
人工智能
上海
The ShanghAI
Lectures
授课

The ShanghAI Lectures

An experiment in global teaching

Fabio Bonsignorio
The BioRobotics Institute, SSSA and Heron Robots

Today from the BioRobotics Institute, Pontedera (PI)

欢迎您参与
“来自上海的人工智能系列讲座”

Lecture 3

Intelligent Systems: Properties and Principles

10 November 2016

ISTITUTO DI BIOROBOTICA
Scuola Superiore Sant'Anna

The ShanghAI Lectures 人工智能上海授课

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

Intelligence?

From the Penguin Dictionary of Psychology

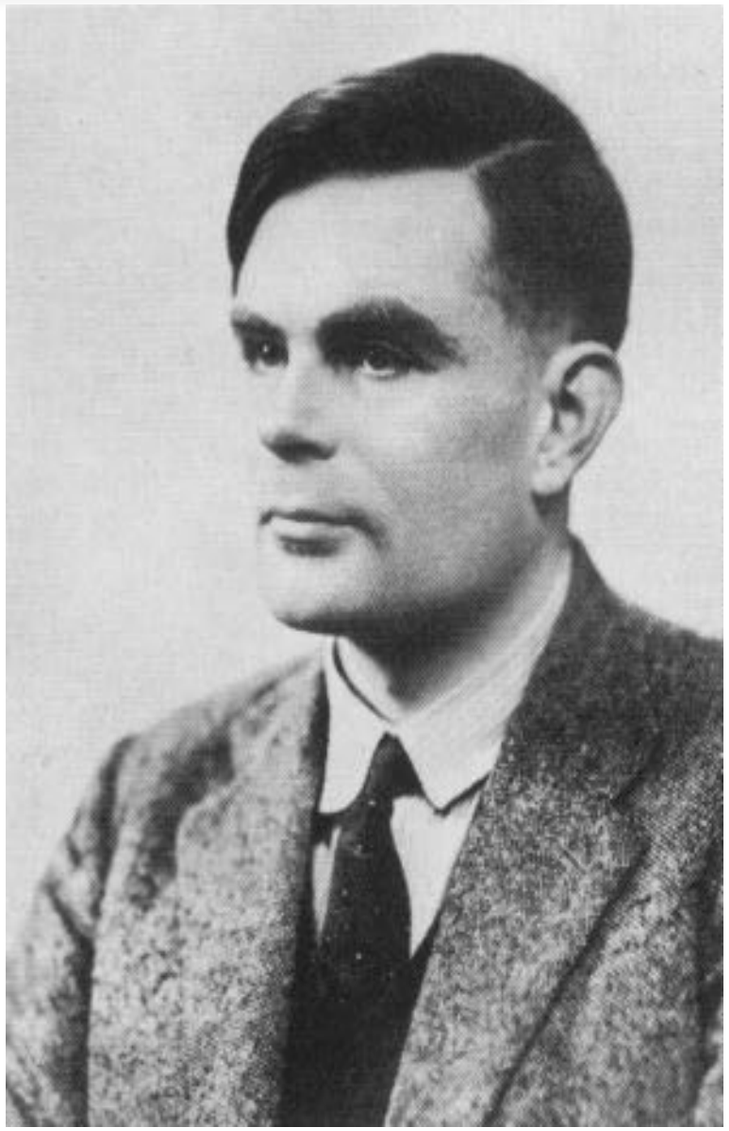
“Few concepts in psychology have received more devoted attention and few have resisted clarification so throughly.”

(Reber, 1995, p. 379)

An empirical test?

Alan Turing (1912 - 1954)

