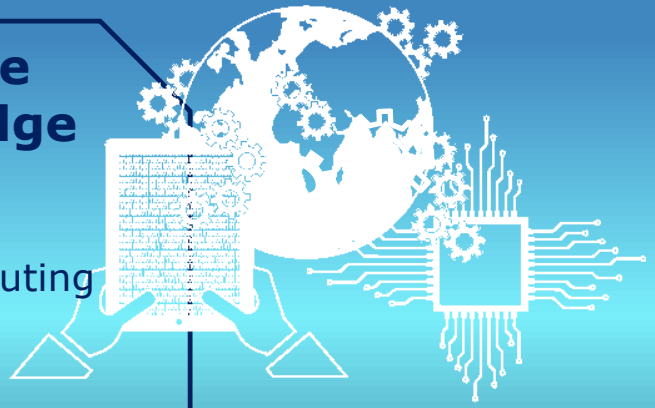
On the deep nature of human knowledge (part II): Physical information, knowledge and language

- a day in the life beyond the brain
- linear information spaces and simplified quantum computing

Gerhard Luhn, PhD, SYSTEMA GmbH
Germar Schneider, PhD, Infineon Technologies Dresden
Gerald Hüther, PhD, Academy for the Exploration of Human Potentials

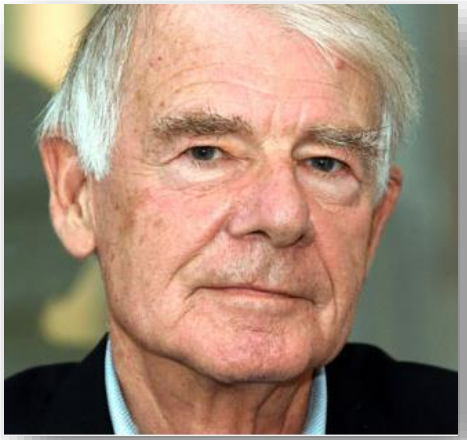


The project iDev40 is co-funded by the ECSEL Joint Undertaking, grants from Austria, Belgium, Germany and Spain as well as the European Structural and Investment Funds. It is coordinated by Infineon Technologies Austria AG.

ECSEL JU

iDev40

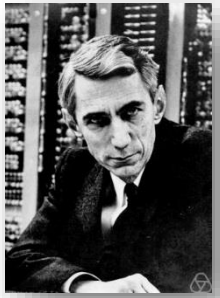
1. On information and imagination
2. “Unproven statements” (new phenomena)
3. Oscillating mind-body system (OMB), challenges for DNN’s
4. Holistic information and linear (simplified quantum) computing
5. Conclusions



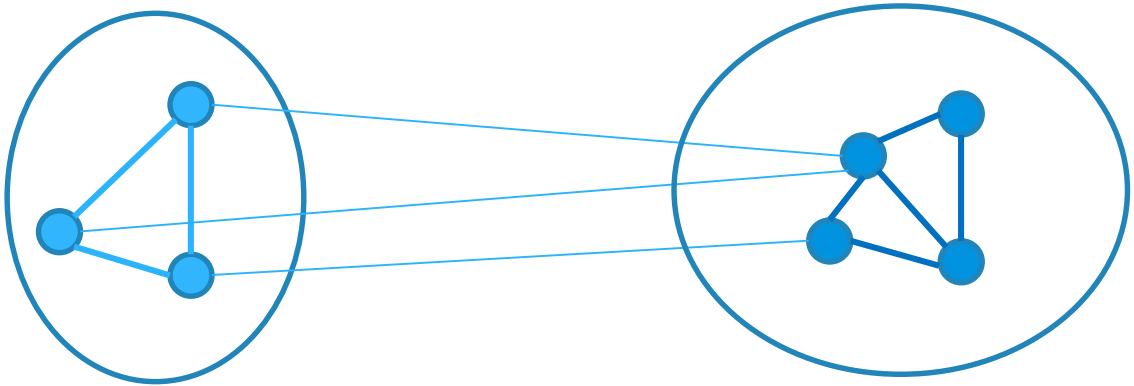
Wolf Singer, German neuroscientist (2013):

- **The brain is by no means a stimulus driven, but a self-active system.**

1. On information and imagination



Claude Shannon
(1916 – 2001)
American
mathematician,
engineer



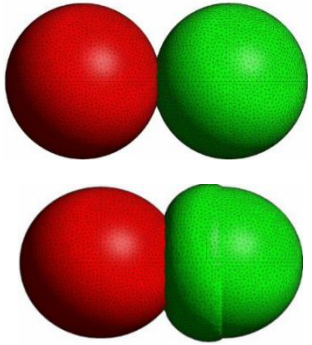
states system 1: n

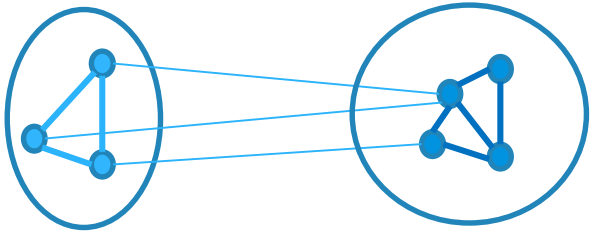
states system 2: m

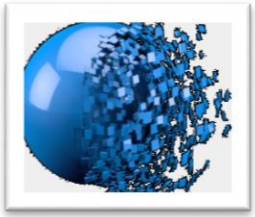
total states < n * m

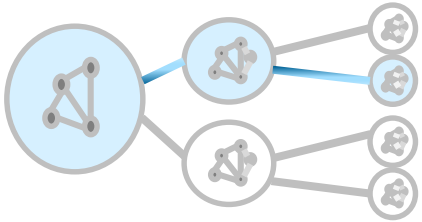
Carlo Rovelli
(* 1956),
Italian
physicist

Information = (structural coupling)law + potentiality









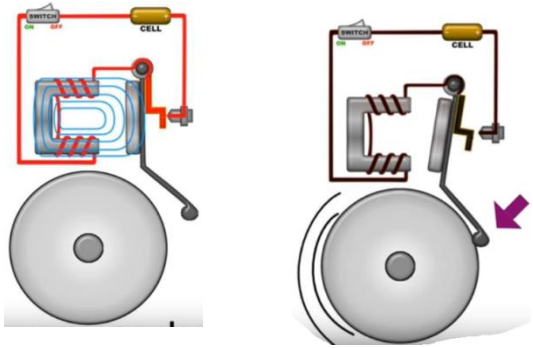
new phenomena might appear (‚realisation' of imaginary-valued system states)

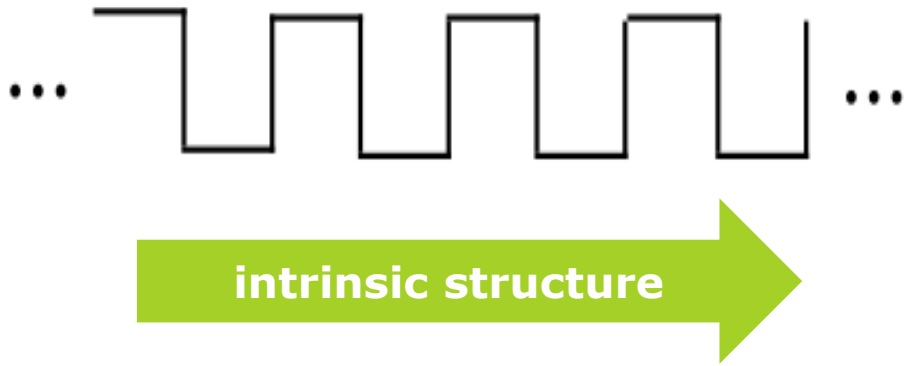
- **Information is relative**
- **Information is a function**

