

Computational Neuroscience

2017



Introduction - Continued

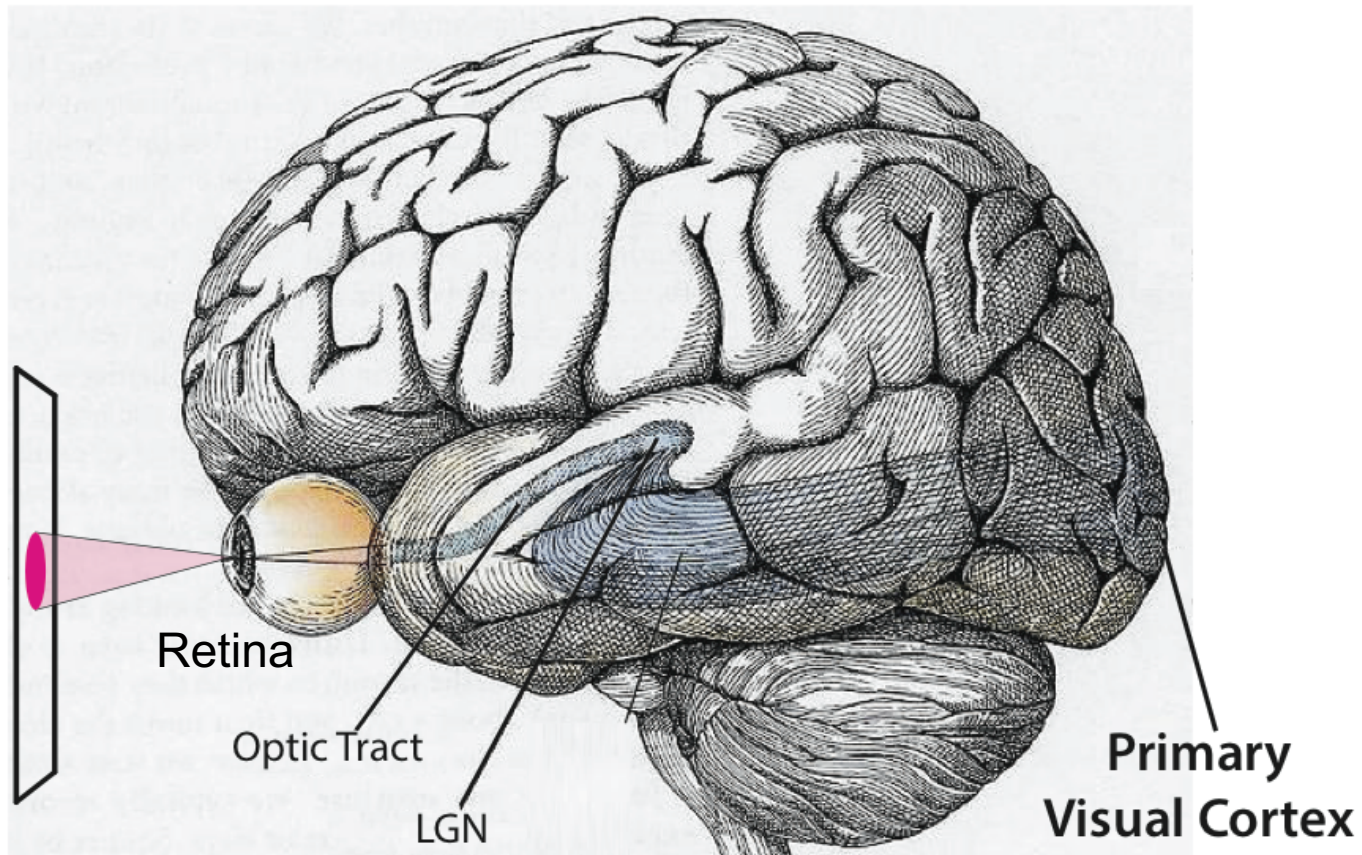
Instructor: Odelia Schwartz

Example: Receptive fields

Classical definition: A region of the visual field that must be Stimulated directly in order to obtain a response from a neuron.

