Student presentations

1. Pros and cons of Searle's Chinese Room thought experiment (a Chinese site)
2. IQ and professional success (see slide about Mensa-Club)

The ShanghAI Lectures
An experiment in global teaching

Rolf Pfeifer
15 October 2014

Today from Osaka University, Japan
大阪大学

Geography

Lecture 1

Intelligence — An Eternal Conundrum

What it is and how it can be studied

Goals of lecture series

- **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**
- **“embodiment”**

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Robots, artificial intelligence in the media

Nestle Japan hiring 1,000 robots to sell espresso machines

SoftBank Corp.'s humanoid robot Pepper is displayed at a high-tech gadget exhibition in Tokyo in June. Food giant Nestle said on Wednesday its Japan unit plans to put 1,000 of the robots to work as sales clerks at stores across the country. | AFP–JIJI

BUSINESS / CORPORATE

Nestle Japan hiring 1,000 robots to sell espresso machines

Robots, artificial intelligence in the media

Pepper humanoid robots are shown during a July event in Tokyo. A drunken 60-year-old man was arrested Sunday for allegedly damaging a similar robot in a fit of rage at a SoftBank outlet, police said. | KYODO

NATIONAL / CRIME & LEGAL

Drunken Kanagawa man arrested after kicking SoftBank robot

Robots, artificial intelligence in the media

SoftBank warns against sex with its android Pepper

Robots, artificial intelligence in the media

IBM's Jeopardy-winning computer "Watson"

"Watson" is also used in the context of "big data" for medical diagnostics, interpretation of x-rays, etc.

Robots, artificial intelligence in the media

IBM's Jeopardy-winning computer "Watson"

Goals

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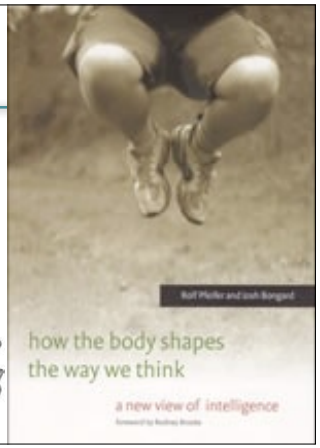
Book for class

Rolf Pfeifer and Josh Bongard

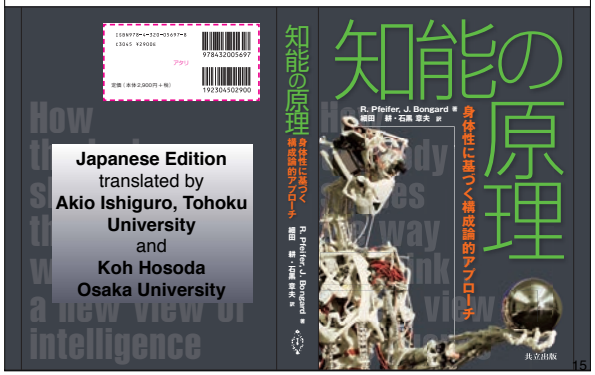
How the body shapes the way we think — a new view of intelligence

MIT Press, 2007

Illustrations by Shun Iwasawa



Japanese edition

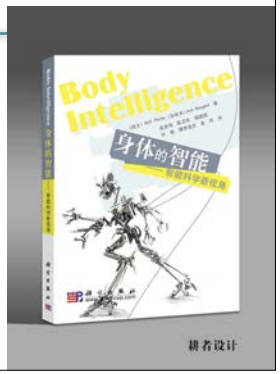


Japanese Edition
translated by
Akio Ishiguro, Tohoku University
and
Koh Hosoda
Osaka University

Chinese translation

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

Foreword by
Lin Chen
Chinese Academy of Science
Beijing



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

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?

What do we intuitively think intelligence is about? We all feel that we know very well what it means - pinning it down exactly is very hard.
- learning
- solving abstract problems
- generalization, transfer to other domains
- language
- playing chess
- doing math
- creativity
- memory

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)

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)

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From a 1927 edition of the Journal of Educational Psychology; leading psychologists at the time were asked for their definitions. Some of these "definitions" are rather odd: what are "relatively new situations in life" (in a definition!); or "… and given a somewhat unified effect in behavior".

