

# Applied Artificial Intelligence

## 01 - Foundations

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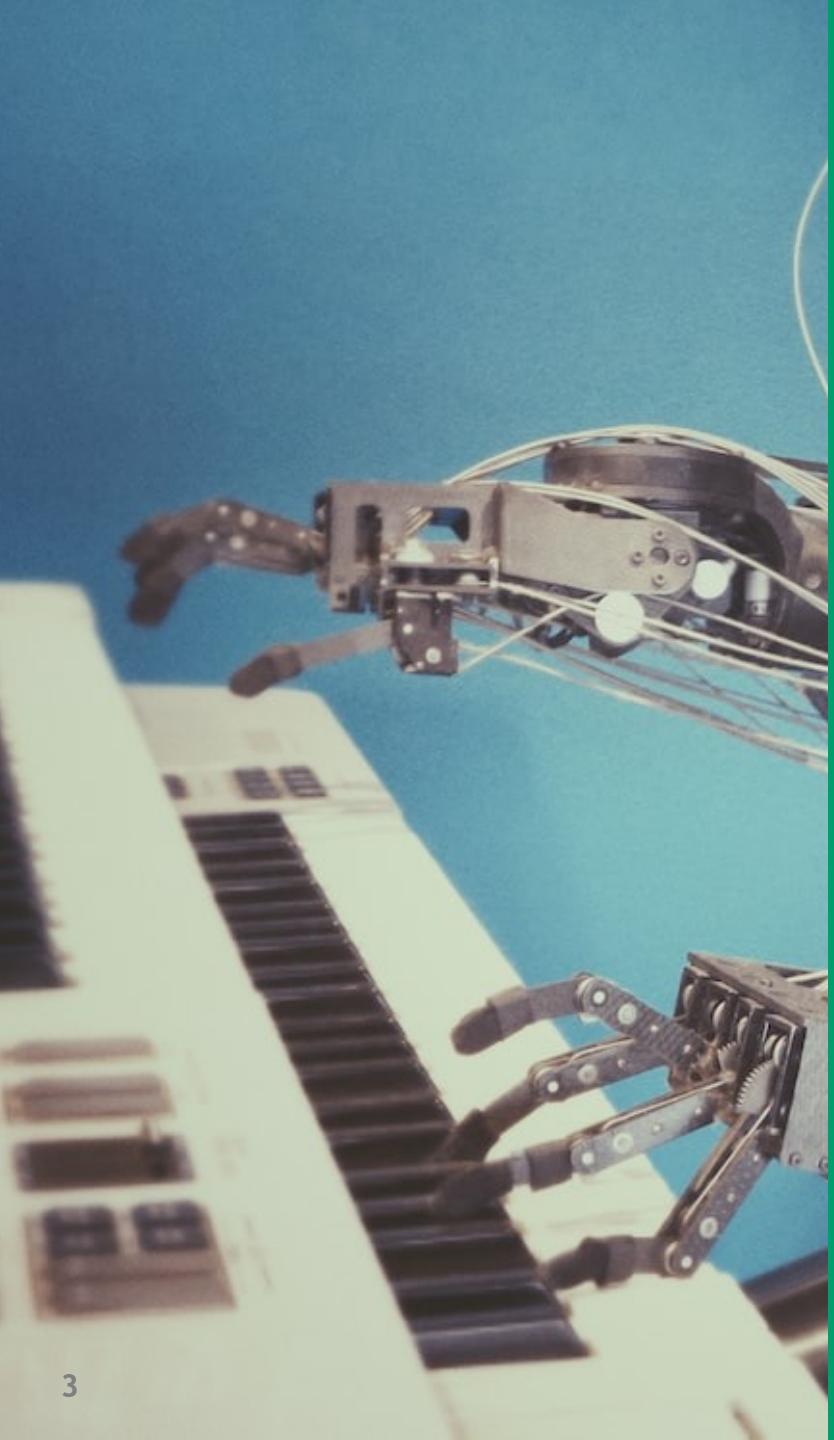
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# Objectives of this lecture

Become familiar with the terminology, in particular Artificial Intelligence, Machine Learning and Systems Thinking

Gain a first understanding of the AI lifecycle



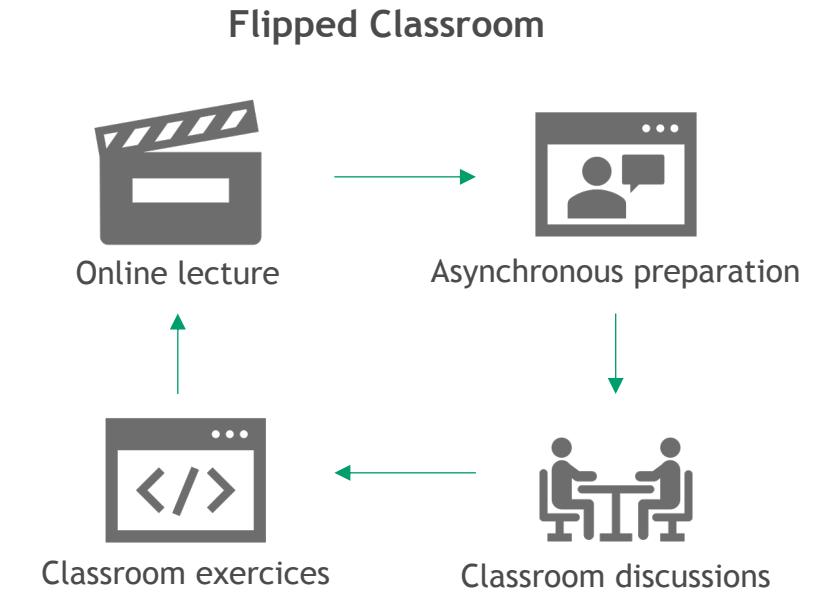
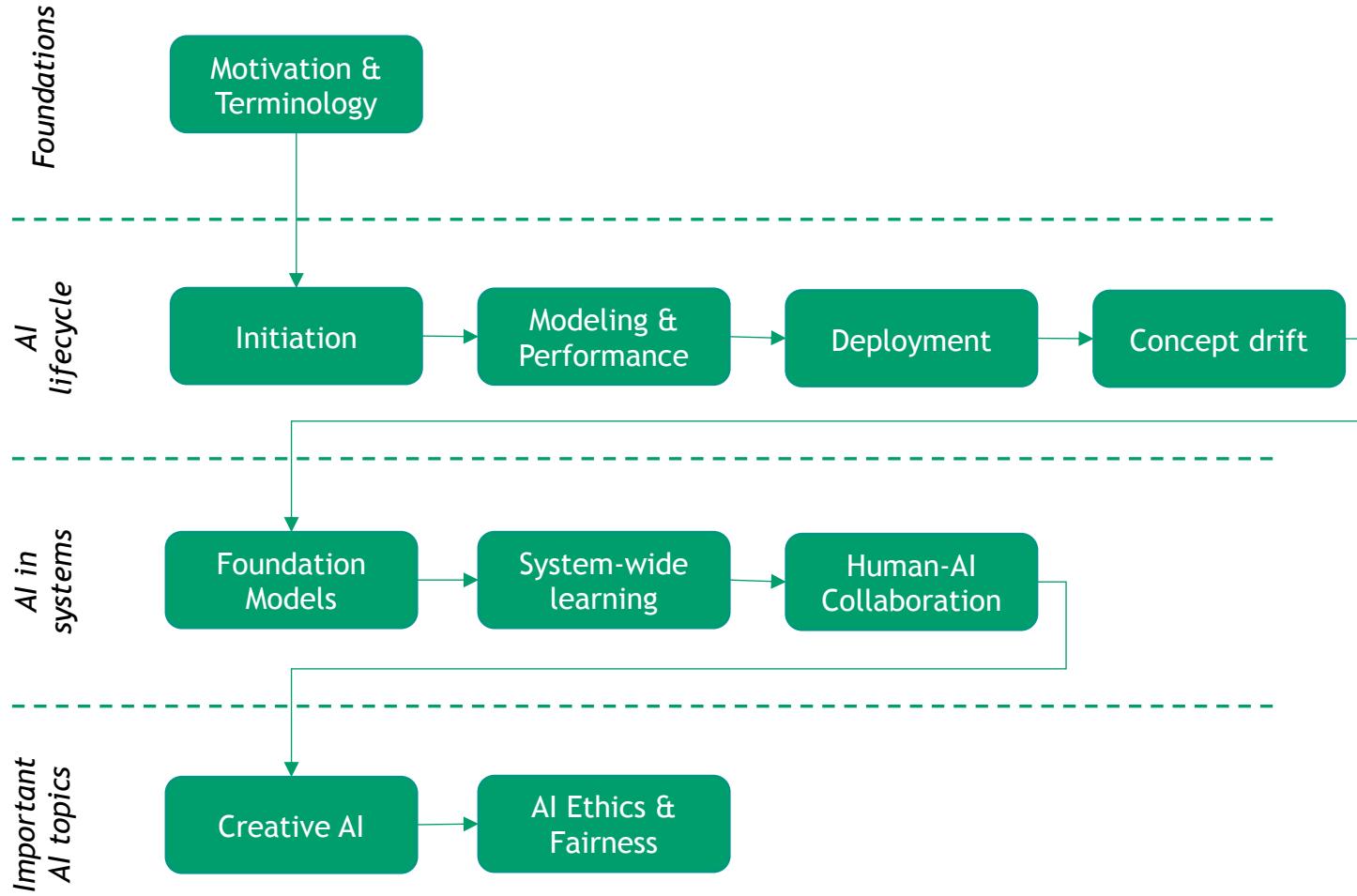
- 1 Organizational
- 2 Artificial Intelligence & Machine Learning
- 3 Systems Thinking
- 4 The AI Lifecycle



- 1 Organizational
- 2 Artificial Intelligence & Machine Learning
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- 4 The AI Lifecycle

# Organizational

## The story of the lecture

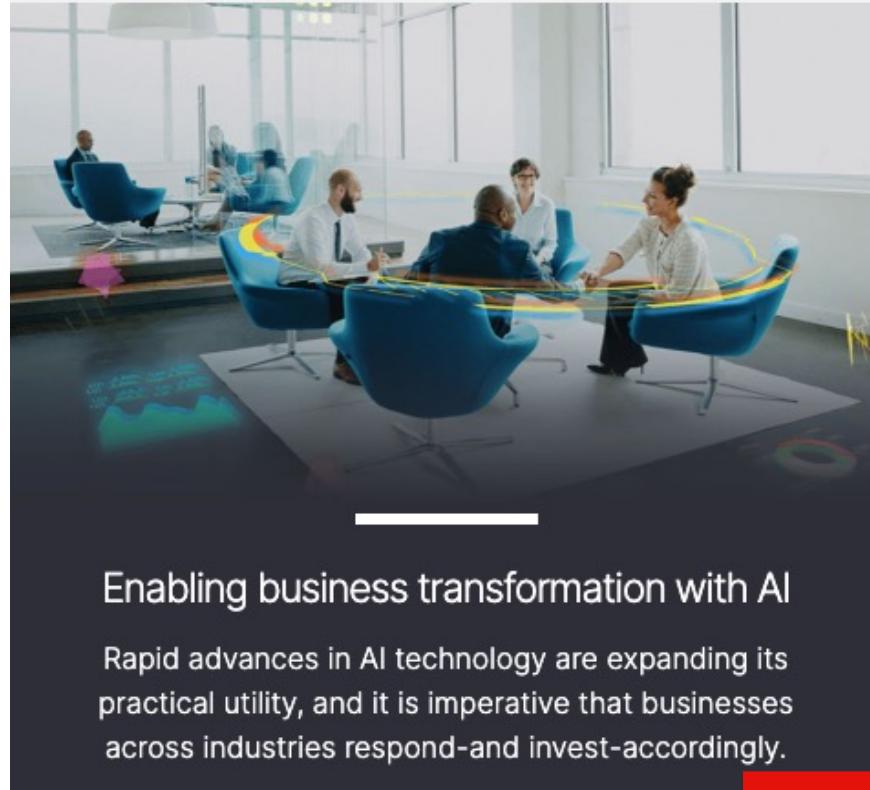




- 1 Organizational
- 2 Artificial Intelligence & Machine Learning
- 3 Systems Thinking
- 4 The AI Lifecycle

