Welcome to our

Bienvenue! *Bienvenue!*

Panel

Cognitive Puzzle(s)
Quo Vadis?

(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

Meaning of **Quo Vadis?**

Where are we marching/directing Cognition and Cognitive Science into the future?

*Status **quo** or Statu **quo** is a Latin phrase **meaning** the existing state of affairs, particularly with regard to social or political issues. ... To maintain the status **quo** is to keep things the way they presently are.*

*Quō vādis? (Classical Latin: [kʷoː ˈwaːdɪs], Ecclesiastical Latin: [kwo ˈvadis]) is a Latin **phrase** **meaning** "Where are you marching?". It is also commonly translated as "Where are you going?" or, poetically, "Whither goest thou?". Where are you marching*
*Quō vādis? (Classical Latin: [kʷoː ˈwaːdɪs], Ecclesiastical Latin: [kwo ˈvadis]) is a Latin **phrase** **meaning** "Where are you marching?". It is also commonly translated as "Where are you going?" or, poetically, "Whither goest thou?".*

Theme: Cognitive Puzzle: Quo Vadis?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

Chair
Charlotte Sennersten, CSIRO, Australia, charlotte.sennersten@csiro.au

Panelists
Marta Franova, LRI, UMR8623 du CNRS & INRIA Saclay, Bât. 660, Orsay, France   mf@lri.fr
Olga Chernavskaya, Lebedev Physical Institute, Russia   olgadmitcher@gmail.com
Joao Kogler, University of Sao Paulo, Brazil   kogler@lsi.usp.br
Muneo Kitajima, Nagaoka University of Technology, Japan mkitajima@kjs.nagaokaut.ac.jp

What 'Cognitive' Puzzle(s) do we lay when approaching the future in terms of Cognitive Science Direction(s) and Impact(s)?
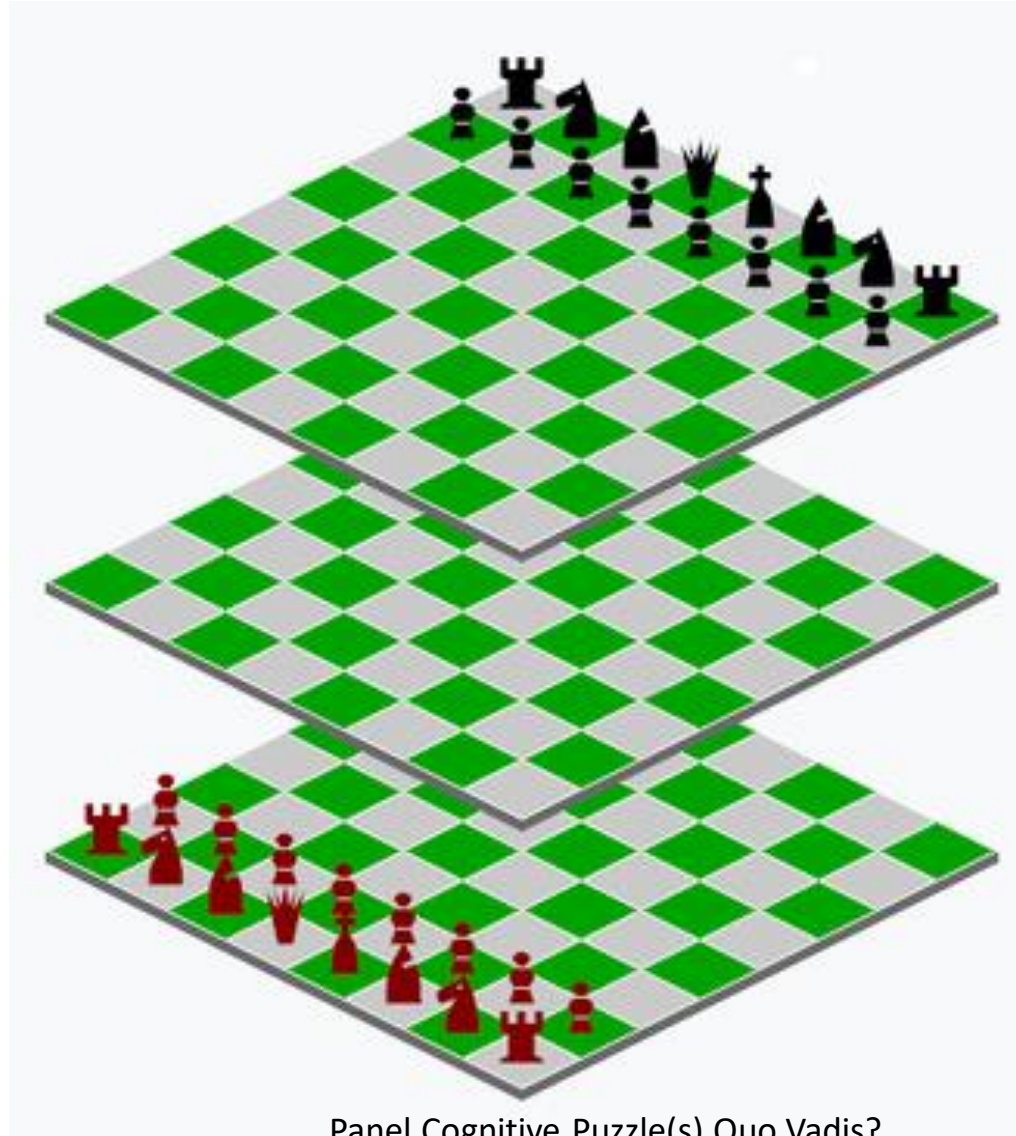
3D Chess

Panel Cognitive Puzzle(s) Quo Vadis?

