



Beyond Generative AI

Which AI Techniques **actually work**
in a **Manufacturing Context?**

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Artificial Intelligence (AI)

- Makes predictions based on data
- Detects issues that are not found by humans (or require a lot of experience)
- Finds solutions very fast that take a lot of time for humans

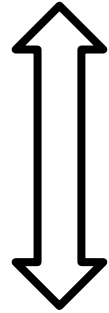
Anomalie
Erkennung



Predictive
Maintenance



Live
Planning



Internet of Things (IoT)

- Delivers data for AI
- Realizes AI results in „real“ world

18 % net value added

- Comparable to annual value creation of Vienna + Styria

- https://msftstories.thesourcemediassets.com/sites/48/2024/08/20240722_KI-und-Produktivitat_EcG.pdf



Source: https://www.researchgate.net/figure/Internet-of-Things-IoT-connected-devices-from-2015-to-2025-in-billions_fig1_325645304



Picture Sources: European Parliament Research Service; plumber-repair-man-repairman-35611 created by Clker-Free-Vector-Images on pixabay.com; PDCA by Eko Purnomo from Noun Project; Anomaly Detection by Muhammad Rofian from Noun Project

Image by [StarShopping](#) from [Pixabay](#); Image by [Jens P. Raak](#) from [Pixabay](#)

What's our Goal?

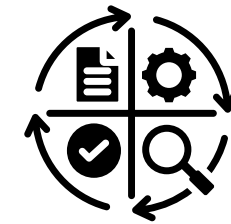
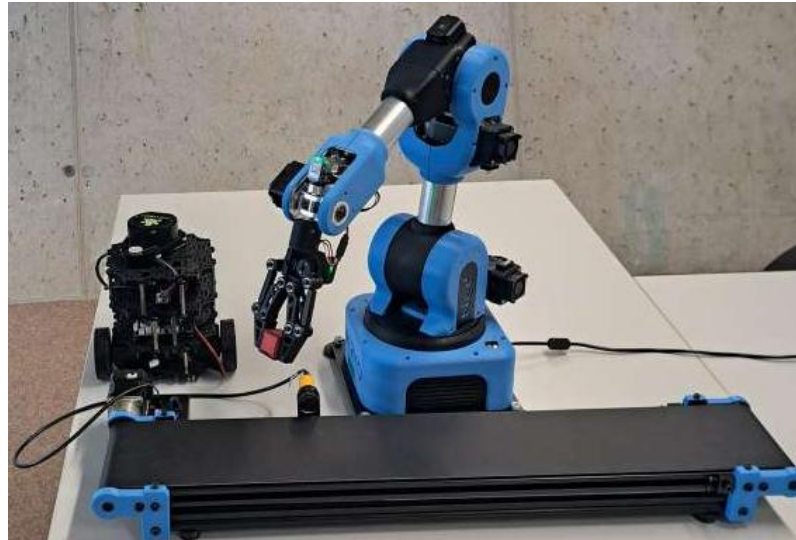
Predictive
Maintenance



Anomaly
Detection



Live
Planning



Continuous
Optimization

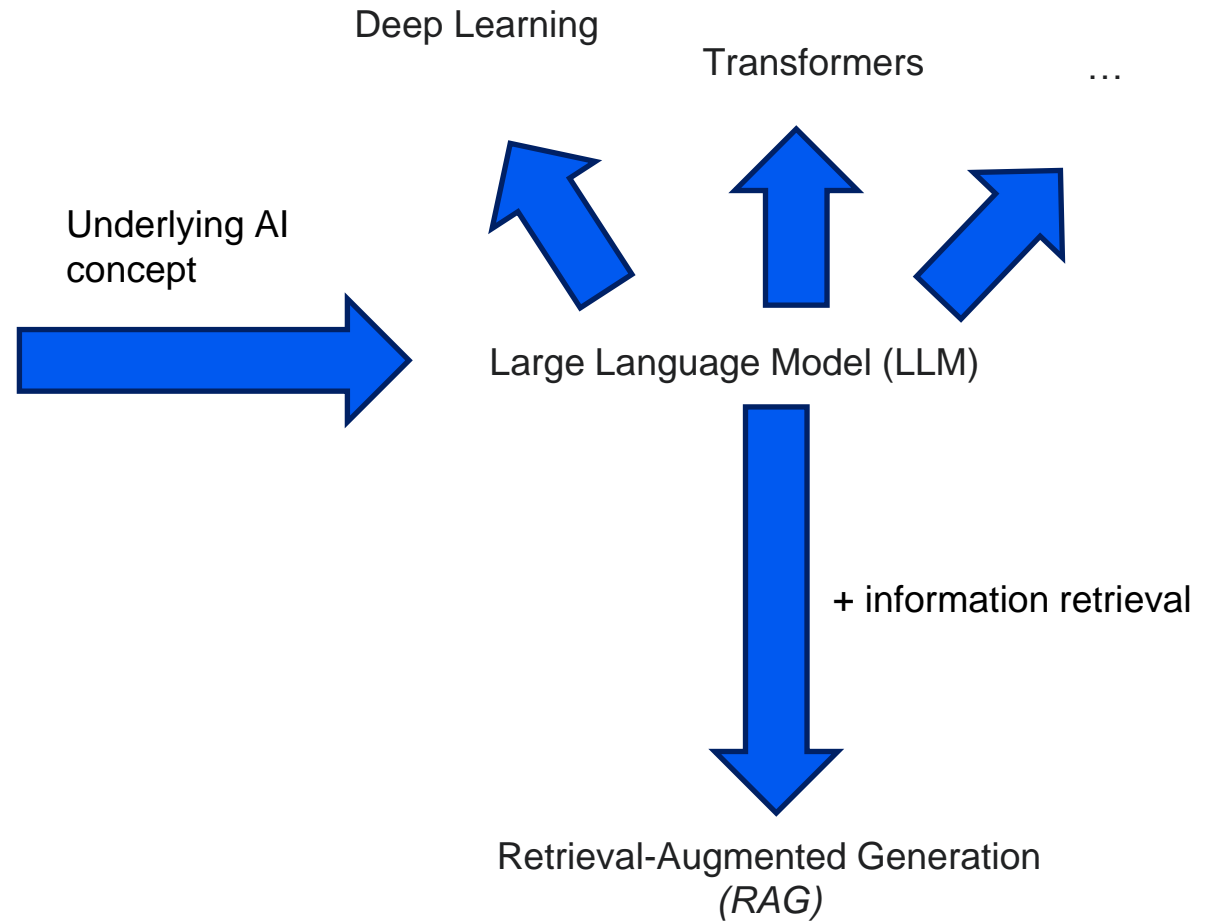
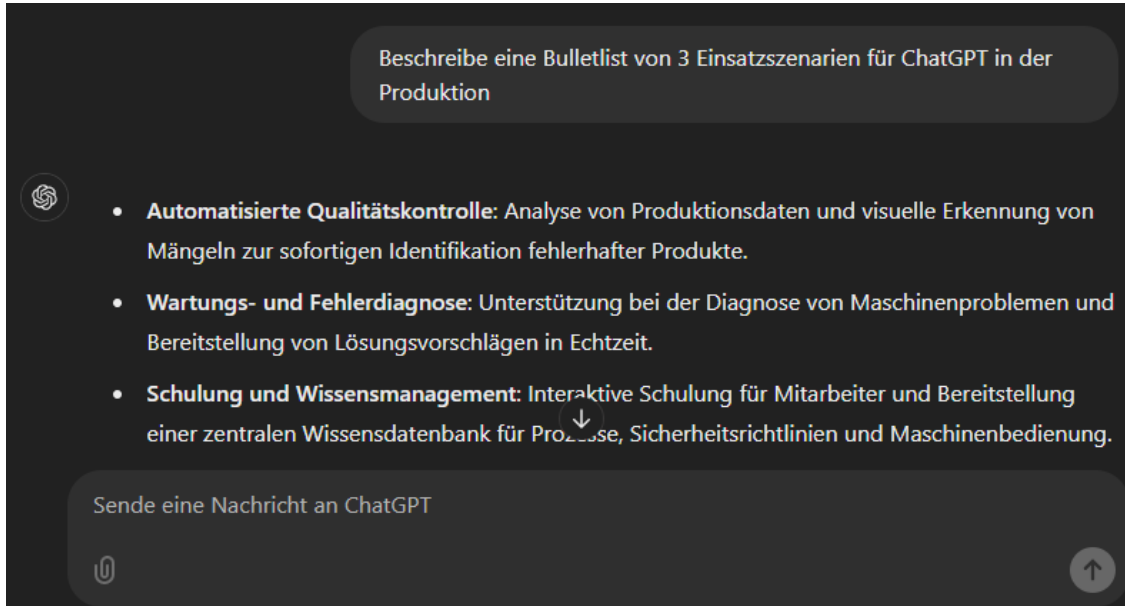


