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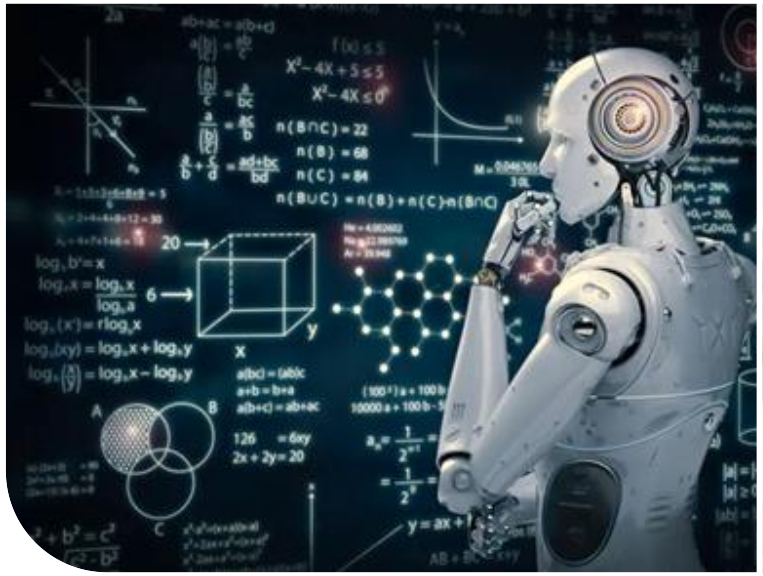
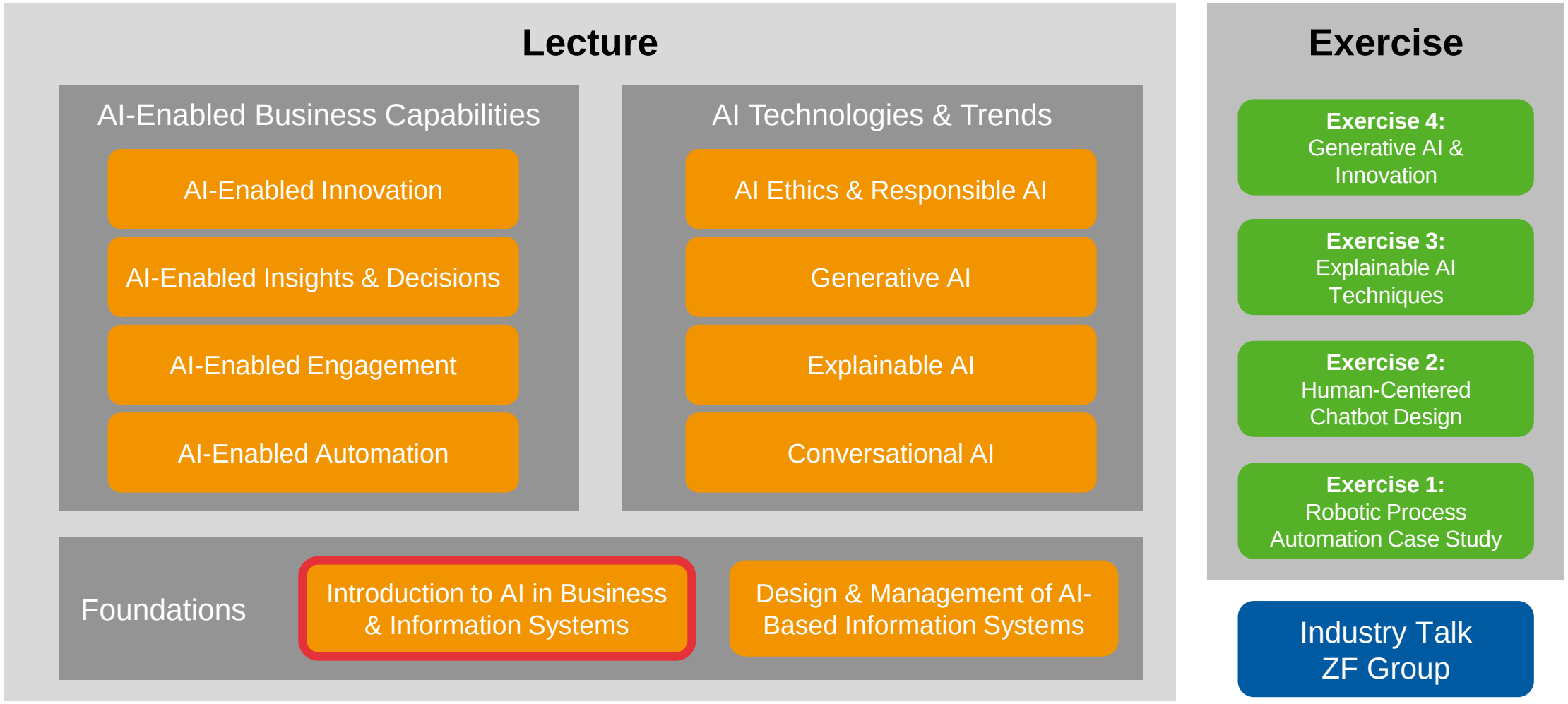
AI-Based Business Information Systems

Introduction to AI in Business & Information Systems



Prof. Dr. Ulrich Gnewuch

Course Organization



Learning Goals

- Define artificial intelligence (AI) based on the two dimensions of capability (thinking vs. acting) and performance (human vs. rational)
- Describe the key elements of an AI-based business information system and explain how they are related to each other
- Explain how AI-based business information systems are different from more traditional business information systems
- Explain why it is useful to look at AI through the lens of business capabilities rather than technologies

