

Bio Inspired System Design

Some critique on data centric engineering

AI in Engineering

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Content

1. Problem
2. Why?
 - Intermezzo Cybernetics
3. 'New' direction
4. Engineered AI Projects
5. Minor A-Systems
 - For High Tech Agricultural Solutions
6. Conclusions

Problems Engineering

Is digital system design becoming too complex?

The 737 Max 8 had two deadly crashes in five months, and aut zeroing in on what went wrong. Plus: Everything you need to the plane.



BY KENT GERMAN | OCTOBER 19, 2019 12:19 PM PDT



'Nearly all' Intel chips have major security flaw

By Mike Moore August 08, 2019 Computing

Vulnerability affects nearly all Intel hardware, Bitdefender says.



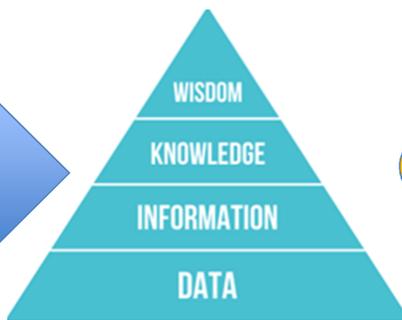
Dutch government IT projects are costing much more money and taking far longer than expected

Dutch government IT projects run €1bn over budget



Why?

What are we going to do with the *data*?
(What *info* → *knowledge* → *wisdom* do we want?)

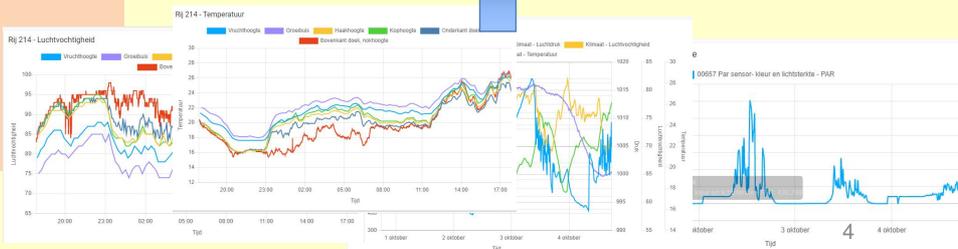


Data costs money !?

Problem:

We have lots of sensor data

- Humidity
- Temperature
- CO₂ ++
- Light
- ...



Digitalisierung gestalten mit dem Periodensystem der Künstlichen Intelligenz

(source: Bitkom study, 2018)

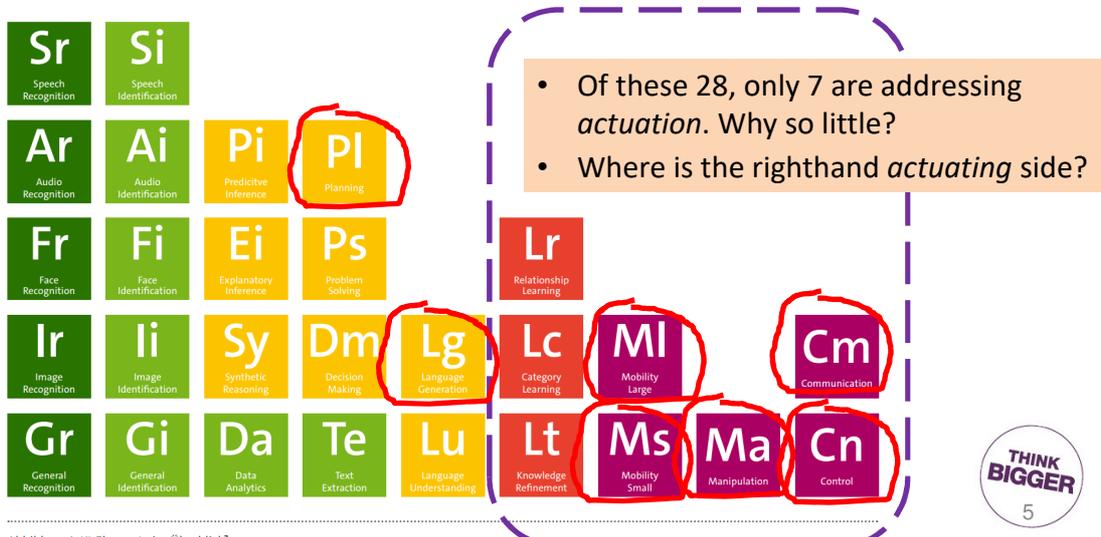


Abbildung 1: KI-Elemente im Überblick?

