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PANEL INTELLI

How Much Intelligence is Enough for the Intelligent Systems?

Petre DINI

Panel

- **Moderator**
  > **Petre Dini, Concordia University, Canada | China Space Agency Center, China**

- **Panelists**
  > **Antonio Martin, Seville University, Spain**

  > **Leo van Moergestel, HU University of Applied Sciences Utrecht, The Netherlands**

  > **Ingo Schwab, Institute of Computational Engineering at IAF, Karlsruhe University of Applied Sciences, Germany**

→ Intelligence

nonADAPTIVE	ADAPTIVE		selfADAPTIVE
HUMANdriven	**AUTOMATED**	**SMART**	**INTELLIGENT**

patterns/fixed procedures

validated algorithms
dedicated hardware
repetitive cycles

embedded agents
embedded procedures
changes
  internal
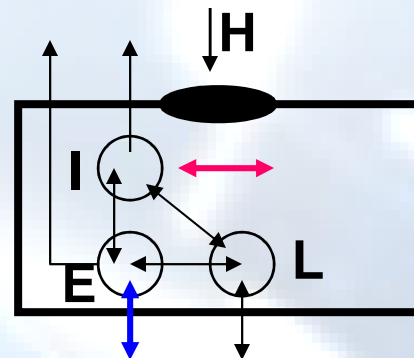   structure
      behavior
  environmental
      behavior

embedded agents
embedded procedures
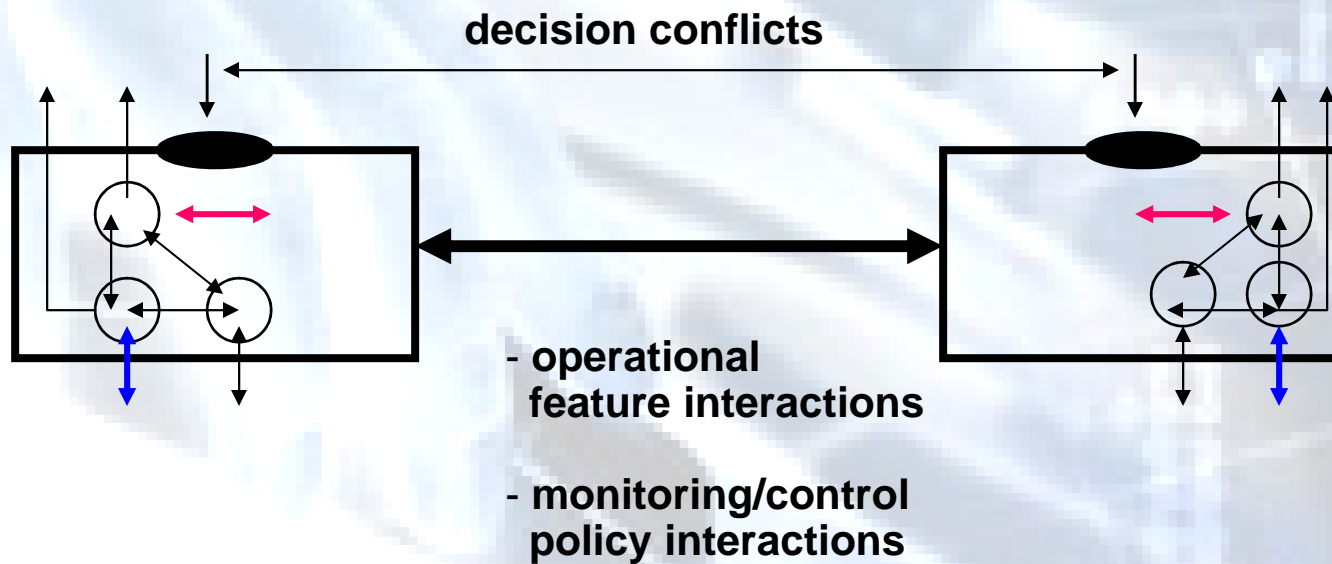changes
  internal
      structure
      behavior
  environmental
      behavior

+
learning agents

Intelligent components

- operational
  feature interactions

- monitoring/control
  policy interactions

decision conflicts

- operational
  feature interactions

- monitoring/control
  policy interactions

Facets, trends

- **Knowledge**

- **Embedded software**

- **Behavioral modeling**

- **Special requirements for production applications/systems**

- **? Need a (particular) methodology for building intelligent systems**

- **? Need better knowledge (mechanisms) for understanding/representing/processing component behavior**

- **? Need a repositioning on formal aspects for validation/feature interactions/policy conflicts**

DTe. Departamento de Tecnología Electrónica

HOW MUCH INTELLIGENCE IS ENOUGH FOR THE INTELLIGENT SYSTEMS?

UNIVERSIDAD DE SEVILLA

Authors: Dr. Antonio Martin
Sevilla, June 2014

What is artificial intelligence?

● It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.

