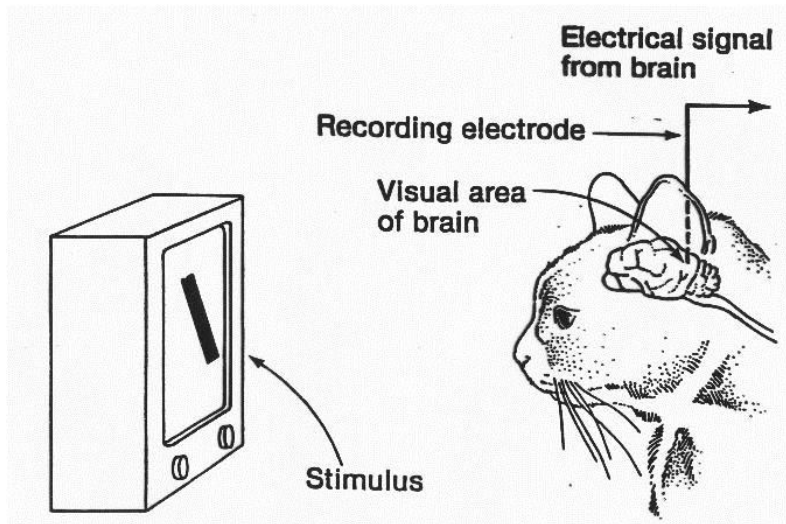


What is Computational Neuroscience?

- ◆ “The goal of computational neuroscience is to explain in computational terms *how brains generate behaviors*” (T. Sejnowski)
- ◆ Computational neuroscience provides tools and methods for “characterizing *what* nervous systems do, determining *how* they function, and understanding *why* they operate in particular ways” (P. Dayan and L. Abbott)
 - ⇒ Descriptive Models (*What*)
 - ⇒ Mechanistic Models (*How*)
 - ⇒ Interpretive Models (*Why*)

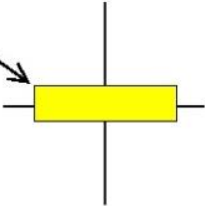
An Example: Models of “Receptive Fields”

Responses of a Neuron in an Intact Cat Brain

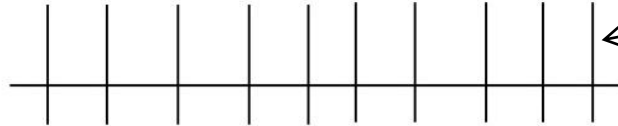


(Hubel and Wiesel, c. 1965)

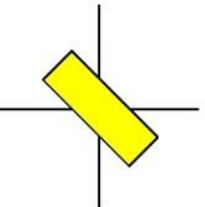
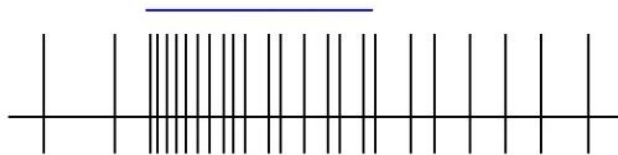
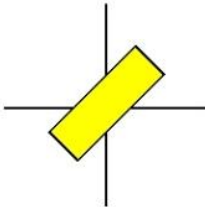
Bar of
Light



