

10th Workshop on the MANUFUTURE AET-community, Hanover, 10.11.2023

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# Towards User-Centered Solutions through Interoperable Data and AI-Services

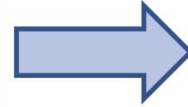
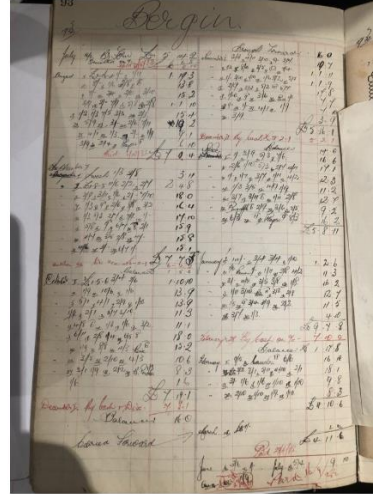
Sebastian Bosse



**What is special about agriculture**  
**Human-centered aspects**  
**Human-AI collaboration in agriculture**  
**The role of interoperability**

# Digitalization: Agriculture vs Retail

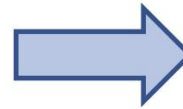
In retail, in one generation from mother to son, from ledger book to self-scanning...



In farming, in almost a century from 1928 to 2021, from pencil and paper to pencil and paper...

ACRES OF CROPS PLANTED OR TO BE PLANTED FOR HARVEST IN 1924

Crop	Planted	Harvested	ACRES OF CROPS PLANTED OR TO BE PLANTED FOR HARVEST IN 1924														
			Wheat	Rye	Buckwheat	Oats	Barley	Flax	Alfalfa	Hay	Other	Timothy	Other	Other			
Wheat	100	90	100	...	...	...	...	...	...	...	...	...	...	...	...	...	...



### On Farm Emissions Reporting Supplementary Information

Name: \_\_\_\_\_

The information in Table 1 is only needed if you cannot access your annual fertilizer summary.

**Table 1: Nitrogen Fertiliser Summary**

Type	Amount (kg)	Nitrogen content (%)	Amount of N applied
As Area	2000	45%	900
Total Nitrogen in Area without urea			
Type	Amount (kg)	Nitrogen content (%)	Amount of N applied
As Area	...	...	...
Total Nitrogen in Area with urea			
Type	Amount (kg)	Nitrogen content (%)	Amount of N applied
As Area	...	...	...

**Grazing (on farm)**

Stock Type & Class	No.	Date Acquired	Date Released

**Grazing (off farm)**

Stock Type & Class	No.	Date Acquired	Date Released

**Activity**

Please calculate my farm GHG emissions using this information:

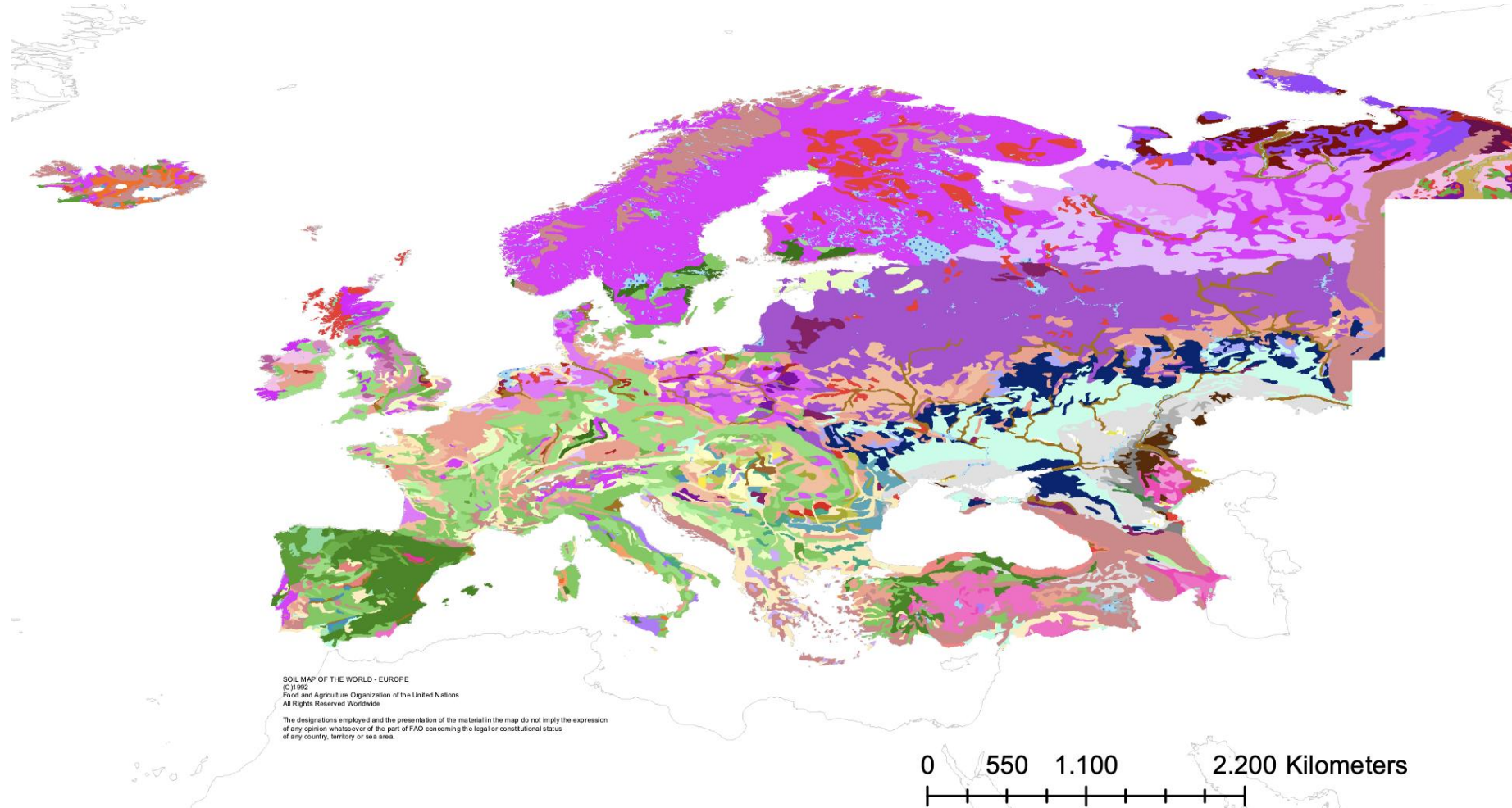
Owner | Director | Partner | Trustee

Why?