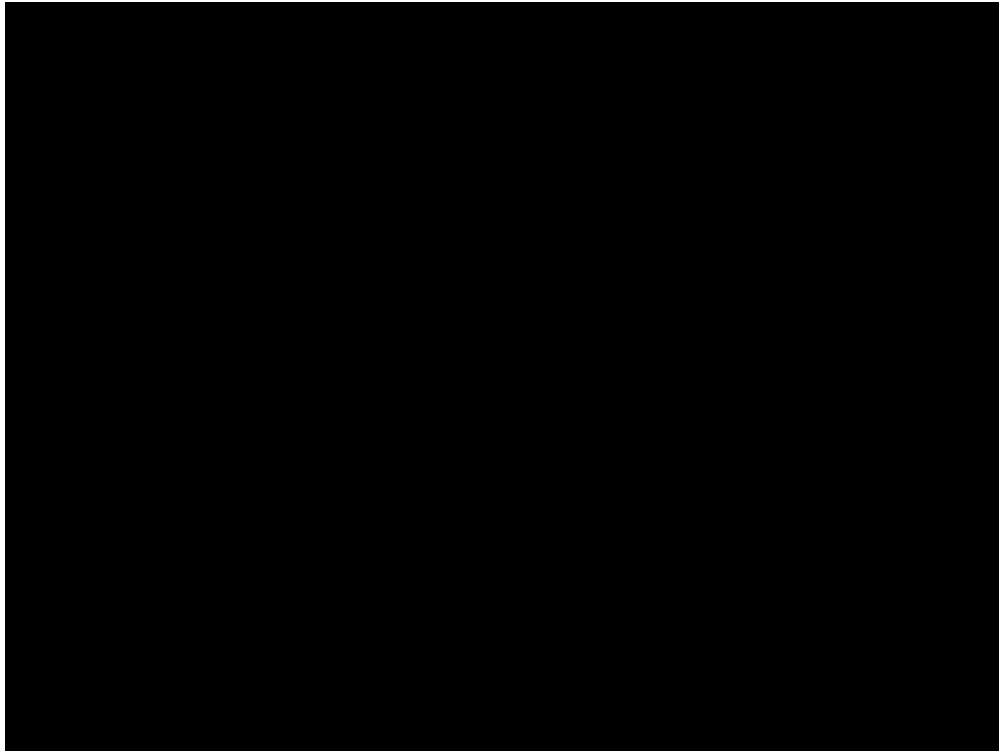
Modern / Computer Science / engineering: filter that captures those attributes of the stimulus that generate responses.
Often assumed linear.

