Hes·so
Haute Ecole Spécialisée de Suisse occidentale

heig-vd
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MCS Model for Cognitics and for Addressing « Complex, Human, and Impossible » Issues

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http://www… ...eivd.ch/iai, ...iplnet.ch


EUROPEAN COMMISSION
Community Research
NEST - PATHFINDER
Call for Proposals on
What it means to be human
Planned deadline – 15 February 2006
NEST
(New and Emerging Science and Technology)
NEST announces a Call for Proposals on What it means to be human, one of its PATHFINDER initiatives for 2005.
The call invites interdisciplinary projects addressing the questions : "what features make human cognitive abilities unique, and what are the origins of these features?" (CA's + SSA's only)
Further information, including the official work programme, reference documents, and submission requirements, can be obtained via the NEST web site :
www.cordis.lu/nest
Information can also be obtained through your National Contact Point (NCP). For contact details please consult:
www.cordis.lu/nest/ncp.htm
Call for Proposals on
Measuring the Impossible
Planned Deadline – 15 February 2006
NEST
Emerging Science and Technology)
e heart of scientific work.
government are presenting
more complex, problematic
etation.
to support interdisciplinary
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dvancing the measurement of
nomena which are mediated
on and/or perception.
including the official work
documents, and submission
btained via the NEST web site :
ned through your National Contact
ils please consult:
p.htm

Content

- Introduction
- Trend towards complex, human, impossible?
- Main definitions and units in MSC
- Necessity of goal-driven approaches
- Collective cognitive entities
- MCS and the complex, human, impossible
- Conclusion

Introduction

- **In history: Development by invention of tools and machines for the physical world**
- **Last century: Definition and explosive developments relating to information**
- **New age: Complexity and Cognitics, automated cognition**

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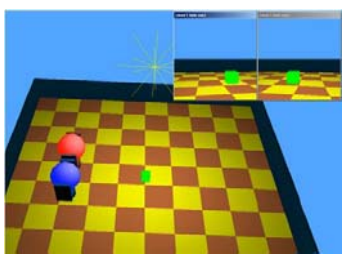
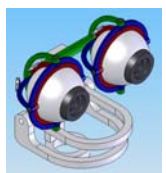
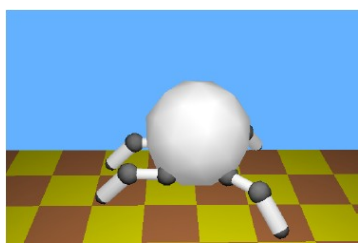
Trend towards complex, human, impossible?

- **Logic. Arithmetic. Toy world**
- **Real world (real time, embedded systems)**
- **Economy of information. Holistic view of value creation networks**
- **Globalization (geographically, socially, thematically)**

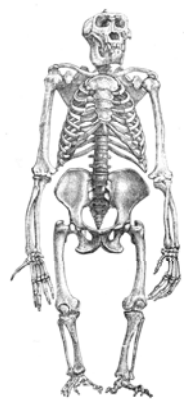
Contributions to the realization of an hominoid robot

- **Simpler locomotion with 4 limbs**
- **Moderate level of cognitive capabilities**
- **Development of concrete elements of implementation**
- **Equivalent elements, in virtual and real worlds (incl. URBI)**
- **Servocontrollers, attitude and acceleration sensors**





NEST-Pathfinder

- **Tackling complexity in science**
- **What it means to be human**
- **Measuring the impossible**

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Main definitions and units in MCS

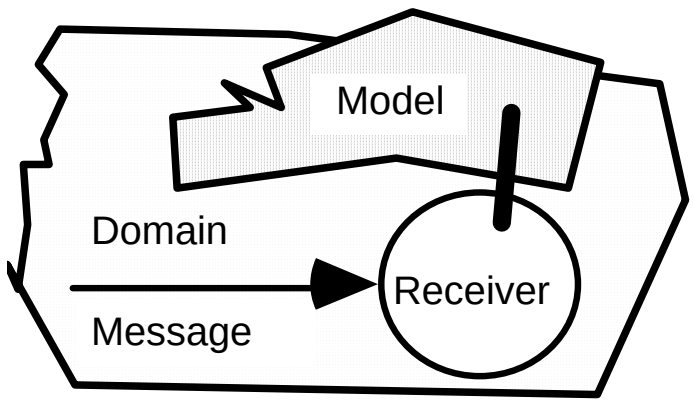
- Model
- Information
- Behavioral, black-box model
- Key cognitive concepts (Complexity, Knowledge, Expertise, Learning, Intelligence, …)


Ceci n'est pas une pipe.

