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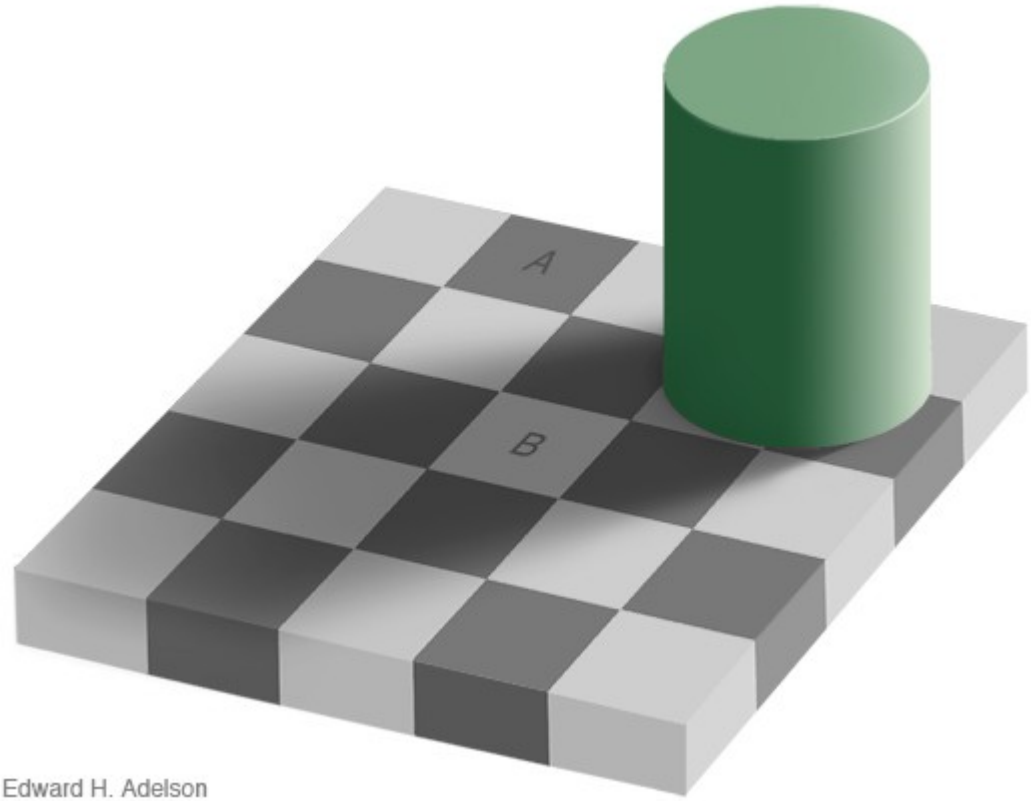
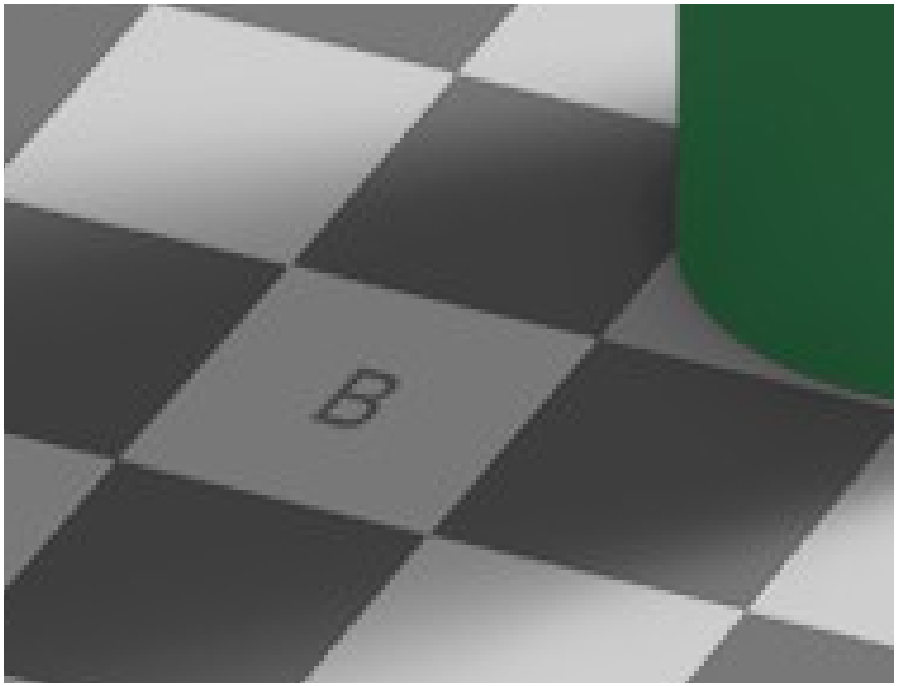
(8)

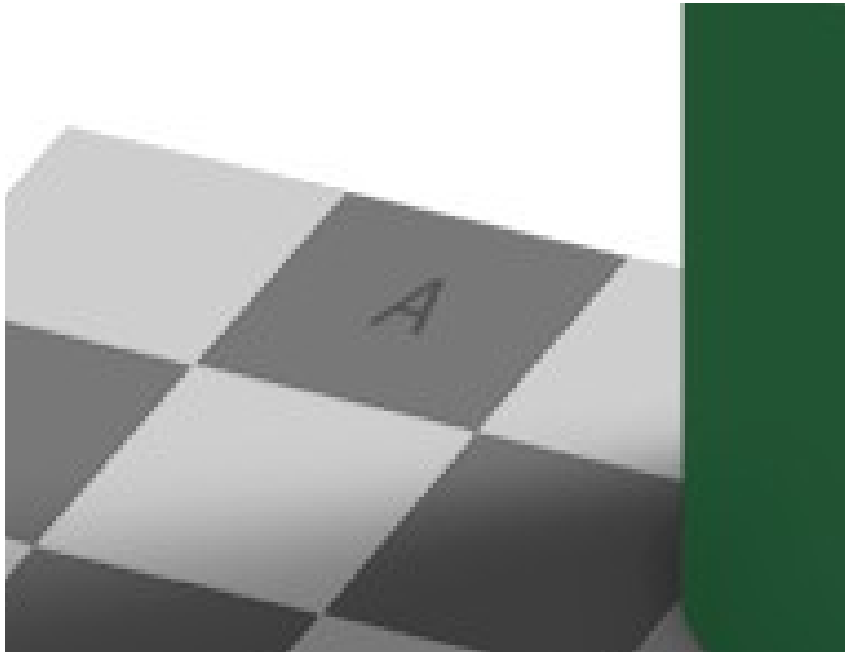
後期２０１０年

The Ultimate Computer: The Brain



The squares marked A and B are the same shade of gray.