Definitions of intelligence

http://www.vetta.org/definitions-of-intelligence/ — now defunct ;-(

with 70 definitions

"… there seem to be almost as many definitions of intelligence as there were experts asked to define it." R.J. Sternberg

(Robert J. Sternberg, distinguished psychologist; famous book "Beyond IQ: A triarchic theory of human intelligence", 1985)

read instead: "A collection of definitions of intelligence", Shane Legg, and Markus Hutter, IDSIA, Switzerland

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Robert Sternberg is a distinguished psychologist at Tufts University in Boston. He has contributed much work to the study of intelligence from a psychological point of view. He is also one of the critics of the IQ, arguing that the IQ is too limited.

Definitions of intelligence

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

Legg and Hutter (webpage): three commonalities

A property that an individual agent has as it interacts with its environment or environments.

Is related to the agent's ability to succeed or profit with respect to some goal or objective.

Depends on how able the agent is to adapt to different objectives and environments.

Their definition:
"**Intelligence measures an agent's ability to achieve goals in a wide range of environments.**"

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As you can see, this is simply yet-another-definition that doesn't help very much. Just try to think what they mean by "goal": For example, if an ant brings a piece of food, e.g. a dead insect, back to the nest, has it "achieved a goal" ? If anything, the goal is in the mind of the observer rather than the ant (see the "frame-of-reference" problem to be introduced later).

Experiment in movie theatre: large and small bags of popcorn. The ones with the larger bags eat more. Did they have the goal to eat more?

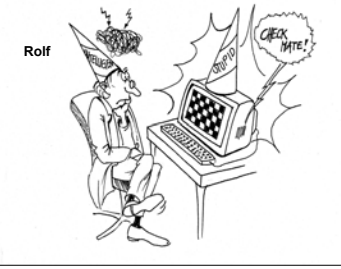
http://arxiv.org/abs/0706.3639

Subjectivity, expectations

Playing chess

Rolf playing chess

Rolf



Personally, I am a mediocre player. If you watch me play, you will not be very convinced of my level of intelligence.

Subjectivity, expectations

Playing chess

baby girl playing chess

Personally, I am a mediocre player. If you watch me play, you will not be very convinced of my level of intelligence. However, replace myself by a baby girl. If she makes precisely the same moves as I do, you will be very impressed with her level of intelligence.

Subjectivity, expectations

Playing chess

dog playing chess

Personally, I am a mediocre player. If you watch me play, you will not be very convinced of my level of intelligence. Replace myself by a dog. If he made the same moves as I you would think he is a genious.

Definitions, arguments

- hard to agree on
- necessary and sufficient conditions?
- are robots, ants, humans intelligent?

Definitions, arguments

- hard to agree on
- necessary and sufficient conditions?
- are robots, ants, humans intelligent?

- three pros ?
- three cons ?

Are ants intelligent? Pro: they can learn, they cooperate, they have high navigational skills, communication abilities, they live in sophisticated societies, they can find the shortest path to the biggest food source; Con: neural plasticity limited, language?, tool use very limited, building artifacts, abstract problem solving?, math.

Are ants intelligent? pros and cons

Are ants intelligent? We can find Pros and Cons.

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?”

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Interaction and observation

Video “Robovie”

Video “Larsen_Bert”

Video “iCub attention”

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The most widespread method to judge whether an agent is intelligent is to observe its behavior.
1st video clip: Robovie
2nd video clip: Larsen_Bert - listening to human
3rdd video clip: iCub attention: the fact that iCub seems to be “looking at” objects and humans in the environment makes us attribute intelligence and emotions to the robot

Interaction and observation

videos:

intelligent?

—> highly subjective

—> Turing suggests empirical test

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Robovie: interaction of robot with kids in Japanese school
real dog vs. Aibo: short interaction of robot dog Aibo with real dog
iCub attention: the fact that iCub seems to be “looking at” objects and humans in the environment makes us attribute intelligence and emotions to the robot

Today's topics

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An empirical test?

Alan Turing (1912 - 1954)

- **computer**
- **"computation"**
- **intelligence**

The Turing Test - the imitation game

interrogator

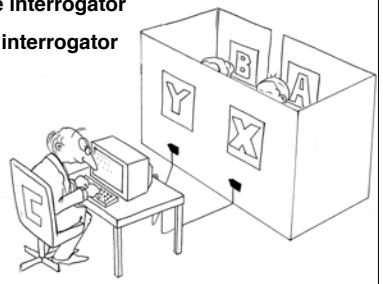
behind wall: human or computer ?

Turing's (more sophisticated) version

A: man, confuse interrogator

B: woman, help interrogator

C: interrogator



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The imitation game is played by three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman. He knows them by labels X and Y, and at the end of the game he says either "X is A and Y is B" or "X is B and Y is A". The interrogator is allowed to put questions to A and B thus: Will X please tell me the length of his or her hair?