Courtesy of Kenneth Irons

# Agroecological heterogeneity: Soil types in Europe

## Agriculture is special...



■ [https://www.fao.org/fileadmin/user\\_upload/soils/docs/Soil\\_map\\_FAO/UNESCO/acrobat/Europe\\_V.pdf](https://www.fao.org/fileadmin/user_upload/soils/docs/Soil_map_FAO/UNESCO/acrobat/Europe_V.pdf)

# Heterogeneity of the ecosystem

## Agriculture is special

There are about 540-570 million

of which about 470 million

Small farms are effective in achieving  
human labor

Smallholder farms produce about



but 6.000 airlines

1000 major banks

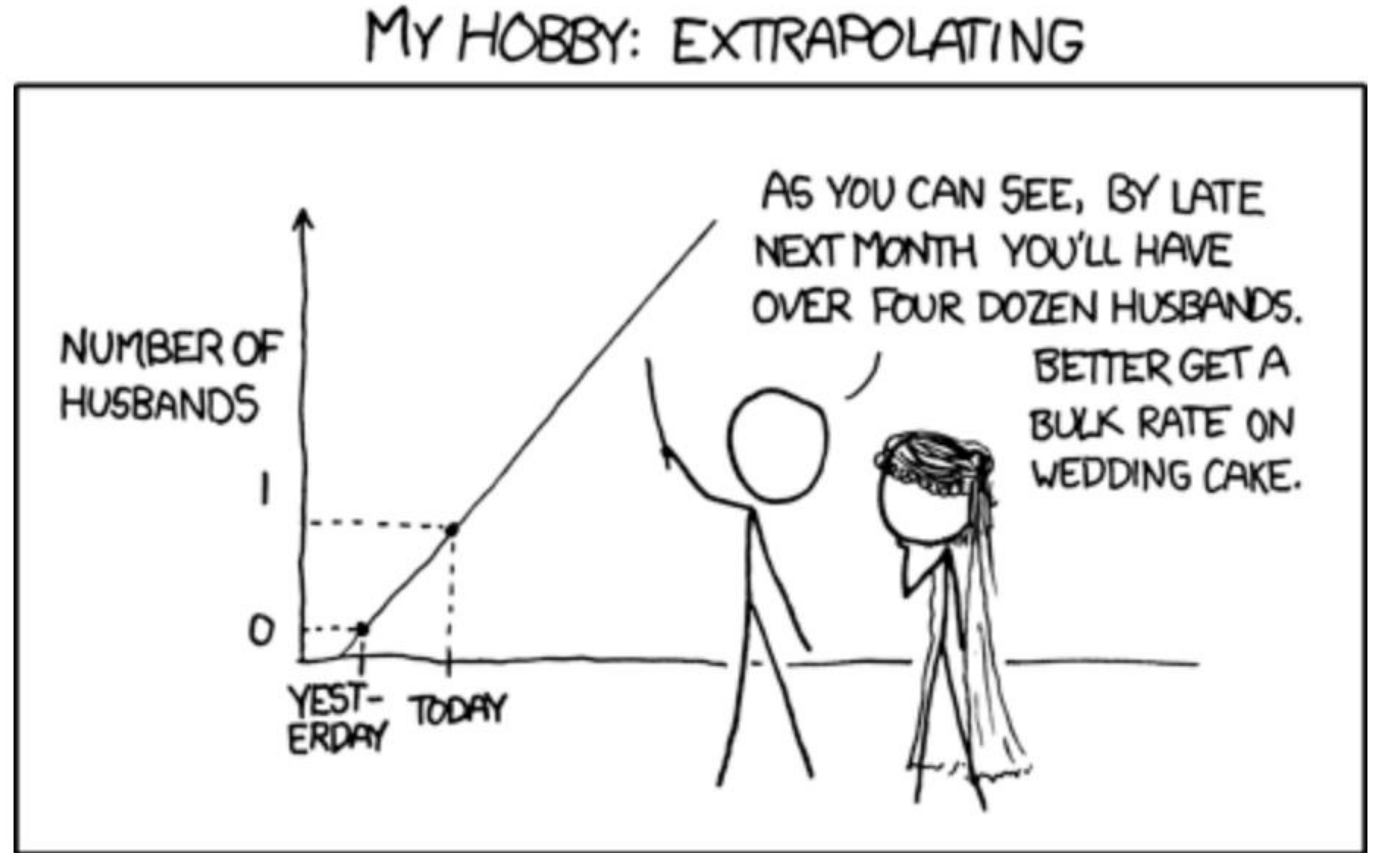
1000 supermarket groups

**540 -570 million business  
decisions**