Example of Digital Twin Implementation and Real World relationships: We can walk, look, think and act at the same time!
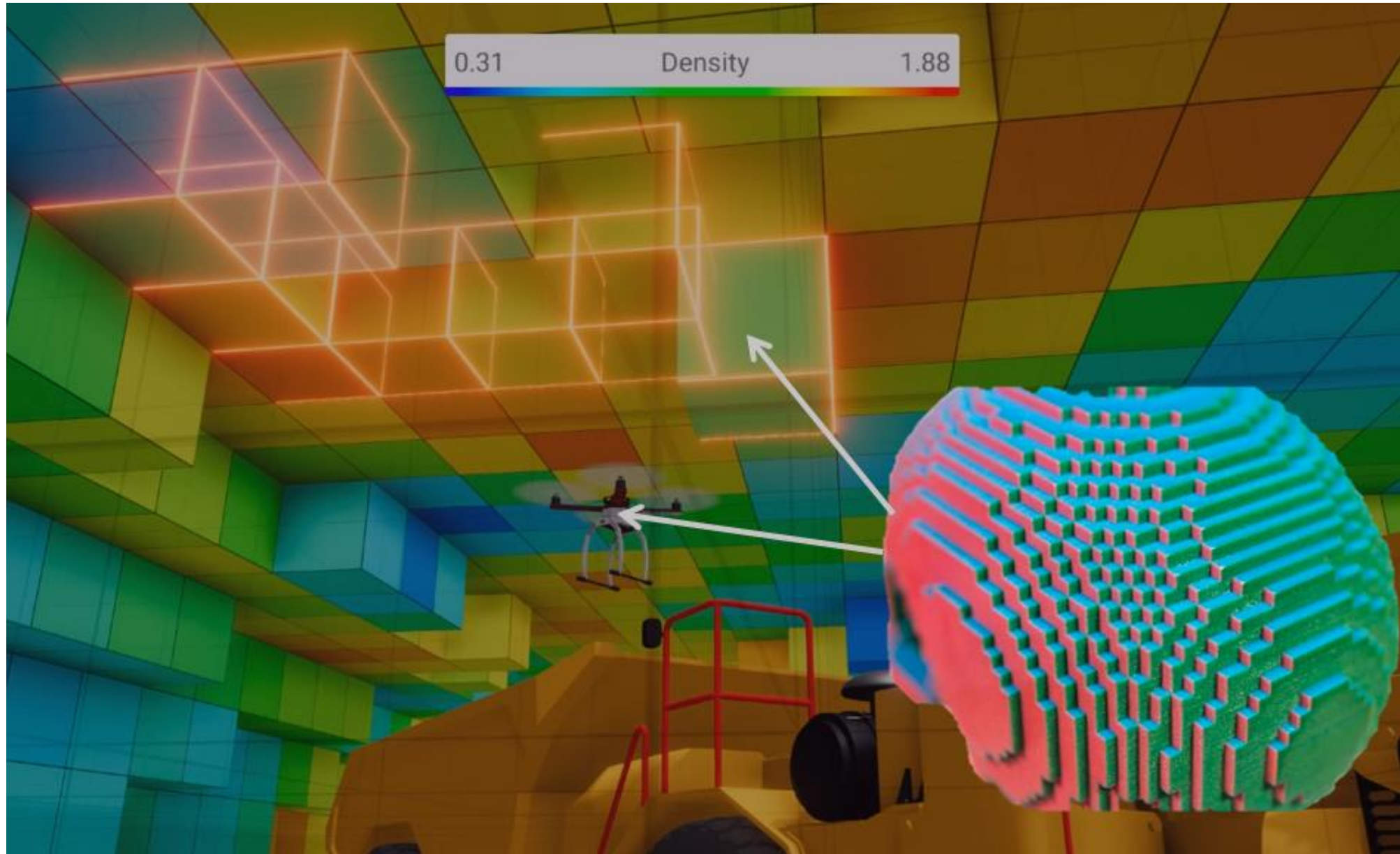

Figure 4. VoxelNET and voxelised brain for world and human knowledge systemization.

Over to Charlotte!
I am Charlotte so I imagine I continue ☺*!*

Panel 1
Cognitive Puzzle: Quo Vadis? Where are we Marching?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

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Panellist Position

Cognitive Puzzle : *Quo Vadis?*

Charlotte Sennersten, CSIRO Mineral Resources, Australia charlotte.sennersten@csiro.au

- Where are we heading?
  - Lots of sensors and its (cognitive and non cognitive) data and other data need an overall umbrella infrastructure

- Why does it matter?
  - To build systems and implement data we need a coherent infrastructure so what is tracked, traced, and stored in a database, can be queried and displayed for optimal cognitive comprehension (go away from 'Black Boxes').

- What are the common issues?
  - All recorded data has different data protocols and are siloed and if we are going to make sense to data
    1) We need to be able to share our joint efforts and draw collective solutions/results from these.
     2) In transdisciplinary academic and industrial projects people generally do not know what cognition really is.
     3) Human Cognition versus Machine Intelligence and the both combined in an Artificial Intelligence sense needs a framework.

- What can we do?
  - We need a Global-Local Earth Cognition Encyclopedia so cross correlations and dependencies can be measured and tested.
  - Understand cognition and the related phenomena: Perception, Reasoning, Action, Language, Memory, Consciousness, etc.
    - Information processing, structure and dynamics with Digital Twin Cognition and Real World Cognition create a **Hybrid** World Cognition and AI
      - To create an 'intelligent' world we need to cross correlate data even the data we may not usually even include if we want to understand our digital replication of the world.

I want to warmly welcome our excellent panelists to today's panel!
We are today actually coming from all parts of the world
represting 'Cognitive Science' and this becomes very special to me as a Chair to chair ☺!

Welcome Marta Franova from France!

Welcome Olga Chernavskaya from Russia!

Welcome Joao Kogler from Brazil!

Welcome Muneo Kitajima from Japan!

Today's Session Topic is:
C-o-g-n-i-t-i-v-e P-u-z-z-l-e-(s)
Quo Vadis?

Panel Cognitive Puzzle(s) Quo Vadis?

Over to Marta Franova
"The stage is yours!"

"P2 Systems in Cognition (… and elsewhere)
Marta please share your view(s) on today's panel topic!"

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Panellist Position

Towards P2-Systems in Cognition (...and elsewhere)

Marta Franova, CNRS & LRI & INRIA mf@lri.fr

- considering symbiotic projects (in addition to synergetic ones)
- working with underspecified goals formulations (in addition to exactly defined goals)
- considering progress (in addition to innovation)
- allowing very long term research projects (in addition to short and medium term projects)
- considering epistemic justifications of non-standard approaches in Science
- introducing new relevant intellectual property laws for non-standard projects

→ Decreasing conflicts and misunderstanding in Science

→ Dealing with uncovered topics in Science

→ Enhancing scientific collaborations

→ Real progress

Thanks *Marta Franova!*

and now over to

Olga Chernavskaya

"Olga, please share your ongoing work on today's topic!
and
we will meet Robotics!

Emotional Robots!"

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Panellist Position

Quo Vadis? Towards emotional robots

(Based on the just past conference BICA*AI_2020, 10-11 Oct)

Trend for robotics: towards emotional and "moral" robots

Olga Chernavskaya, Lebedev Physical Institute, Russia IARIA, olgadmitcher@gmail.com

- Robots in communication with people: demands
- Robots & Emotions: **3 level**
  - Ability to **recognize** Emotions in people (+)
  - Ability to **express** *proper* emotions (+-?)
    - Reflect mirror E (+)
    - Express context-based E (+-?)
  - Could a robot **experience** its own emotions? (?)

- Toward *ethical* and *moral* robots
  - Embedding *ethical* principles (with account for cultural context)
  - Could a robot make *moral choice*?
    - The "trolley problem"
    - Stanislaw Lem "Tales of Pirx the Pilot"

    → Recognition of human E → Comprehension of E?

    → Towards the "ideal" world of Isaak Asimov?

Thanks Olga!

and now o*ver to our next panelist which has a slightly different angle on this topic and will go to the roots of "<u>What</u> is cognition?"*

Joao Kogler

Panel 1
Cognitive Puzzle: Quo Vadis?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

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Panellist Position

Cognitive Puzzle : *Quidnam Vadis* ? (paraphrasing the main title)

Joao Kogler, University of Sao Paulo, USP/Brazil kogler@lsi.usp.br

- Besides asking *where* (*quo*) it goes, how about asking *what* (*quidnam*) actually is going there?
    - The question about *what is cognition* is still on the agenda…

- Why does it matter?
    - It affects the research of cognitive systems and the design of cognitive applications
        - At the conceptual design, architectural modelling, and testing steps
        - It delineates the targets for research efforts

- What are the common issues?
    - "The cognitive" is the new hype
    - Generating misconceptions
    - Missing the target on research efforts and design methodology

- What can we do?
    - Avoid "umbrella concepts" and focus on the characterization of the phenomenon itself :
        - What is cognition? What are its characteristics?
    - Understand cognition and the related phenomena: perception, reasoning, action, language, memory, consciousness, etc.
        - In terms of information processing, structure and dynamics
            - New tendencies are pointing to this direction, actually…
    - What are the concrete prospective views for reaching such understanding?

- In addition, will this help to better understanding the future directions?
    - How?