Now suppose the X is actually A, then A must answer. It is A's object in the game to try and cause C to make the wrong identification.

The object of the game for the third player (B) is to help the interrogator.

We now ask the question, "What will happen when a machine takes the part of A

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The object of the game for the third player (B) is to help the interrogator.

We now ask the question, "What will happen when a machine takes the part of A in this game? Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman?" These questions replace the original "Can machines think?". (UI pp. 16/17).

Often, simplified versions of the imitation game are used, where there is only a computer and a human and the interrogator has to find out who is the human and who is the computer.

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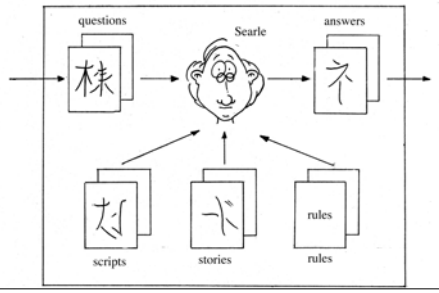
Searle's "Chinese Room" thought experiment



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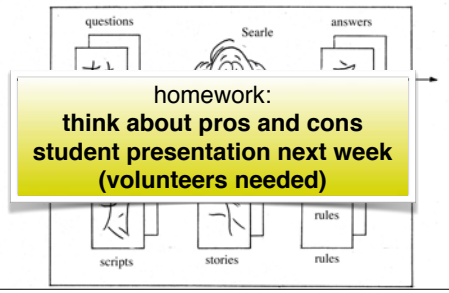
In this original paper, the person locked in the Chinese Room was Searle himself. The argument holds for anyone else, as long as he doesn't speak Chinese. Initially Searle is given two large batches of writing, one with Chinese characters and one written in English. The batch with the Chinese characters represents a data base of common sense knowledge required to answer questions handed to him through the opening on the left of the room. The second batch consists of rules containing the instructions on how to ``process'' the questions, that is, they tell Searle how to produce an answer from the questions written with Chinese characters. This is done by comparing the characters of the question to the characters in the commonsense knowledge base and by choosing certain characters that will make up the answer. When this process is finished, the answer is handed through the opening on the right of the room. Note that the comparison of Chinese characters and the choice of characters that make up the answer is done entirely on the basis of their shapes, that is, on a purely formal or syntactic basis. Let us now suppose that Searle keeps playing this game for a while and gets really proficient at following the instructions for manipulating the Chinese symbols. From an external point of view, that is from the point of view of somebody outside the Chinese Room, Searle's answers to the questions are indistinguishable from those of native Chinese speakers. Nobody looking at Searle's answers can tell that he doesn't speak a word of Chinese. He has

Searle's "Chinese Room" thought experiment



homework:
think about pros and cons
student presentation next week
(volunteers needed)

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Variations on the Turing Test

- **Historical: ELIZA (Doctor), Josef Weizenbaum, 1966**
- **Movie "Blade Runner", 1982, based on novel by Philipp 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?**

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Weizenbaum, J. (1966). ELIZA--A Computer Program For the Study of Natural Language Communication Between Man and Machine. Communications of the ACM. Volume 9, Number 1 (January 1966): 36-35.

(Excerpt of conversation with ELIZA (the DOCTOR program) of a visitor to MIT from Russia)
DOCTOR: Good afternoon. Please type in your name.
[The visitor did so, and the doctor continued with some polite preliminaries.]
DOCTOR: What brought you here to see me today?
VISITOR: Oh, nothing much. I'm feeling a bit tired, that's all.
DOCTOR: Why do you think you're feeling a bit tired?
VISITOR: Well, I've been traveling a lot, and away from home.
DOCTOR: Tell me about your family.
…

Weizenbaum's DOCTOR program

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…
[visitor sends people out of the room]

42

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Turing tests

Video "Blade Runner"

Video "real dog vs. AIBO"

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1st video clip: from the cult movie "Blade runner", showing a TTT, a Total Turing Test, where not only the input-output behavior is relevant, but also the external appearance.

(from Wipedia): ***Blade Runner*** is a 1982 American science fiction film directed by Ridley Scott and starring Harrison Ford, Rutger Hauer, and Sean Young. The screenplay, written by Hampton Fancher and David Peoples, is loosely based on the novel *Do Androids Dream of Electric Sheep?* by Philip K. Dick.