AI Offers New (Business) Opportunities …

Bored at work? How AI could come to the rescue

AI Creates New Business Models

HOW AI CAN HELP COMBAT CLIMATE CHANGE

AI Is a Game-Changer in the Fight Against Hunger and Poverty. Here's Why

… But Also Creates New (Business) Challenges

27% of jobs at high risk from AI revolution, says OECD

Rise of AI Puts Spotlight on Bias in Algorithms

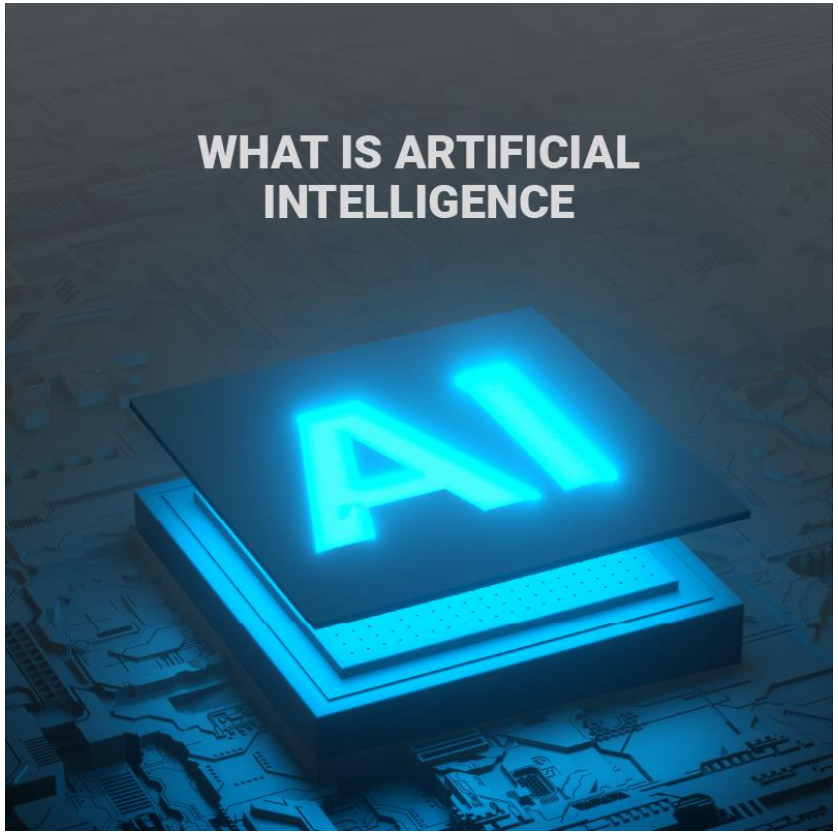
A.I. Could Soon Need as Much Electricity as an Entire Country

Is the AI apocalypse actually coming? What life could look like if robots take over

What is AI? What is an AI-based business information system?

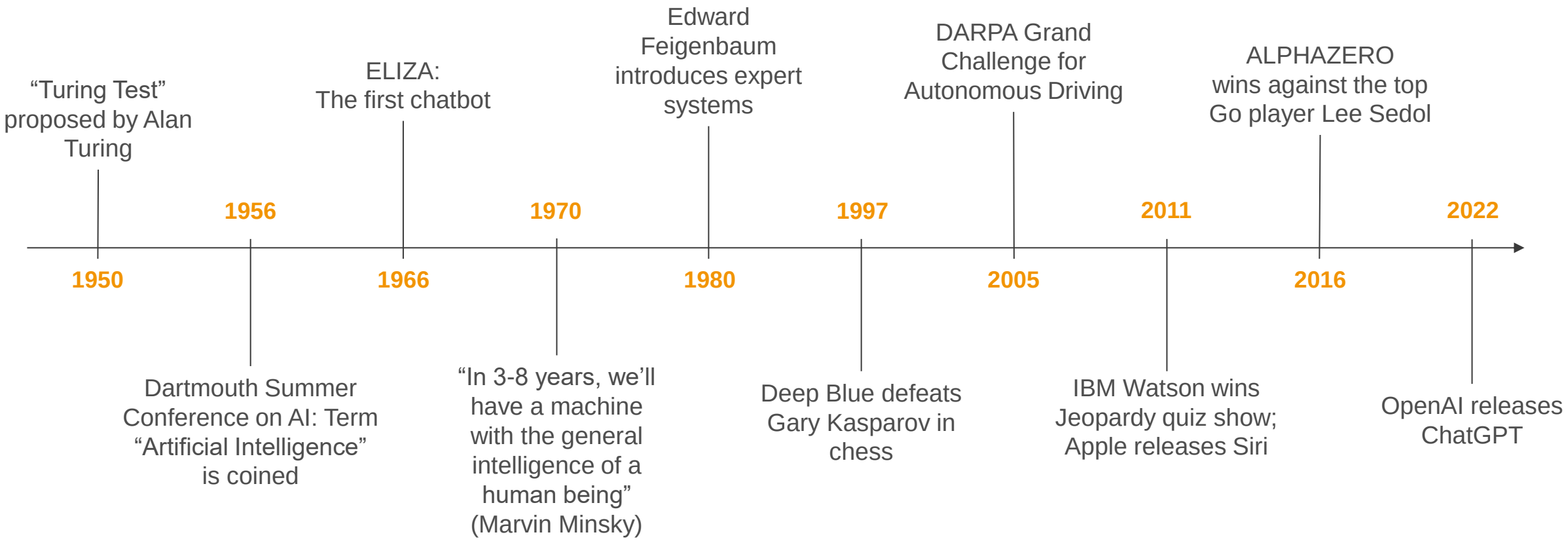
What is AI?

