Combining Human and Artificial Intelligence

Swiss Safety Committee (SSC), Meeting 2024-1

Olten, 5.9.2024

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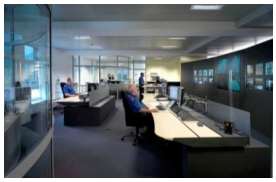
School of Applied Psychology

Institute Humans in Complex Systems (MikS)

– Analysis, evaluation and design of complex systems
  – Increased technical and organizational complexity
  – Individuals and groups confronted with such complexity

– Objectives
  – Increase the reliability and safety of sociotechnical systems
  – Healthy humans and organizations



Outline

- Intelligence
- Amazing abilities of machines
- Humans are different
- Amazing abilities of humans
- Outlook: Combining man and machine
  HORIZON-Project AI4REALNET

Intelligence

Intelligence:
Ability to learn from experience, solve problems and use knowledge to adapt to new situations.
(Myers, 2005, S. 460)

Artificial intelligence:
Replication of human intelligence within computer science.
(Wikipedia, 2023)

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Focus: Experts

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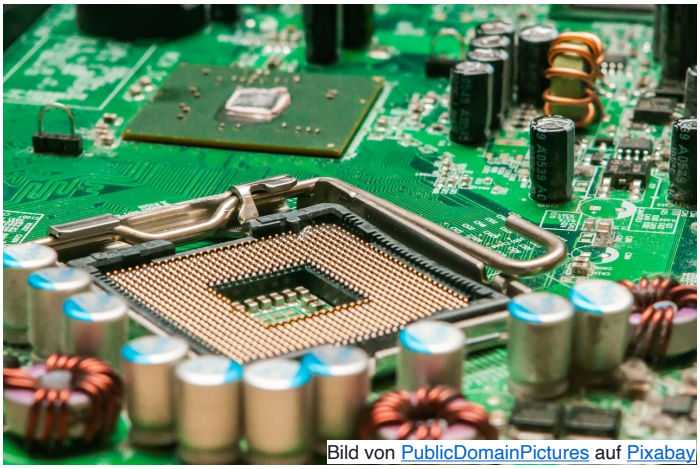
Enormous Increase in Hardware Performance

Performance doubles approximately every two years (cf. Moore's law)



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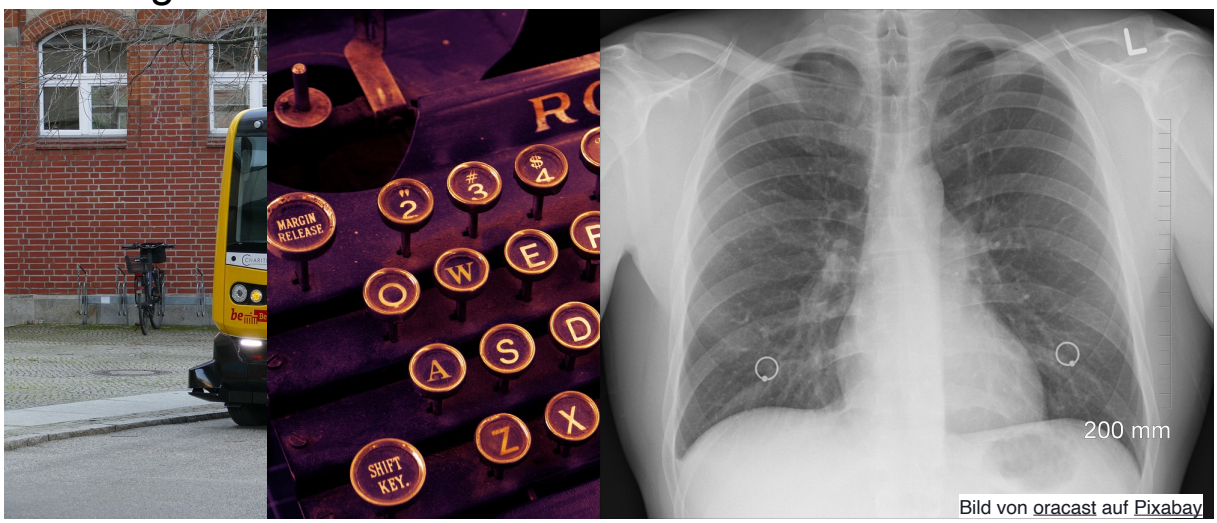
Amazing Abilities of Machines



