Computational Neuroscience

2019

Introduction - Continued

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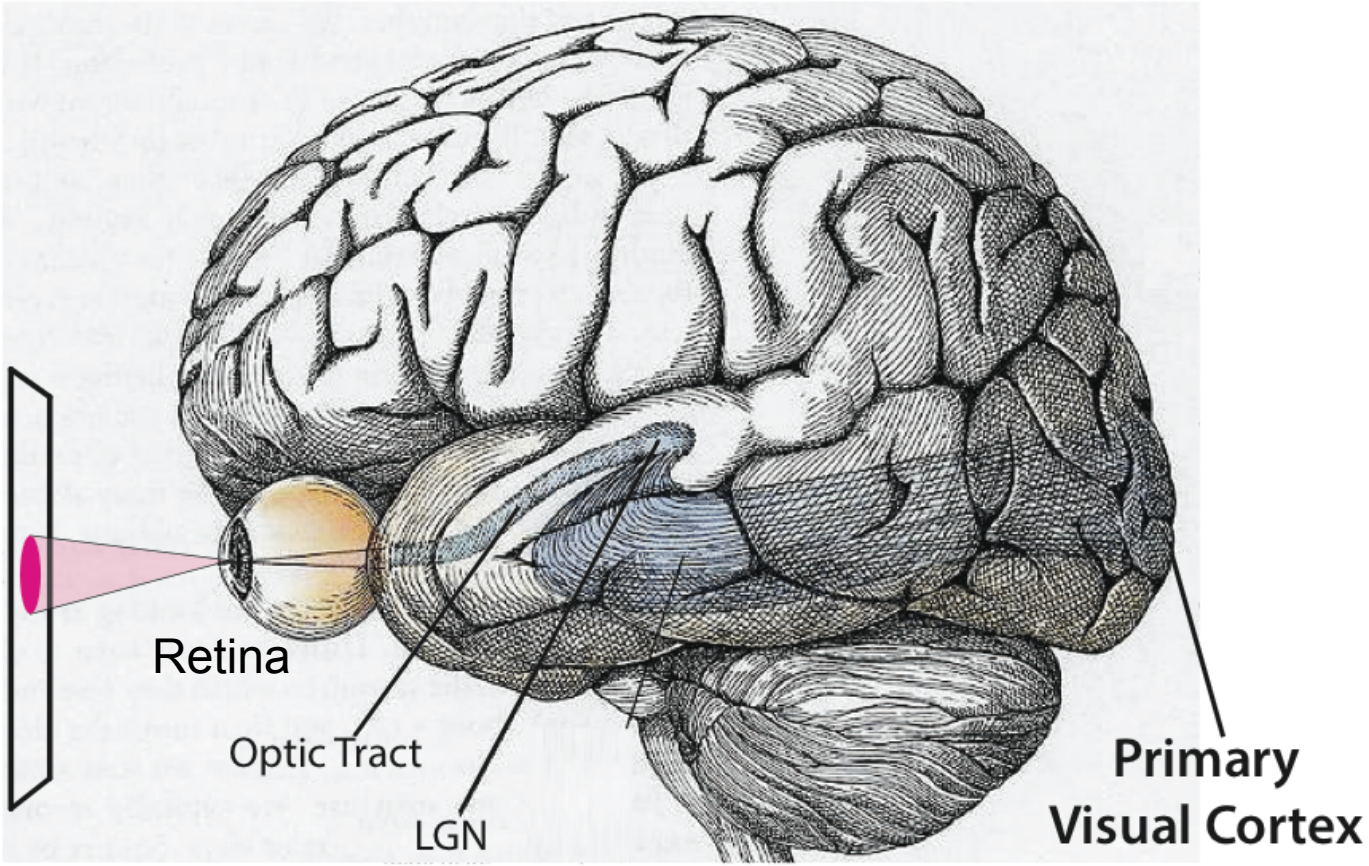
Example: Receptive fields

