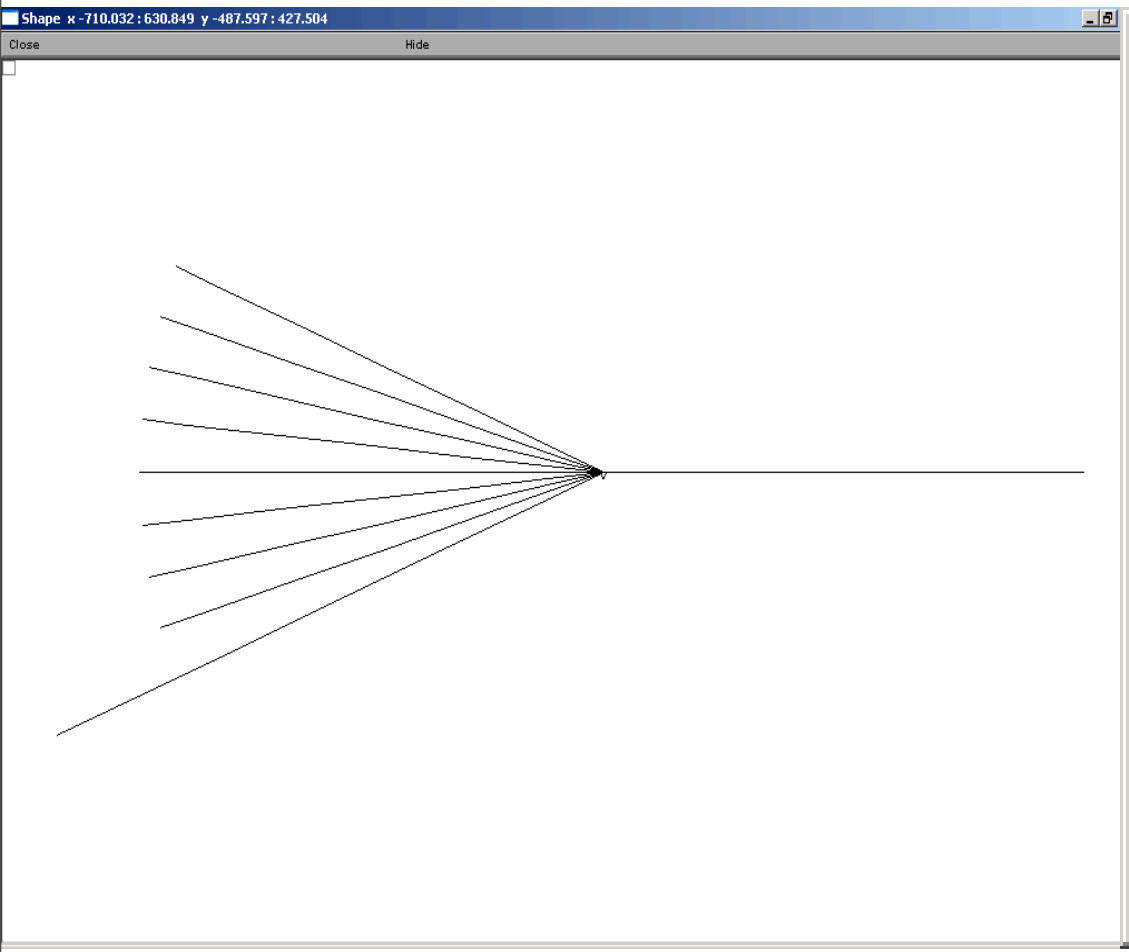
Homework M.*: Be creative with the bonus

