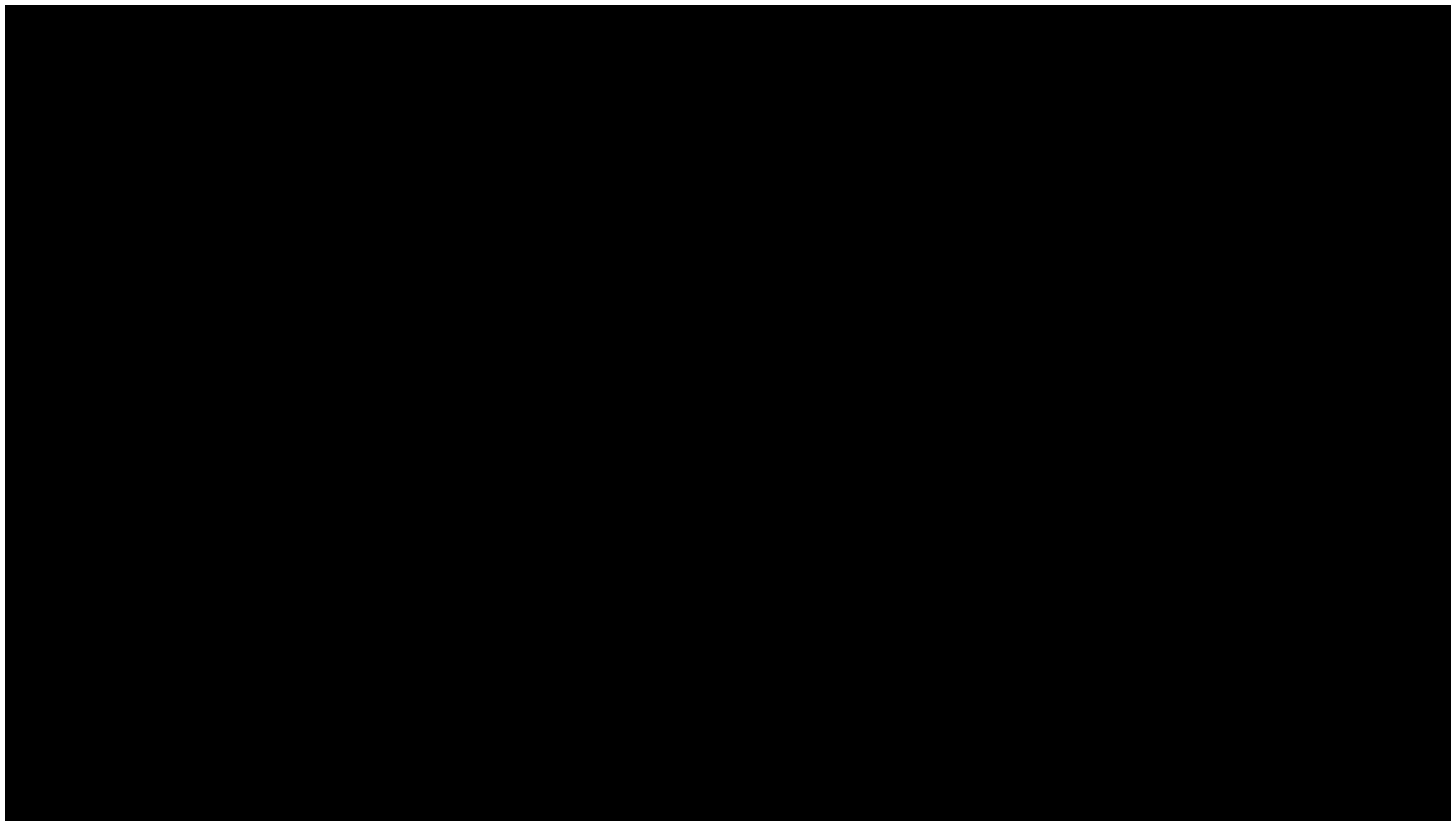


The Shanghai Lectures 2019

HeronRobots *Pathfinder Lectures*

Natural and Artificial Intelligence in Embodied Physical Agents





The ShanghAI Lectures

An experiment in global teaching

Fabio Bonsignorio
The ShanghAI Lectures and Heron Robots

欢迎您参与
“来自上海的人工智能系列讲座”

Lecture 1

Intelligence

things can be seen differently

What it is and how it can be studied

31 October 2019



Goals

- What is intelligence? Natural and artificial?
- conceptual and technical know-how in the field
- informed opinion on media reports
- things can always be seen differently
- new ways of thinking about ourselves and the world around us