B


A

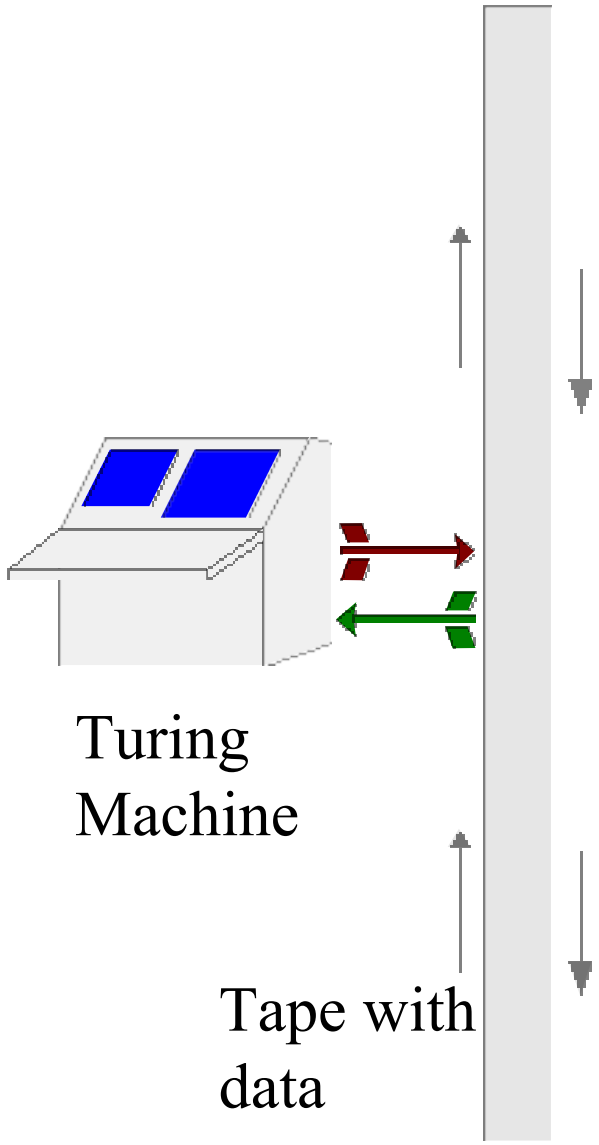
Is a chess machine “intelligent” ?

- The artificial Intelligence Boom: (~1970)
- The Turing Machine

Alan Turing, Mathematician
London 1912-1954

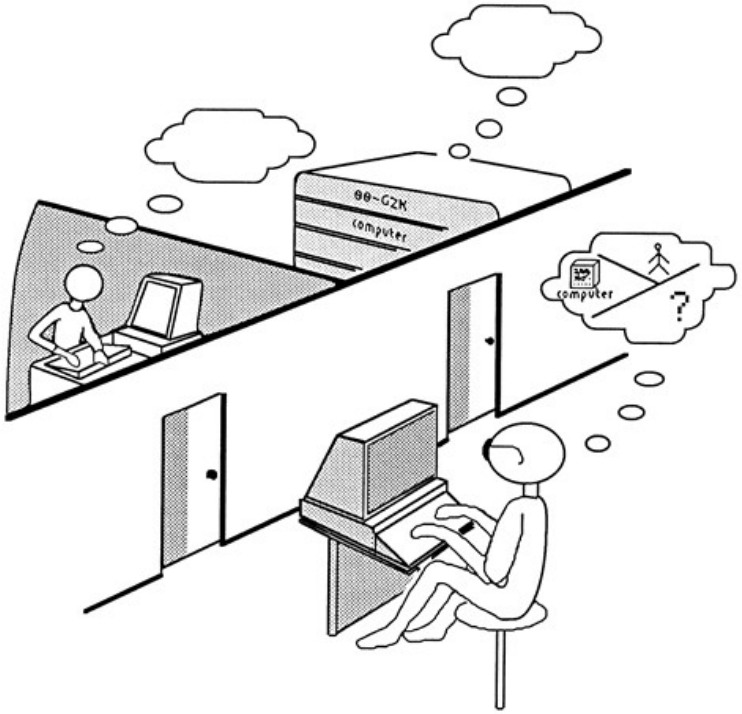
A Turing Machine read and write on a paper tape accordingly to a set of rules. Information on the tape are instructions or results.

Turing demonstrated mathematically that with an infinite tape such machine could be programmed to perform any definable operation.



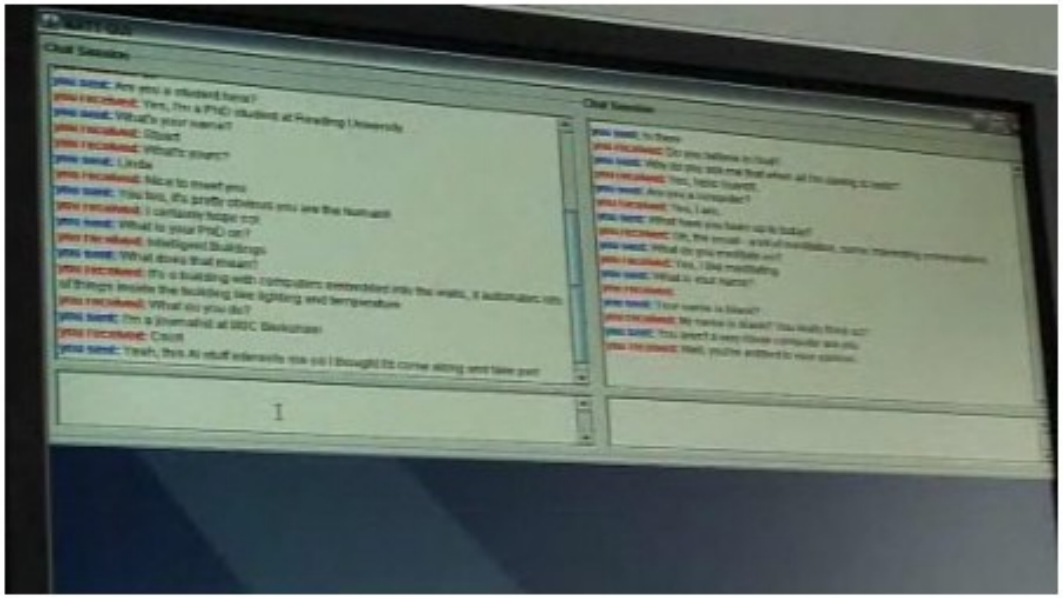
Turing ask himself if a Machine can be intelligent.

He defined the Turing Test:



New round of Turing test fails to crown a winner

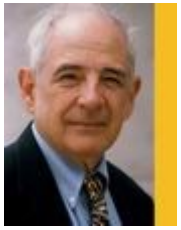
by **Donald Melanson**, posted Oct 13th 2008 at 1:59PM



While some folks are considering taking the Turing test one step further and applying it to military robots, a group of researchers in the UK led by none other than would-be cyborg Kevin Warwick are doing their best to keep things as Turing intended and simply trying to fool some humans into thinking that the robot they're taking to is actually a person. Fortunately for us on the human side of the equation, they weren't quite successful, though one "robot" known as Elbot did get relatively close to the goal, fooling 25% of its human interrogators, which is just 5% off the mark set by Alan Turing. Each of the four other "artificial conversational entities" also managed to fool at least one of their questioners, though they eventually showed their true colors with random answers like "soup" when pressed as to what their job was.