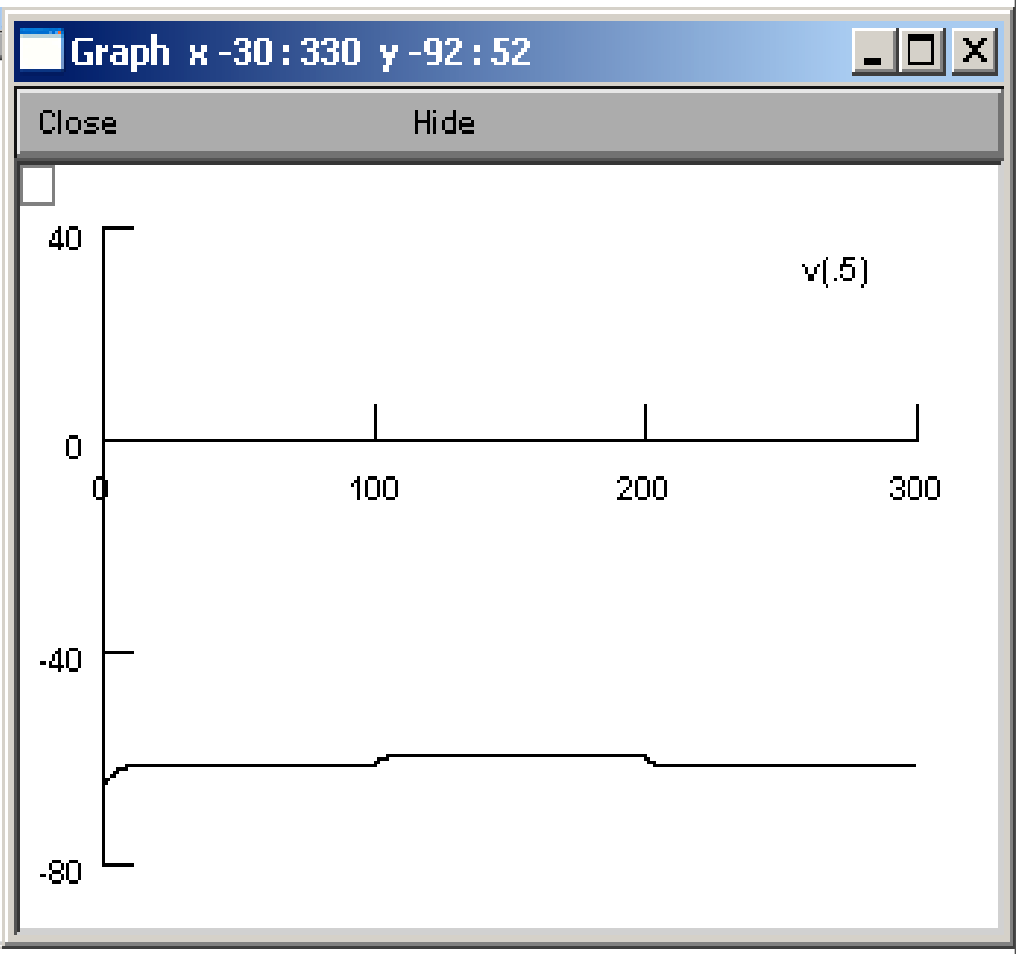


- oc>for i=0, 99 dend[i] {
- > oc>nseg=5
- > oc>diam=3.18
- > oc>L=701.9
- > oc>Ra=123
- > oc>insert pas
- > oc>g_pas=0.0001667
- > oc>e_pas=-60.0
- > oc>}
- oc>for i=0, 99 connect dend[i](0), soma (i/100)
- oc>stim.amp=10

By only increasing the stimulation amplitude, it showed an action potential-like sudden increase in its membrane potential.

Problem M.Bonus.





Increased the number of dendrites to 10.
Nine of them connected to soma at 0, one dendrite connected to soma at 1.
The same amount of stimulus failed to trigger an action potential.