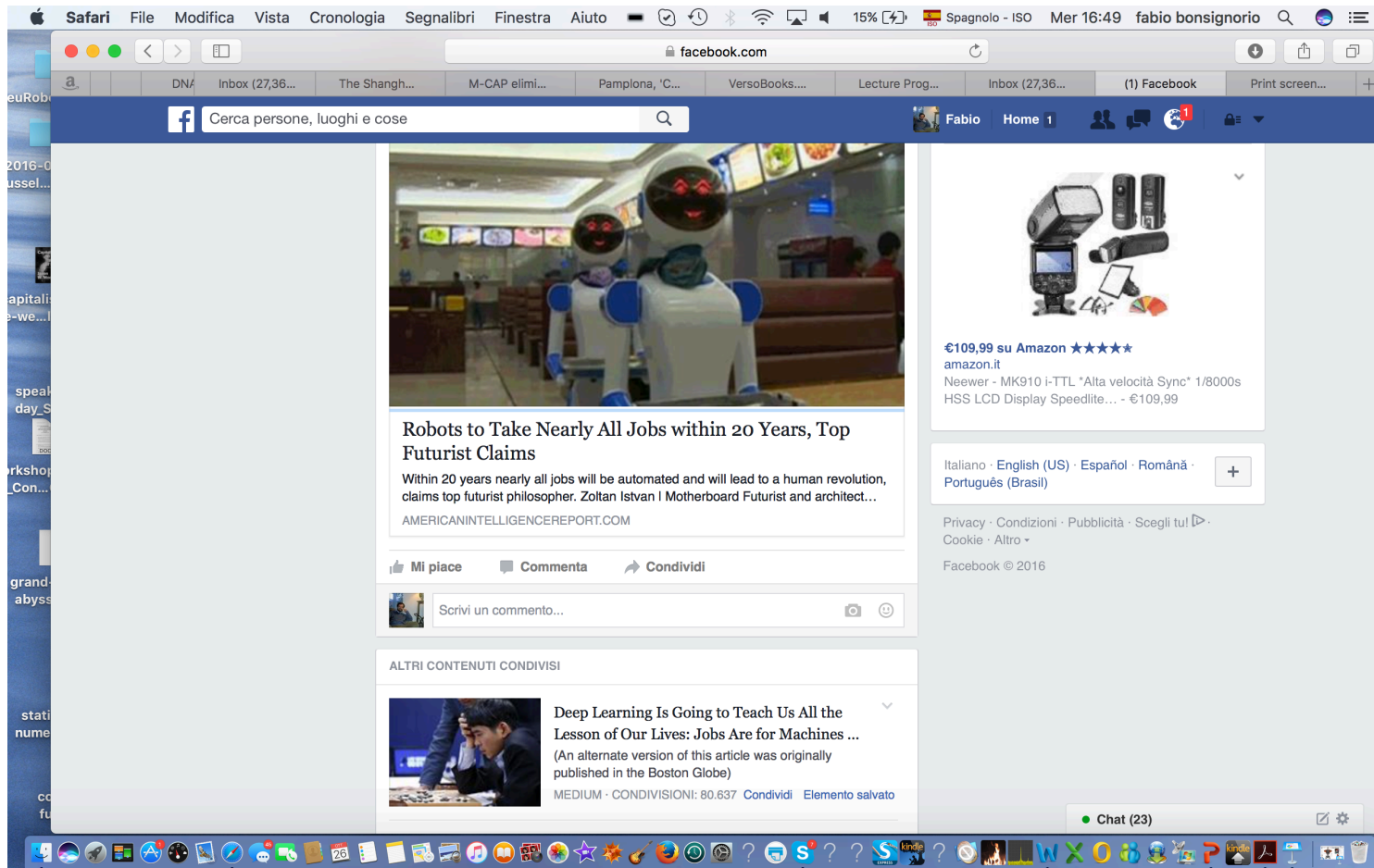


Goals

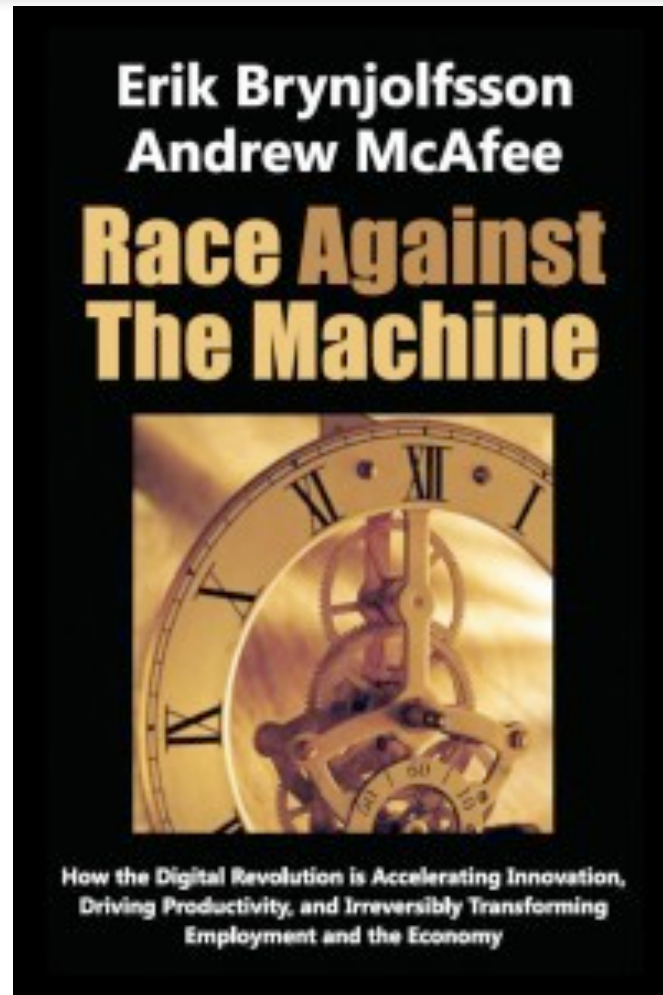
- What is intelligence? Natural and artificial?
- conceptual and technical know-how in the field
- **informed opinion on media reports**
- things can always be seen differently
- new ways of thinking about ourselves and the world around us



Info in the media....



Someone is worried....



But maybe we should not be....

Erik Brynjolfsson (first author of the book above):

“The key to growth?

Race _with_ the machines”

(check his nice TED talk here:

<http://www.youtube.com/watch?v=sod-eJBf9Y0>)



Goals

- What is intelligence? Natural and artificial?
- conceptual and technical know-how in the field
- informed opinion on media reports
- things can always be seen differently
- new ways of thinking about ourselves and the world around us



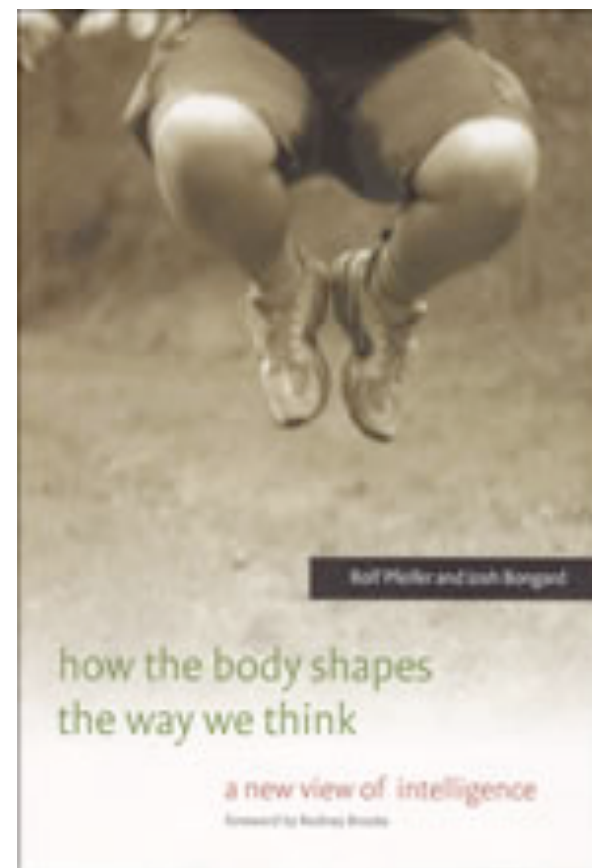
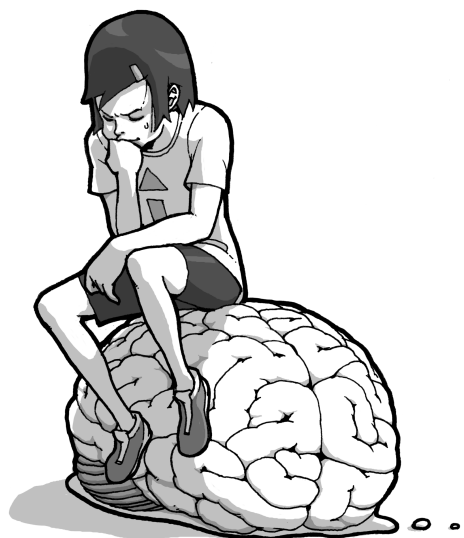
Book for class