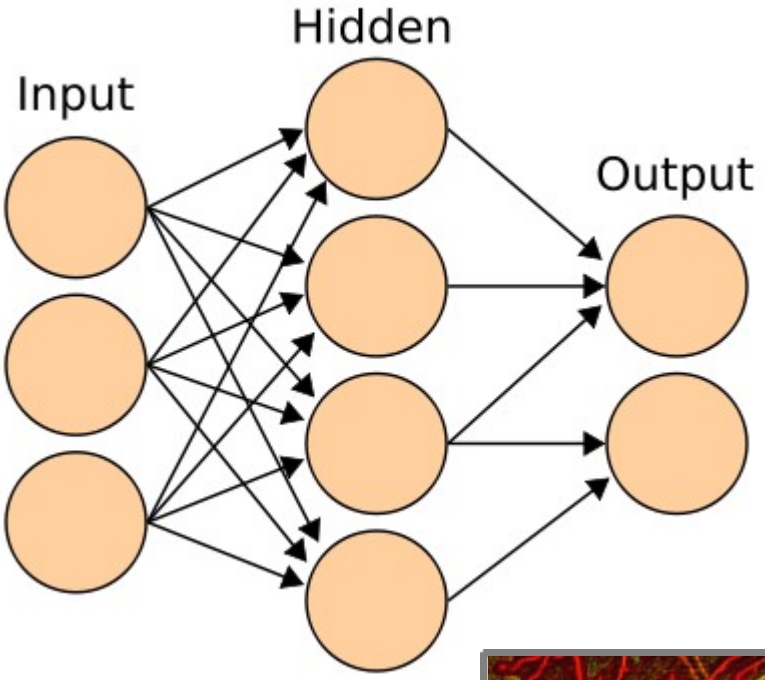
http://testing.turinghub.com/
www.fil.ion.ucl.ac.uk/~asaygin/tt/ttest.html

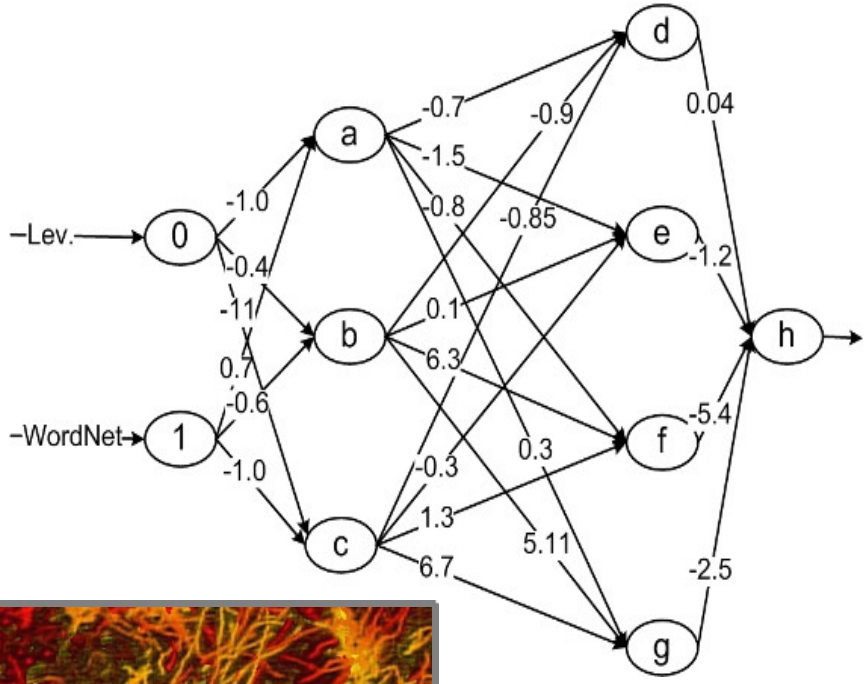
Does Turing Test define an “Intelligent” Machine ?
The Chinese Room Experiment.



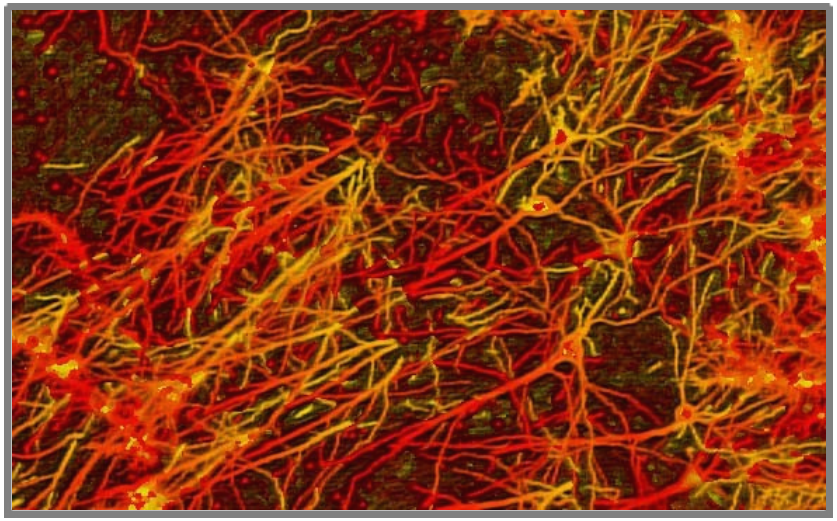
John Searle
1980

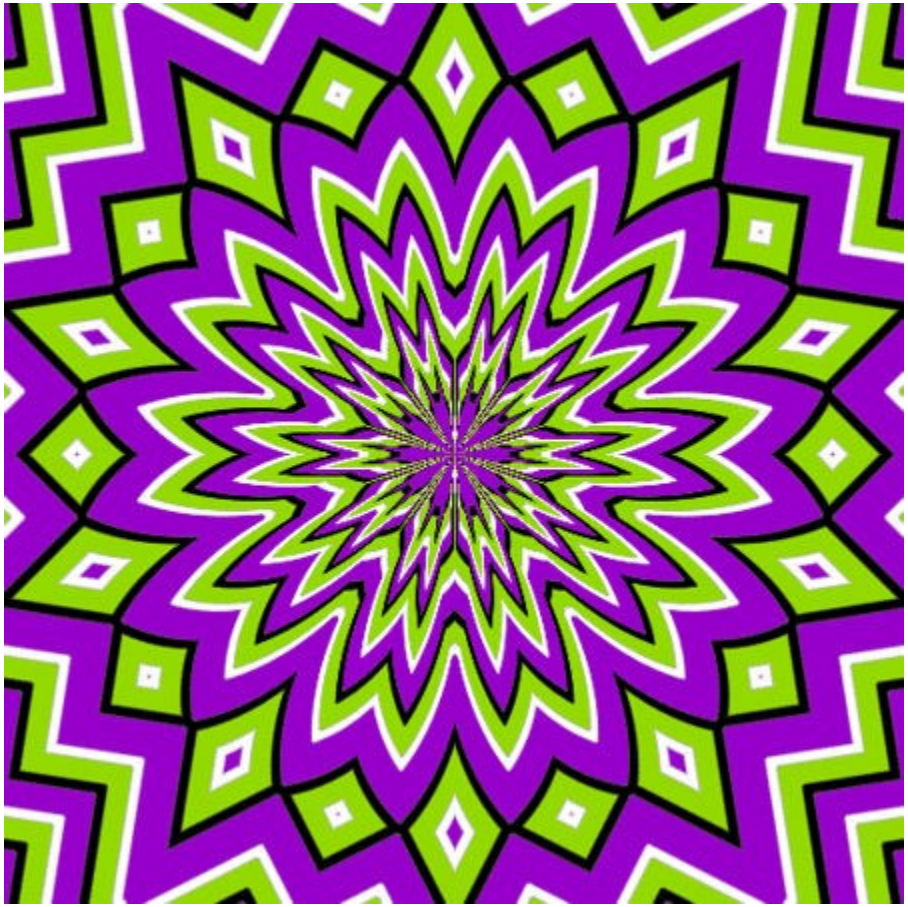
NO! And the digital computer is a Chinese Room!