(world of physics, chemistry) -> quantitative equations, total reduction

$y = f(x)$

$y = f(x_n)$

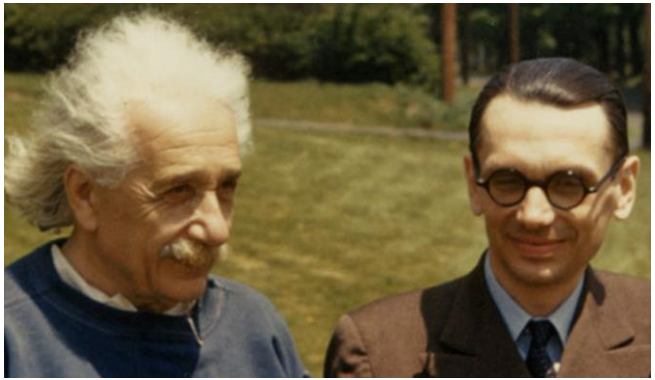




(world of biology) -> qualitative equations, reduction to domains

$y = y_{n+1} = f(x_n)$

2. “Unproven statements” (new phenomena)



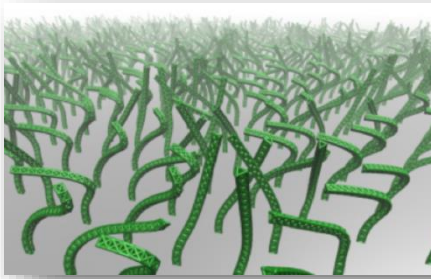
Kurt Gödel (1906 – 1978) Austrian-American mathematician

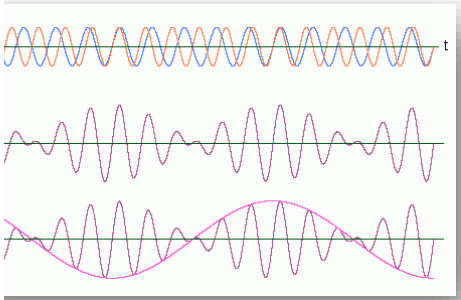
George Spencer Brown (1923 – 2016), British mathematician

- **Information is recursive; the “meaning-marker” oscillates**

Birth of the self:

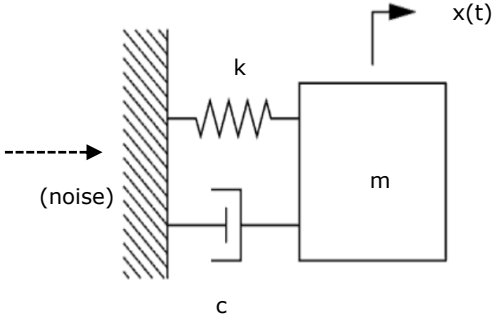
- Surfing on waves
- Self measuring
- Collapsing in “unproven statements”

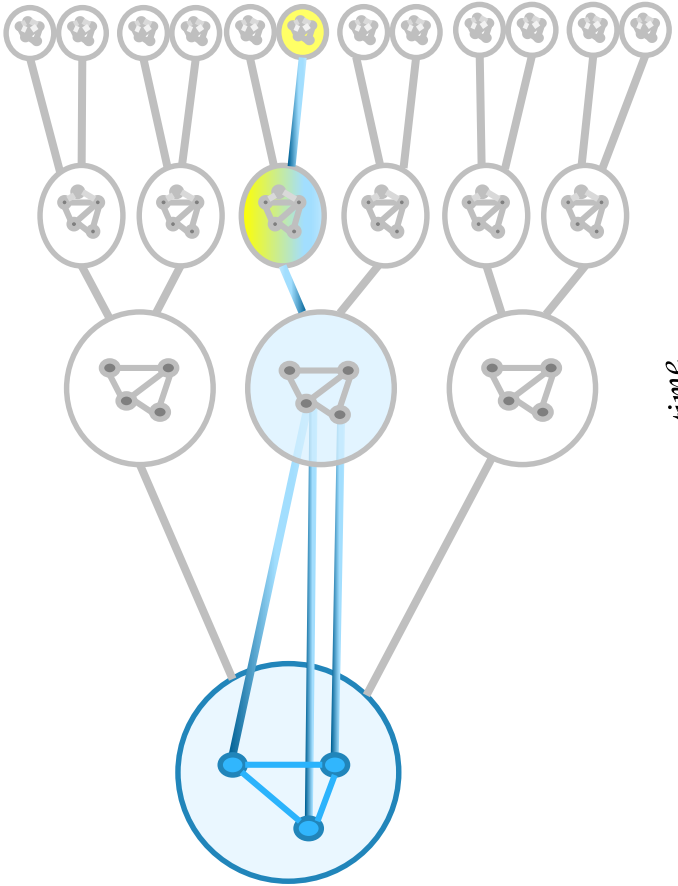


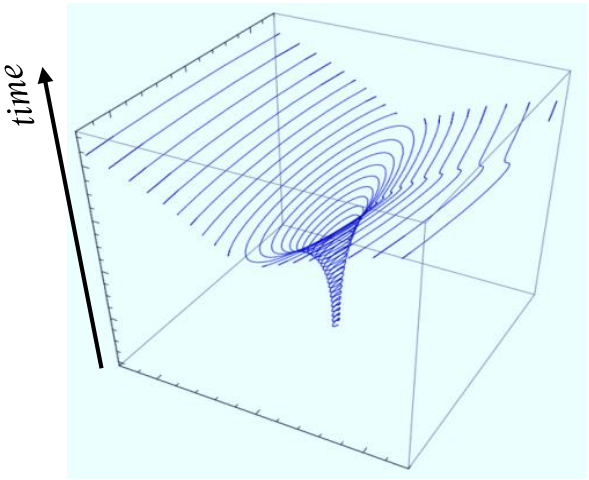


https://www.ingenieur.de/technik/forschung/computersimulation-lueftet-geheimnis-pantoffeltierchen/

Robert B. Laughlin: Critical waves and the length problem of biology, 2015
PNAS, August 18, 2015, vol. 112, no. 33, 10371–10376

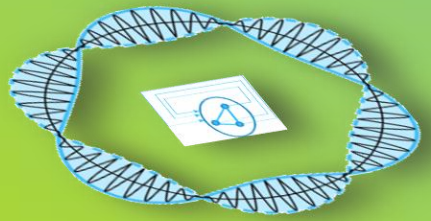






Physically damped, oscillating system:

- Energy gets pumped into the system
- Imaginary valued damping (‘impedance’), fed by imaginary target structure (emerging physical fields)



“Self active system”:

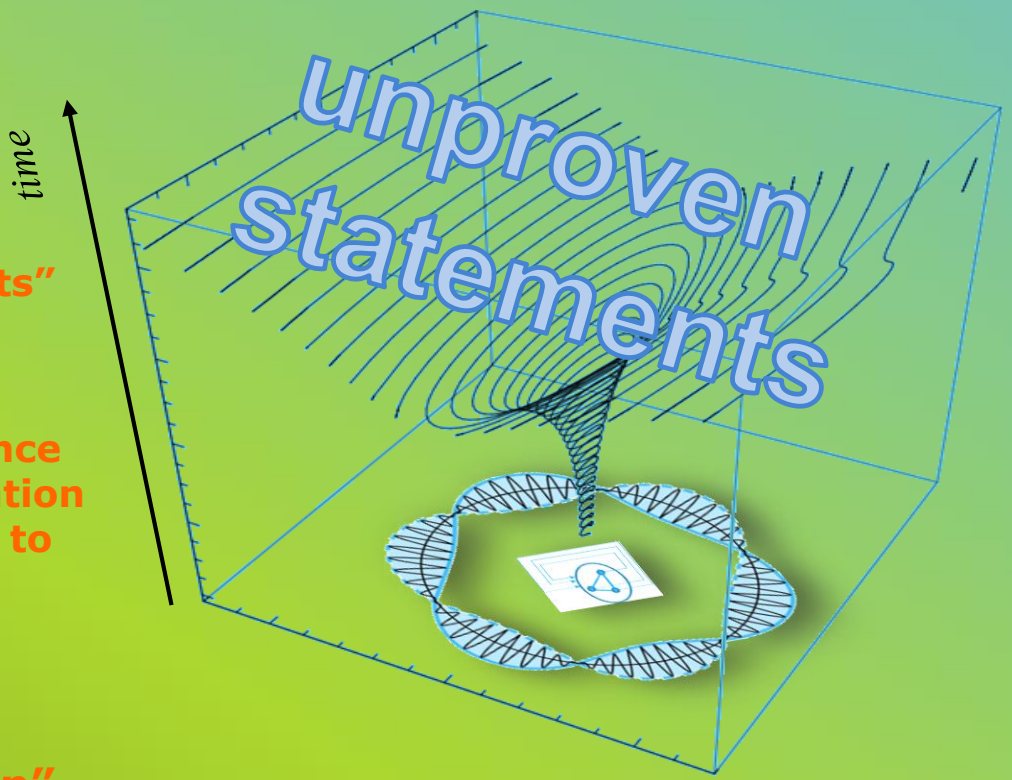
1. Information: Structural Self-coupling

2. Imaginary dimension: Eigenvalues / imaginary roots -> “unproven statements” via “meaning-marker”

3. biological systems are predominately related to their history, and the emergence of structural coupling: continuous formation of several levels of organization (Poised to criticality)

4. Ontological Perceptiveness / “unique law” of biological systems

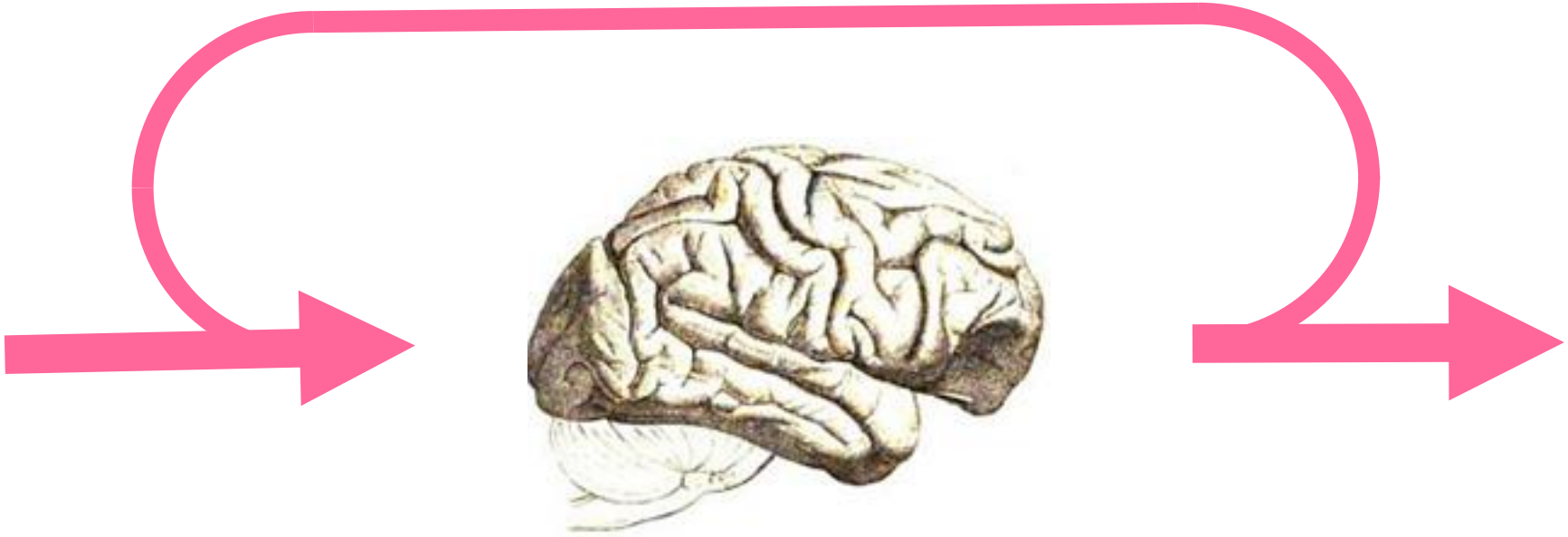
->What we perceive as “information” is the tendency of nature to “complete” itself



Longo, G.; Montévil, M.; Pocheville, A. (2012): From bottom-up approaches to levels of organization and extended critical transitions. In: Frontiers in PHYSIOLOGY. published: 17 July 2012, doi: 10.3389/fphys.2012.00232

Damasio, Antonio: The Strange Order of Things: Life, Feeling, and the Making of Culture, Pantheon 2018

3. Oscillating mind-body system, challenges for DNN's



chimp

http://www.scienceupdate.com/files/2012/10/ManchimpbrainsGervais-Paul-1816-1879-1854.png

Clive Wearing – phenomenological richness of episodes / knowledge

Clive Wearing conducting a choir seven months before his illness.

herpes simplex virus, most severe cases of amnesia

semantic / music memory works (recall condition)

He lost his orientation in time (losing the capability to create new competences, or even to maintain existing ones).

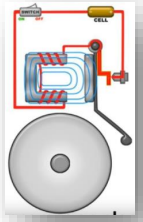
his conscious experience is entirely in the present (Suddendorf et.al. 2009).

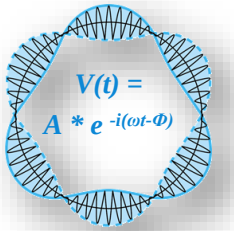
phenomenological richness of imagined events as well as the number of such events decreases.

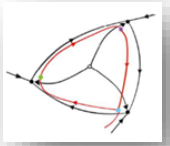
Clive Wearing cannot imagine future or remember past episodes, not to speak about creating further meaning of his life.

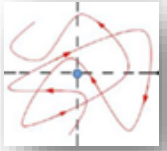
He has lost contact to higher dimensional phase spaces, which would require further structural development of the self.

