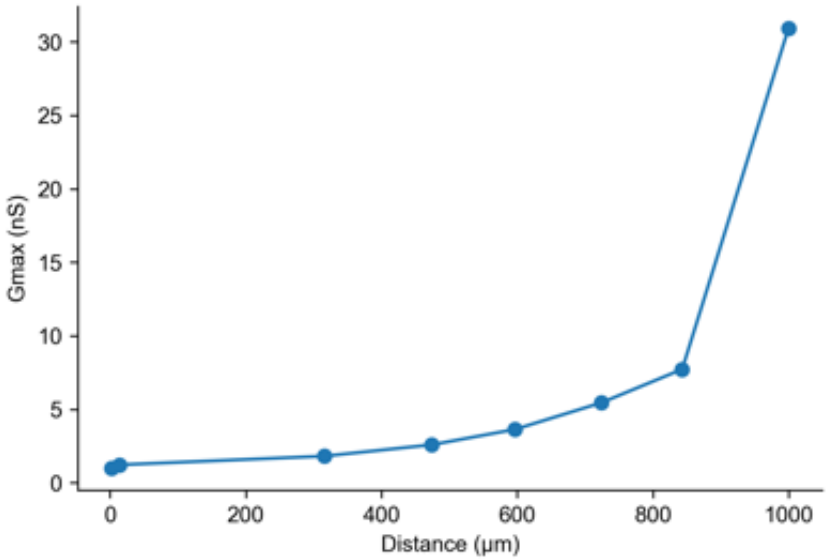
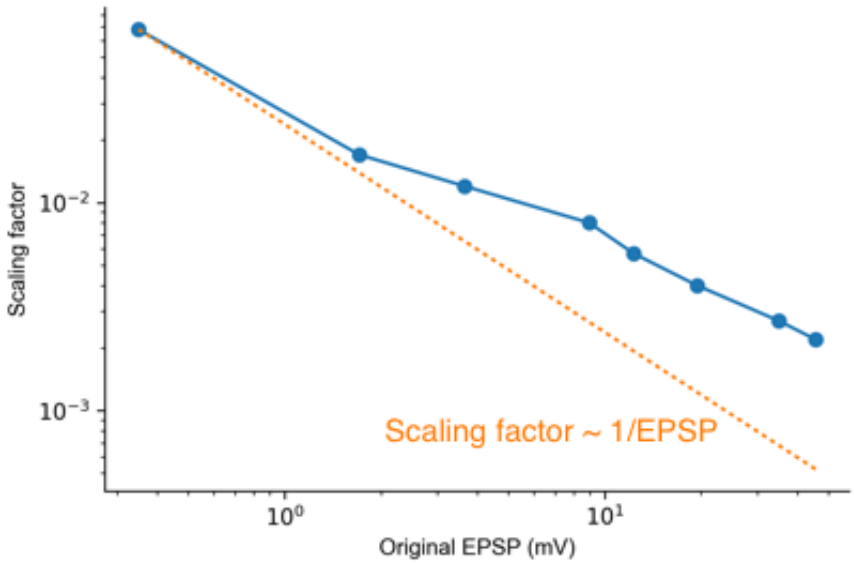
Assignment 2 feedback

