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# Lecture 4

## Synthetic Psychology: Designing from the bottom up

# The Android Robot “Actroid”

2003 International Robot  
Exhibition  
Tokyo

“Robot Technology  
Pioneers the Future -  
From Manufacturing to  
Personal Life”



ALL THE NEWS WITHOUT FEAR OR FAVOR

# The Japan Times

Friday, 21 November 2003

# Karakuri Ningyo with bow and arrows

2003 International Robot  
Exhibition  
Tokyo





ALAN TURING, 1912 - 1954

"Turing believes machines think.  
Turing lies with men.  
Therefore machines do not think."

Mock syllogism written by Alan Turing in 1952 while facing arrest for homosexual behavior.

# On Alan Turing

<http://www.japantimes.jp/life.htm>

*artwork by Jin Wicked 2002*

ALL THE NEWS WITHOUT FEAR OR FAVOR

# The Japan Times

**Sunday, 23 November 2003**

# On Alan Turing

<http://www.japantimes.jp/life.htm>

Talk to her - Artificial Intelligence vs. human stupidity

by Victoria James

(an article around the Turing Test, ELIZA, and PARRY)

The Enigma

by Andrew Hodges

(an article about the life of Alan Turing)

I, Robot

by Andrew Hodges

(an article about the Turing Test and the Loebner Prize competition)



# On Alan Turing

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<http://www.japantimes.jp/life.htm>

“Turing believes machines think.  
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Therefore machines do not think.”

*Mock syllogism written by Alan Turing in 1952.*



# On Alan Turing

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<http://www.japantimes.jp/life.htm>

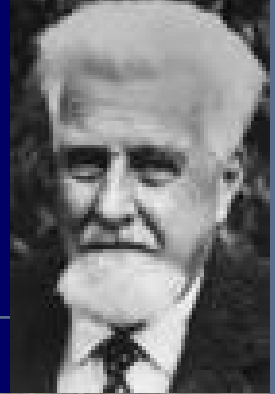
*Andrew Hodges*

“Alan Turing: The Enigma.” Walker & Co. 2000  
(paperback)



# Konrad Lorenz

1903 - 1989



birthday: 7 November 1903  
this year: 100th birthday

co-founder of ethology/behavioral  
science

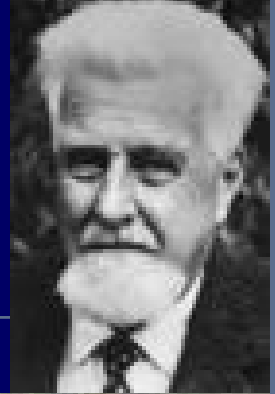
Nobel prize: 1973 (Medicine and  
Physiology) together with K. von  
Frisch and Nikolaas Tinbergen

famous for his work on the  
“greylag goose”



# Konrad Lorenz

1903 - 1989



birthday: 7 November 1903  
this year: 100th birthday

today:

***3rd Sino-German Workshop on  
Cognitive Neuroscience, Beijing***

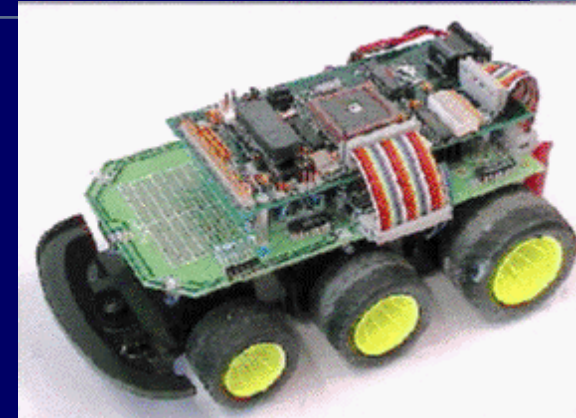
Prof. Ernst Poeppel  
Director, Inst. for Medical Psychology  
University of Munich



# Questions from last week?

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# The „Didabot“ experiment



“Didabot”:  
simple robot for  
didactical purposes

arena with Styrofoam cubes

Experiment by René te Boekhorst and Marinus Maris

# Assignments last week

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- Read chapter 4 of “Understanding Intelligence”
- Exercise 3
- *Special Assignment for Warsaw-participants:* prepare a short presentation on the concept of ecological niches and how this applies to robots.

*Inspiration:*

David McFarland, Oxford University, one of the leading ethologists (Focus 4.1)

# Today's topics

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- ecological niche (Warsaw students)
- complete autonomous agents (Chapter 4)
  - autonomy and situatedness
  - self-sufficiency
- Case study: Didabots
- Braitenberg Vehicles
- Building brains and bodies:  
embedded artificial neural networks
- “The latest from Japan/Zurich



Today:

Presentation by  
Fumiya Iida and Prof. Rolf Pfeifer  
Artificial Intelligence Laboratory  
Dept. of Information Technology  
University of Zurich and  
Dept. of Mechano-Informatics  
The University of Tokyo



The Latest from  
Japan/Switzerland

# List of terms (to know)

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- ecological niche
- domain (high-level) ontology/low-level specification
- hybrid system (low-level spec./high-level ont.)
- complete autonomous agents
  - embodiment
  - autonomy
  - situatedness
  - self-sufficiency (circadian cycles, irrecoverable deficit)
- adaptivity
- real worlds vs. virtual worlds
- emergence

# Masanao Toda's "Fungus Eater"

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- 1960s
- Institute for Advanced Studies
- cognitive psychology --> fragmentation
- alternative: simple but complete, distant planet

