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Intelligent Systems and Applications, AI/CO Education
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Cognition to perceive, explore and model the world
Prof. Dr. Jean-Daniel Dessimoz, MBA, HES-SO / HEIG-VD
15:15 - 15:40, 18 November 2014
http://lara.populus.org/rub/3
18/11/2014
J.-D. Dessimoz, HESSO.HEIG-VD, SGAICO, Basel
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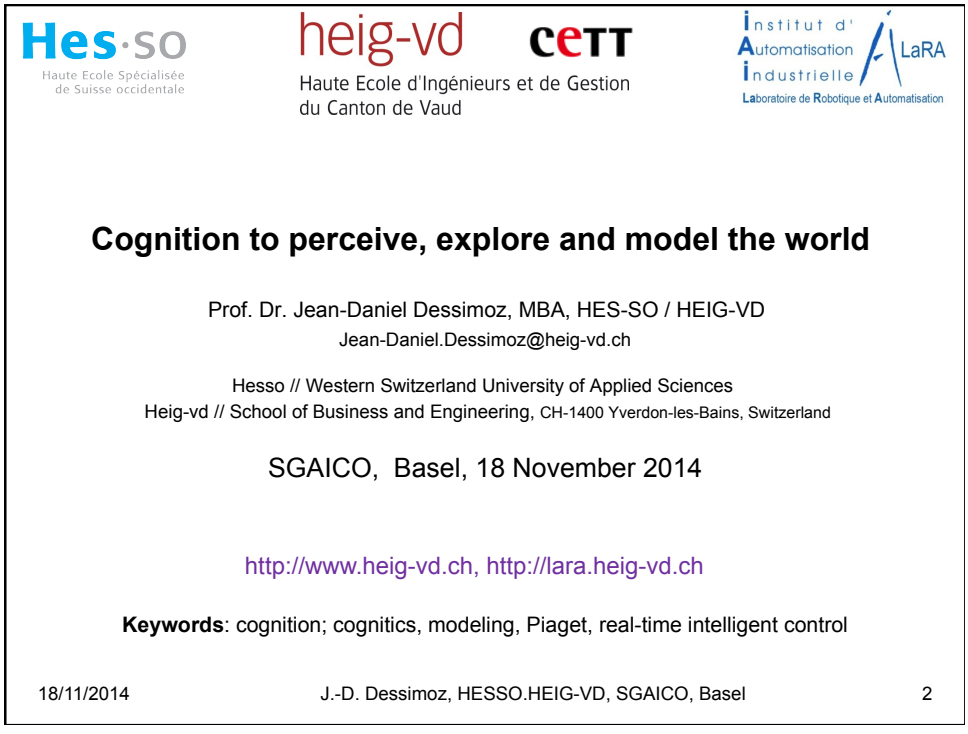
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Cognition to perceive, explore and model the world
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# 1. Introduction

- In general terms, cognition has made the condition of humans very attractive and successful, in comparison to other elements of nature as we know it [1].
- Progress in sciences, engineering, and especially ICT's, now allows to address with good chances of success automated applications relating to cognitive issues (for AI aspects, re. e.g. [2]).
- Five theses about cognition have recently been delineated [3] , which can be seen both as paths towards better insights in human and social nature and also as a roadmap for simultaneous and iterative processes capable to freely foster a better future for individuals and society
- The presentation develops the first of these five theses : cognition allows to know the world, to explore and perceive, to model.



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5. Innate and acquired capabilities
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# 2. Context 1 of 2

- **Overview of the five delineated theses about cognition:**
  1. **cognition allows to know the world, to explore and perceive, to model;**
  2. **cognition allows for defining alternative worlds and possible futures, visions, for anti-causality;**
  3. **cognition allows for effective control;**
  4. **cognitics allows for a large scale, technical deployment of cognition;**
  5. **social cognitics can provide a foundation for team action and increased momentum for change.**

.



# 2. Context 2 of 2

**•The presentation will develop the first of these theses: « Cognition is necessary to perceive, explore and model the world ».**

**Therefore:**

- **first, cognition requires a better understanding**
- **then, making the underlying capability automated will boost its deployment**

**• Cognition features two very different components:**

- **elements of immaterial nature**
- **physical supporting infrastructure**

**• Modeling is necessary for the creation/replication of cognitive systems, as well as for their evolution**

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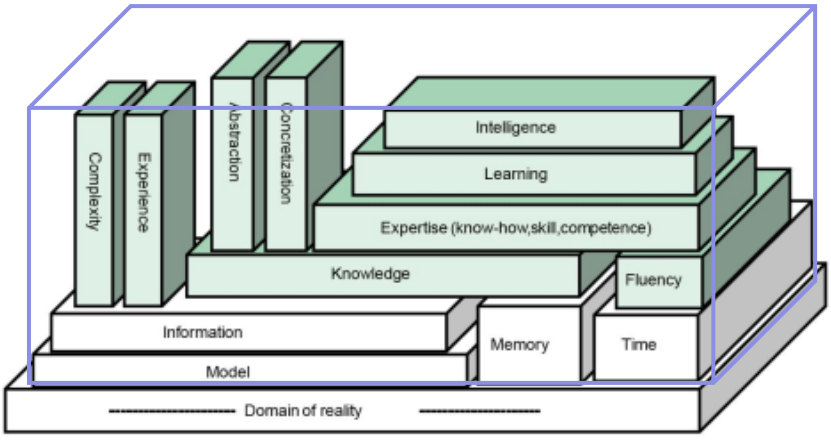
# 3. Immaterial aspects 2 of 4