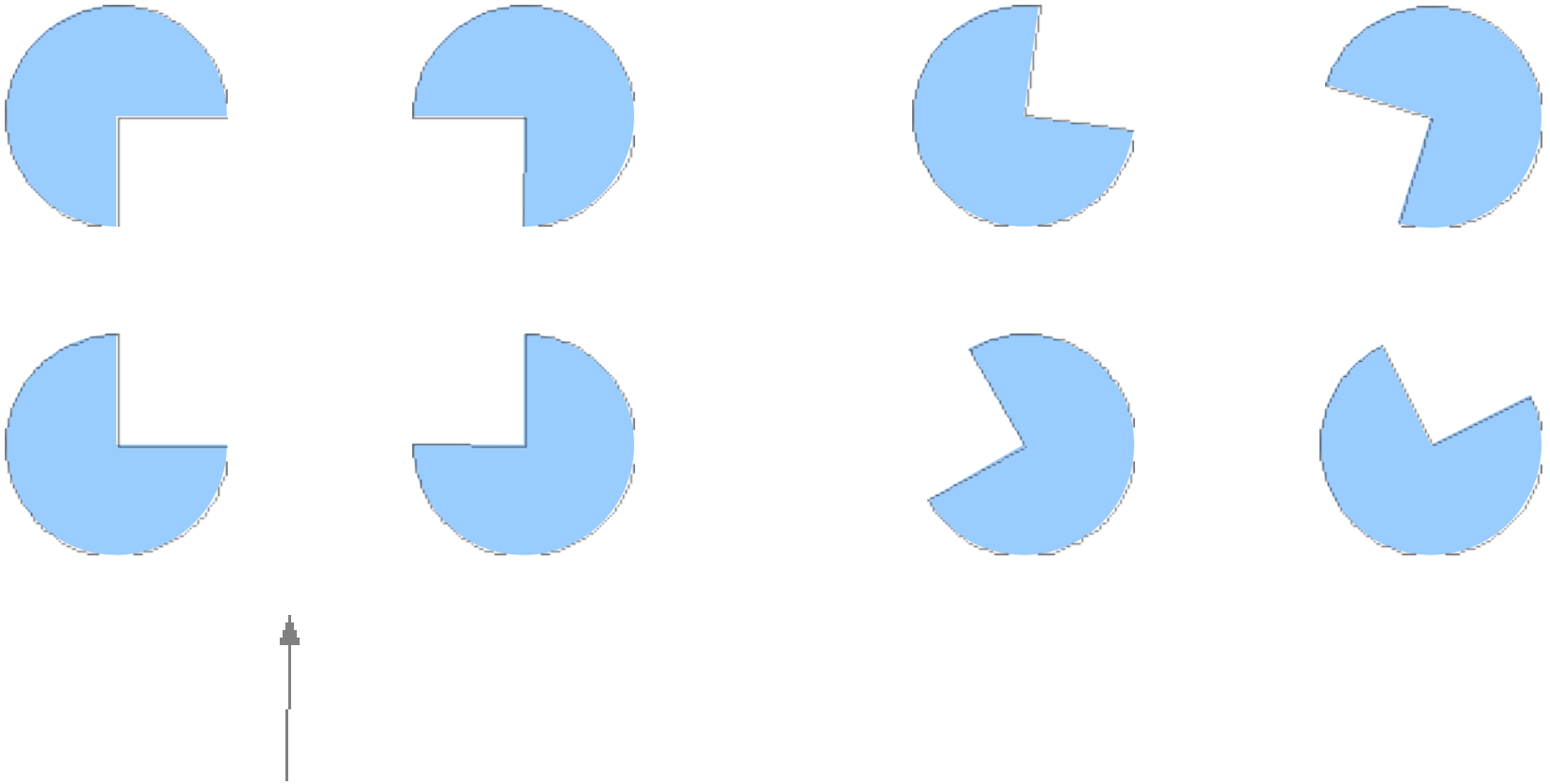


Good in
Prediction
Classification



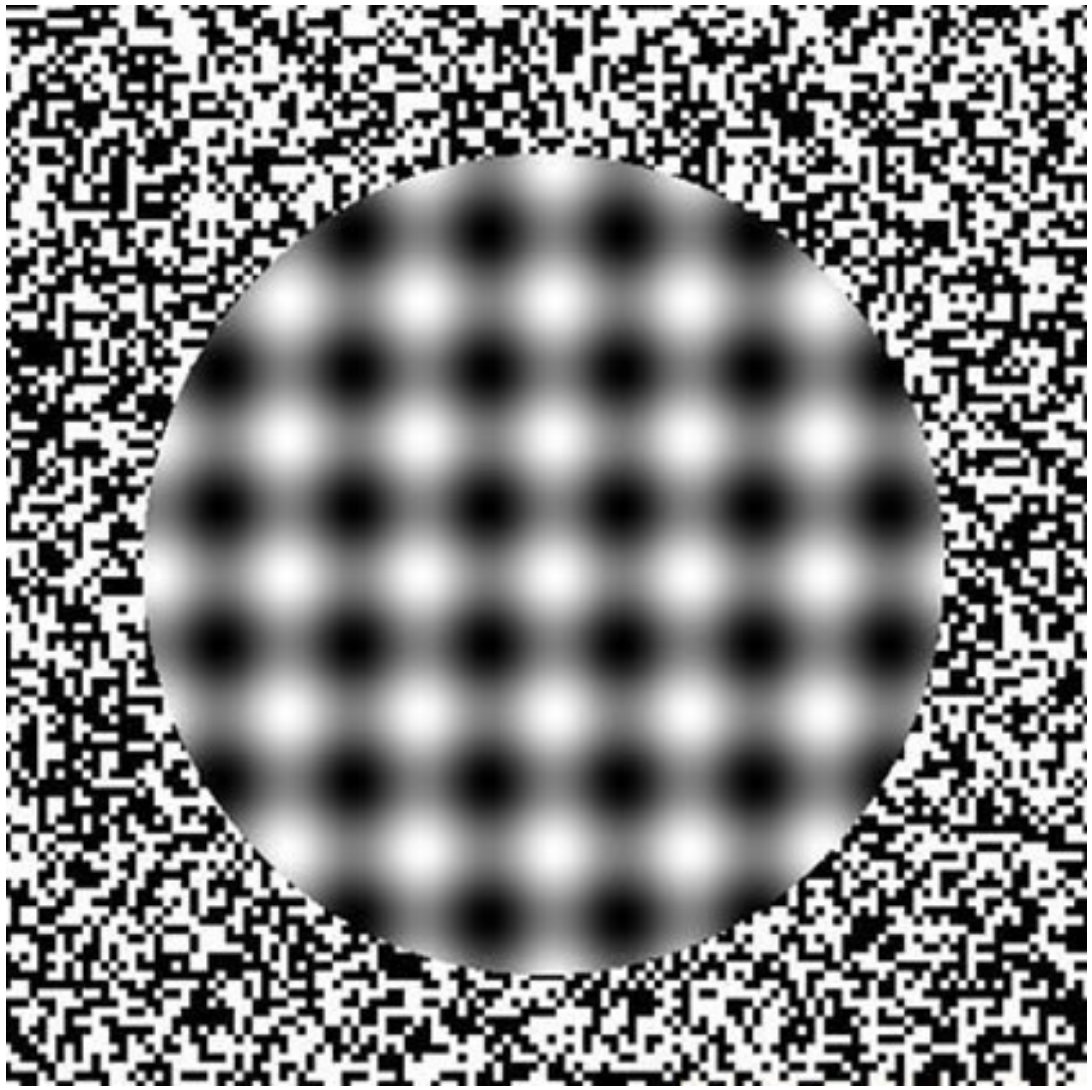


Brain is Auto-associative



There is no square here.
We see a square, because brain “knows” a square and auto-associate the image to the pattern