Problem M. Bonus

sthB.hoc - Microsoft Word

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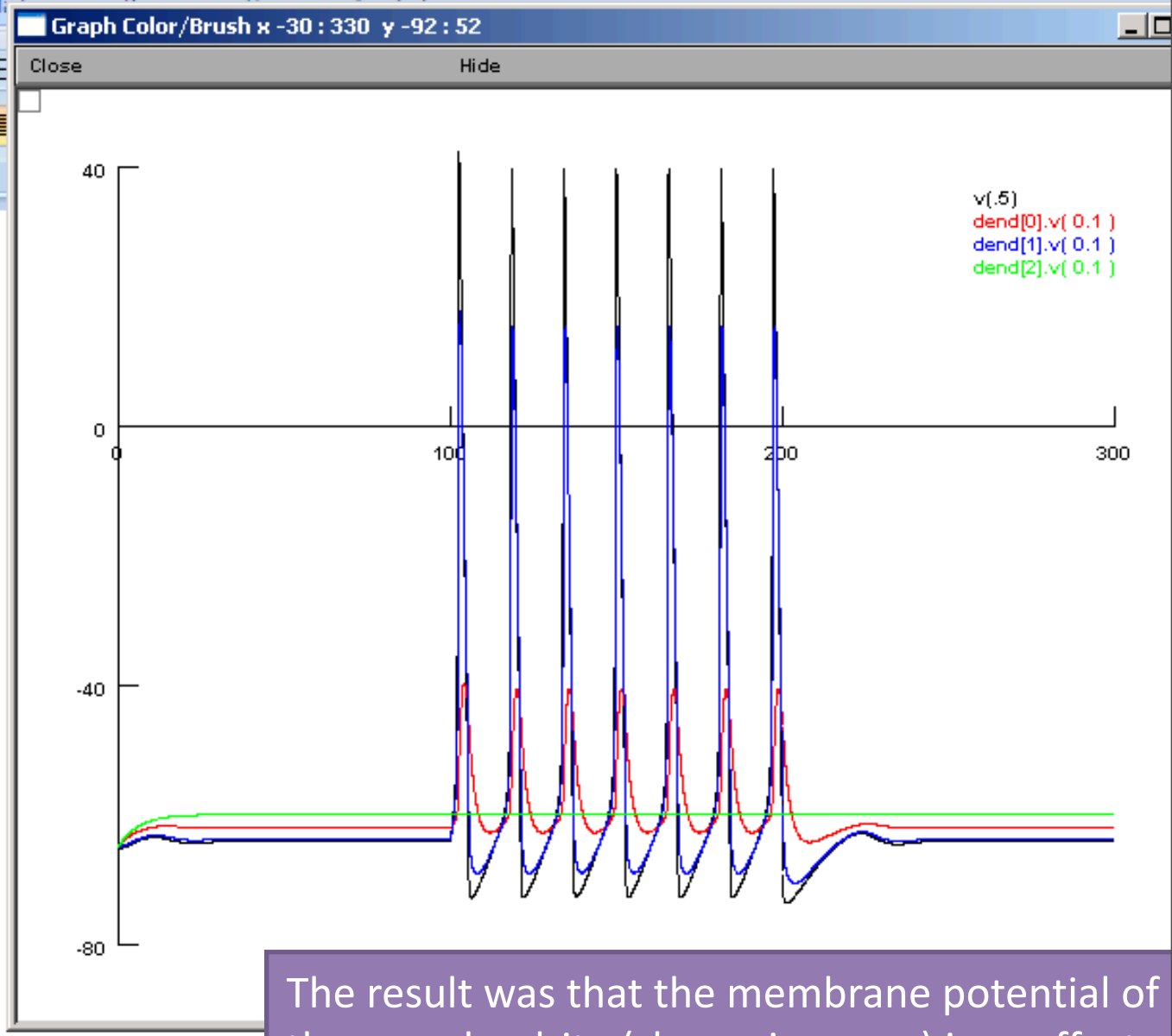
```
dend[0] {
    nseg = 5
    diam = 0.1
    L = 701.9
    Ra = 123
    insert pas
    g_pas = .0001667
    e_pas = -60.0
}

dend[1] {
    nseg = 5
    diam = 2.0
    L = 549.1
    Ra = 123
    insert pas
    g_pas = .0001667
    e_pas = -60.0
}

dend[2] {
    nseg = 5
    diam = 2.0
    L = 549.1
    Ra = 123
    insert pas
    g_pas = .0001667
    e_pas = -60.0
}


// Connect things together
connect dend[0](0), soma(0)
connect dend[1](0), soma(1)
connect dend[2](0), dend[0](1)


// create an electrode in the soma
```



I changed the diameter of the first dendrite from 3.18 to 0.1 micrometers.

I added a third dendrite identical to the second and connected it to the distal end of the first dendrite

The result was that the membrane potential of the new dendrite (shown in green) is unaffected by the injected current and is pretty much flat.