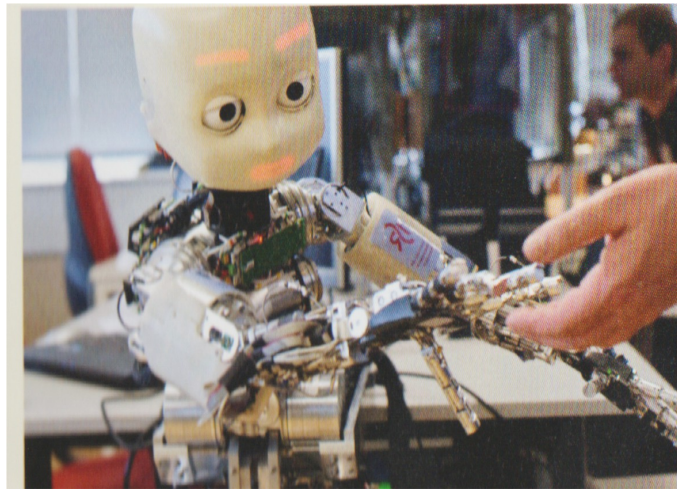# Mathematical Models in Neuroscience
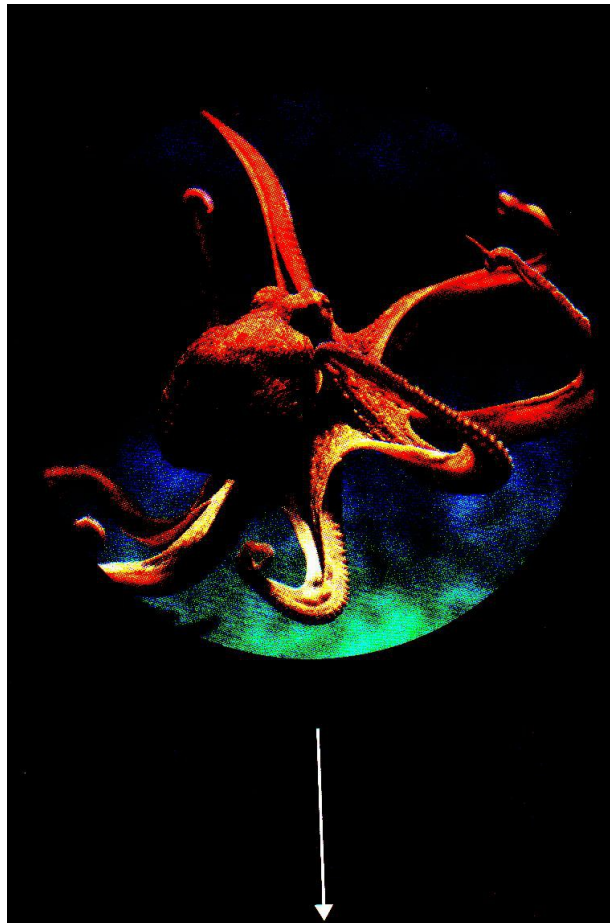
Lecture 5
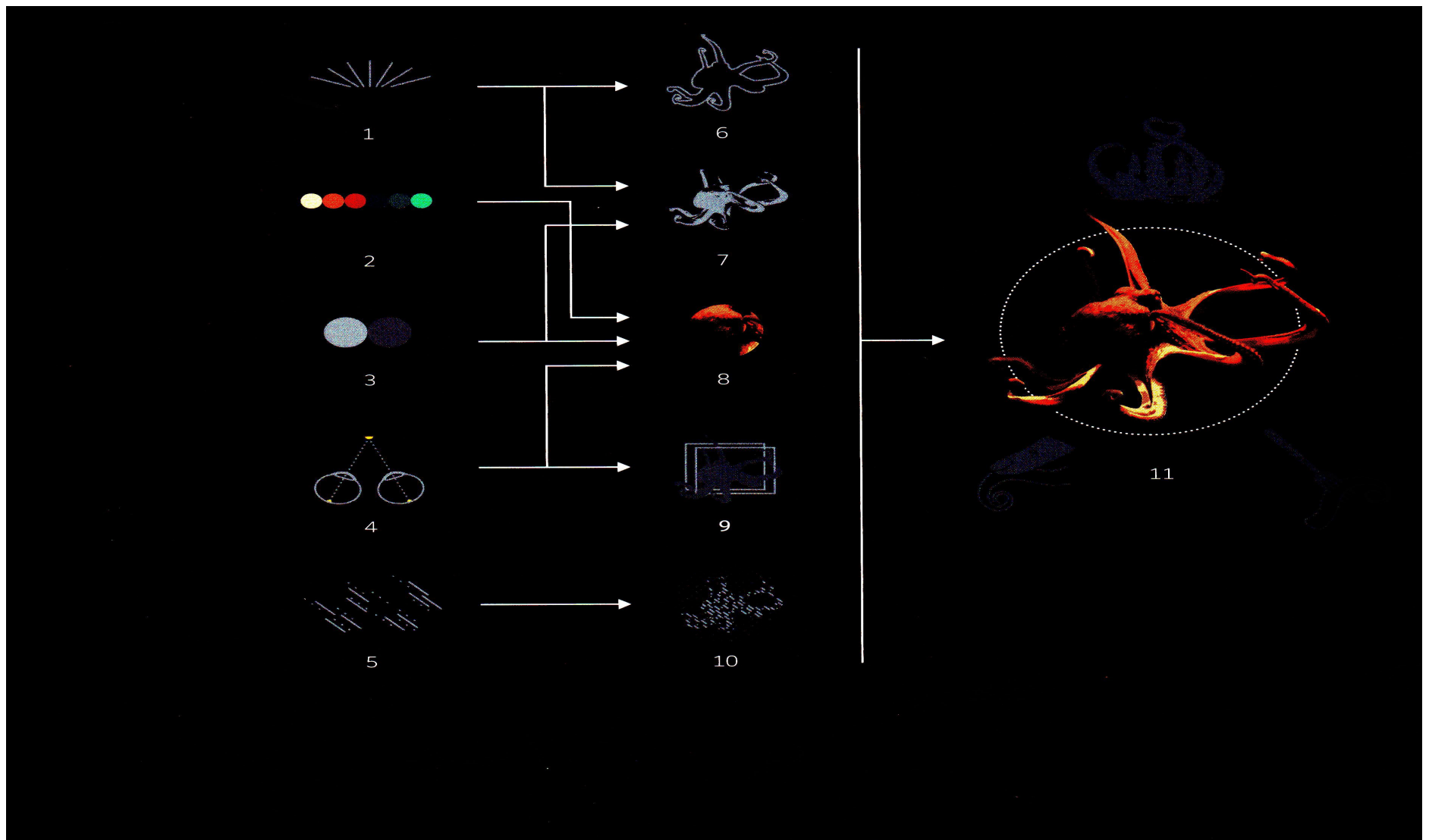## Applications of Neural Fields to Robotics