- No singular, agreed-upon definition for AI
- AI is not a technology or set of technologies, but a continually evolving frontier of emerging computing capabilities
- *“AI is whatever we are doing next in computing”:*
  - 1980s: Expert systems
  - 2000s: Machine learning / deep learning
  - 2020s: Generative AI
  - 2040s: ?



Berente et al. 2021

Milestones in the History of AI



OECD 2019

A Conceptual Approach to Defining AI

Natural language understanding
Computer vision

Machine learning / Deep learning (→ can process vast quantities of data)

Performance

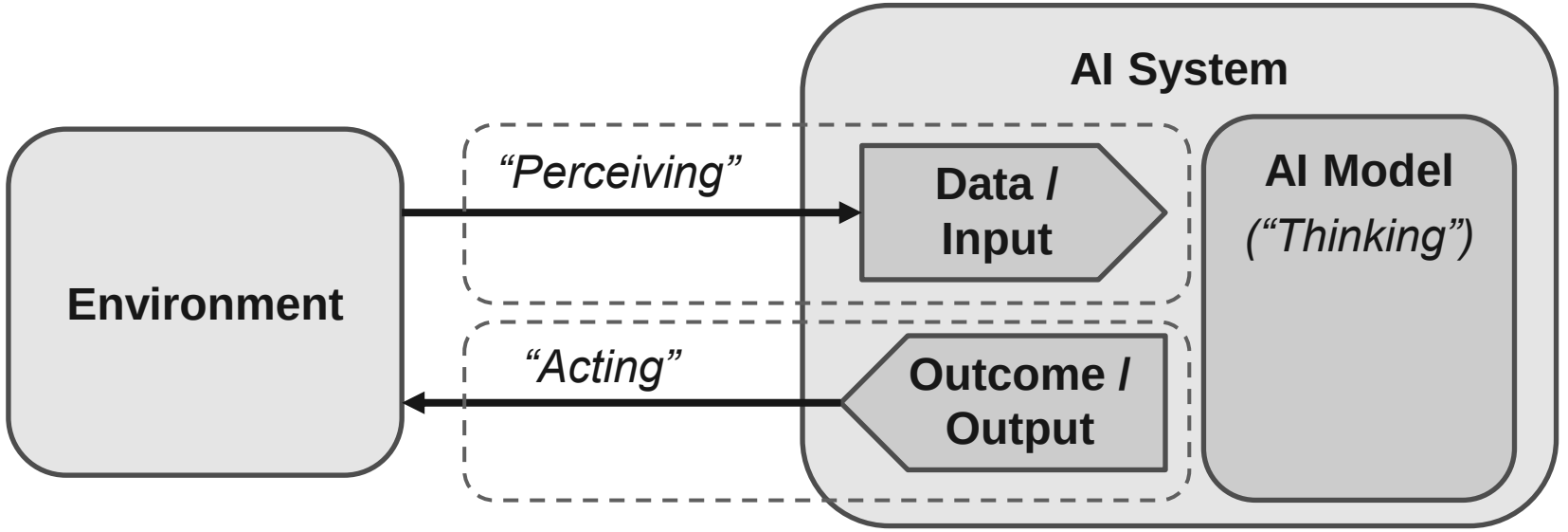
Capability	Human	Rational ("ideal")
Thought Processes	Thinking Humanly	Thinking Rationally
Behavior	Acting Humanly	Acting Rationally

Natural language generation
Industrial robots

Autonomous cars (→ can reduce accidents, traffic congestion, and fuel consumption)