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Humans are Different

Object recognition vs.
patterns in pixels

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Humans are Different

Object recognition vs. patterns in pixels

Understanding vs. data patterns

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Humans are Different

Object recognition vs. patterns in pixels

Understanding vs. data patterns

Value system (understanding of the world) vs. pursuit of goals?

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Humans are Different

- Object recognition vs. patterns in pixels
- Understanding vs. data patterns
- Value system (understanding of the world) vs. pursuit of goals?
- Empathy (Theory of Mind) vs. inability to put oneself in the other person's shoes

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Humans are Different

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- Understanding vs. data patterns
- Value system (understanding of the world) vs. pursuit of goals?
- Empathy (Theory of Mind) vs. inability to put oneself in the other person's shoes
- Taking responsibility vs. functioning

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Expertise I: Humans' Experience = Tacit Knowledge

Experts recognise patterns:
They can „read" situations

Often an unconscious process

Mostly tacit knowledge: not explainable

Prerequisite: Experience

- What is important about the situation?
- What needs to be taken into account?
- What needs to be done?

(Klein, 1993)

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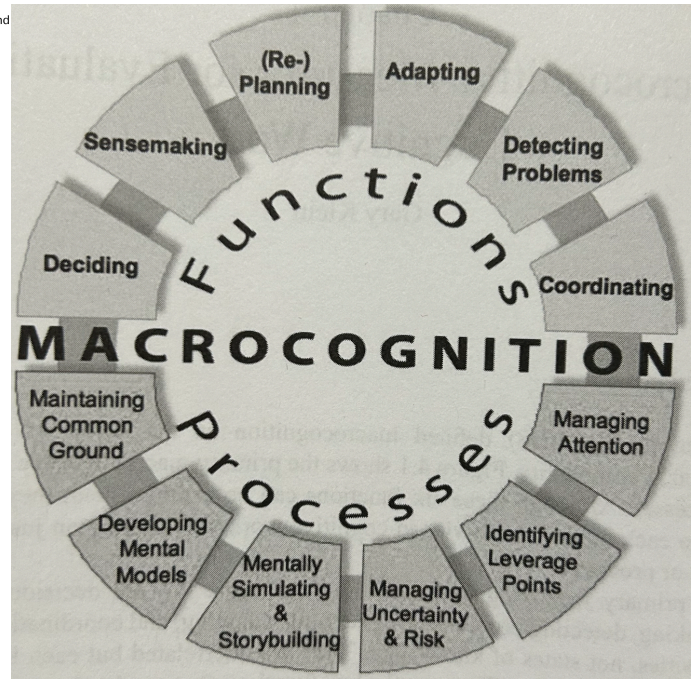
Macrocognition



(Klein, 2010)