# Artificial Intelligence & Machine Learning

## Why AI? A business perspective.



Artificial intelligence  
is driving real  
business innovation

How organizations can build and  
scale game-changing generative AI  
services



June 14th 2024

The Washington Post

<https://impact.economist.com/projects/facing-the-future-with-ai/enabling-business-transformation-with-ai/> [1]  
<https://www.washingtonpost.com/creativegroup/aws/artificial-intelligence-is-driving-real-business-innovation/> [2]

# Artificial Intelligence & Machine Learning

## Why AI? A research perspective.

 www.nature.com/jbg

**REVIEW ARTICLE** OPEN Check for updates

# Advances in AI and machine learning for predictive medicine

Alok Sharma<sup>a,1,2</sup>, Artem Lysenko<sup>2,3</sup>, Shangru Jia<sup>a</sup>, Keith A. Boroevich<sup>2,4</sup> and Tatsuhiko Tsunoda<sup>2,4,5</sup>

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The field of omics, i unprecedented opp analysis and interpret models in omics as This review explore convolutional neur in tabular (table-like effectiveness. This app and improving per issues related to the approach, involving illuminates these co analysis and related

Health Sciences Review 10 (2024) 100150

Contents lists available at ScienceDirect

**Health Sciences Review**

journal homepage: [www.elsevier.com/locate/hsr](http://www.elsevier.com/locate/hsr)

**Journal of Human G**

**INTRODUCTION**  
Recent advances in g deep learner into t. Among these, one example of approach greatly improved our understanding many import this research. We propose solutions to unlock its I from the insufficient capture of full disease numbers of variants, vari often small and conte isms that translate gen integration of genetic i

**Talha Iqbal**<sup>a,b,\*</sup>, **Mehedi Masud**<sup>a</sup>, **Bilal Amin**<sup>a,c</sup>, **Conor Feely**<sup>d</sup>, **Mary Faherty**<sup>d</sup>, **Tim Jones**<sup>d</sup>, **Michelle Tierny**<sup>e</sup>, **Atif Shahzad**<sup>a,e</sup>, **Patricia Vazquez**<sup>b</sup>

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**ARTICLE INFO**

**Kyoword:**  
Artificial intelligence  
Recommender systems  
Personalized healthcare  
Performance validation

**ABSTRACT**

In the era of big data, artificial intelligence (AI) algorithms have the potential to revolutionize healthcare by improving patient outcomes and reducing healthcare costs. AI algorithms have frequently been used in health care for predictive modelling, image analysis and drug discovery. Moreover, as a recommender system, these algorithms have shown promising impacts on personalized healthcare. A recommender system is a system that recommends the behaviour of the user and predicts the user's next purchase (or preference) based on their previous preferences. Implementing AI as a recommender system improves this prediction accuracy and solves cold start and data sparsity problems. However, most of the methods and algorithms are tested in a simulated setting which cannot recapitulate the influencing factors of the real world. This review article systematically reviews prevailing research in AI-based recommender systems and discusses AI algorithms as a recommender system. A detailed discussion of the field of healthcare. It also provides a summary around the latest AI-based cutting-edge academic and practical contributions present in the literature, identifies challenges in the implementation of AI as a recommender system, and acceptance of AI-based recommender systems by clinicians. The findings of this article direct researchers and professionals to comprehend currently developed recommender systems and the future of medical devices integrated with real-time recommender systems for personalized healthcare.

# Medical

frontiers | Frontiers in Environmental Science

TYPE Review  
PUBLISHED: 20 February 2024  
DOI: 10.3389/fenvs.2024.1336088

OPEN ACCESS

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RECEIVED: 10 February 2023  
ACCEPTED: 06 February 2024  
PUBLISHED: 20 February 2024

CITATION

Popeciu SM, Mansoor S, War  
Sharma V, Sharma A, Arya VM  
Hou D, Bokar M and Chung Y  
Intelligent sensing and AI-driven  
technologies for IoT-driven  
environmental pollution moni  
toring and management.

Front. Environ. Sci. 12:1336088.  
doi: 10.3389/fenvs.2024.1336088

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# Artificial intelligence and IoT driven technologies for environmental pollution monitoring and management

Contents lists available at ScienceDirect  
**Environmental Science and Ecotechnology**  
journal homepage: [www.journals.elsevier.com/environmental-science-and-ecotechnology/](http://www.journals.elsevier.com/environmental-science-and-ecotechnology/)

## Review

### The synergistic interplay of artificial intelligence and digital twin in environmentally planning sustainable smart cities: A comprehensive systematic review

Simon Elias Bibri <sup>a,1</sup>\*, Jeffrey Huang <sup>a</sup>, Senthil Kumar Jagathesaperumal <sup>b</sup>, John Krogstie <sup>c</sup>

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#### ARTICLE INFO

##### Article history:

Received: 06 December 2023

Received in revised form

14 May 2024

Accepted: 15 May 2024

##### Keywords:

Sustainable smart cities  
Artificial intelligence  
Artificial intelligence of things  
Urban digital twin  
Data-driven urban planning  
Environmental planning  
Environmental sustainability

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#### ABSTRACT

The development of sustainable smart cities is witness to a significant paradigm shift due to the integration of emerging technologies, such as technologies and innovative models. These advancements are reshaping data-driven planning strategies, practices, and approaches, thereby facilitating the achievement of environmental sustainability goals. The transformative wave signals a fundamental shift – marked by the synergistic operation of artificial intelligence (AI), Internet of things (IoT), and digital twin (DT) – in which each technology has its unique role to play. In this study, we have analyzed the AIoT, DT, and UDT in isolation, a significant knowledge gap exists regarding their synergistic interplay, collaborative integration, and collective impact on data-driven environmental planning in the dynamic context of sustainable smart cities. To address this gap, this study presents a comprehensive systematic review to answer four main research questions: 1. What are the theoretical and practical applications of AIoT, DT, and UDT in data-driven environmental planning? 2. How can these technologies be integrated and used to support decision-making processes in environmental sustainability in sustainable smart cities? 3. How can AI and AIoT complement the capabilities of DT to enhance data-driven environmental planning processes in sustainable smart cities? 4. What challenges are barriers in integrating AI, AIoT, DT, and UDT in data-driven environmental urban planning, and what strategies can be devised to surmount or mitigate them? Methodologically, this study involves a rigorous analysis and synthesis of studies

# Environmental

www.nature.com/scientificreports/

**scientific reports**

**OPEN**

# Opportunities and challenges of integrating artificial intelligence in

Information Development  
OnlineFirst  
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<https://doi.org/10.1177/0266699321100628>

**Sage Journals**

## *Original Manuscript*

### Artificial intelligence in developing countries: The impact of generative artificial intelligence (AI) technologies for development

Nishith Reddy Mannuru, Sakib Shahriar, Zoë A Ted, Ting Wang, Brady D Lund , Solomon Al-Etijani, Chalermpchai Oak Phobsoon, Daniel Agbaji , Joy Alhassan, Jacklyn Galley, Raana Kousari, Lydia Ogbadu-Oladapo, Shubham Kumar Saurav , Aishwarya Srivastava, Sai Priya Tummuru, Sravya Uppala, and Praveenkumar Vaidya

**Abstract**  
 This paper explores the potential impact of Generative Artificial Intelligence (Generative AI) on developing countries, considering both positive and negative effects across various domains of AI development, culture, and industry. Generative Artificial Intelligence refers to artificial intelligence (AI) systems that generate content, such as text, audio, or video, aiming to produce novel and creative outputs based on training data. Compared to conversational artificial intelligence, generative AI systems have the unique capability of not only providing replies but also generating the content of those responses. Recent advancements in Artificial Intelligence during the Fourth Industrial Revolution, exemplified by tools like ChatGPT, have gained popularity and reshaped content production and creation. However, the benefits of generative artificial intelligence are not equally accessible to all, especially in developing countries, where limited access to cutting-edge technologies and inadequate infrastructure pose challenges. This paper seeks to understand the potential impact of generative AI technologies on developing countries, considering economic growth, access to technology, and the potential paradigm shift in education, healthcare, and the environment. The findings emphasize the importance of providing the necessary support and infrastructure to ensure that generative AI contributes to inclusive development rather than deepening existing inequalities. The study highlights the significance of integrating Generative AI into the context of the Fourth Industrial Revolution in developing countries, where technological change is a crucial determinant of progress and equitable growth.

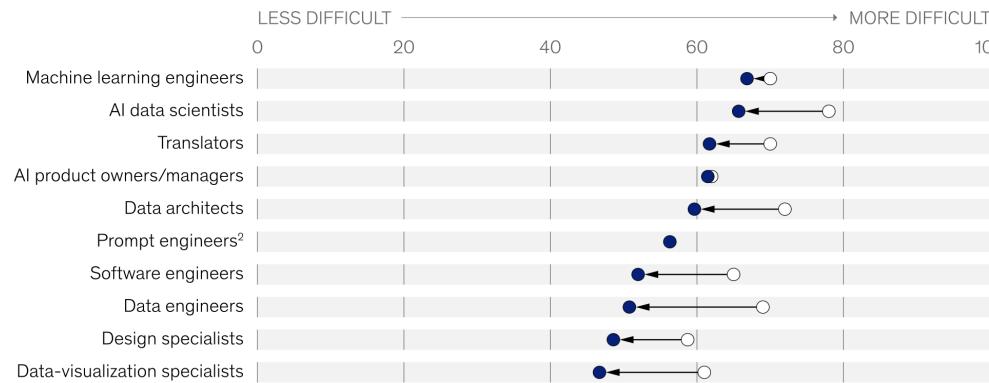
# Social

# Artificial Intelligence & Machine Learning

## ...but why now? It is not just ChatGPT.

Hiring for AI-related roles remains a challenge, though reported difficulty has decreased since 2022 for many roles.

Share of respondents reporting difficulty in organizations' hiring of AI-related roles,<sup>1</sup> %



<sup>1</sup>Asked only of respondents whose organizations have adopted AI in at least 1 function and who said their organization hired the given role in the past 12 months. Respondents who said "easy," "neither difficult nor easy," or "don't know" are not shown.

<sup>2</sup>Not asked of respondents in 2022.