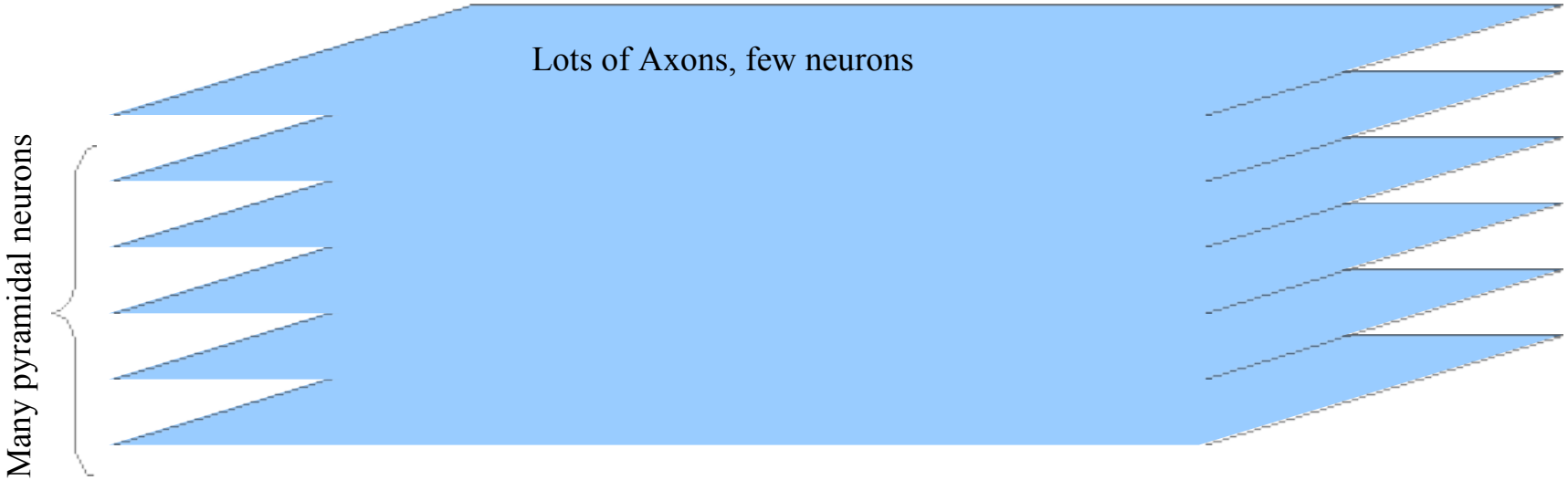

日本タレント名鑑



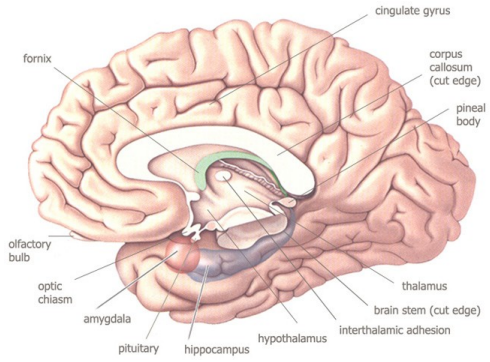
Why we dont understand the Brain yet ?