Measuring intelligence

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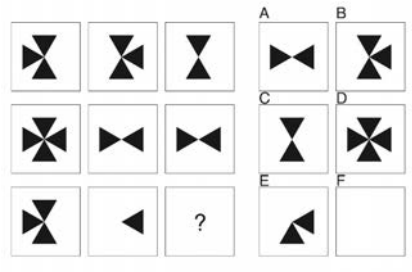
Probably the most famous means of measuring intelligence is the IQ test. In fact, many IQ-like tests have been developed to measure particular abilities.

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



Typical item from an IQ test. What is the solution? Why?

IQ testing — issues

There is a huge literature on IQ testing, and also about many other kinds of testing. There is still a lively debate going on on whether IQ testing is useful or not.

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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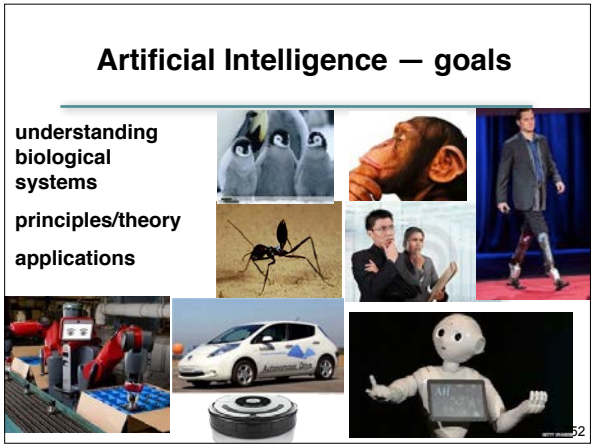

Three goals: understanding biological systems (animals, humans); abstracting principles that not only hold for biological systems but for intelligent systems in general; develop useful applications (bionic legs - Hugh Herr, factory automation, self-driving vehicles, vacuum cleaners, social interaction robots)

All areas: self-driving cars, autonomous lawnmowers, flying drones in a circus, pet robots, hamburger-robots, robot selling ice cream to children, robot waiters, toy robots, Hamburger machines, and so on. Self-driving cars are technologically almost ready, but there are man ethical and legal issues.

In the medical domain we have surgical tools, power-assist suits (to carry heavy objects), robots reminding elderly people to measure blood pressure, bionic legs (Hugh Herr, MIT), brain-controlled wheelchair, the “baby seal” Paro, delivery robots, rehabilitation devices, etc. Most of these exist as commercial products.

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The synthetic methodology

Slogan:

"Understanding by building"

modeling behavior of interest
abstraction of principles

robots as tools for scientific investigation

abstractions, NOT copy of nature

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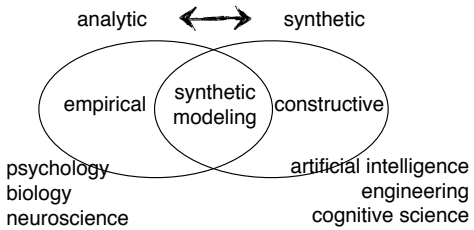
In fact, there is a mega-trend in science towards synthetic methodologies, as testified by the exponential growth of the computational sciences. For example, by using computational - synthetic - models of bio-chemical processes in animals, animal experiments for drug testing can be largely avoided. Because we are interested in embodiment, our tools of choice are robots, or realistic, physics-based simulations of robots (also called "embodied agent simulations").

How to study intelligence?



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The synthetic methodology allows for novel types of experiments because things can be changed arbitrarily. For example, in a model of a certain brain region, lesions can be introduced, or in a robot, the morphology can be modified in many different ways - this is simply not possible on biological organisms.

The synthetic methodology

Slogan:

"Understanding by building"

modeling behavior of interest
abstraction of principles

→

robots as tools for scientific investigation

abstractions, NOT copy of nature

Many examples during ShanghAI lectures

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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?

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A highly interesting and entertaining book looking into this, and which is also fun to read is: Malcolm Gladwell, "The Outliers: The story of success". Little, Brown and Co., 2008.

Issues to think about: IQ and professional success

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homework:
think about this issue
student presentation next week
(volunteers needed)

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Assignments for next week

- Next lecture on 22 October 2015: “Cognition and Computation - successes and failure. The need for an embodied approach”.
- Read chapters 1 and 2 of “How the body …”

End of lecture 1

Thank you for your attention!

stay tuned for lecture 2: “The need for an embodied perspective on intelligence”