# Rhinogrades (Stümpke)

*Nasobema  
lyricum*

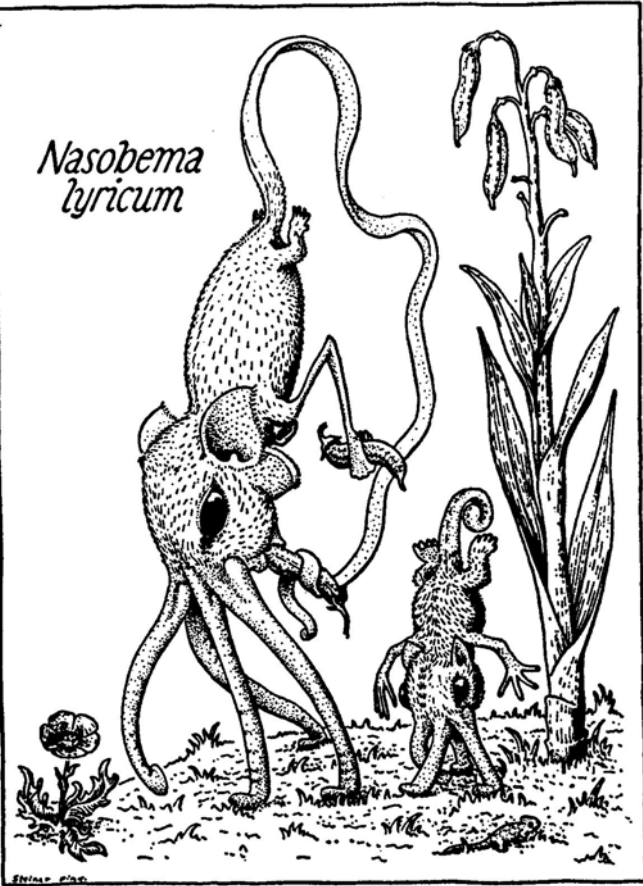


PLATE X

# Rhinogrades (Stümpke)

*Nasobema lyricum*



PLATE X

*Hopsorrhinus aureus*

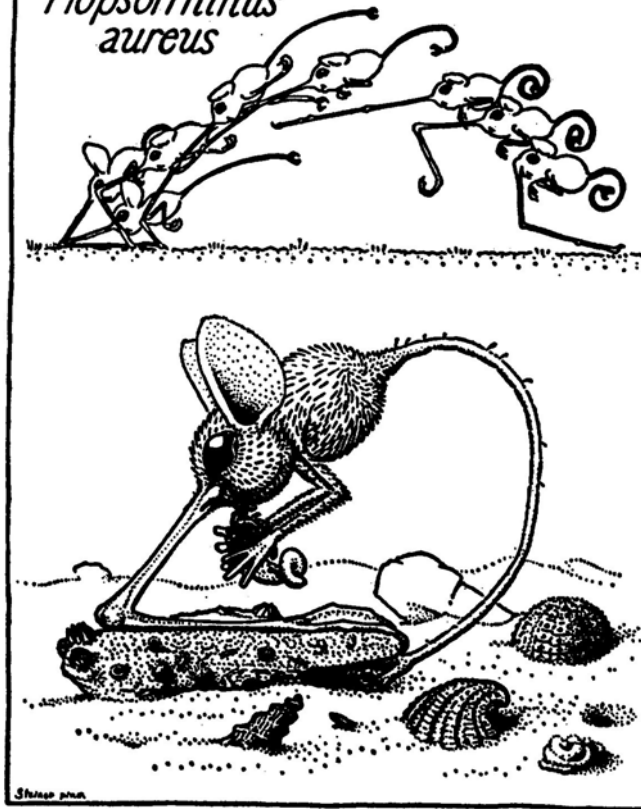


PLATE VI

# Rhinogrades (Stümpke)

*Nasobema lyricum*

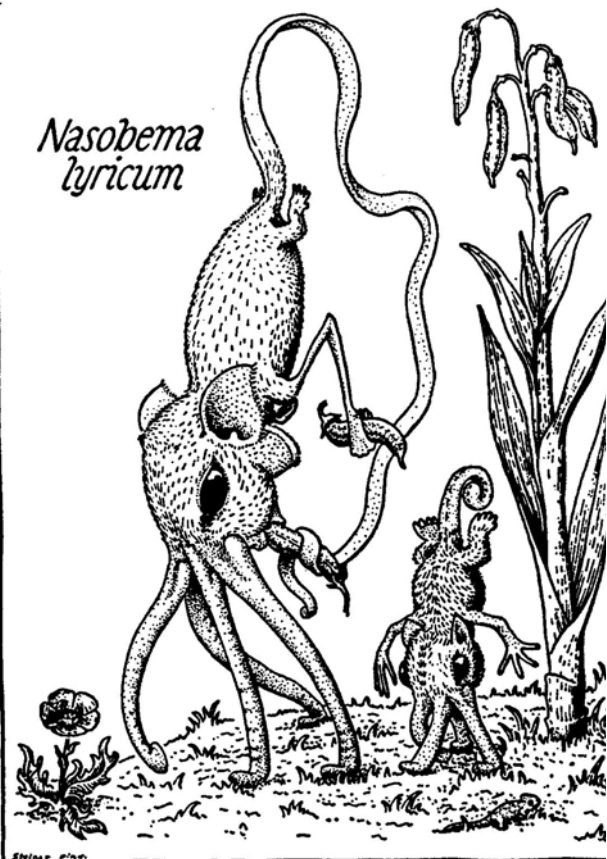


PLATE X

*Hopsorrhinus aureus*

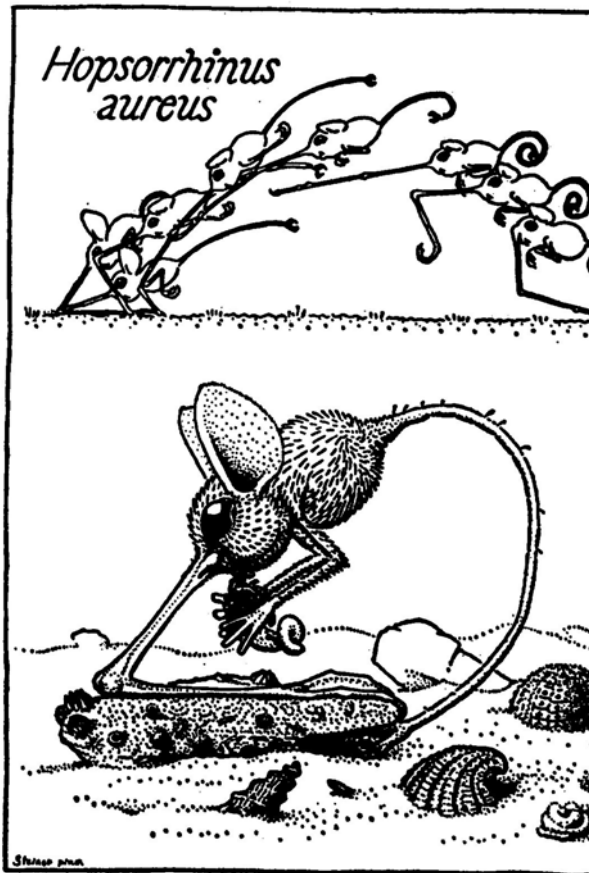


PLATE VI

*Ranunculonasus pulcher*

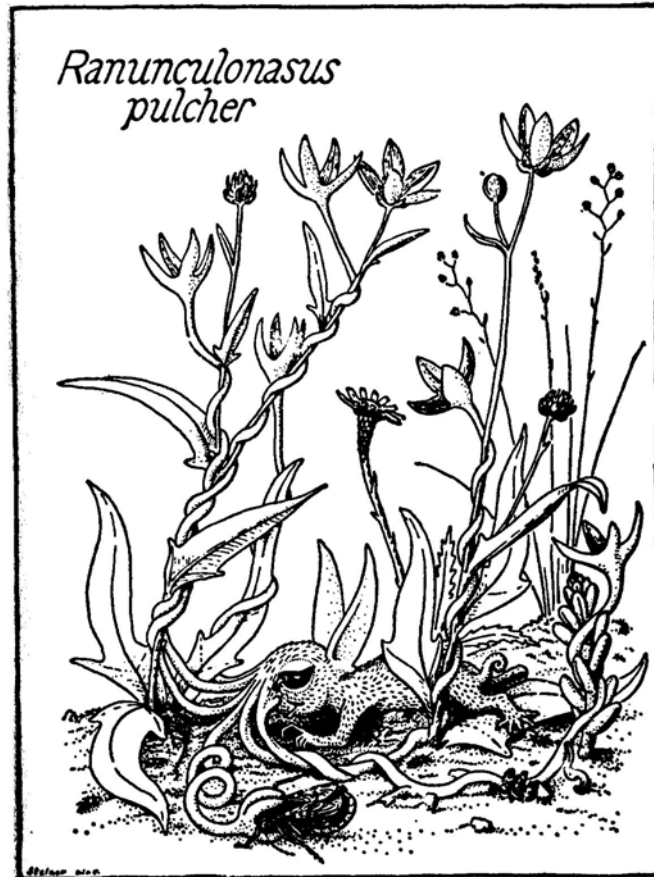