Rolf Pfeifer and Josh Bongard

How the body shapes the way we think — a new view of intelligence

MIT Press, 2007

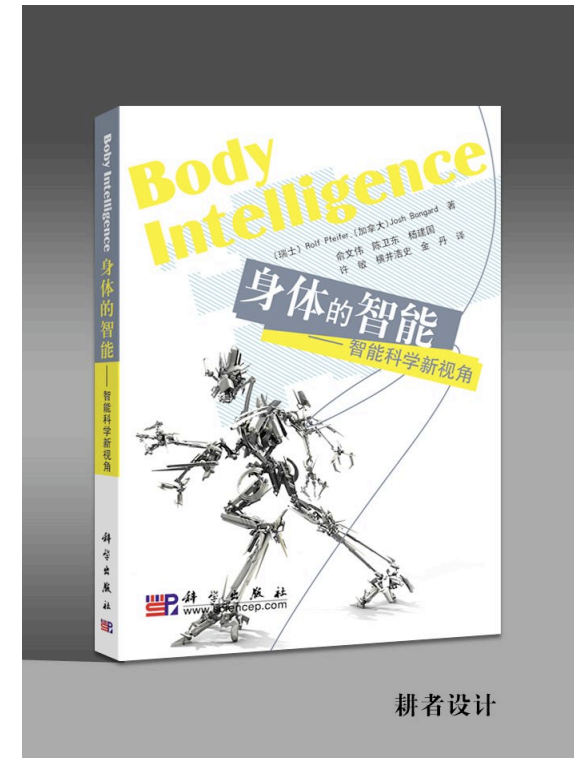
Illustrations by Shun Iwasawa



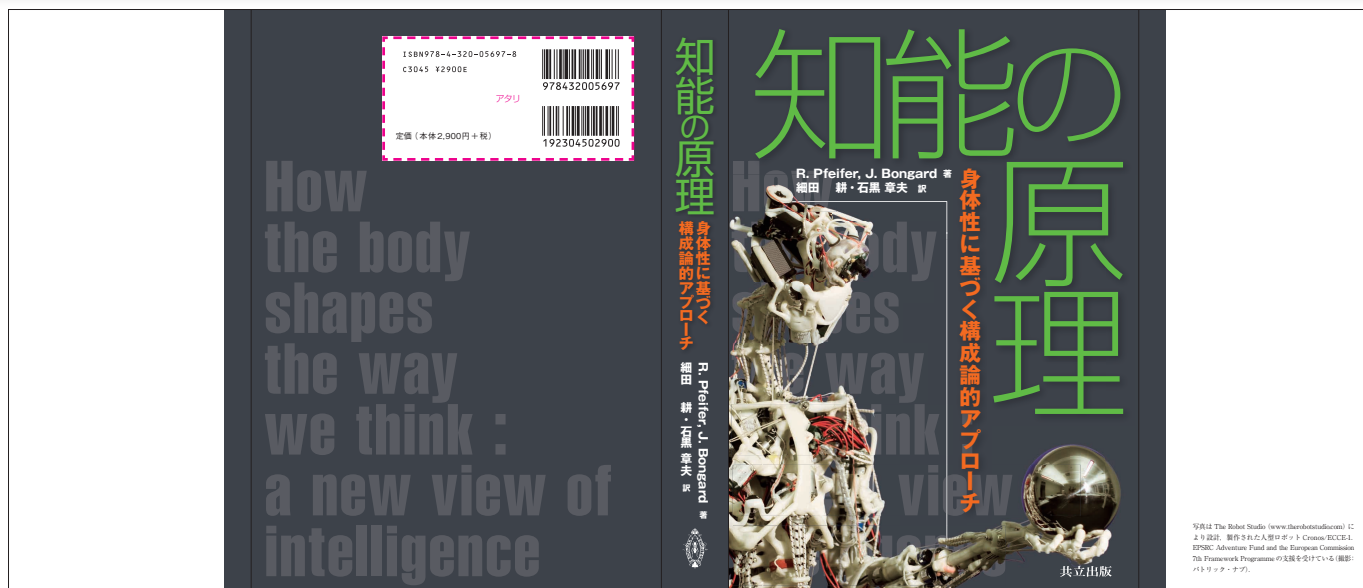
Chinese edition

Translated by
Weidong Chen
Shanghai Jiao Tong University
and
Wenwei Yu
Chiba University, Japan

Foreword by
Lin Chen
Chinese Academy of Science, Beijing



Japanese edition



translated by
Koh Hosoda, Osaka University
and
Akio Ishiguro, Tohoku University



Arabic edition

كيف يشكل الجسد. طريقة تفكيرنا

Arab Scientific Publishers,
(100 pages)



French edition

La Révolution de l'intelligence du corps

Rolf Pfeifer

Alexandre Pitti



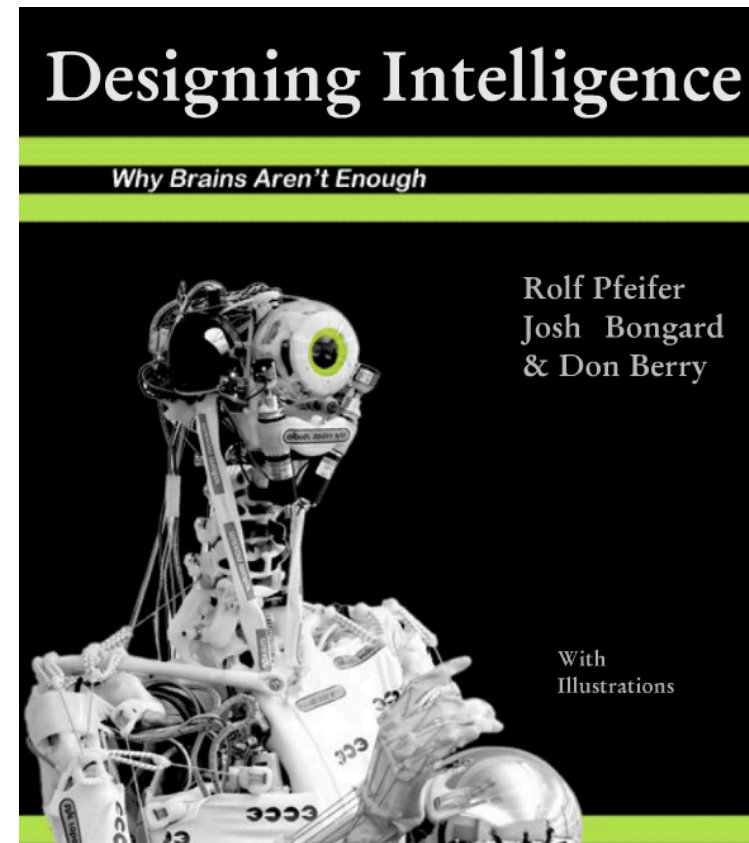
Short e-book version

<http://ailab.ifl.uzh.ch/>

Designing
Intelligence

Why Brains
Aren't Enough

Rolf Pfeifer
Josh Bongard
Don Berry



Can be downloaded from here:

<http://www.grin.com/e-book/165548/designing-intelligence#inside>

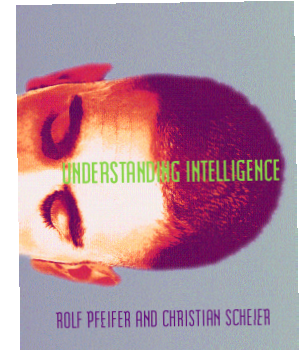


Can be complemented by

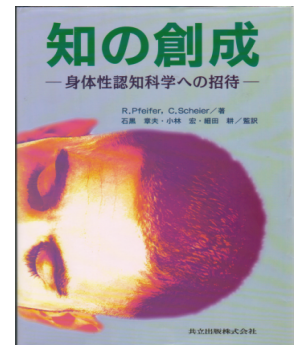
Rolf Pfeifer and Christian Scheier

Understanding Intelligence

MIT Press, 1999 (paperback edition)



知の創成、共立出版、2001



Can be complemented by

Editorial | Published: 11 June 2019

Robotics and the art of science

Nature Machine Intelligence **1**, 259 (2019) | [Download Citation](#)

Bringing reproducibility to robotics.

It is an exciting time to work in robotics. There are plenty of interesting challenges in designing machines that intelligently interact with both humans and their environment, and a range of techniques and insights from engineering, computer science, physics, biomechanics, psychology and other fields are available to help solve them. The

International Conference on Robotics and Automation, organized by the IEEE, is a lively affair: over 4,000 pa

It is an exciting prospect that robotics can start growing as a scientific discipline, with clearly defined methods of evaluation and measurements in place.