How can musicians keep playing despite amnesia?
https://www.bbc.co.uk/news/magazine-15791973

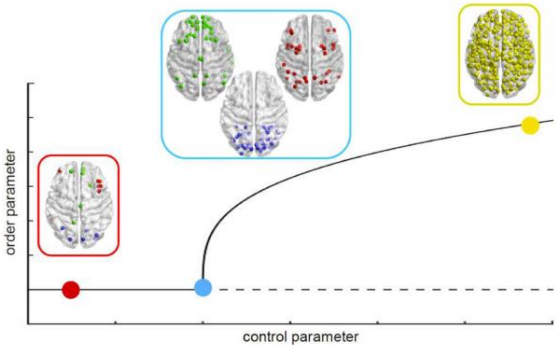


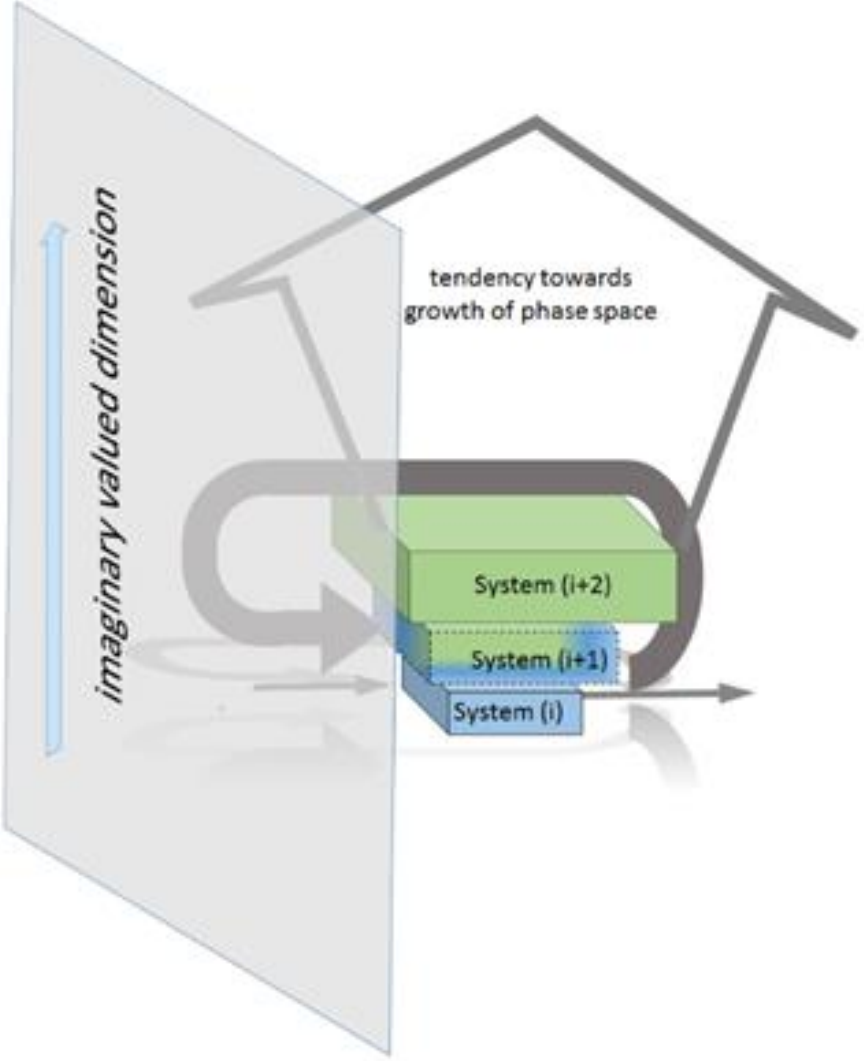






2nd law

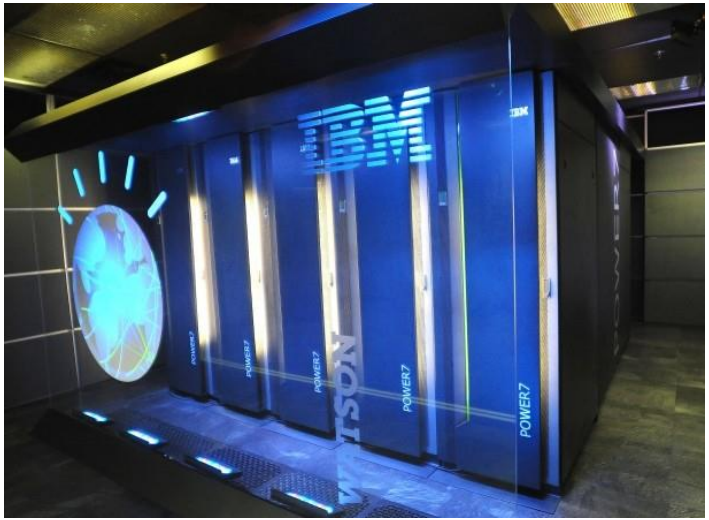




Luca Cocchi Leonardo L. Gollo, Andrew
brain: A synthesis of neurobiology, mode
https://arxiv.org/ftp/arxiv/papers/1707/17(