# Why is this relevant for AI in agriculture?

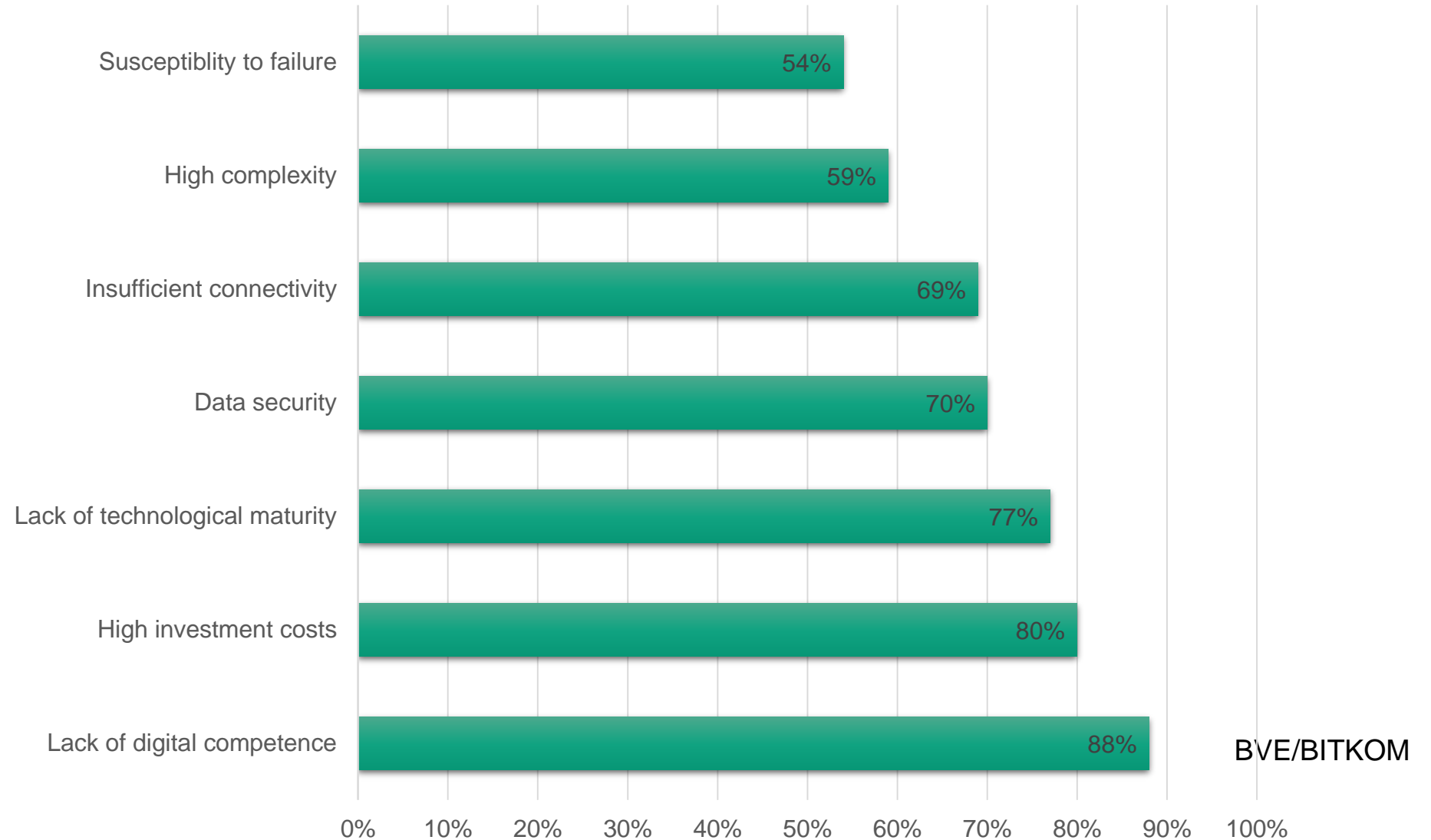
We need to extrapolate quite a bit, but

- Artificial intelligence is notoriously bad at extrapolation
- Datasets need to be representative to train generalizing models
- Heterogeneity inherently causes distribution shifts

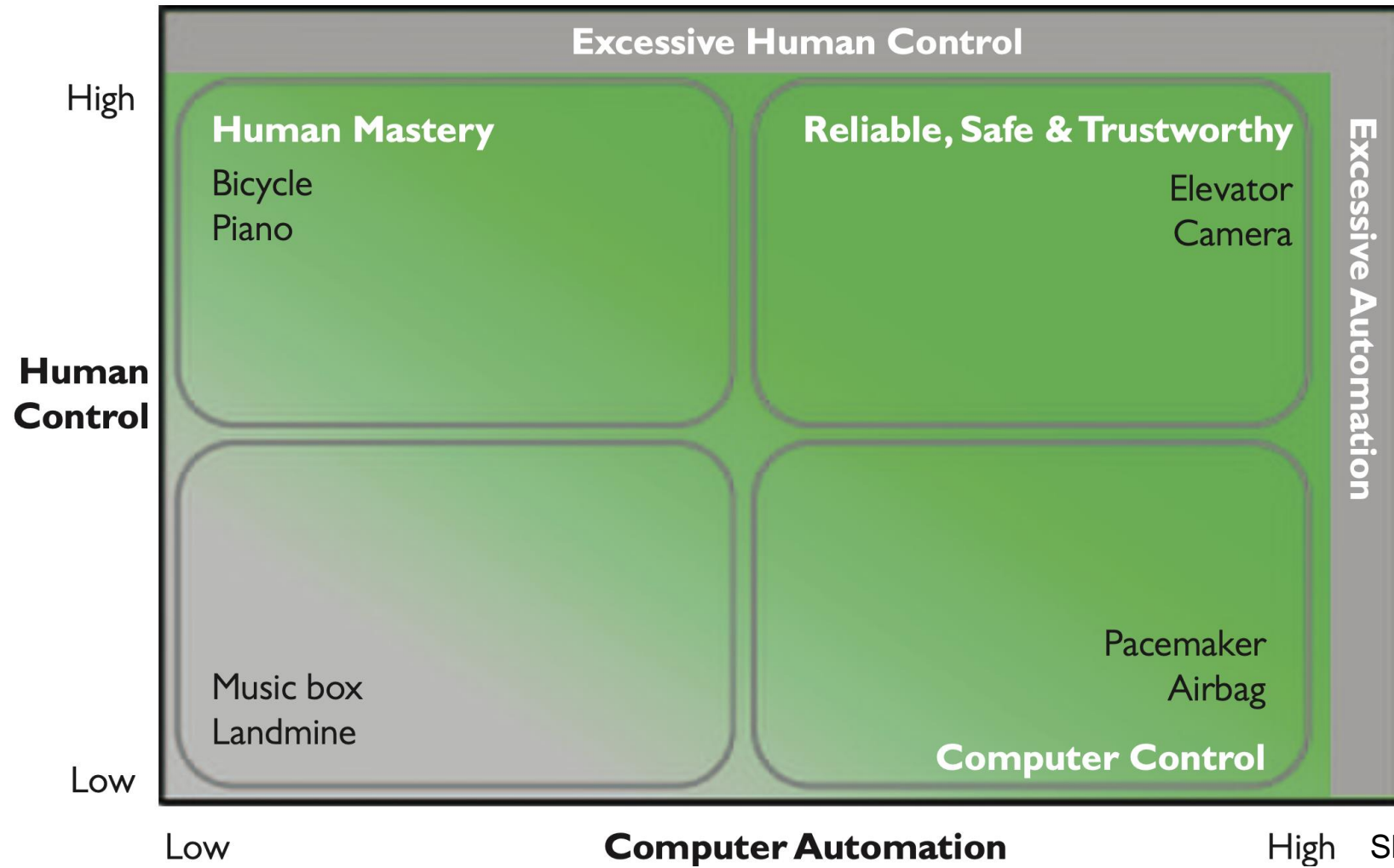


Source: <https://xkcd.com/605/>

# ”What are the greatest obstacles in digitizing the food industry?”



# Human and computer control



Shneiderman, 2022



# NaLamKI: Platform-based human-centered design of AI in agriculture

Inherently brings

- Data sovereignty
- Heterogeneous ecosystems
- Graceful complexity reduction
- Mitigation of lack of digital competence