Russel & Norvig, 2016

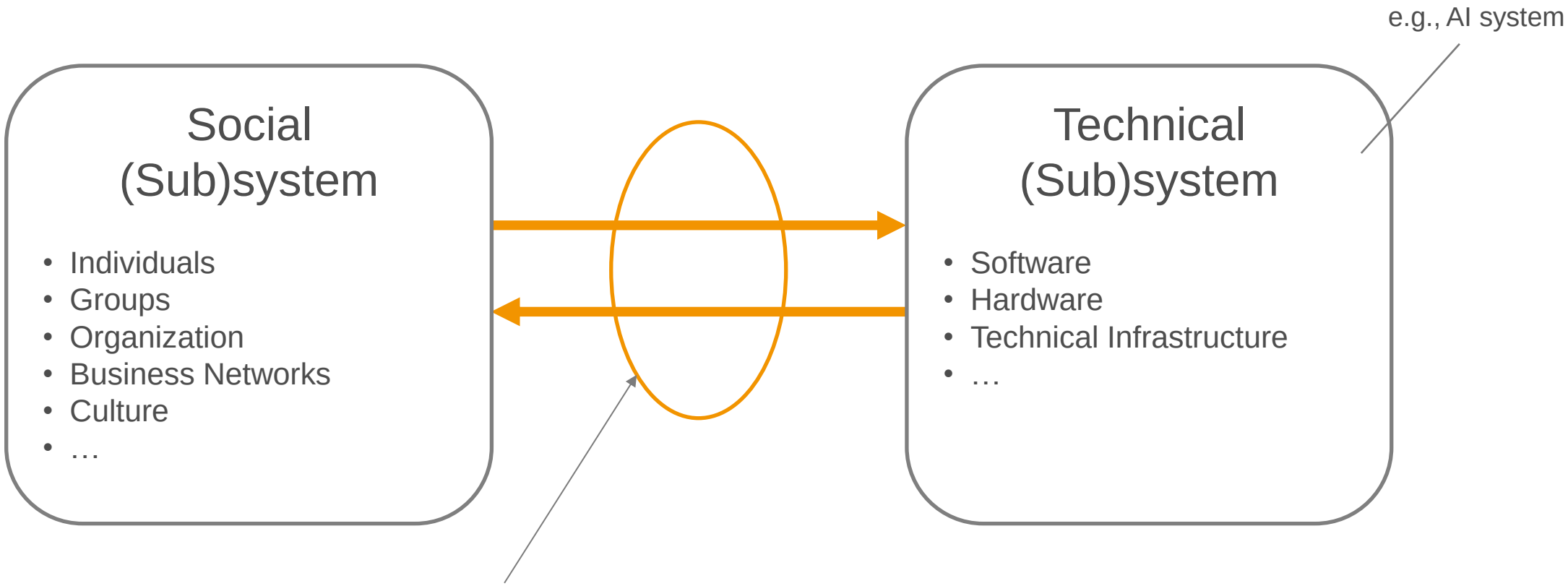
Technical Perspective on AI Systems



An AI system is a machine-based system that […] infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. *(based on OECD 2019)*

OECD 2019

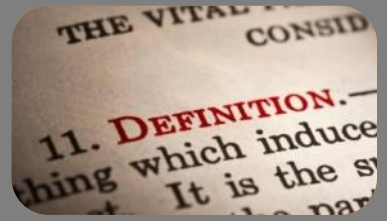
Socio-Technical Perspective



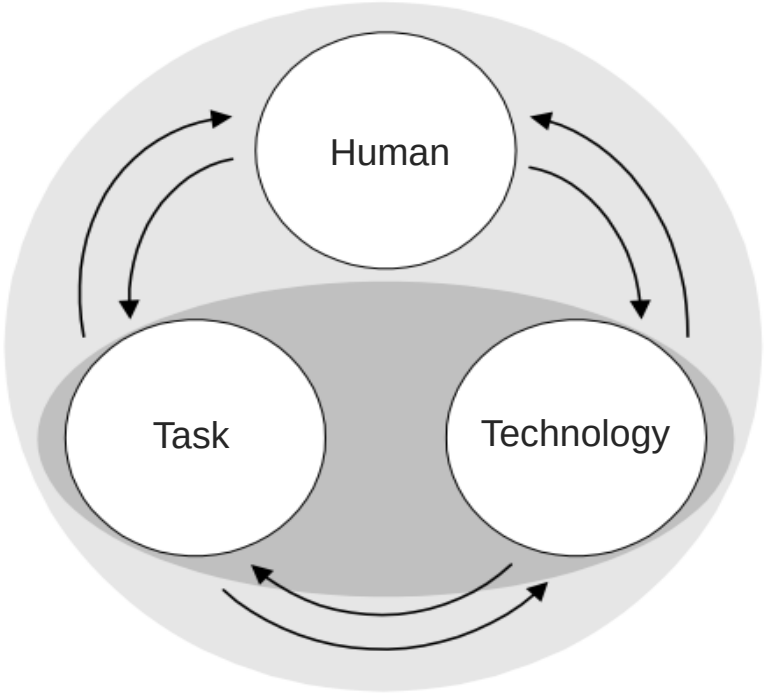
Reciprocal interactions between social subsystem and technological subsystem

Sarker et al. 2019

Definition: Information System (IS)



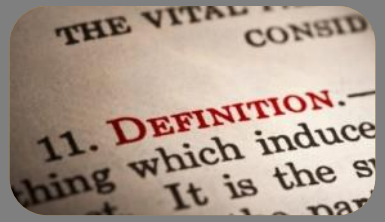
Information systems are socio-technical systems composed of the interrelated elements of human, task, and technology.



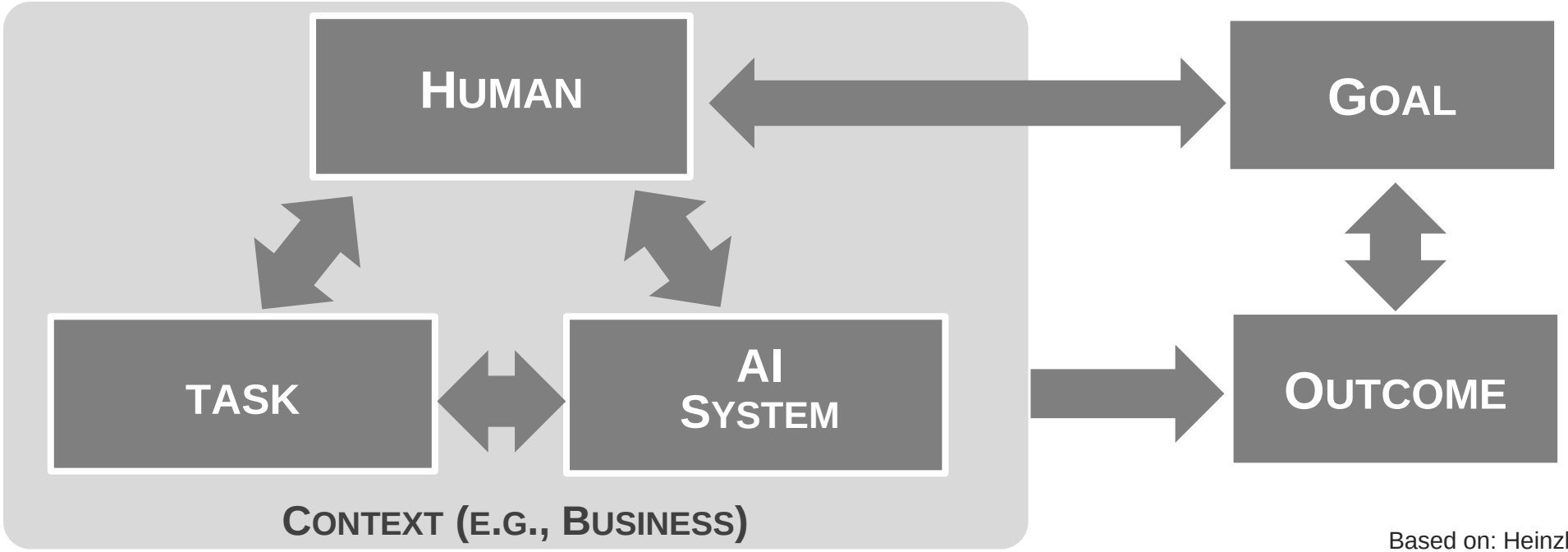
- Broad and generic definition applicable to any context (e.g., business, private life)
- Tasks can be embedded in more complex structures (e.g., organizational structures)
- Information technology (IT) can be any hard- or software (e.g., an AI system)