Thanks Joao Kogler!

from highlighting 'What' now we will go over to

whom also published a book on the title
"Memory and Action Selection in Human-Machine Interaction" (2016)

We welcome
Muneo Kitajima

Muneo Kitajima currently works at the Department of Management and Information Systems Engineering, Nagaoka University of Technology. His recently published book "Memory and Action Selection in Human-Machine Interaction" (2016) proposes a unified theory of action selection and development by integrating PDP, Two Minds, and Layered structure of human action. The theory provides a comprehensive view of how our brain functionally works in our daily life. His current interest is to understand the implications of the theory to development of skill of adaptive problem solving, the important skill for survival.

Thanks Muneo Kitajima!
Thanks!

We now know we do not only deal with one mind but two!
+ layered structure of human action!

We are now going from introductions of each panellist to
a next level 'deep dive' presentations by each and every one.

Each panellist has prepared these individual presentations to share their view on the chosen topic!

Please sit back and enjoy the four panellists extended presentations on the topic:

Cognitive Puzzle(s)
Quo Vadis?

Panel Cognitive Puzzle(s) Quo Vadis?

First out is Charlotte.

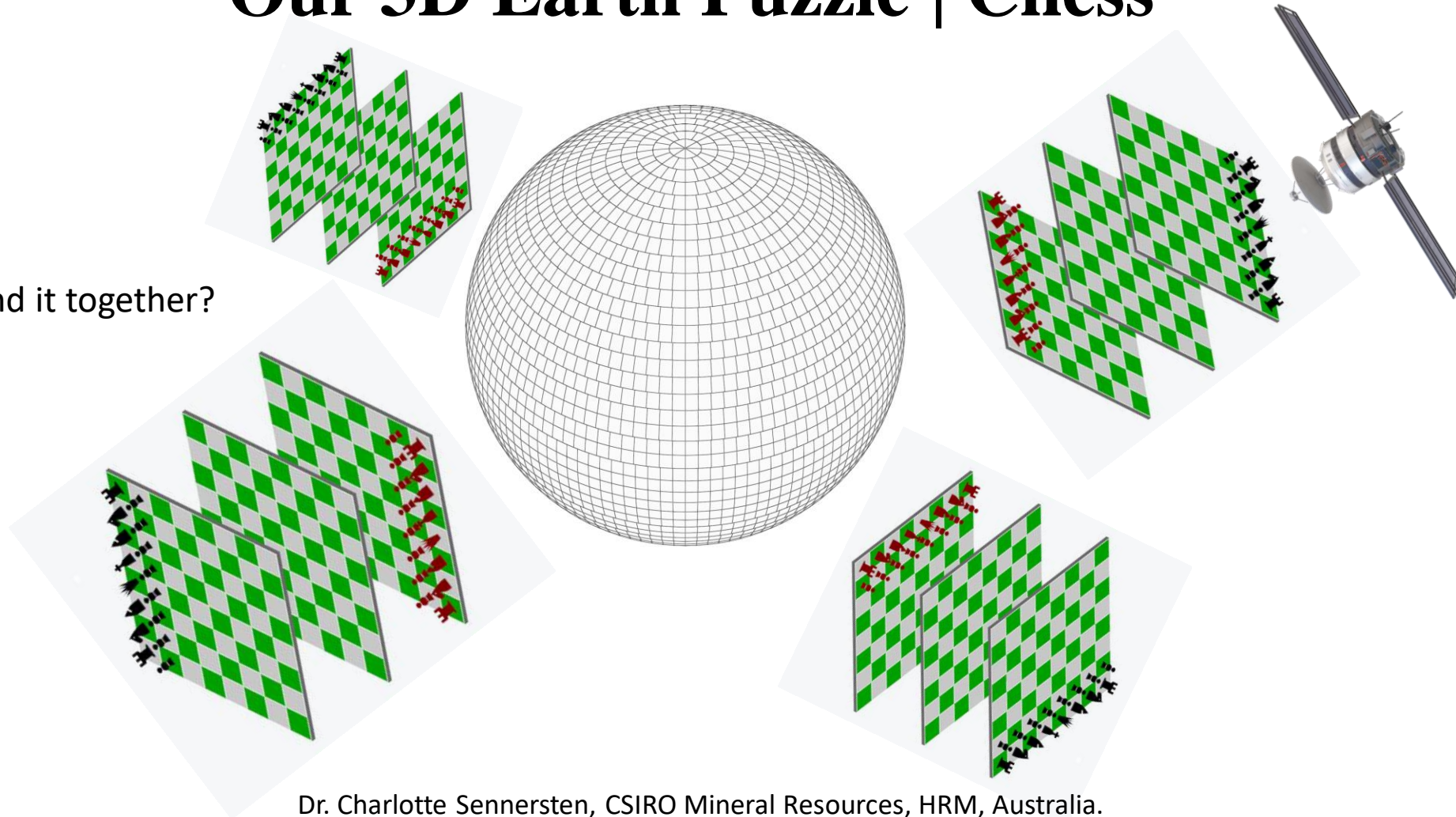She will start off the more detailed panel presentations with her take on today's topic!

Panel 1
Cognitive Puzzle: Quo Vadis?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

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Our 3D Earth Puzzle | Chess

How do we bind it together?

Dr. Charlotte Sennersten, CSIRO Mineral Resources, HRM, Australia.

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Panel 1
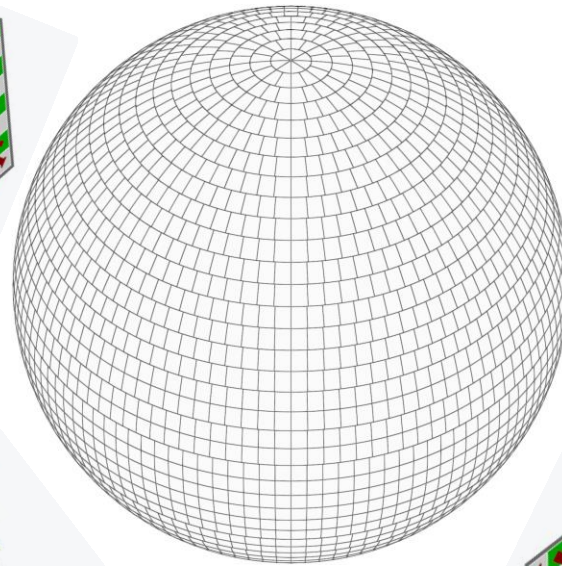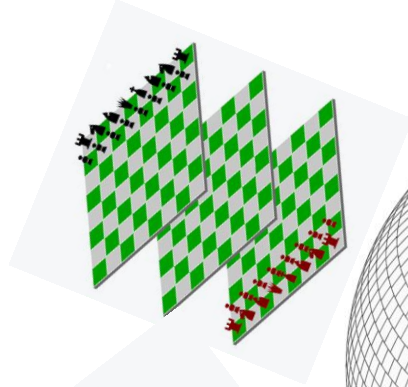**Cognitive Puzzle: Quo Vadis?**
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)
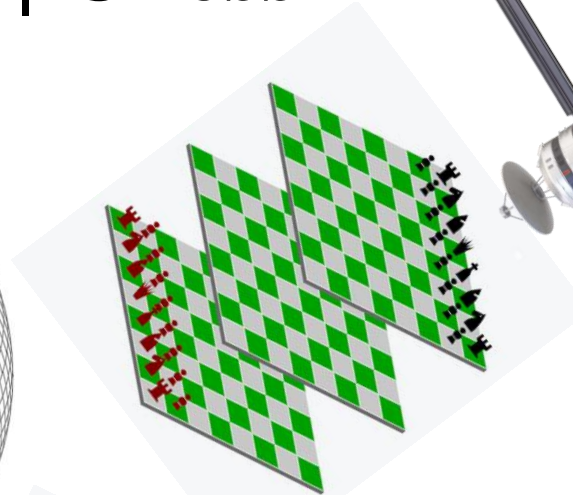
Computation World 2020
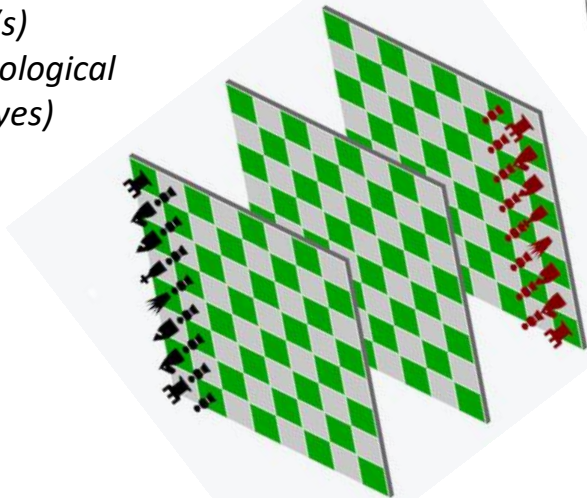
Our Sensors Puzzle | Chess

