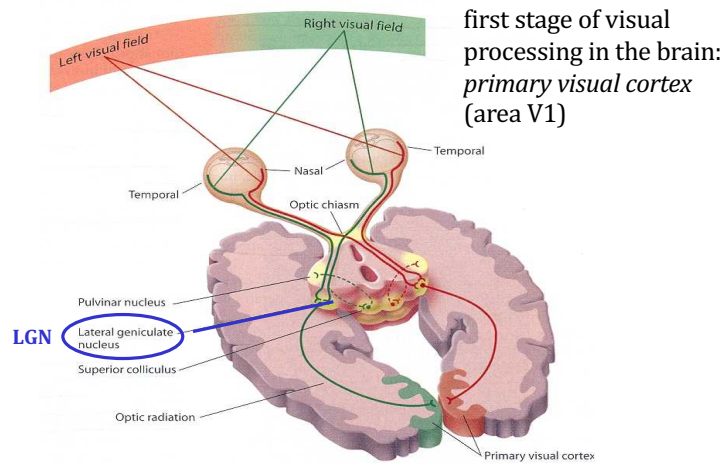


Projection from the retina to visual cortex



1

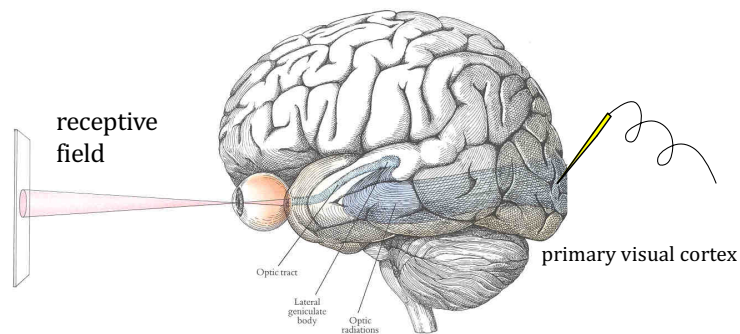
Mapping cortical receptive fields



David Hubel & Torsten Wiesel
1981 Nobel Prize in Physiology or Medicine

2

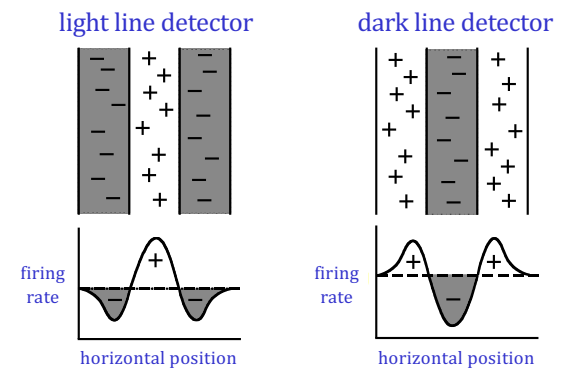
Single-cell recording from visual cortex



Hubel & Wiesel identified 3 basic cell types:
simple, complex, hypercomplex cells

3

Some simple cells respond best to lines...

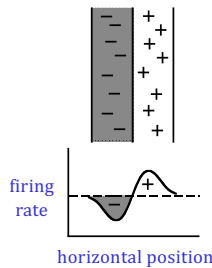


... of a particular contrast sign, orientation, position

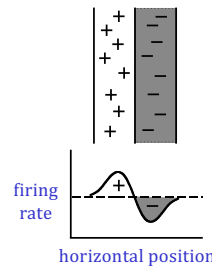
4

Some simple cells respond best to edges

dark-to-light edge detector



light-to-dark edge detector

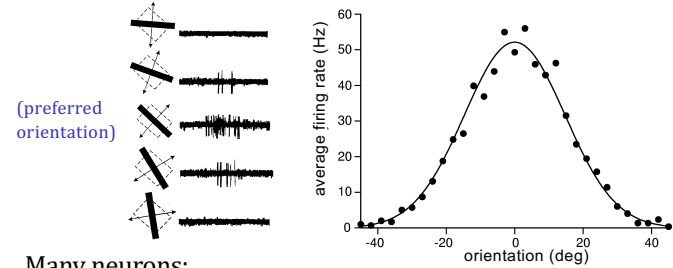


Again, of a particular contrast sign, orientation, position
 large receptive fields → coarse spatial structure
 small receptive fields → fine spatial structure