Source: McKinsey Global Survey on AI, 1,684 participants at all levels of the organization, April 11–21, 2023

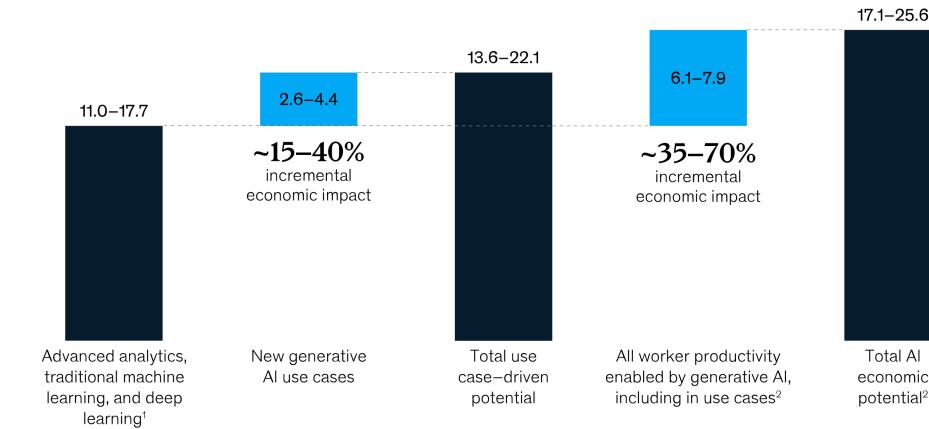
McKinsey & Company

### Report August 1, 2023

[www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year](http://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year)

Generative AI could create additional value potential above what could be unlocked by other AI and analytics.

AI's potential impact on the global economy, \$ trillion



<sup>1</sup>Updated use case estimates from "Notes from the AI frontier: Applications and value of deep learning," McKinsey Global Institute, April 17, 2018.

<sup>2</sup>The range of potential value from the combined impact of new generative AI use cases and the increased worker productivity they could enable is \$6.1 trillion to \$7.9 trillion, including revenue impacts conservatively translated into productivity impact as difference between total impact and cost-isolated impact.

McKinsey & Company

### Report: August 25, 2023

<https://www.mckinsey.com/featured-insights/mckinsey-explainers/whats-the-future-of-generative-ai-an-early-view-in-15-charts>

# Artificial Intelligence & Machine Learning

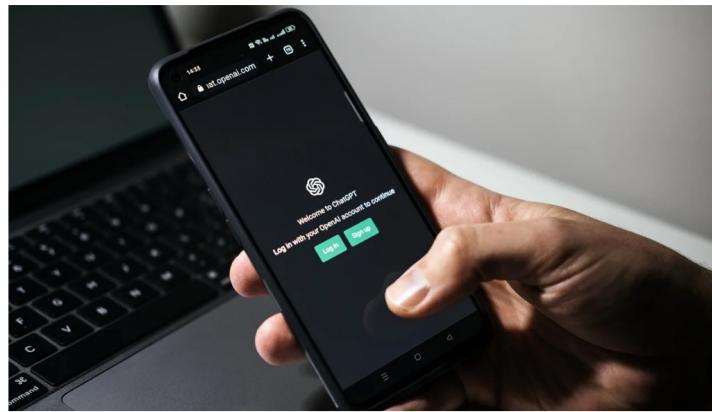
## What are the challenges in application?

### Bias in Data

[1]

**AI can be racist, sexist and creepy. What should we do about it?**

 Analysis by Zachary B. Wolf, CNN  
Published 9:29 AM EDT, Sat March 18, 2023



The ChatGPT chatbot developed by OpenAI.

### Labor Conditions

[2]

News • Policy & Finance  
**AI boom is dream and nightmare for workers in Global South**

Lax labour regulations and low wages are the norm for data annotation workers in poorer nations, but many have no choice.



In the Philippines - long an outsourcing destination for its young, English-speaking population - freelance data annotation on platforms such as Upwork has become highly competitive. Image: ILO Asia-Pacific, CC BY-SA 3.0, via Flickr.

Thomson Reuters Foundation

6 minute read • March 16, 2023

### Sustainability

[3]

**Artificial Intelligence Is Booming—So Is Its Carbon Footprint**

Greater transparency on emissions could also bring more scrutiny



Pipes pass through the chiller plant at a Google data center in Changhua, Taiwan. Photographer: Ashley Pory/Bloomberg

By [Josh Saul](#) and [Dina Bass](#)

9 March 2023 at 15:00 CET

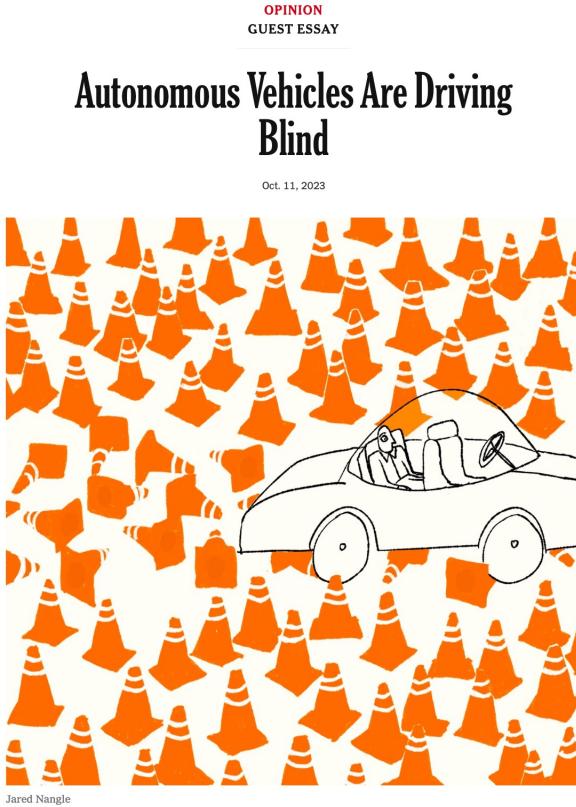
<https://edition.cnn.com/2023/03/18/politics/ai-chatgpt-racist-what-matters/index.html> [1]

<https://www.eco-business.com/news/ai-boom-is-dream-and-nightmare-for-workers-in-global-south/> [2]

<https://www.bloomberg.com/news/articles/2023-03-09/how-much-energy-do-ai-and-chatgpt-use-no-one-knows-for-sure?embedded-checkout=true> [3]

# Artificial Intelligence & Machine Learning

## Is it safe though? Appropriate Reliance.



[1]

### ChatGPT provided better customer service than his staff. He fired them.

Artificial intelligence is rapidly changing the world of customer service and call centers. Developing economies worry they'll face the brunt.



By Pranshu Verma

October 3, 2023 at 7:00 a.m. EDT



(Davide Bonazzi for The Washington Post)

[2]

### Appropriate Reliance on AI Advice: Conceptualization and the Effect of Explanations

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**ABSTRACT**  
AI advice is becoming increasingly popular, e.g., in investment and medical treatment decisions. As this advice is typically imperfect, decision-makers have to exert discretion as to whether actually follow that advice: they have to "appropriately" rely on correct and turn down incorrect advice. However, current research on appropriate reliance still lacks a common definition as well as an operational measurement concept. Additionally, no in-depth behavioral experiments have been conducted that help understand the factors influencing this behavior. In this paper, we propose Appropriate Reliance of Advice (AoR) as an underlying, quantifiable two-dimensional concept of advice seeking. We propose a research model that analyzes the effect of providing explanations for AI advice. In an experiment with 200 participants, we demonstrate how these explanations influence the AoR and, thus, the effectiveness of AI advice. Our work contributes fundamental concepts for the analysis of reliance behavior and the purposeful design of AI advisors.

**CCS CONCEPTS**  
• Human-centered computing → Empirical studies in HCI • Computing methodologies → Artificial intelligence.

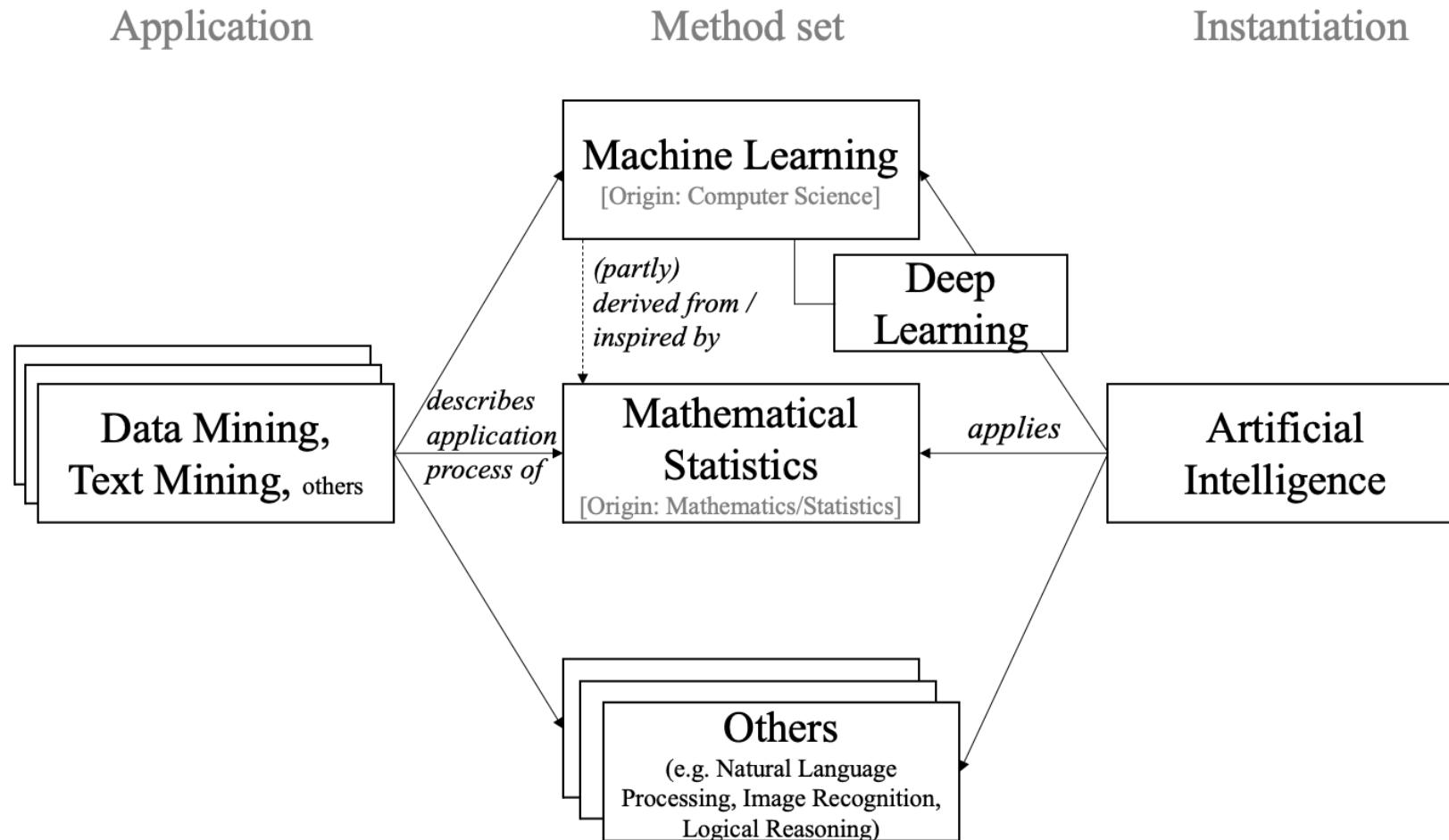
**KEYWORDS**  
Appropriate Reliance, Explainable AI, Human-AI Collaboration, Human-AI Complementarity

**ACM Reference Format:**  
Max Schemmer, Niklas Kühl, Carina Benz, Andrea Bartos, and Gerhard Satzger. 2023. Appropriate Reliance on AI Advice: Conceptualization and the Effect of Explanations. In *28th International Conference on Intelligent User Interfaces (IUI '23)*, March 27–31, 2023, Sydney, NSW, Australia. ACM, New York, NY, USA, 13 pages. <https://doi.org/10.1145/3581641.3584066>

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IUI '23, March 27–31, 2023, Sydney, NSW, Australia  
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ACM ISBN 979-8-4007-0106-1/23/03. \$15.00  
<https://doi.org/10.1145/3581641.3584066>

# Artificial Intelligence & Machine Learning

## So many terms - What do they mean?



# Artificial Intelligence & Machine Learning

## What is AI? Is Mark Zuckerberg really talking about AI?



[1]

In Mark Zuckerberg's US senate hearing in April 2018,  
he stressed the necessary capabilities of Facebook's

**“AI tools (...) to (...) identify hate speech (...)” or “  
(...) terrorist propaganda”**

The Washington Post (2018), Transcript of Mark Zuckerberg's Senate hearing [1]

# Artificial Intelligence & Machine Learning

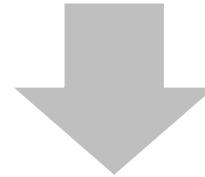
## Different views on AI definitions.

