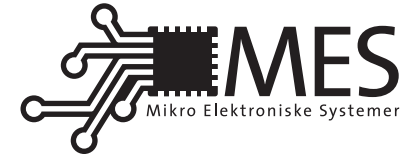




UNIVERSITY
OF OSLO



Neuromorphic Electronics

Neurophysiology in a Nutshell



Overview

method	test subjects	observation area	temp. res.	spat. res.
Psycho- physics	alert humans			
EEG	alert humans	patches of brain surface	ms	cm ²
fMRI and PET	alert humans	brain cross- sections	40ms	5mm ³
Extra Cellu- lar Electr.	alert test animals	neighbourhood of neurons	μs	0.1 ³ mm ³
Intra Cellu- lar Electr.	anesthetized test ani- mals, slice preparations	one neuron	μs	10 ³ μm ³
Fluorescent Tracers	anesthetized test ani- mals, slice preparations	a dendritic tree	?	< μm



Psychophysics

Measuring human performance in special tasks in order to make conclusions on physiology.

Examples:

- reaction times in deciding whether there is food in a picture.
- optical illusions
- attention tasks: <http://viscog.beckman.uiuc.edu/grafs/demos/15.html>



EEG (1/2)

Electro-encephalogram: Surface electrodes on skin, measuring correlated activity of a population of neurons.

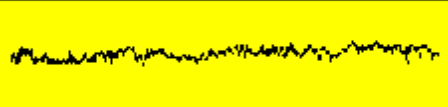
EEG (2/2)

256 A

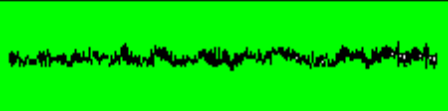


Waking

A. Alert (beta rhythm)

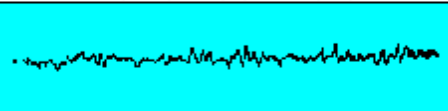


B. Relaxed with eyes closed (alpha rhythm)

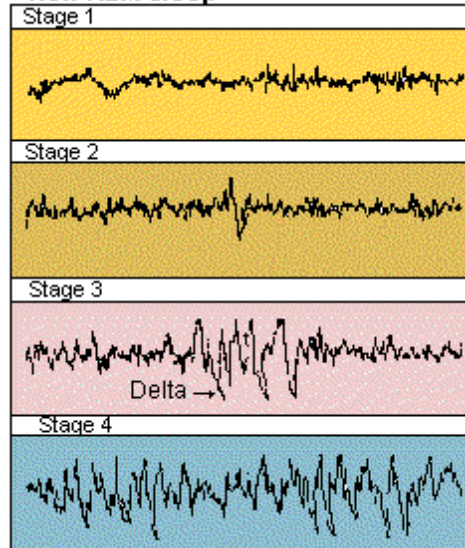


REM Sleep

Paradoxal (REM) sleep (beta rhythm)



Non-REM sleep

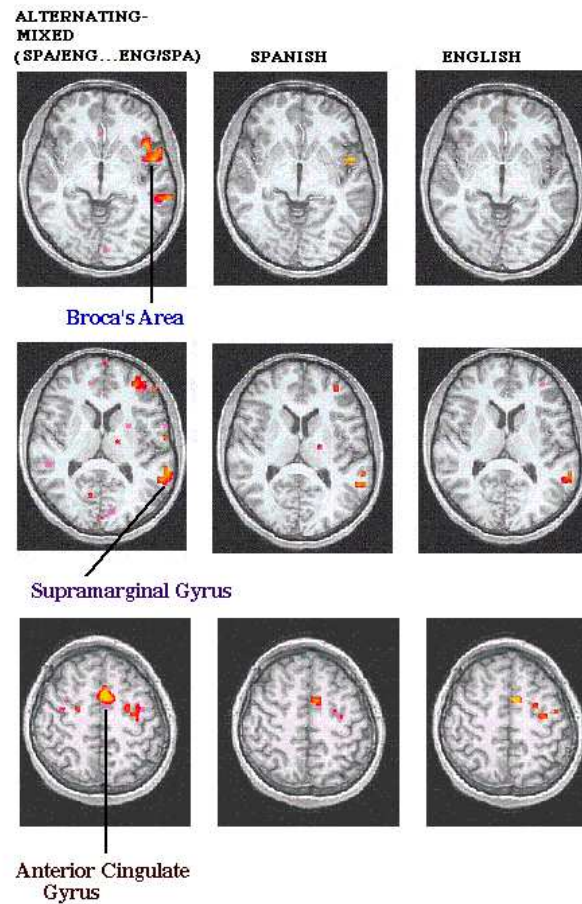




fMRI and PET (1/2)