Intermezzo Cybernetics

(source: Inaugural talk prof David Abbink TUD 2019)

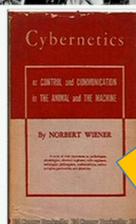
Problem
Behaviour of *Natural systems*, unlike *Informatics systems*, is inherently **indeterminate**. Hence, there is a need for regulatory systems to deal with it → **cybernetics**

Macy Conferences on Cybernetics (1946-1953)

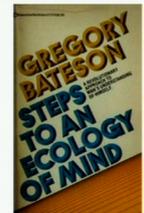
Norbert Wiener
mathematician

Goal: to discuss "Circular Causal and Feedback Mechanisms in Biological and Social Systems"

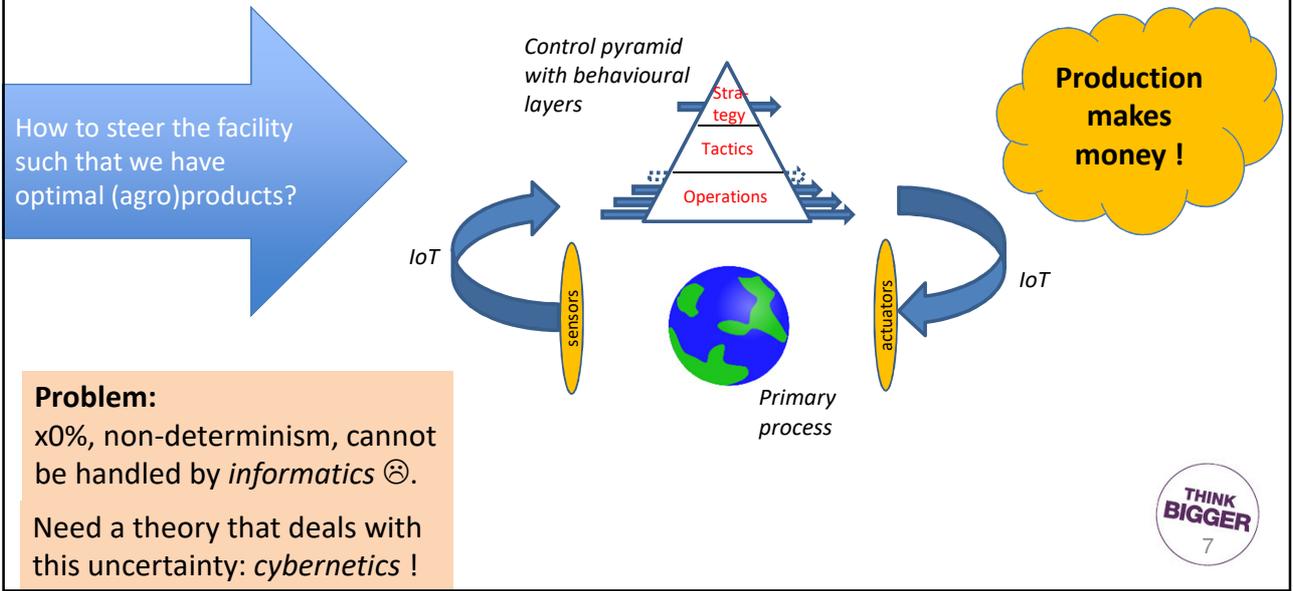
Gregory Bateson
anthropologist



Wiener's book "Cybernetics" (1948)
Or the Control and Communication in the Animal and the Machine

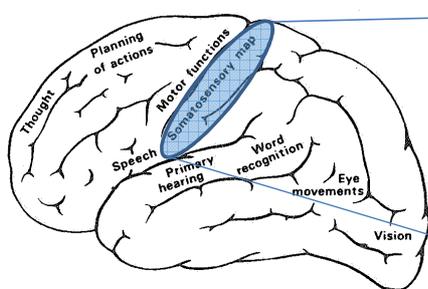


Stacking behaviours in control architecture (Embodied Intelligence)



Example: Bio Inspired Adaptivity (1/4) Self Organising Maps, a basic component for self-learned intelligence

biological plausibility of topological ordering
(Teuvo Kohonen, HUT Finland)