Expertise II: Humans' Experience = Trained Skills

Many skills are also experience-based

Cannot be learnt theoretically

Need to be trained

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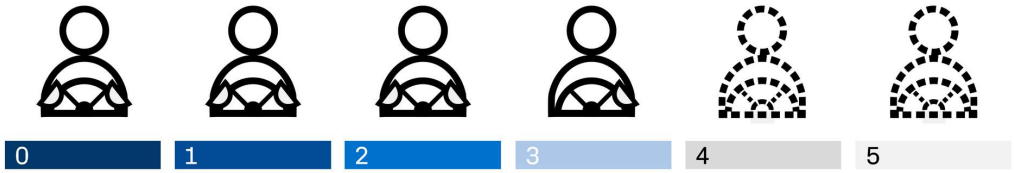
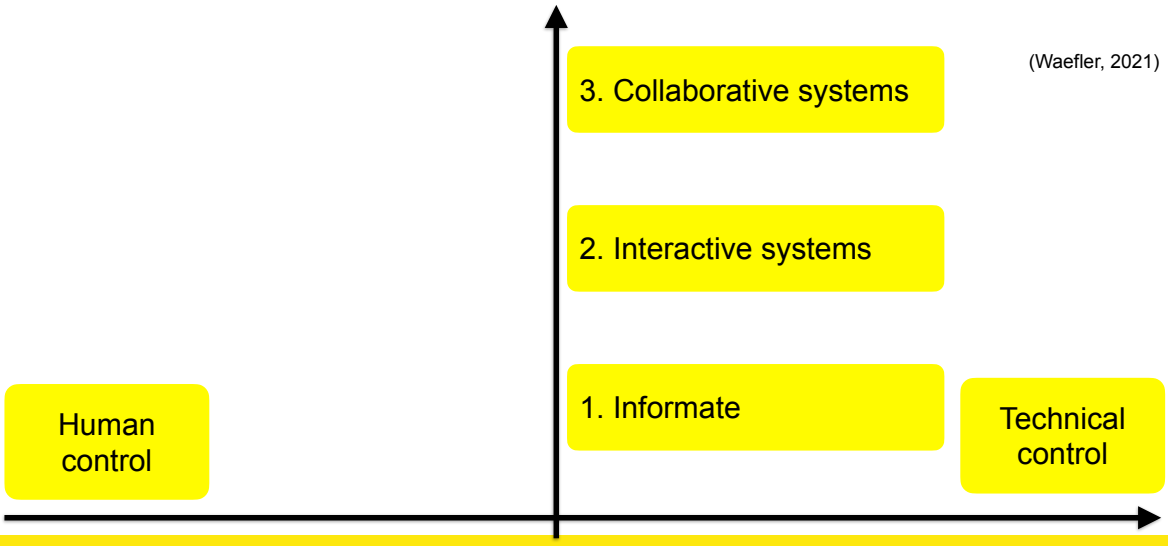
Classic View: Automation = Increasing Technical Autonomy



0	1	2	3	4	5
No automation	Driver assistance	Partial automation	Conditional automation	High automation	Full automation
Zero autonomy: the driver performs all driving tasks.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

(credit-suisse.com)

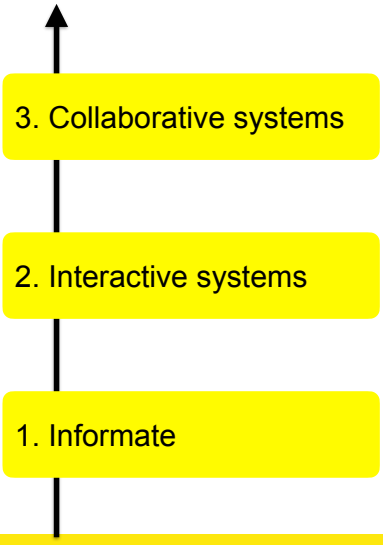
Alternative View: Increasing Cooperation of Humans and Technology



(Waefler, 2021)

(Wäfler, 2020)

Human Roles



Verification of AI: Verify AI-based decision proposals

Improving AI: Identifying weaknesses and biases in AI-based decisions

Learning from AI: Learning from the AI, which also expands the horizon of human experience

Taking responsibility and compliance with regulatory and ethical standards

(Samek et al., 2017)

"To trust it, they need to understand what the machines are doing." (Davide Castelvecchi)

AI4REALNET.EU

AI4REALNET has received funding from European Union's Horizon Europe Research and Innovation programme under the Grant Agreement No 101119527