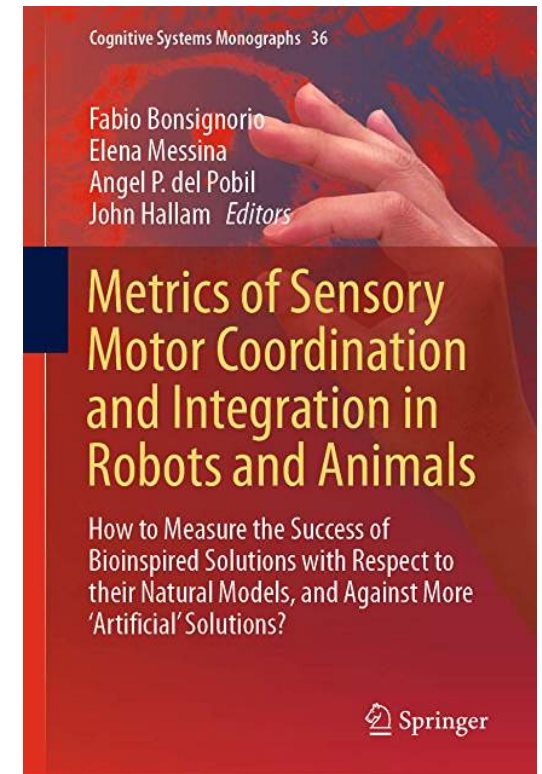
References

1. Leitner, J. *Nat. Mach. Intell.* **1**, 162 (2019).

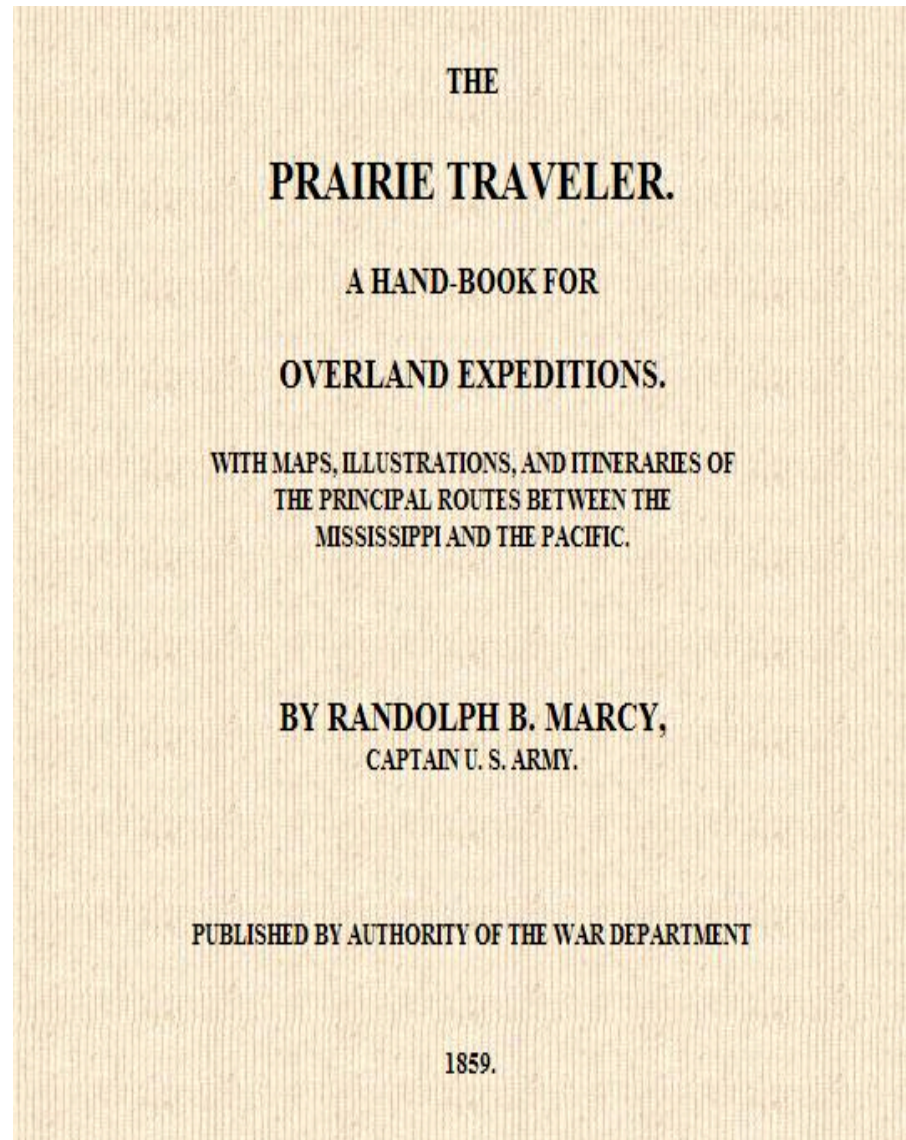
[Article](#) [Google Scholar](#)

2. Bonsignorio, F. & Del Pobil, A. P. *IEEE Robot. Autom. Mag.* **22**, 32–35 (September, 2015).

3. Bonsignorio, F. A. *IEEE Robot. Autom. Mag.* **24**, 178–182 (September, 2017).



'Caveat'



Today's topics

- characterizing intelligence, thinking, and cognition
- “Turing Test” and “Chinese Room Experiment”
- intelligence testing — IQ
- artificial intelligence and its goals
- how to study intelligence: the “synthetic methodology”



Today's topics

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Intelligence?



From the Penguin Dictionary of Psychology

“Few concepts in psychology have received more devoted attention and few have resisted clarification so thoroughly.”

(Reber, 1995, p. 379)



Some definitions (1927 psychology journal)

“The ability to carry on abstract thinking” (L. M. Terman)

“Having learned or ability to learn to adjust oneself to the environment” (S. S. Colvin)

“The ability to adapt oneself adequately to relatively new situations in life” (R. Pintner)

“A biological mechanism by which the effects of a complexity of stimuli are brought together and given a somewhat unified effect in behavior” (J. Peterson)

“The capacity to acquire capacity” (W. Woodrow)

“The capacity to learn or to profit by experience”
(W. F. Dearborn)



Definitions of intelligence

<http://www.vetta.org/definitions-of-intelligence/> — now

de

Robert Sternberg is an eminent psychologist who has been “fighting” against a simplistic notion of IQ. One of his famous books is “Beyond IQ: A triarchic theory of intelligence”, first published 1984

“ . as many definitions of
in oerts asked to define it.” R.J.

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(R ologist; famous book “Beyond IQ: A triarchic

the

re of definitions of intelligence”,
S tter, IDSIA, Switzerland



Definitions of intelligence

<http://www.vetta.org/definitions-of-intelligence/>

Robert Sternberg is an eminent psychologist who has been “fighting” against a simplistic notion of IQ. One of his famous books is “Beyond IQ: A triarchic theory of intelligence”, first published 1984 published 1984

Three commonalities

Intelligence is what an agent has as it interacts with its

environment

Intelligence is what helps an agent to succeed or profit with its environment.

Intelligence is what helps an agent to adapt to different environments.

Intelligence

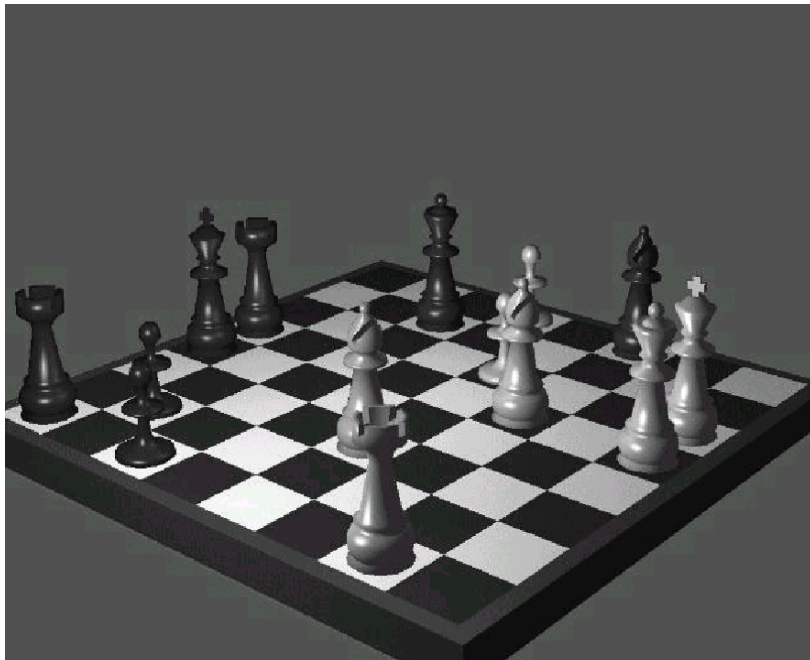
Intelligence

Intelligence is an agent's ability to achieve goals in a

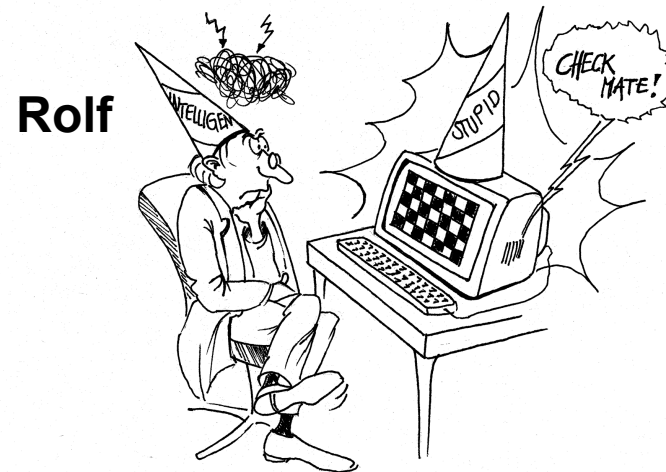
wide range of environments.