- **computer**
- **“computation”**
- **intelligence**

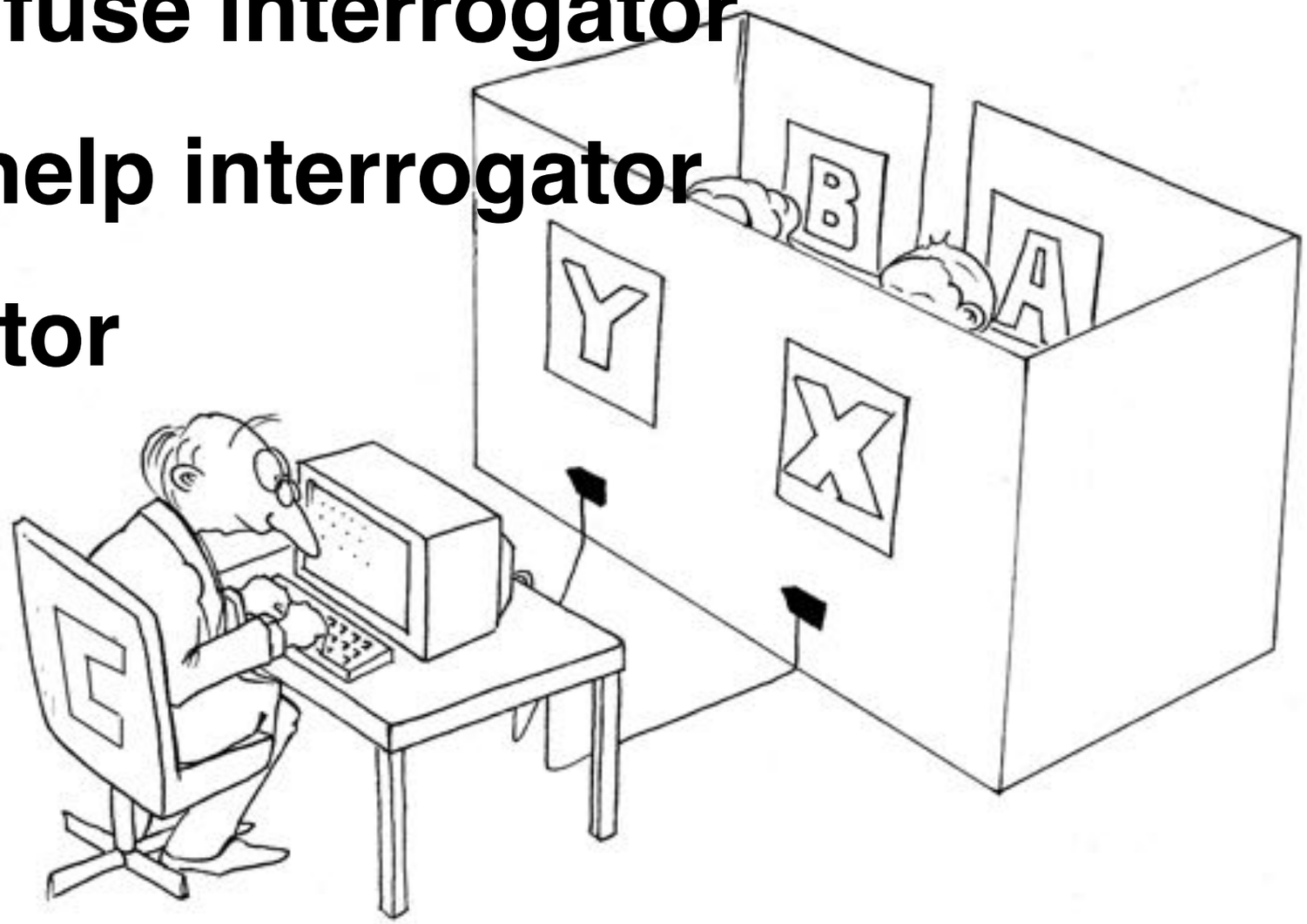


The Turing Test

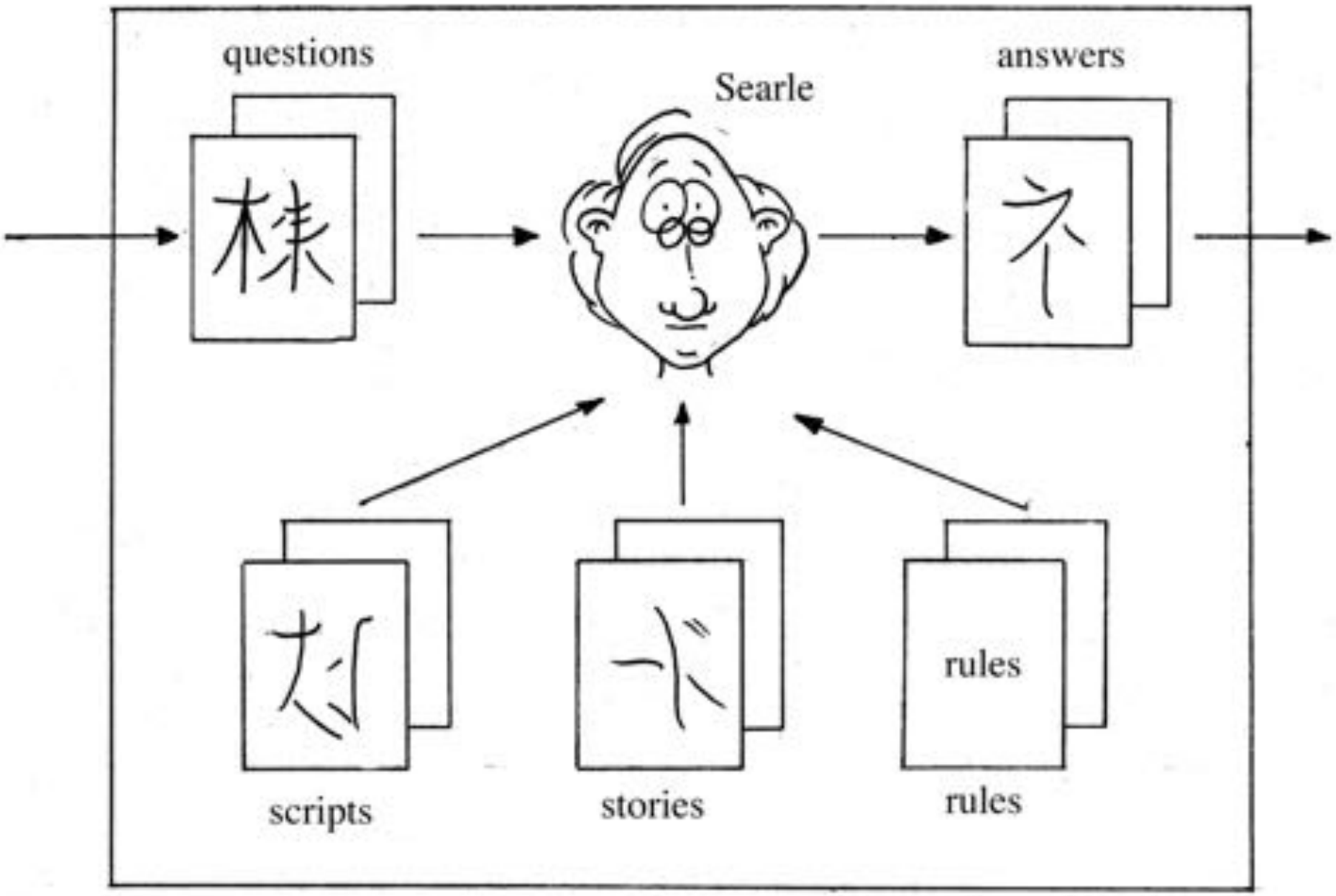
A: man, confuse interrogator

B: woman, help interrogator

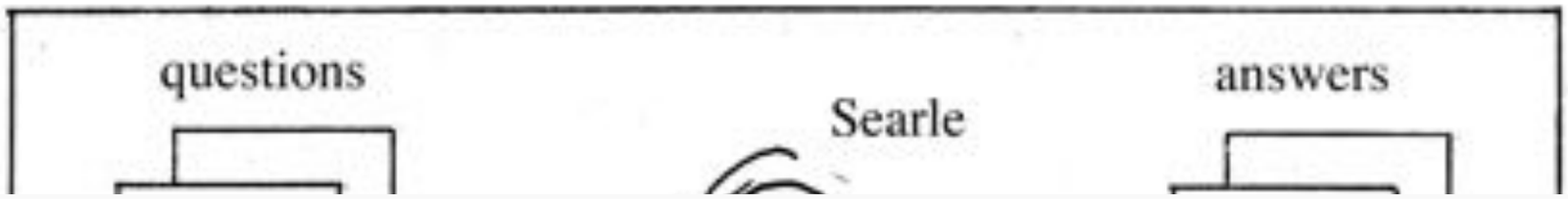
C: interrogator



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**

Turing tests

Video: “Blade runner”