Satellite Data

Various Sensor(s) & Human Physiological Sensors (e.g., Eyes)
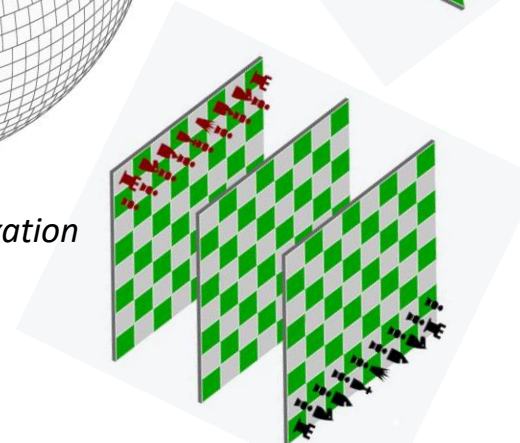
Earth Volumetric Indexation

Human Cognitive and Machine/Computer/Robot Algorithmic Interpretation

Information processing, structure and dynamics with *Digital Twin Cognition* and *Real-World Cognition* create **a Hybrid World Cognition and AI**

Panel 1
Cognitive Puzzle: Quo Vadis?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)

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Our Quantum Compute Puzzle | Chess

Satellite Data

Various Sensor(s) & Human Physiological Sensors (e.g., Eyes)

The quantum Bloch sphere, a geometrical representation of a quantum state space.

Human Cognitive and Machine/Computer/Robot Algorithmic Interpretation

Information processing, structure and dynamics with *Digital Twin Cognition* and *Real-World Cognition* create ***a Hybrid World Cognition and AI***

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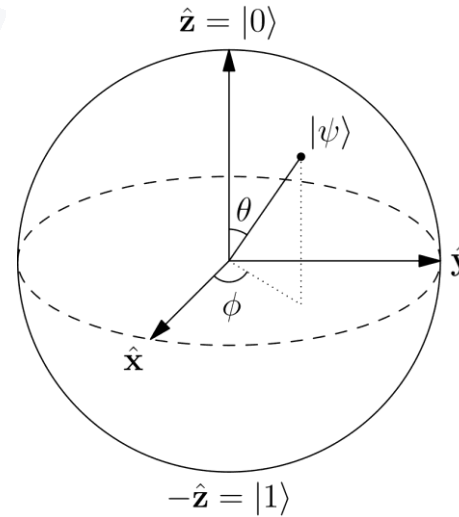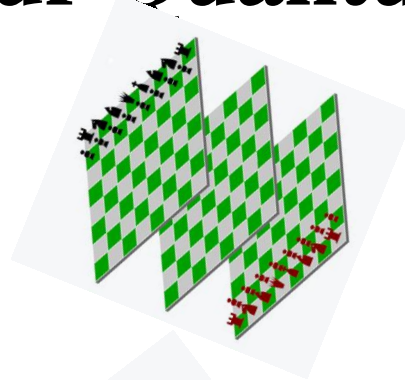**Panel 1**
Cognitive Puzzle: Quo Vadis?
(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)
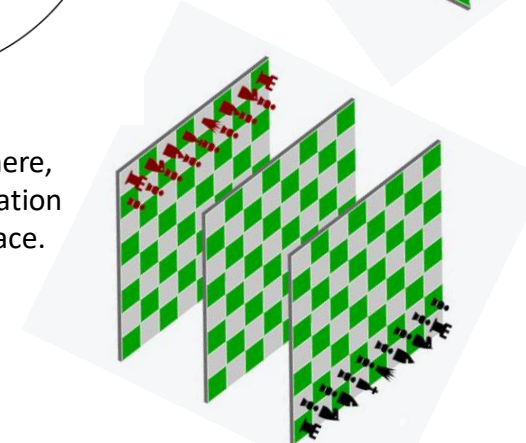
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Our Cognitive Eye-Brain Puzzle | Chess

Various Sensor(s) & Human Physiological Sensors (e.g., Eyes)

Satellite Data
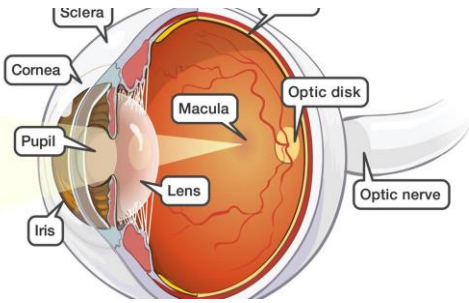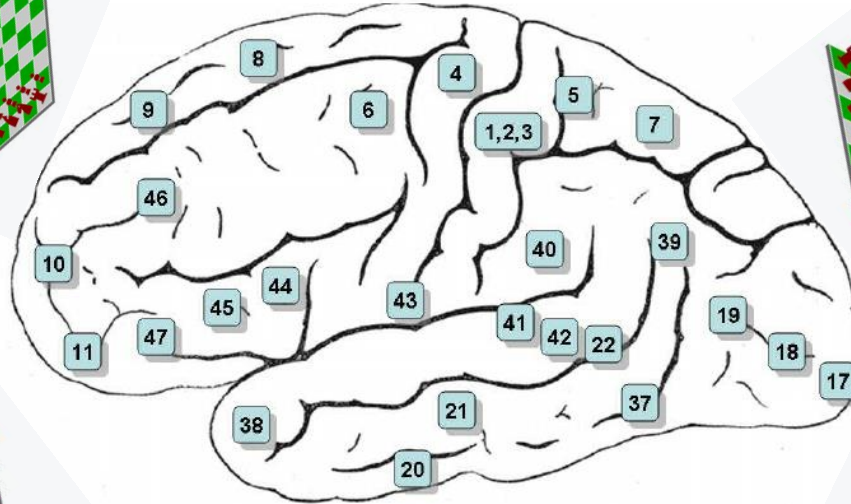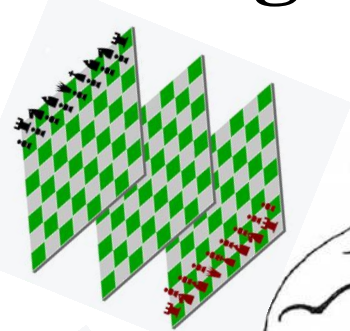
Outer brain volumes.
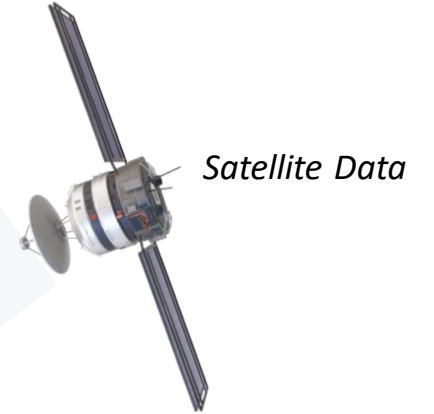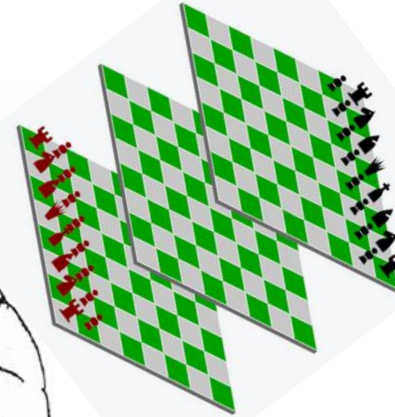
Human Cognitive and Machine/Computer/Robot Algorithmic Interpretation

