


# IV. Neural Network Learning

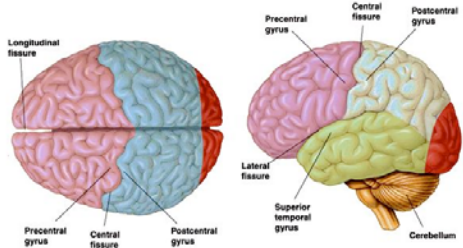
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# A Very Brief Tour of Real Neurons



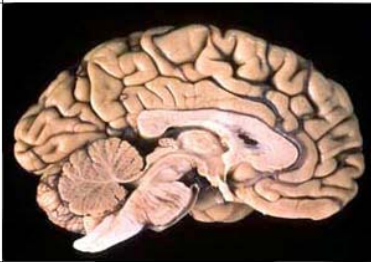
(and Real Brains)

### ► The Lobes of the Cerebral Hemispheres



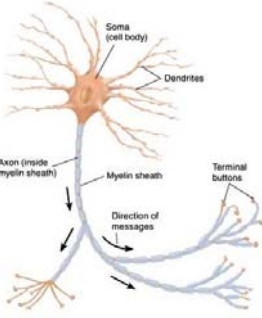
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# Left Hemisphere



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# Typical Neuron




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# Animation of Neuron

- An animated film about nicotine addiction
- A good visualization of a single neuron
- ©2006, Hurd Studios
- Winner of NSF/AAAS Visualization Challenge
- [View flash video](#)

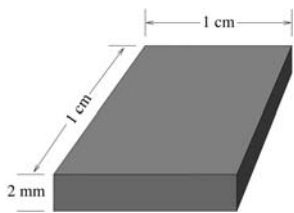
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### Grey Matter vs. White Matter



9/30/08 (fig. from Carter 1998) 7

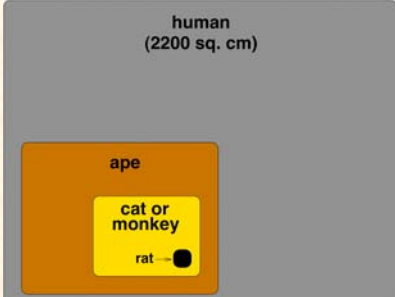
### Neural Density in Cortex



- 148 000 neurons / sq. mm
- Hence, about 15 million / sq. cm

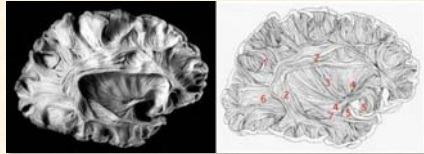
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### Cortical Areas



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### Intercortical Connections



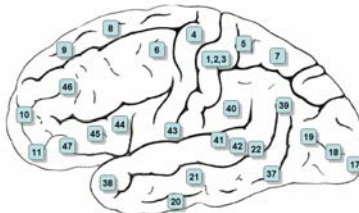
- (1) Short arcuate bundles, (2) Superior longitudinal fasciculus, (3) External capsule, (4) Inferior occipitofrontal fasciculus, (5) Uncinate fasciculus, (6) Sagittal stratum, (7) Inferior longitudinal fasciculus