Light on



A “spike” from the
recorded neuron



0.5 seconds

Receptive Field

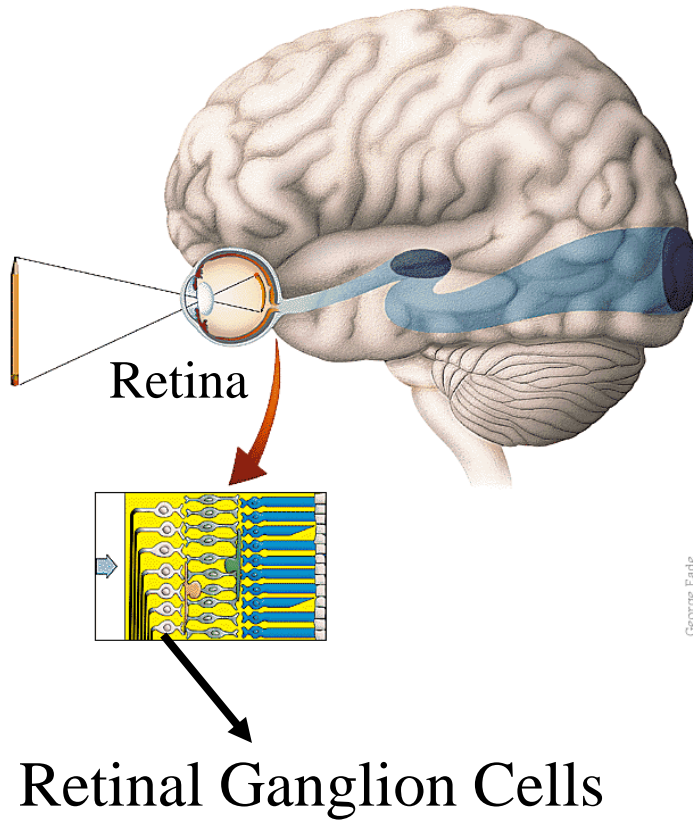
- ♦ Definition: *Specific properties* of a sensory stimulus that generate a strong response from the cell
- ♦ Examples:
 - ⇒ Spot of light that turns on at a particular location on the retina
 - ⇒ Bar of light that turns on at a particular orientation and location on the retina

Receptive Field Models

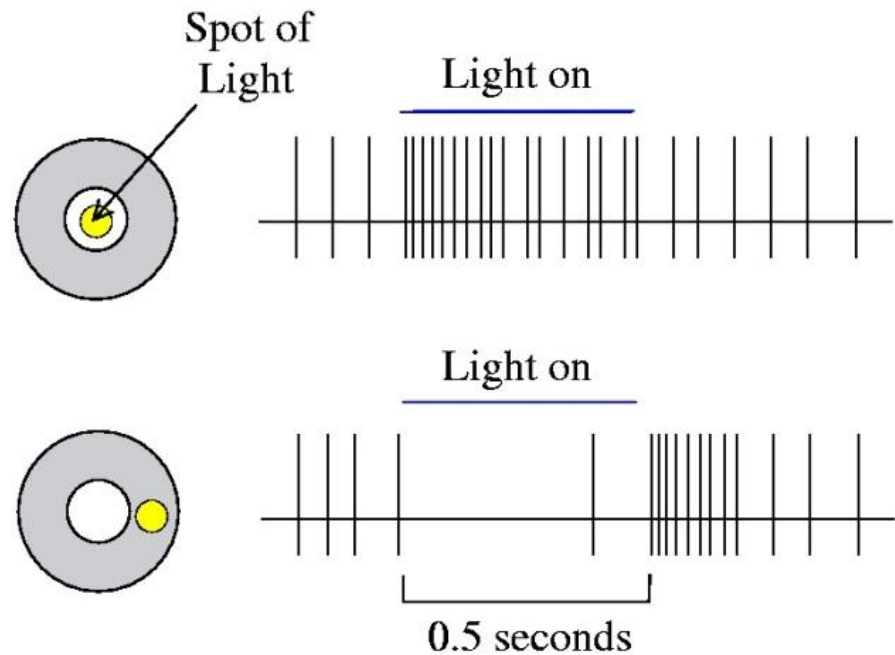
Let's look at:

- I. A *Descriptive Model* of Receptive Fields
- II. A *Mechanistic Model* of Receptive Fields
- III. An *Interpretive Model* of Receptive Fields