"The capacity to learn and solve problems" in particular the ability to solve novel problems, to act rationally, and to act like humans.

Artificial Intelligence build and understand intelligent entities with different approaches.

● **What's involved in Intelligence?**

- Ability to interact with the real world to perceive, understand, and act

- Reasoning and Planning: modelling the external world, given input; solving new problems, planning, and making decisions; ability to deal with unexpected problems, uncertainties

- Learning and Adaptation: continuously learning and adapting internal models to the environment work.
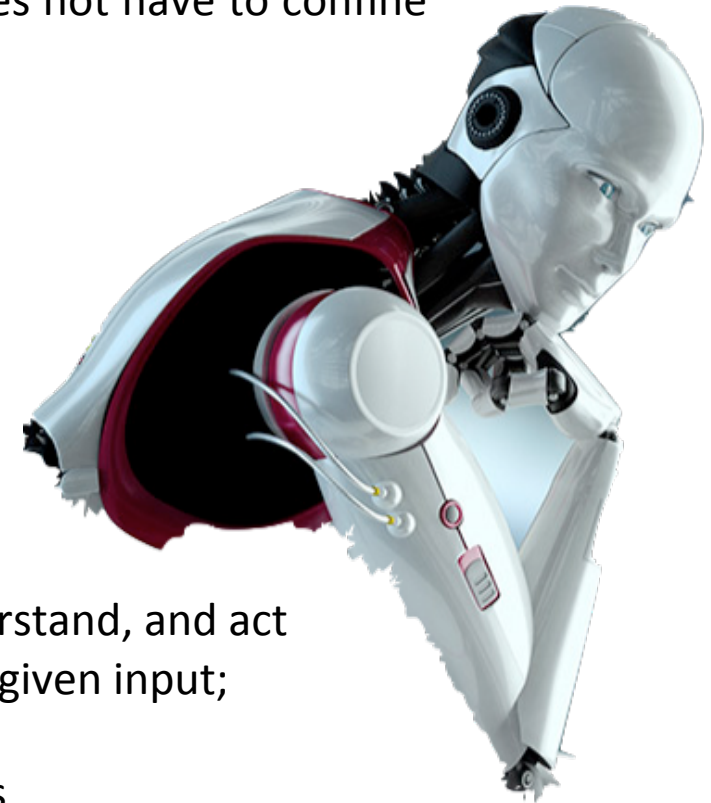
How much intelligence is enough for the Intelligent Systems?

● Intelligence is the computational part of the ability to achieve goals in the world. Varying kinds and degrees of intelligence occur in people, many animals and some machines.