The Visual System



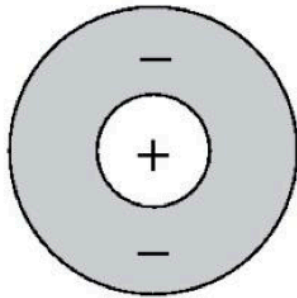
From Hubel

Example: Receptive fields

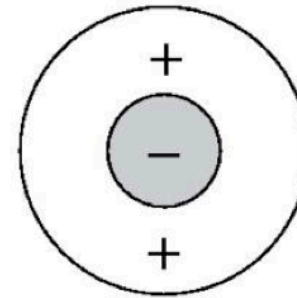


- Receptive fields in Retina and LGN are similar
- Shown here LGN

Example: Receptive fields retina / LGN



On-Center
Off-Surround
Receptive Field



Off-Center
On-Surround
Receptive Field

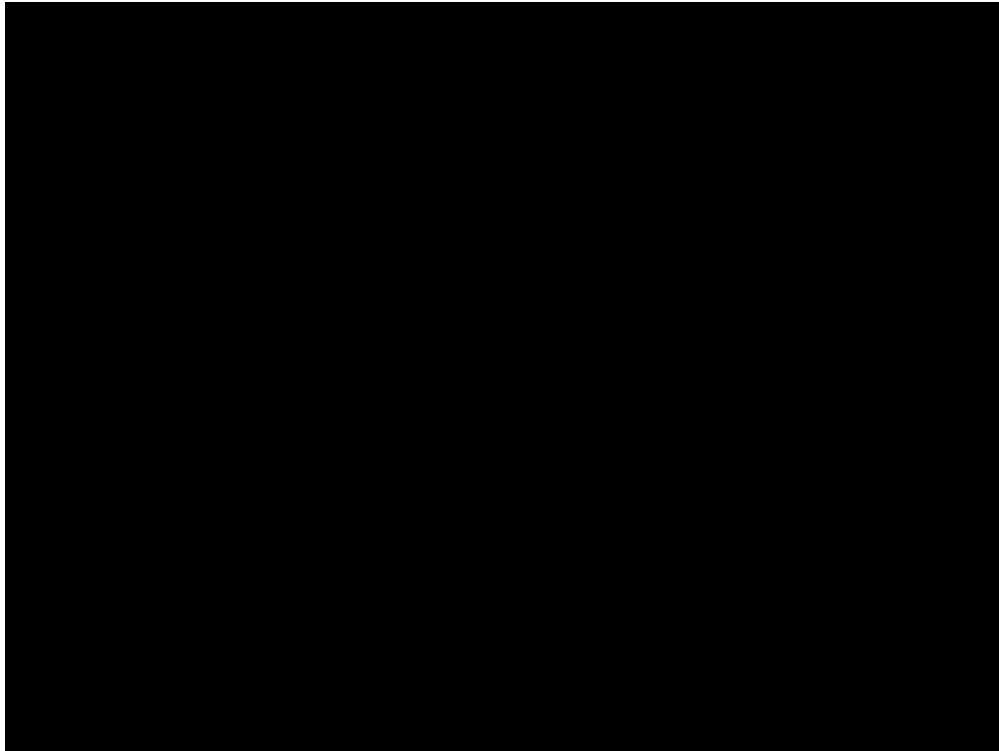
Neural processing

Primary visual cortex

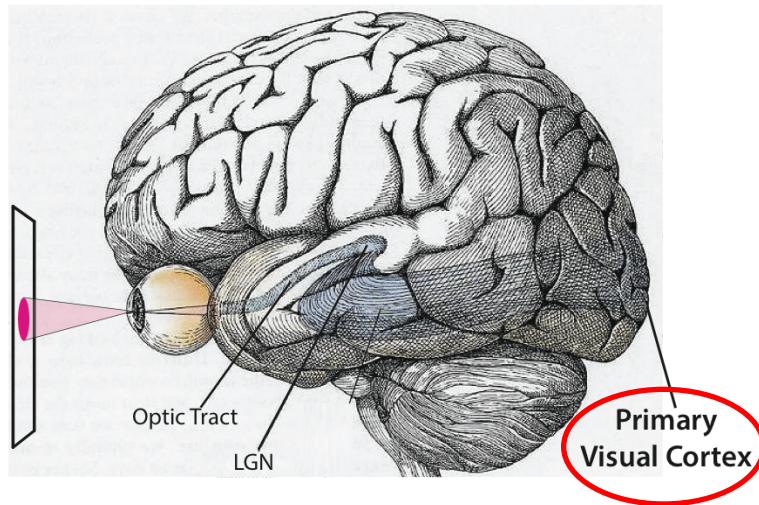
Hubel and Wiesel, 1959



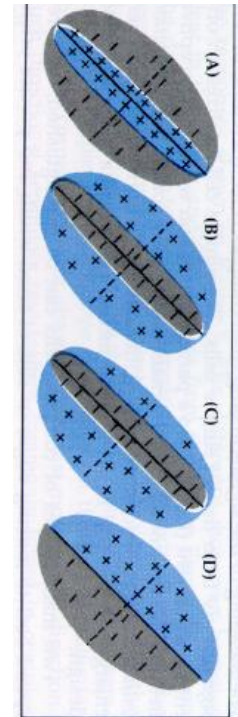
Example: Receptive fields



Example: Receptive fields V1



R. Rao, 528 Lecture 1

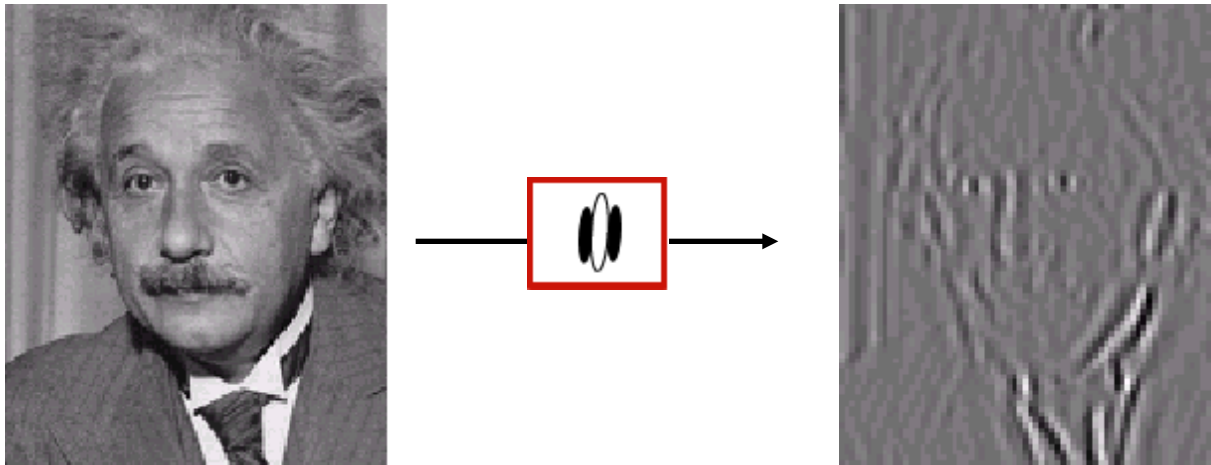


(From Nicholls et al., 1992)

Examples of