Subjectivity, expectations

Playing chess



Rolf playing chess

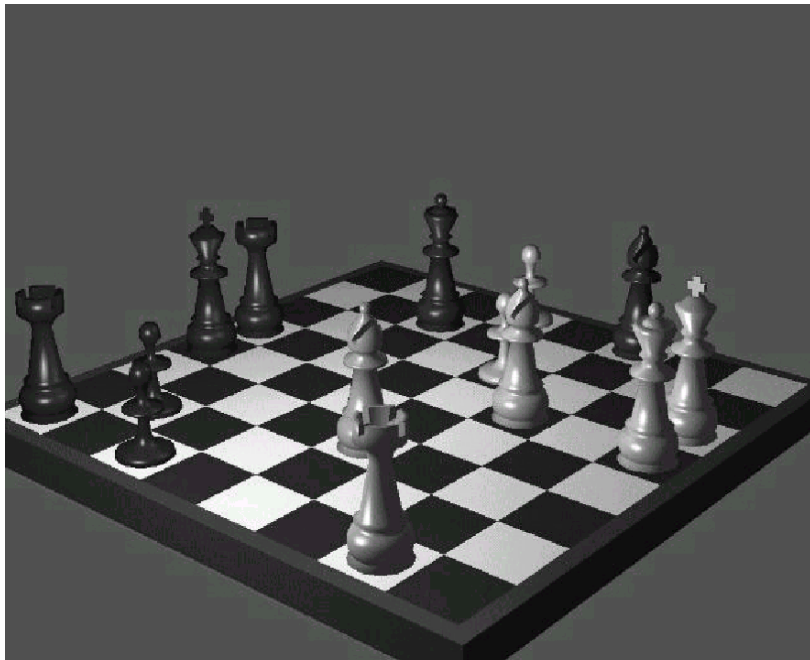


Note: Fabio is obviously much better :-)



Subjectivity, expectations

Playing chess

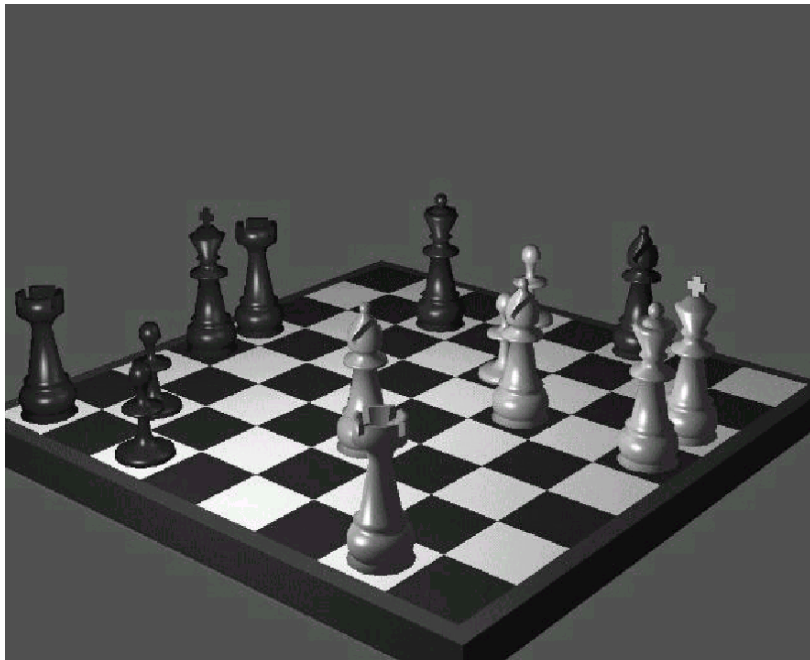


baby girl playing chess



Subjectivity, expectations

Playing chess



dog playing chess



Definitions, arguments

- hard to agree on
- necessary and sufficient conditions?
- are robots, ants, humans intelligent?
- more productive question:
“Given a behavior of interest, how does it come about?”



Interaction and observation

Video “Robovie”

Video “iCub attention”



Interaction and observation

videos:

intelligent?

—> highly subjective

—> Turing suggests empirical test



Today's topics

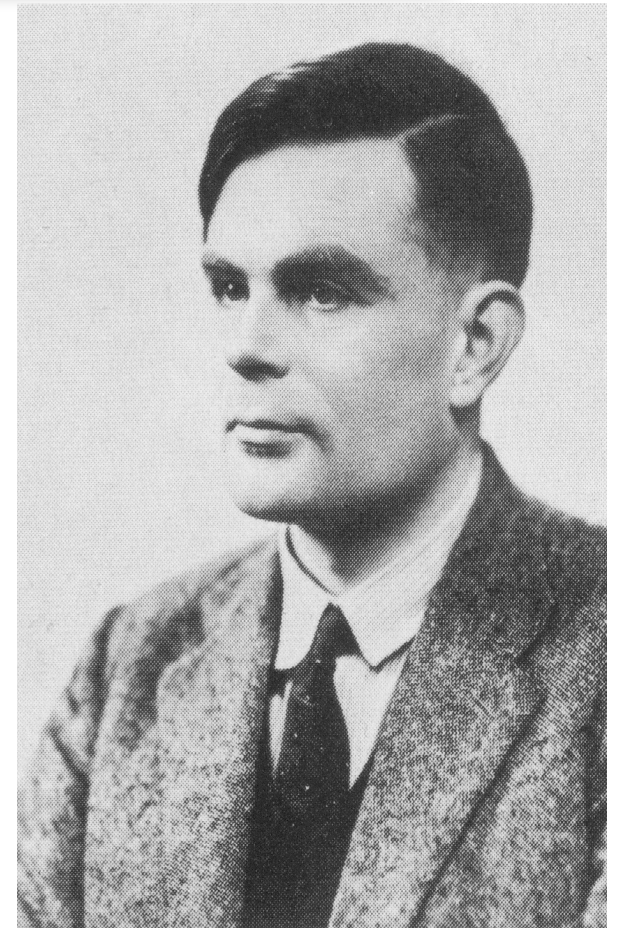
- characterizing intelligence, thinking, and cognition
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An empirical test?

Alan Turing (1912 - 1954)