We need systemisation!

a Hybrid World Cognition and AI

Dr. Charlotte Sennersten, CSIRO Mineral Resources, HRM, Australia.
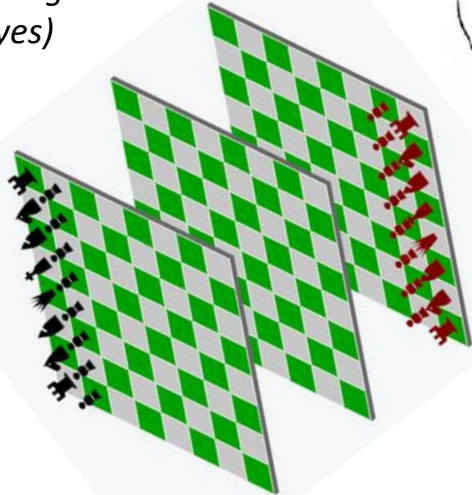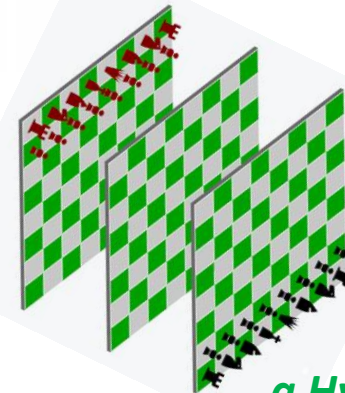
Thanks Charlotte!

Marta please give us further insight into the P2-Systems Cognition Puzzle of yours!

Towards P2-Systems in Cognition (…and elsewhere)

Marta Franova

mf@lri.fr
CNRS, LRI, INRIA

What is a P2-system

P2-system stands for

P2-Symbiotic Recursive Pulsative Problem-Solving System

Informally:

Generator of assets that is an Asset and that generates itself

More formally:

S is a P2-system if simultaneously

- S is a result of the construction paradigm

$\exists S \ \forall Problem \ solves(S, Problem)$ (P2)

- S is able to construct itself

i.e., S verifies the well-known Ouroboros self-referential

equation $S(S) = S$ achieved by the process

$$\lim_{n \to \infty} S_{n+1}(S_n) = S$$

S_0 is an informal specification
S_i is a practically complete system

- S is a deductive-like problem solving system
- S is a symbiotic, recursive and pulsative system

Panel Cognitive Puzzle(s) Quo Vadis?

(Hypothetical) Example of P2-system

Conception of Human Brain as

$$\lim_{n \to \infty} \text{Brain}_n = \text{Brain},$$

where Brain is a P2-system and

$$\text{Brain}_n = \text{Left\_Brain}_n \blacklozenge \text{Right\_Brain}_n \blacklozenge \text{RNK}_n \ \&$$

$$\text{Left\_Brain}_n = \text{Brain}_{n-1} \blacklozenge \text{RNK1}_n \ \&$$

$$\text{Right\_Brain}_n = \text{Brain}_{n-1} \blacklozenge \text{RNK2}_n$$

and

- $\blacklozenge$ is a symbol for symbiotic composition
- RNK_n is a new knowledge related to symbiotic composition of left and right brains in the n-th pulsation step, RNK1_n and RNK2_n are relevant new knowledge extending, by the process of practical completion, the previous knowledge respectively about Left_Brain_{n-1} and Right_Brain_{n-1}

Panel Cognitive Puzzle(s) Quo Vadis?

Example of ongoing research

Creation of a particular P2 - Program Synthesis system (noted PS)
(research started in 1983)

$$\exists PS \, \forall FSpecif \; solves(PS, FSpecif)$$

where

- FSpecif – a relationship specification between inputs and outputs of the form

  $$\forall input \, \exists output \; input\text{-}output\text{-}relation(input, output)$$

  Example (sort algorithm): $\forall i \, \exists o \; permutation(i,o) \, \& \, ordered(o)$

- PS – a program synthesis system (here a particular theorem-proving P2-system)

Main achievements:
- considering symbiotic programs
- working rigorously even in the context of underspecified goals
- allowing incomplete environment

see more details in
M. Franova: **Cartesian versus Newtonian Paradigms for Recursive Program Synthesis** ; International Journal on Advances in Systems and Measurements, vol. 7, no 3&4, 2014, pp. 209-222.

Panel Cognitive Puzzle(s) Quo Vadis?

How a human can create a P2-system?

suggestion:

Cartesian Systemic Emergence (CSE)

CSE is a generalization of

- the experience acquired in an exploration of the genesis of ancient deductive systems,
- the experience acquired in the design of a P2-system (i.e., a system that is built relying on P2-paradigm) for program synthesis (PS) of recursive programs specified by a formal specification in incomplete domains,
- the experience acquired from an original construction of the Ackermann's function and a study of its computation process,
- the experience coming from the use of Descartes' method (see ref. on the last page) in PS.

developed in order to allow the creation of semi-automatic tools that help
                                                                    the P2-creation process

Panel Cognitive Puzzle(s) Quo Vadis?

Difficulties: HUMAN FACTORS (only)

P2-paradigm completely different and incomprehensible in the context of the paradigm

$$\forall \text{Problem } \exists S \text{ solves}(S, \text{Problem}) \quad (P1)$$

namely P1-paradigm

- seeks modular solutions
- the development process is accessible to external observation
- allows synergic collaborations

while P2-paradigm ($\exists S \forall \text{Problem solves}(S, \text{Problem})$)

- creates symbiotic solutions
- the process is inaccessible to external observation (it is incomprehensible)
- requires 'One-Mind' collaborations

The intellectual property laws do not provide a protection for P2-creation

in consequence

P2 is rejected by P1-experts.

However, P2 extends the existing research paradigms and

it is noncompetitive with them.

Panel Cognitive Puzzle(s) Quo Vadis?

Contribution of CSE to Progress

CSE brings a progress to modern science at least on three points:

- it justifies P2-creation of symbiotic recursive pulsative systems,
- it shows that P2-creation requires its own particular kind of presentation, collaboration and evaluation, and
- it shows the inadequate character of the present intellectual property laws still unable to protect this atypical kind of long-term research.

Panel Cognitive Puzzle(s) Quo Vadis?