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

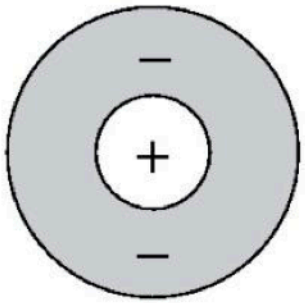


From Hubel

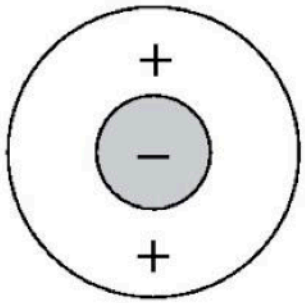
Example: Receptive fields

- 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

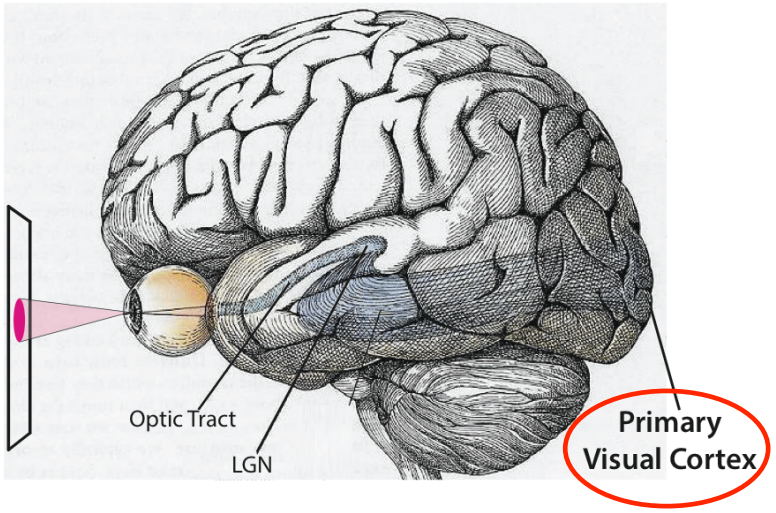
Neural processing

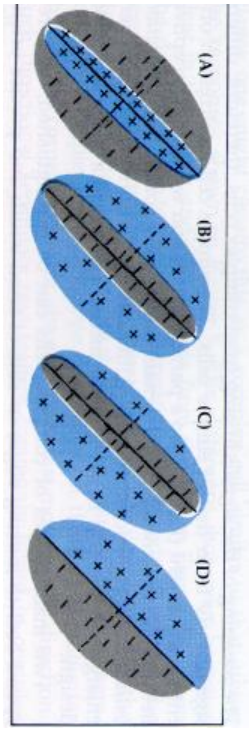
Primary visual cortex

Hubel and Wiesel, 1959

Example: Receptive fields

Example: Receptive fields V1



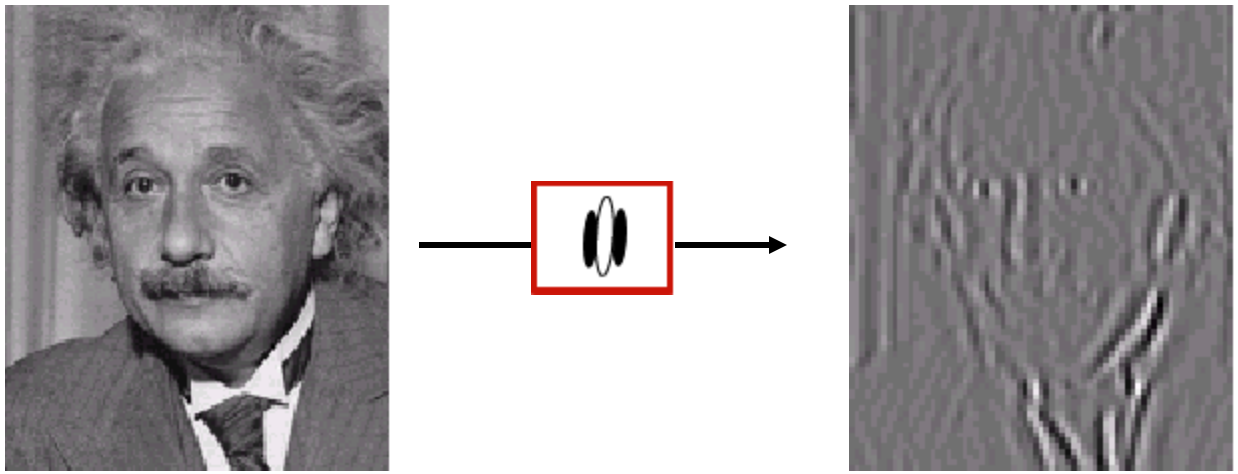


(From Nicholls et al., 1992)