Robot iCub

How our brain processes images

Suppose you are observing an octopus. How does your brain process the image?

The image is processed **step by step:**
1. the brain collects image **attributes**: orientation (1), color (2), contrast (3),differences (4), signs of motion (5).
2. the brain **defines** the object : silhouette (6), form (7), texture (8), location in 3D-space (9), motion (10).
3. The brain **recognizes** the object.

Which parts of the brain are used to recognize the object?
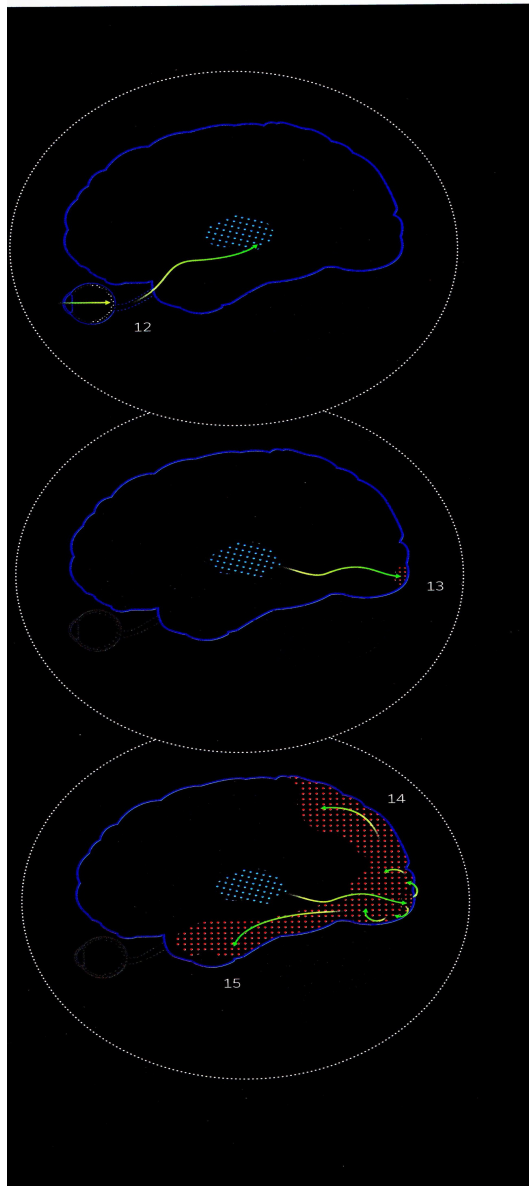
1. The information goes from the retina to the thalamus (12)...
2. from the thalamus to the visual cortex (13)...
3. from the visual to the parietal cortex (14)
4. from the parietal to the temporal inferior cortex …(15)

What is a memory?