fMRI (functional magnet resonance imaging) and PET (positron emission tomography) measure indicators of neuron activity like increased bloodflow and oxygene consumption

fMRI and PET (2/2)





Extra Cellular Electrodes/Field Potentials

Electrodes in the brain tissue that record field potentials caused by the surrounding neurons. Reconstruction methods are sometimes able to isolate activity of individual neurons.



Intra Cellular Electrodes (1/2)

Sharp electrodes and patch clamp electrodes observe activity inside a neuron



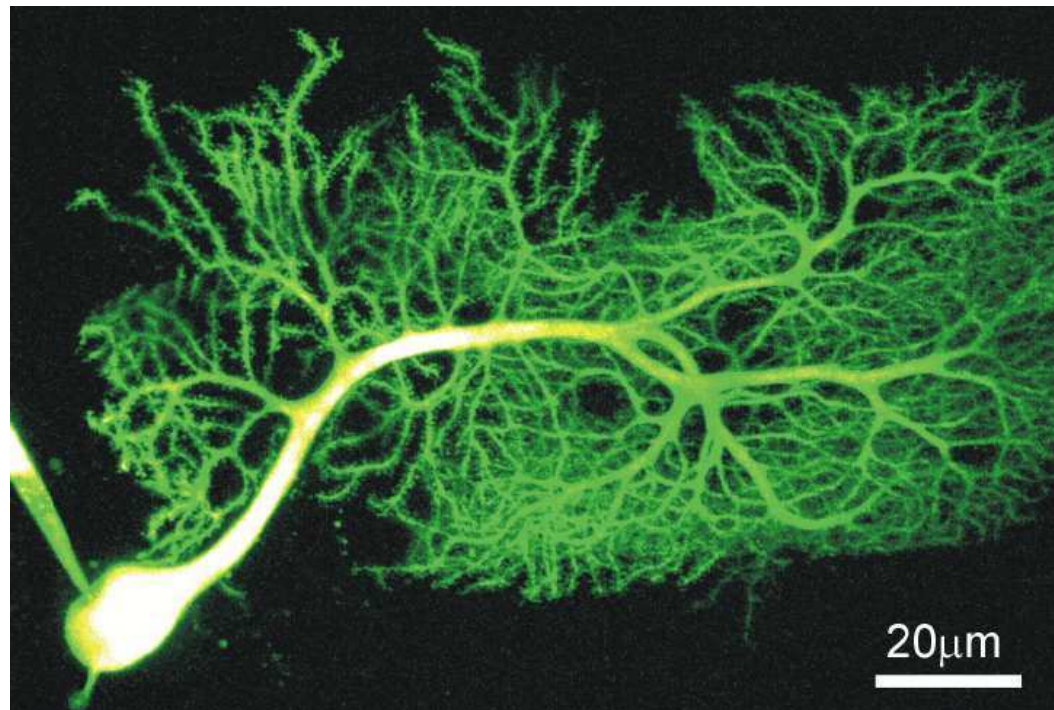
Intra Cellular Electrodes (2/2)





Imaging with Fluorescent Tracers

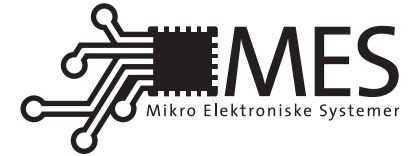
For example two photon microscopy to observe dynamics of chemicals, e.g. calcium