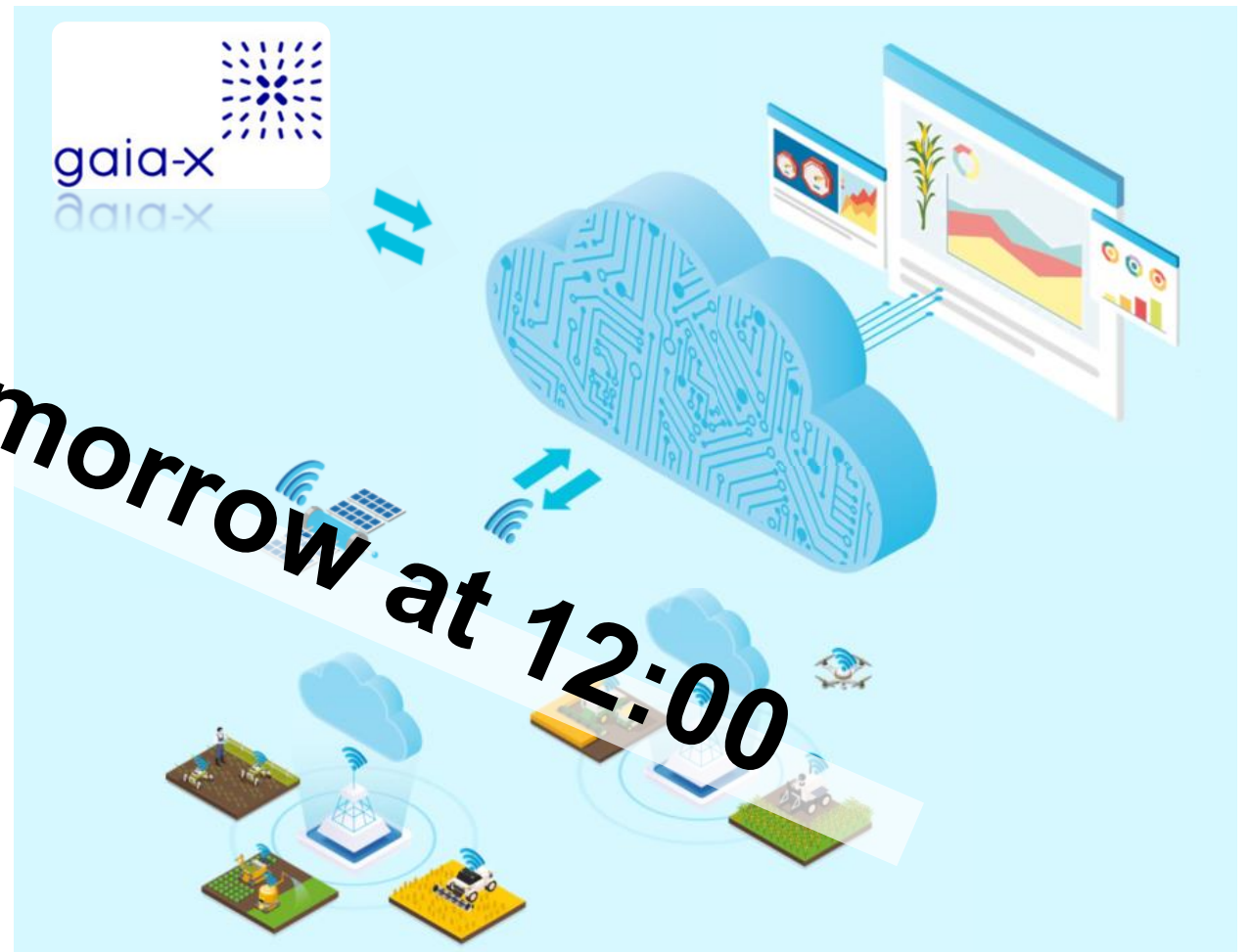
Supported by:



on the basis of a decision  
by the German Bundestag



NaLamKI



# The role of interfaces

## Mortgage Loan Explanations

(a) **Post-hoc Report**

**Enter amounts to request mortgage:**

Mortgage amount requested	<input type="text" value="375000"/>
Household monthly income	<input type="text" value="7000"/>
Liquid assets	<input type="text" value="48000"/>

(b)

**Enter amounts to request mortgage:**

Mortgage amount requested	<input type="text" value="375000"/>
Household monthly income	<input type="text" value="7000"/>
Liquid assets	<input type="text" value="48000"/>

We're sorry, your mortgage loan was not approved. You might be approved if you reduce the Mortgage amount requested, increase your Household monthly income, or increase your Liquid assets.

(c) **Exploratory User Interface**

**Adjust sliders to report your situation:**

Mortgage amount requested	<input type="range" value="375000"/>	<input type="text" value="Score needed for approval"/>	<input type="text" value="Your score"/>
Household monthly income	<input type="range" value="7000"/>		
Liquid assets	<input type="range" value="48000"/>		

Shneiderman, 2022

# Example of visualizations: NaLamKI

The screenshot displays the NaLamKI web application interface. The top left shows the logo for NaLamKI at WALDESRUH BAUERNHOF. A navigation menu on the left includes 'Ergebnismonitor', 'Feldverwaltung', 'Datenaustausch', 'Services', and 'Team'. The main area features an aerial view of an orchard with a specific row of trees highlighted in blue. A search bar at the top indicates 'Apfelerkennung' and shows a timestamp of '12.09.2023, 14:15'. On the right, a panel titled 'Baum Jonagold3\_2' shows a photo of the tree and a line graph labeled 'Blattfläche' (leaf area) in m<sup>2</sup>. The graph shows a peak in leaf area around the time of the photo.

Time	Leaf Area (m <sup>2</sup> )
12.09.2023, 14:15	0.55
~12.09.2023, 15:00	1.10
~12.09.2023, 16:00	1.05
~12.09.2023, 17:00	1.00
~12.09.2023, 18:00	0.95

Bonn  
Consulting

# Explaining AI with horses: Computer, what do you see?



**“Of course, it’s a horse!”**

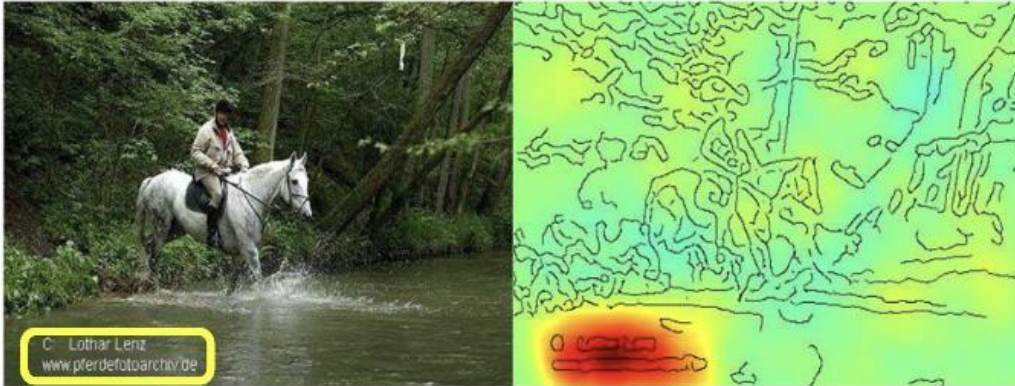
## Explaining AI with horses: Computer, what do you see?