IBM AI System Watson does not meat expectations

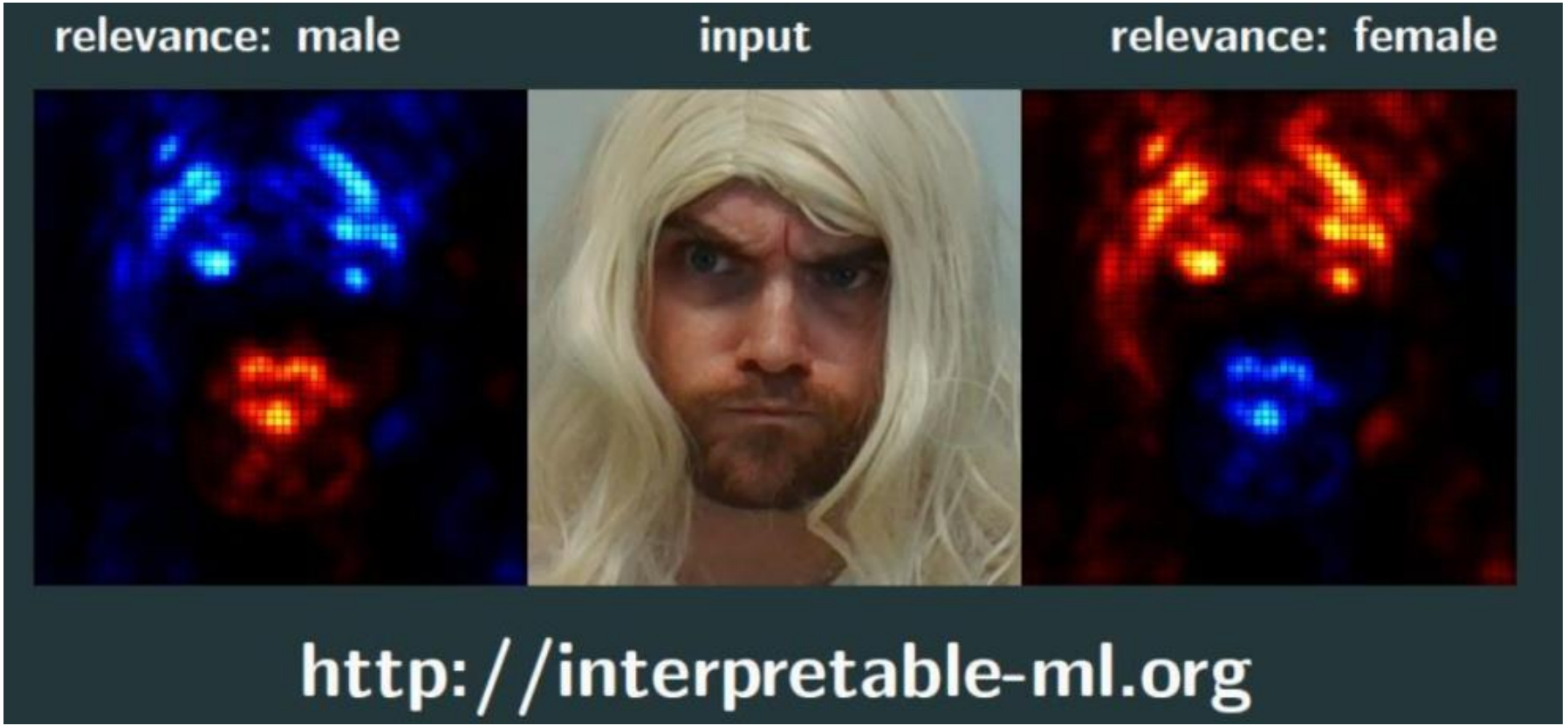
DKFZ Heidelberg



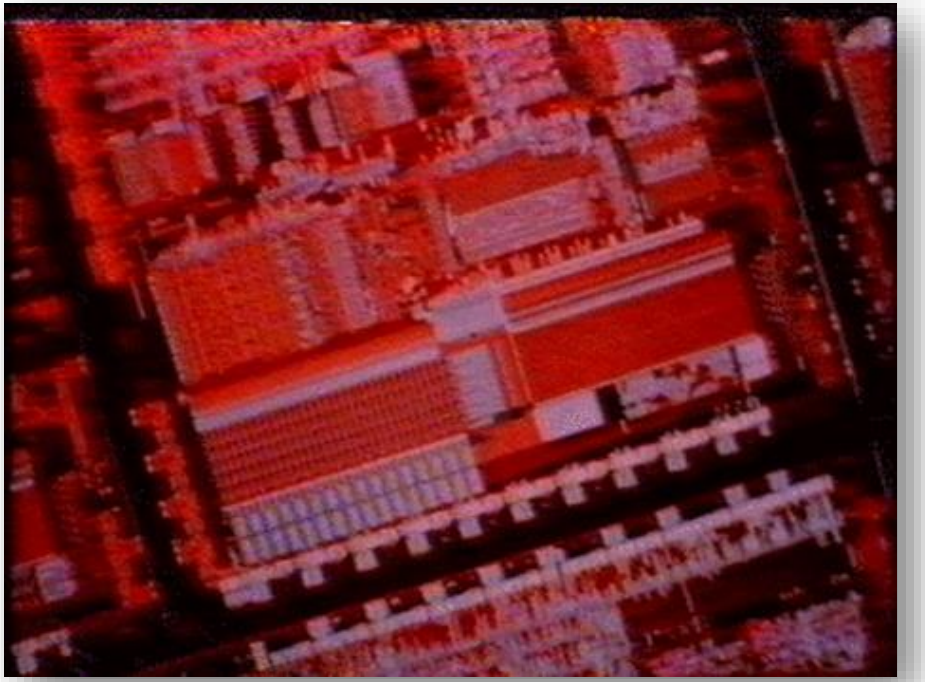
„The framework contract expired without money flowing to IBM.“ (Heidelberg, 2017)

http://www.faz.net/aktuell/wirtschaft/kuenstliche-intelligenz/computer-watson-scheitert-zu-oft-bei-datenanalyse-15619989.html

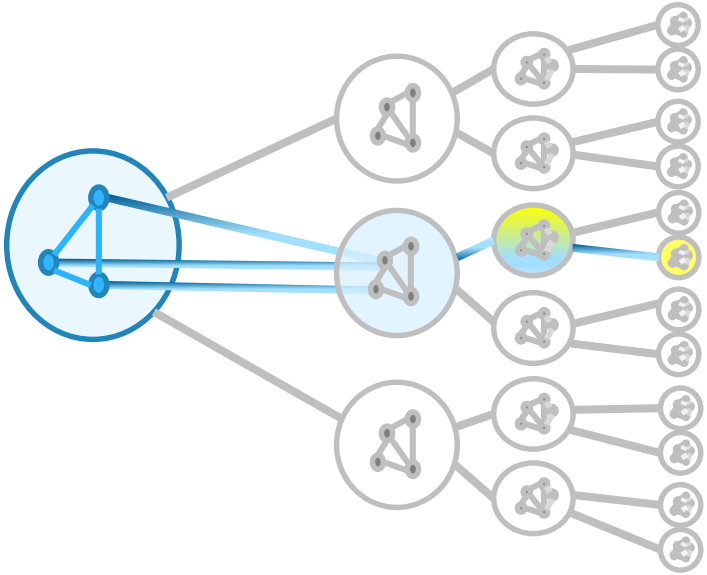
Layer-wise Relevance Propagation (LRP)

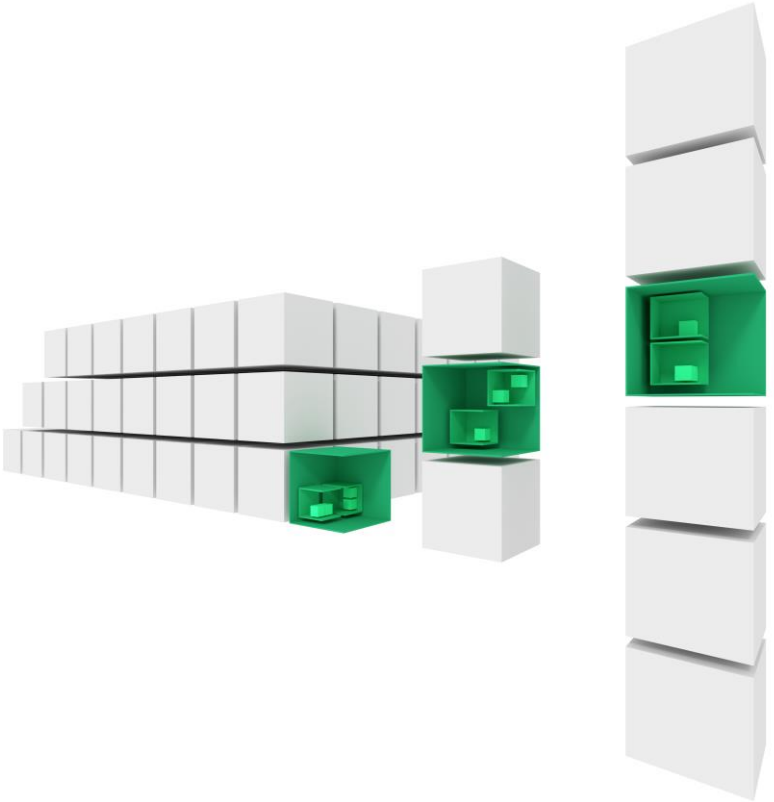


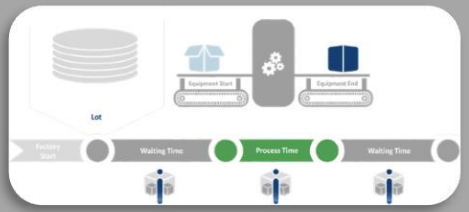
Mapping of knowledge between domains

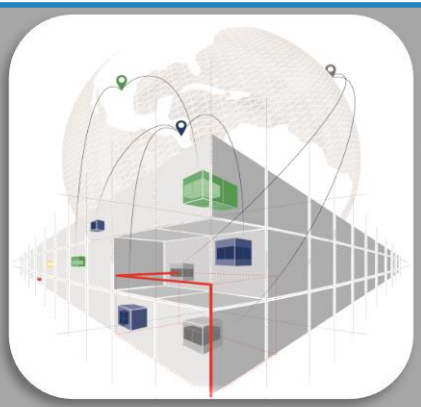


1. Holistic Information and linear (quantum-like) computing





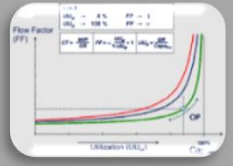


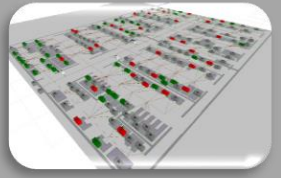


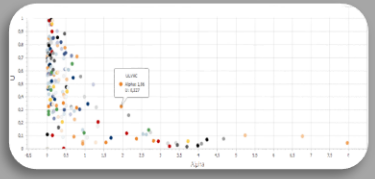
Complexity – comparison to quantum computing:

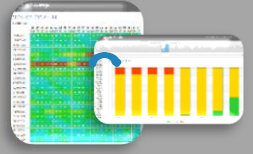
Classical:	Grover (Quantum):	HIM:
Write: O(n)	-	O(n)
Read : $O(n^2)$	$O(n*\sqrt{n})$	O(n)
	O(n)	

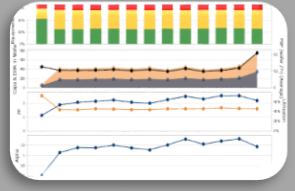
Advanced Fab Analytics



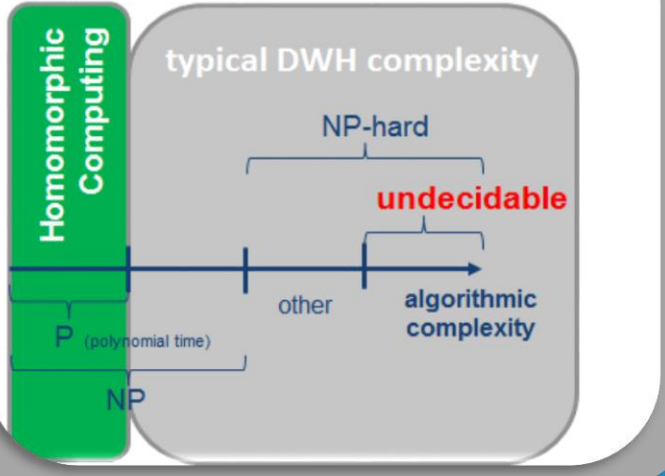




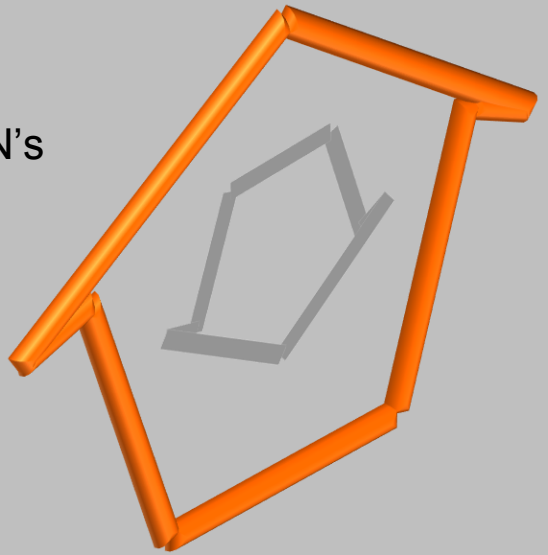




Algorithmic Complexity



- Information = (structural coupling)law + potentiality
- Information is relative – no “final truth”
- “Deep knowledge” composes of rich episodes and imagination of the future
- Methodological support required to enable success of DNN’s



<u>Summary:</u>

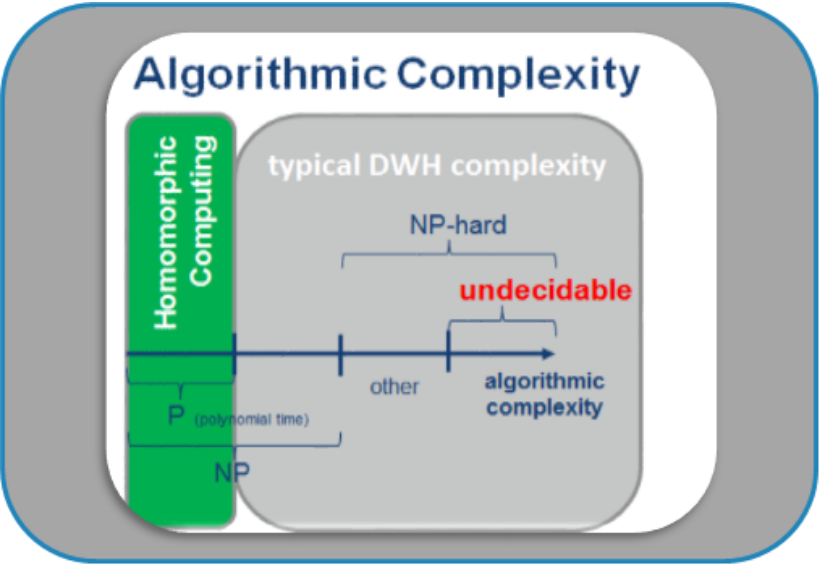
Engineering and also society demands comprehensive understanding and further development of AI / DNN’s

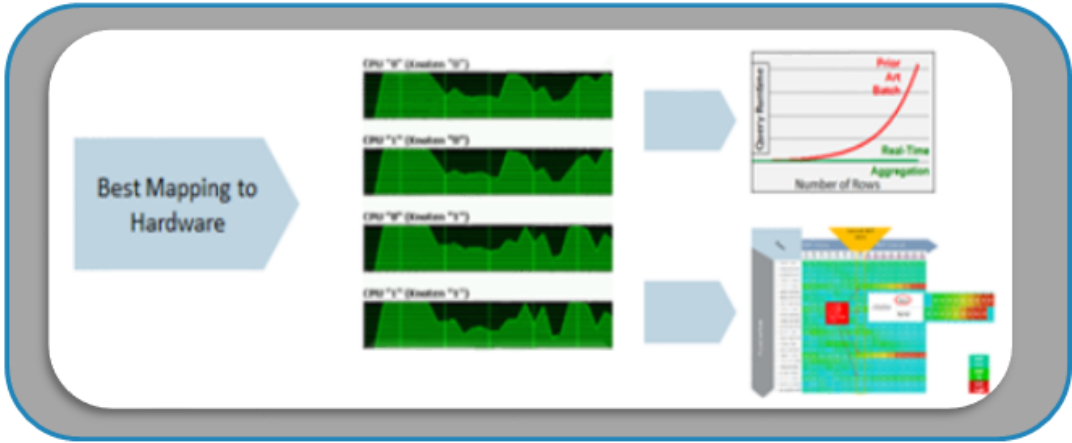
Upcoming ideas in physically inspired neuroscience

Thank You!

The project iDev40 is co-funded by the ECSEL Joint Undertaking, grants from Austria, Belgium, Germany and Spain as well as the European Structural and Investment Funds. It is coordinated by Infineon Technologies Austria AG.