Circular
Economy

Innovation through Digitalization



ChatGPT

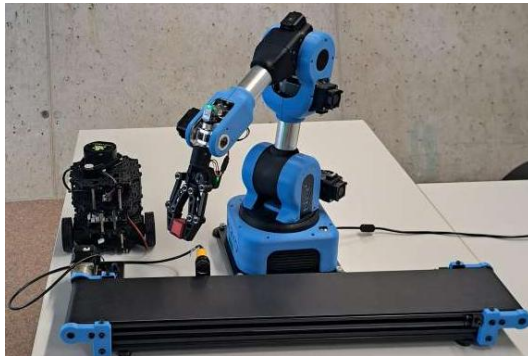


Example: Analysis of Live Data

Beschreibe eine Bulletpointlist von 3 Einsatzszenarien für ChatGPT in der Produktion

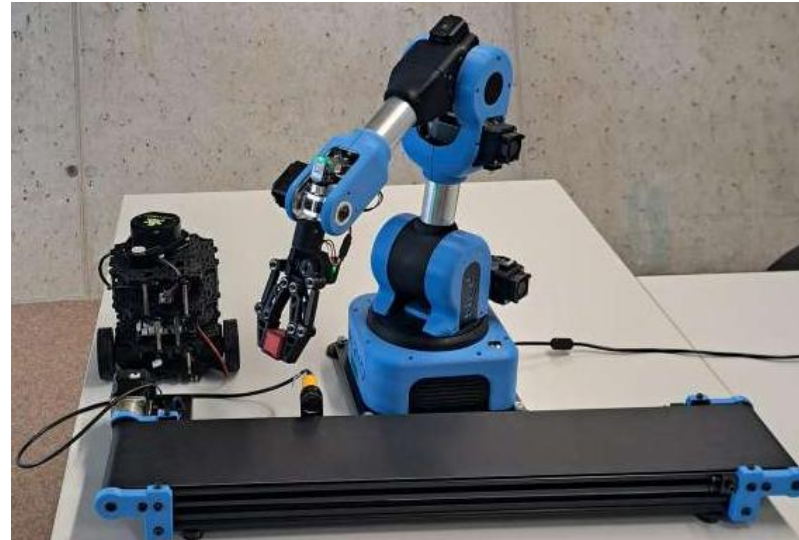
- **Automatisierte Qualitätskontrolle:** Analyse von Produktionsdaten und visuelle Erkennung von Mängeln zur sofortigen Identifikation fehlerhafter Produkte.
- **Wartungs- und Fehlerdiagnose:** Unterstützung bei der Diagnose von Maschinenproblemen und Bereitstellung von Lösungsvorschlägen in Echtzeit.
- **Schulung und Wissensmanagement:** Interaktive Schulung für Mitarbeiter und Bereitstellung einer zentralen Wissensdatenbank für Prozesse, Sicherheitsrichtlinien und Maschinenbedienung.

Sende eine Nachricht an ChatGPT



What's our Goal?

