

# 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 auto-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.

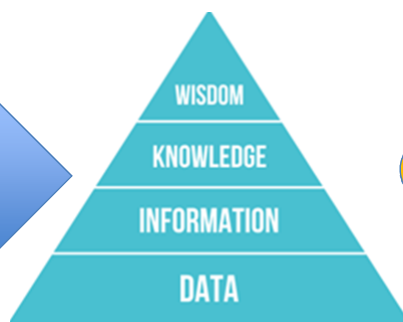


Dutch government IT projects run €1bn over budget  
Dutch government IT projects are costing much more money and taking far longer than expected

THINK BIGGER  
3

## Why?

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



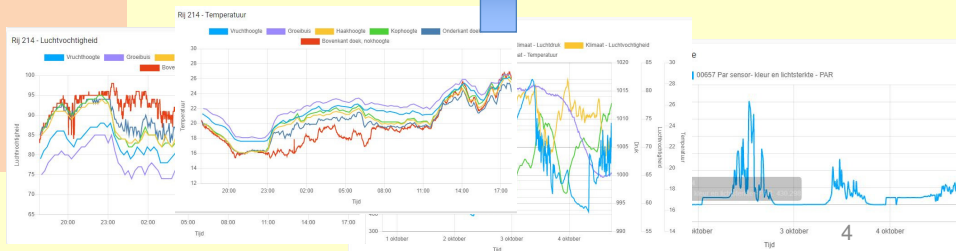
Data costs money !?

### Problem:

We have lots of sensor data

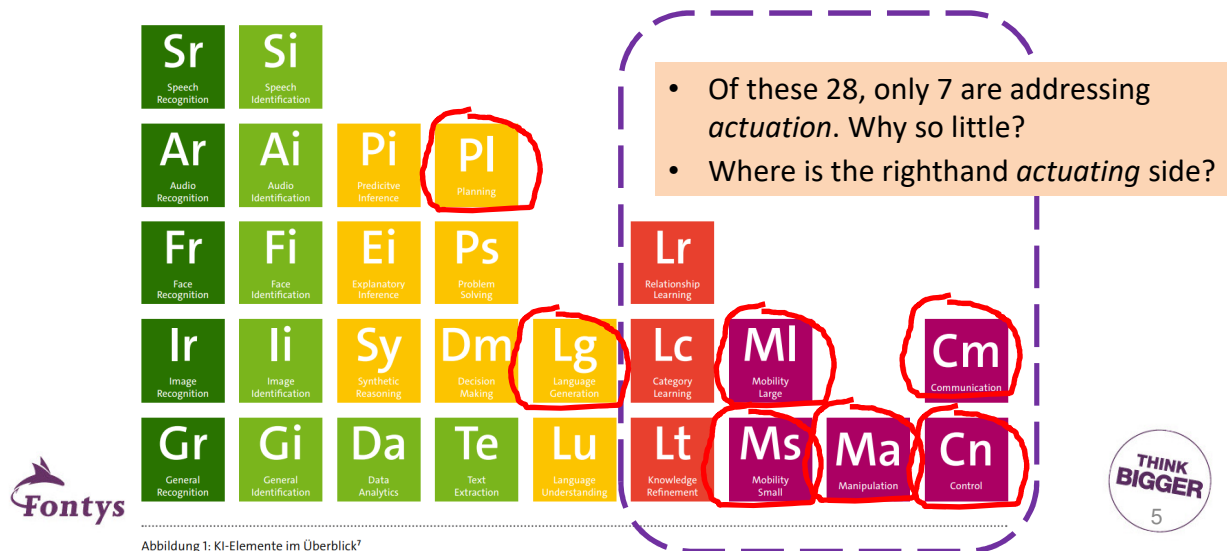
- Humidity
- Temperature
- CO<sub>2</sub> ++
- Light
- ...

Fontys UNIVERSITY OF APPLIED SCIENCES



# Digitalisierung gestalten mit dem Periodensystem der Künstlichen Intelligenz

(source: Bitkom study, 2018)



## 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**

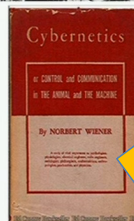
### Macy Conferences on Cybernetics (1946-1953)

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

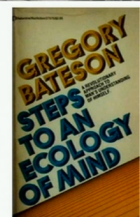
Norbert Wiener  
mathematician



Gregory Bateson  
anthropologist

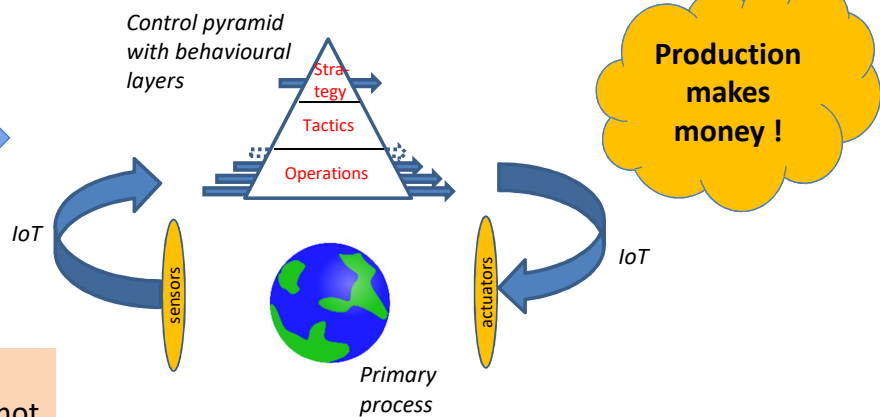


Wiener's book "Cybernetics" (1948)  
Or the Control and Communication in the Animal and the Machine



## Stacking behaviours in control architecture (Embodied Intelligence)

How to steer the facility such that we have optimal (agro)products?