### Research Currents:

Different scientific viewpoints on what constitutes important aspects of AI research

### Agent-based AI:

Agents are the central instantiation of AI

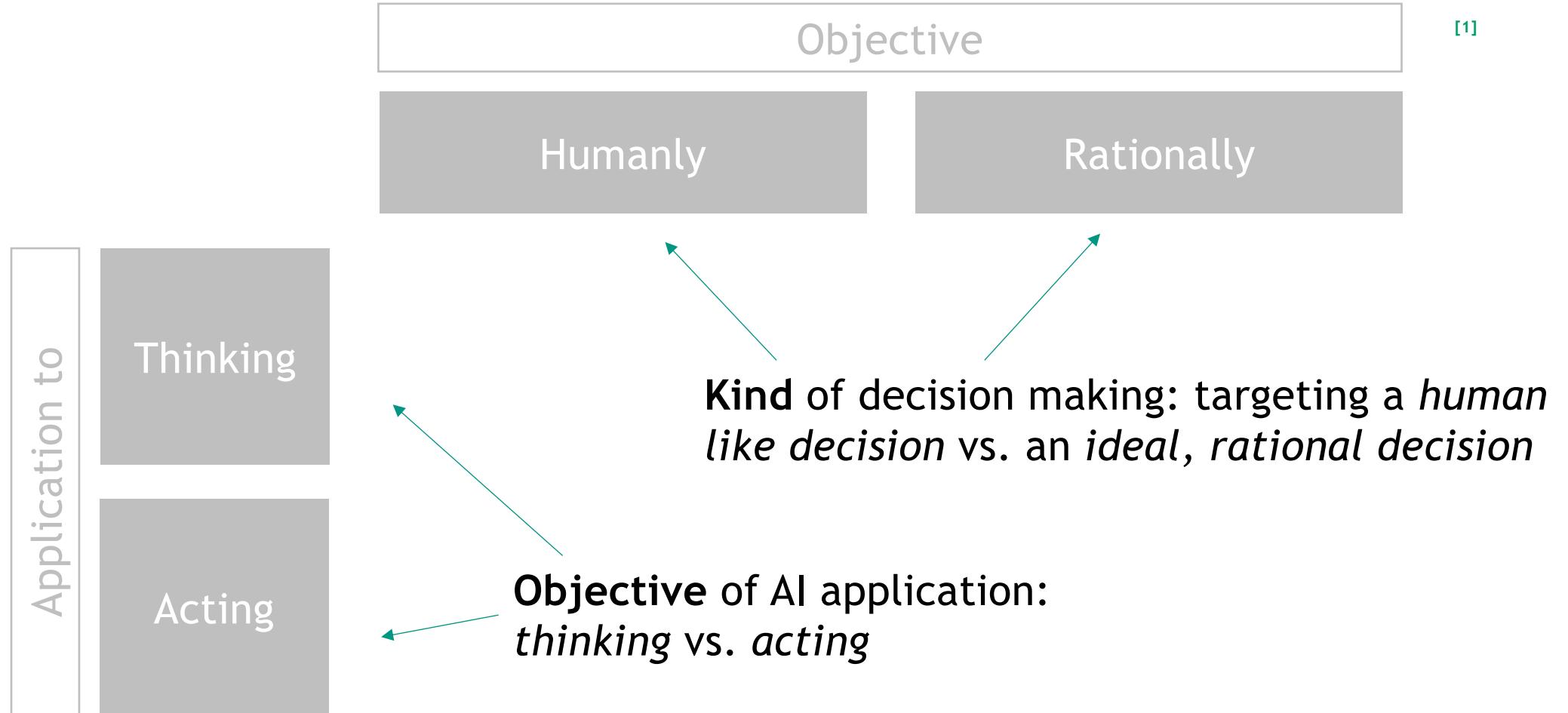


### Level of Intelligence:

AI can be differentiated by its cognitive capabilities

# Artificial Intelligence & Machine Learning

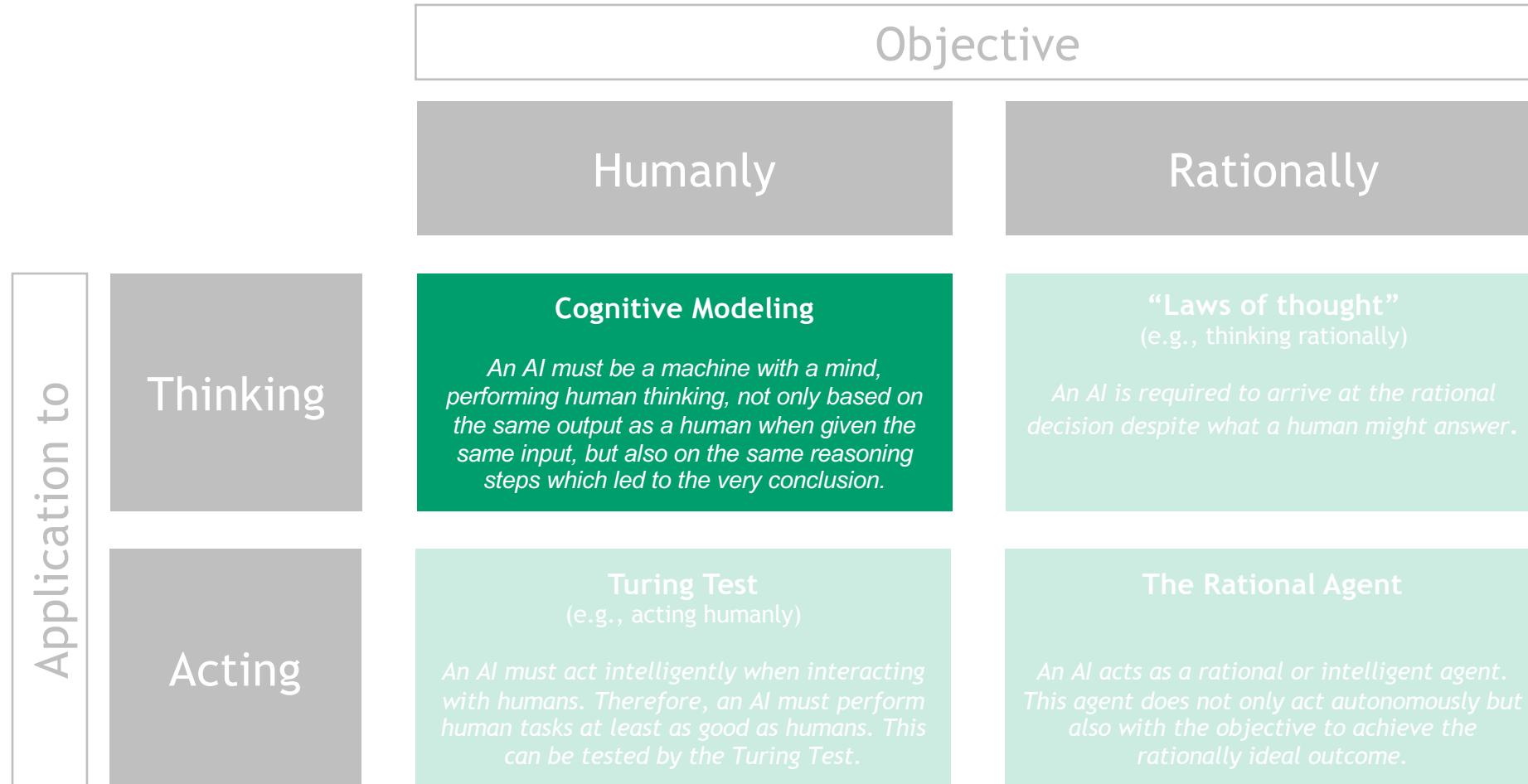
## Research currents of AI.



Russel and Norvig (2015), Artificial Intelligence: A Modern Approach ; Haugeland (1989), Artificial Intelligence: The very idea ; Bellmann (1978), An Introduction to Artificial Intelligence: Can Computers Think? ; Newell and Simon (1961), GPS, a program that simulates human thought ; Kühl, Goutier, Hirt, Satzger (2019): Machine Learning in Artificial Intelligence: Towards a Common Understanding [1]