Predictive Maintenance



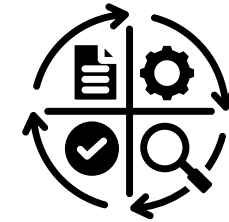
Anomaly Detection



Live Planning



Continuous Optimization



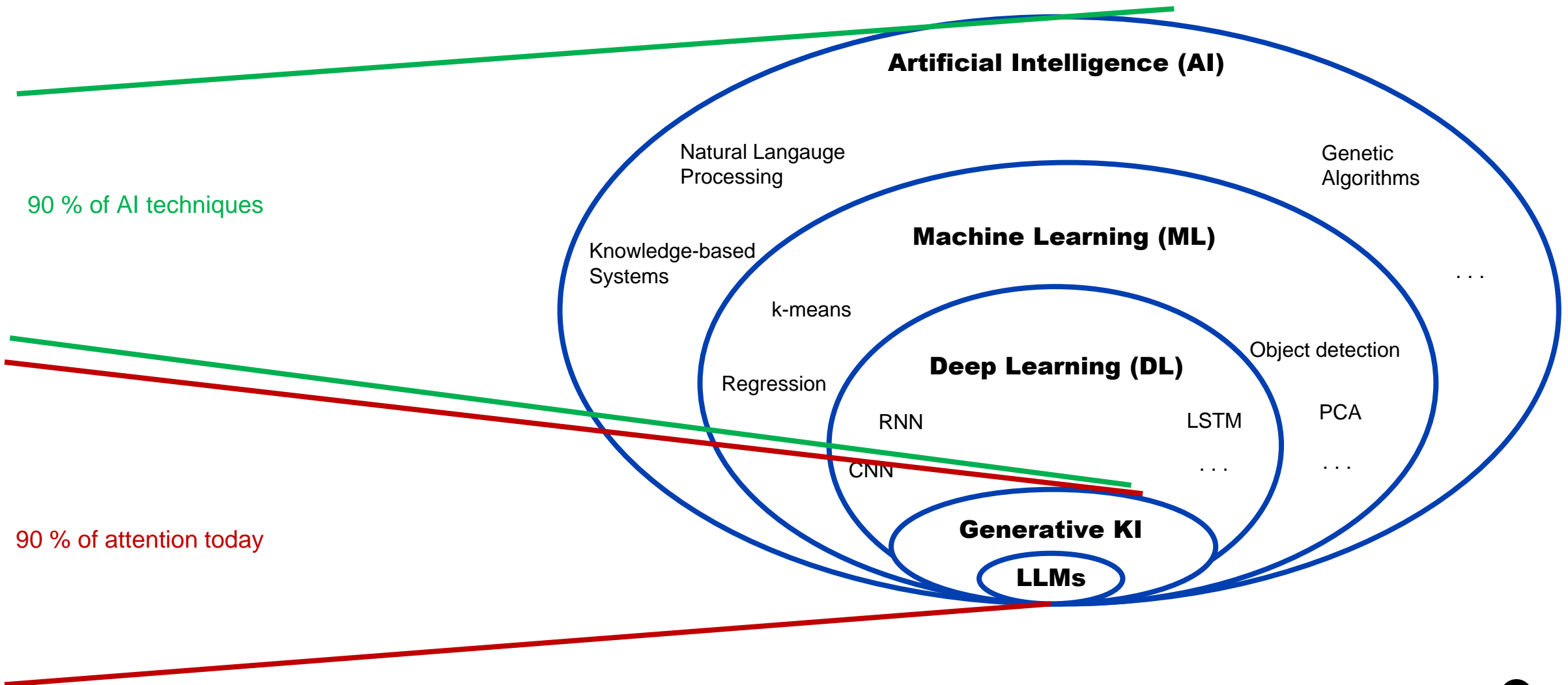
Circular Economy



Innovation through Digitalization



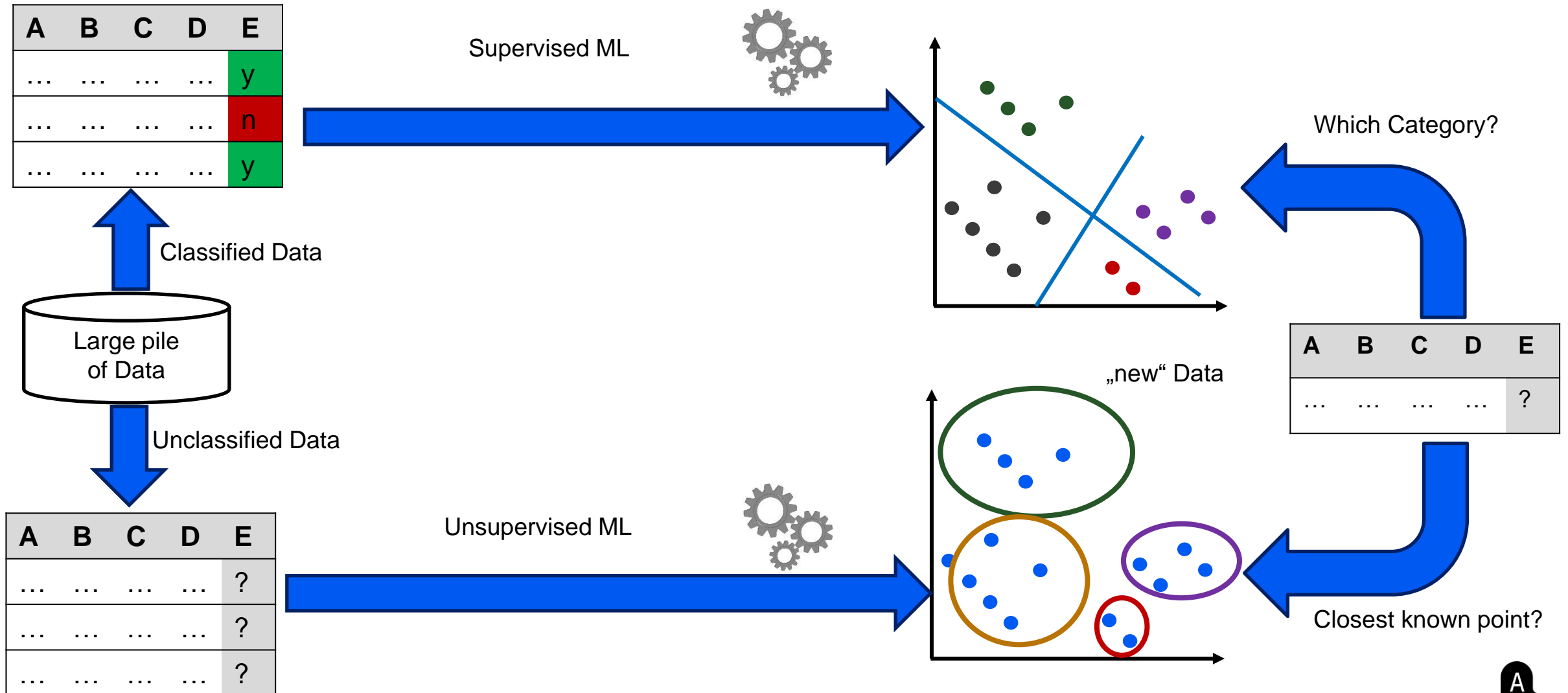
„AI Tunnel View“



Source: https://www.linkedin.com/posts/jaylatta_llm-tunnel-vision-weve-fallen-into-the-activity-7386990451360387072-y6KI



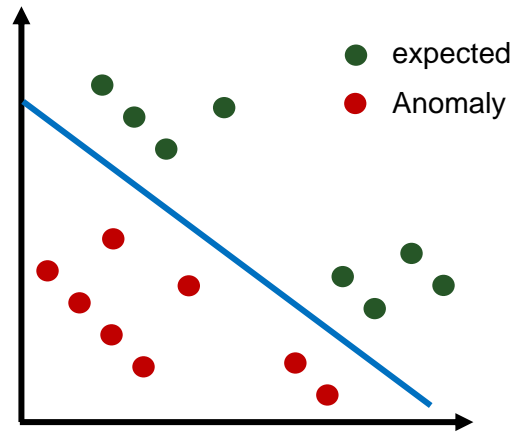
Machine Learning (ML)



Example 1: Anomaly Detection

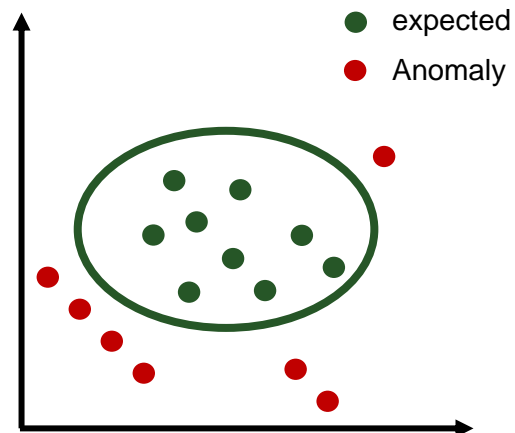


Supervised



- Eigene Kategorie für „Anomalie“
- + menschliche Einschätzung
- Bestehende Fehlerdaten nötig
- Unbekannte Szenarien?

Unsupervised



- Alles „außerhalb der Norm“ wird als Anomalie klassifiziert
- + kann „live“ passieren
- höhere Fehleranfälligkeit

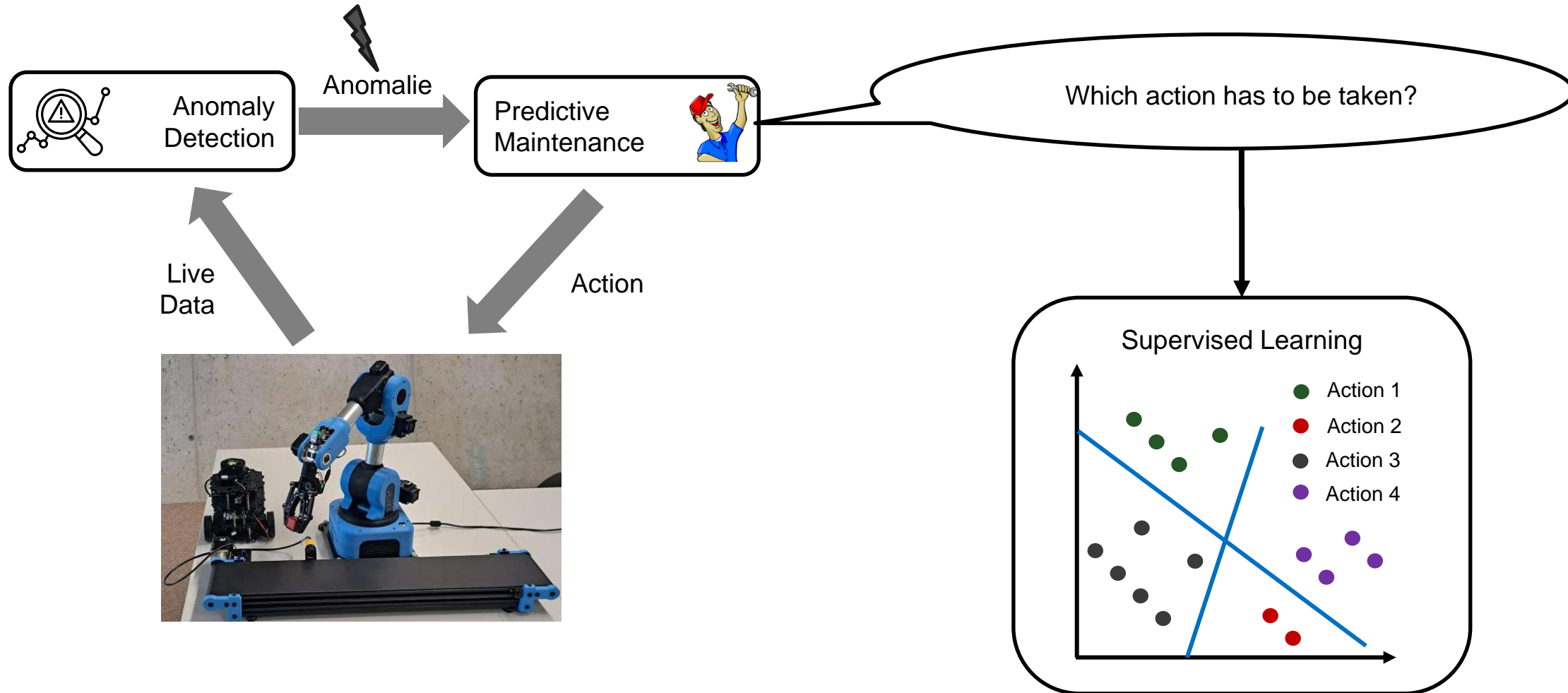


Hands-On Course

online in next few days: <https://ai-at.eu/trainings/>

<https://towardsdatascience.com/the-basics-of-anomaly-detection-65aff59949b7>

Example 2: Predictive Maintenance



<https://towardsdatascience.com/the-basics-of-anomaly-detection-65aff59949b7>

plumber-repair-man-repairman-35611 created by Clker-Free-Vector-Images on pixabay.com; Anomaly Detection by Muhammad Rofian from Noun Project



What are Artificial Neural Networks?

Simulation of the brains' working mode

Allows „**biological**“ processing of information

Also a **technical concept for problem solving**

- Pattern recognition
- Prediction
- Planning
- ...