What we can

What we know

What we understand

What we can explain
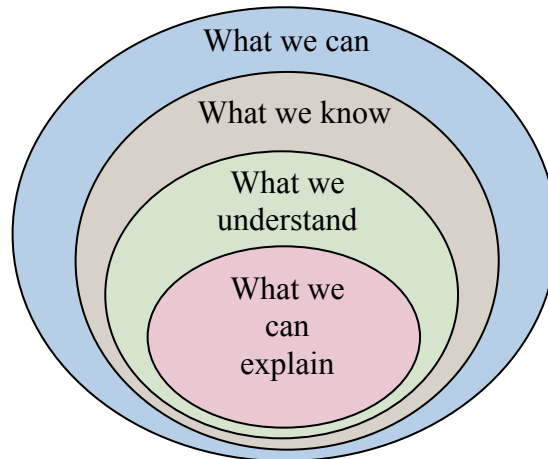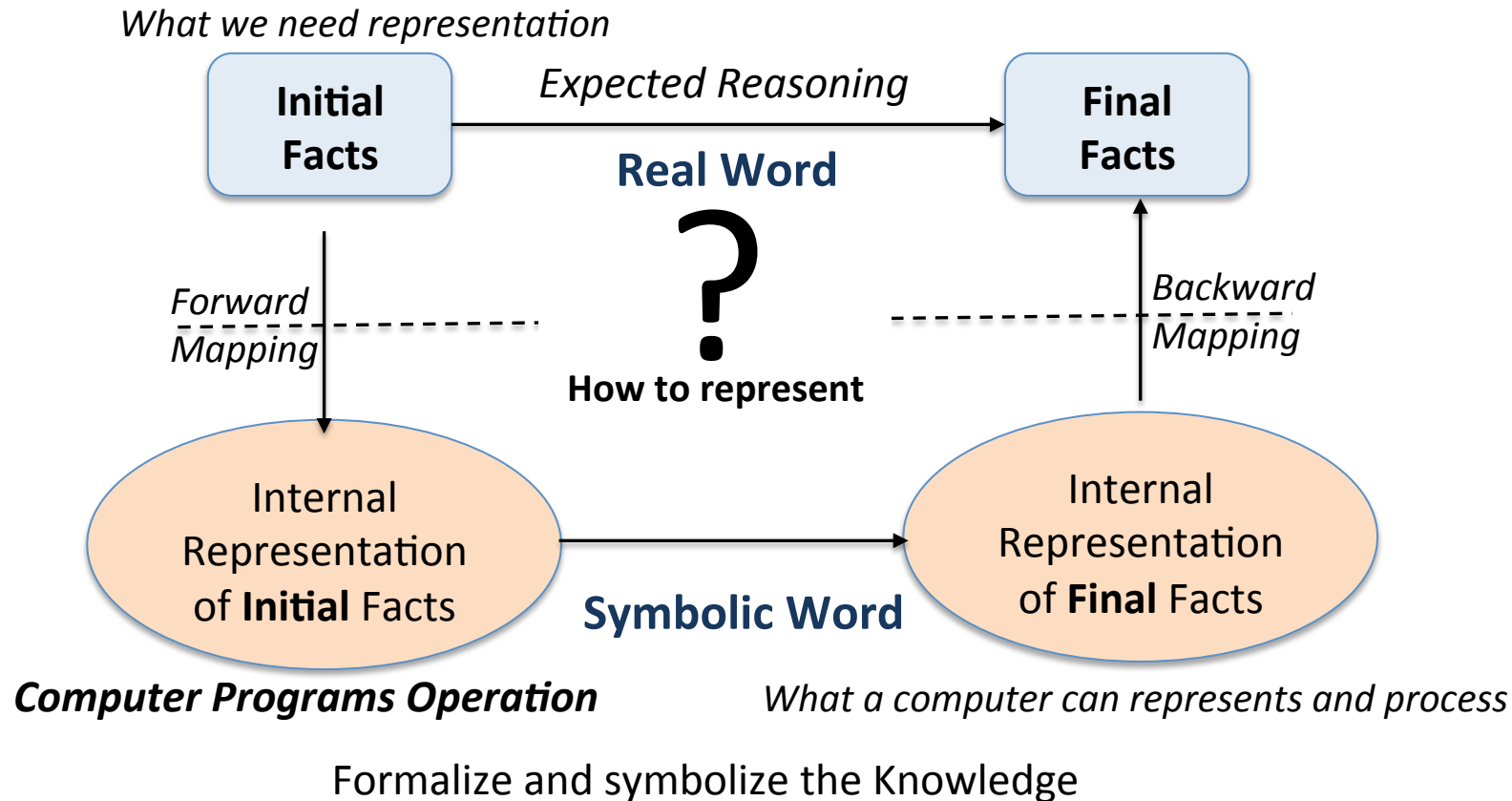
Different Types of Artificial Intelligence

● Modelling exactly how humans actually think

● Modelling exactly how humans actually act

● Modelling how ideal agents "should think"

● Modelling how ideal agents "should act"

"We achieve more than we know. We know more than we understand. We understand more than we can explain."

Claude Bernard, *19th Century French scientific philosopher.*

➤ Nature produces intelligence of the brain in a natural way. Science is a product of the brain.

Emphasis is on intelligent agents that behave rationally to take the best actions, on average over time, within computational limitations.

➤ The rapid deployment of sophisticated machines and science in our lives has been nothing short of spectacular. The great successes have made many people believe that machines not only do things to help us, but one day will think for us.

Knowledge Representation
Overall Structure

What we need representation

```
┌─────────┐      Expected Reasoning      ┌─────────┐
│ Initial │ ───────────────────────────► │  Final  │
│  Facts  │                              │  Facts  │
└─────────┘          Real Word           └─────────┘
     │                                        ▲
     │                    ?                    │
  Forward                                   Backward
  Mapping        How to represent           Mapping
     │                                        │
     ▼                                        │
  ┌──────────────┐                    ┌──────────────┐
  │   Internal   │                    │   Internal   │
  │Representation│ ─────────────────► │Representation│
  │ of Initial   │   Symbolic Word    │  of Final    │
  │    Facts     │                    │    Facts     │
  └──────────────┘                    └──────────────┘
```

Computer Programs Operation   *What a computer can represents and process*

Formalize and symbolize the Knowledge

- All of the learning about a concrete application field.
What is it? Why do we need? How do we process?
- In should include: Concepts, terminologies, objects, relationships, govern rules, etc.

- Propositional logic, predicate logic, Semantic-net, conceptual graph, ontological diagram, ...

Efficient Knowledge Representation

● Acquire and capture the knowledge in the specific domains and store them in a certain way.

● Retrieve knowledge in a efficient way and inferring /reasoning to obtain concrete results.

● We should make different activities for the development of a knowledge-based system:

 - Implementation of the structured knowledge into knowledge bases
 - Development of a knowledge-based system structure
 - Acquisition and structuring of the related information
 - Knowledge and specific preferences (IPK model)
 - Testing and validation of the inserted knowledge
 - Integration and maintenance of the system
 - Revision and evaluation of the system.

Conclusions

Can Computers Learn and Adapt ?