# Artificial Intelligence & Machine Learning

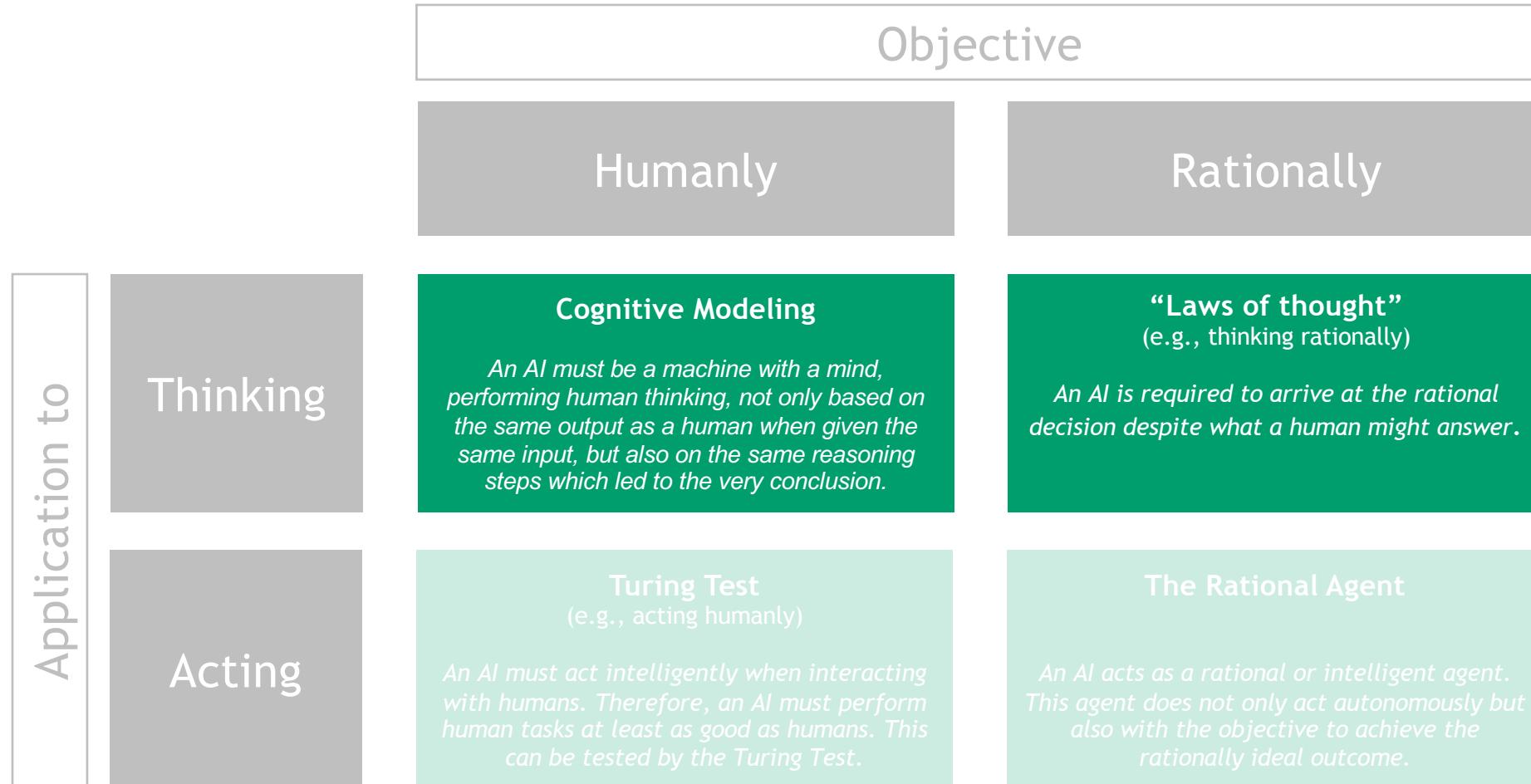
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# Artificial Intelligence & Machine Learning

## Research currents of AI.

		Objective	[1]
		Humanly	Rationally
Application to	Thinking	Cognitive Modeling  <i>An AI must be a machine with a mind, performing human thinking, not only based on the same output as a human when given the same input, but also on the same reasoning steps which led to the very conclusion.</i>	“Laws of thought” (e.g., thinking rationally)  <i>An AI is required to arrive at the rational decision despite what a human might answer.</i>
	Acting	Turing Test (e.g., acting humanly)  <i>An AI must act intelligently when interacting with humans. Therefore, an AI must perform human tasks at least as good as humans. This can be tested by the Turing Test.</i>	The Rational Agent  <i>An AI acts as a rational or intelligent agent. This agent does not only act autonomously but also with the objective to achieve the rationally ideal outcome.</i>

Russel and Norvig (2015), Artificial Intelligence: A Modern Approach ; Haugeland (1989), Artificial Intelligence: The very idea ; Bellmann (1978), An Introduction to Artificial Intelligence: Can Computers Think? ; Newell and Simon (1961), GPS, a program that simulates human thought ; Kühl, Goutier, Hirt, Satzger (2019): Machine Learning in Artificial Intelligence: Towards a Common Understanding [1]

# Artificial Intelligence & Machine Learning

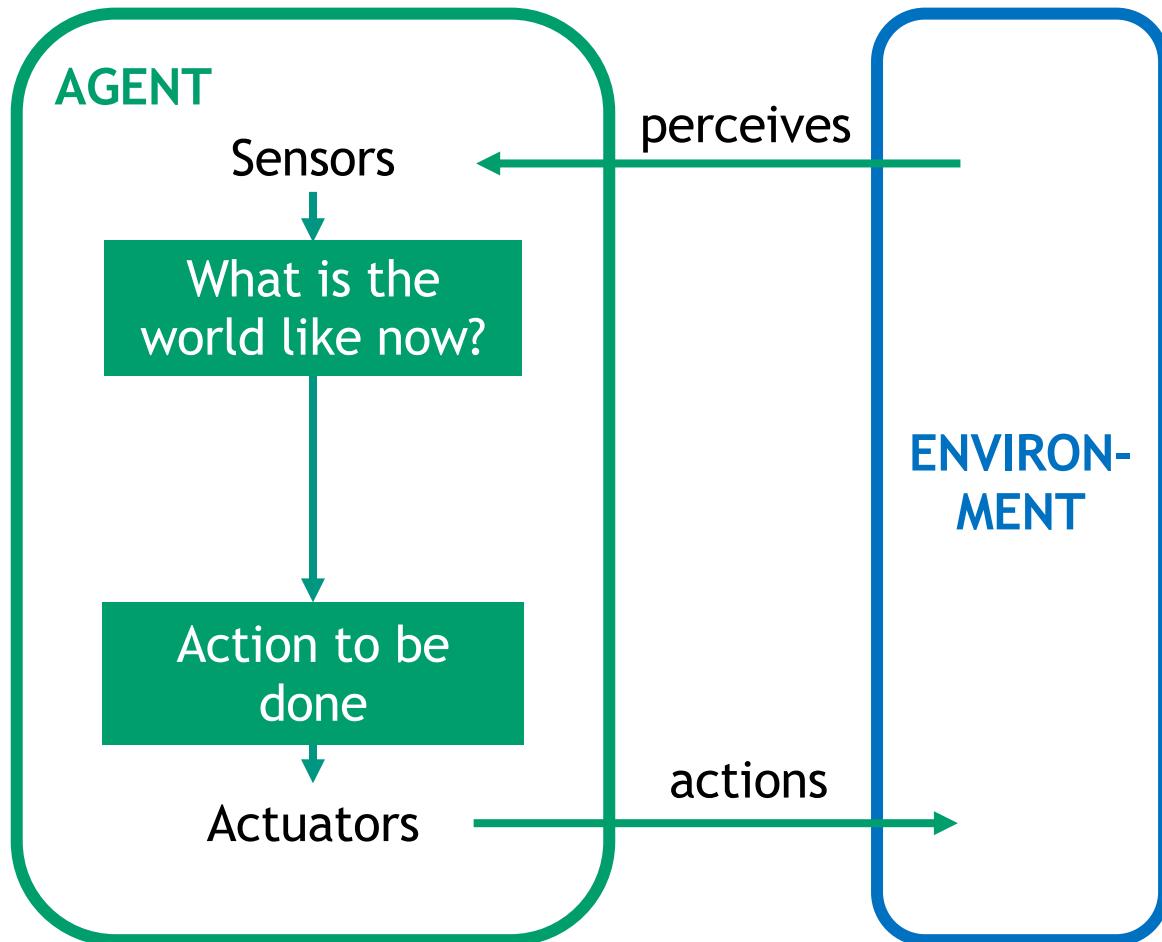
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# Artificial Intelligence & Machine Learning

## Definition of AI: An agent-oriented view.



[1]

- An **intelligent agent** interacts with an environment
- The **agent** perceives states of an **environment** and decides about what actions to take depending on these states
- Receiving sensors and executing actuators exist in a circular relationship

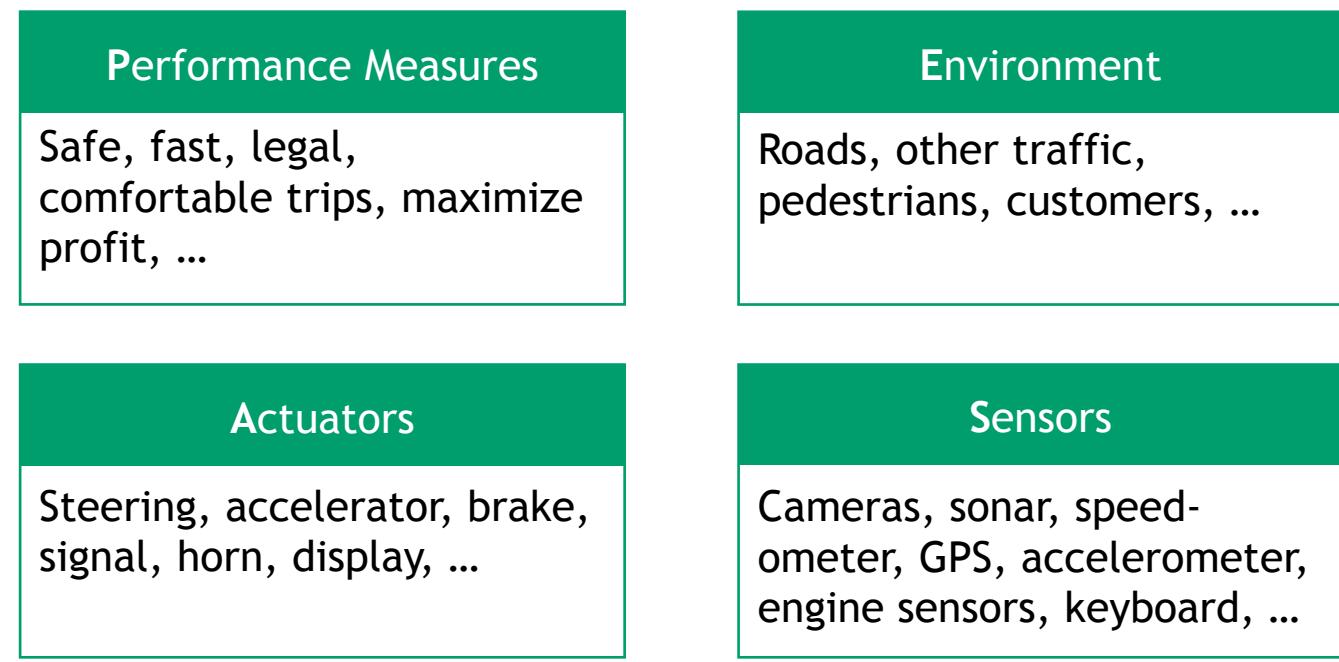
Russel and Norvig (2015), Artificial Intelligence: A Modern Approach [1]

# Artificial Intelligence & Machine Learning

## The PEAS model.

[1]

Example:  
The agent is a taxi driver



*A simple aggregation of an agent's performance measures, in an environment with actuators and sensors (PEAS)*