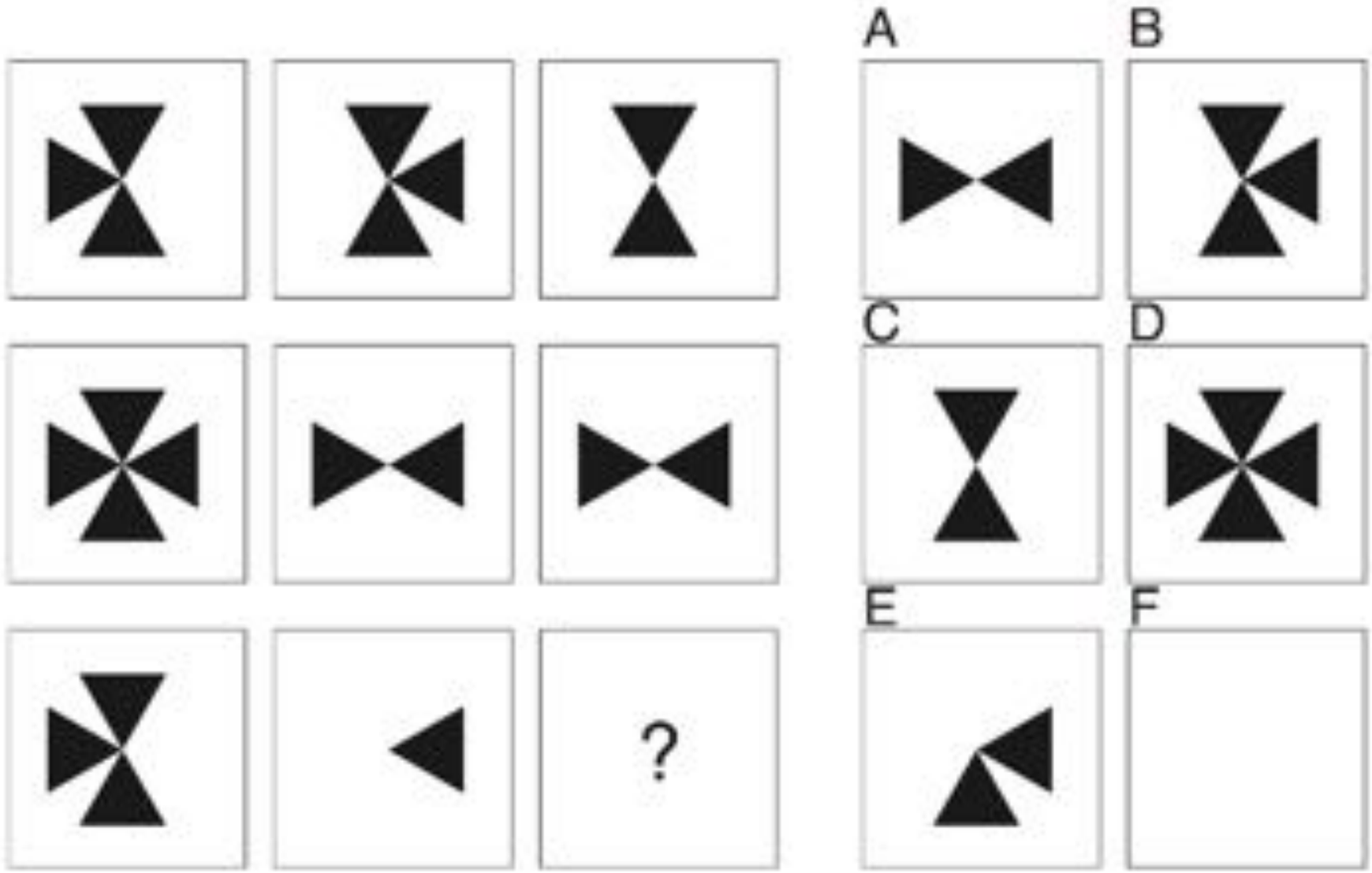
Video “real dog vs. Aibo”

Measuring intelligence

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

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)