PLATE XIII

# Masanao Toda's "Fungus Eater"



*Isabelle Follath*

# Autonomy and Situatedness

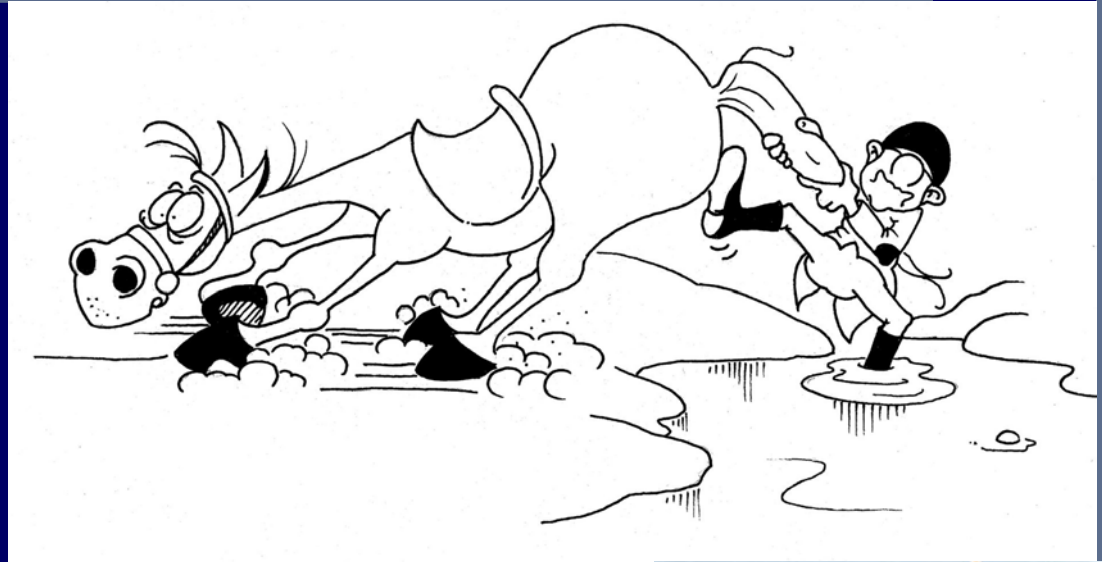


# Autonomy and Situatedness



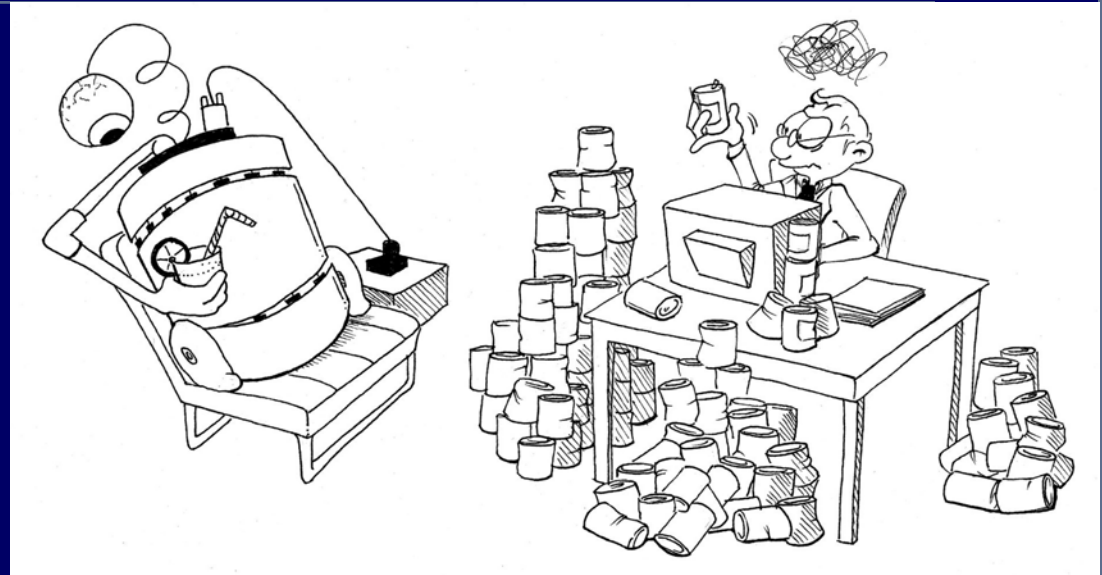
*“You can lead a horse to the water  
but you can’t make him drink”*

# Autonomy and Situatedness



JPL-25888AC

# Self-Sufficiency



# Please read: Chapter 4

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- difficult chapter
- not everything obvious at first reading