Without any human assistance machine learning allows computers to learn to do things without explicit programming many successful applications.

Yes, computers can learn and adapt, when presented with information in the appropriate way.

Can computers plan and make optimal decisions?

No, real-world planning and decision-making is still beyond the capabilities of modern computers

Exception: very well-defined, constrained problems
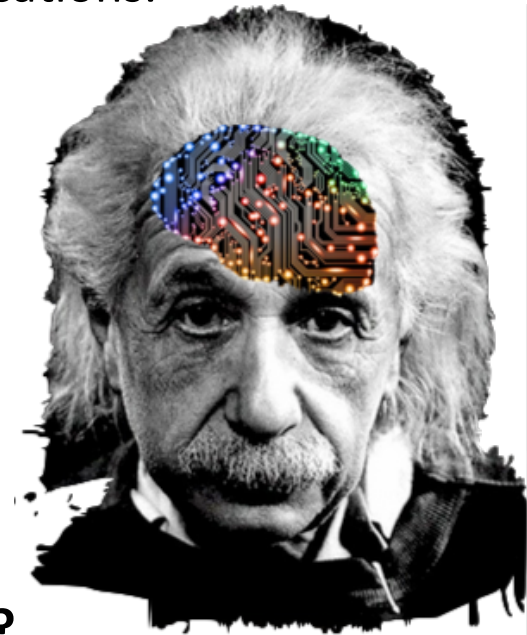
Can we build intelligent systems as complex as the brain?

Building hardware is very different from making a computer behave like a brain.

This will have far fewer interconnections, wires or synapses than the brain.

With much faster updates than the brain.

Yes, can have computers with as many basic processing elements as our brain, but in specific areas of work.

Thank you

Gracias

How much intelligence is enough
for the Intelligent Systems?

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Company profile / expertise

Hochschule Karlsruhe Technik und Wirtschaft
Karlsruhe University of Applied Sciences

- Founded in 1878

- University status awarded in 1971

- Number of full-time students: 7,000

- Number of full professors: 200

- Other teaching and research staff: 350

- Technical and administrative staff: 310

Intelligent Systems Research Group

Hochschule Karlsruhe
Technik und Wirtschaft
UNIVERSITY OF APPLIED SCIENCES

IAF
Institut für
Angewandte Forschung
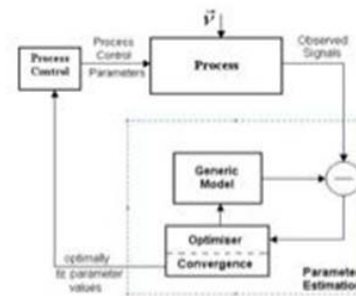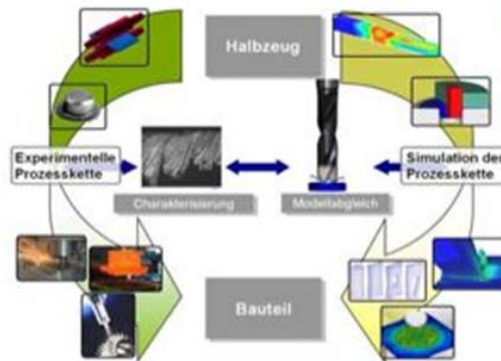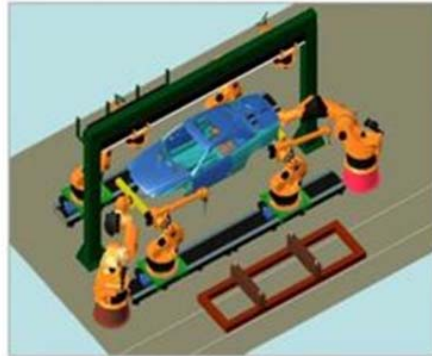
scientific field:

gaining information from data.

areas:
- Data Modeling,
- Dynamic Systems,
- Data Mining and
- Computer Vision.

Institute of Applied Sciences (IAF)

Knowledge acquisition flow: fayyad (1996)