**In cognition, conceptual elements (re. blue box) are immaterial (non-physical), even when they relate to reality [4] .**

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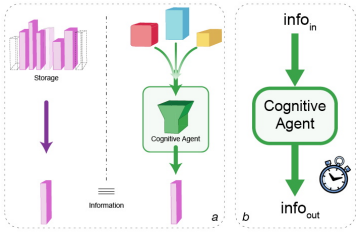
# 4. Physical support infrastructure 1

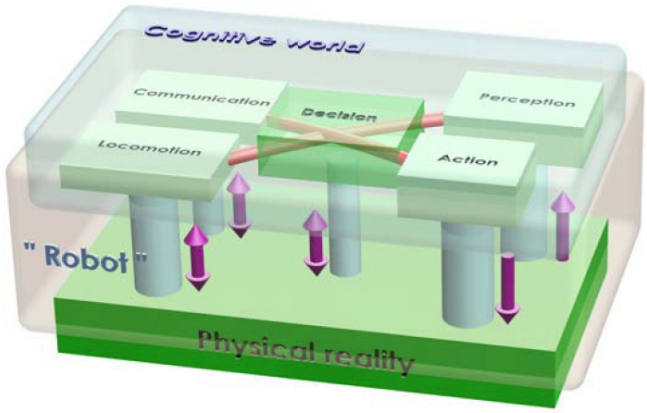
- **Information is carried by messages, and requires an implemention on physical supports ("signals").**
- **Cognition requires a physical infrastructure, an "engine", in order to yield pertinent output, as the latter information is usually not stored as such.**
- **For deployment in the real world, physical resources, such as energy or structural elements, are also required.**




*Schematic view of cognition. (a) Cognition and, effectively, cognitive systems generate information.*
*(b) Cognitive properties can be quantatitatively estimated on the basis of the input-output information flows, and time.*

PROCESS → ACTION

# 4. Physical support infrastructure 2




*Schematic view of a robot, modeled as featuring 5 essential capabilities. Information flows are shown in red, and energy in purple color.*



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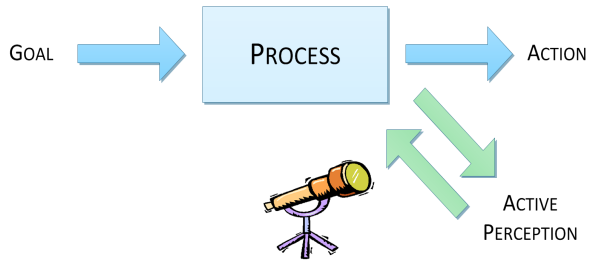
# 5. Innate and acquired capabilities 1

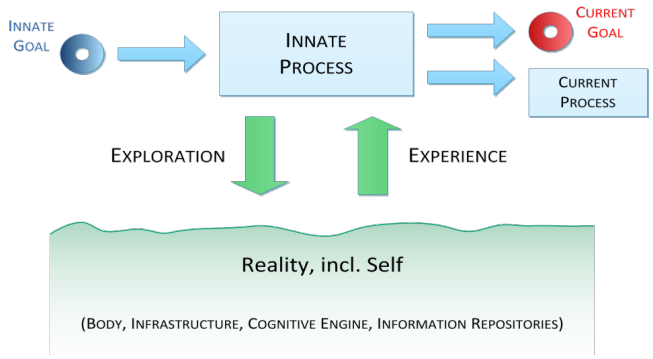



**In cognition, backtracking is the rule.**

**From the selected goal, specifications are derived, which then lead the cognitive process, and in particular an active perception ("exploration") faculty capable of acquiring the non-physical experience necessary for action and possibly later improvements.**



# 5. Innate and acquired capabilities 2




**Current goals and processes may result from exploration performed and/or experience acquired by an agent, running a given cognitive process in a certain domain of reality.**

**Initial goals and processes are innate (or "wired").**

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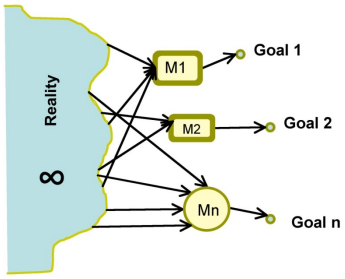
# 6. The challenges of modeling 1

- **The complexity of reality is infinite**
  - **How to acquire information? (the perception problem)**
    - **How to sense**
    - **How to explore**
  - **How to induce information processing schemes? (the cognition problem)**
- **Chance and dedication can help**
  - **truly novel solutions typically occur by chance**
  - **observations and experiments should be recorded**
  - **critical elements should be identified, possibly by replicating experiments with systematic variations of parameters**
  - **Re-use best known, proven solutions**

# 6. The challenges of modeling 2

- **The complexity of models should be minimized**
- **Experts are said to be very good at ignoring non-critical parameters**
- **Trade truth and completeness (correspondance to reality) for wisdom (correspondance to goal) and effectiveness**



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# 7. Conclusion

- Time as come for cognitics
- In cognition, modeling the world is the first challenge to address, starting with the modeling process itself
- The cognitive world is essentially non-pysical, immaterial
- Cognition requires though a physical support infrastructure, as well as "engine" and for mediating input-output resources (sensors and actuators) wrt real world
- Some initial cognitive capabilities must be innate/wired. Possibly, new capabilities may be acquired.
- Some hints have been given for addressing the main modeling challenges:
  - for probing the infinitely complex reality,
  - for reducing goal-oriented processes to tractable yet effective solutions



# References


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