**“I don’t know, but certainly not a horse!”**

# Why would I trust you?

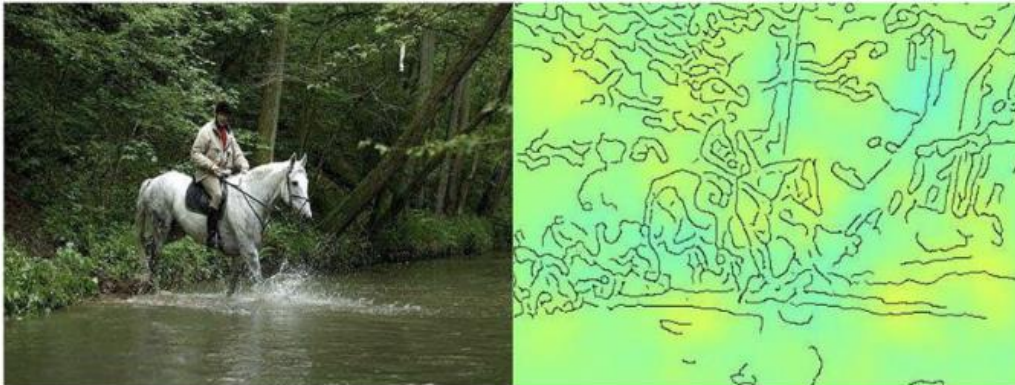
Horse-picture from Pascal VOC data set



Source tag present



Classified as horse



No source tag present

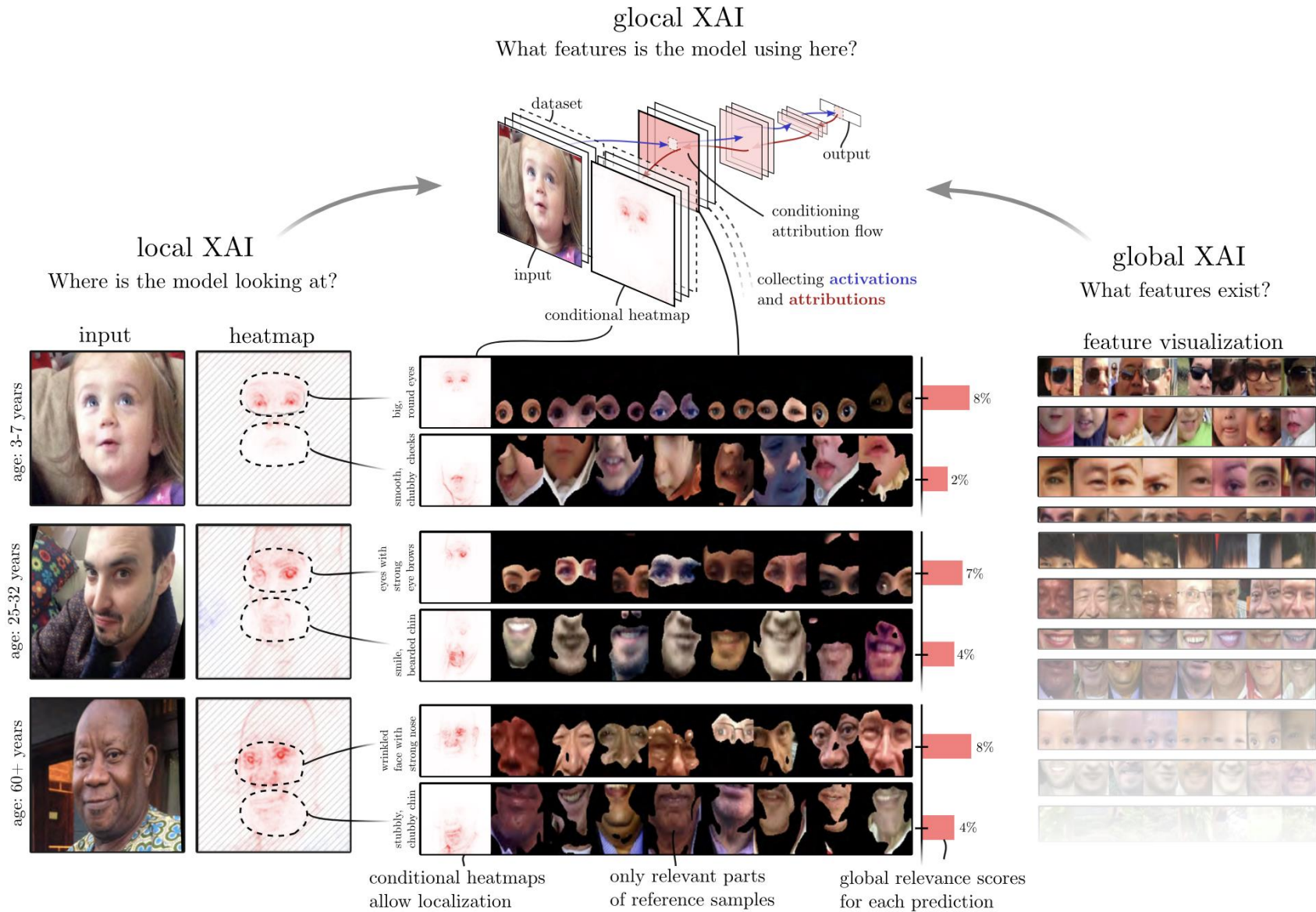


Not classified as horse