source:http://www.emeraldinsight.com/journals.htm?articleid=1567630
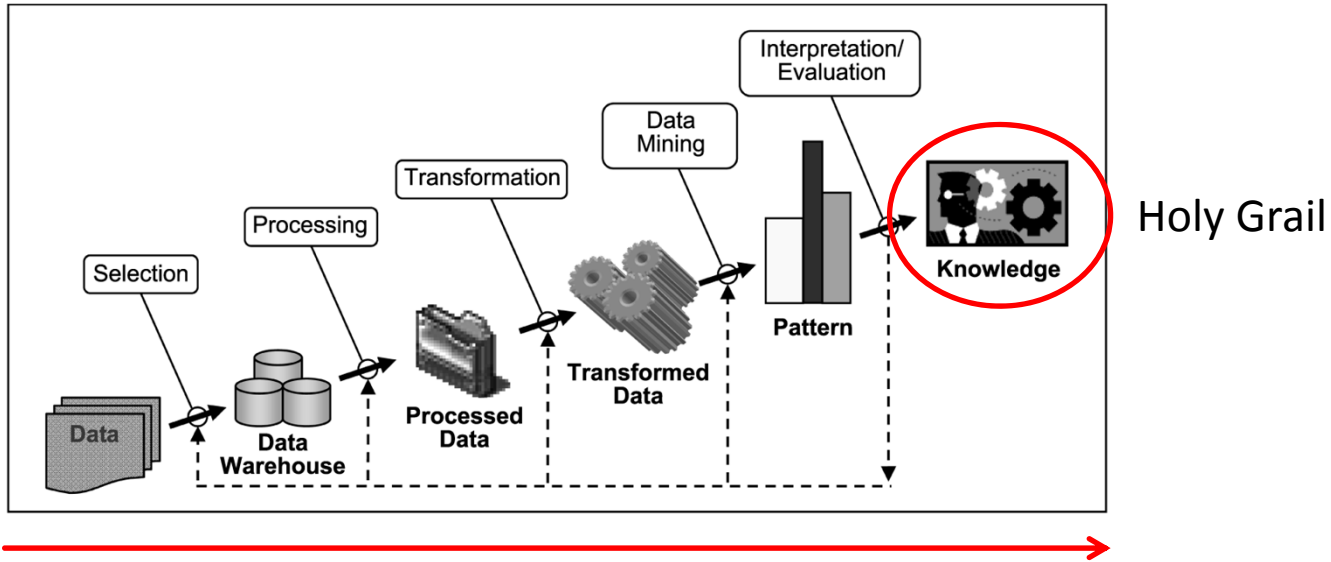
For each process step experts are needed!
Big Data collects (nearly) everything. Does it improve the quality of the knowledge?

Knowledge acquisition flow: fayyad (1996)

source:http://www.emeraldinsight.com/journals.htm?articleid=1567630
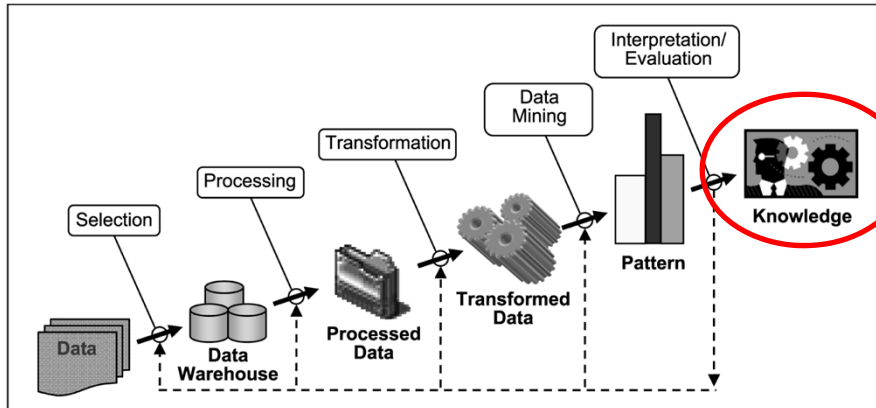
What is knowledge?
What kind of knowledge?

What is understandable knowledge?
(symbolic/subsymbolic knowledge representation.
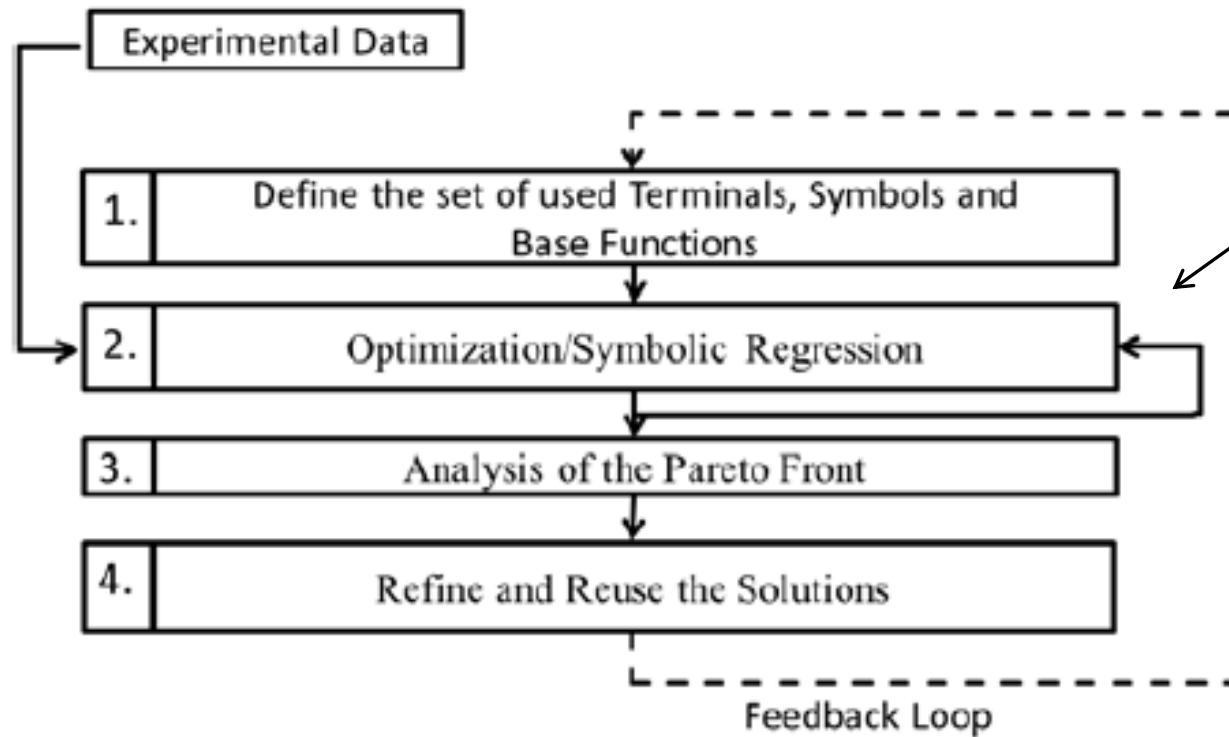Artificial Neural Network: Distributed knowledge