Model and information

- **Model : very simple representation of reality; very much incomplete; useful for specific applications and contexts.**

- **Information: what allows a receiving agent to create and update its model of a domain**



Information (1 of 2)

- **Information is conveyed by messages**
- **Quantity of information in average , n :**

$$n = \sum p_i \log_2(1/p_i) \text{ [bit]}$$

where p_i is the probability of message i

« forms or updates receiver's model »

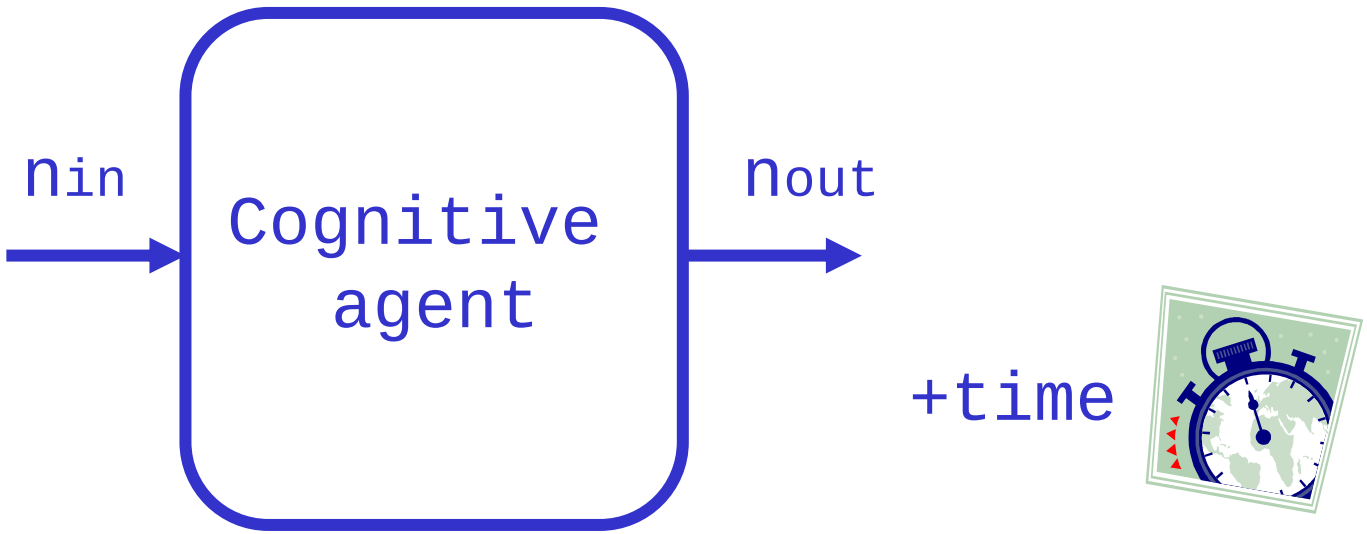
Information (2 of 2)

- **Quantity of information conveyed by input or respectively output messages, in average:**

$$n_{in} = \sum p_{in\ i} \log_2(1/p_{in\ i}) \text{ [bit]}$$

$$n_{out} = \sum p_{out\ i} \log_2(1/p_{out\ i}) \text{ [bit]}$$

Behavioral, black-box model



« just input and output flows are considered »

Complexity

- **Complexity of cognitive domain :**

$$L = n_{out}\, 2^{n_{in}} \text{ [bit]}$$

« Quantity of information required for description»