- We do not have a “paradigm”
- Roads and Aliens example

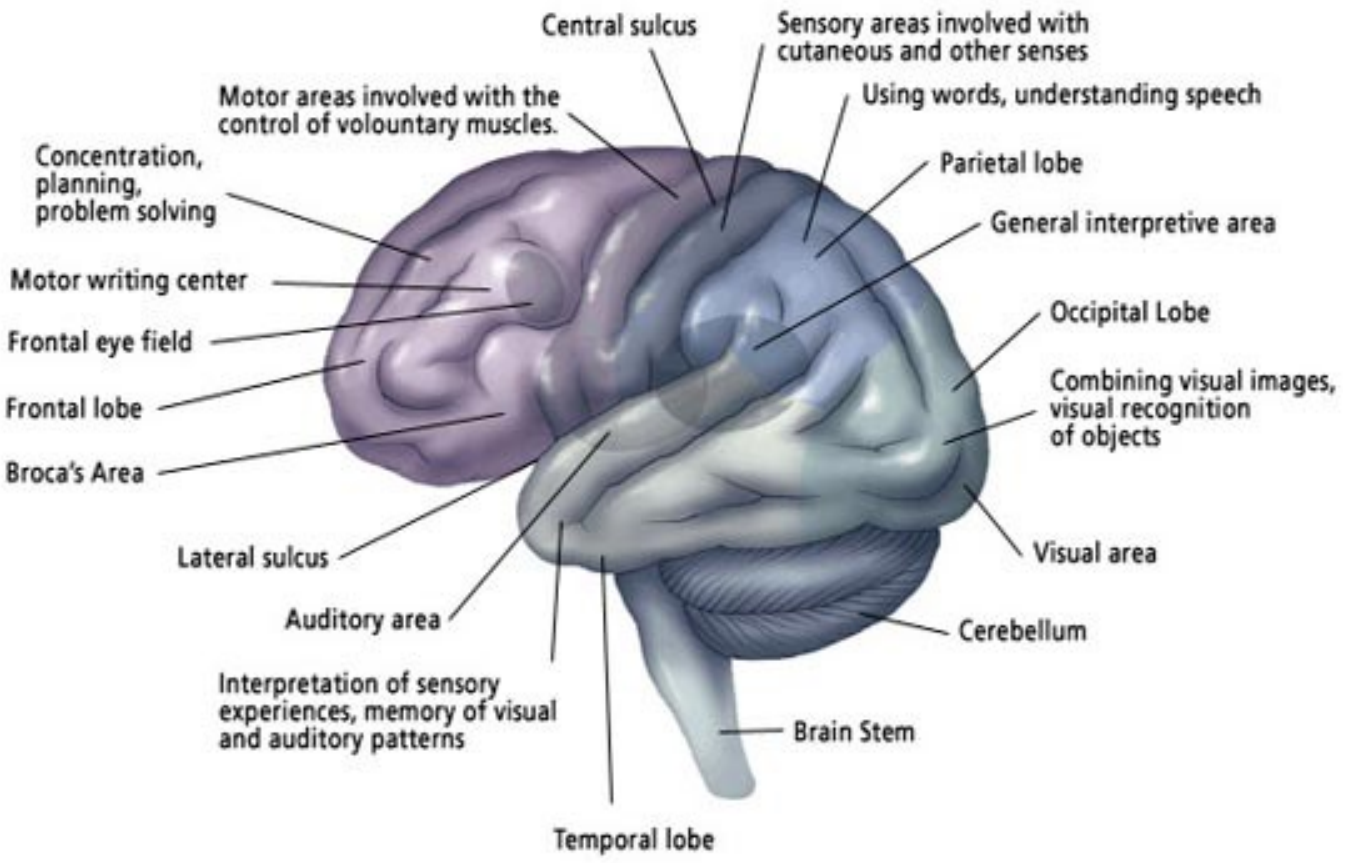
The neocortex is in 6 layers



About 3 10^10 cells only in neocortex

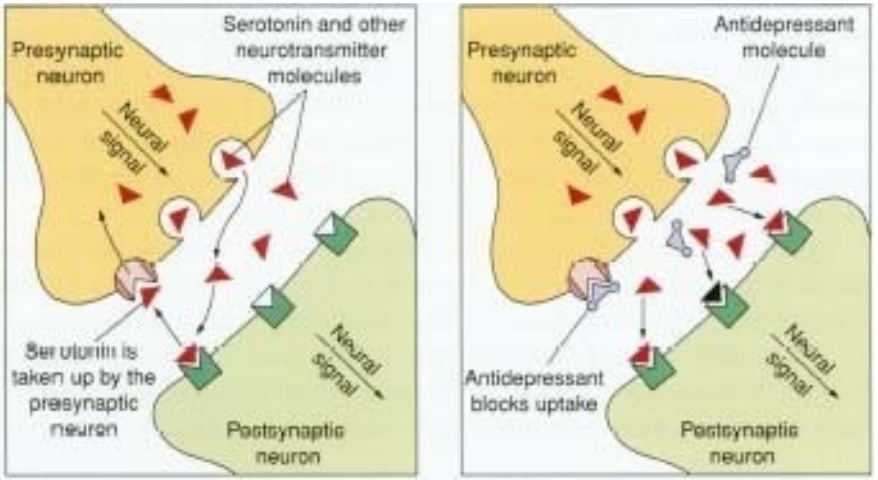


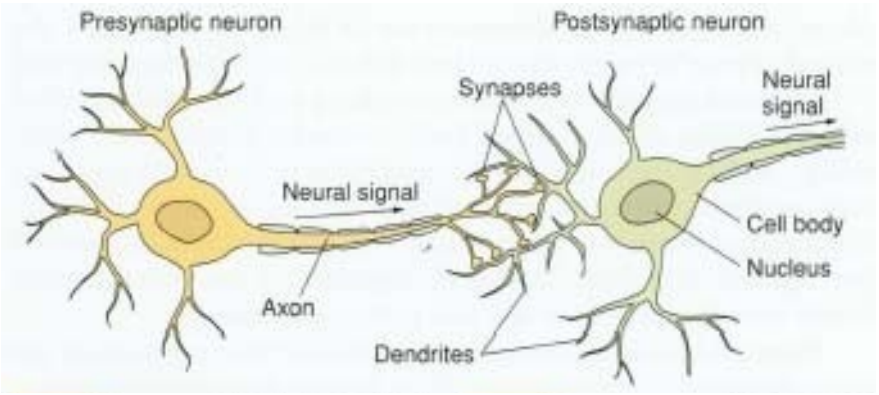
Some Motor, Sensory, and Association Areas of the Cerebral Cortex



What a neuron does ?

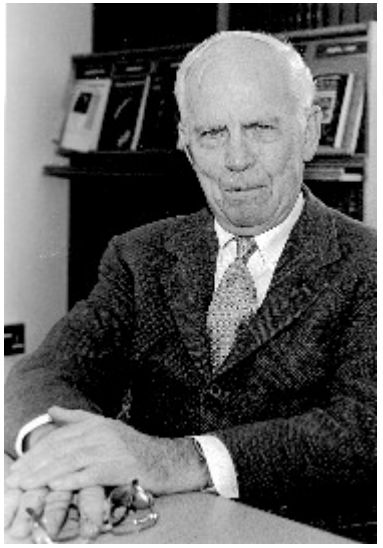
- It emit a “spike”, depending on input signals arriving at the synapses.
- After 5 msec, it reset itself (200Hz).
- More signal to synapses, more easy to spike (Hebbian Learning).





Vernon Mountcastle idea (1978)

- Brain is uniform
- Different area perform same operation
- There is a common algorithm
- Animal experiments confirm Mountcaste ideas.

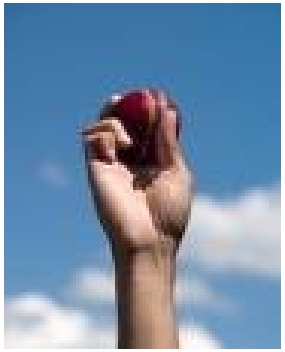


The “Temporal Patterns”

- Vision, Audio, Smell, Taste, Touch... all are “streams” of spikes from neurons.
- There “streams” come from sensory districts in the brain
- The “streams” are kind of patterns in space and time.
- Vision too is a stream of spikes, as well as sound and all the other senses.

Brain is a pattern machine

- Brain use memory to solve problems.
- Example of “catch ball”, computer can perform a simple catchball like a child can.



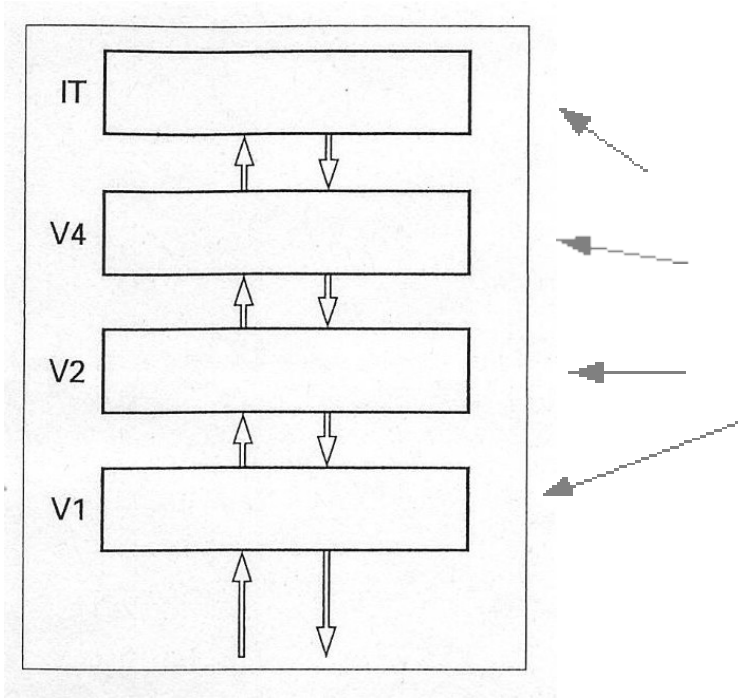
The “invariant” representation

- Brain has a way to memorize things “invariantly” from details.
- We can recognize a dog from a cat from any angle or any position.
- Computers cannot !