Knowledge acquisition workflow

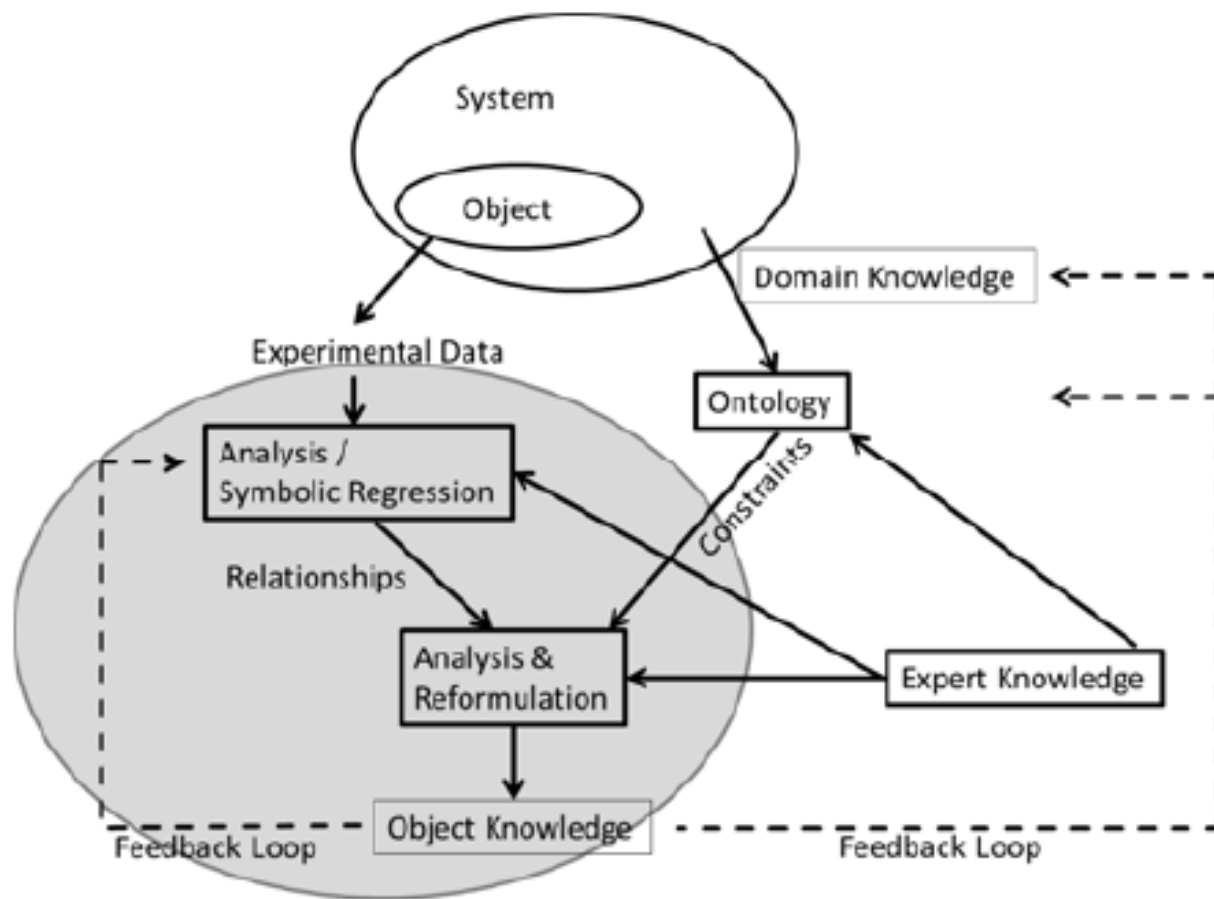
Figure 2. The knowlede acquisition workflow.