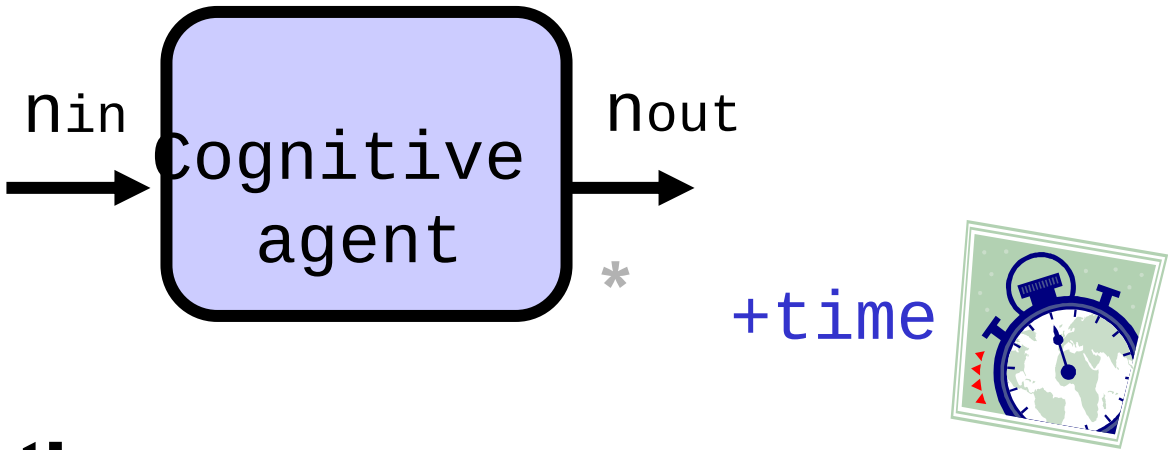
Knowledge

- **Knowledge :**

$$K = \log_2(L) = \log_2(n_{out}\, 2^{n_{in}}) \quad [\text{lin}]$$

« does it right»

Expertise

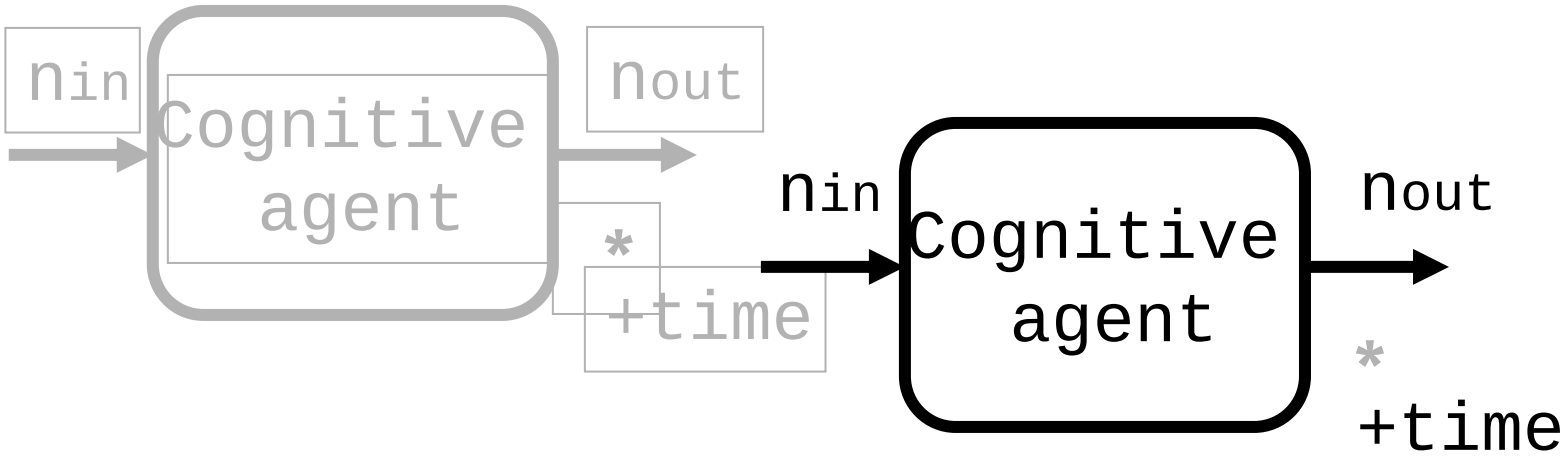


- **Expertise :**

$$E = K/\Delta t \ [lin/s]$$

« does it (right and) fast»