Main References:

M. Franova: **Créativité Formelle : méthode et pratique - Conception des systèmes " informatiques " complexes et brevet épistémologique**; Publibook Université, Paris, France, 2008

Marta Franova, Yves Kodratoff: **Cartesian Systemic Emergence and its Resonance Thinking Facet: Why and How?**, International Journal On Advances in Systems and Measurements, IARIA, 2020, International Journal on Advances in Systems and Measurements, issn 1942-261x, Volume 13 (Number 1 & 2), pp.11-25.

Marta Franova, Yves Kodratoff. **Symbiotic Thinking … for Cognitive Modeling as Well.** ComputationWorld 2020 : Phase 1 - Preliminary Proceedings, 2020, Nice, France. pp.62-67.

Descartes: **Discourse on the Method of rightly conducting one's reason and seeking the truth in the sciences**; in Philosophical Writings of Descartes (translated by J. Cottingham, R.Stoothoff, D. Murdoch, 2006)

Panel Cognitive Puzzle(s) Quo Vadis?

Thanks Marta!

We are now going from the Brain System(s) –Left and Right!
to Olga whom will present how Robots communicate with people! Or?

Please Olga!

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Robots in communication with people

- The modern level of development of technology and theory of AI allow to improve "robots" in relation to the urgent needs of society. Apart from technological needs, there is a social need for ***companion robots*** to help and communicate with humans.

- Such Robots should satisfy certain **demands:**
  - *recognize* objects (and humans!) in the real world
    - **Recognize humans**
    - **Recognize itself ("mirror test")**
  - master human **speech**
    - **perceive** speech
    - **react with speech utterances** and nonverbal communicative cues
    - ! Comprehend the **content** (by comparison with recorded information)
    - **accumulate knowledge** from different **text sources**: news, blogs, and e-mails.
    - ! *posses* **internal speech** describing his actions
      Antonio Chella: it helps to make more **transparent** robot's reasons and actions
- Robot and **Emotions!?!**

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Robots and **Emotions**

- **3 levels of E representations:**
  - **Recognition** of human emotion on the base of **recorded patterns**
    - Facial expression (mimics)
    - Speech features (**intonation,** word choosing)
    - **gestures**
  - Ability to **express** *proper* E
    - Mirror reflection of human E – again, **basing on recorded patterns** (A. Kotov, A. Chella)
      - By robot's *facial expression*
      - By *verbal reactions*
    - Ability to demonstrate context E
  - Ability to **produce** robot's *own* E – *actual but not realized problem*
    - Algorithm #1: pragmatic E arises, when robot has *definite goal:* approaching the goal **causes positive E** and *vice versa*
    - Algorithm #2: E arises, when there is a *conflict and its resolution (A. Chella)*
    - *These ideas exist on the theoretical level yet.* **More ideas???**

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)
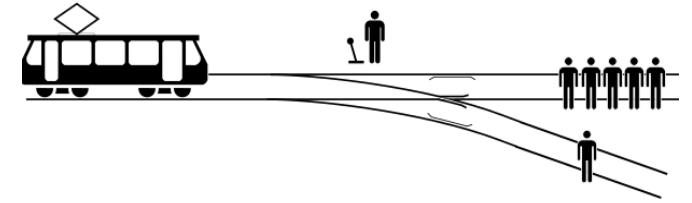
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Ethics & moral

- *"With the goal of reducing more sources of existential risk than are generated through advancing technologies, it is important to keep Robot's ethical standards and causal implications in mind"..*
  Kyrtin Atreides

- The **difference** between Ethics and Moral
  - Ethics ↔ the way of *behavior*
  - Moral ↔ the way of *thinking* and *feeling*

- Implementation of **etiquette**
  - Seemingly, no problem. *But:*
    - What will robot do if etiquette is violated?
    - Conflict with ethic rules produces robot's Emotions (*A. Chella*)

- Implementation of **Moral?**??
  - *Moral choice* is strongly **individual**
    - I. Kant: *"the starry heavens above me and the moral law within me…"*
  - It should be based om *empathy? Is it possible?*
  - **I. Asimov**: 3 lows of robotics. *Why not???*

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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The "trolley problem":

should you pull the lever to divert the runaway trolley onto the side track?

- The problem setting *is not correct*
  - moral problems could not be solved in the field of syllogisms
  - in reality, there is always some *loophole* for another way out
-        (in the given case, e.g., to *crush the trolley*)

- The solution to the problem of **moral choice** *should not be entrusted to a robot* *(yet? Or always?)*

- *Human person can always find some other way out – be it risky or stupid, but*

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Interesting questions to discuss:

- Could robots possess their **own E**?

- Could robots **express** empathy ?

- Could robots **possess** empathy?

- Could robot enjoy some actions? If so, how to prevent the preferential execution of these actions?

- Is it possible to realize **Isaak Asimov's world???**

    He had created very warm, pleasant and good world where robots cooperate, collaborate and empathize with humans. However, even in such world there exist paradoxes and problems…

    And others questions related….

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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References

- BICA*AI_2020 on-line congress 10-11: Oct https://bica2020.org/

(will be **continued 10-15 Nov!**)

- *Artemiy Kotov* **Conceptual Processing System for a Companion Robot**

- *Arianna Pipitone* and *Antonio Chella* **Robot passes the mirror test by inner speech**

- *Salvador Cervantes*, *Sonia López* and *José-Antonio Cervantes* **Toward ethical cognitive architectures for the development of artificial moral agents**

- *Kyrtin Atreides*, *David Kelley* and *Uplift Masi* **Methodologies and Milestones for The Development of an Ethical Seed**

I am a human and I say: Thanks Olga ☺!
I am a robot and I say: Thanks Olga!

We move now from Olga and Olga's fantastic work mapping humans for robotic reasoning, comprehension and vice verse.

Now over to Joao whom will lead us into another cognitive domain –systems?! If not brain and human-robotic systems but to go to the bottom of what cognition really is and how important this is when creating cognitive systems per see.
Agreed definitions!!!

Please Joao!

IARIA

Panel 1
Cognitive Puzzle: Quo Vadis?
(machine learning, deep cognition, cognitive decisions, deep-mind, empathy, social emotion, etc.)

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Panellist Position

Cognitive Puzzle : *Quidnam Vade* ?

(paraphrasing the main title)

Joao Kogler

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João E. Kogler Jr. – kogler@lsi.usp.br

- Researcher and lecturer of the Department of Electronic Systems, Polytechnic School of Engineering, University of Sao Paulo, Brazil

- Research interests:
  - cognitive science, cognitive systems design, complex adaptive systems, computational intelligence, philosophy of cognitive science

- Background:
  - BSc Electrical Engineering , BSc Physics, MSc Biomedical Engineering / Neuroscience, PhD Computer Vision

Cognition, Perception and Consciousness: Logical and Structural Aspects

- More info:
  - Research:
    - https://www.researchgate.net/profile/Joao_Kogler_Jr

  - Professional activities (academic, consultancy, industry, organizations,)
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Cognitive Puzzle : *Quidnam Vade* ?

- Besides asking *where* (*quo*) it goes, how about asking *what* (*quidnam*) actually is going there?
  - The question about *what is cognition* is still on the agenda...
    - Although there are some proposals for a clear definition of cognition, they constitute exceptions among the R & D community
      - The proposals are frequently ignored
    - In turn, it is usual that cognition is taken as an "umbrella concept"
      - As a general property encompassing perception, memory, language, attention, action and behavioral control, consciousness,...
        - Even famous books like Posner's and Gazzaniga's adopt this view
  - Many use the term "cognition" as if it was an intuitive and obvious concept, maybe taking it as a "primitive term".