Yellow circles - active neurons.
Dashed lines – synapses.

Memory is a group of connected neurons. Once a neuron of this group is activated the whole neural network becomes active.
The more times the network is activated , the stronger the connection between neurons becomes.

When you store in memory the information about an event, you store different elements, which are kept in separate neural networks.
If just one of the neurons is activated, all the connected neural networks also become active.

Then the information contained in these networks is reproduced , and you remember the event associated to these networks.
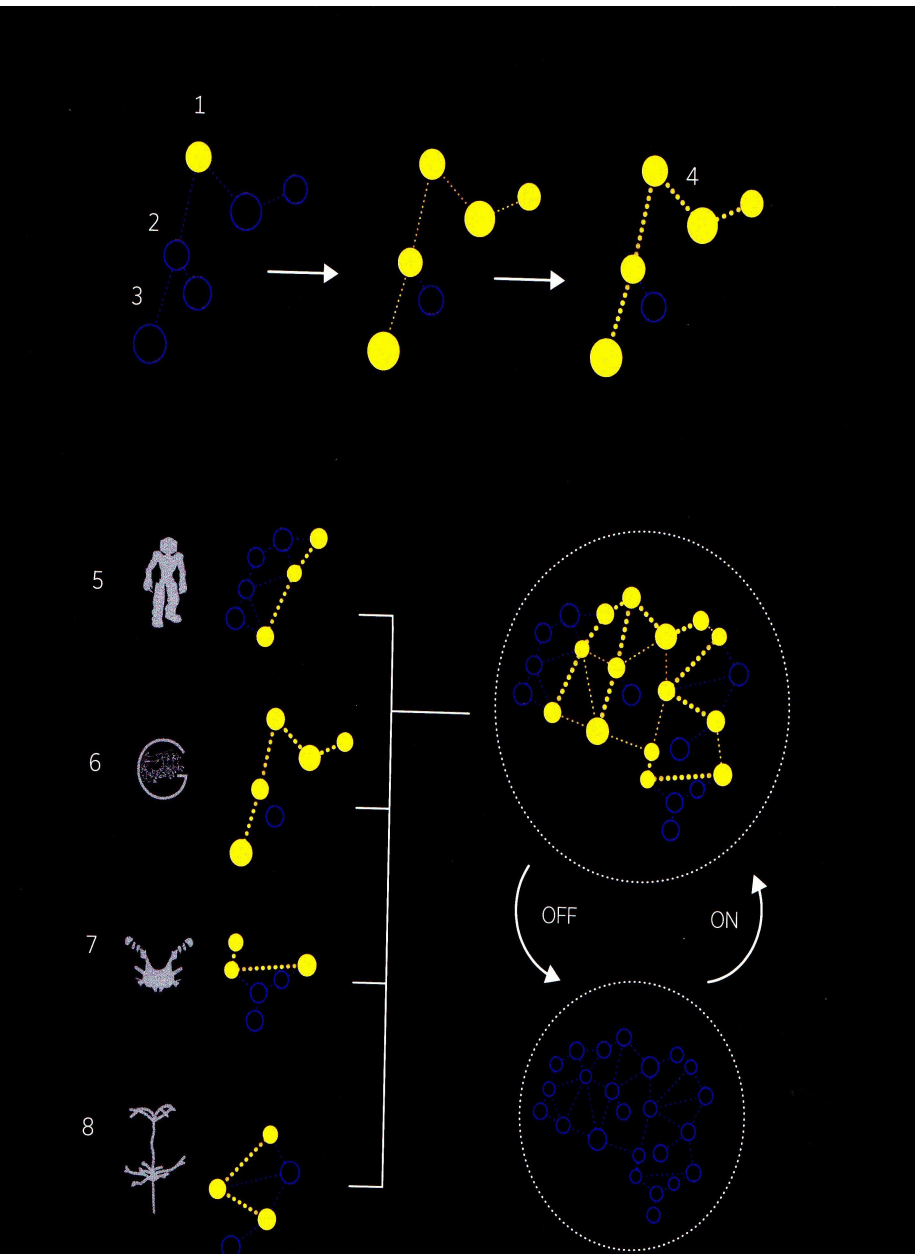
Space Memory

Space memory – Memory about location of objects in space.

When the space memory is often used the corresponding part of the brain grows (for example, a certain part of the hypocampus is more developped in taxi drivers).

Place cells – fire when you are in a certain place.

Grid cells – fire when you move in a certain direction.