1. Synaptic scaling

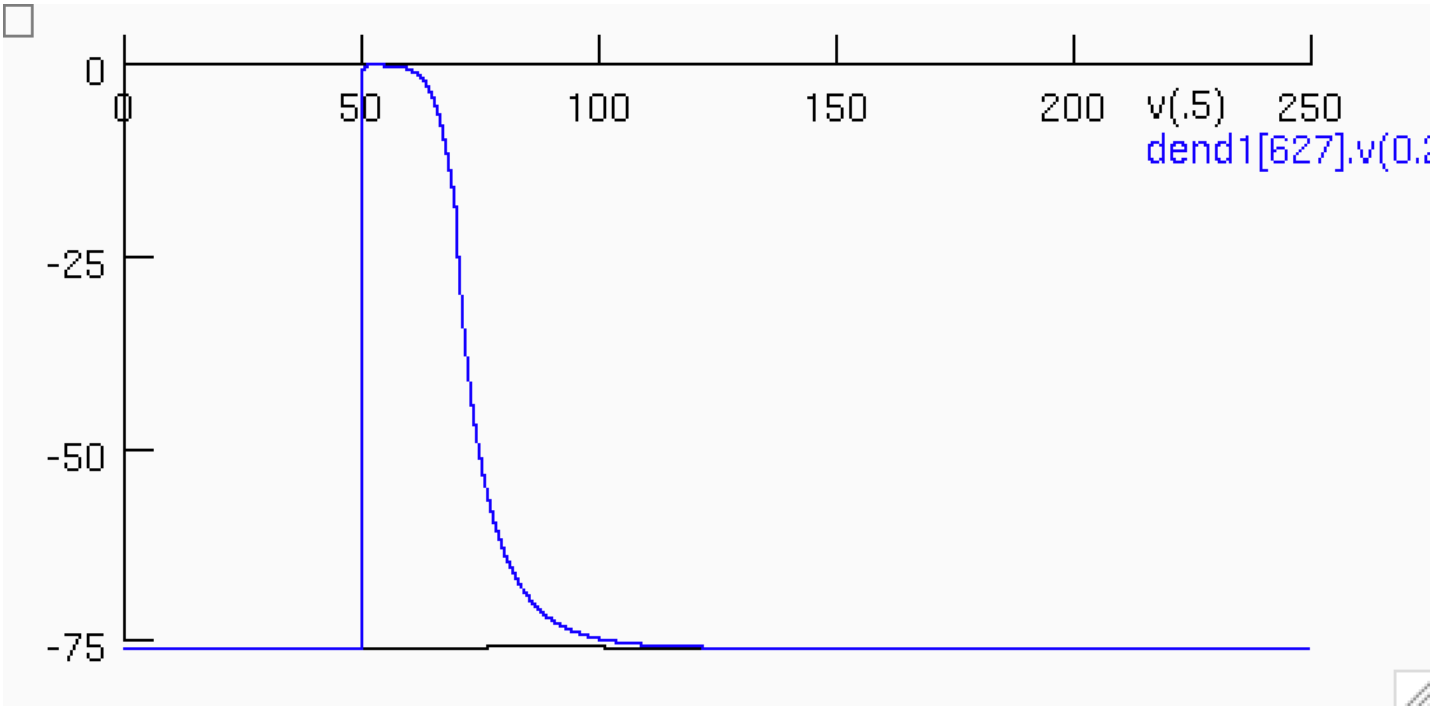
1. Along an apical dendrite, `gmax` required to achieve an ~0.2 mV EPSP at soma grows nonlinearly as the following figure.



Compared with the case `gmax` is held constant (0.1 nS), the synaptic conductance needs to be scaled to achieve EPSP ~ 0.2 mV as the following figure. Note that the scaling factor deviates from ~1/EPSP, and therefore `gmax` required should be larger than a prediction that EPSP grows linearly with `gmax`. The effect is more pronounced in a distal dendrite, since the membrane potential is more depolarized with a synaptic input and therefore the synaptic current decreases.



2. In dendrites very far from a soma, an AMPA synapse is impossible to cause a ~2 mV EPSP. In those dendrites, even when `gmax` is sufficiently large to make the membrane potential reach a reversal potential (0 mV, blue), the EPSP at soma is only ~ 0.25 mV (black).



2. Summation of excitatory inputs

It should be easy to check that $EPSP_{1+2} \approx EPSP_1 + EPSP_2$ when synapses are placed in different dendritic branches, whereas sublinear summation $EPSP_{1+2} < EPSP_1 + EPSP_2$ occurs when they are placed in the same dendrite.

3. Effects of proximal and distal inhibition

For question 1 and 2, Although it is a different situation, the peak EPSP shows the same effect as Fig 5.1 — a distal inhibitionhas a subtractive effect on an excitatory input whereas a proximal inhibition is divisive.

For question 3, you should be able to check that the shunting inhibition cause a very weak effect on a distal excitatory input.

For question 4 and 5, you might be tempted to say that different types of interneurons making synaptic connections to different parts can contribute to their different computation on the pyramidal neuron output. It is plausible, but you should note that the effects that you have observed so far is about membrane depolarization and are not guaranteed to work for spiking outputs as well. It is still needs to be clarified how much of the whole effect (on spiking) can be explained by an argument based on analysis of the passive membrane.