- computer
- “computation”
- intelligence

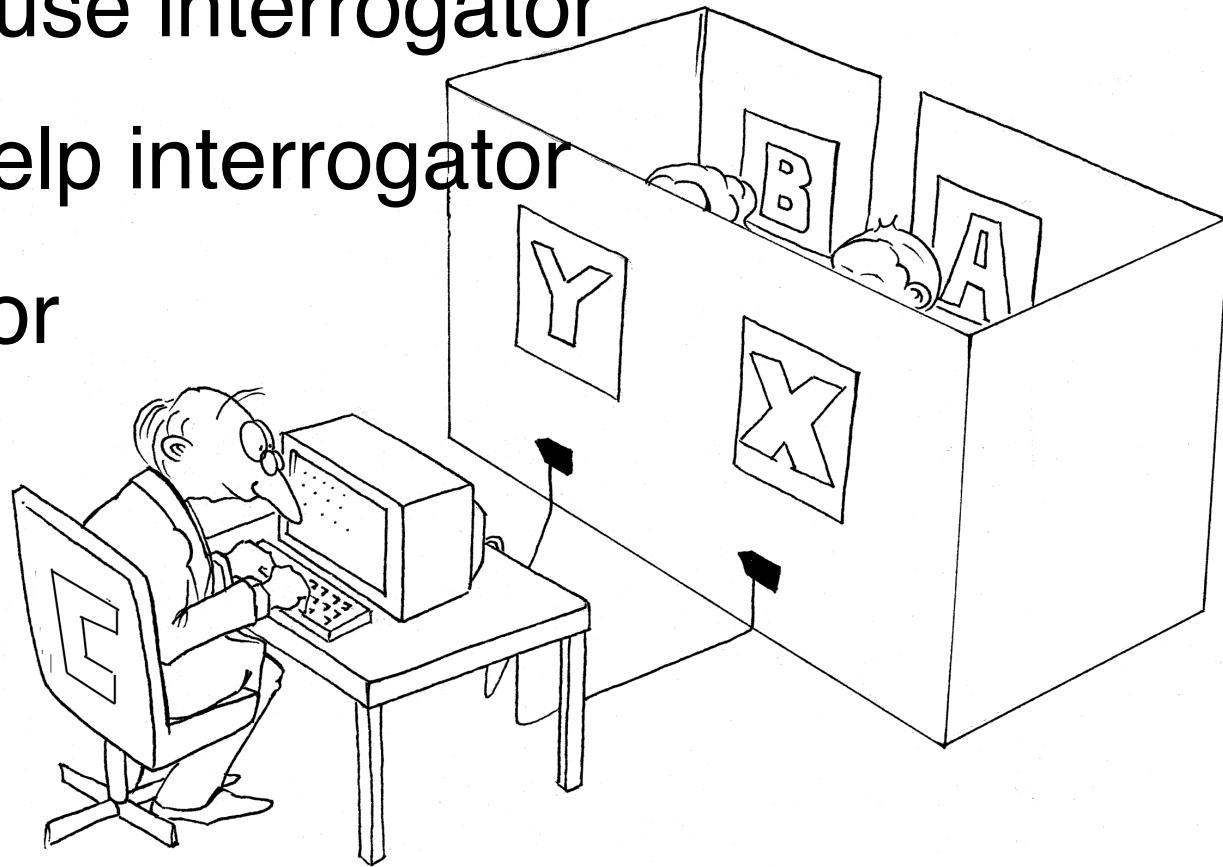


The Turing Test

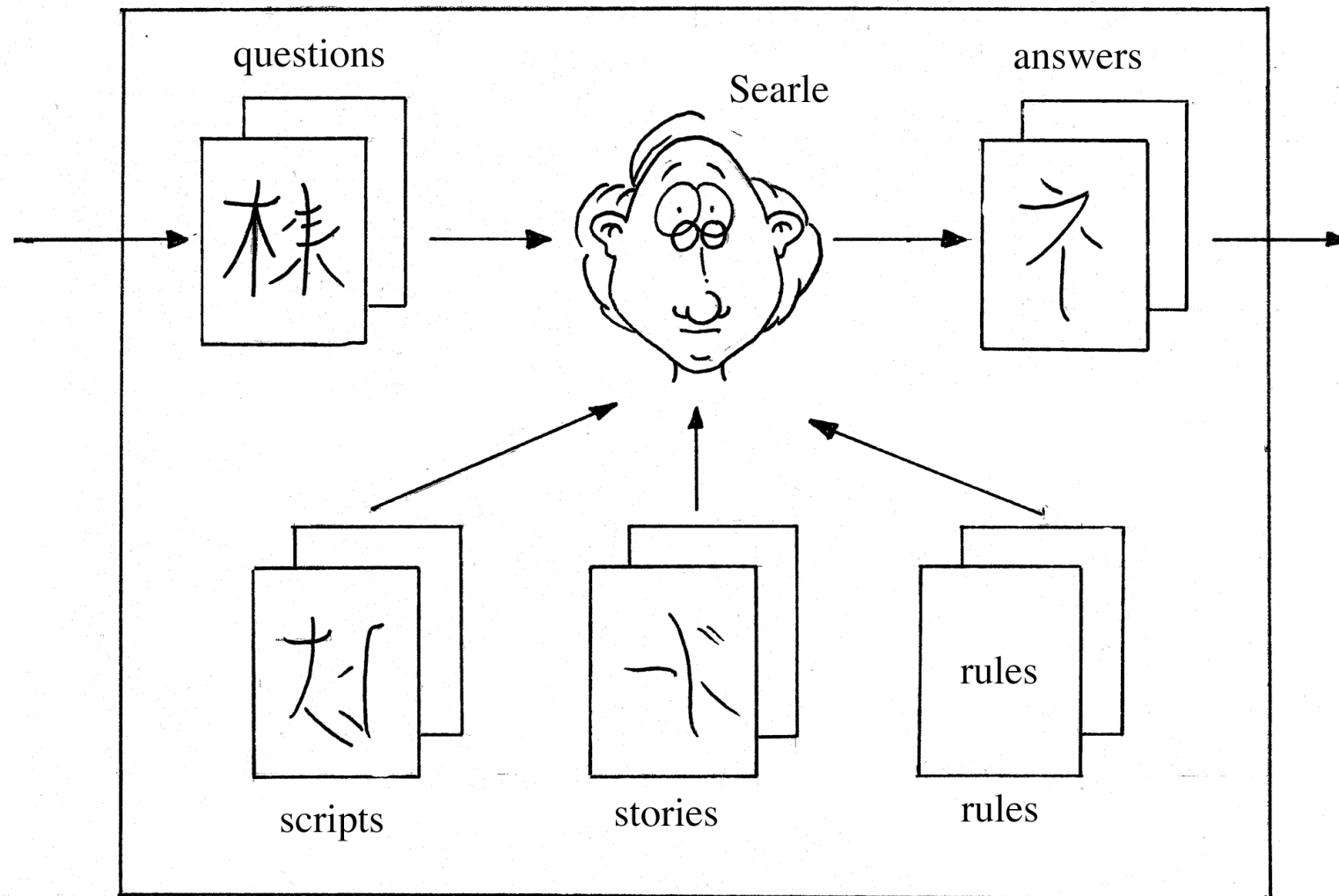
A: man, confuse interrogator

B: woman, help interrogator

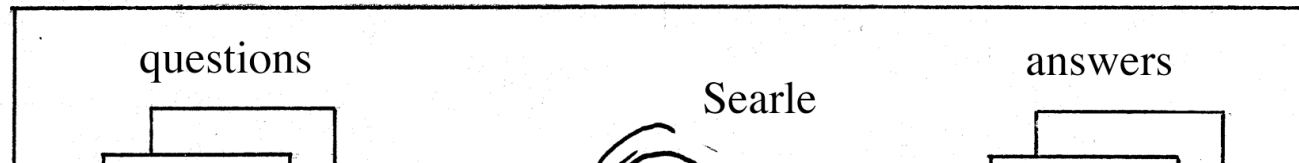
C: interrogator



Searle's "Chinese Room" thought experiment



Searle's "Chinese Room" thought experiment



homework:
think about pros and
cons
student presentation
next week

Variations on the Turing Test

- Historical: ELIZA (Doctor), Josef Weizenbaum, 1966
- Movie “Blade Runner”, 1982, based on novel by Philip K. Dick (“replicants” look like humans, programmed to die after 4 years —> video clip)
- The Loebner Prize Competition (every year)
- Chatterbots (text-based conversational agents)
- Simplified versions: Computer or Human?



Turing tests

Video: “Blade runner”

Video “real dog vs.
Aibo”