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

Artificial Intelligence — goals

1. **Understanding biological systems**

animals

humans

2. **Making abstractions, developing theory**

3. **Applications**

vacuum-cleaner

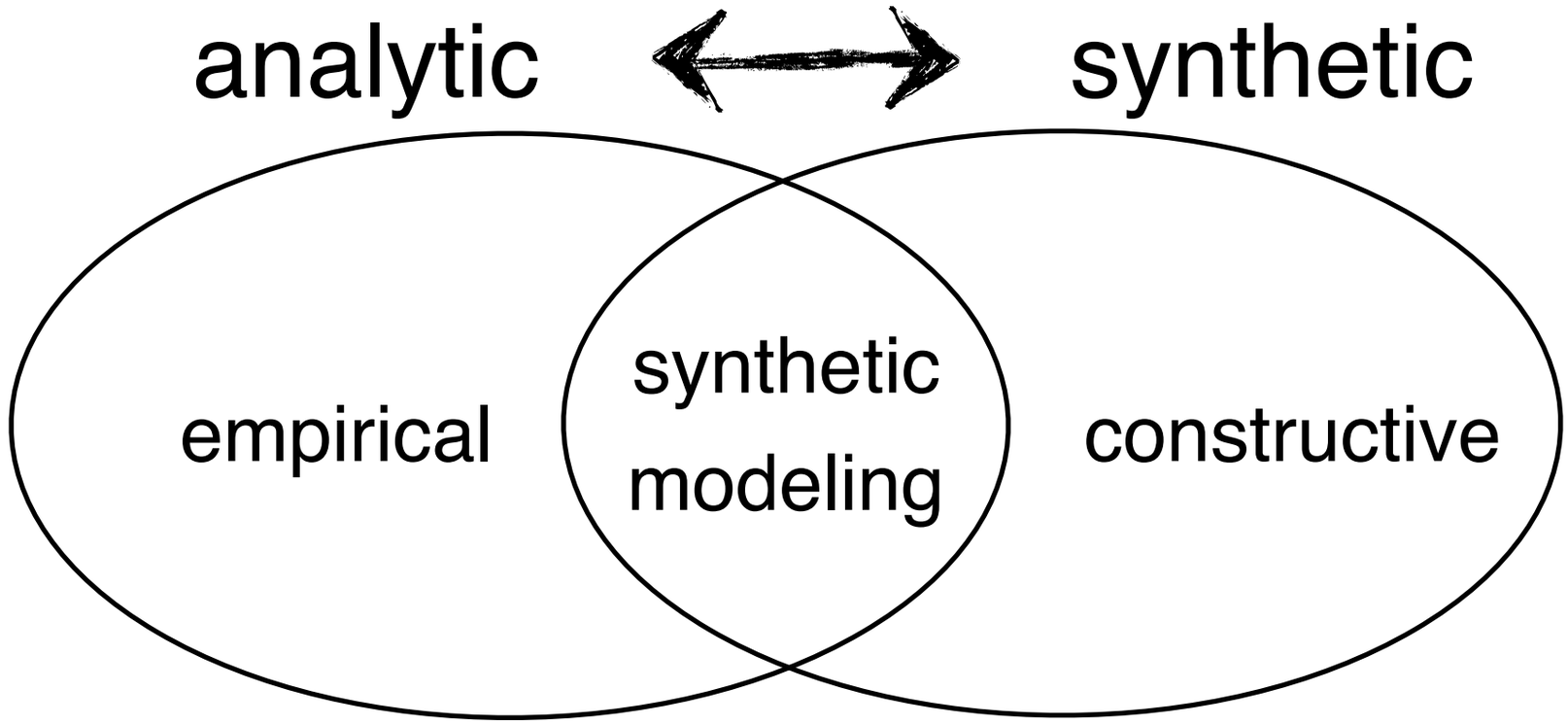
beer-serving robot

Engkey

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**

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

ISTITUTO DI BIOROBOTICA

Scuola Superiore Sant'Anna

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

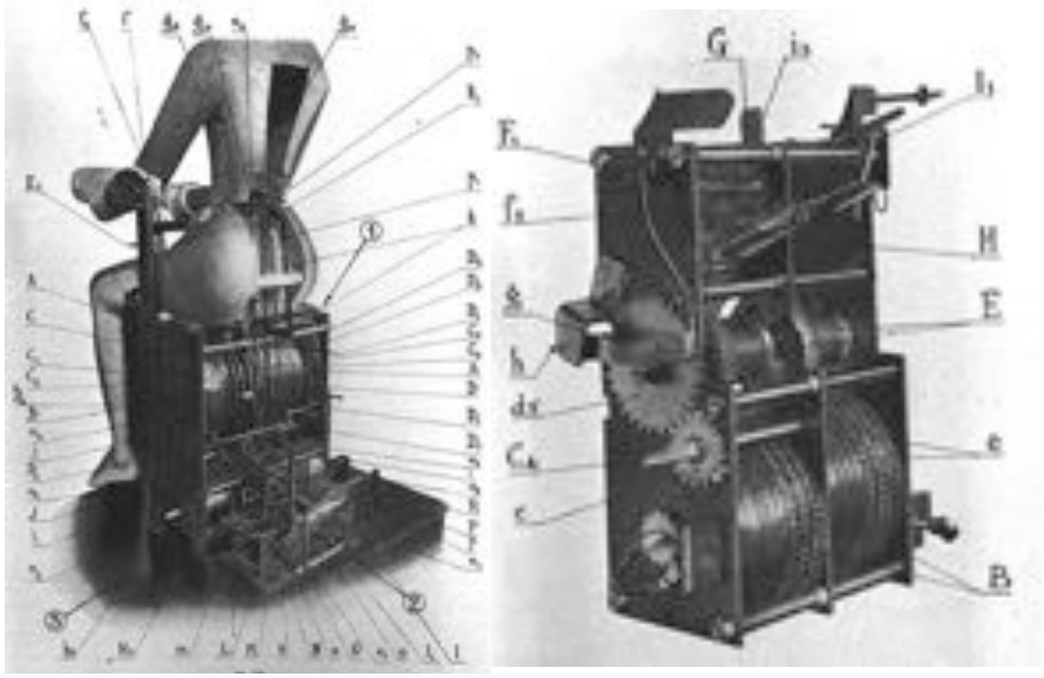
“The part of the quote "or even of its own accord” is elsewhere translated as "or by seeing what to do in advance" etc. (you may find many translations). I think this is an important part of the quote, so it's good to go back to the original text: Aristotle uses the word "προαισθανόμενον" – proaisthanomenon this means literaly: 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 (!) ”

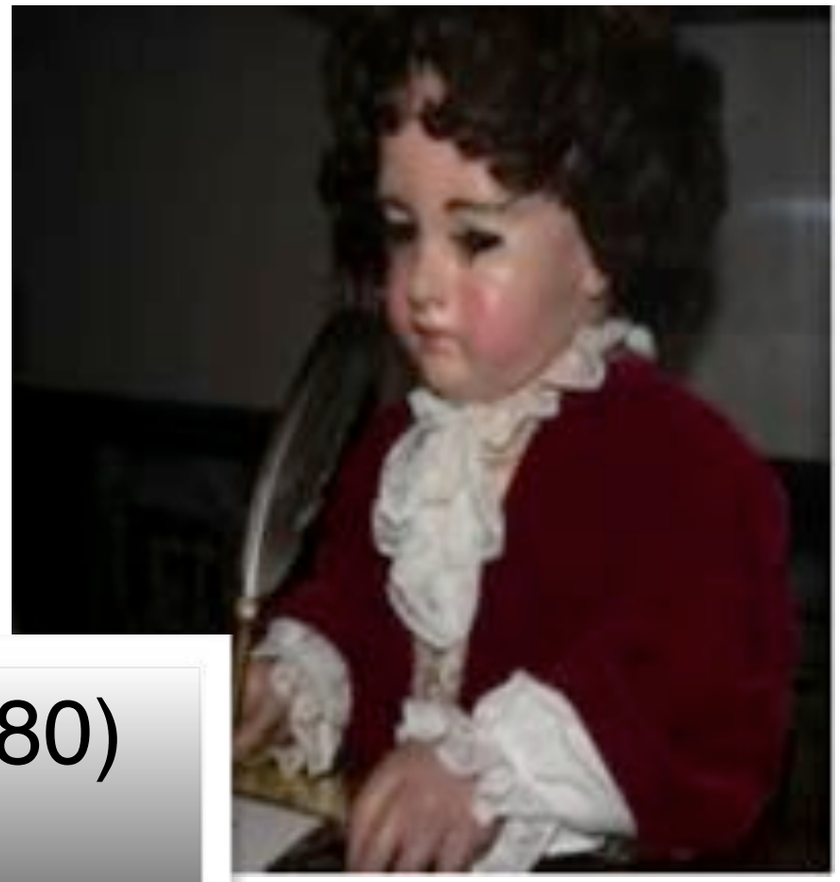
personal communication, Dr. Katerina Pastra
Research Fellow
Language Technology Group
Athens, Greece

