# EECS 391: Introduction to AI

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# Announcements

- HW5 due Thursday (read ahead to answer cross validation question)

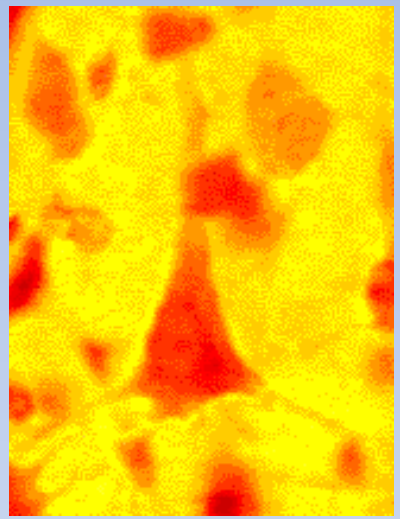
# Today

- Artificial Neural Networks (chapter 18.7.1-18.7.3)

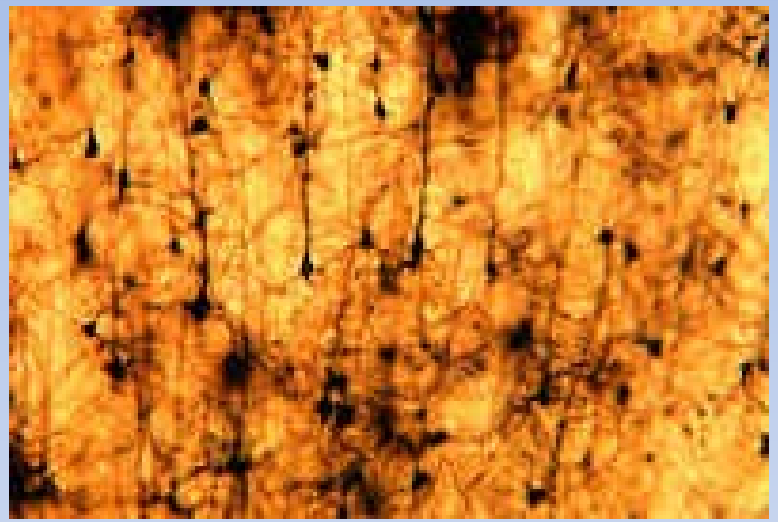
# Artificial Neural Networks

- How does the brain perform classification?
  - We don't quite know, but it is a network of neurons
- Let's try to simulate the structure of the brain and see if we get similar functionality
- Create basic simulation of neuron, connect them up in large numbers, and see what happens
  - Thus the school of "Connectionism" was born
  - http://en.wikipedia.org/wiki/Connectionism

# Neurons



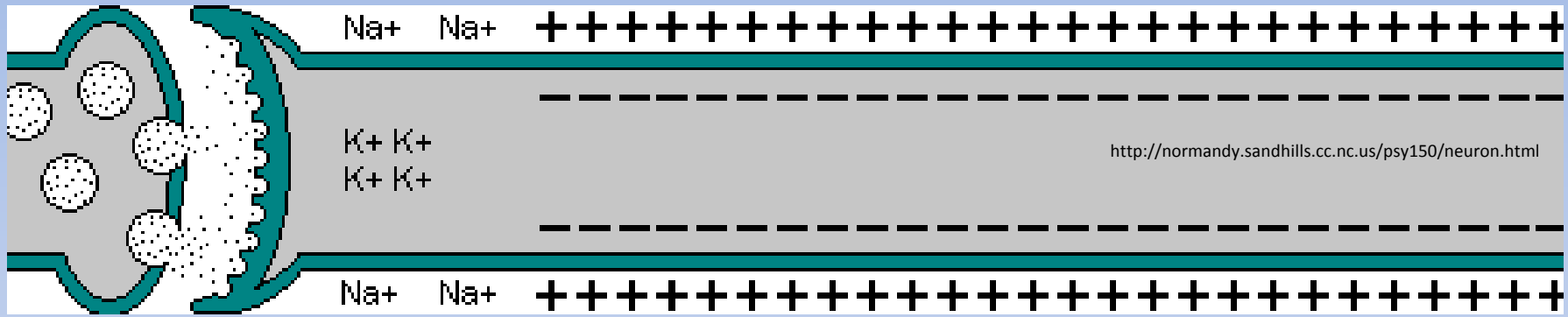
Cell body located in the deeper layers of the cerebral cortex. This is called a pyramidal neuron based on its shape.
From
http://faculty.washington.edu/chudler/cellpyr.html