I. Descriptive Model of Receptive Fields

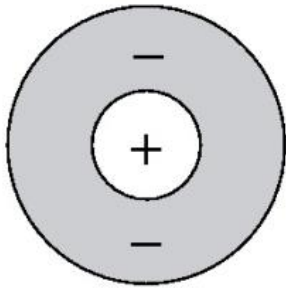


Receptive Fields in the Retina

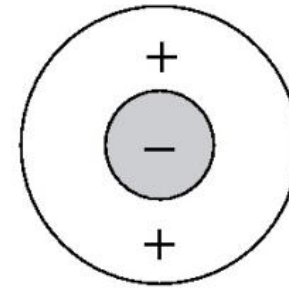


I. Descriptive Model of Receptive Fields

Center-Surround Receptive Fields in the Retina

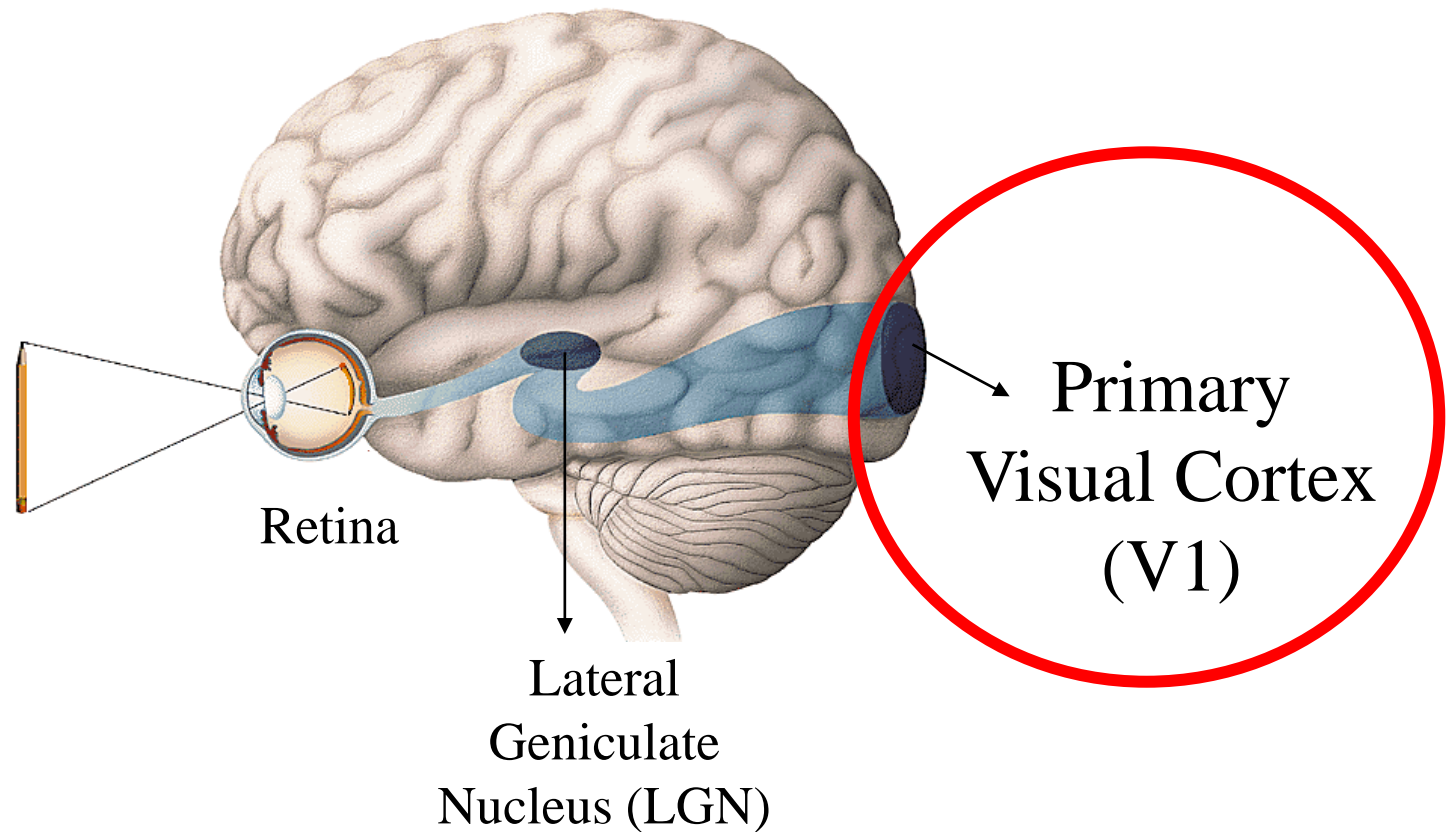


On-Center
Off-Surround
Receptive Field



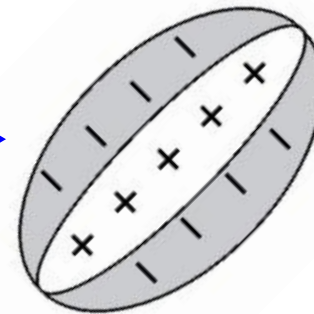
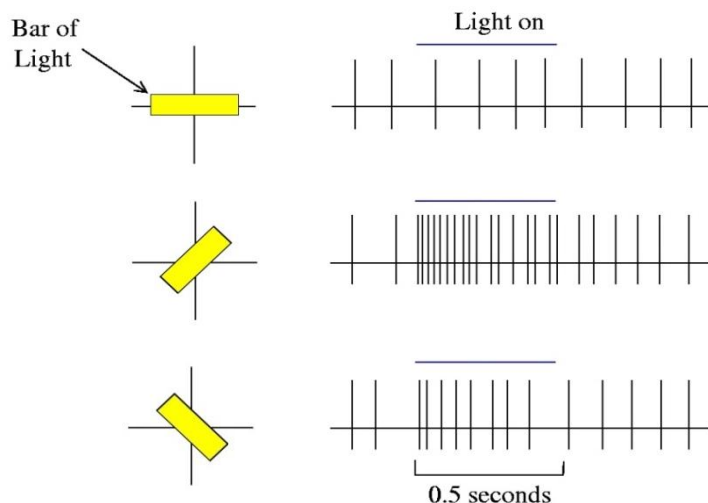
Off-Center
On-Surround
Receptive Field

Descriptive Models: Cortical Receptive Fields