Heinzl et al. 2024

Definition: AI-Based (Business) Information System



AI-based information systems are socio-technical systems in which humans perform tasks by using an AI system in a specific context to achieve specific goals and outcomes.



Based on: Heinzl et al. 2024

(1) Human

People who interact with or are affected by an AI system when performing a task.

- The terms “human” and “user” are often used interchangeably
- This role not only includes people who directly interact with the AI technology (“users”) but also those affected by it in some way
- It also includes those involved in the planning, design and development, implementation and introduction, and maintenance of the AI system

Based on: Heinzl et al. 2024

(2) Task

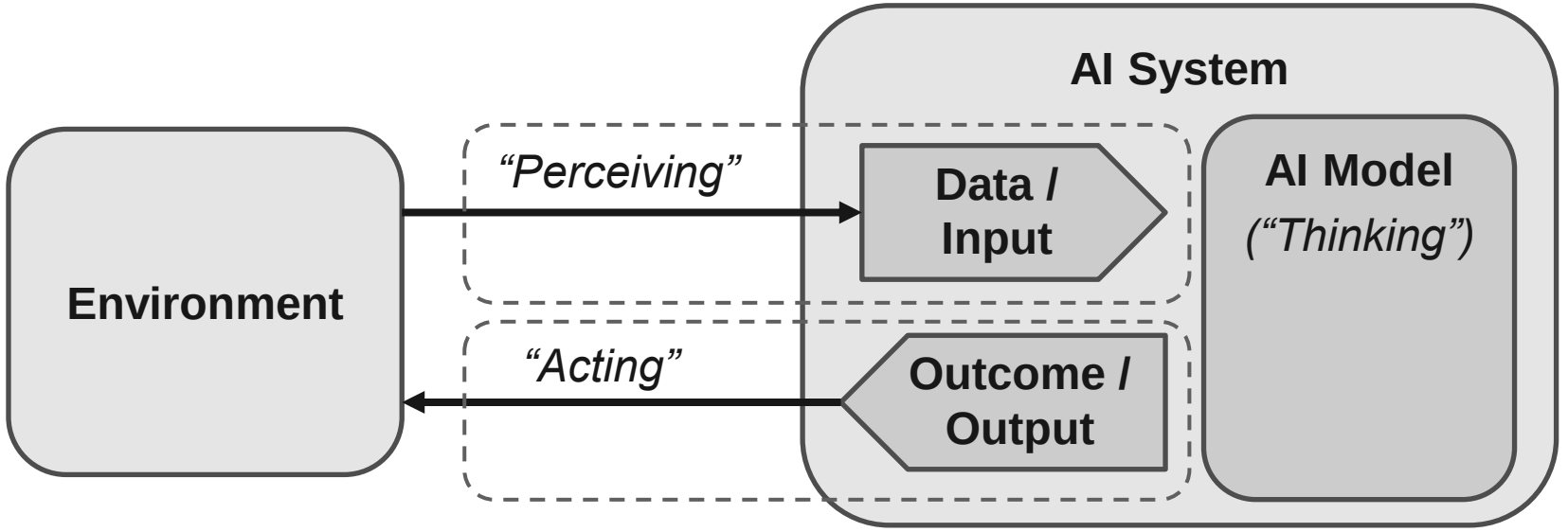
A set of activities undertaken in order to achieve a specific goal.

- Can refer to single tasks or larger groups of tasks (e.g., business processes)
- Includes many different types of tasks:
  - Work tasks (e.g., production, procurement, administration, logistics)
  - Design and development tasks (e.g., modelling of business processes, creation of software prototypes)
  - Private life tasks (e.g., online shopping, entertainment)

Heinzl et al. 2024

(3) AI System

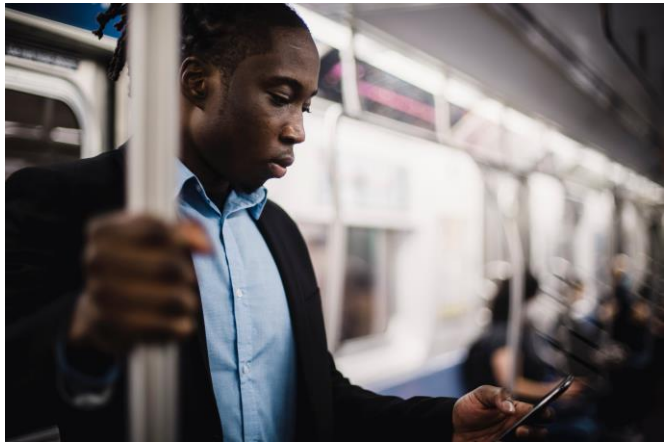
An AI system is a machine-based system that […] infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments.