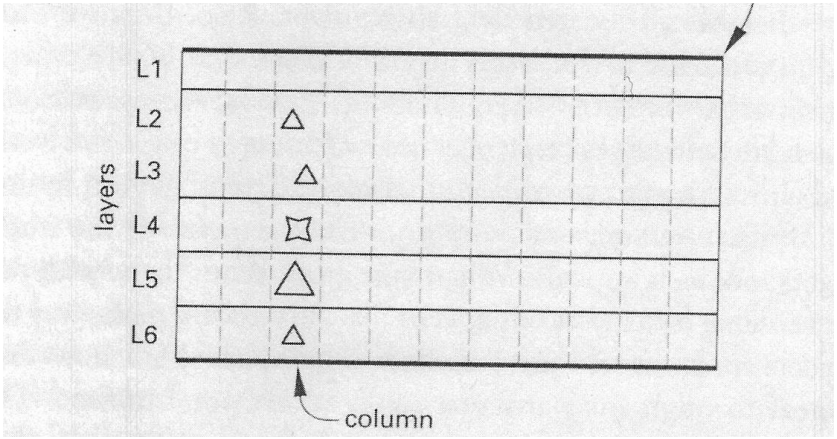
The hierarchy

- Brain use a hierarchy to store informations.
- We remember and do things in sequence.

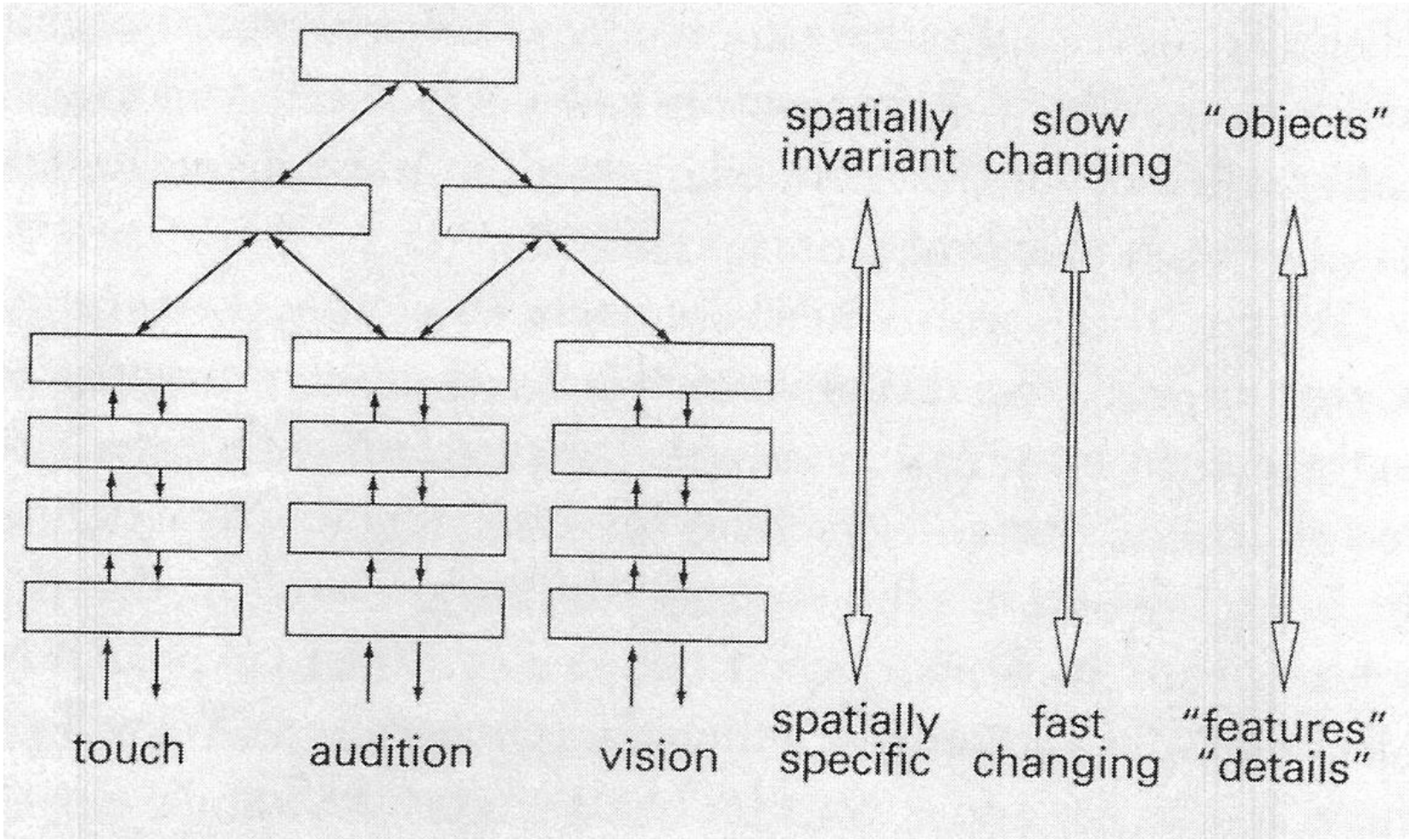
4 Visual regions in the brain
Each box is divided in the 6 layers.



