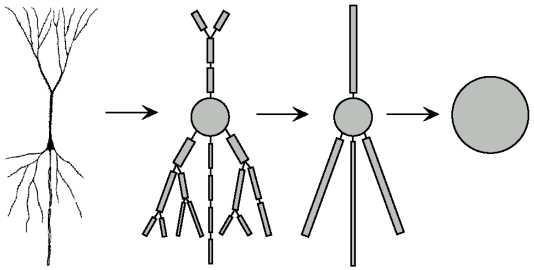
Model Neurons (II): Conductances and Morphology

Dayan and Abbott (2001) Chapter 6

- Multicompartment models.

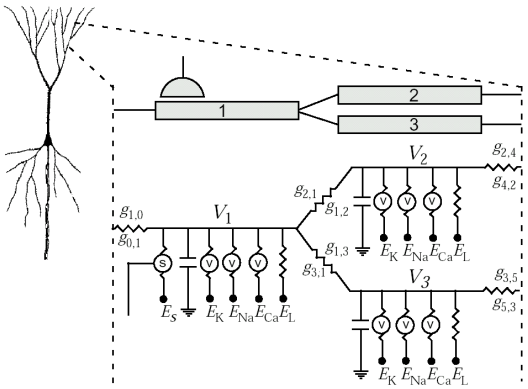
Instructor: Yoonsuck Choe; CPSC 644 Cortical Networks

Modeling Morphology



- The neurons morphology is sectioned into connected compartments, where each compartment has its own membrane potential associated with it.
- Numerical methods are used to solve the membrane equations.
- Compartments can be very detailed, or as simple as a single compartment.

Multicompartment Model Equation



- Adding neighboring compartments to a compartment μ, we get:

$$\underbrace{c_m \frac{dV_\mu}{dt} = -i_m^\mu + \frac{I_e^\mu}{A_\mu}}_{\text{Original single compartment equation}} + \underbrace{g_{\mu,\mu+1}(V_{\mu+1} - V_\mu) + g_{\mu,\mu-1}(V_{\mu-1} - V\mu)}_{\text{Currents from neighboring compartments}} .$$

Simulation Tools

- XPP-AUT: `http://www.math.pitt.edu/~bard/xpp/xpp.html`
- NEURON: `http://www.neuron.yale.edu/`
- GENESIS: `http://www.genesis-sim.org/`