OECD 2019

(4) Context

The physical, social, and technical conditions in which a human interacts with or is affected by the AI system.



(5) Goal

Goals are the targets or accomplishments that a human wants to achieve in the near or long term.

- A goal is typically expressed in the form of a condition or state
- In contrast, a task is typically expressed in the form of an activity
- Example:
  - Goal: Visit a friend in a small city, 100 km away
  - Task: Rent a car using a car rental website

(6) Outcome

Outcomes are the consequences or results of the interplay between the three elements of human, task, and AI system.

- Large variety of possible outcomes:
  - Instrumental outcomes (e.g., task performance, efficiency, productivity)
  - Psychological outcomes (e.g., satisfaction, happiness, well-being)
  - System outcomes (e.g., performance, errors)
  - …
- Can be immediate or downstream and intended or unintended

Sarker et al. 2019

Your Examples of AI-Based Business Information Systems

Please look at the conceptualization of AI-based business information systems and reflect on real-world examples of AI systems you are familiar with. What are the different elements (user, task, etc.) in your examples?

→Discuss this question with a partner for **~5 minutes** and be ready to share one example

How are AI-based business information systems different from more traditional business information systems?

How are AI-based business information systems different?

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Autonomy

"Acting without human intervention"

Learning

"Improving through data and experience"

Inscrutability

"Being unintelligible to specific audiences"

Berente et al. 2021; Baird & Maruping 2021

Autonomy

- AI-based business information systems have an increasing capacity to act on their own, without human intervention (and sometimes even without human knowledge!)
- Examples:
  - AI-driven credit underwriting software that automatically makes credit and loan decisions
  - Robotic process automation (RPA) bots that log into ERP systems and automatically execute business processes
  - Robo-advisor platforms that automatically rebalance investments
  - …

Autonomy

"Acting without human intervention"

Berente et al. 2021; Baird & Maruping 2021

Learning

- Previous generations of business information systems had limited ability to automatically improve through data and experience
- AI advances have enabled the learning capacity of AI-based business information systems to evolve from basic approaches for inductive learning to large-scale approaches (e.g., deep learning)
- Examples:
  - Product recommendation systems that learn from customers' shopping behavior in real time
  - Predictive maintenance software in manufacturing plants that learns from previous errors and breakdowns
  - AI-driven recruitment systems that learn from previous successful hires
  - …

Learning

"Improving through data and experience"

Berente et al. 2021

Inscrutability

- AI-based business information systems and their outputs often are intelligible only to a select audience (e.g., developers, data scientists)
- For others, such as managers or business users, they can be a “black box”
- Examples:
  - AI-based credit and loan decisions that are difficult to understand for financial advisors in a bank
  - AI-based sales forecasts that are difficult to understand for sales managers
  - AI-based therapy recommendations that are difficult to understand for medical professionals
  - …

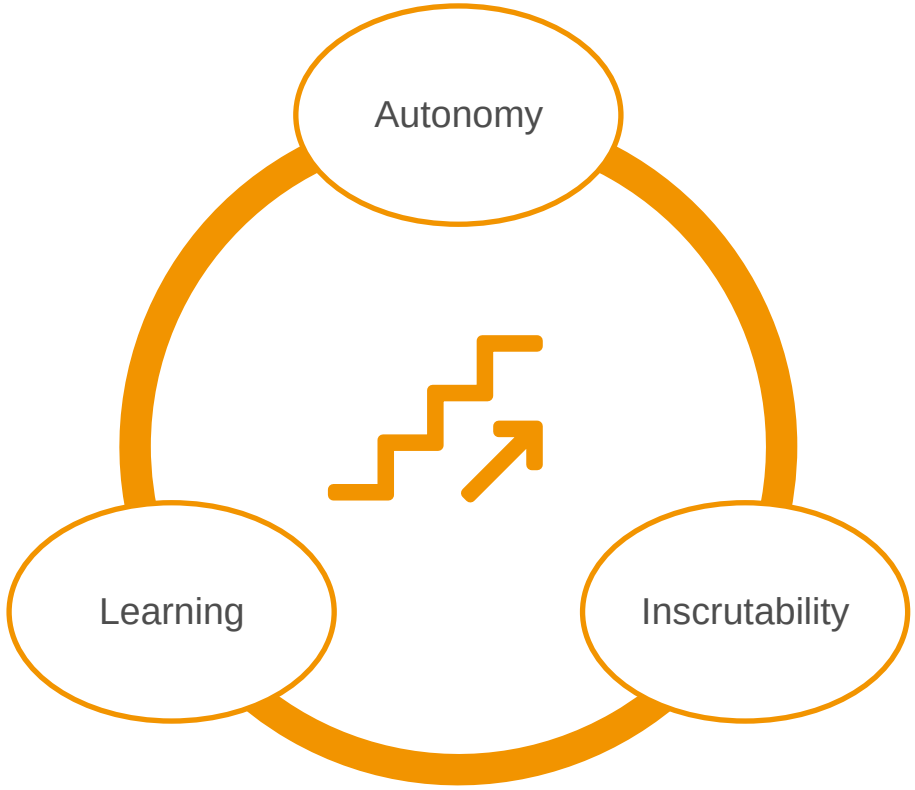
Inscrutability

“Being unintelligible to specific audiences”

Berente et al. 2021

Autonomy + Learning + Inscrutability

- Autonomy, learning, and inscrutability are interdependent facets that feed into each other:
  - Learning contributes to, and results from, autonomy
  - Both autonomy and learning result in inscrutability
- The levels of autonomy, learning, and inscrutability continue to increase!