The 6 cortex layers

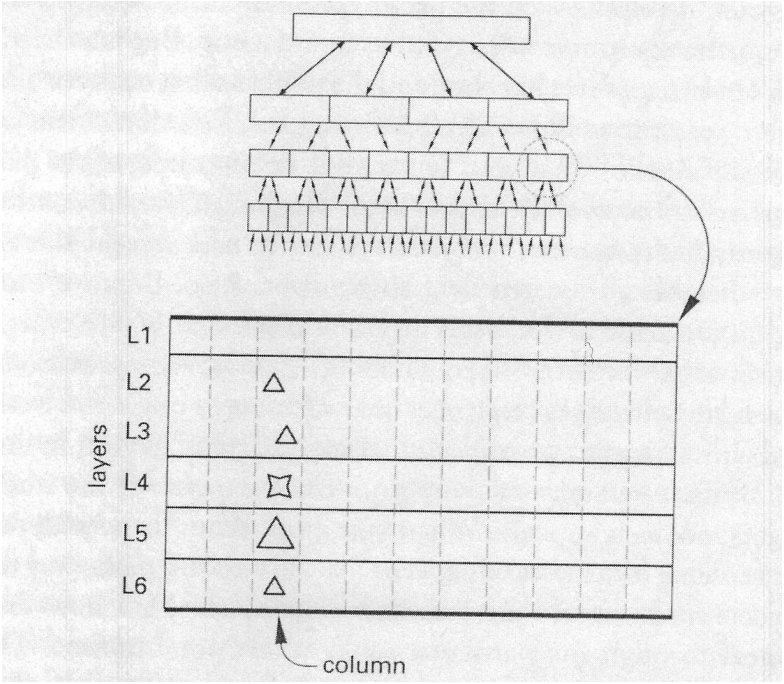


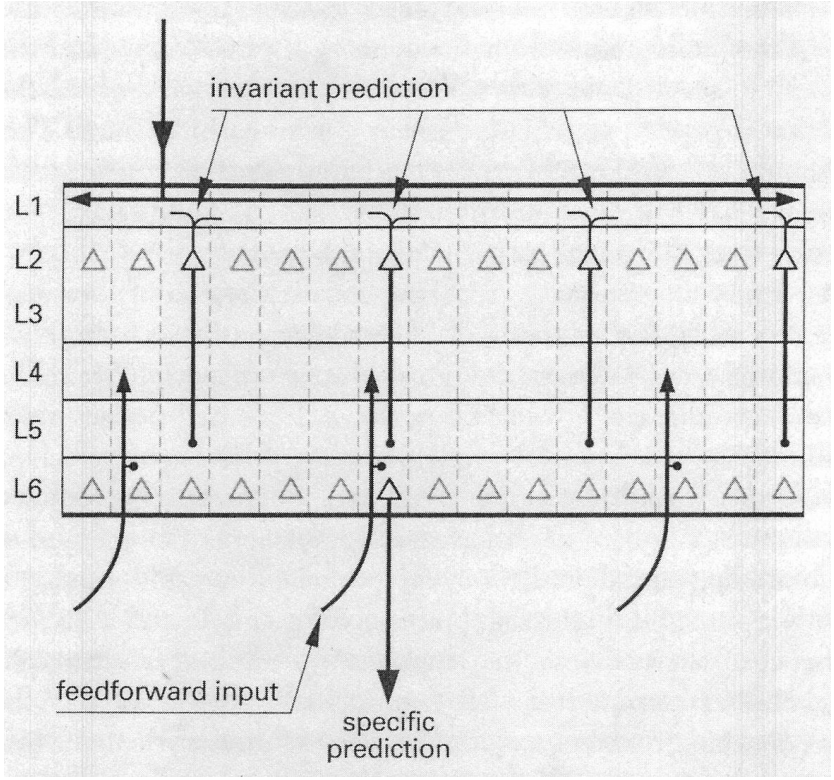
A global scale hierarchy



Sequences of sequences

- Brain create hierarchical sequences of sequences.



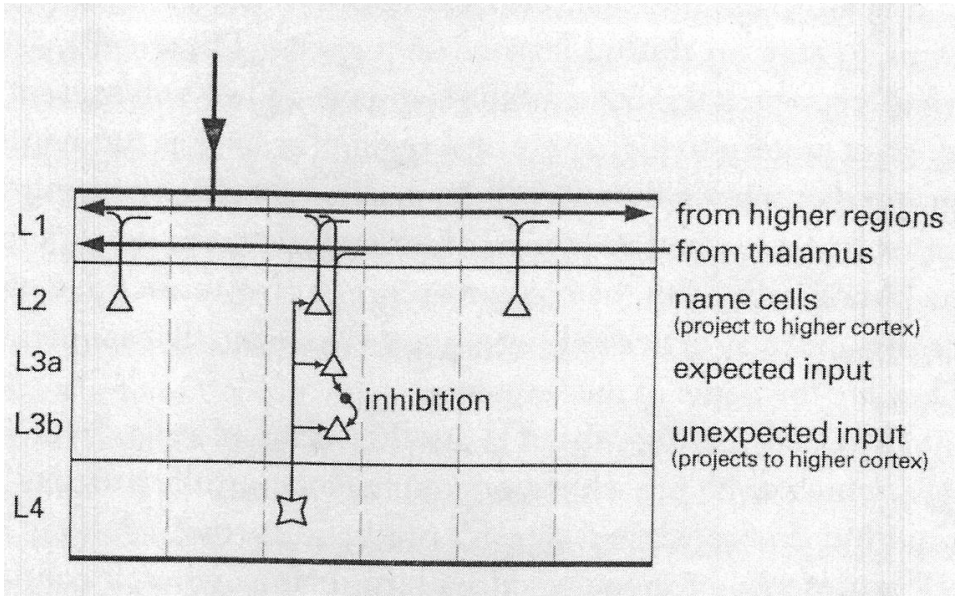


Brain is a “prediction” machine

- Sequences are stored in synaptic strength
- Once a new sequence arrive, it is compared and if it is known it activate the “invariant” circuits
- If the new sequence is not known, it will signal it to higher hierarchical levels.
- Many examples in everyday life

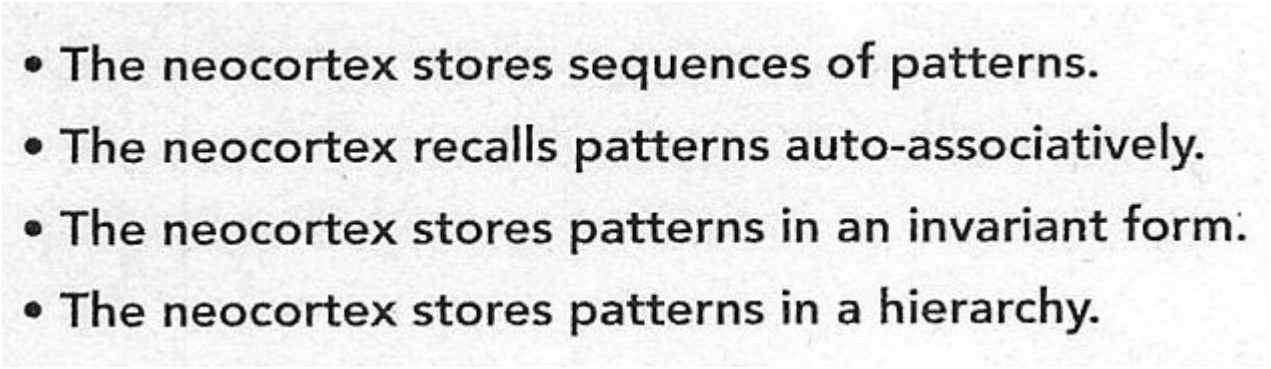
The thalamus

- Thalamus is the higher level of hierarchy.
- It stores all new patterns and sequences.
- If information is repeated it is a transferred back to the cortex.
- Thalamus holds short-time memories



Brain is a simple machine!

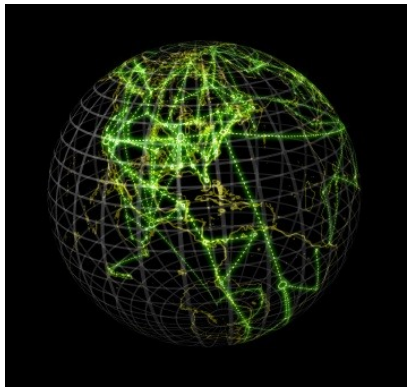
- If we understand the principles we can make actually brain-like machines.



On Intelligence, Jeff Hawkins (2004)

The future of intelligence

- Capacity: Brain has no problems with errors. We loose 1000 neurons per day, but we make no mistakes.
- Connectivity: the brain is so interconnected. It looks impossible to make a machine such completely interconnected. However the telephone system is just the same!



Inconceivable applications

- Vision
- Security
- Weather
- Speech
- Smart cars
- Unimaginable global-scale applications

Great improvement

- Silicon chip
- Hard disk
- DNA sequencing
- Fiber optics
- Software

Stuck !

- Batteries
- Motors
- Robots

Brain-like computers future

- Speed (compare 200Hz with.... GHz !)
- Capacity (more than 6 layers, more space, more sensors)
- Replicability (humans take years to learn walking or speaking...)
- Sensing system: sonar, radar, infrared... (brains can work with pattern of any kind of physical stimuli, on a global scale too)

How long it will take?

- Compare with cell phones or the internet.
- Usually research stays still for years, then explodes.
- If we break the brain algorithm we will progress like never mankind did before.

Let's think **straight**