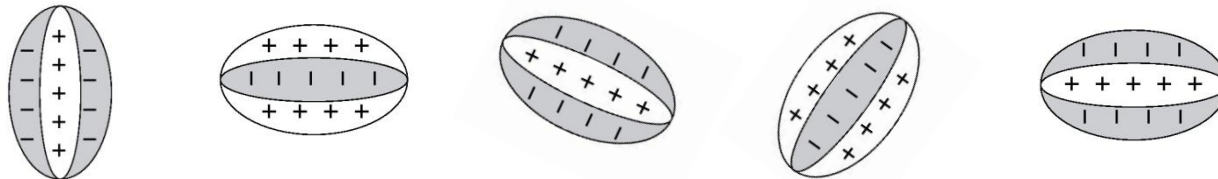
Descriptive Models: Cortical Receptive Fields

Orientation Preference

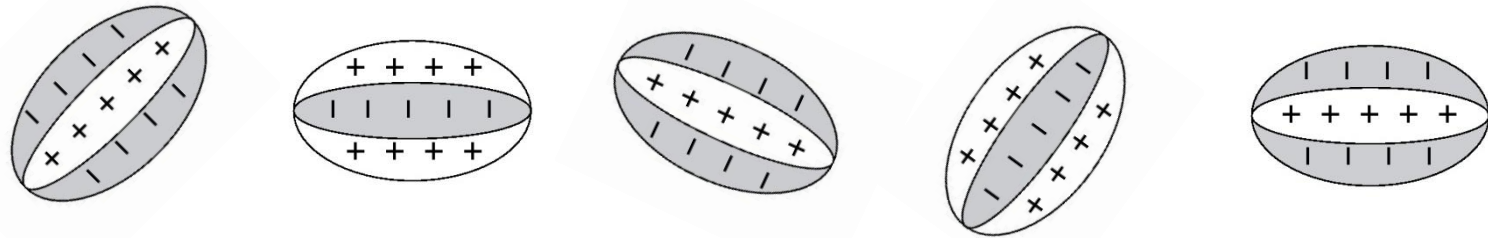


Oriented
receptive field
of a neuron in
primary visual
cortex (V1)

Other examples of oriented receptive fields



We will learn later how to quantify these using **reverse correlation**



How are these *oriented* receptive fields obtained from *center-surround* receptive fields?

Next Lecture: **Mechanistic Model of Receptive Fields**