THINK  
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7

## 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)*

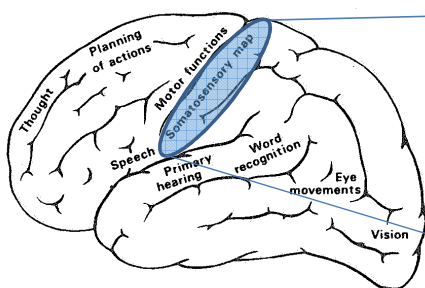


Fig. 2.7. Brain areas

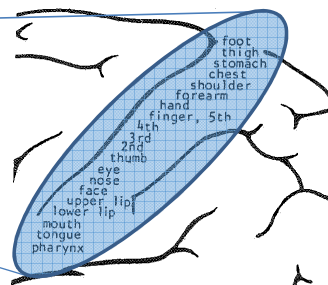


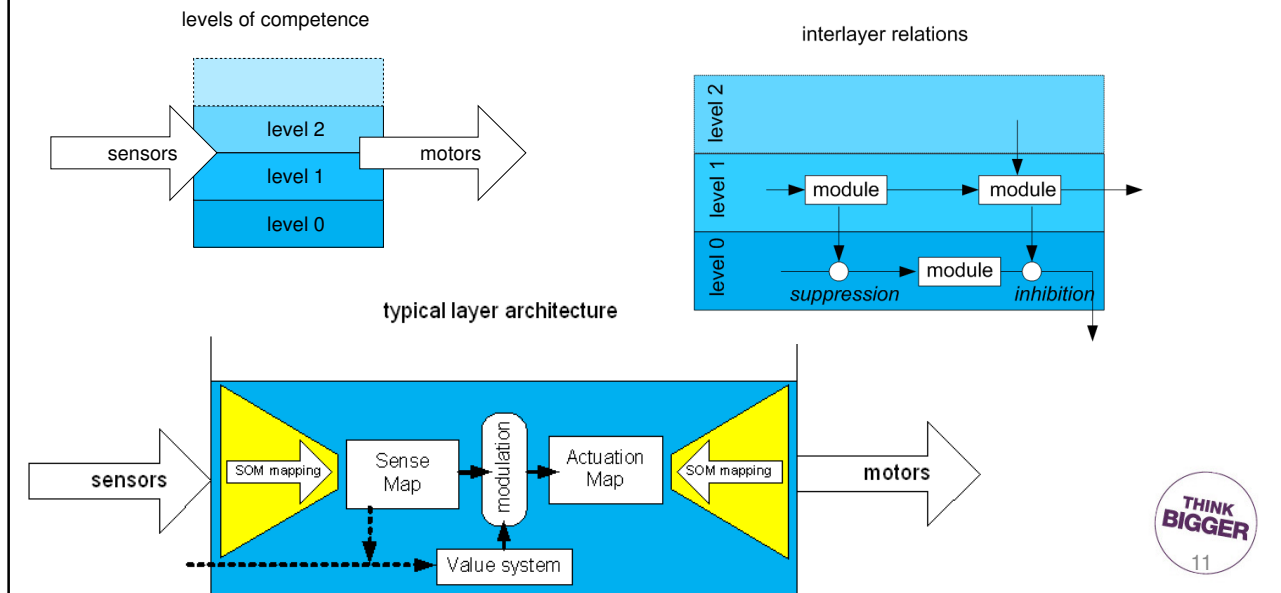
Fig. 2.8. The somatotopic map

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8



## SOM background (4/4)

### Behavioural layers



## 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

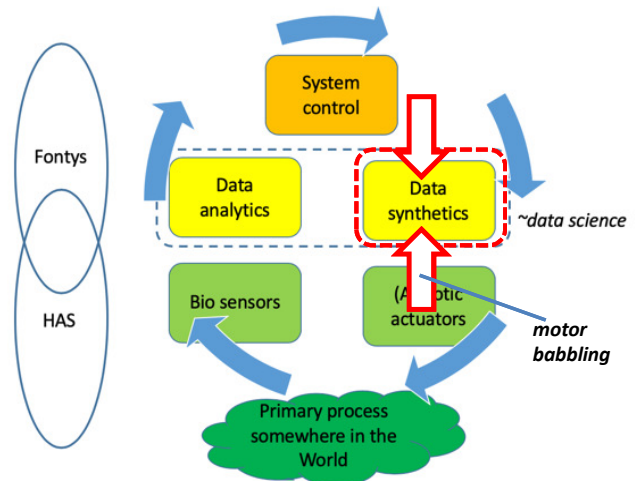
Educate HAS and Fontys students with balanced *knowledge* and *skill* sets

## 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 5<sup>th</sup> & 6<sup>th</sup> & 7<sup>th</sup> 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

