Norwegian University of Life Sciences

Solution to Exercise 9:
Forward modelling of extracellular potentials

(i) This is actually a complicated question, where you in general have to find a balance between False Nagative errors (not registering a spike that is there) and False Positive errors (registering a spike that is not there), see Figure 1.
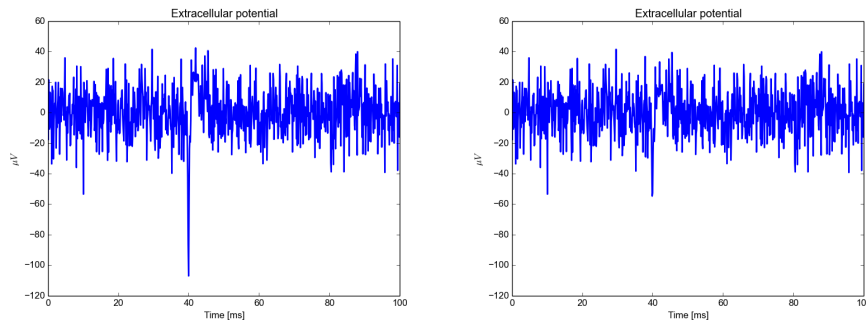

Figure 1: For white noise with a Root-Mean-Square amplitude of 15 μV added to the extracellular signal, the spike is visible in the extracellular medium 30 μm (left) to 40 μm (right) away from the soma.

(ii) In Figure 2 we can see that the somatic and distal apical dendrite synapse gives a dipole-like LFP. Any higher order multipole will generally decay more rapid with distance than a dipole, implying that somatic and distal apical synapses can be expected to have larger contributions to the LFP than the input to the center of the apical dendrite.
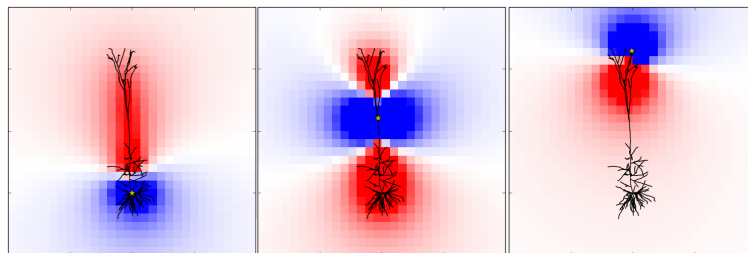

Figure 2: The amplitude of the LFP at a time shortly after the synaptic input has arrived either to the soma (left), to the middle of the apical dendrite (center), or to the distal apical tuft (right). The color scale is the same in all figures.

(iii) [Optional]   Cells that are have sperical symmetry, like the interneuron, will not get as clean dipole LFP, and this will lead to a more rapid decay of signal power with distance, decreasing their importance for the LFP. See paper by Lindèn et al. (2010) that is cited in the exercise.