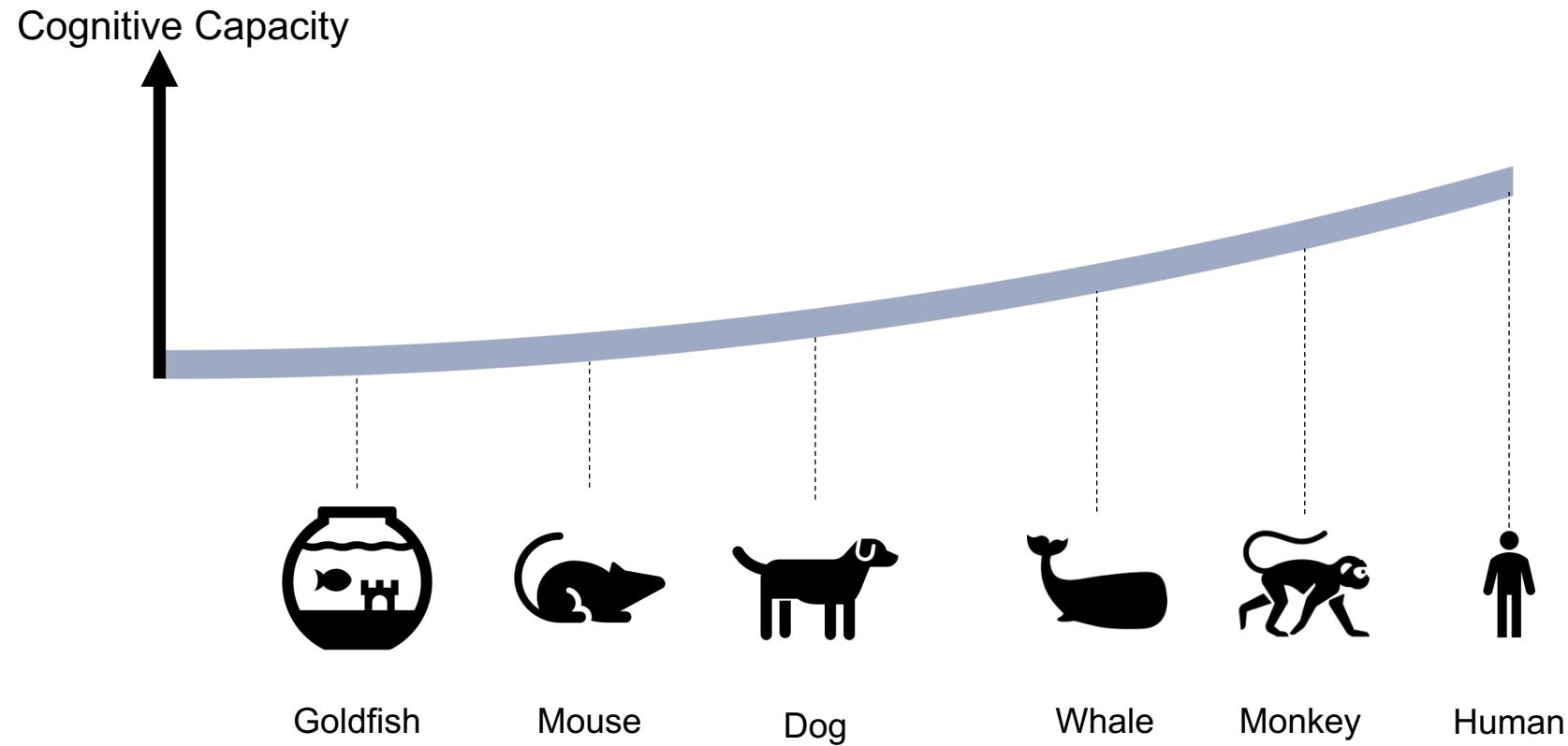
Russel and Norvig (2015), Artificial Intelligence: A Modern Approach [1]

# Artificial Intelligence & Machine Learning

## Definition of AI: An intelligence-level-oriented view

Intelligence: *The ability to perceive information, to retain it as knowledge and to apply it towards adaptive behaviors within an environment.*

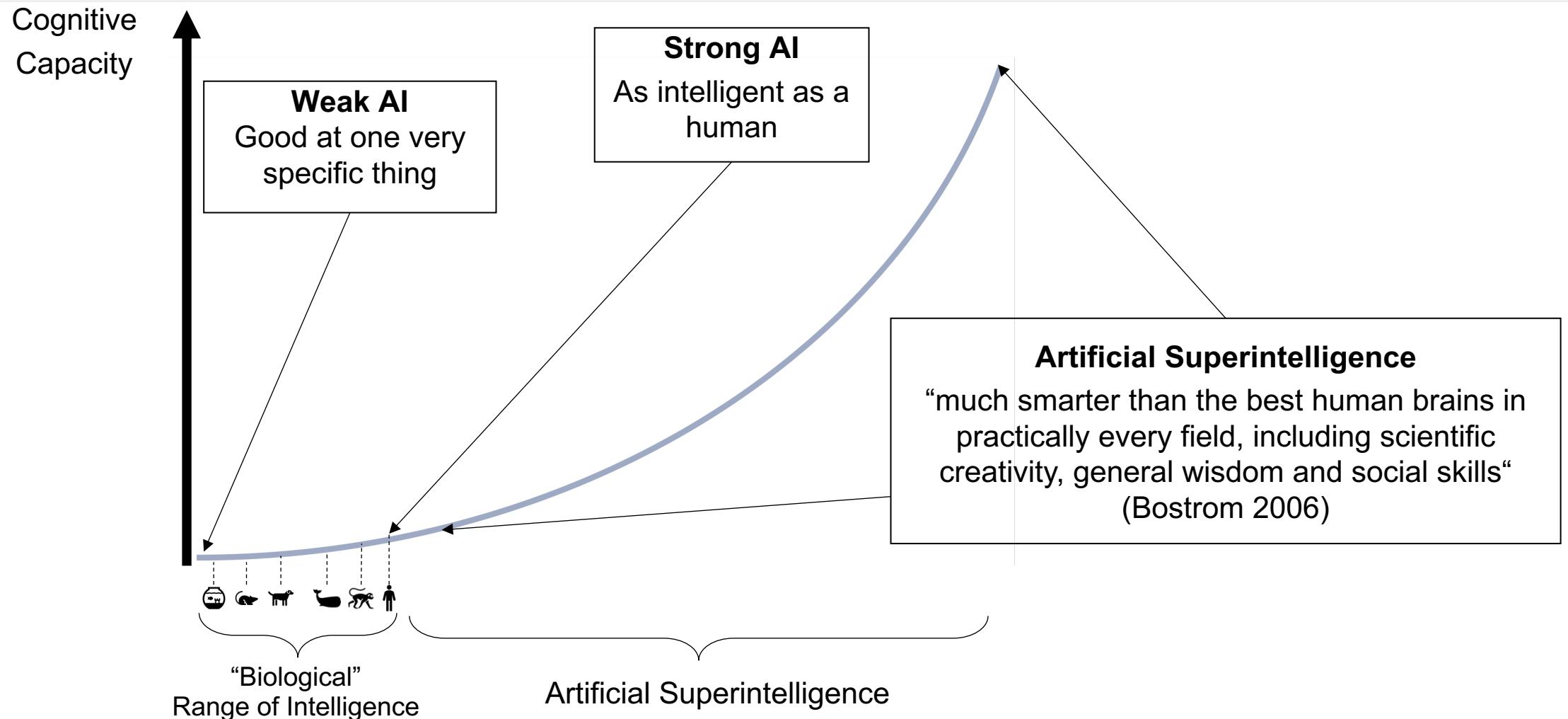
[1]



Cairo (2011) [1]

# Artificial Intelligence & Machine Learning

## What “levels” of AI can we define?



# Artificial Intelligence & Machine Learning

Three different types of machine learning are common.

## Machine Learning Types

### Supervised Learning

- Learn the mapping from the input to the output
- Typical: regression / classification
- Simplified example: Let a child sort toy cars and tell it there are sports cars and SUVs with distinct properties



[1]

### Unsupervised Learning

- Identify previously unknown patterns in data
- Typical: clustering / association rules
- Simplified example: Let a child sort toy cars and let the child determine how to arrange/cluster them



[2]

### Reinforcement Learning

- Get feedback (rewards) on actions taken
- Simplified example: Child picks toy car and labels it ("action") as truck vs. passenger car and gets response ("reward") from his dad



[3]

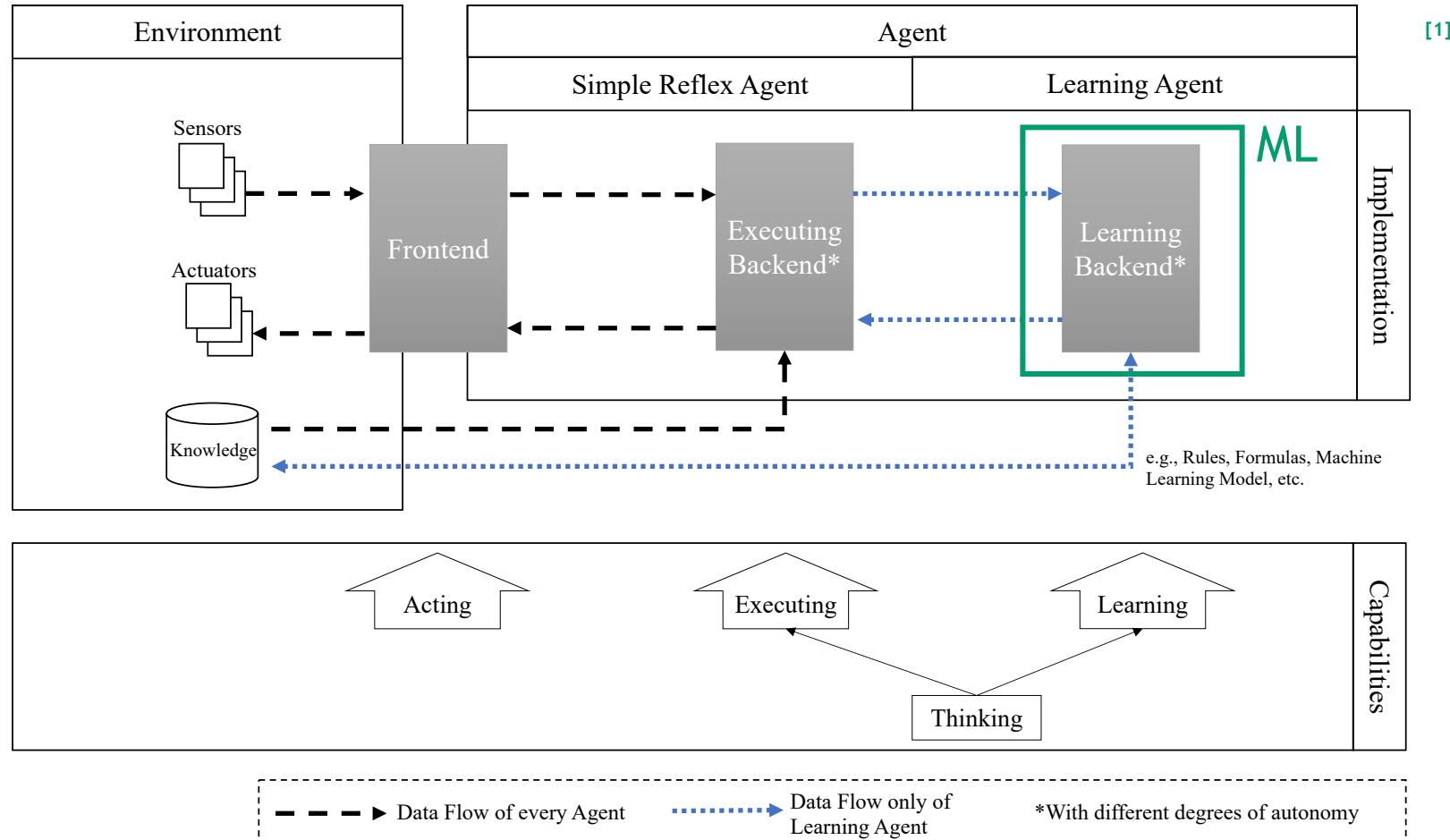
<https://www.pexels.com/photo/young-girls-playing-with-toy-cars-4491563/> [1]