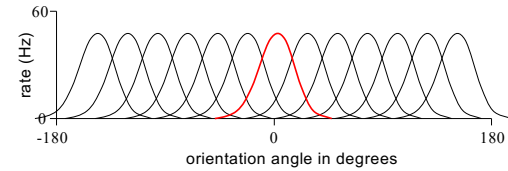
5

Orientation tuning curves

Single neuron:

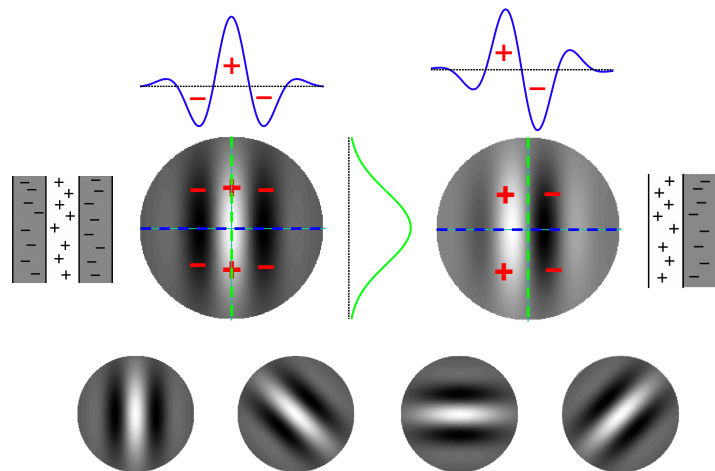


Many neurons:



6

Receptive fields resemble 2D Gabor functions

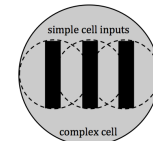


7

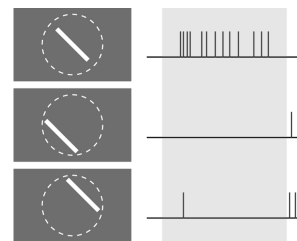
Complex cells

Complex cells are similar to simple cells, but...

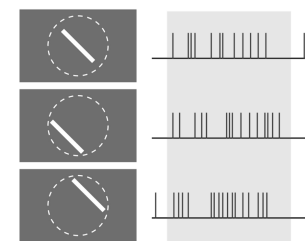
- larger receptive fields
- more tolerant to position changes
- some also selective for stereo disparity (depth) or direction of motion



simple cell



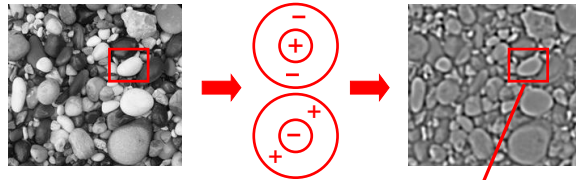
complex cell



response to a light bar at different positions within the receptive field

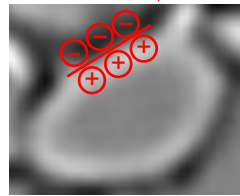
8

Detecting intensity "edges"



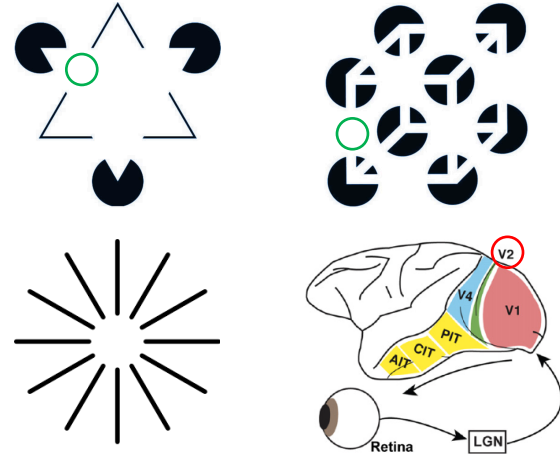
simple & complex cells
detect *edges and lines* of
preferred orientations
and sign of contrast ...

... some are also selective
for depth and motion



9

Illusory contours in area V2



10



11