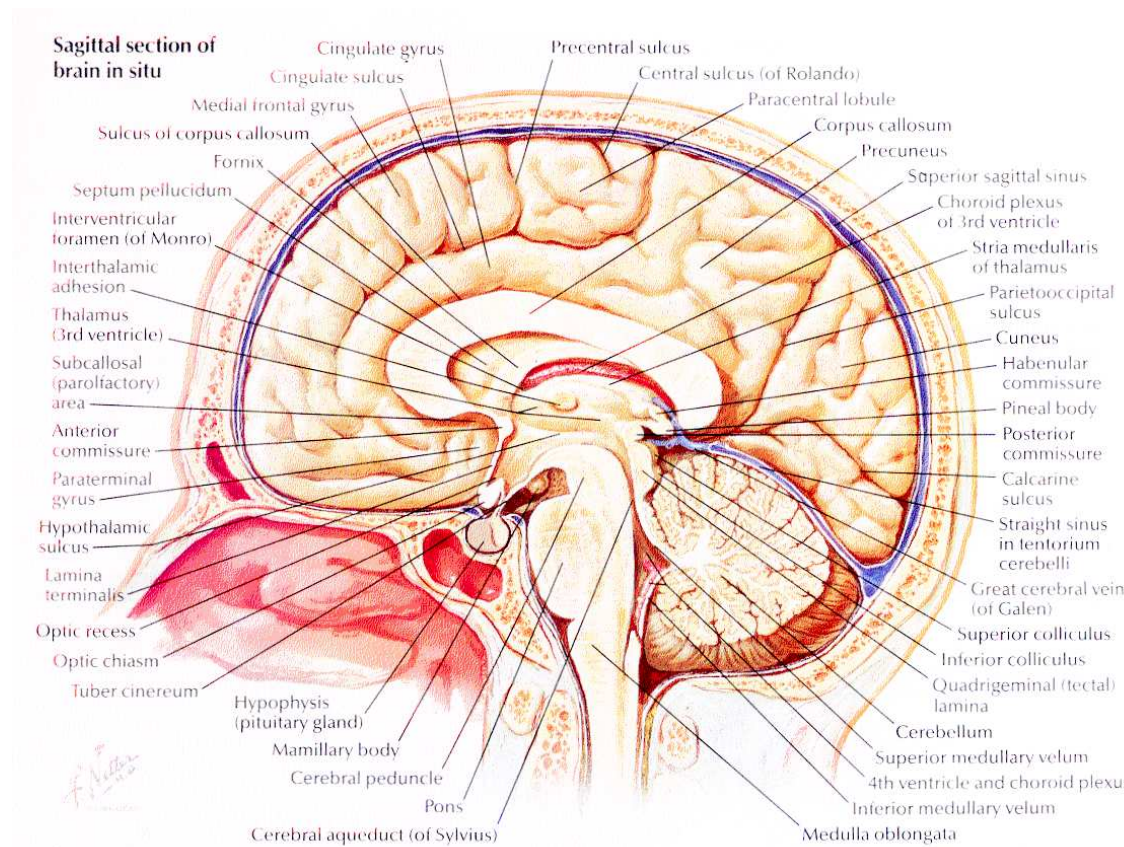
UNIVERSITY
OF OSLO

Methods



Left out here: Methods in Neuroanatomy

Brain Parts



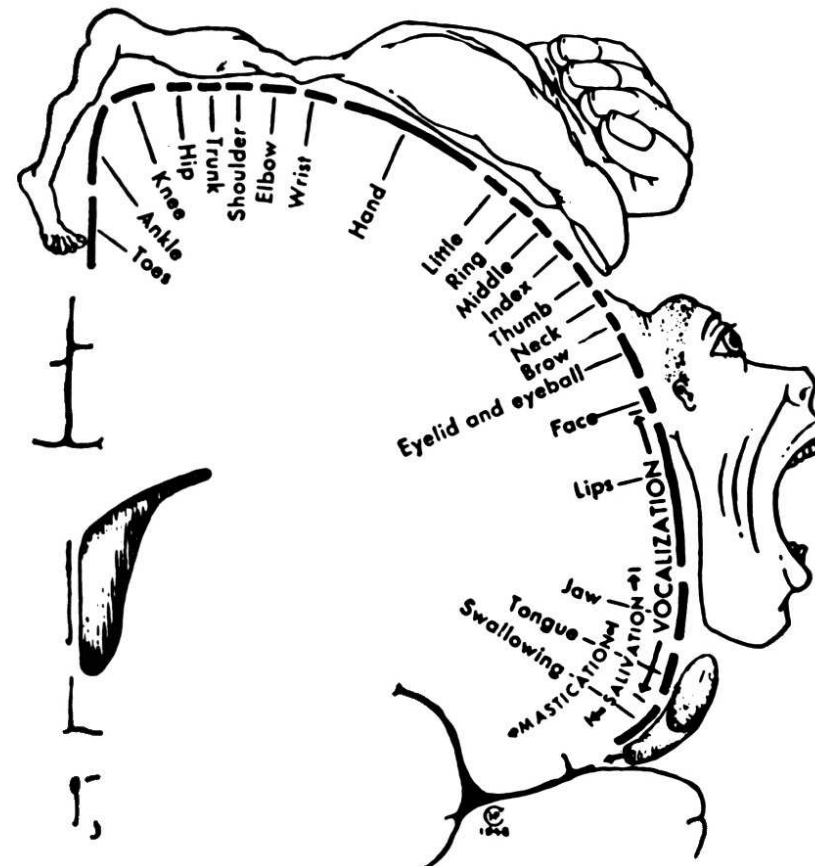
Cortical Regions (1/3)