ISTITUTO DI BIOROBOTICA
Scuola Superiore Sant'Anna

The ShanghAI Lectures 人工智能 上海授课

Old attempts





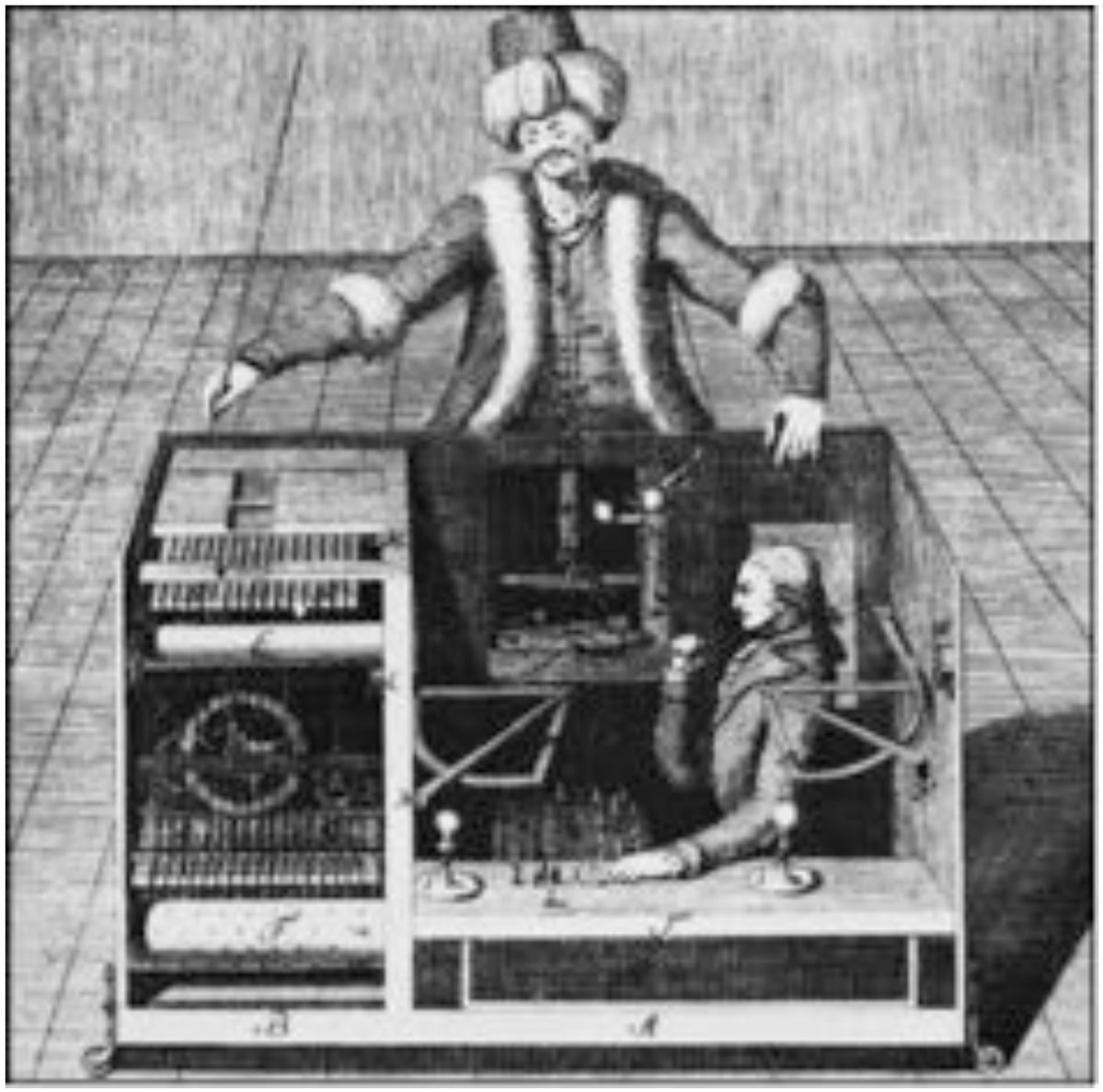
Jaquet-Droz Brothers (1720-1780)

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

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

The "Mensa International" http://www.mensa.org/ is an organization whose roughly 100.000 members worldwide score in the top 2 % on int his is arc times be sional su f the "M essful wh

homework:
think about this issue
student presentation
next week

Issues to think about: an unfair comparison

Video: an excellent robot's "bad day"

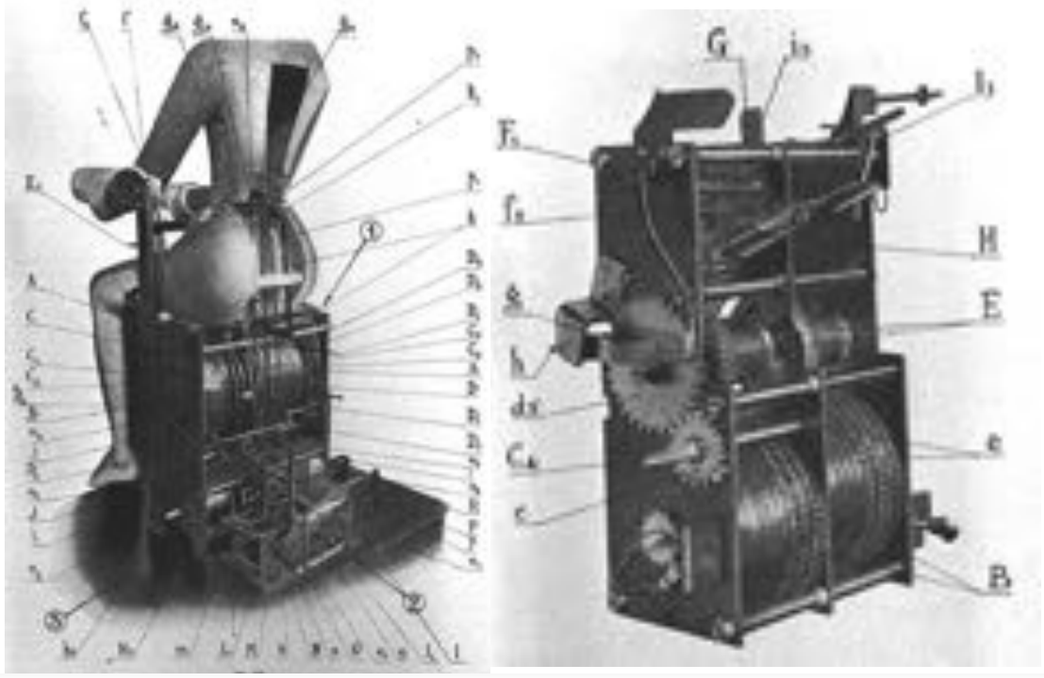
Video: "the inner life of a cell"