Holistic Information and simplified linear (quantum-like) computing





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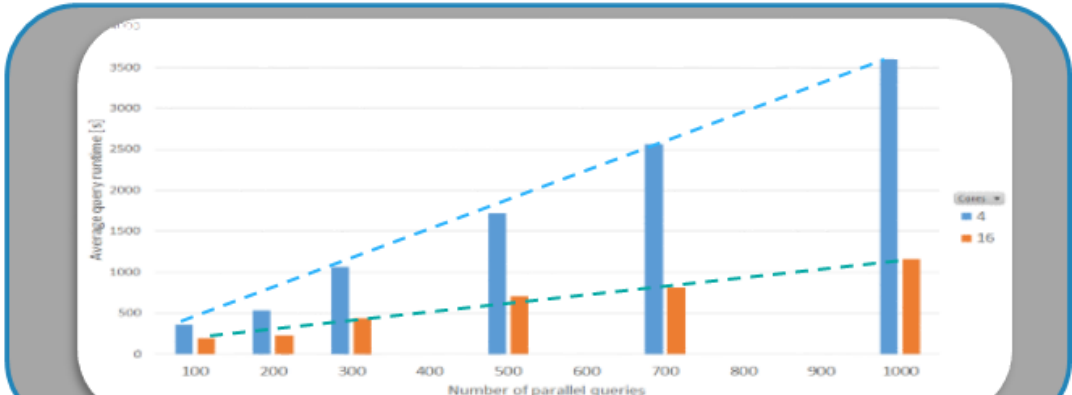
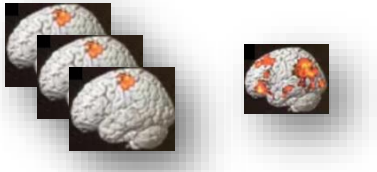
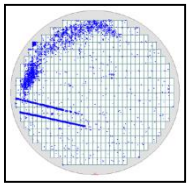
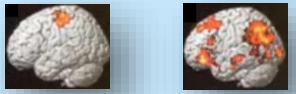
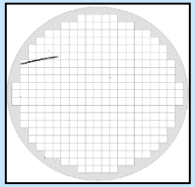
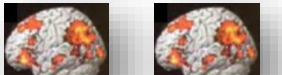
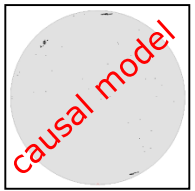
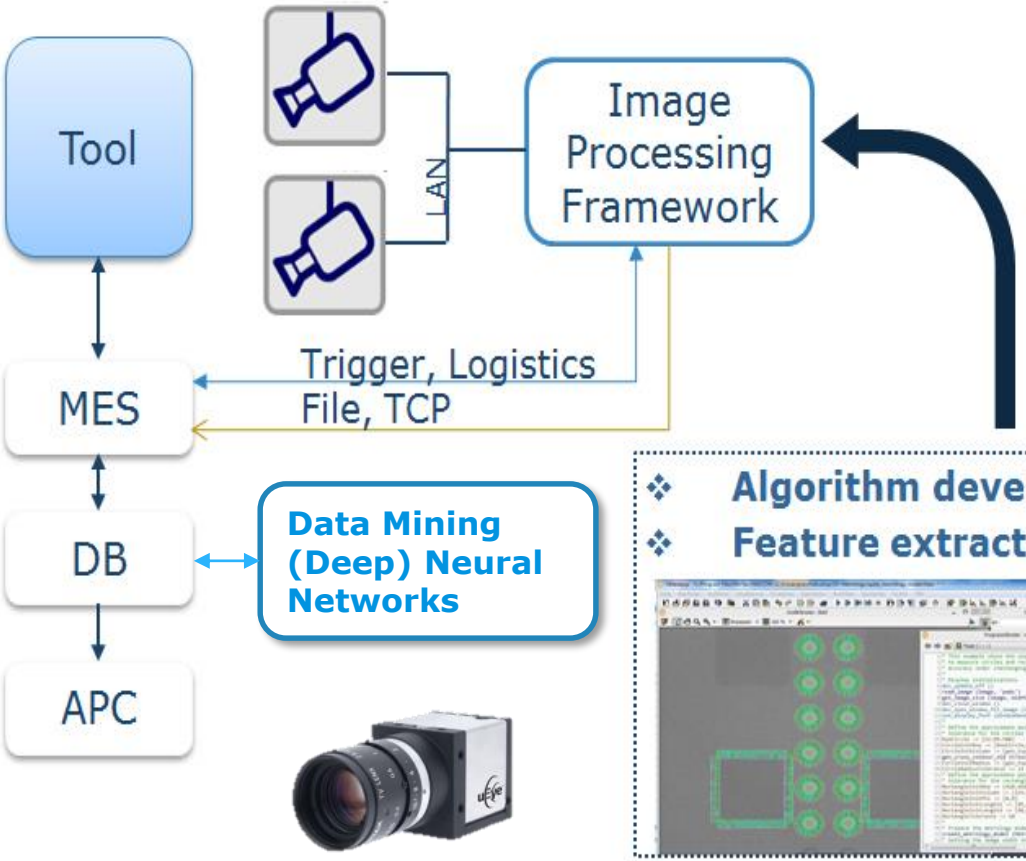
	O(n)	

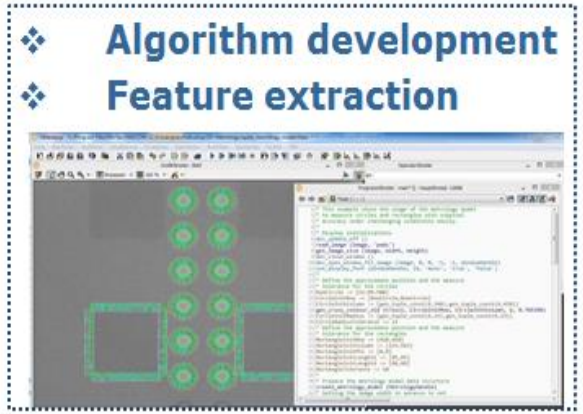


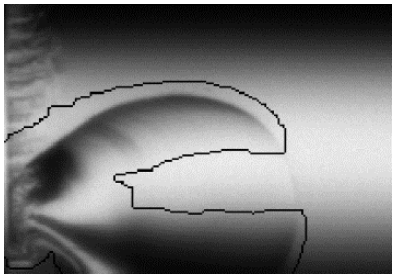
The change of DDE characteristics from the 90´s to > 2020

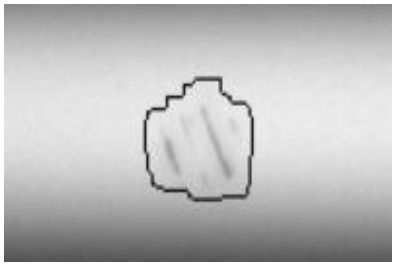
Year	Type of Control	Example for Defects	Cognitive
90´s	› Manual inspection by operator 	 big scratches Formula / Algorithm: $y = f(x)$	› No IT › Operator guided › Few engineering support
2000 - 2020	› Semi-automated inspection by microscope / SEM 	 small scratches Formula / Algorithm: $y = f(x) + f'(x)$	› Decision guided inspection › Demi-autonomous DDE inspection
> 2020	› Highly-automated inspection methods, including machine learning 	 fine spots Formula / Algorithm: $y = f(x) + f'(x) + f''(x)$	› Advanced engineering guided › Mostly autonomous DDE inspection › assistance systems

