UNIVERSITÉ CÔTE D'AZUR

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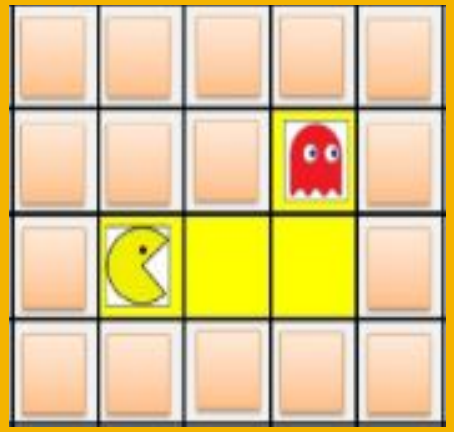
LINE

Computational Neuroscience Cognition Mnemosyne Memory Brain & Body Complex Systems

AIDE : Artificial Intelligence Devoted to Education.

AIde

AIDE is a project aimed at developing computational thinking through the creation of an interactive machine learning environment. This project will be used to study the development of computational thinking, while using a digital expertise approach that is both creative and critical.



The socio-political challenge

⇒ 21st century education for everyone

⇒ Computational and critical thinking (CT) initiation

We MUST scientifically study
the way we teach how to learn such competences.

A complementary approach to the links between artificial intelligence and education

In education, AI is usually applied as a tool, that is often disruptive (for e.g., digital assistant), that uses machine learning algorithms. In this approach the learner interacts with machine learning tools. However, it is possible to consider that the learner continues to carry out disconnected activities, but the environment and traditional tools are enriched in order to capture, analyze, and understand learning processes better, while providing feedback in real time. Thus, machine learning can be seen as a means of enriching these learning devices in which analogous and disconnected activities can take place.
On the other hand, we also highly recommend the need for citizen training in artificial intelligence in order to master, and thus understand, these mechanisms and implement them [2] (Cuisi et al 2018, Romero 2018).

Here we propose a third axis that appears to be little or not developed:

use the formalisms and mechanisms of machine learning as a paradigm in the science of education.

In other words, before using artificial intelligence to, for example, improve human learning, let's try to use it to better understand how a human learns.

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The triple scientific disruption

model the learner toward *computational educational science*

⇒ Create a neuro inspired cognitive model of the learner behavior

⇒ Use machine learning formalism not [only] as a tool but for modeling

⇒ Integrate both symbolic (ontology modeling) and numeric (reservoir computing) mechanisms formalisms

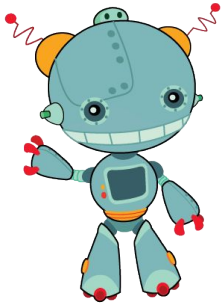
The three operational components of the AIDE project

The AIDE project has three operational components, complementary to what already exists:

- At the theoretical level, use the machine learning formalisms as a model of the learner, as it can be done in computational neuroscience on another scale.

- At the experimental level, use machine learning tools to obtain more formalized, more reliable, and more automated measures of variables related to a learning situation.

- At the pedagogical level, help the learner to understand in his own process of learning to learn, which is a matter of mechanical processes of what is creative and making these two aspects explicit.