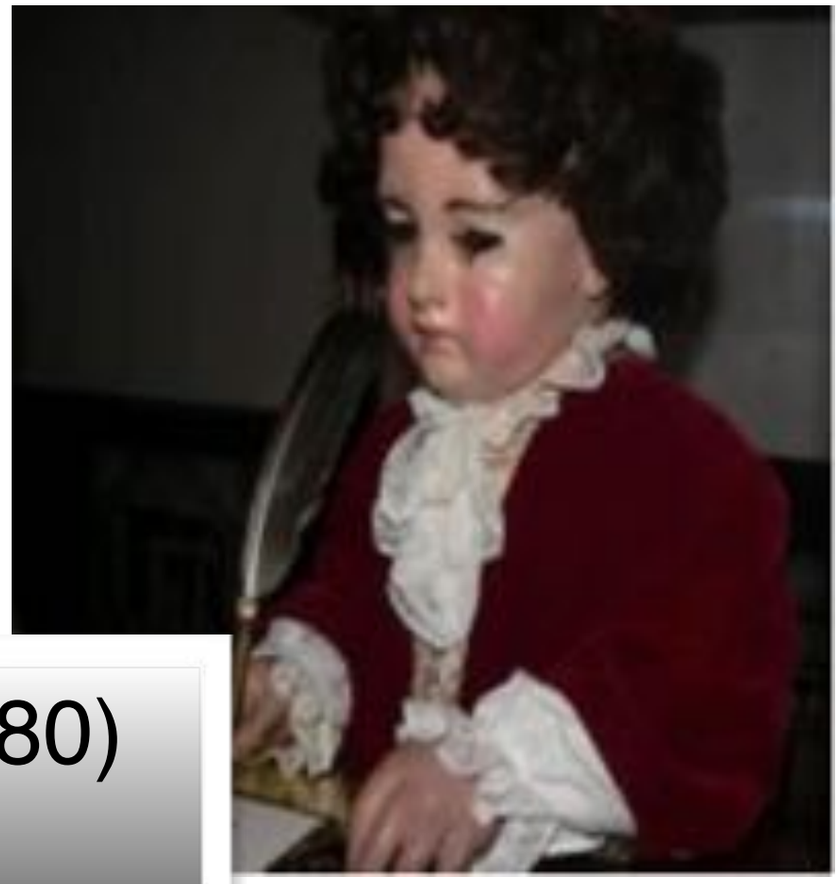
Issues to think about: an unfair comparison

Video: an excellent

homework:
think about this issue
student presentation
next week

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.

THE BIOROBOTICS INSTITUTE

Scuola Superiore Sant'Anna

Older and newer attempts

Juanelo Torriano alias Gianello della Torre, (XVI century) a craftsman from Cremona, built for Emperor Charles V a mechanical young lady who was able to walk and play music by picking the strings of a real lute.

Hiroshi Ishiguro, early XXI century

Director of the Intelligent Robotics Laboratory, part of the Department of Adaptive Machine Systems at Osaka University, Japan

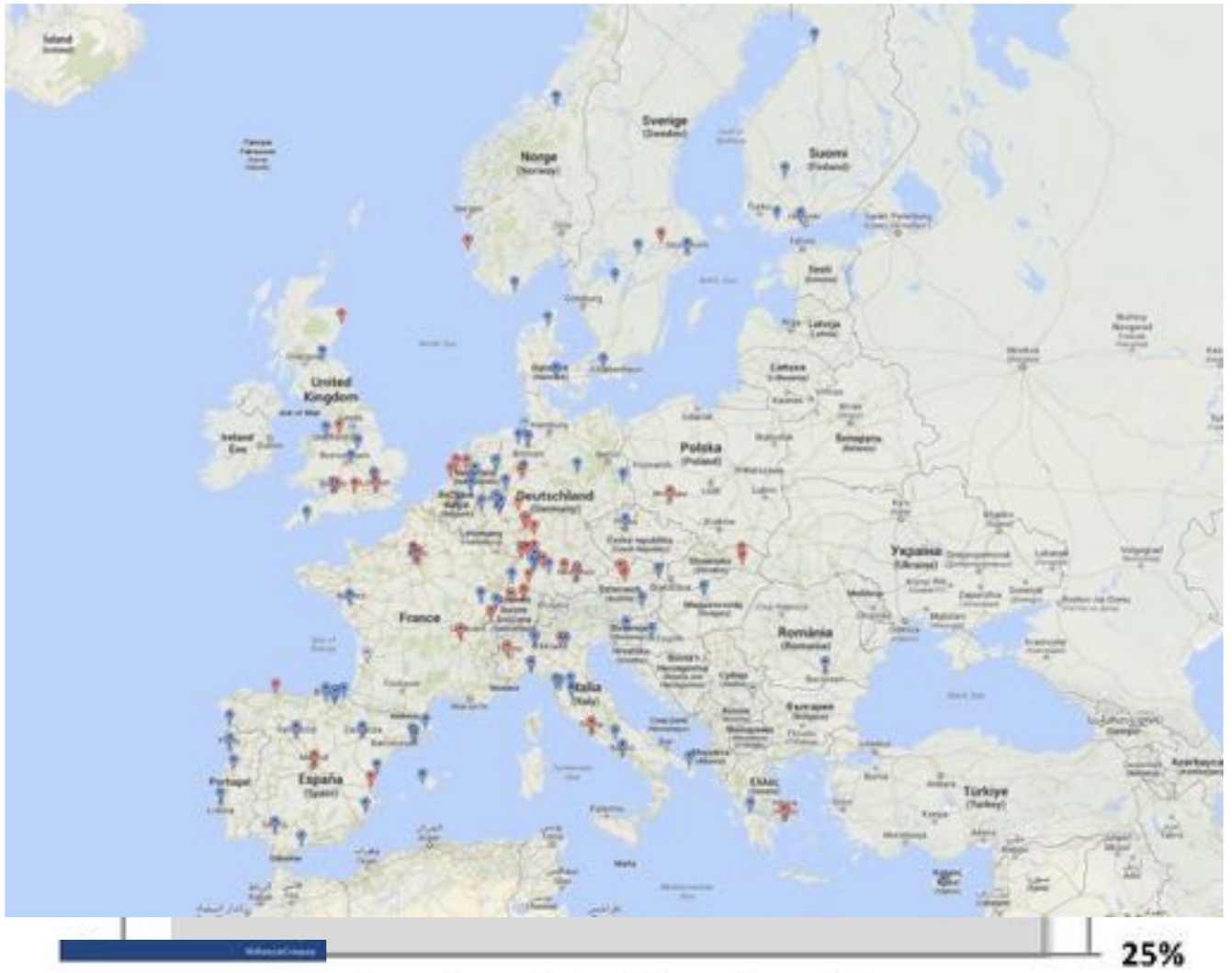
THE BIOROBOTICS INSTITUTE

Scuola Superiore Sant'Anna

Data are very important, but they are not all in a digital economy. ACTIONS, MOBILI and STRENGTH are also needed! **Robotics**: a great opportunity to **innovate, connect** and **transform. Robotics is technology and business, but it is also creativity and fun!**