- turn back to this chapter later
  
- pay attention to: “Time Perspectives for Explanations” (p. 127 - 130).

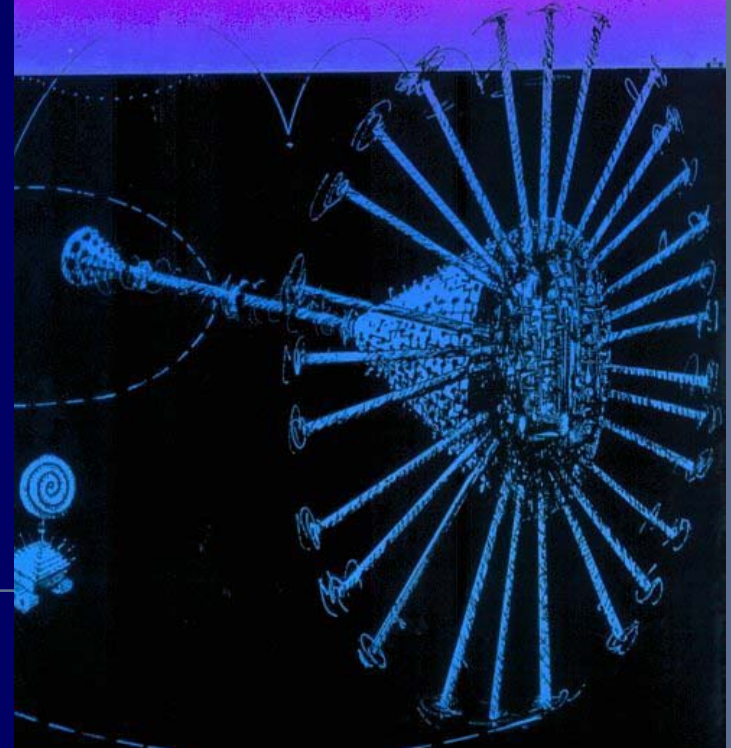
# Designing from the bottom up

***Vehicles –  
Experiments in  
Synthetic Psychology***  
Valentino Braitenberg

## VEHICLES

Experiments in Synthetic Psychology

Valentino Braitenberg



## Case study: Didabots

*KVAI02-didabots*

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- carefully observe!