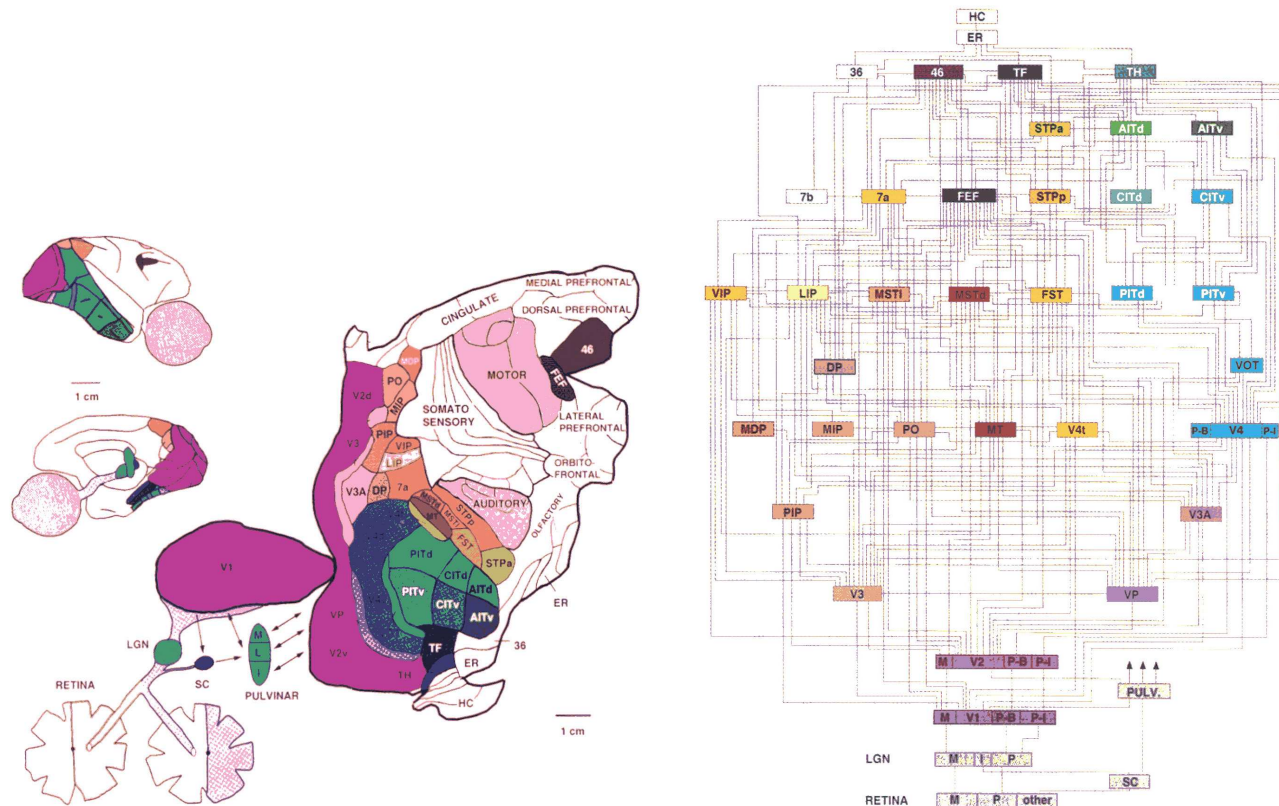
"Whoa! That was a good one! Try it, Hobbs — just poke his brain right where my finger is."