Artificial picture of a car



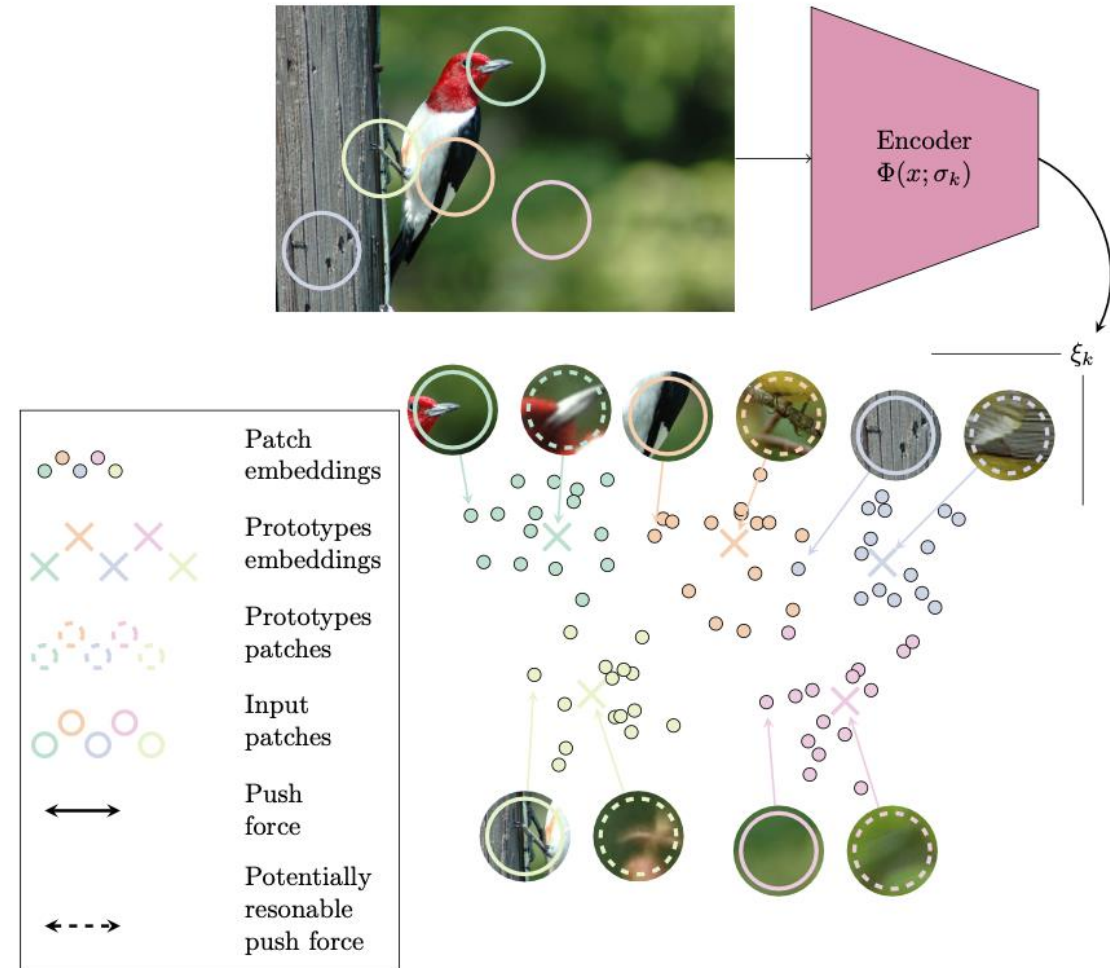
# Towards understanding the inner workings



# Explanatory interactive learning

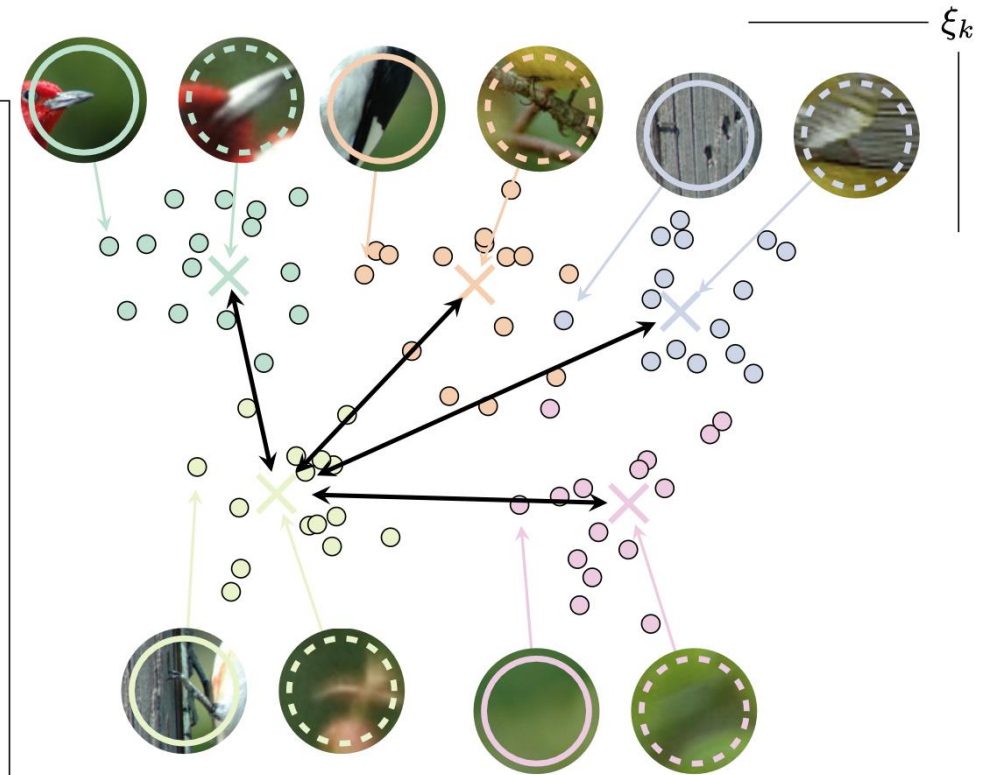
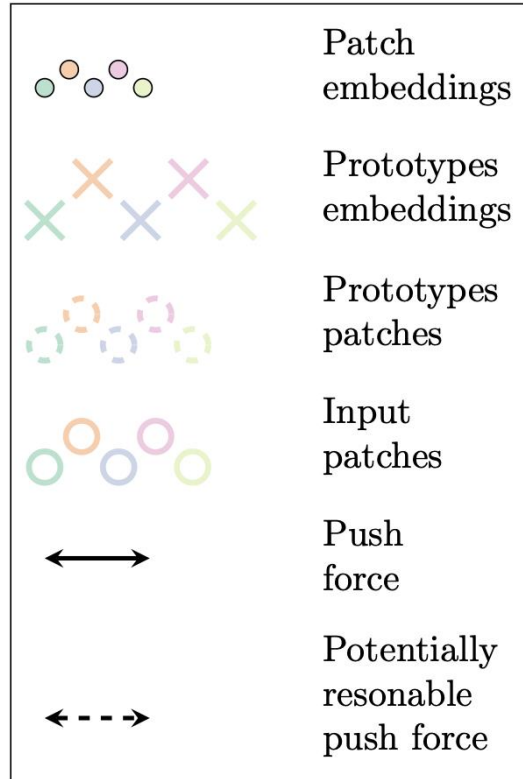
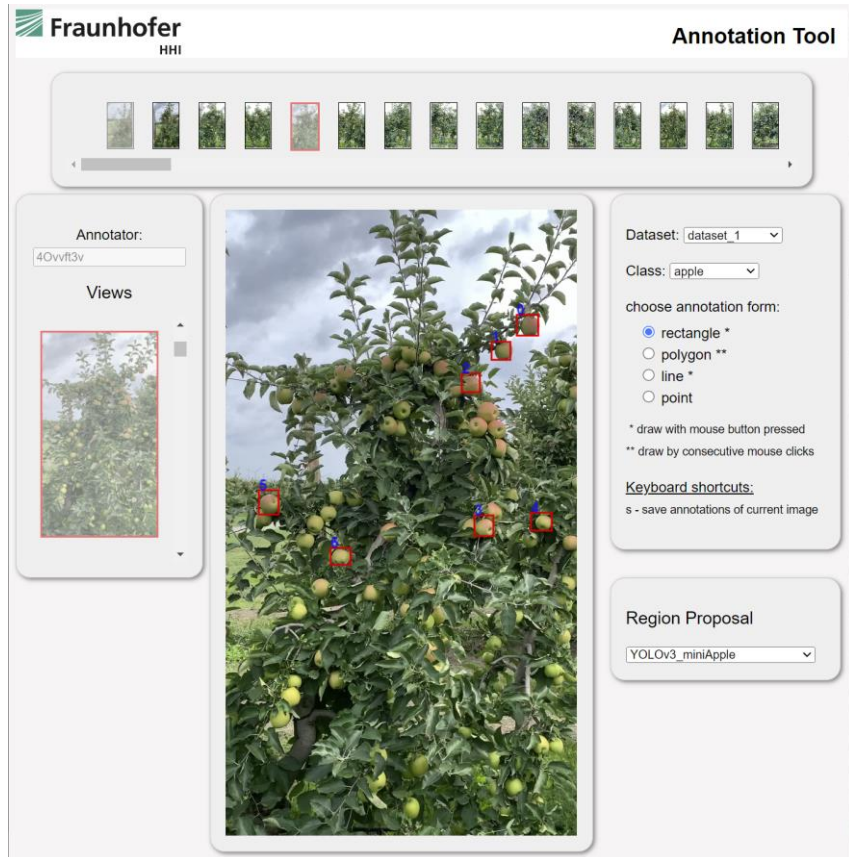
Attributes of an inference might be