Learning

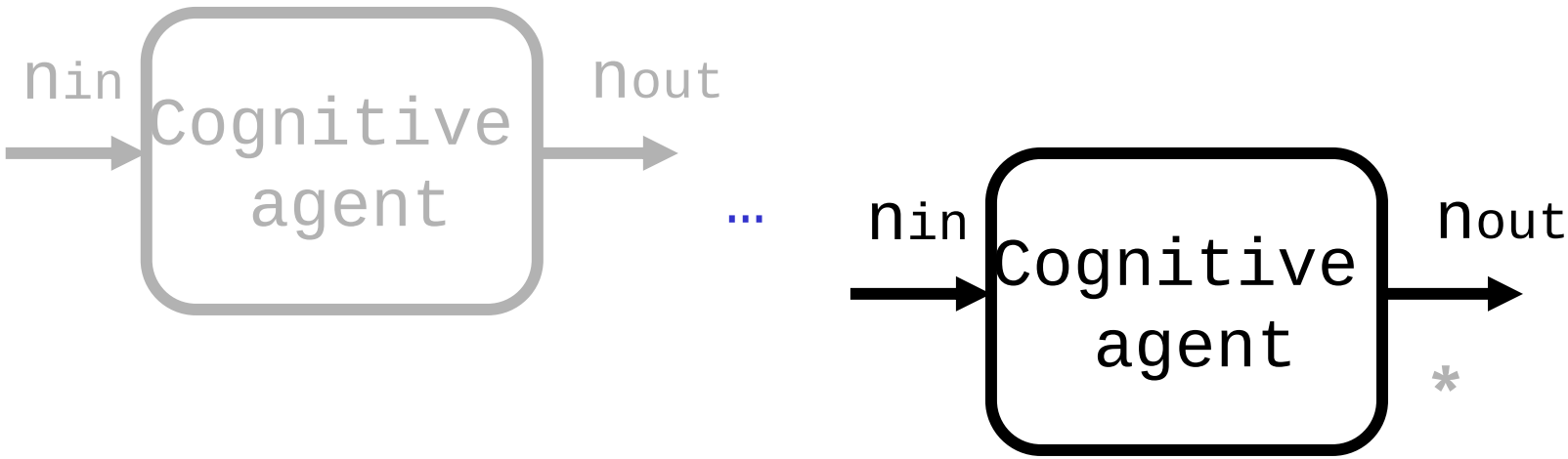


– **Learning :**

$$\Delta E = E(t_1) - E(t_0);\ >0\ [\text{lin/s}]$$

« increases its expertise »

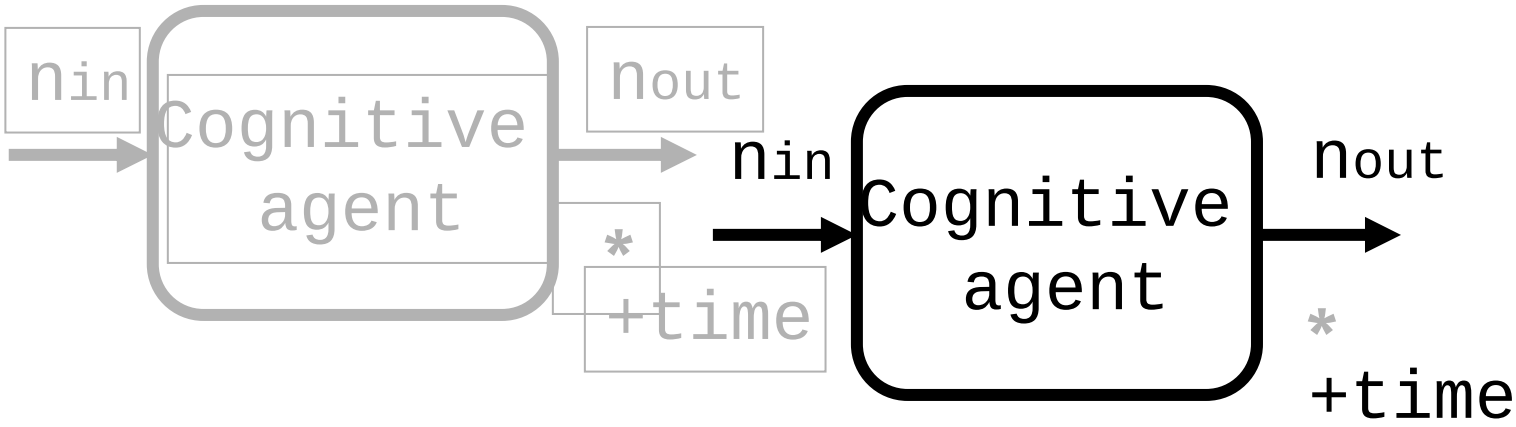
Experience



- **Experience:** $\Delta n = \sum n_{in\,i} + \sum n_{out\,i}$ **[bit]**

« quantity of information observed »

Intelligence



- **Intelligence : I=ΔE/Δn [lin/s/bit]**

« ratio of expertise gained on experience »

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Necessity of goal-driven approaches (1 of 2)

- **We are usually aware of models ***
- **Complexity of reality is infinite, no matter how focussed and constrained ***
- **In cognition and cognitics: goal-based model elaboration and selection are required**
- **The « starting point » … is the goal!**
- **Ethics ultimately dictates agent's choices**


Ceci n'est pas une pipe.