Cortical Regions (2/3)

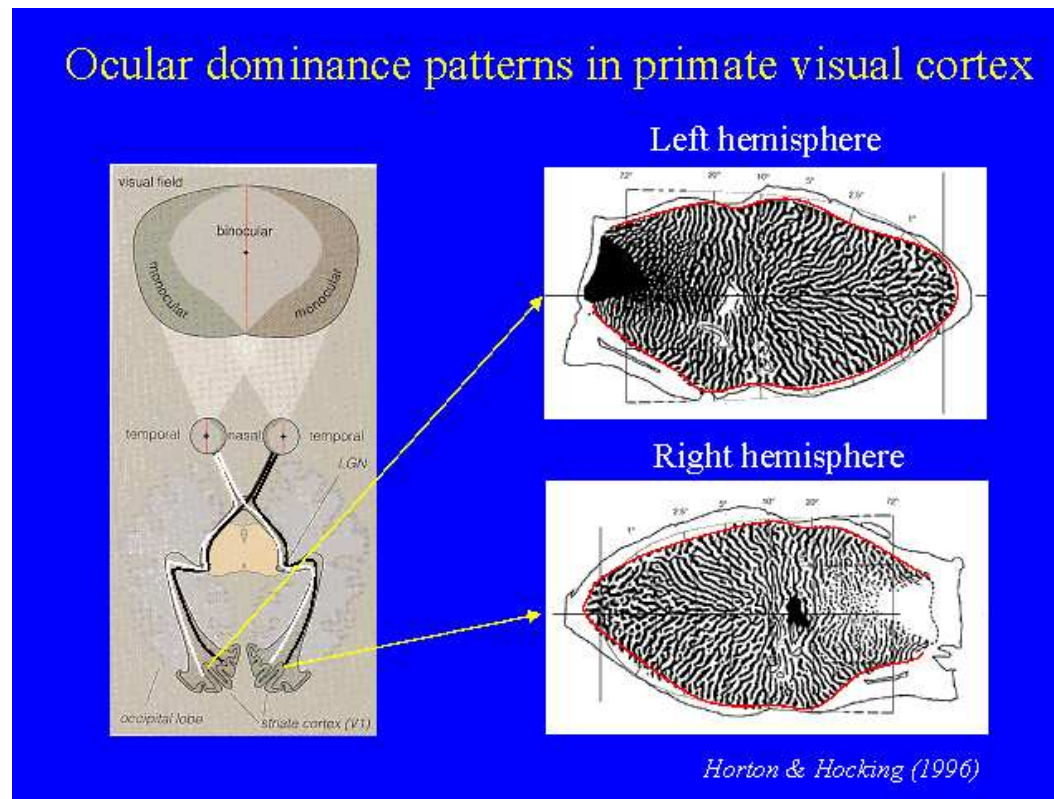


Cortical Regions (3/3)



Orgaization within cortical regions (1/3)