The low-cost tabletop unplugged playful educational activity prototype

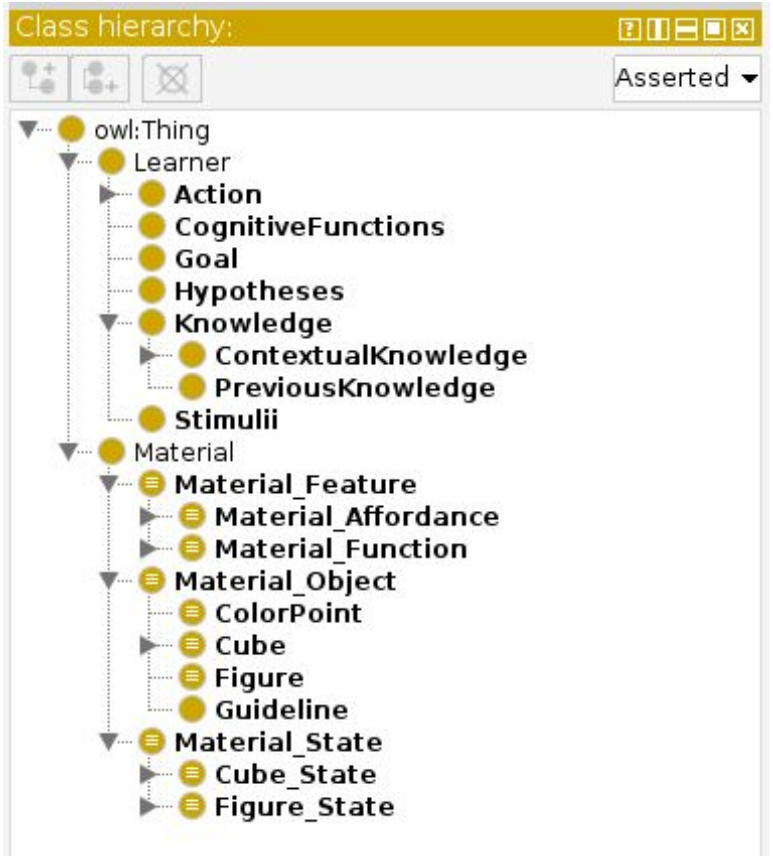
A precise scientific track

- Multi-disciplinary modelization of the learner
  - At the educational science level: socio-constructivism linked to cognitivism.
  - At the neuro-cognitive level: Computational formalization of executive functions.
  - At the machine-learning level: Reinforcement learning extended framework.

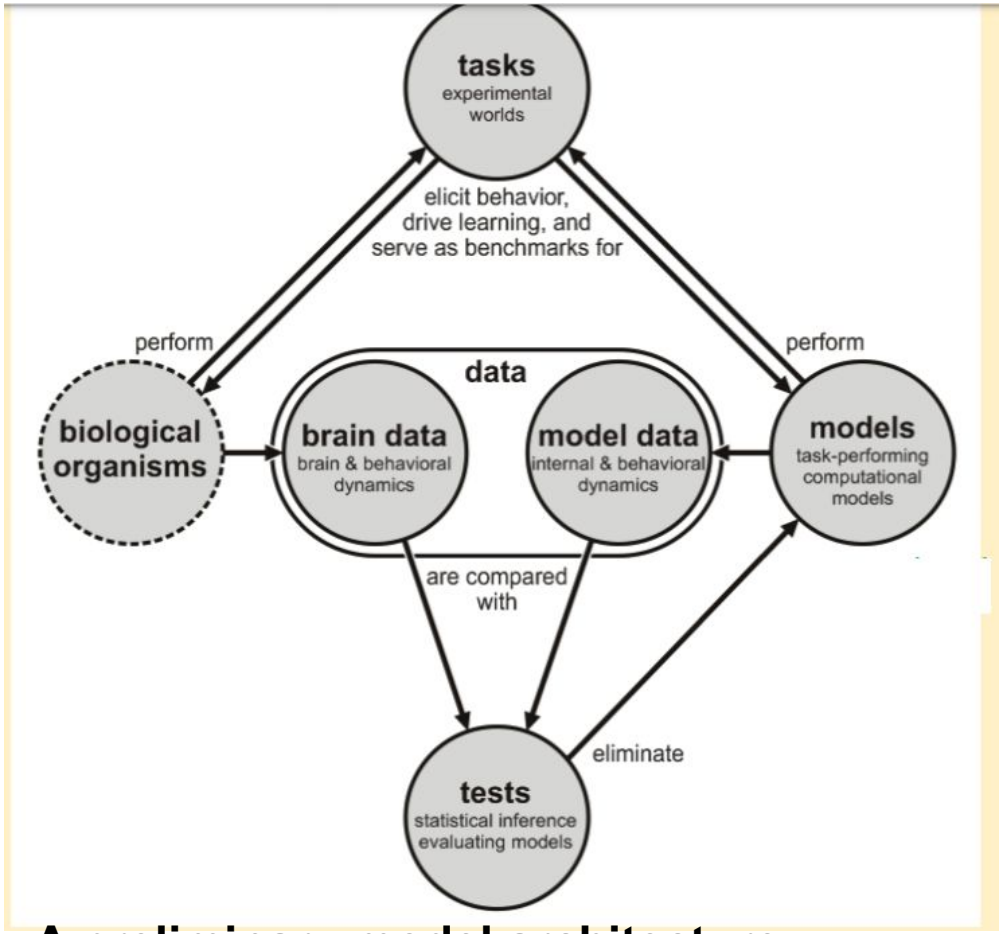
- Multi-formalization of the learning task:
  - Finite state sampling of the task objectives, actions and the learner goals and state.
  - Bayesian partially observable markov chain to state hypothetical causal relations.
  - Ontological description of the implicit knowledge at both the task and learner level.
  - Event based temporal formalization of the learning task sequence.
  - Mixed low sample size statistical and possibility representation of the event occurrences.