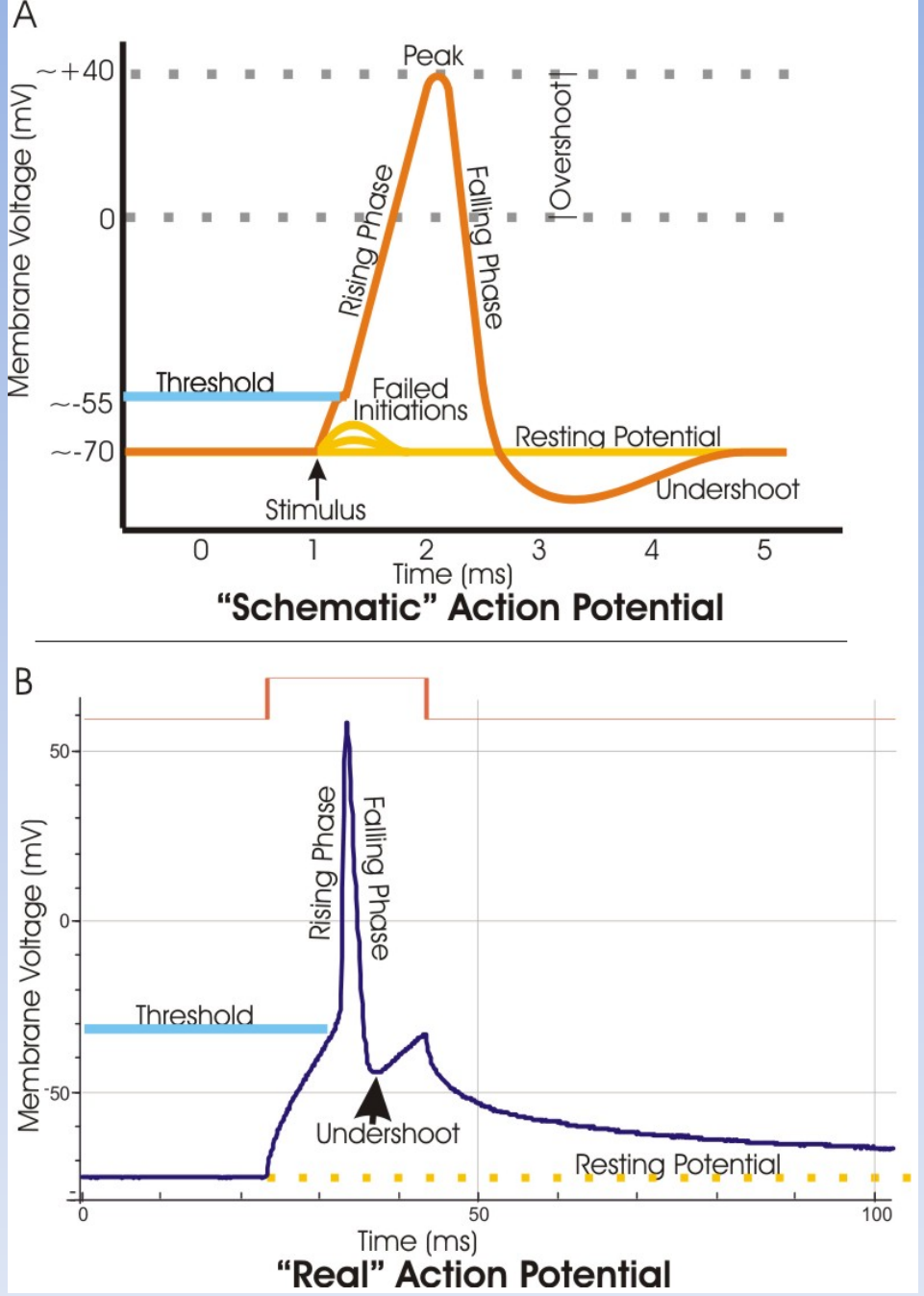
Neurons located in the cerebral cortex of the hamster.
From
http://faculty.washington.edu/chudler/cellpyr.html

See http://en.wikipedia.org/wiki/Neuron for more details.