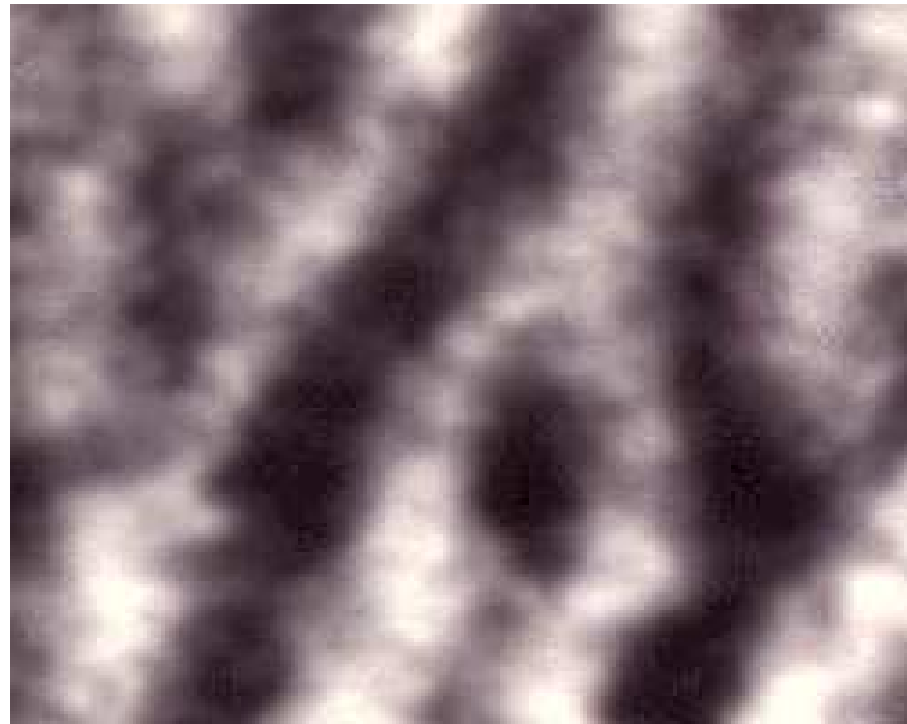
Ocular dominance patterns





Organization within cortical regions (2/3)

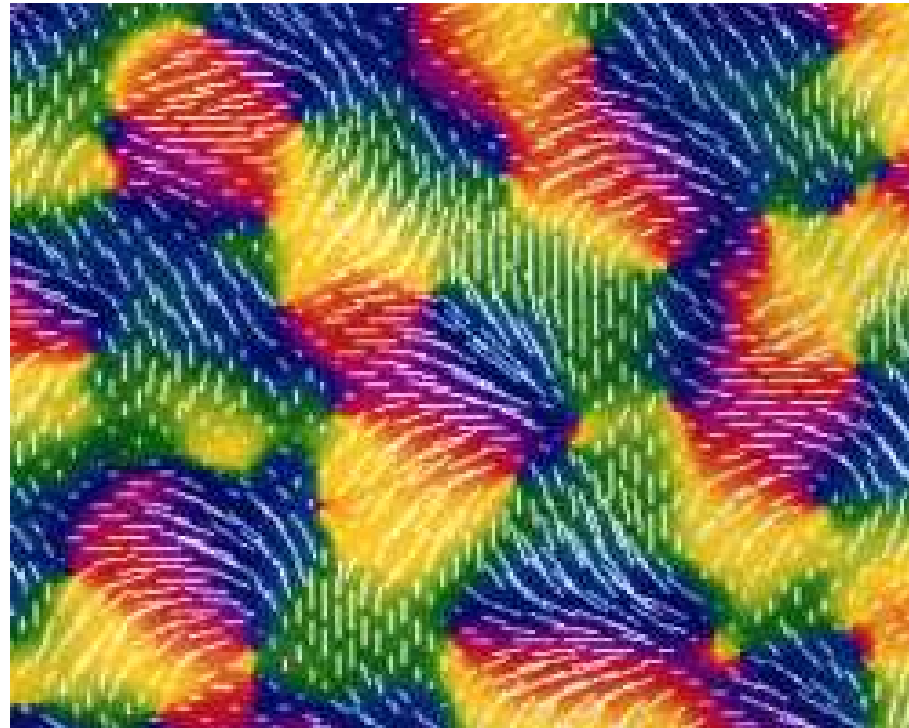
Ocular dominance patterns





Organization within cortical regions (3/3)