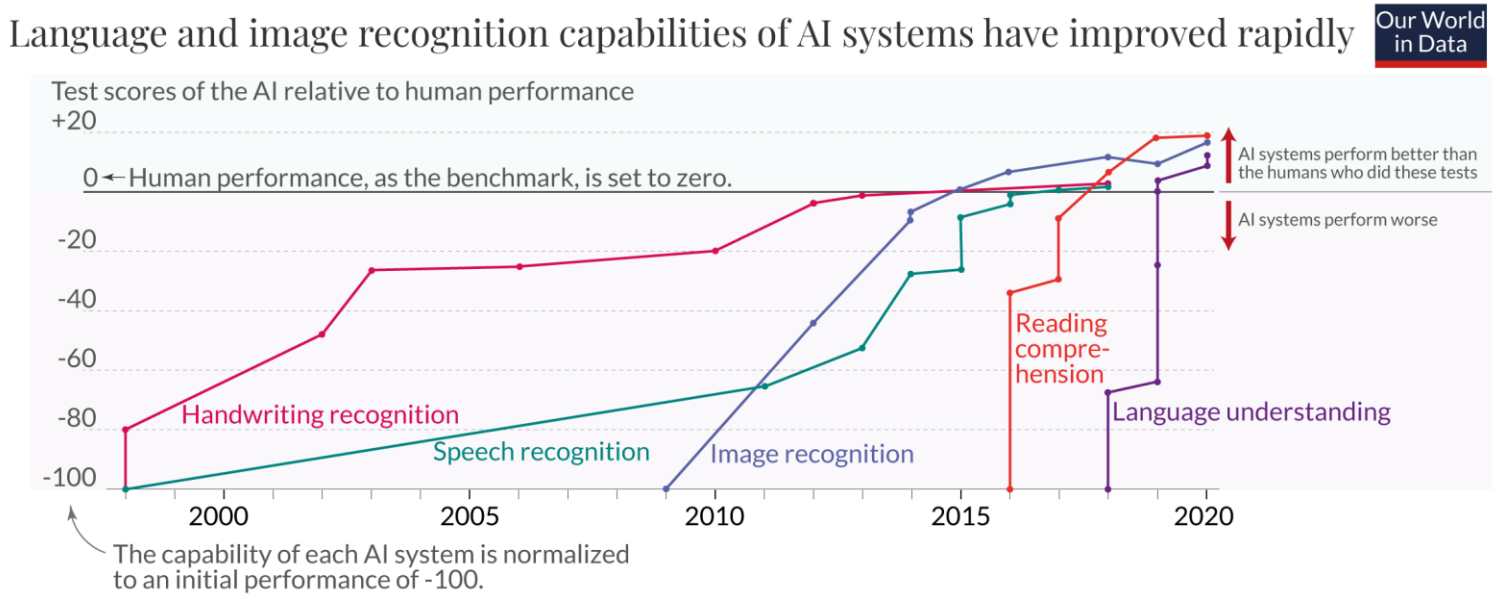
Berente et al. 2021

How can AI create business value?

How (Some) Organizations View AI …

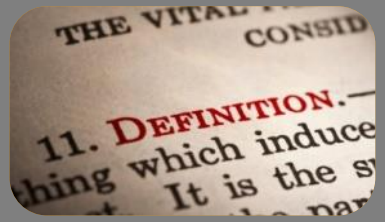
Rapid Pace of AI Development

- AI capabilities have developed rapidly, and AI technology continues to advance at a rapid pace (see LLMs)
- Technology is constantly evolving
- Rather than looking at AI through a technological lens, it is useful to look at it through the lens of *business capabilities*



Giattino et al. 2023

Business Capabilities



Business capabilities refer to the core activities and competencies that enable an organization to achieve its business objectives and deliver value to its stakeholders. *(based on Margherita 2014)*

- Ask: What business needs and objectives can AI support? How and where can AI be used to enhance core business activities or enable new ones?
- Instead of: Which data could we use for machine learning? How can we leverage large language models?