- Scientific levers:
    - Considering both symbolic and numeric artificial (and model of natural) intelligence.
    - Inject as much a-priori information as possible to increase statistical significance.
    - Target both interpretability and explicability of the formalization processes.

AIde : Artificial Intelligence Devoted to Education (AIDE)



Modeling using an ontology



A preliminary model architecture

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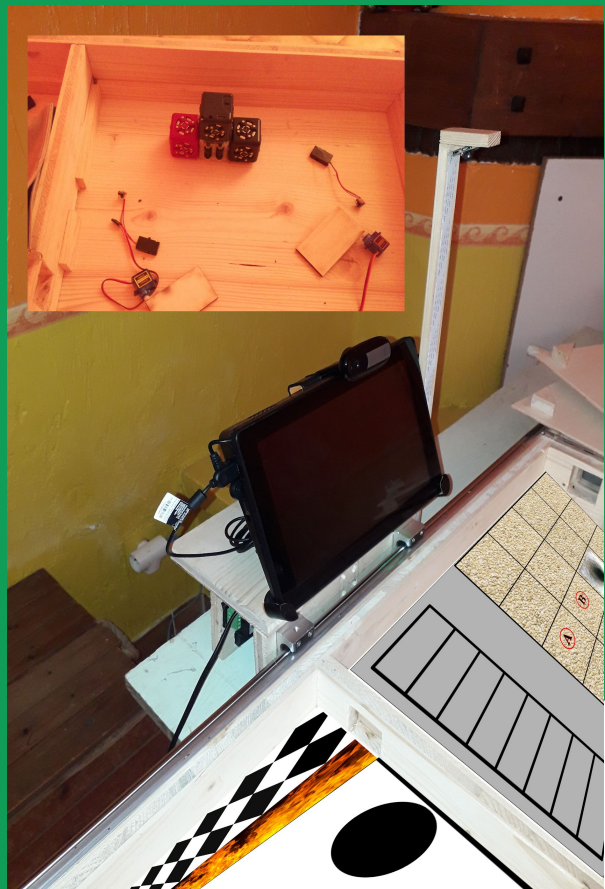
A realistic experimentation

⇒ A tabletop activity platform :

- Well established unplugged CT activities
- Automatic learning analytics measures

⇒ An experiment campaign planned

+ During science outreach activities
+ In the INSPÉ application school



A specific object of study: disconnected (i.e., “unplugged”) activities

Learning of computational thinking as the foundation of digital education seems to be really effective with activities disconnected for several well-understood reasons (but not easy to establish experimentally.

We propose here to build a measuring device that allows a learner (or a small group) to practice a unplugged activity to solve a problem related to computers and educational robotics in connection with the existing work. The use of machine learning tools will make it possible to:

- Make measures based on the gestures or attitudes of the learner in order to automate and ensure reliable collection of data, and to connect them better to cognitive processes, such as the exploitation and exploration processes.

- Confront the cognitive mechanisms involved in human learning with underlying models in machine learning (e.g., duality actor / critic in learning situations with reward (reinforcement)).

https://csunplugged.org

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Strategic interests and valorization.

⇒Multi-disciplinary, toward “computational educational science”

⇒ Direct valorization in the Edtech domain

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⇒ Lead to science outreach with some positive societal impact

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APPENDIX

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What is NOT this project ?

- Using IA ? Not to “improve” learning (or not ;)) but to better STUDY (thus model) learning.

- Using neuroscience ? Not for modeling the brain but to get *inspired* by brain modeling in order to develop a new never done before cognitive behavioral model.
  -> not computational neuroscience but computational educational science.

- Science outreach (SO) ? These unplugged activities are used in SO with success but here we want to study and evaluate them (which is almost not yet done).

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What are the risky and “never done” issues ?

- Divert and twist a neuroscience framework to create a learning cognitive model.
- Measure learning analytics during unplugged activities using machine learning.
- The three disruptive scientific challenges.