# Didabot-experiment: Discussion

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*comments*  
*Munich*

# Designing from the bottom up

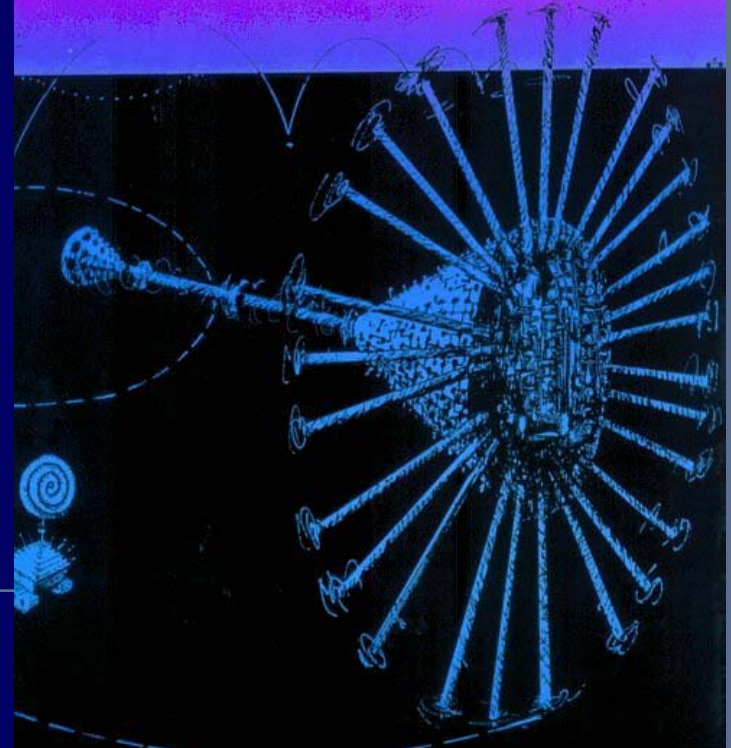
***Vehicles –  
Experiments in  
Synthetic Psychology***  
Valentino Braitenberg

*Please read chapter 6 of  
“Understanding Intelligence”*

## VEHICLES

Experiments in Synthetic Psychology

Valentino Braitenberg



# Vehicle 1

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*how will it move?*  
*Warsaw*

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# Vehicle 2

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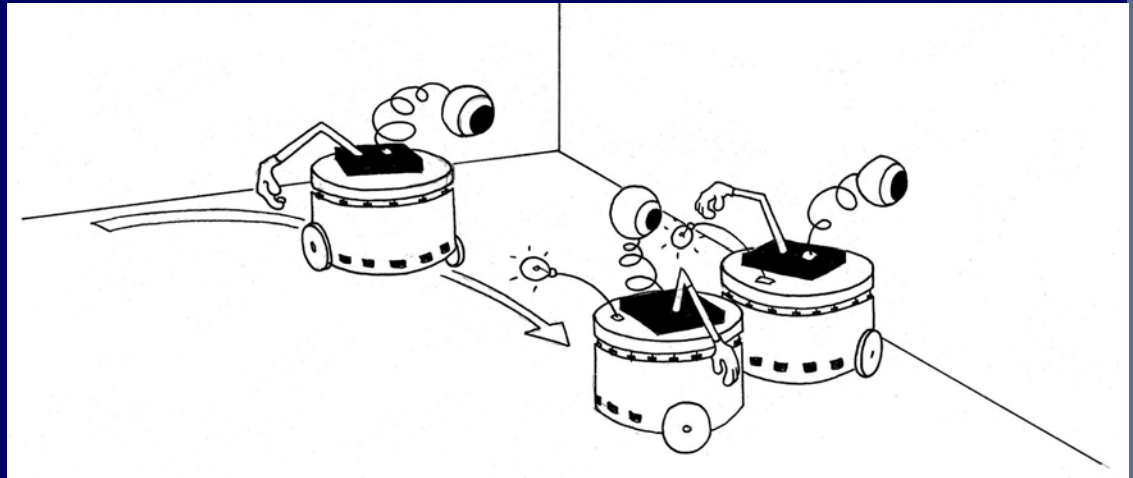
*how will they move?*  
*Tokyo*

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# Vehicle 2: Video

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*light-following*



# Vehicle 3

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*how will they move?*  
*Tokyo*

---

# Vehicle 3

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*2 types of sensors*

*how will they move?*

*Warsaw*

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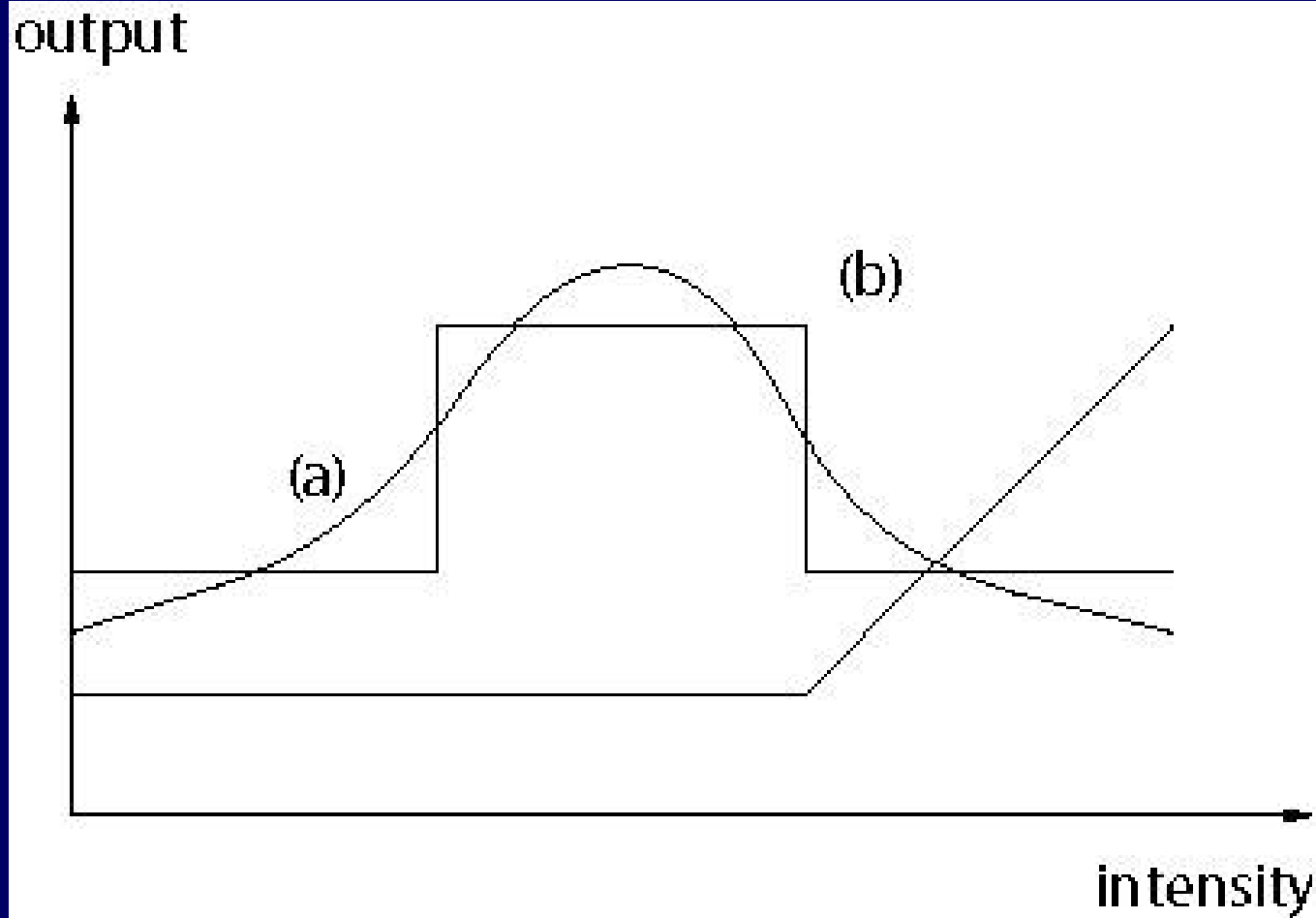
# Demo Braitenberg