Measuring intelligence

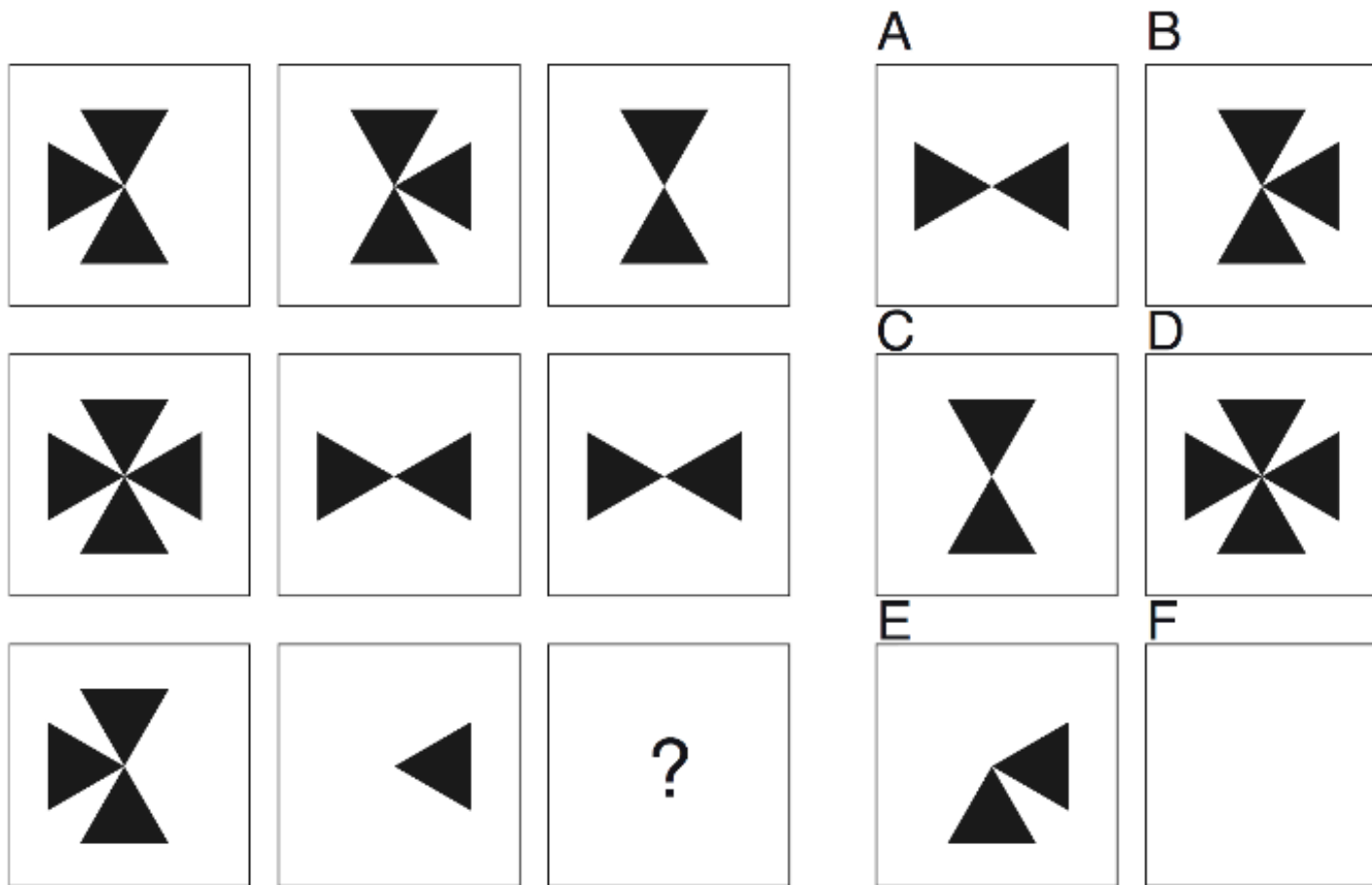


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Measuring intelligence



IQ testing — issues



IQ testing — issues (1)

- IQ in genes (nature) or acquired (nurture)? — the “nature-nurture debate”
- IQ trainable — increased through practice?
- cultural differences?
- professional success? why are some with high IQ successful, others not?
- emotional intelligence?
- relation to brain processes?



IQ testing — issues (2)

- many different abilities, not just one number? (tests for different abilities; see Howard Gardner, Robert Sternberg, Steven J. Gould, and many others)
- the “Flynn Effect” (IQ increasing over the years)



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Artificial Intelligence — goals

1. Understanding biological systems



animals

2. Making abstractions, developing theory



humans

3. Applications



vacuum-cleaner

beer-serving robot



Engkey

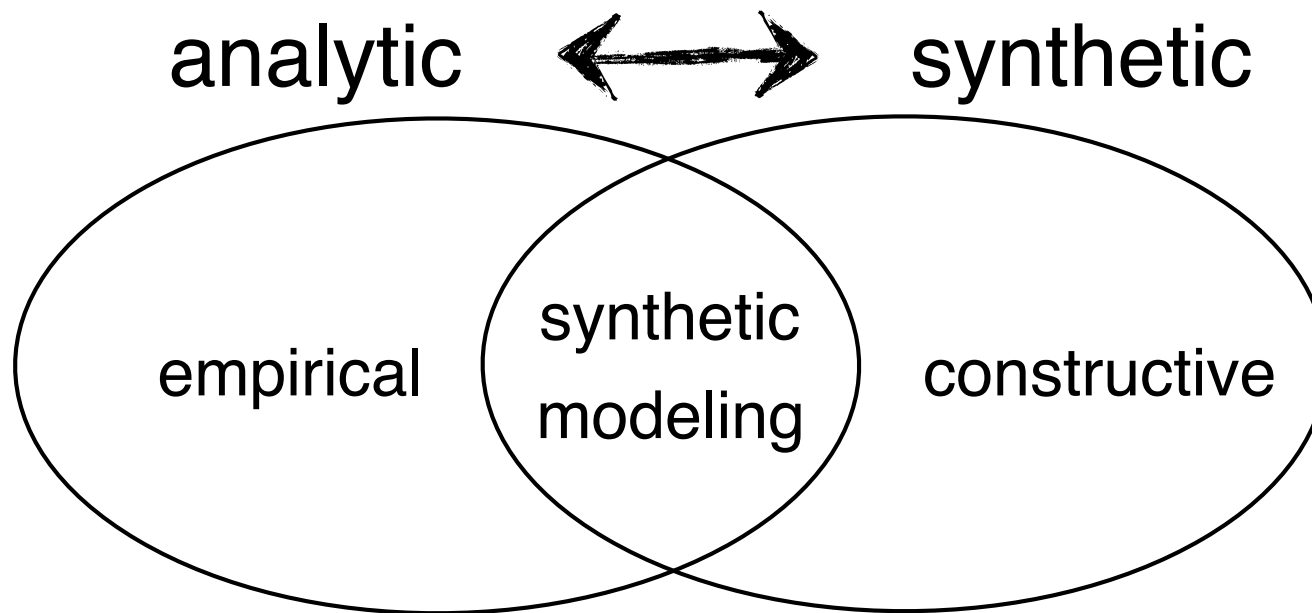


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How to study intelligence?



psychology
biology
neuroscience

artificial intelligence
engineering
cognitive science



The synthetic methodology

Slogan:

“Understanding by building”

modeling behavior of interest
abstraction of principles



robots as tools for scientific
investigation



An old dream



“If every tool, when ordered, or even of its own accord, could do the work that befits it, just as the creations of Daedalus moved of themselves . . . If the weavers' shuttles were to weave of themselves, then there would be no need either of apprentices for the master workers or of slaves for the lords.”

Aristotle

(from Politics, Book 1, 1253b, 322 BC)



Aristoteles dixit

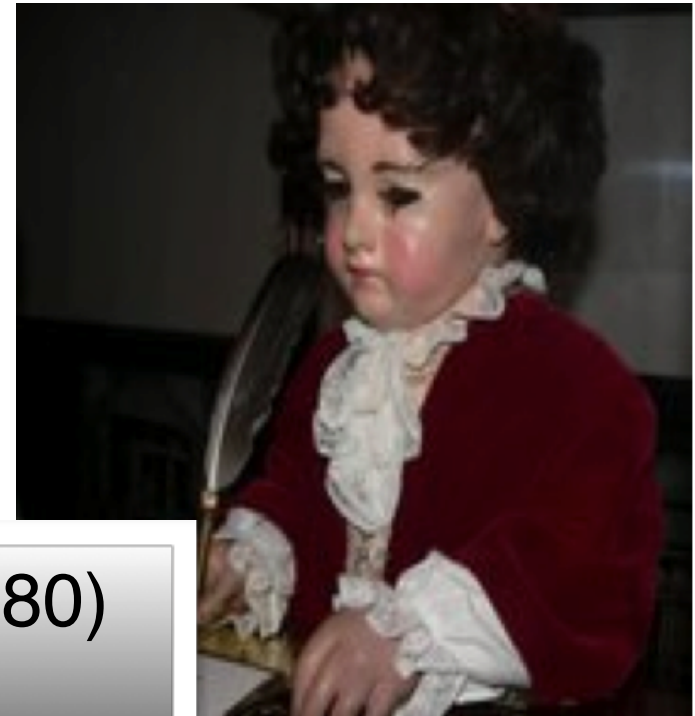
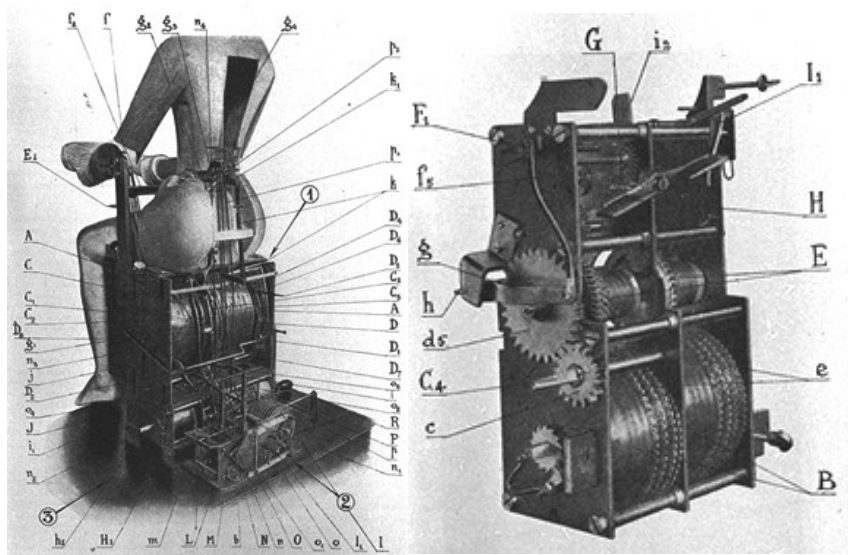