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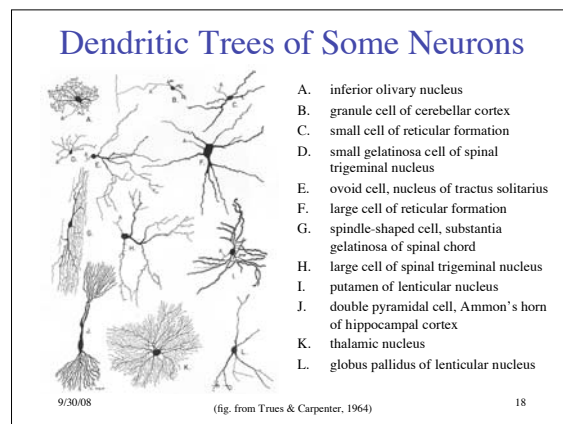
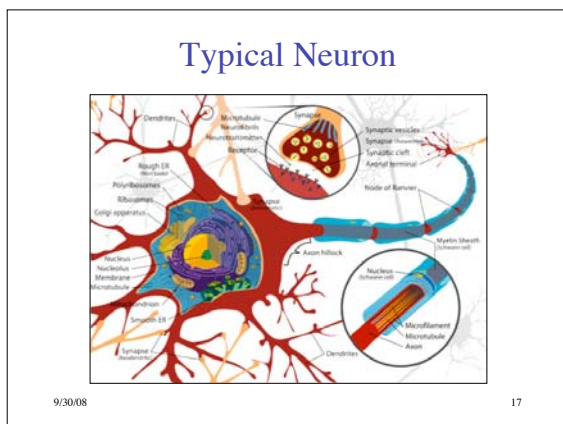
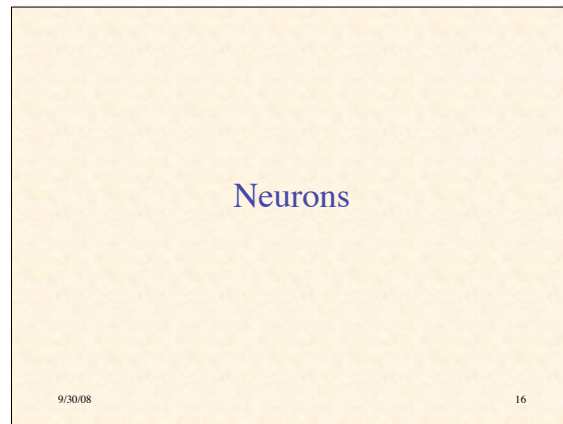
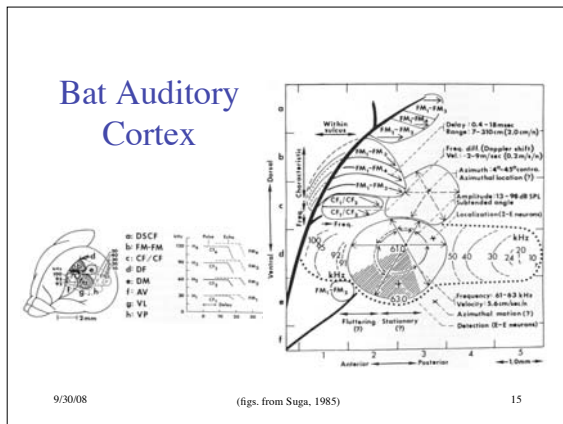
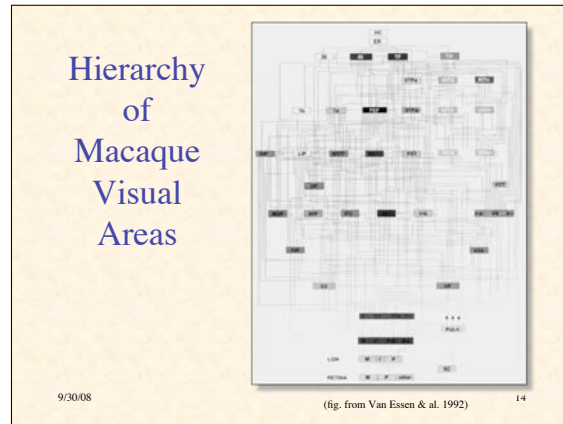
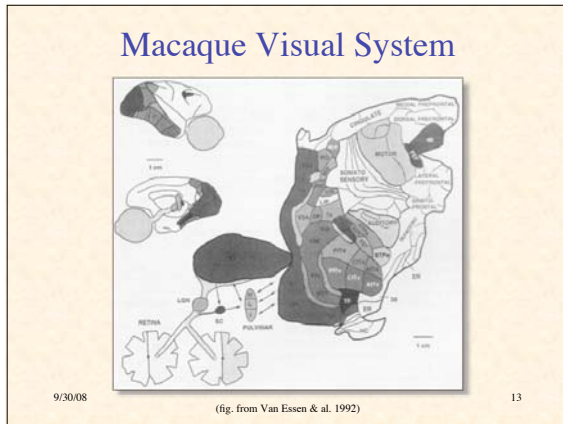
### Neural Representations