<https://www.pickpik.com/child-toys-on-the-floor-floor-fun-car-82464> [2]

<https://www.pexels.com/photo/close-up-of-father-and-son-playing-with-plastic-toys-outdoors-4933608/> [3]

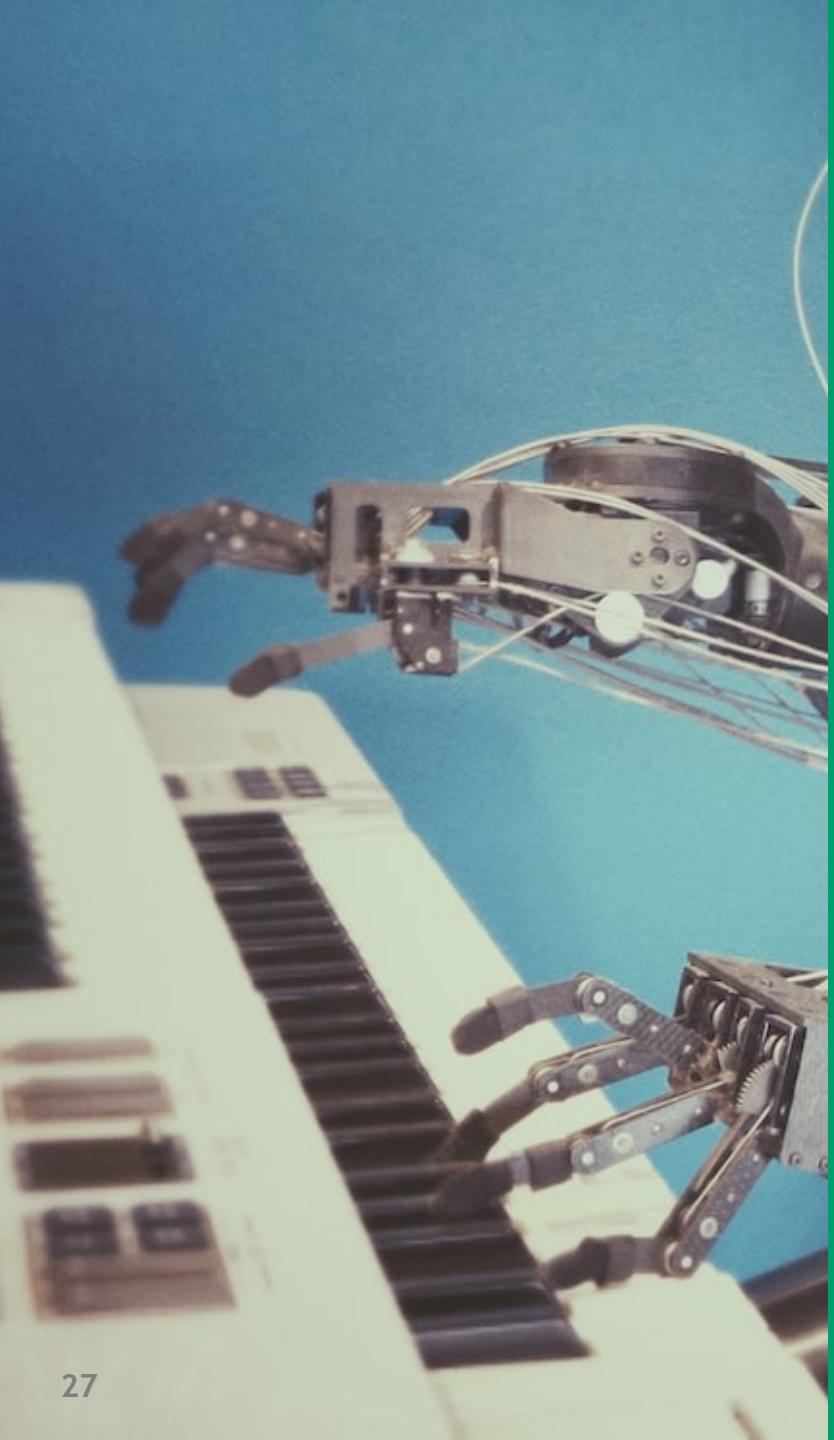
# Artificial Intelligence & Machine Learning

## What role does ML play in AI?



# Artificial Intelligence & Machine Learning

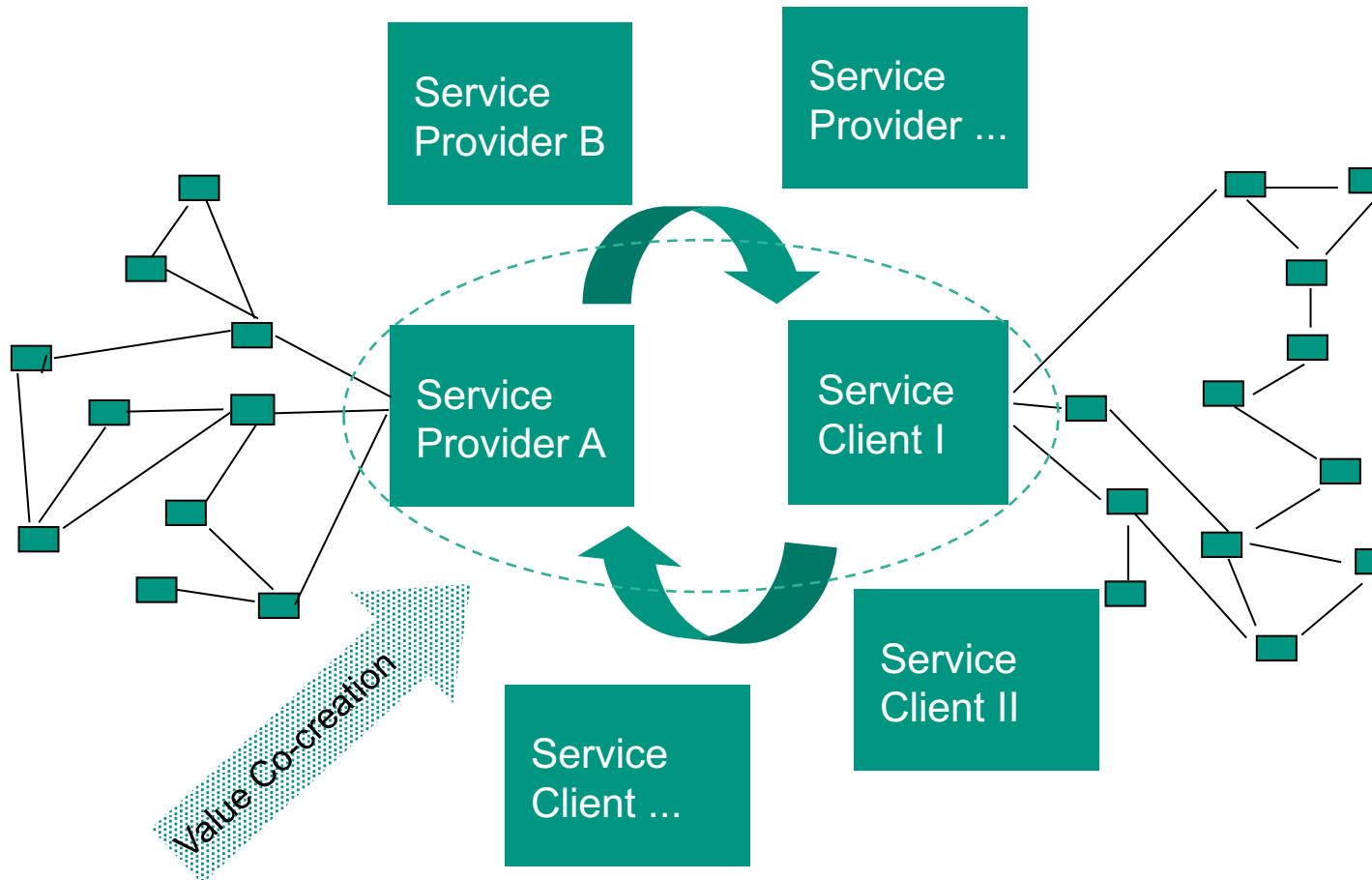
## So... was Mark Zuckerberg right?



- 1 Organizational
- 2 Artificial Intelligence & Machine Learning
- 3 Systems Thinking
- 4 The AI Lifecycle

# Service Systems

## What are (Service) Systems?



Service System comprises  
“**service providers and service clients working together to coproduce value in complex value chains or networks**” [1]

■ Entities  
/ Link

Spohrer et al. [1]

# Service Systems Examples



customer's resources  
(car)

Value Co-Creation

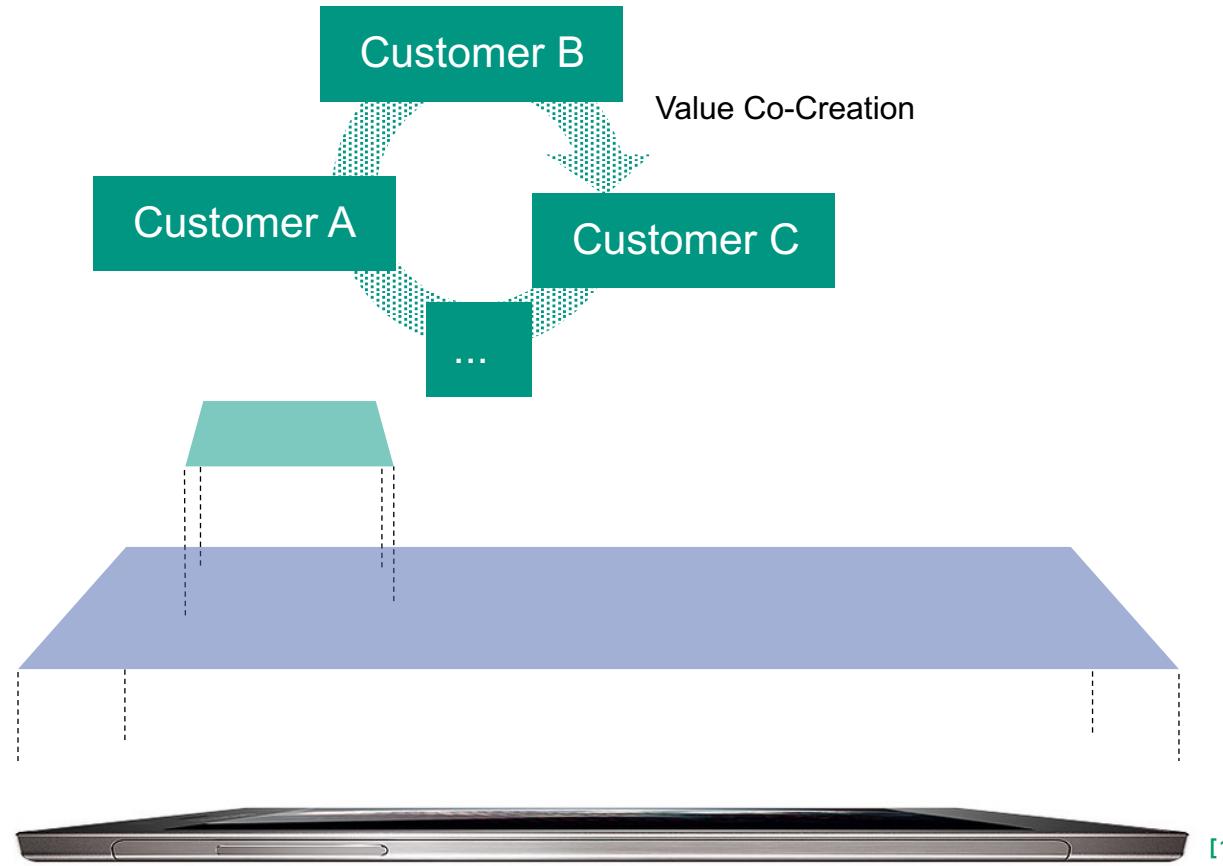


provider's resources  
(car wash, staff, commodities)