Figure 3. The Knowledge Flow.

Discussion / Open Questions:

Why are classical semantic/ artificial intelligence knowledge representations often unsuccessful?

What is intelligence/an intelligent system?
Is an intelligent system a system with knowledge (learning)? Or is it a clever form of using standard techniques?

How can knowledge be extracted from data driven black box knowledge representations
(i.e., support vector machines, neural networks).

In the context of data driven inductive learning:
What kind of knowledge is included in the data?
How can interesting data be identified?
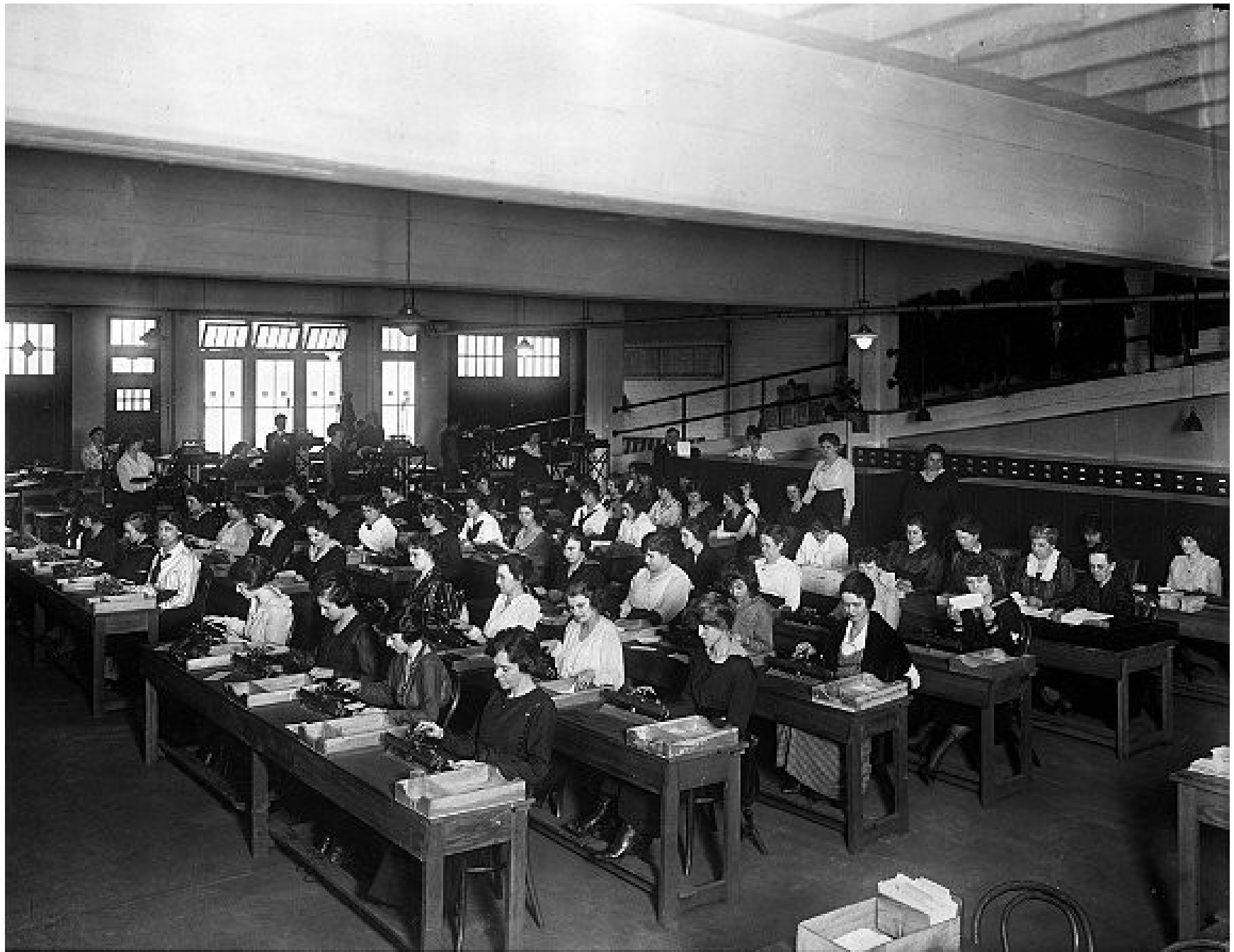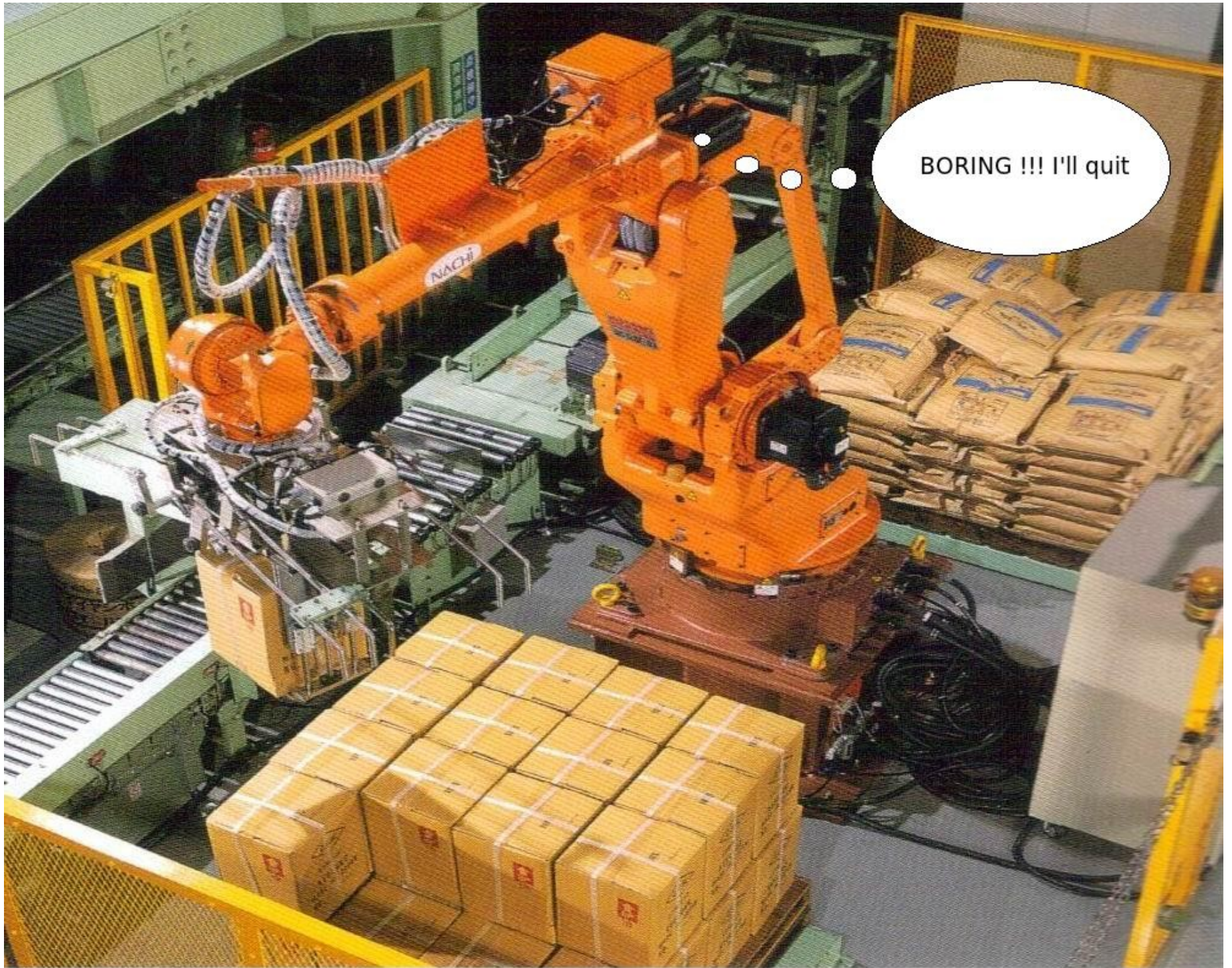Is the desired process knowledge included in the data?

Panel

How much intelligence is enough for intelligent systems?

Leo van Moergestel
Utrecht University
HU Utrecht University of Applied Sciences
The Netherlands (also known as Holland)

Humans acting like Robots/Computers
Versus
Robots/Computers acting like Humans

Picture 1: movie 'modern times'
Picture 2: (human) computers at work
Picture 3: a 'thinking' robot
Picture 4: movie 'her'

Industrial Robots
No Emotions

however

Lean
Manufacturing
improvements?

but

Autoconfiguration
Reconfigurable (RMS)
Reliable, Error recovery
Safe (ISO-13482 E)

Emotions

Is Our Brain
a Computer?

Consciousness
Understanding

Intelligent != Smart

How smart do you want
your car to be?
(accident-dilemma)

Daniel Kahneman
Thinking, Fast and Slow

Emergent
Intelligence

Design for specific domain

The Network is the Computer

Deep Blue
Chess-playing

Watson
Jeopardy

Huxley: Brave New World
5 levels of intelligence

Final Remarks

In our manufacturing research, we try to develop a system that could be classified as a MaaS system, where MaaS stands for Manufacturing as a service.

For really intelligent systems, many problems are still to be solved. Some are philosophical, some are social or biological, some are technical. Our own intelligence is quite intriguing!