Necessity of goal-driven approaches (2 of 2)

- We are usually aware of models*
- Complexity of reality is infinite, no matter how focussed and constrained *
- **In cognition and cognitics:** *goal-oriented* **model elaboration and selection are required**
- **The « starting point » of cognitive process is … the goal! (« backtracking »)**
- **Which goal? Ethics ultimately dictates agent's choices of appropriate goals**

Right, etc.

- **Right, true and good**
  - **Right: complying with a given law**
  - **True: complying with reality**
  - **Good: complying with a given goal**
- **Wrong, false, and bad**
  - **Complement right, true, and good, respectively**
- **Six of them: Boolean values**

Wisdom

- **Intuitively: specific property of cognitive agents, which refers to their ability to take *good* decisions**
- **In MCS terms: expertise in reaching a *goal***
- **Quantitatively:**
  - **For simplicity: Boolean value (reaches or not the goal)**
  - **For refinement: expertise units: lin/s**
- **Typically relates to complex situations or « meta-goals »**

Sapience (an explicit link with humans)

- Essential property of a cognitive agent, i.e. of an active structure capable of cognition
- Appears under a number of signs, such as knowledge, expertise, or intelligence (already defined and made measurable in MCS)
- Quantitatively: (index) computed by reference to humans (“homo sapiens”)
- Sapience (index) is a ratio; no specific unit.

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Collective cognitive entities

- **In principle, MCS definitions and units apply equally to individual and collective agents/society**
- **New: Communication between members**
  - **Channel**
  - **Code, with reference to a collective model**
  - **Collective model : set of intangible underlying, shared factors or culture, i.e. the “spirit”**

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MCS and the complex, human, impossible

- **Complexity: (structure and) deal with small contexts**
- **Human character: beware of limits and avoid too much anthropocentric view**
- **Measuring the impossible: think in terms of cognitive anf intangible aspects**
- **NEST: Broadcast MCS and study cases in very different application domains**

…More on Coping with Complexity

- **Clear metrics (same unit as inform.)**
- **Goal-oriented (focus, backtrack)**
- **Use expertise to provide numerous (abstract) views, matching specific user goals, and keeping with small contexts**
- **Critical operations: fetching information, organizing data access (sorting, indexing…)**
- **NEST: Build-up a meta table of structuring methods in math, law, or generally natural and human sciences in a way similar to patent-based TRIZ principles**

…More on Human nature (cognitive aspects)

- **MCS shows we don’t know reality**
- **Life shows we can survive**
- **For humans culture is critical**
- **Limits (in cognitive abilities) for machines to attain human expertise level is the lack of shared (human life) experience**

…More on Measuring the impossible

- **Think in terms of cognitive and intangible aspects**
- **Quantitative assessment based on information concept**
- **Beware of the difficulties in grasping the (classical) information concept, especially in complex and human sciences contexts**

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Conclusion (1 of 2)

- **Trends: complex, human, « impossible »**
- **Definitions and metrics for information are extended to cognition (re. cognitics)**
- **MCS provides metrics for knowledge, expertise learning etc.**
- **Singular consequence: reality can be known in infinitesimal manner only**
- **Ethics is what characterizes the process of choosing good goals (and conditions)**

Conclusion (2 of 2)

- **Change of paradigm:**
  - **Agent must in priority start by freely projecting his/her/its goal(s) in some convenient future**
  - **Then induction and backtracking dictates his/her/its intermediary actions and indeed the proper selection and/or elaboration of (ancillary) models**
- **Notion of cognitive groups now to be considered.**
- **NEST Initiative is an opportunity to boost impact of MCS and cognitics on society**
- **Build-up a table of principles for dealing with complexity from science, in a way similar to TRIZ from patents**