Fontys Fig. 2.7. Brain areas

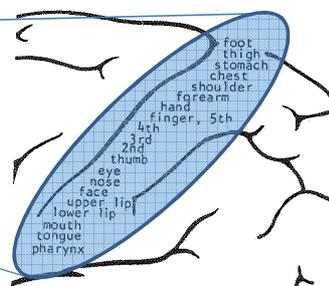


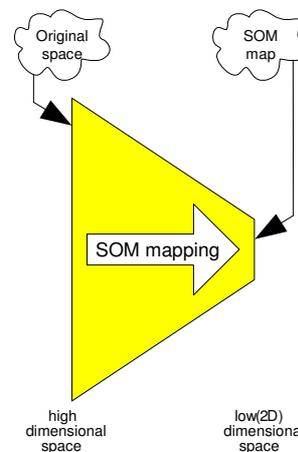
Fig. 2.8. The somatotopic map

THINK BIGGER
8

SOM background (2/4)

	small	medium	big	Two legs	Four legs	Hair	Hooves	Mane	Feathers	Hunt	Run	Fly	Swim
Dove	1	0	0	1	0	0	0	0	1	0	0	1	0
Hen	1	0	0	1	0	0	0	0	1	0	0	0	0
Duck	1	0	0	1	0	0	0	0	1	0	0	0	1
Goose	1	0	0	1	0	0	0	0	1	0	0	1	1
Owe	1	0	0	1	0	0	0	0	1	1	0	1	0
Hawk	1	0	0	1	0	0	0	0	1	1	0	1	0
Eagle	0	1	0	1	0	0	0	0	1	1	0	1	0
Fox	0	1	0	0	1	1	0	0	0	1	0	0	0
Dog	0	1	0	0	1	1	0	0	0	0	1	0	0
Wolf	0	1	0	0	1	1	0	1	0	1	1	0	0
Cat	1	0	0	0	1	1	0	0	0	1	0	0	0
Tiger	0	0	1	0	1	1	0	0	0	1	1	0	0
Lion	0	0	1	0	1	1	0	1	0	1	1	0	0
Horse	0	0	0	0	0	0	1	0	0	0	0	0	0
Zebra	0	0	0	0	0	0	1	0	0	0	0	0	0
Cow	0	0	0	0	0	0	1	0	0	0	0	0	0

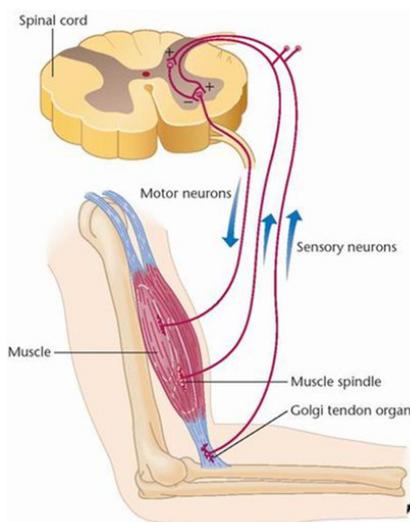
SOM training



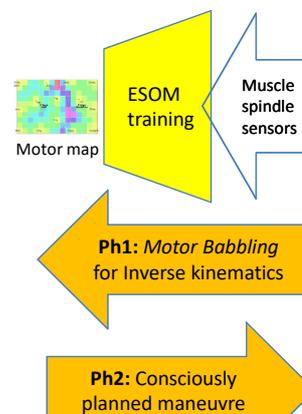
SOM background (3/4)