Neural Networks in Biology

Brain comprises ~10 Billion Neurons

Each Neuron is connected with 10.000 other Neurons

All inputs are processed in parallel by Neuron

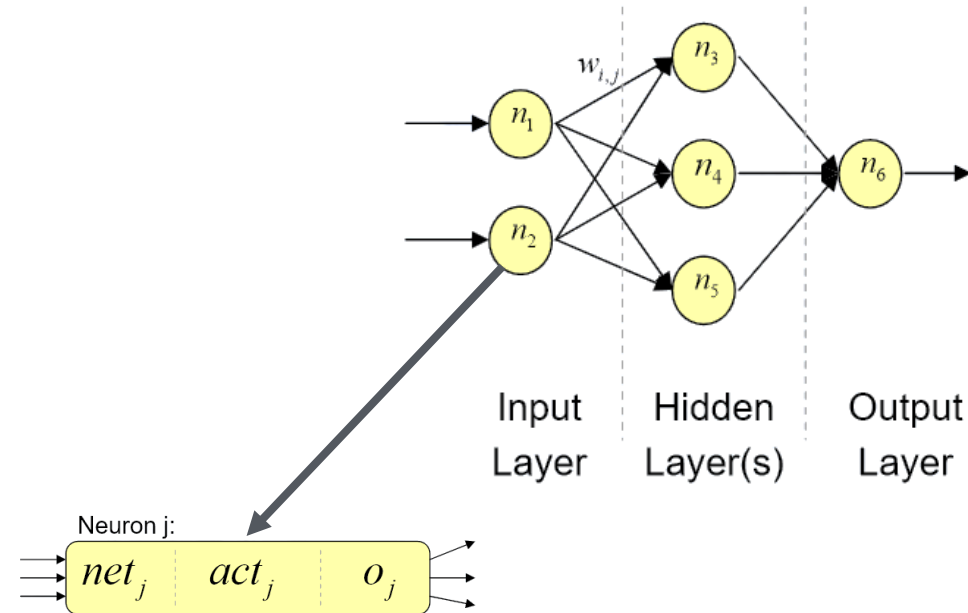
Learning = change in connections between neurons (=Synapses)



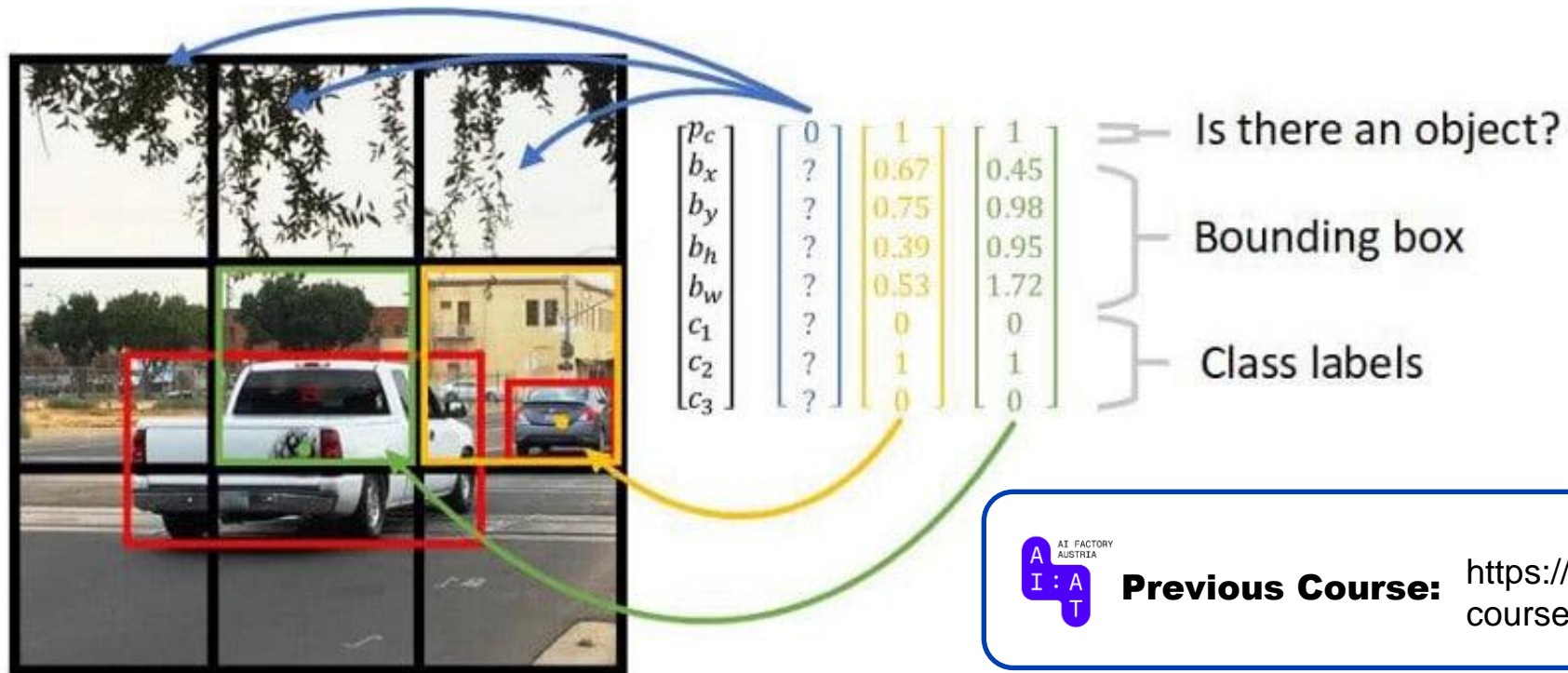
Artificial Neural Networks

Simple Neural Network

- Directed, weighed graph
- Layers of Perceptrons
- Each weighed edge connects two Perceptrons from different layers