“The part of the quote "or even of its own accord" is elsewhere translated as "or by seeing what to do in advance" etc. (you may find many translations). I think this is an important part of the quote, so it's good to go back to the original text: Aristotle uses the word "προαισθανόμενον" – proaisthanomenon this means literally: pro = before, aisthanomenon = perceiving, apprehending, understanding, learning (any of these meanings in this order of frequency) in my view it is clearly a word that is attributed to intelligent, living agents....i.e. ones with cognitive abilities (!) ”

personal communication, Dr. Katerina Pastra
Research Fellow
Language Technology Group
Athens, Greece



Old attempts



Jaquet-Droz Brothers (1720-1780)



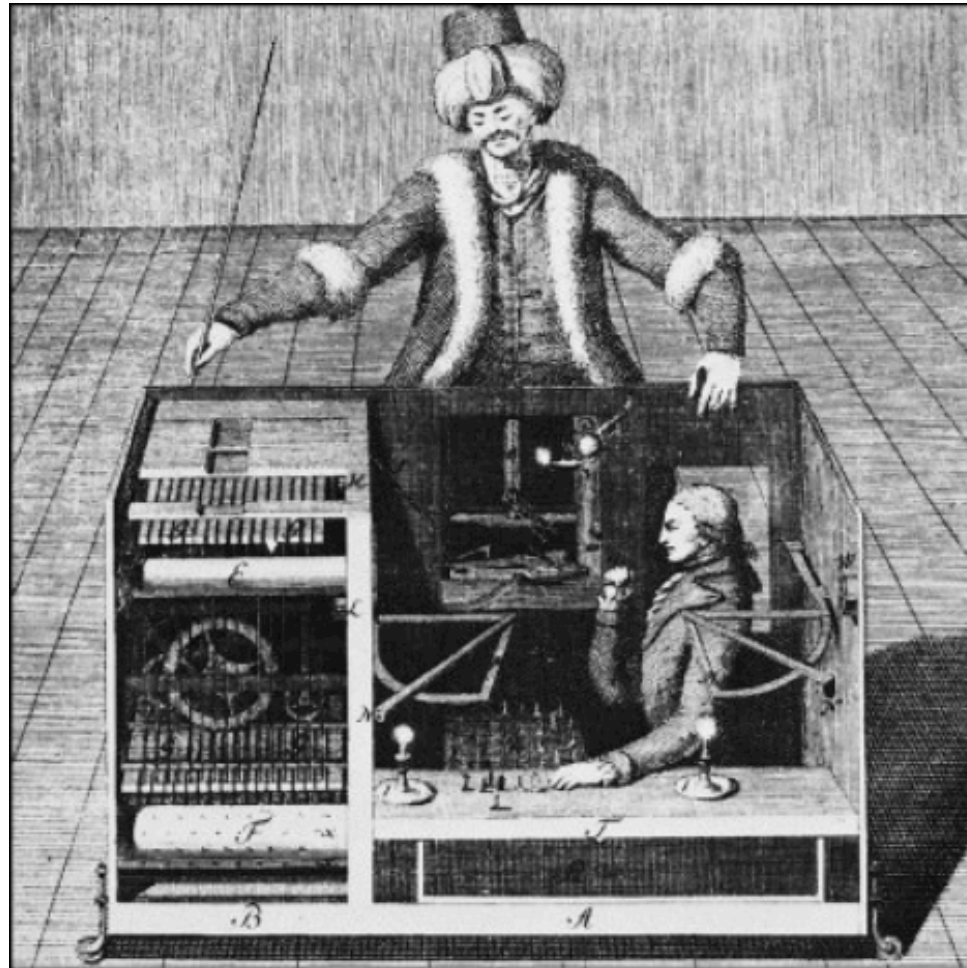
Old attempts



Karakuri Dolls
Chahakobi Ningyo (Tea Serving Doll) by SHOBEI Tamaya IX, and plan from 'Karakuri Zuii' ('Karakuri - An Illustrated Anthology') published in 1796.



W. Van Kempelen's Chess Player (1769)



The synthetic methodology

Slogan:

“Understanding by building”

modeling behavior of interest
abstraction of principles



robots as tools for scientific
investigation

Many examples during ShanghAI lectures



Issues to think about:

IQ and professional success

The “Mensa International” <http://www.mensa.org/> is an organization whose roughly 100.000 members worldwide score in the top 2 % on intelligence tests. On standard IQ tests, this is around 140 or above.

While IQ has sometimes been taken as a predictor for professional success, it is interesting that some of the “Mensa” members are professionally successful whereas others aren’t.

Why could that be?



Issues to think about: IQ and professional success

The “Mensa International” <http://www.mensa.org/> is an organization whose roughly 100.000 members worldwide score in the top 2 % on intelligence tests.

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**homework:
think about this issue
student presentation
next week**

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Issues to think about: an unfair comparison

Video: an excellent
robot's “bad day”

Video: “the inner life of
a cell”



Issues to think about: an unfair comparison

Video: an excellent

homework:
think about this issue
student presentation
next week



Assignments for next week

- Next lecture on 7 November 2019:
“Evolution: Cognition from Scratch”.
- Read chapters 1 and 2 of “How the body
...”

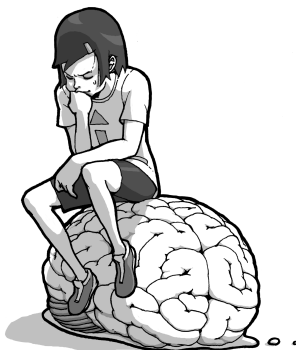


End of lecture 1

Thank you for your attention!

stay tuned for lecture 2

“Evolution: Cognition from Scratch”

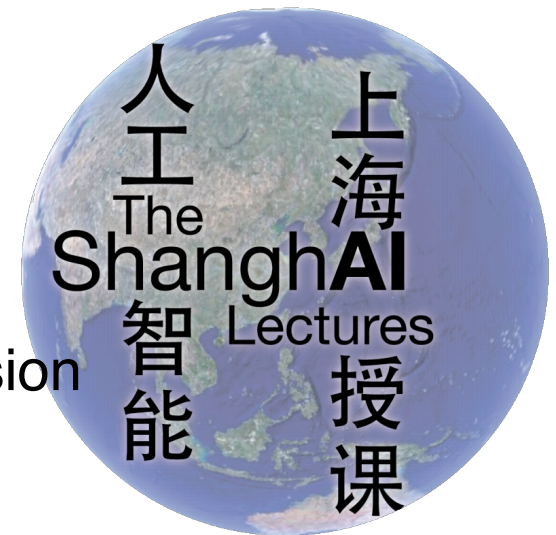


Fabio Bonsignorio
CEO and Founder Heron Robots
Former Vis.Prof, the BioRobotics Institute, SSSA
2014-2019
Santander - UC3M Chair of Excellence 2010



Research interests

- embodied intelligence, cognition/AI and robotics
- experimental methods in Robotics and AI
- Advanced approaches to Industry 4.0 and Precision Agriculture
- synthetic modeling of life and cognition
- novel technologically enabled approaches to higher education and lifelong learning



The ShanghAI Lectures
2013-2019

