Cognition to perceive, explore and model the world

Prof. Dr. Jean-Daniel Dessimoz, MBA, HES-SO / HEIG-VD

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

- Information is carried by messages, and requires an implementation 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.

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Schematic view of cognition: (a) Cognition and, effectively, cognitive systems generate information. (b) Cognitive properties can be quantitatively estimated on the basis of the input-output information flow, and time.
4. Physical support infrastructure

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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.

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”).
6. The challenges of modeling

- 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

- 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-physical, 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