Examples of receptive fields in primary visual cortex (V1)

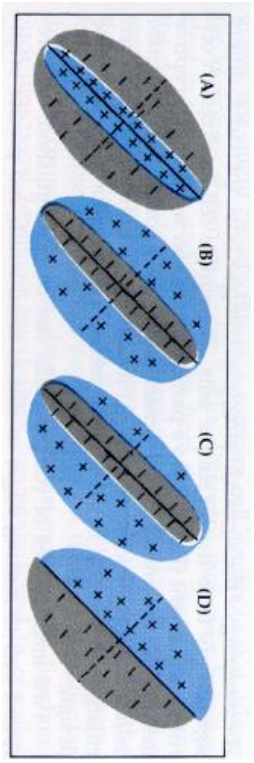
Computer science / engineering

Visual receptive field or filter!



Example: Receptive fields

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



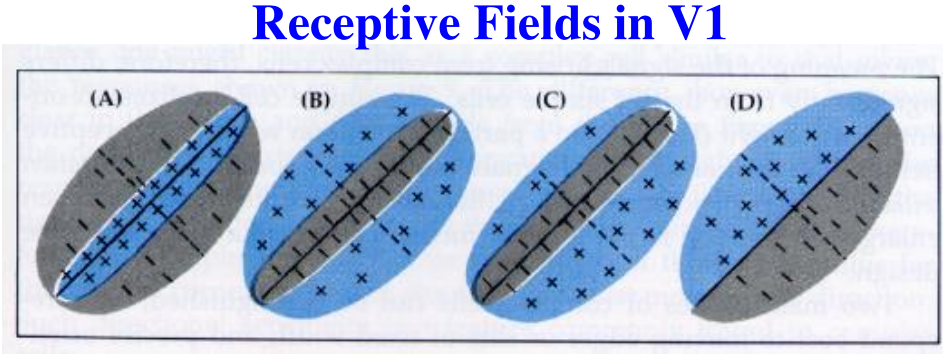
What are the computational advantages of such receptive fields?

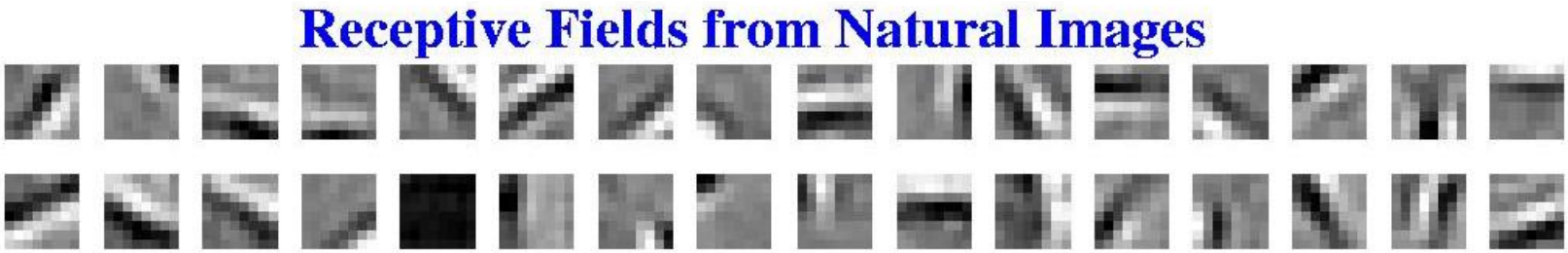
- Interpretive/normative model: Why

Example: Receptive fields

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

Example: Receptive fields





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