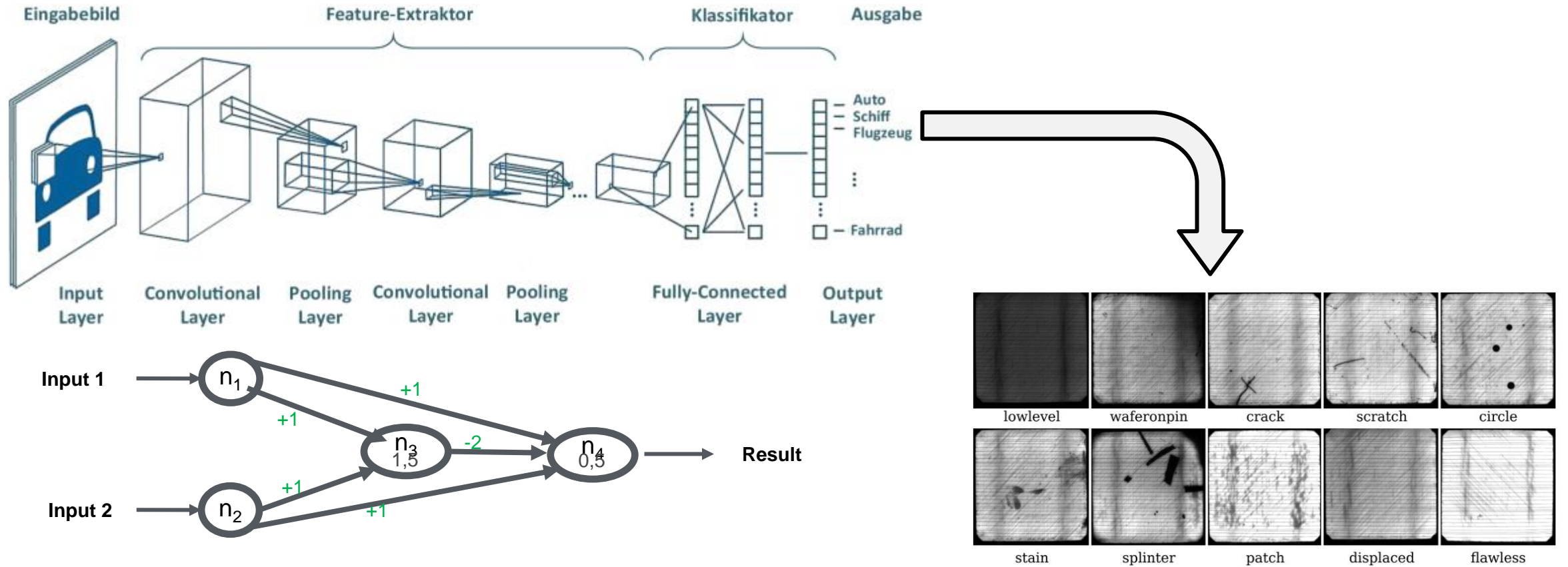


Example 3: Image Detection




Source: <https://datasolut.com/einfuehrung-in-maschinelles-sehen/>

Example 4: Anomaly Detection in Manufacturing



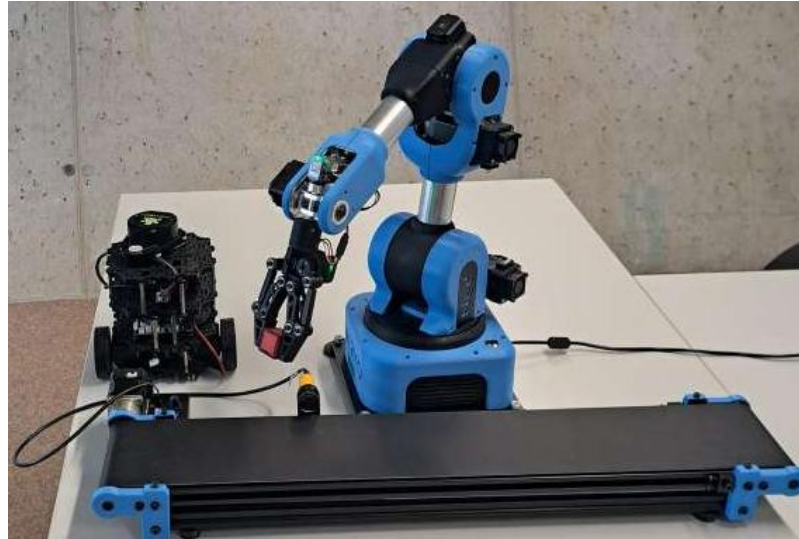
Source: <https://link.springer.com/article/10.1365/s40702-020-00641-8>

What's our Goal?

✓ Predictive Maintenance 

✓ Anomaly Detection 

Live Planning 



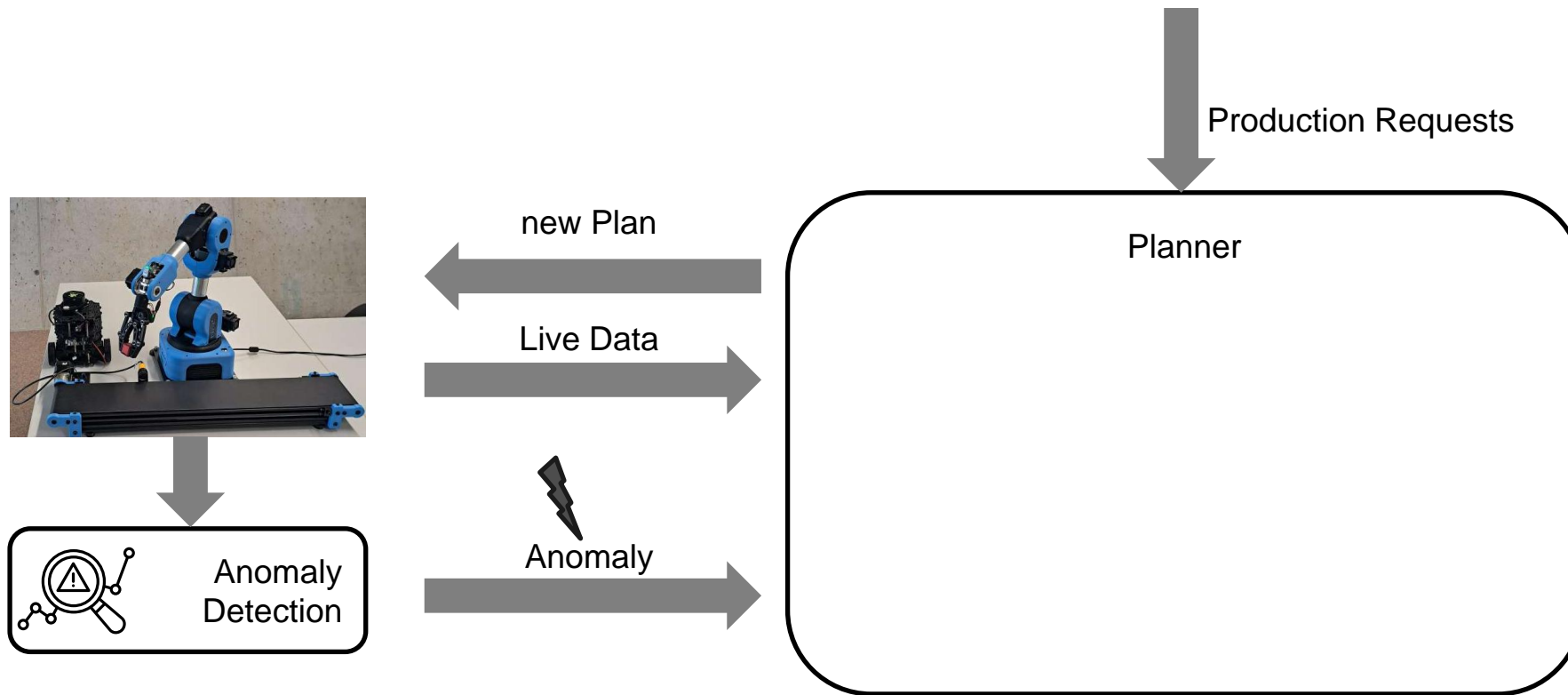
 Continuous Optimization

 Circular Economy

Innovation through Digitalization



Example 5: Live Planning



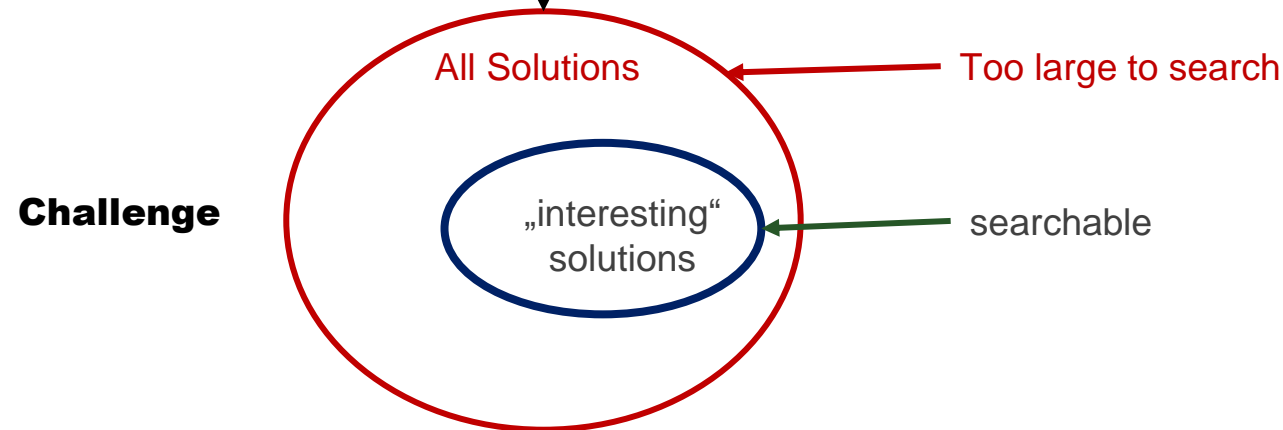
Genetic Algorithms - Overview

Problem statement

„What's the optimal plan?“



Solution: Genetic Algorithm



Live-Planung mit Genetischen Algorithmen

Individuum = eine mögliche Lösung

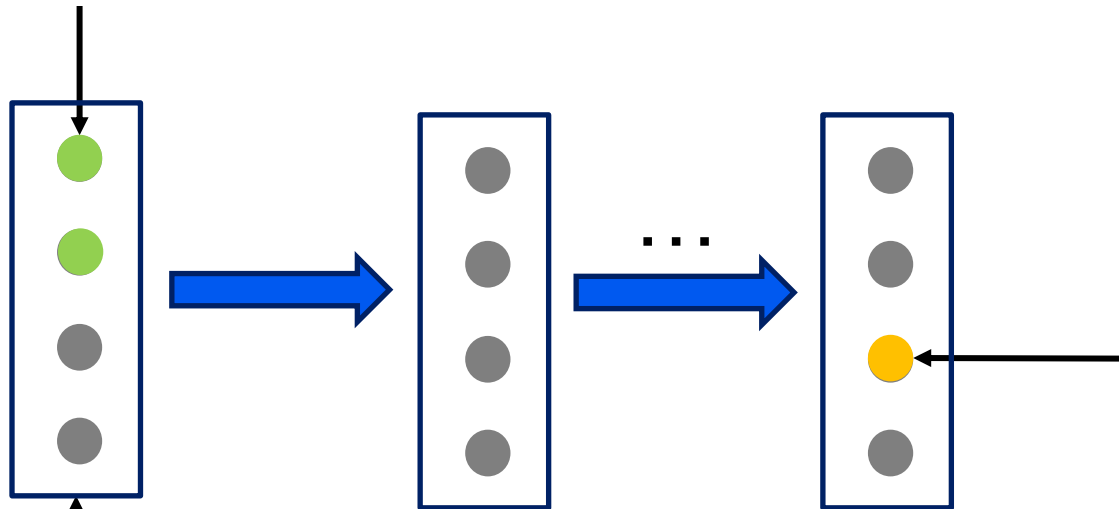
- **Eigenschaften** = Alleinstellungsmerkmale
- **Fitness** = wie gut erfüllt es das Ziel?