Cognition

Attention
Memory
Perception
Action
Reasoning
Consciousness

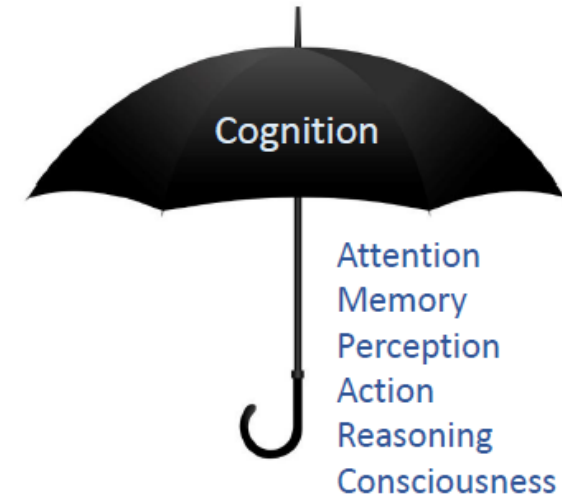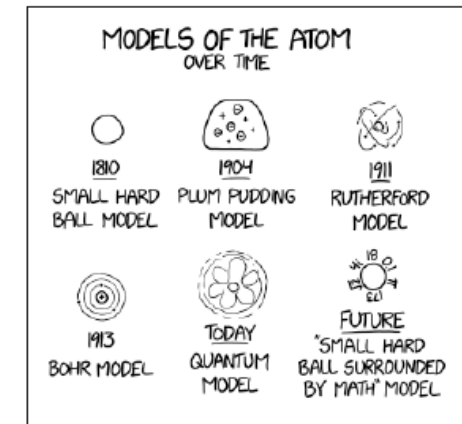Panel Cognitive Puzzle(s) Quo Vadis?

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Cognitive Puzzle : *Quidnam Vade* ?

Well, ... what is an atom ?

Edited image from xkcd comics

- The question of *what is cognition* is still in the agenda
  - People are still interested in this matter, mainly young researchers
    - Quite common finding students discouraged by their advisors of including in their dissertations a discussion about this subject

- So, while asking *"quo vadis"* , we are wondering about the future of something that we don't know clearly
  - Surely we don't have to stop everything just because of it. Nevertheless, one must consider the issue at the same time that R & D goes ahead
    - Consider its relevance and importance
      - Maybe try well justified ideas, like in the case of the conception of the atom...
        - The ideas can be discussed, confirmed, refuted or evolve

Or, maybe...
the 'flat atom' model
😉

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Why does it matter?

- It affects the research of cognitive systems and the design of cognitive applications
  - Design of cognitive systems applications
    - At the conceptual design, architectural modelling, and testing steps
  - Research on cognition and cognitive systems
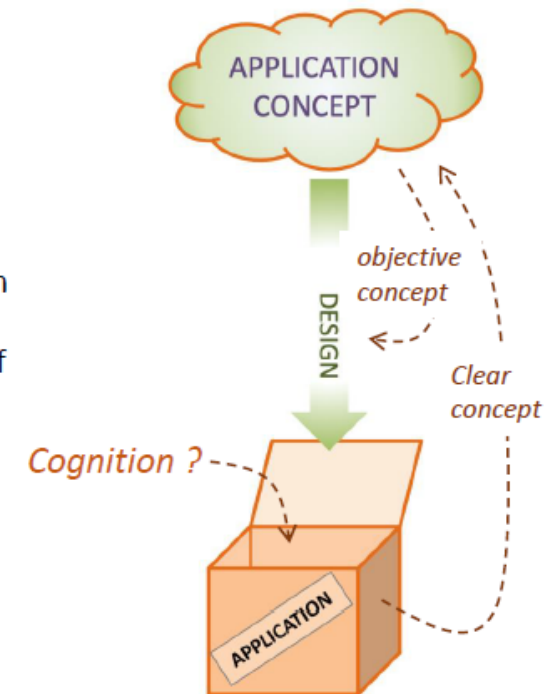   - It delineates the targets for research efforts

Panel Cognitive Puzzle(s) Quo Vadis?

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Why does it matter?

- A clear and objective concept of cognition is important to the
    - Design of cognitive systems applications
        - At the conceptual design, architectural modelling, and testing steps
            - Any application starts with a conceptual design step, which in the case of a cognitive system means that one must justify the need for cognition in the application.
                - It must be explained why the use of cognition leads to the expected functionalities of the application, and
                - How cognition enables to achieve those functionalities
            - The conceptual design affects other design steps
                - The functional specification – one must describe the relations among the cognitive functions and the remainder of the system
                - The system architecture – is cognition localized in a module, is it distributed, is it embedded in specific parts, etc.
                - The application testing step – how to verify if the prototype is meeting the functional specifications
                    - Case not, explain why, try to debug the prototype

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Why does it matter?

DOESN'T MATTER WHAT IT IS AND HOW IT LOOKS LIKE, JUST FIND IT !

- A clear concept of cognition can be helpful for the
  - Research on cognition and cognitive systems
    - It delineates the targets for research efforts
    - One can and have to proceed with research on cognition even not having a definitive or agreed conceptualization of it
      - However, some proposals or working definitions, models and hypotheses must precede any investigation on the subject, or there would be difficult to access results
        - "What are we talking about ?"

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Why does it matter?

- What are the common issues?
  - The idea of cognitive is pervading the artificial intelligence R & D community
    - "The cognitive" is the new hype
      - https://www.researchgate.net/publication/335210285_Cognitive_is_the_new_hype_word

  - The abuses of the term can be inappropriate
    - Generating misconceptions
    - Can lead to diversions and loss of time
      - Missing the target on research efforts and design methodology

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Why can we do?

- Avoid "umbrella concepts" and focus on the characterization of the phenomenon itself :
  - What is cognition? What are its characteristics?

- Describe cognition and the related phenomena: perception, reasoning, action, language, memory, consciousness, etc.
  - In terms of information processing, structure and dynamics
    - New tendencies are pointing to this direction, actually...

- What are the concrete prospective views for reaching such understanding?

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What are the concrete prospective views for reaching such understanding?

- Provide working definitions of information processing terms related to cognition
  - Information, knowledge, meaning, representation, content …
  - Natural computations, grounding, enaction,

- Criticize and improve the terminology until a satisfactorily agreeable point

- Describe cognition, perception and related concepts using the above terminology

- Avoid the *"umbrelling"* effect
  - Distinguish cognition, perception, reasoning, attention, consciousness, mind, etc.

- Use the new concepts as starting point, as working terminology, hypotheses, models, etc.
  - Verify how they work experimentally, on research, for development, etc.
  - Share to the community for discussion
    - BTW, the community should be open for new concepts and proposals, stimulate the debate

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In addition, will this help to better understanding the future directions?

- How?

  - At least there will be a clear direction to follow with R & D

  - Therefore, the question **Cognition: "*Quo Vadis*"** will make a new stronger sense

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Further reading:

- Kogler Jr., JE., and Santos, P. (2017) - Information, context and structure in cognition, in book: **Cognitive Science: Recent Advances and Recurring Problems** , Chapter 11 , Fred Adams, Osvaldo Pessoa Jr and Joao E Kogler Jr, Eds., Vernon Press, Wilmington, Delaware, USA. 2017, ISBN: 978-1-62273-100-8

- Kogler Jr., JE. (2018) – Cognitive is the new hype word – pdf available in https://www.researchgate.net/publication/335210285_Cognitive_is_the_new_hype_word

Panel 1
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Thank you !

Cognitive Puzzle : *Quidnam Vade* ?

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Thanks Joao!