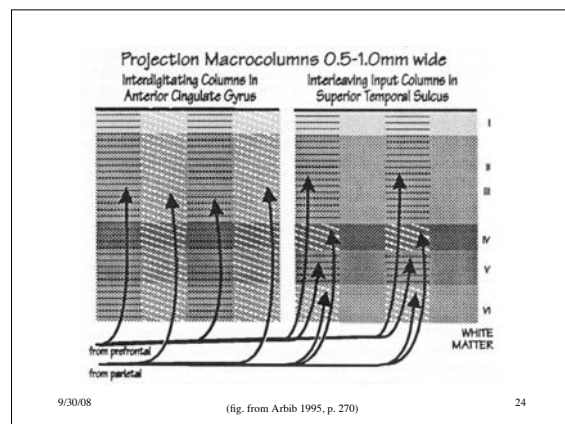
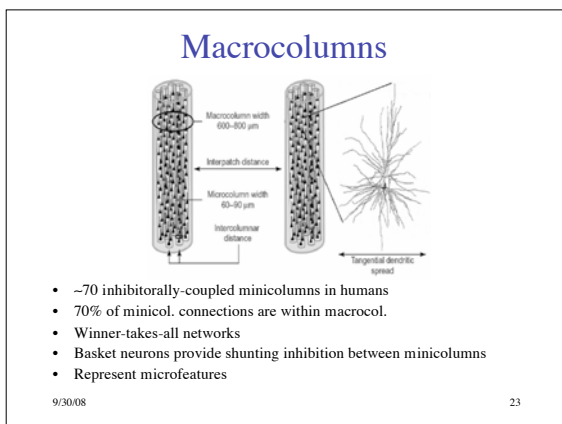
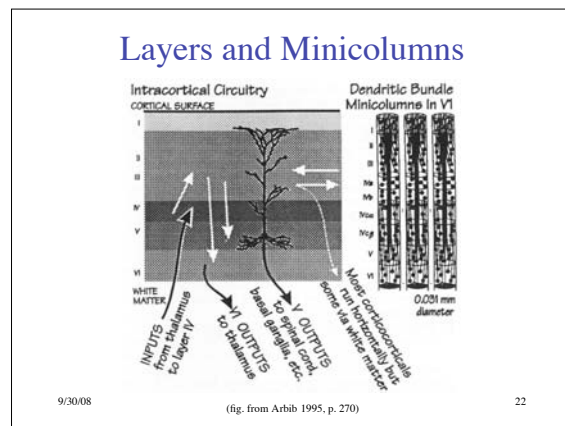
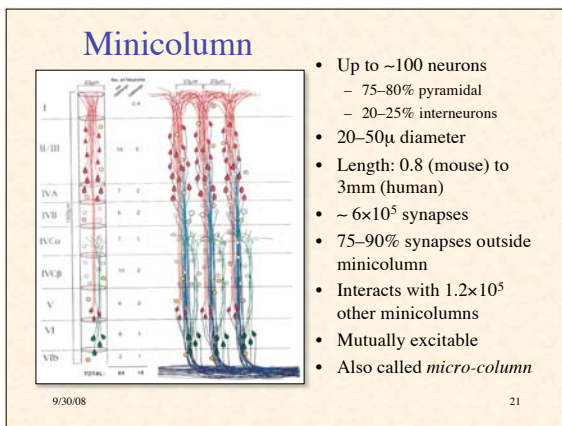
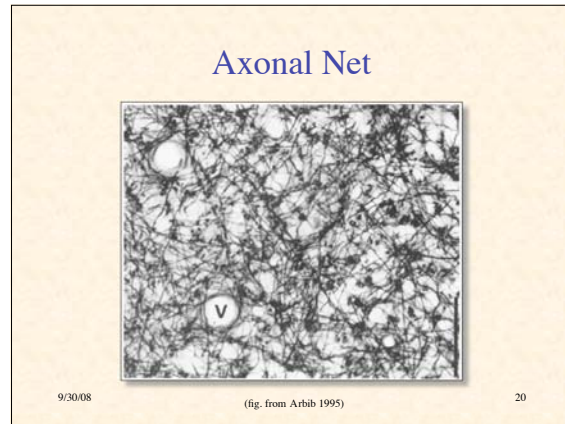
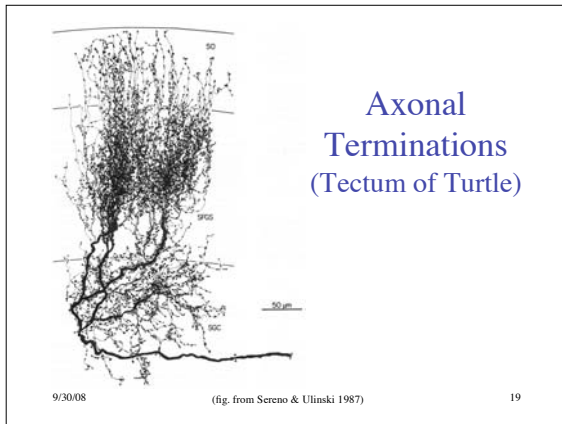
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### Brodman's Areas



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### Intracortical Connections

- Dendrites extend 2–4 minicol. diameters
- Axons extend 5× (or even 30–40×) minicol. diameter
- Periodic spacing of axon terminal clusters causes entrainment
- $\sim 2 \times 10^7$  connections to macrocolumn

A few axonal and dendritic connections originating in this minicolumn

macrocolumn

1 mm

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### Neural Networks in Visual System of Frog

b

c

d

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(fig. from Arbib 1995, p. 1039)

### Reorganization of Cortex

- Median nerve sectioned to show fluidity of cortical organization
- (C) before
- (D) immediately after
- (E) several months later

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(fig. < McClelland & al. *Par. Distr. Proc. II*)

### Orientation Columns

(C)

L  
P  
M

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(fig. < Nicholls & al., *Neur. to Brain*)

### Orientation Columns

(D)

L  
P  
M

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(fig. < Nicholls & al., *Neur. to Brain*)

### Slow Potential Neuron

Arriving Action Potentials

Filtered EPSPs at cell body

EPSPs

Output Axon

Filtered IPSP at cell body

IPSP

Summed potential converted to outgoing action potentials

Summed potential

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(fig. < Anderson, *Intr. Neur. Nets*)