Schritt 1: berechne „fitteste“ Individuen

Schritt 2: Generiere nächste Generation
- Kombination fittester Individuen

Schritt 3: Wiederhole bis Abbruchbedingung erfüllt

Ergebnis: Individuum mit höchster Fitness in letzter Generation

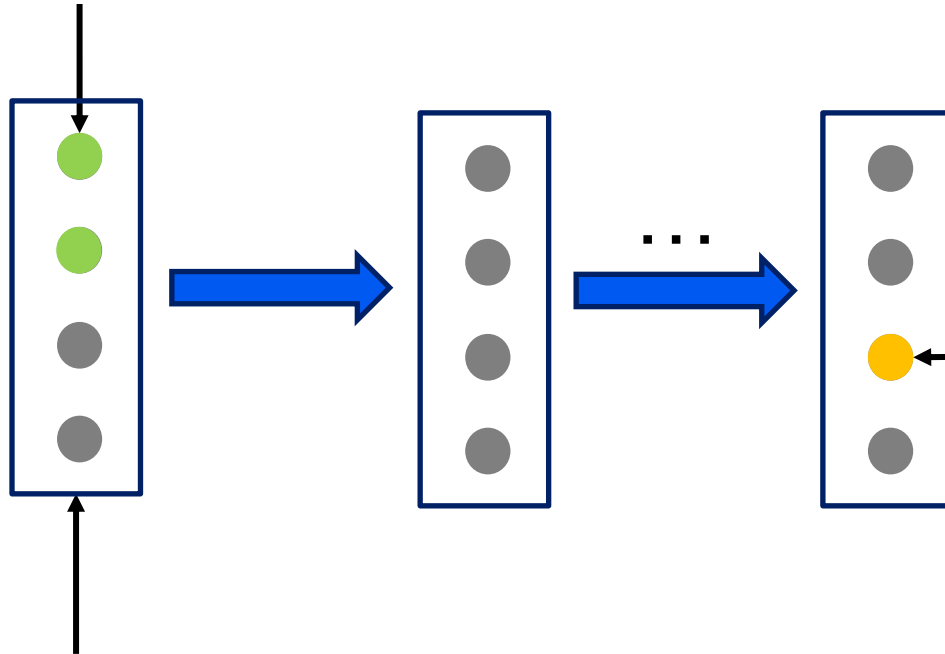


Generation
- Anzahl an Individuen

Live planning with genetic algorithms

Individual = one possible solution

- **Properties** = what makes this individual unique?
- **Fitness** = how well is goal satisfied by individual (based on properties)?



Generation

- Number of Individuals

Step 1: calculate „fittest“ Individuals

Step 2: Generate next Generation
- Combination of fittest individuals

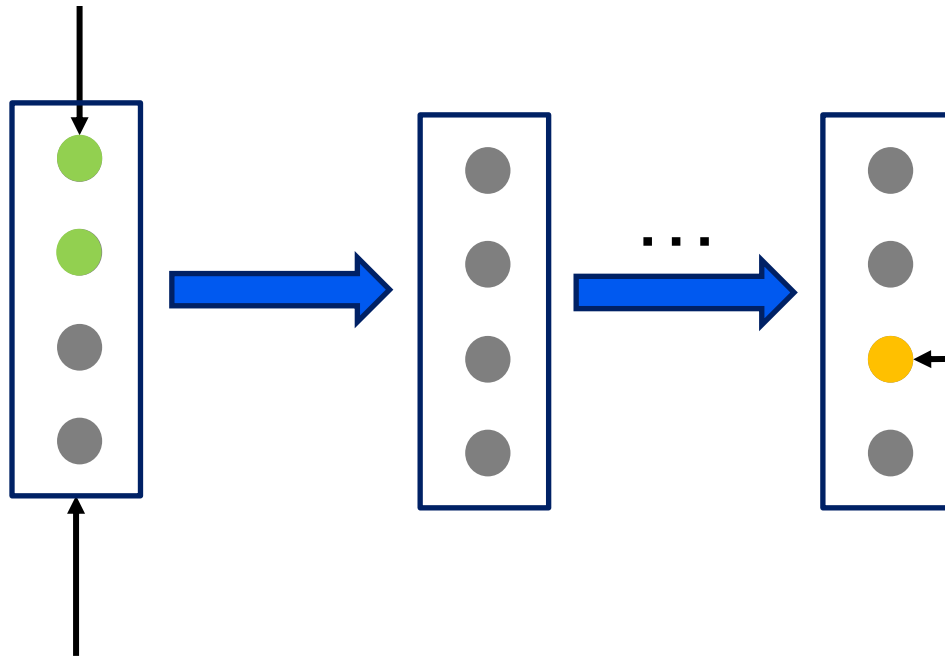
Step 3: Repeat until stop criteria met

Result: Best performing individual in last generation

Live planning with genetic algorithms

Individual = Plan

- **Properties** = actions to be executed
- **Fitness** = required time to reach goal