"[...] The size of the robotics market is projected to grow substantially to 2020s. This is a global market and Europe's traditional competitors are fully engaged in exploiting it. Europe has a 32% share of the industrial market. Growth in this market alone is estimated at 8%-9% per annum. Predictions of up to 25% annual growth are made for the service sector where Europe holds a 63% share of the non-military market. […]"

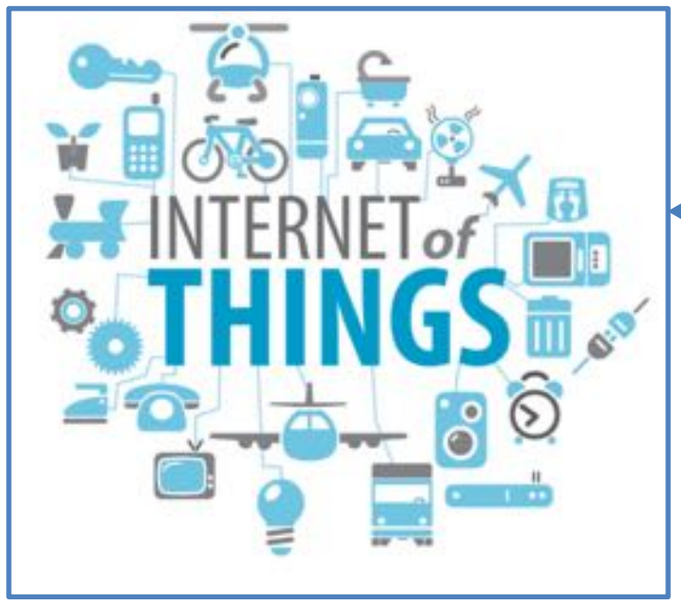
"[…] From today's €22bn worldwide revenues, robotics industries are set to achieve annual sales of between €50bn and €62bn by 2020. […]"



Robotics is one of the 12 disruptive technologies identified by McKinsey

http://sparc-robotics.eu/about/
SPARC Strategic Research Agenda

Robotics: a great opportunity to **innovate, connect** and **transform**

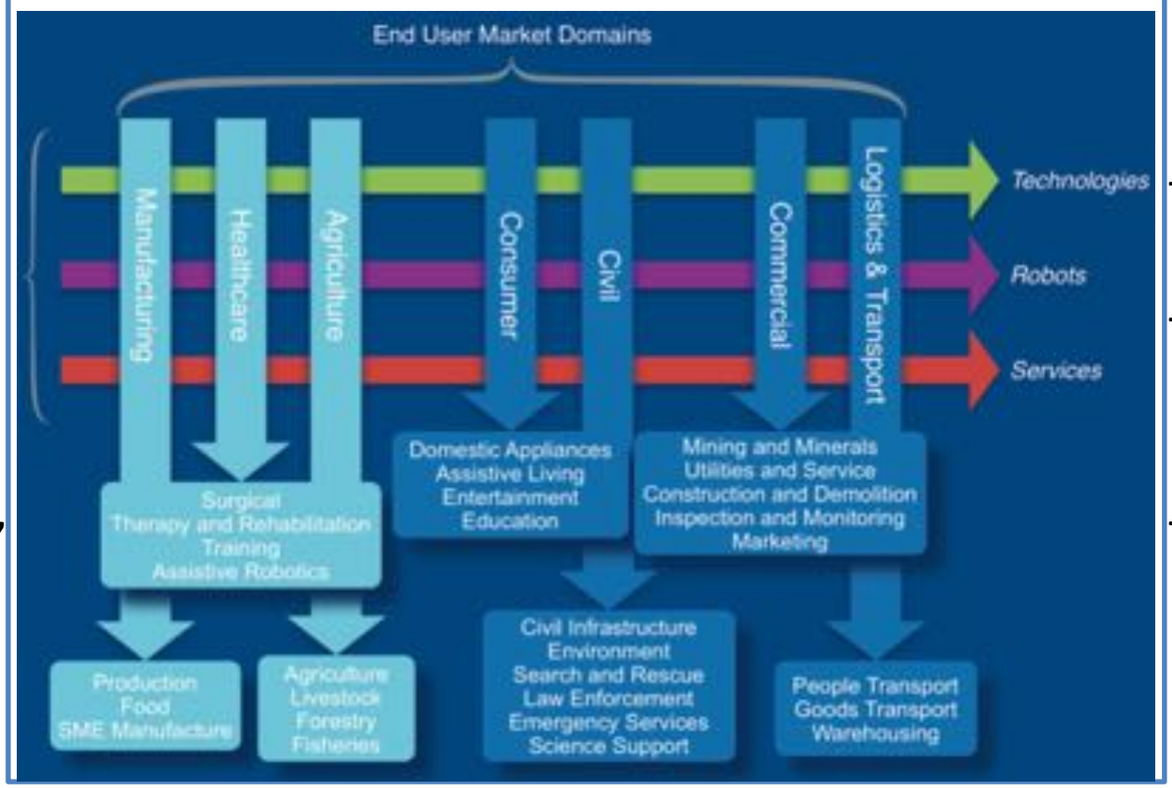


- The web and IoT pull new robotic applications
- Robotics expands the boundaries of the Web and of IoT
- The Web is an 'infrastracture' of future robotics

The value chain of robotics, ICT components and IoT

Robotics is inclusive and interdisciplinary

Robotics market domains



ICT enabling components and technologies, e.g., MEMS, 4G, 5G

- Robotics integrates enabling ICT components
- Robotics will drive the development of new ICT components
- Robotics pulls the development of next generation communication networks

Robots and Jobs

- Creating **new jobs** in robotics (manufacturing and servicing robots)
- Creating new industrial opportunities (and **jobs**) by using robotics and automation (human-robot cooperation, circular economy)
- Taking advantage of robotics and automation to enable GDP growth while **reducing workload and even enabling more leisure and free time**

http://sparc-robotics.eu/about/
http://www.mathisintheair.org

ECHORD++: a EU initiative to bring robotics innovation from the lab to the market http://www.echord.eu/

The Waves of Robotics Innovation

Third wave

Second wave

First wave

Society

& Bioinspiratio

Multif. Nanomat.

Cognitive Science

MC, Simpl., Self-org.