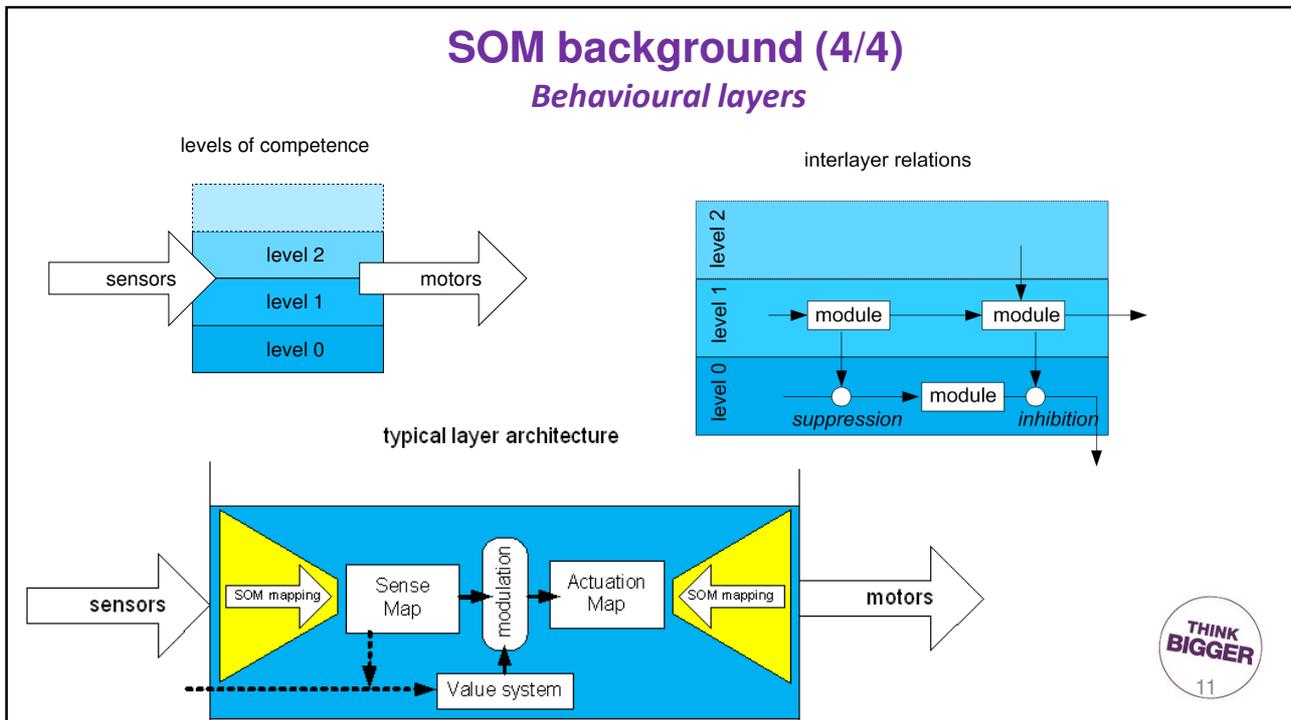
Proprioception

- All muscles have nerve fibers which detect the amount the muscle is stretched
- Joints have fibers which detect the relative position of each bone
- These allow you to determine the position of every part of your body.



Babbling baby





Engineered AI Projects (demos @ our stand)

- Digital Twinning:
 - Virtual Plant Modeling (VPM) for Deep Learned (DL) robots
 - Generic VPM for DL robots for harvest prediction (plant treatment)
- Scout by Learning
- Indoor navigation
- Nematods counting
- Talking Tomatoes
- Wild animal damage assessment
- Monitoring plant growth
- ...

Minor A-Systems: High tech agricultural solutions

Goal

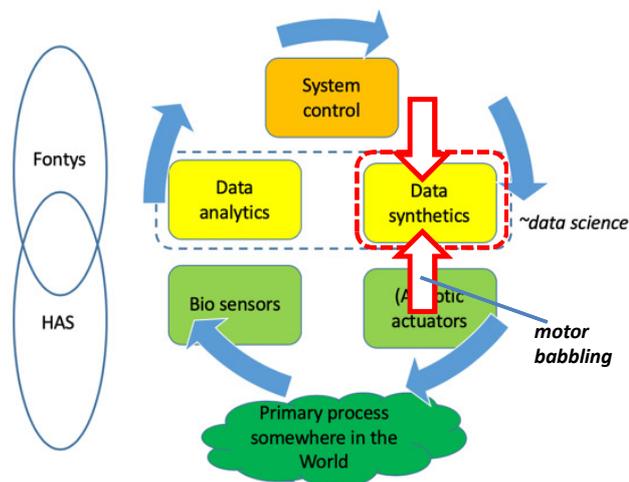
Educate HAS and Fontys students with balanced *knowledge* and *skill* sets

Synergy

- Cyclic: Cybernetic/System control
- Flow: Data science, analytics & synthetics
- Bio inspired tech: stimulates behavioural learning
 - E.g. motor babbling

Planning

- February 2020 1st roll out, 2/year
- Implemented in 5th & 6th & 7th semester



Conclusions

- Different goals: *Production optimisation* versus *Data* → *Wisdom*
- Nature is inherently indeterminate, meaning that *digitisation...*
 - partly has to be set up in a regulated way (*cybernetic cycle*)
 - partly can be set up in a determined way (*informatics flow*)
- Think synergetic:
 - Keep focus on primary process → close the control cycle
 - Data is a means → sensor driven *analytics* and actuator preparing *synthetics*
- Fontys Minor A-Systems educates in this synergetic mix (Feb2020)
- GreenTechLab offers challenging and inspiring arena
- Think in production terms:
 - process* is prime, *data* is (an important) means