Generation

- Number of potential plans

Step 1: calculate „fittest“ Individuals

Step 2: Generate next Generation
- Combination of fittest individuals

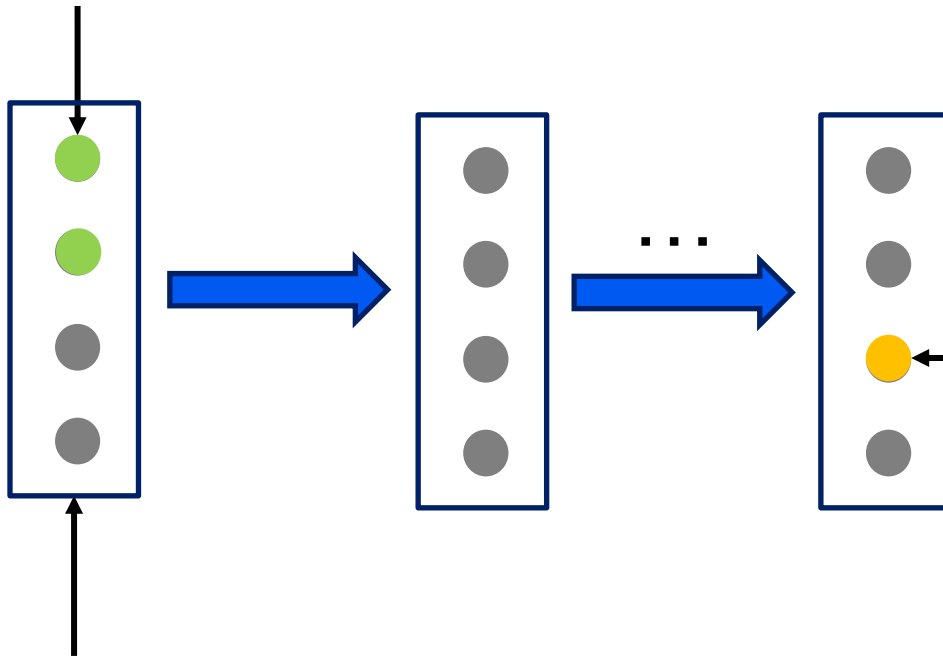
Step 3: Repeat until stop criteria met

Result: Plan with **min time** in last generation

Live-Planung mit Genetischen Algorithmen

Individuum = Plan

- **Eigenschaften** = gesetzte Aktionen
- **Fitness** = benötigte Zeit



Generation

- Anzahl möglicher Pläne


Schritt 1: berechne „fitteste“ Individuen

Schritt 2: Generiere nächste Generation
- Kombination fittester Individuen

Schritt 3: Wiederhole bis Abbruchbedingung

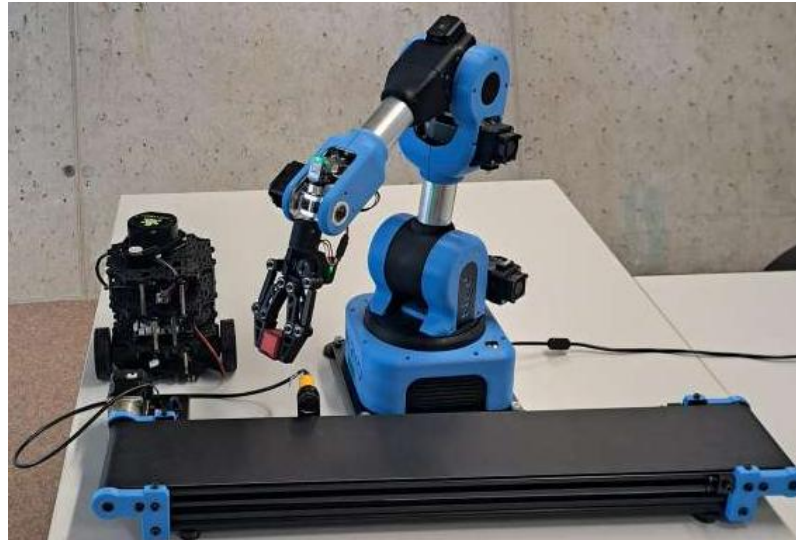
Ergebnis: Plan mit **min Zeit** in letzter Generation

What's our Goal?

✓ Predictive Maintenance 

✓ Anomaly Detection 

✓ Live Planning 



 Continuous Optimization

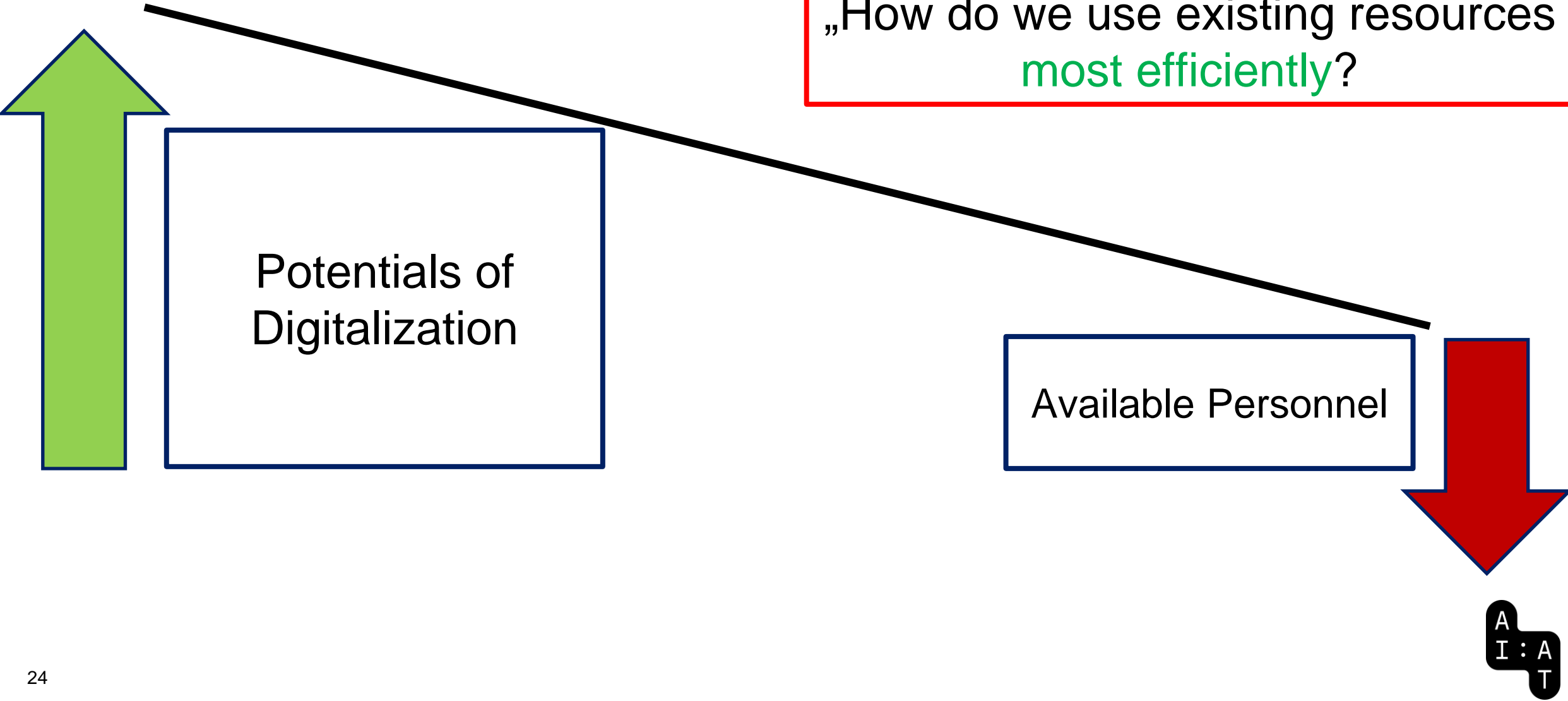
 Circular Economy

Innovation through Digitalization



#1 Challenge of Digitalization

„How do we use existing resources
most efficiently?“

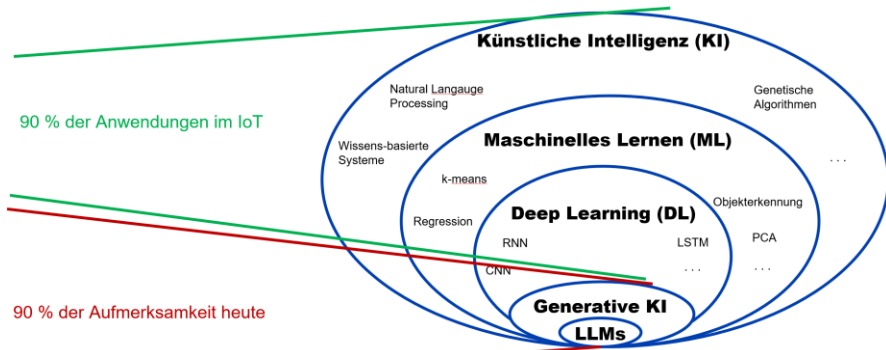


Potentials of
Digitalization

Available Personnel

Key Takeaways

„KI Tunnelblick“



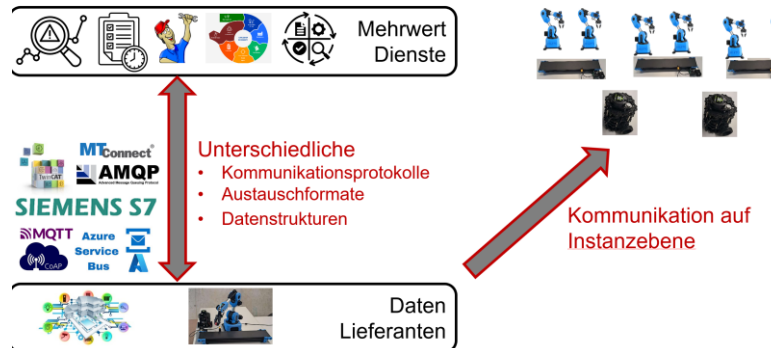
Source: https://www.linkedin.com/posts/javafifa_its-tunnel-vision-weve-fallen-into-the-activity-7386990451360387072-yf9K

Wo wollen wir hin?



Innovation durch Digitalisierung!