IoT

ML

AI

Mech Eng

Ctrl Eng

Comp Sci

SEVENTH FRAMEWORK PROGRAMME

FIFTH FRAMEWORK PROGRAMME

SIXTH FRAMEWORK PROGRAMME

1st crest

2st crest

New wave of use-centered science-based radical innovations

Sustainable industrial leadership and ubiquitous societal impact

Robot Companions for Citizens

Coordination Action for the design and description of the FET flagship candidate

1st crest

2st crest

Advanced, Future and Emerging Robotics & Cognitive Systems

Industrial leadership and societal impact

SPARC

HORIZON 2020

1st crest

2st crest

Methodologies and Technologies for Robotics and Mechatronics

Industrial robotics

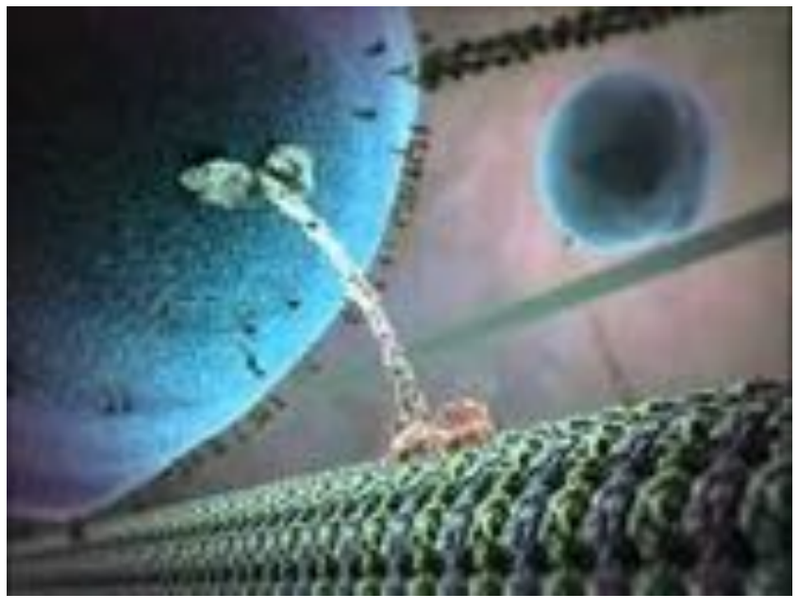
Robotics body of knowledge

Future of Robotics

1990 2000 2015 2020 2025 2030

Is It Alive?

- A marvelous robot's bad day
- The inner life of a cell



THE BIOROBOTICS INSTITUTE

Scuola Superiore Sant'Anna

The need for an embodied perspective

- **“failures” of classical AI**
- **fundamental problems of classical approach**
- **Wolpert’s quote: Why do plants not have a brain? (but check Barbara Mazzolai’s lecture at the ShanghAI Lectures 2014)**
- **Interaction with environment: always mediated by body**

THE BIOROBOTICS INSTITUTE

Scuola Superiore Sant’Anna

Two views of intelligence

classical:
cognition as computation

embodiment:
cognition emergent from sensory-motor and interaction processes

End of lecture 3

Thank you for your attention!

stay tuned for lecture 4

Fabio Bonsignorio
Prof,the BioRobotics Institute, SSSA
CEO and Founder Heron Robots
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

- synthetic modeling of life and cognition

- novel technologically enabled approaches to higher education and lifelong learning

The ShanghAI Lectures
2013-2016

Rolf Pfeifer
Prof,
Institute for Academic Initiatives, Osaka University, Japan
Dept. of Automation, Shanghai Jiao Tong University, China
Prof Em.,Former Director AI Lab, Univ. of Zurich

How the body shapes the way we think

MIT Press

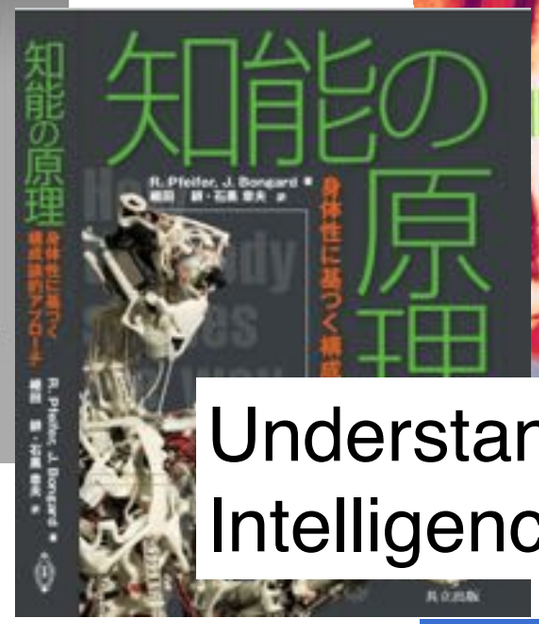
Research interests

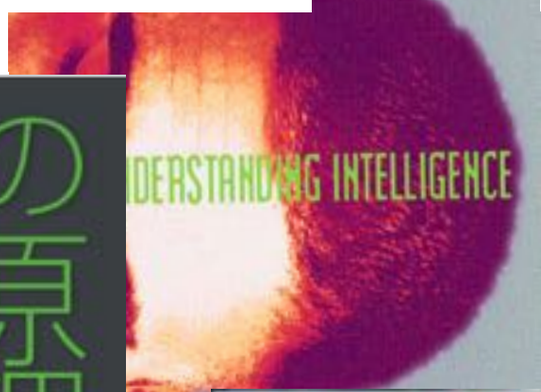
- embodied intelligence

- bio-inspired robotics

- self-organization and emergence

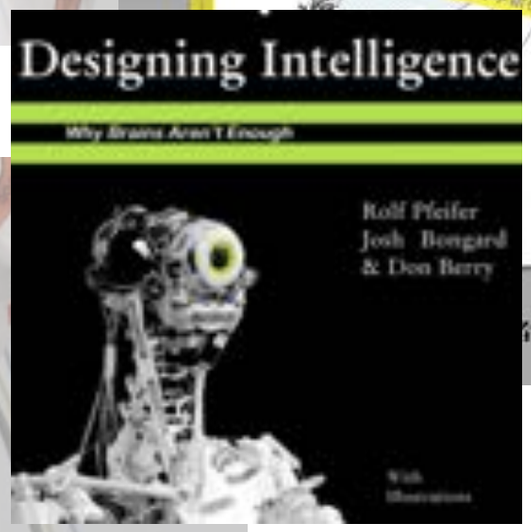
- educational technologies





Understanding Intelligence

The ShanghAI Lectures



DI BIOROBOTICA

Scuola Superiore Sant'Anna