Orientation selection patterns

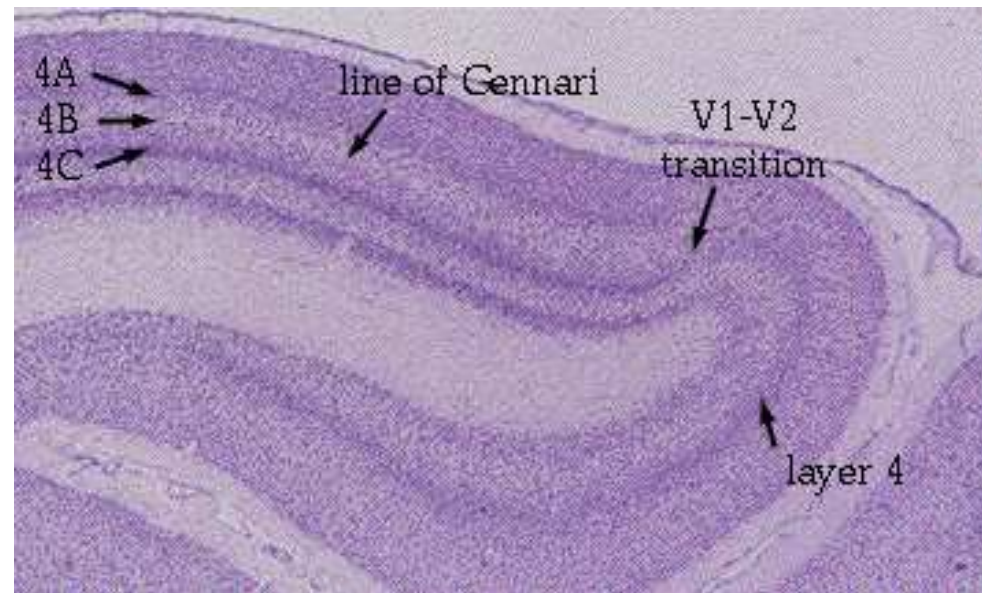




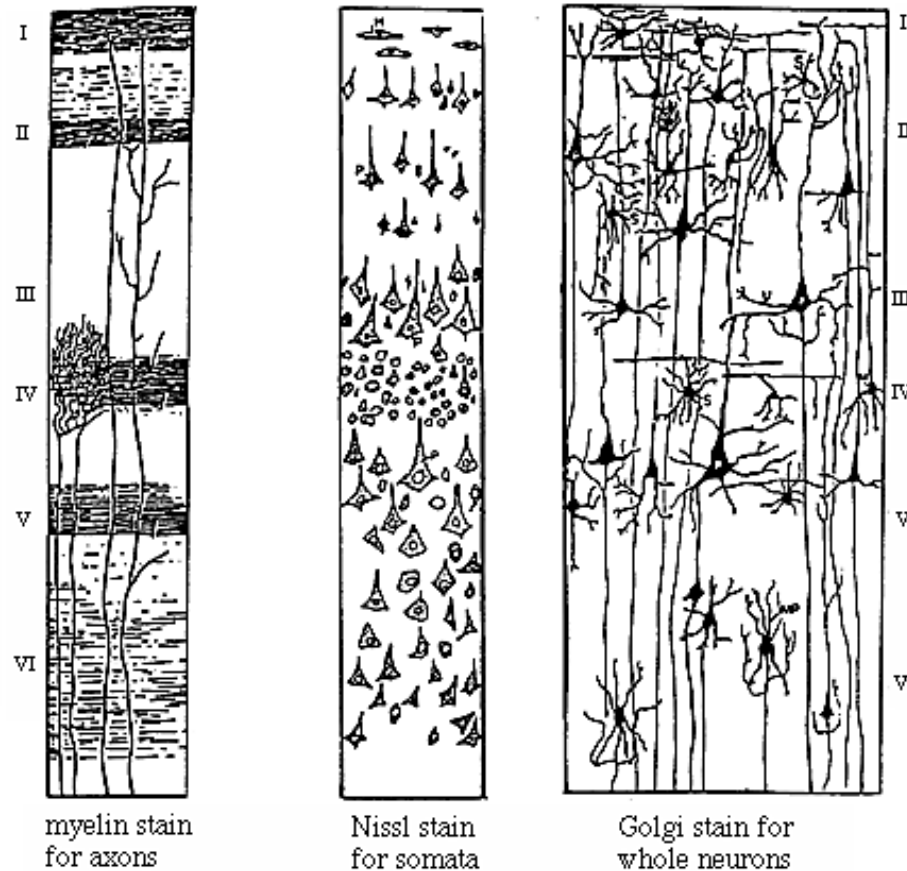
Cortical Layers and Microcolumns(1/3)



Cortical Layers and Microcolumns(2/3)



Cortical Layers and Microcolumns(3/3)



Neurons and Synapses

More about those in dedicated lectures