Aktuelle Herausforderungen in der Praxis



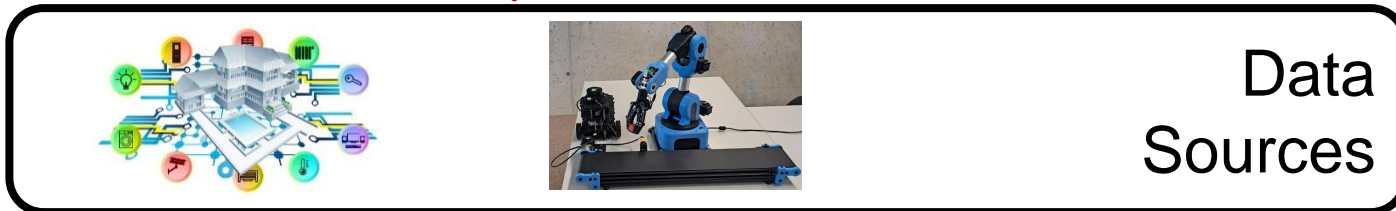
Where are we currently?



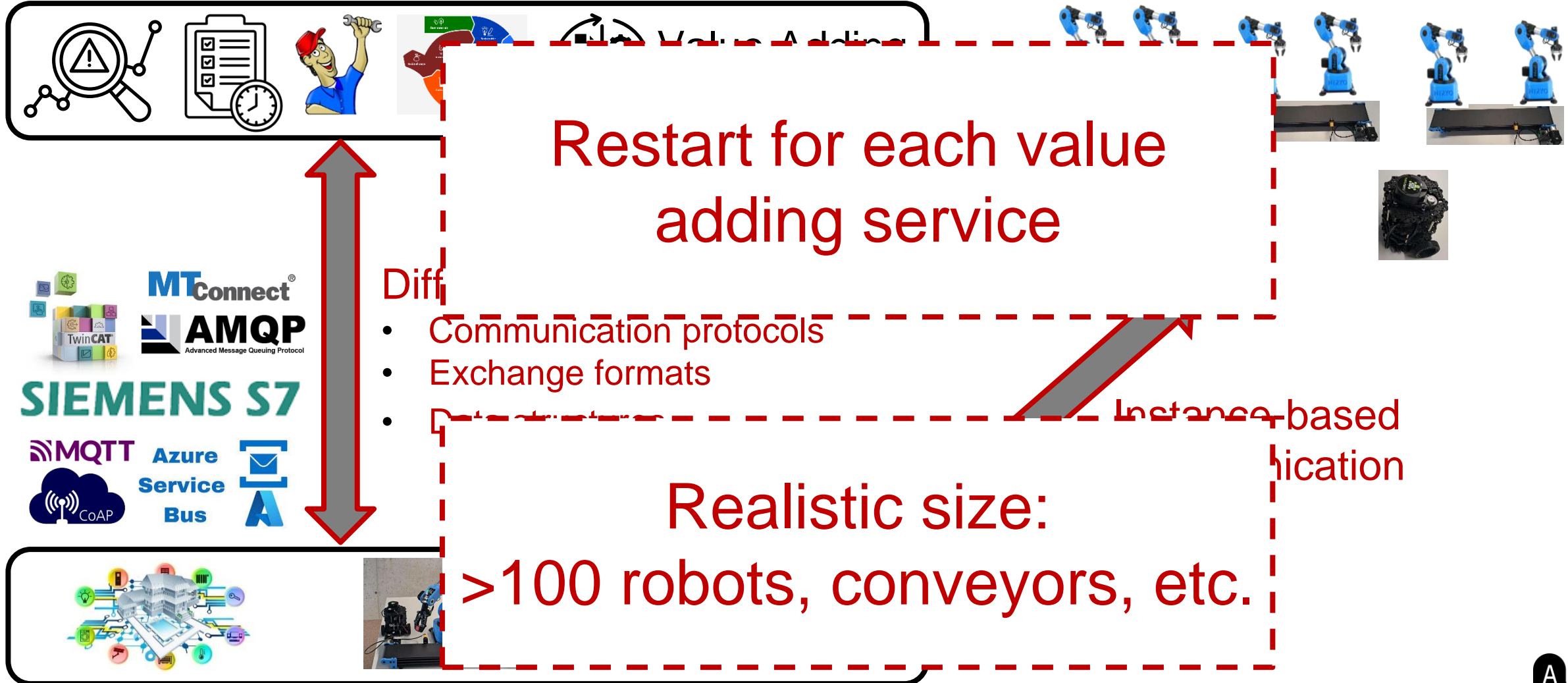
Different

- Communication protocols
- Exchange formats
- Data structures

Instance-based Communication

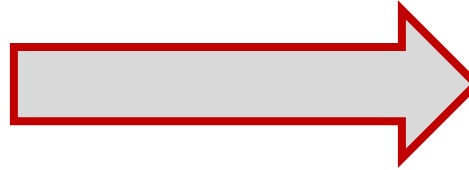


Where are we currently?



Challenges

Challenge 1:
Proprietary Systems

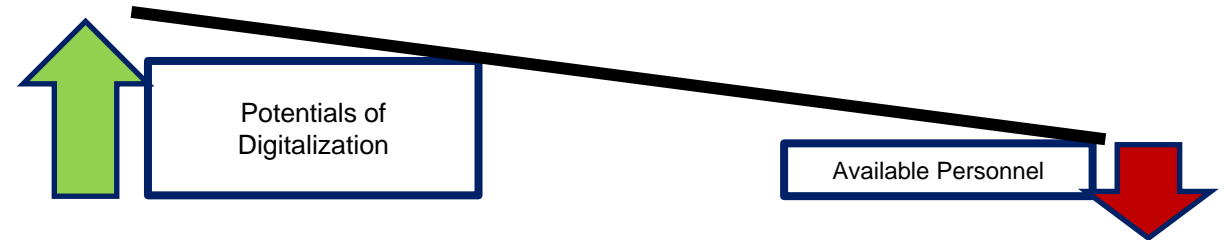


Interdisciplinary knowledge
required

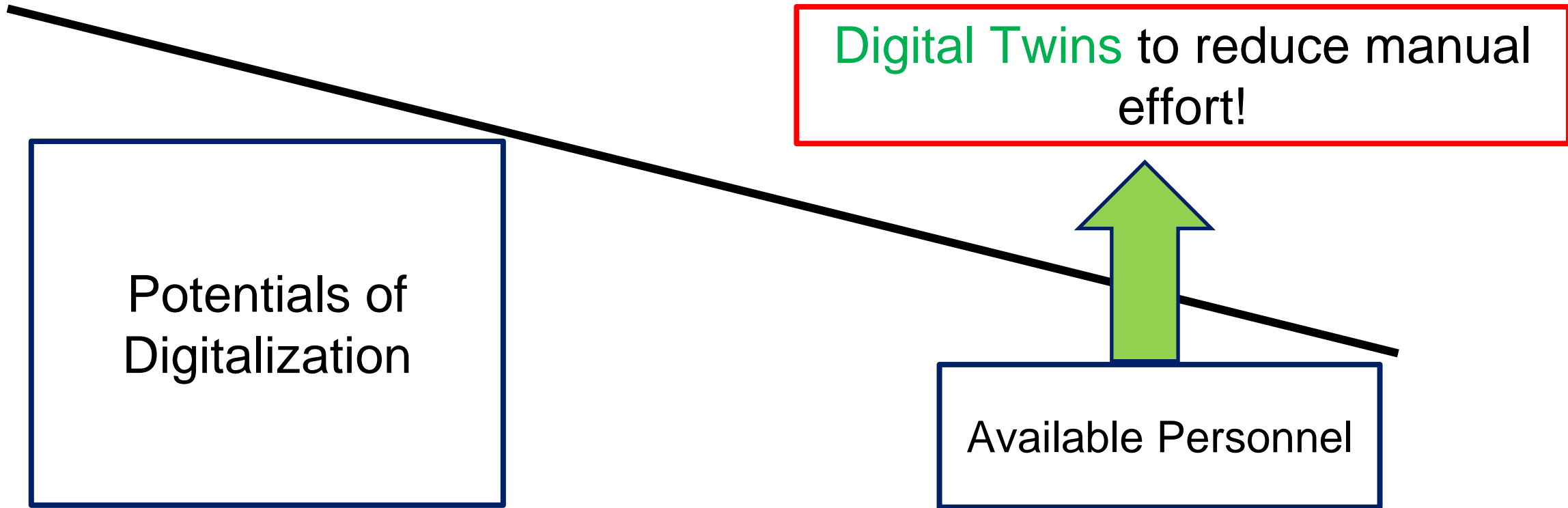
Challenge 2:
Instance-based communication



High manual effort due to
increasing complexity



Digital Twin as Solution



Contact

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and Infrastructure
Republic of Austria**

under discussion with



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