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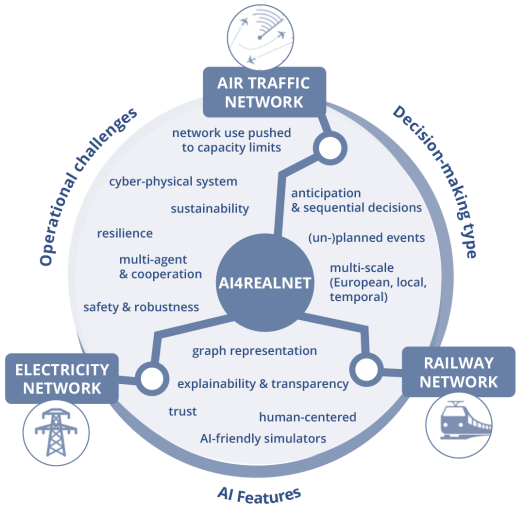
Focus on critical infrastructures



Our core elements are:

1 **AI algorithms mainly composed by supervised and reinforcement learning.**
Unifying the benefits of existing heuristics, physical modelling of these complex systems and learning methods, as well as a set of complementary techniques to enhance transparency, safety, explainability and human acceptance.

2 **Human-in-the-loop decision making for co-learning between AI and humans.**
Considering integration of model uncertainty, human cognitive load and trust.

3 **Autonomous AI systems relying on human supervision.**
Embedded with human domain knowledge and Safety rules.

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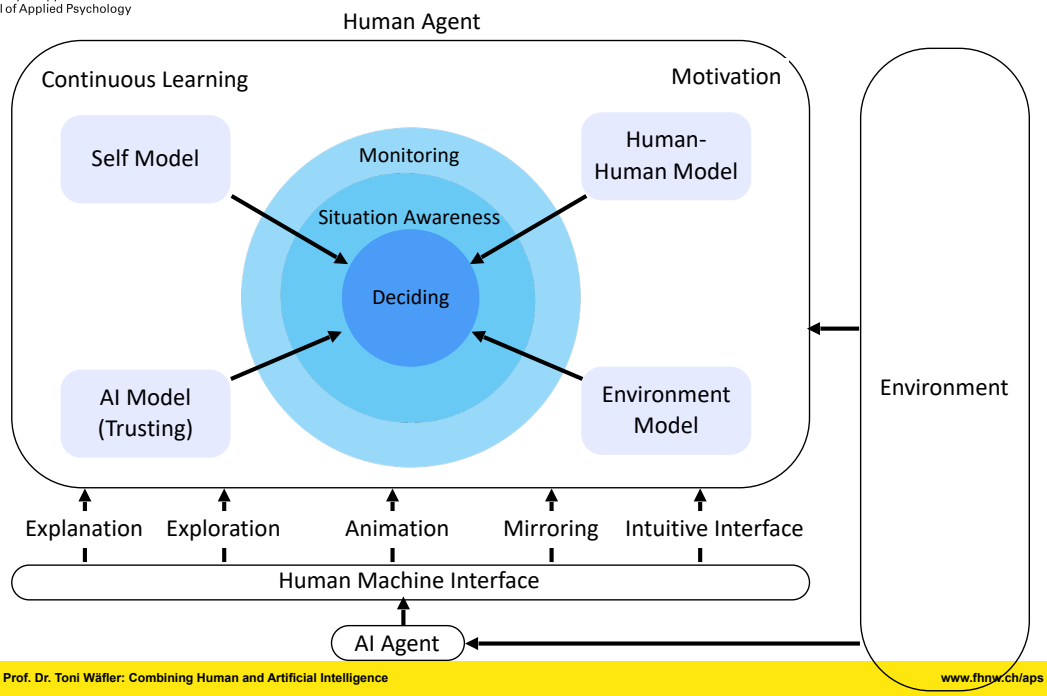

Summary

- Humans and artificial intelligence are very different
- Artificial intelligence can (partially) emulate human intelligence
- Based on their different strengths and weaknesses, humans and artificial intelligence can complement each other

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Thank you for your attention!

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