Several vehicles

*Simon Bovet: Zurich*

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# Vehicle 4



# Vehicle 5

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adding “brain power”  
(see “embedded neural networks”)

*thought experiment with Vehicle 1:*  
adding large brain

*comment: Munich*

# Principle of “ecological balance”

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## *balance in complexity*

- given task environment
- match in complexity of sensory, motor, and neural (control) system

## *balance / task distribution between*

- morphology
- neuronal processing (nervous system)
- materials
- environment

# Vehicle 6

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# The “law of uphill analysis and downhill invention”

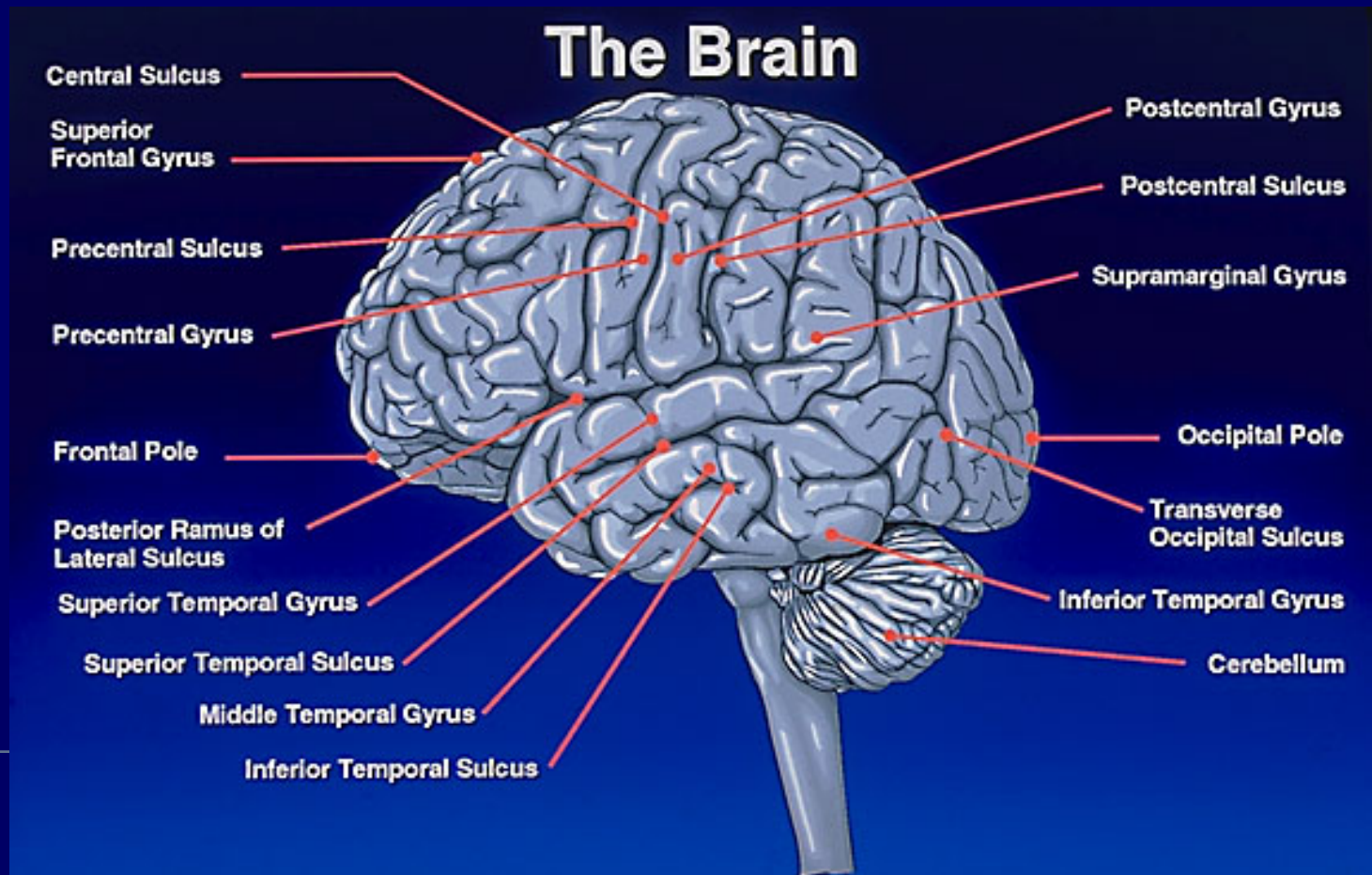
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# This concludes chapter 6