- Correct (trivial)
- Based on nonsensical concepts
- Based on a faulty choice of concepts
- Both



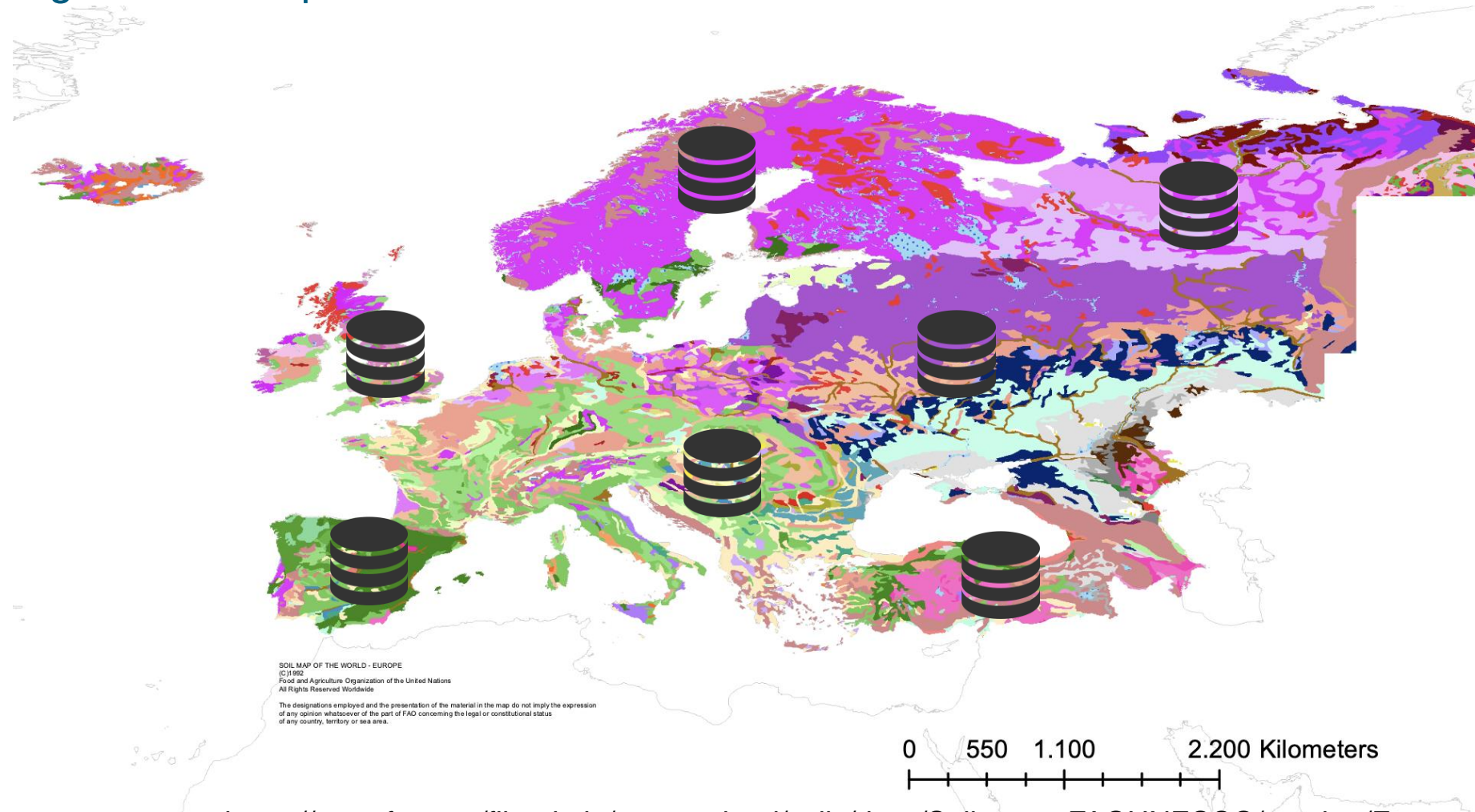


# Towards human interactions in the latent space



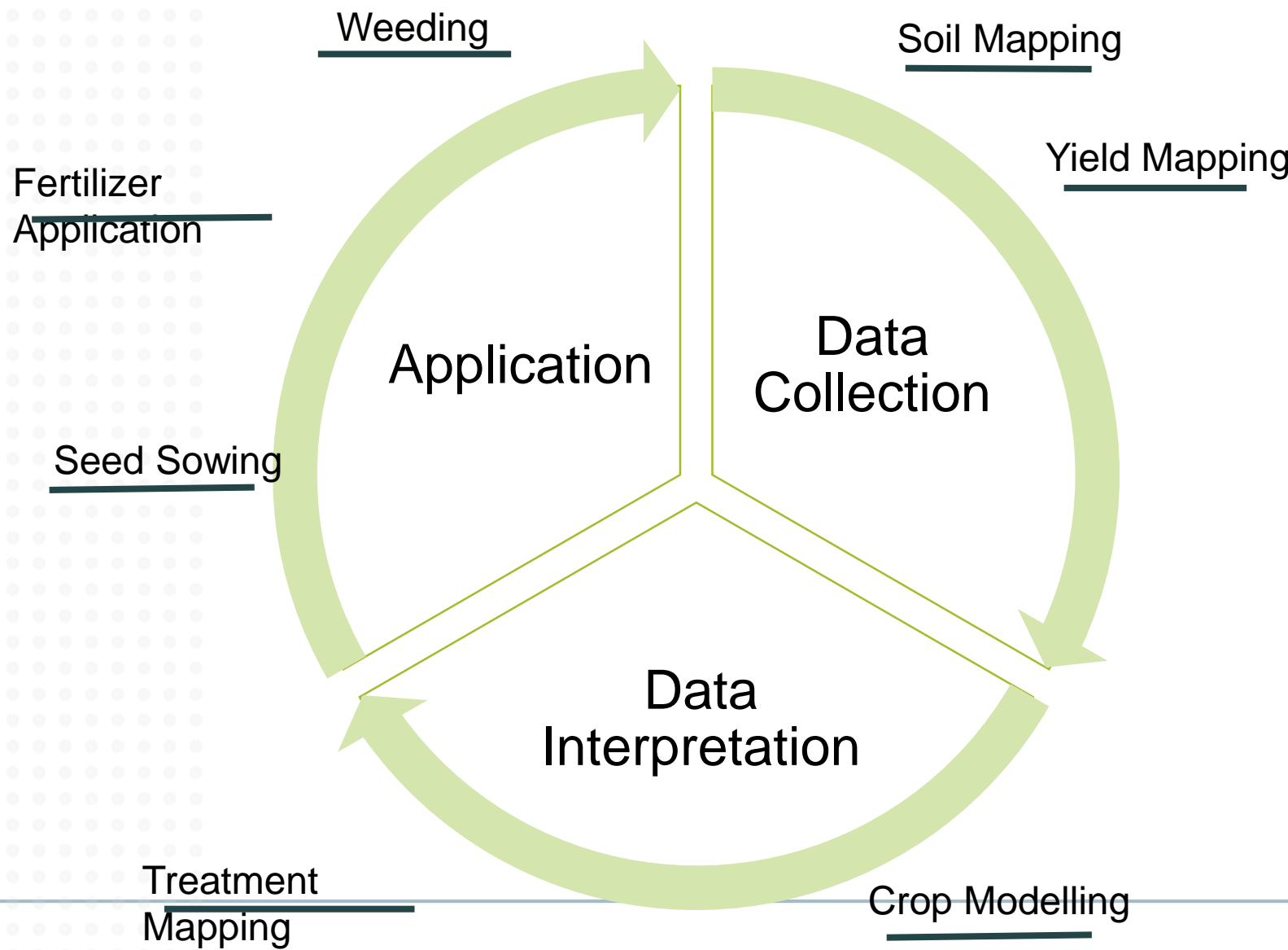
# Why would I want to do that?

## Because agriculture is special...



[https://www.fao.org/fileadmin/user\\_upload/soils/docs/Soil\\_map\\_FAOUNESCO/acrobat/Europe\\_V.pdf](https://www.fao.org/fileadmin/user_upload/soils/docs/Soil_map_FAOUNESCO/acrobat/Europe_V.pdf)

# Digital Agriculture Cycle





**Focus Group on Artificial Intelligence (AI) and Internet of Things (IoT) for Digital Agriculture**



# Scope of FG-AI4A

Established by ITU-T Study Group  
20



AI and IoT  
Use-cases



Key Concepts



Gap Analysis



Architecture



Community  
Building

Mobile Applications



IoT



Robotics

Big Data



AI



UAVs



# FG-AI4A Management

## Chair

- Sebastian Bosse (Fraunhofer HHI, Germany)
- Ramy Ahmed Fathy (Egypt)

## Vice-Chair(s)

- Chunlin Pang (TIAA, China)
- Zhongxin Chen (FAO)
- Gyu Myoung Lee (Republic of Korea)
- Paolo Gemma (Huawei Technologies Co., Ltd.)
- Guillermo Ariel González Conosciuto (Argentina)
- Ted Dunning (Hewlett Packard Enterprise)
- Sushil Kumar (Department of Telecommunications, Government of India)
- Long Hoang, John Deere
- Marco Brini, EnvEve



# Working Groups

## Glossary



## Use-cases and Solutions



## Data Acquisition & Modelling



## Roadmap



## Ethics



## Outreach





# Deliverables



*Roadmap on Digital Agriculture: Analysis of the Standardization Landscape*

*Glossary on Digital Agriculture*



*Technical Report on Digital Agriculture Use-cases and Solutions*

*Technical Report on Data Acquisition and Modelling for Digital Agriculture*



*Technical Report on the Ethical and Security Considerations relating to the use of AI for Agriculture*



## Topics Groups

- Data Science for surface and underground water monitoring
  - Georeferenced Data Management
  - Weather modelling and forecasting
  - Yield monitoring and Prediction
  - Irrigation strategy and smart water management
-

# Conclusion

Integration of human cognition into digital systems is a necessary condition for the digitization of agriculture

Interoperability between data acquisition and AI and data models is a crucial



# Thank you very much!

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NaLamKI

Supported by:



Federal Ministry  
for Economic Affairs  
and Climate Action

on the basis of a decision  
by the German Bundestag



**AI and Internet of Things  
for Digital Agriculture**  
ITU Focus Group