# Basic Neuronal Cell Biology




- Resting state of neuron maintains -70mV because of ion imbalance
- Signals from neighboring neurons reach end of axons
- Vesicles containing neurotransmitter released into synapse and attach to receptors on neighboring neuron
- When enough vesicles attach, molecular “gates” open on the membrane and allow positive ions in, suddenly depolarizing the neuron
- Eventually, these ions are transported back outside, returning the cell to its rest potential

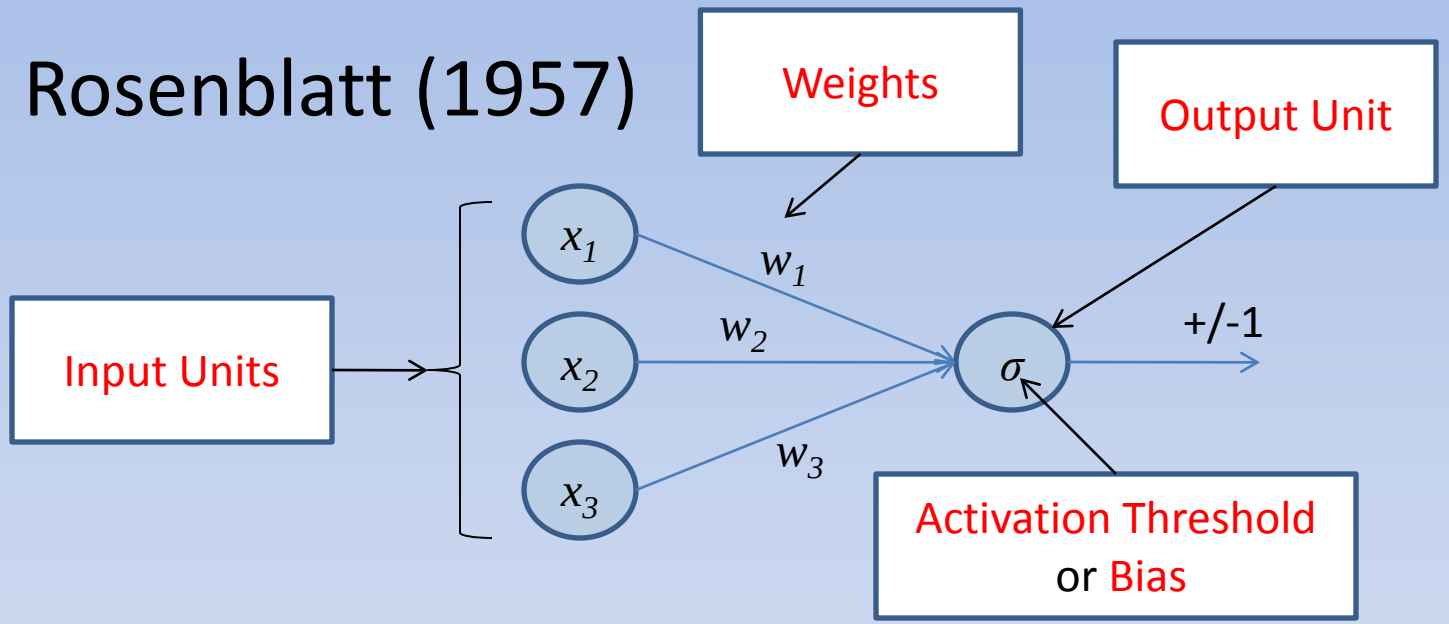



"Integrate-then-fire"

http://en.wikipedia.org/wiki/File:Action_potential_vert.png

# Perceptron/Linear Threshold Unit

- Rosenblatt (1957)




$$h(\mathbf{x};\mathbf{w}) = \begin{cases} +1 \text{ if } \mathbf{w}\bullet\mathbf{x} \geq \sigma \\ -1 \text{ else} \end{cases} = sign(\mathbf{w}\bullet\mathbf{x} - \sigma)$$

Activation Function
sign(x)=+1 if x ≥ 0, −1 else