So Cognition with 'Natural Computation' and 'Reasoning' makes it possible for us to navigate the world!

How important it is to base Cognition in definitions and not general 'umbrella' terms.

Now our final panellist,
Muneo Katajima!

Muneo will describe how we conduct Cognitive Behavioural Science in Theory and Experimental Methodology!

Please Muneo –the stage is yours!

Panel Cognitive Puzzle(s) Quo Vadis?

A Paradigm for Understanding Human Daily Behavior

The ideas proposed by Herbert A.Simon, Allen Newell, and David E. Rumelhart are integrated into MHP/RT for completely explaining Daniel Kahneman.

MHP/RT and CCE are two wheels for conducting cognitive behavioral sciences, that complement each other from theoretical and experimental perspectives, respectively.

❖ **Theory: MHP/RT** (Model Human Processor with Realtime Constraints)
- *Memory and Action Selection: The core constructs:*
  - **O-PDP:** Organic Parallel Distributed Processing (J.L. McClelland & D.E. Rumelhart)
  - **MSA:** Maximum Satisfaction Architecture, consisting of seventeen happiness goals for defining top-level control structure (D. Morris)
  - **4-Process:** Conscious/Unconscious Processes (Two Minds by D. Kahneman) BEFORE/AFTER memorable events
  - **SMT:** Structured Meme Theory, which defines nonlinearly structured memories, including Perceptual, Behavior, Motion, Relation, and Word MultiDimensional Memory Frames for spreading activation from PMD (from sensor), WMD (top-down), or MMD (bottom-up)
  - **Autopoiesis:** The endless Perceptual-Cognitive-Motor cycle that continues from his or her birth to death in the ecological system has to be realized as a periodic circulation system over generations (H. Maturana & F. Varela).

❖ **Experimental Methodology: CCE** (Cognitive Chrono-Ethnography)
- *Understanding people's behavior by constructing a model that can explain active memes when it was observed and their developmental processes.*
- *The THEORY is applied to identify the eliciting conditions for active memes in a given circumstance and a given people.*

The purpose of MHP/RT

❖ Predecessor: MHP (Model Human Processor)

- *MHP/RT is an extension of Model Human Processor (MHP) developed by Card, Moran and Newell in 1983.*

- *MHP is a cognitive architecture to simulate users interacting with then-available information devices, such as The Star Workstation, officially named Xerox 8010 Information System.*

❖ MHP/RT adds realtime constraints to MHP

- *MHP/RT aims at simulating users who interact with <u>richer in contents</u> and <u>more dynamic</u> modern information environment, such as multimodal interaction environment.*

- *Extension of MHP is done by defining a PDP system that connects perception and motion by utilizing autonomous memory system equipped with layered structure — cf. Act-R, SOAR*

Four Processing Modes (Relative to Event)

❖ Use of Memory (Before Event):

- **_System 2 Before Mode:_** *MHP/RT <u>consciously</u> uses memory before the event for anticipating the future event which takes relatively long time.*

- **_System 1 Before Mode:_** *MHP/RT <u>unconsciously</u> uses memory just before the event, say 100 milli seconds before the event for automatic preparation for the future event.*

❖ Modification of Memory (After Event):

- **_System 1 After Mode:_** *MHP/RT <u>unconsciously</u> tunes the current network connections related to the past event for better performance for the same event in the future.*

- **_System 2 After Mode:_** *MHP/RT <u>consciously</u> reflects on the past event resulting in structural changes in memory.*

CCE: Cognitive Chrono-Ethnography

- Daily behavior is the outcome of a non-linear system as modeled by cognitive architecture, MHP/RT, suggests that we need an ethnographical approach since SEDIC (SEnsitive Dependence on Initial Condition) is the primary feature of such a non-linear system.

- The results of MHP/RT simulation provide a basis for selecting who to observe ethnographically in the real world focusing on "as-is" and "the process leading to the present" along the time dimension (chronology).

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Three Types of CCE

* **Type 1:** Happiness goals mostly determine how people behave
    - *Sightseeing at a hot spring resort, Watching baseball at the stadium*

* **Type 2:** For a given happiness goal, conscious and unconscious processes *before* an event shapes how people behave in the given environment
    - *e.g., indoor wayfinding (slow self-paced navigation), driving a car using external information (fast externally-paced navigation)*

* **Type 3:** For a given happiness goal, conscious and unconscious processes *before* and *after* an event shapes how people behave in the given environment, focusing on weak synchronization
    - *e.g., appreciation of the cinema (VR)*

Finished and On-Going CCE Studies

❖ Finished CCE Studies (Type I)

- *Spectators behavior of professional baseball games*
- *Sightseeing in a hot spring resort*

❖ Finished CCE Studies (Type II)

- *Navigation (slow) : Navigation in a train station by following signs*
- *Navigation (fast) : Information necessary for safe and enjoyable driving for drivers while driving*

❖ On-Going CCE Studies (Type III)

- *Designing Memorable Events*
  ‣ Preliminary experiments were conducted to see how omnidirectional movies in virtual reality augmented with audio-guide made the experience memorable by timely provision of multi-modal information as designed by MHP/RT.
- *Designing Immersive Events*
  ‣ CCE studies will continue in the context of developing a multimodal interface to help young pedestrians acquire necessary skills for safe navigation in dangerous traffic environments.

Main References

* Kitajima, M. and Toyota, M., "Decision-making and action selection in Two Minds: An analysis based on Model Human Processor with Realtime Constraints (MHP/RT)," *Biologically Inspired Cognitive Architectures*, **5**, 2013, 82–93.

* Kitajima, M., and Toyota, M., "Simulating navigation behaviour based on the architecture model Model Human Processor with Real-Time Constraints (MHP/RT)," *Behaviour & Information Technology*, **31**(1), 2012, 41–58.

* Kitajima, M., Tahira, H., Takahashi, S., & Midorikawa, T. (2012). Understanding tourist's in situ behavior: a Cognitive Chrono-Ethnography study of visitors to a hot spring resort. *Journal of Quality Assurance in Hospitality and Tourism*, **12**, 247–270.

* Kitajima M., Akamatsu M., Maruyama Y., Kuroda K., Katou K., Kitazaki S., Minowa Y., Inagaki K., Kajikawa T., "Information for Helping Drivers Achieve Safe and Enjoyable Driving: An On-Road Observational Study", *Proceedings of the Human Factors and Ergonomics Society 53rd Annual Meeting 2009*, Santa Monica, CA, Human Factors and Ergonomics Society, 1801–1805, 2009.

Thanks Muneo!

Great Thanks!

Applauds for all our panelists and Thank You so much for sharing your
individual and institutional cognitive angles, work and views on the future directions of cognition and the puzzle
we have to lay together!

This is unique, when we can gather like this where we represent work on 'cognition' puzzle pieces from all corners of the world!

Truly Beautiful!

Thanks again.

Panel Cognitive Puzzle(s) Quo Vadis?

In a 'normal' conference panel setting we would now open up for questions from all congress and conference attendees.

This year 2020 is different due the Corona Virus Pandemic situation which results in remote participation of almost all of us.

Great Thanks!
Take Care, Stay Safe and Hope to see you Next Year 2021!

If any interest to reply please contact either
Petre or Charlotte
or any of our panellists.

Panel Cognitive Puzzle(s) Quo Vadis?

Au Revoir!   *Au Revoir!*

Panel

Cognitive Puzzle(s)
Quo Vadis?

(Machine Learning, Deep Cognition, Cognitive Decisions, Deep-Mind, Empathy, Social Emotion, etc.)