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# Building Brains and Bodies: Embedded Artificial Neural Networks

*Drawing inspiration from nature*



# Brain vs. Computer

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*ideas: Beijing  
Warsaw*

# Brain vs. Computer

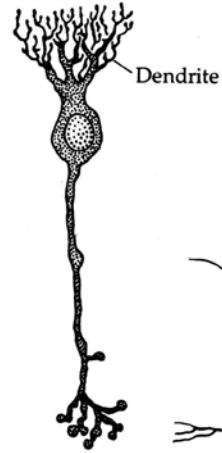
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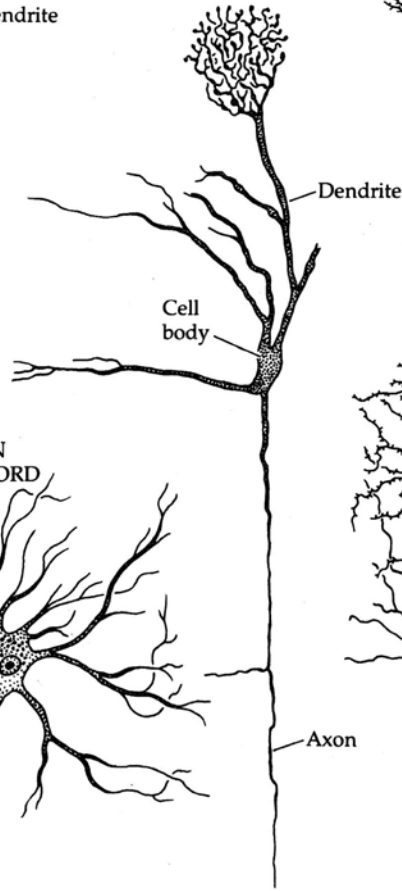
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# Different Types of Neurons