receptive
fields in
primary
visual cortex
(V1)

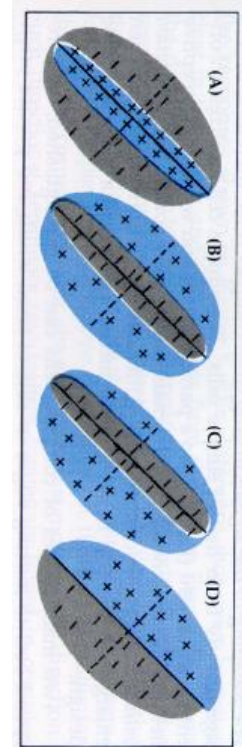
Computer science / engineering

Visual receptive field or filter!



Example: Receptive fields

- ◆ The Question: *Why* are receptive fields in V1 shaped in this way?



What are the computational advantages of such receptive fields?

- Interpretive/normative model: *Why*

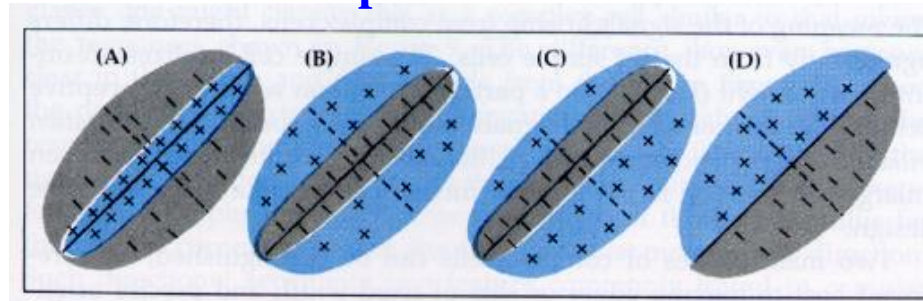
Example: Receptive fields



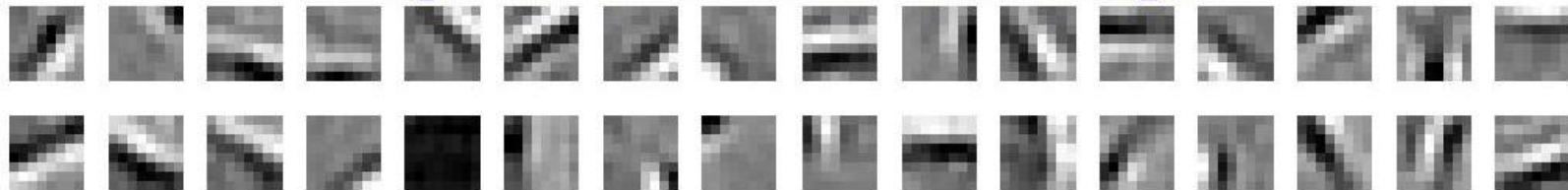
- Interpretive/normative model: Why
- Brain optimized to the structure of images

Example: Receptive fields

Receptive Fields in V1



Receptive Fields from Natural Images



- Interpretive/normative model: Why
- More on later!