Defect engineering – substrate inspection



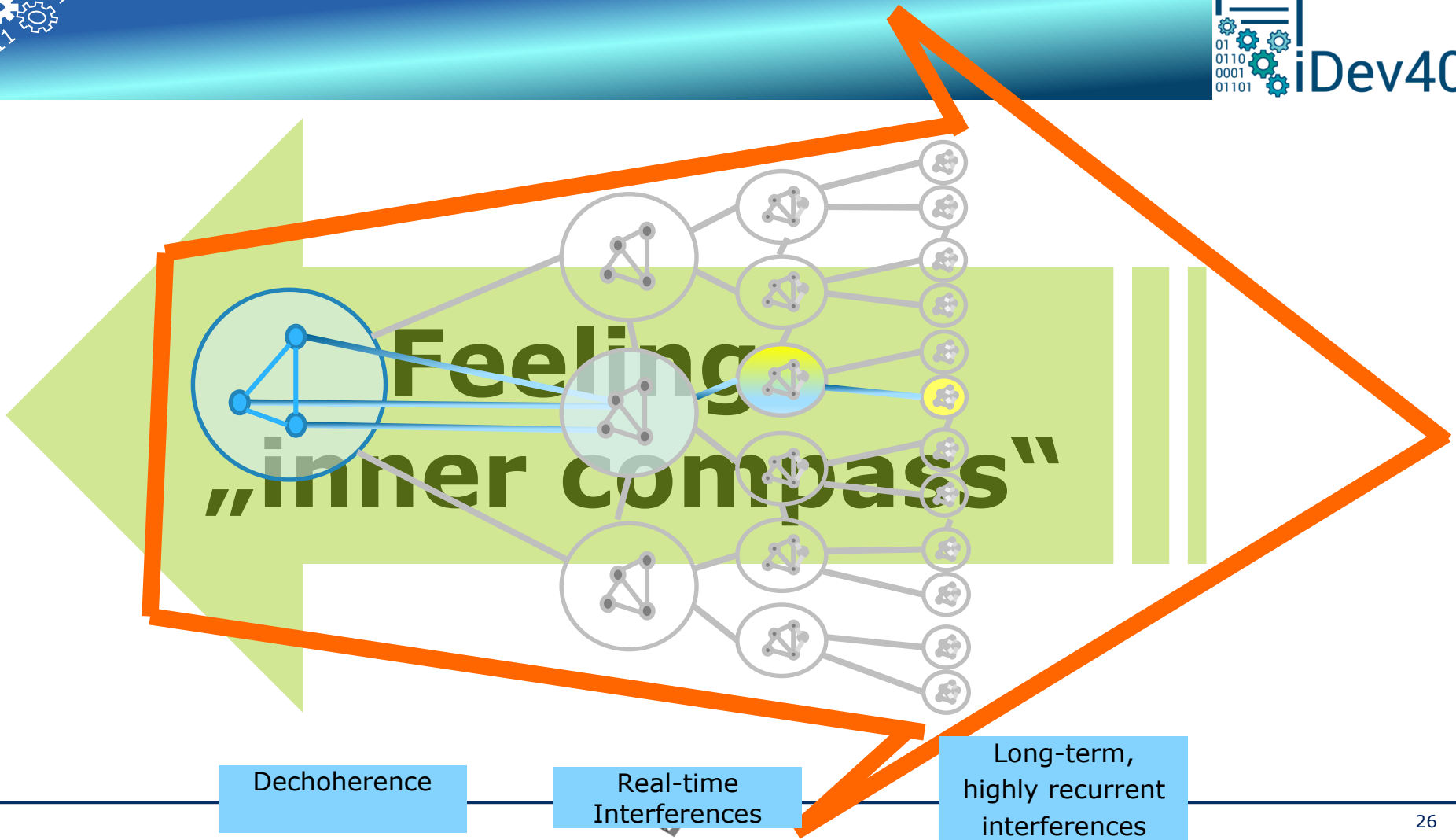


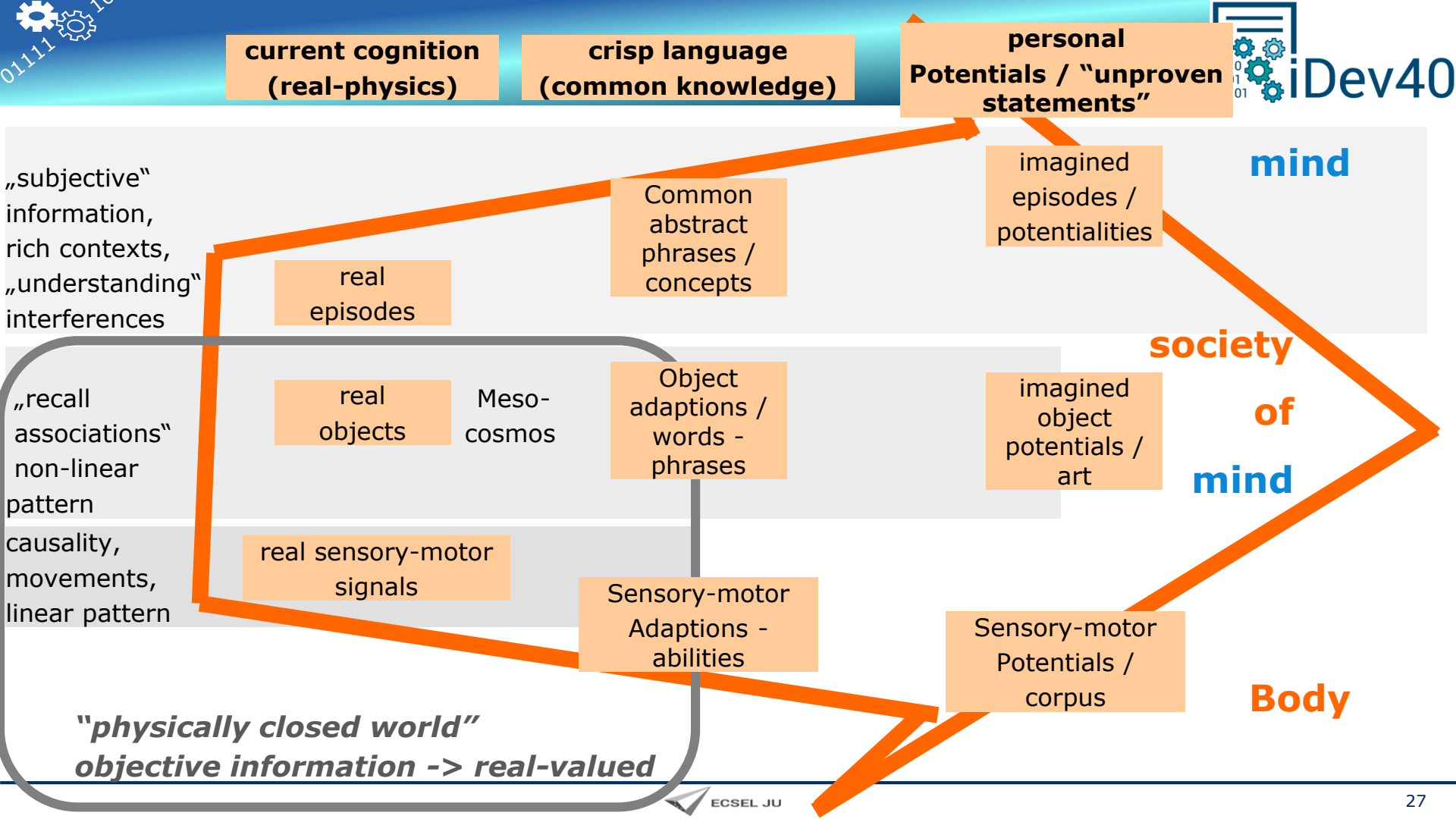




Tool connection & integration

examples of defects


Feeling
„inner compass"
Dechoherence
Real-time Interferences
Long-term, highly recurrent interferences


current cognition (real-physics)
crisp language (common knowledge)
personal Potentials / "unproven statements"
„subjective" information, rich contexts, „understanding" interferences
mind
imagined episodes / potentialities
Common abstract phrases / concepts
real episodes
society of mind
„recall associations" non-linear pattern
real objects
Meso-cosmos
Object adaptions / words - phrases
imagined object potentials / art
causality, movements, linear pattern
real sensory-motor signals
Sensory-motor Adaptions - abilities
Sensory-motor Potentials / corpus
Body
"physically closed world"
objective information -> real-valued