Davenport & Ronaki 2018; Benbya et al. 2021

AI-Enabled Business Capabilities

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Automation

Engagement

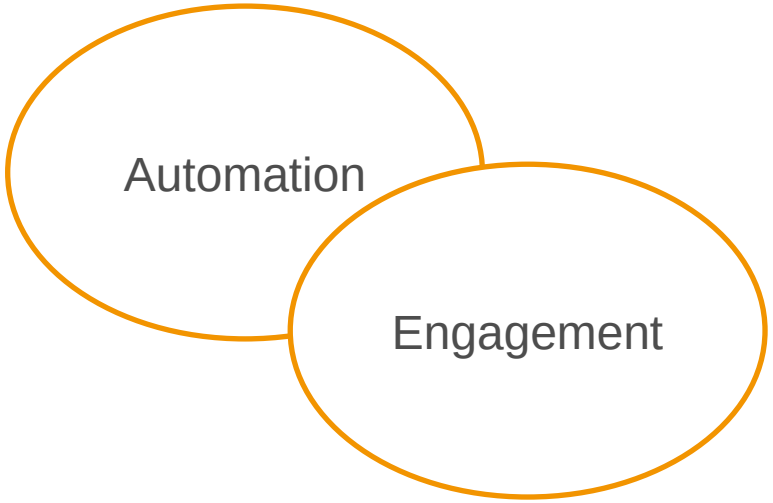
Insights & Decisions

Innovation

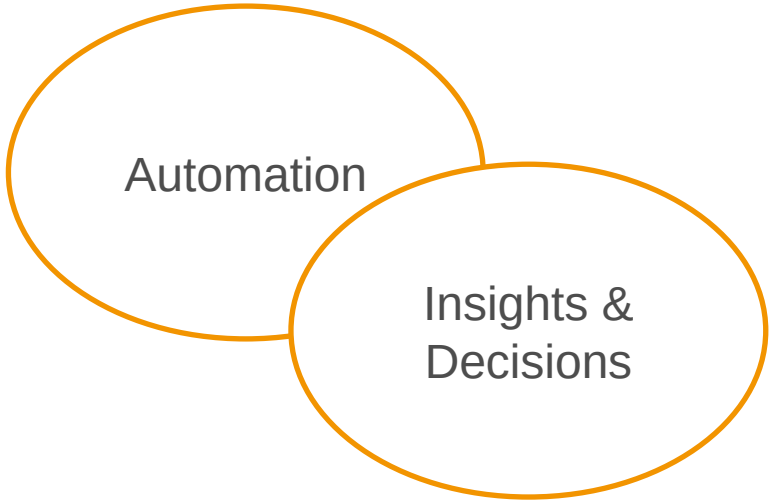
Local Interpretable Model-agnostic Explanations

Benbya et al. 2021

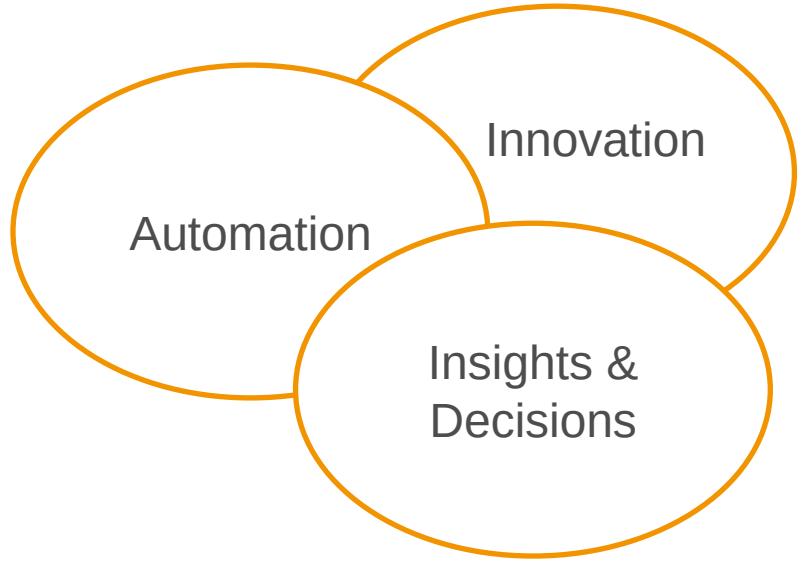
Multiple Business Capabilities Are Possible!



Customer service chatbots



Automated loan decision-making



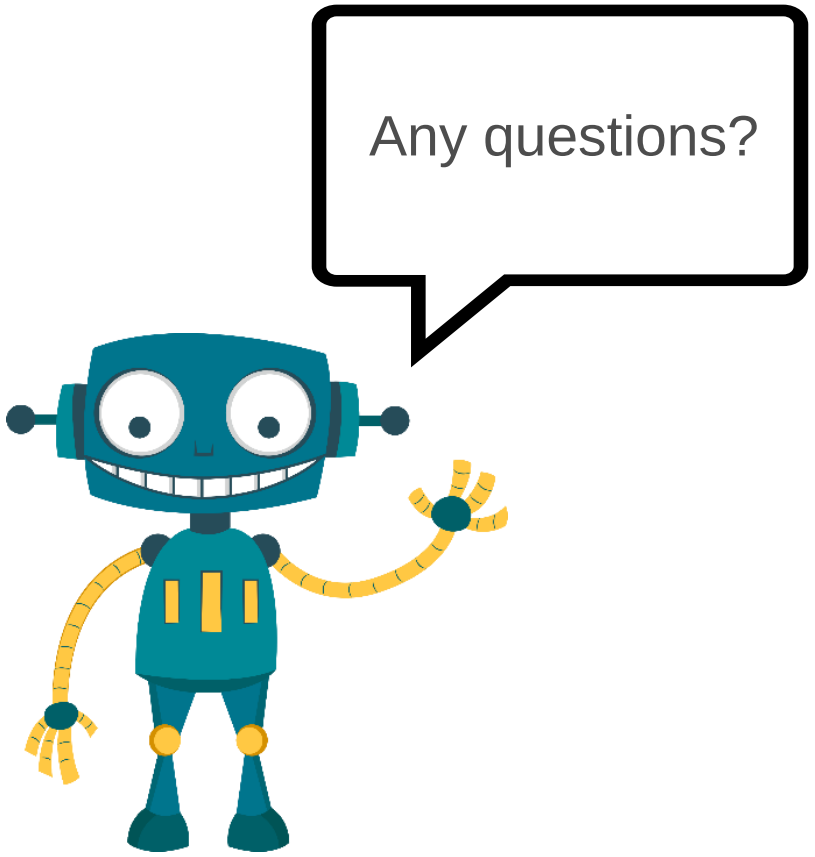
Recommendation systems (e.g., Netflix)

Benbya et al. 2021

Key Takeaways From This Lecture

- There is no single, agreed-upon definition of AI, but one way to define AI is to consider the two dimensions of capability (thinking vs. acting) and performance (human vs. rational)
- AI-based (business) information systems are socio-technical systems: It is not only about the AI system but also about humans, tasks, goals, and outcomes
- AI-based business information systems are different from more traditional business information systems in three facets: autonomy, learning, and inscrutability
- AI-based information systems enable different (and sometimes multiple) business capabilities:
  - Automation, engagement, insights & decisions, innovation

Thank you for your attention!



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