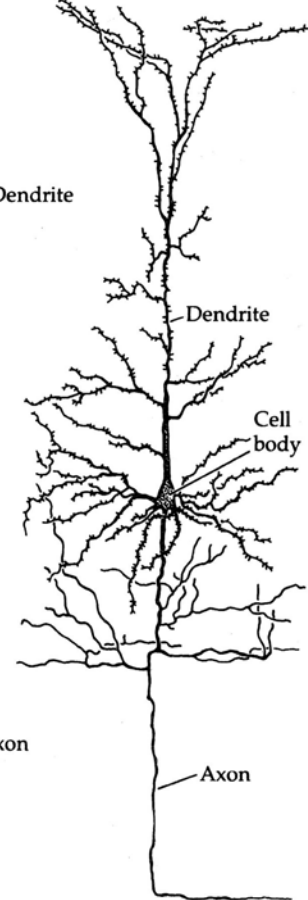
BIPOLAR CELL  
FROM RETINA



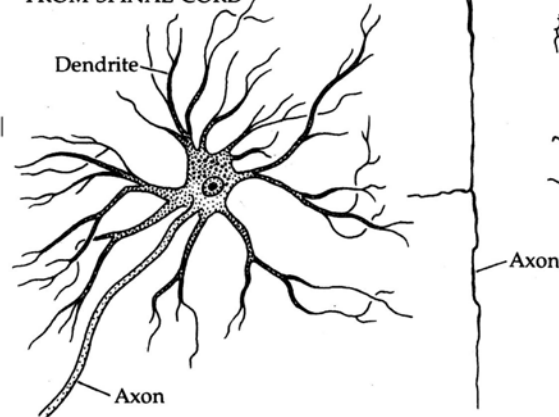
MITRAL CELL FROM  
OLFACTORY BULB



PYRAMIDAL CELL  
FROM CORTEX

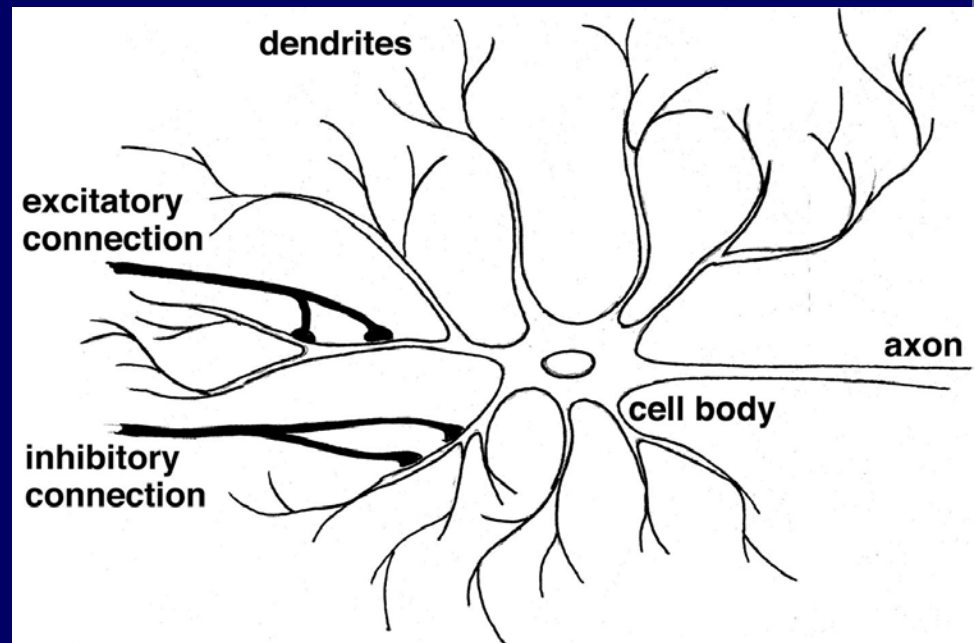


MOTOR NEURON  
FROM SPINAL CORD

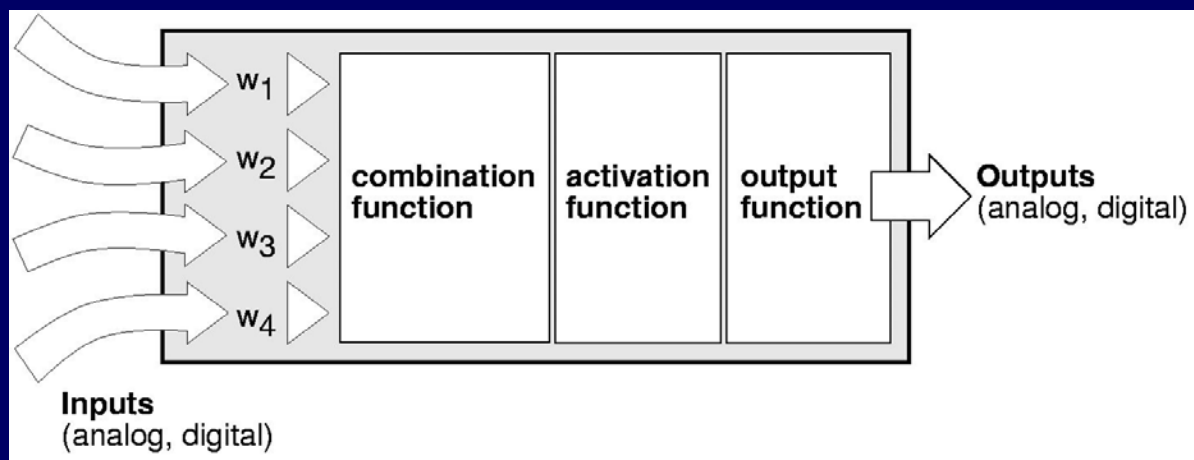


# Modeling a neuron - neural networks

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# Artificial Neuron

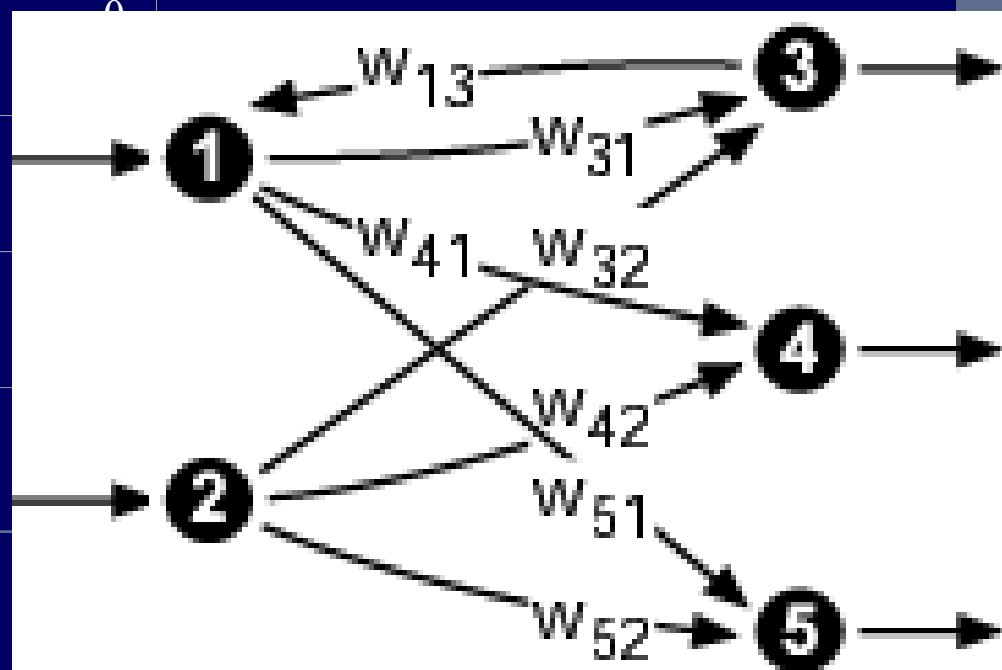


# Artificial Neural Network: Representations

	<i>node</i> 1	<i>node</i> 2	<i>node</i> 3	<i>node</i> 4	<i>node</i> 5
<i>node</i> 1	0	0	0.8	0	0
<i>node</i> 2	0	0	0	0	0
<i>node</i> 3	0.7	0.4	0	0	0
<i>node</i> 4	1.0	-0.5	0	0	0
<i>node</i> 5	0.6	0.9	0	0	0

*Matrix*

*Graph*





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The University of Tokyo



The Latest from  
Japan/Switzerland

# Assignments

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- Read chapter 5 (up to p. 152) and 6 of “Understanding Intelligence”
- Exercise 4
- Zurich:  
prepare a short presentation on  
“Action selection and segmentation of  
Behavior” for next week (2 December 2003).