Maglio, P.P., Vargo, S.L., Caswell, N. et al. Inf Syst E-Bus Manage (2009) 7: 395. <https://doi.org/10.1007/s10257-008-0105-1> [1]  
<https://freerangestock.com/photos/94025/person-washing-car-with-sponge.html> [2]

# Service Systems Examples



Application Provider, e.g.,  
TikTok

Operation System Provider,  
e.g., Google

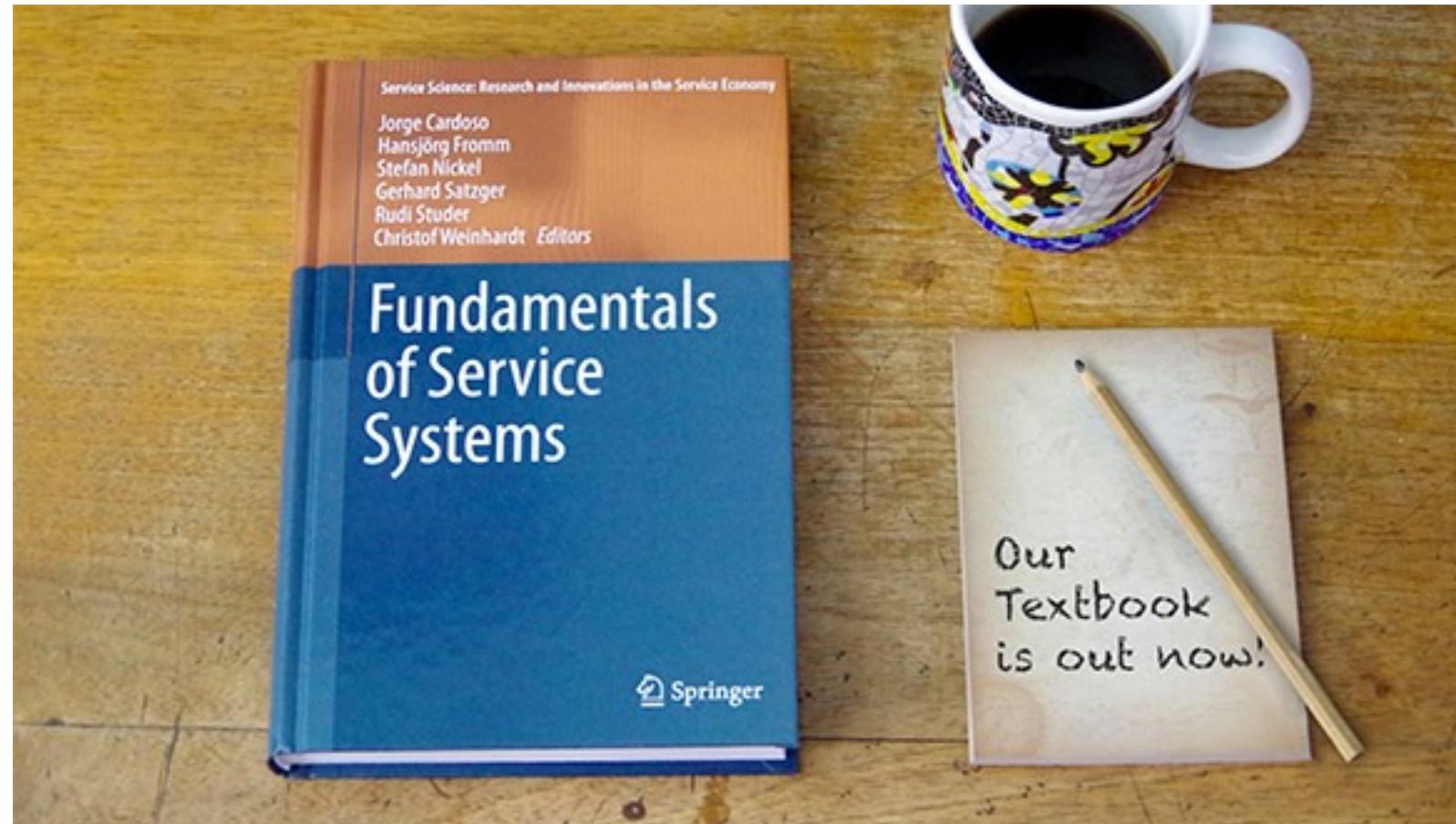
Smartphone Provider,  
e.g., Samsung

[1]

<https://www.flickr.com/photos/blltz/9369660668/> [1]

# Service Systems

The first textbook of Service Systems is available

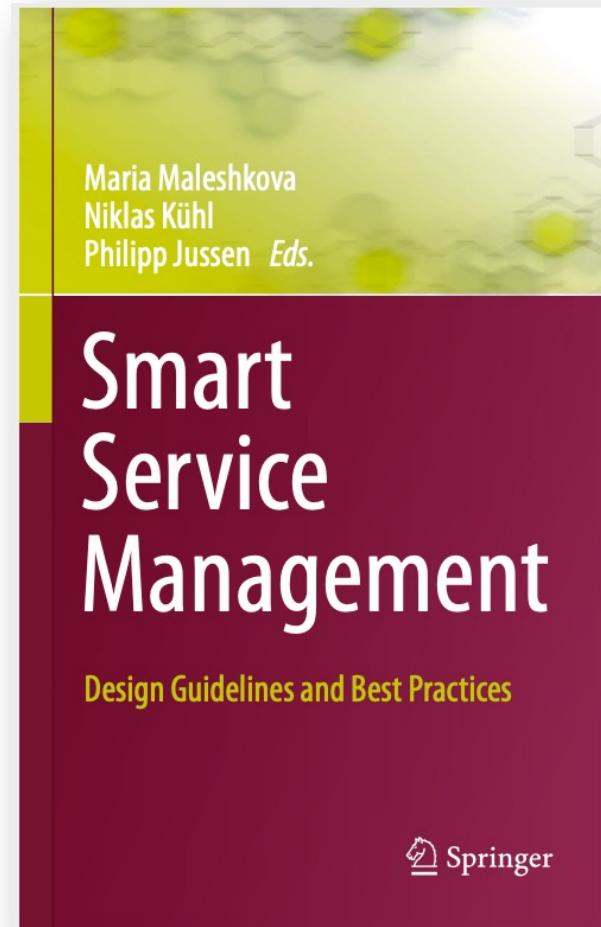


[1,2]  
]

Fundamentals of Service Systems. (2015). Deutschland: Springer International Publishing. [1]  
<https://fundamentals-of-service-systems.ksri.kit.edu/> [2]

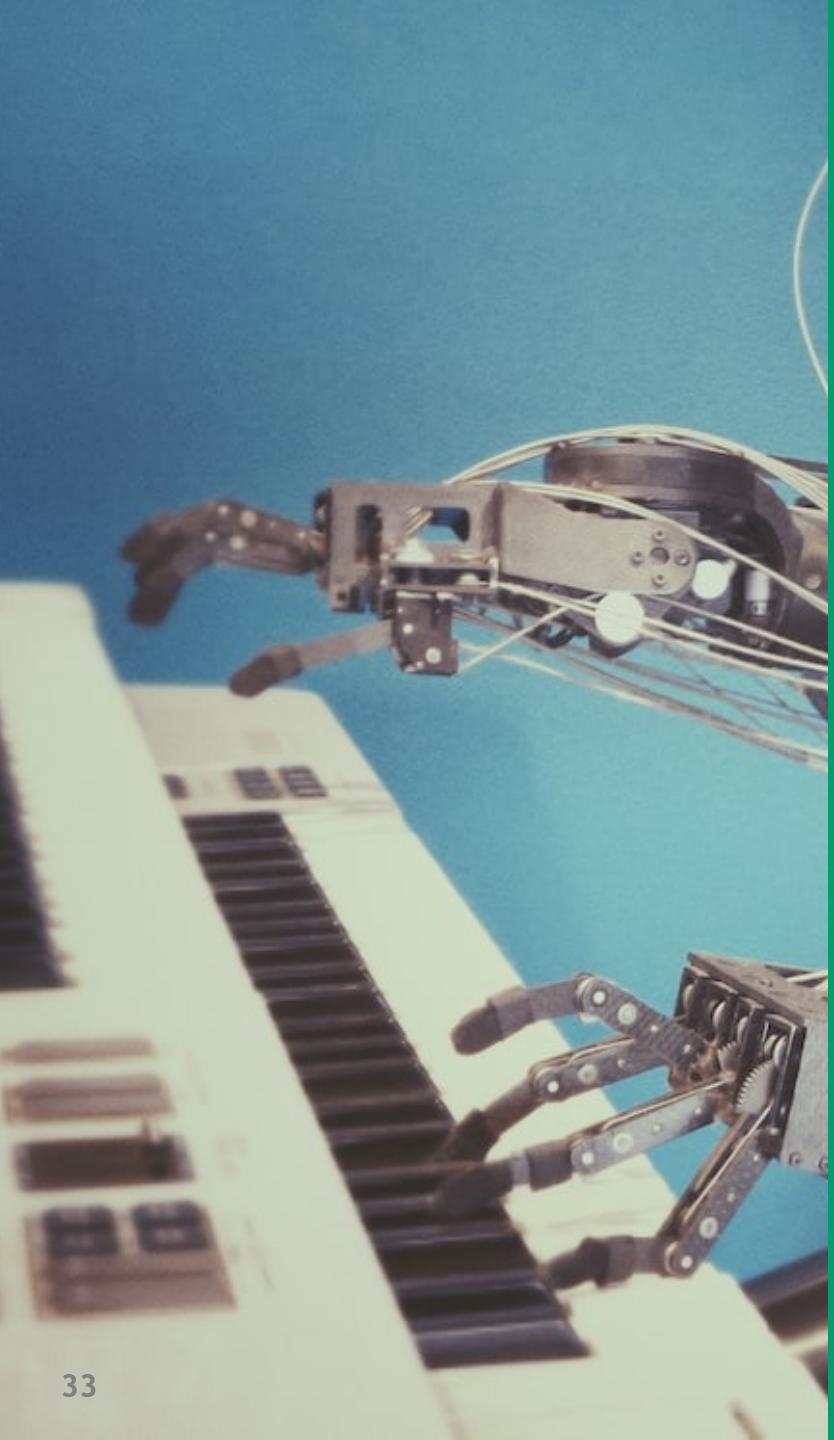
# Service Systems

...as well as one on their management



[1]

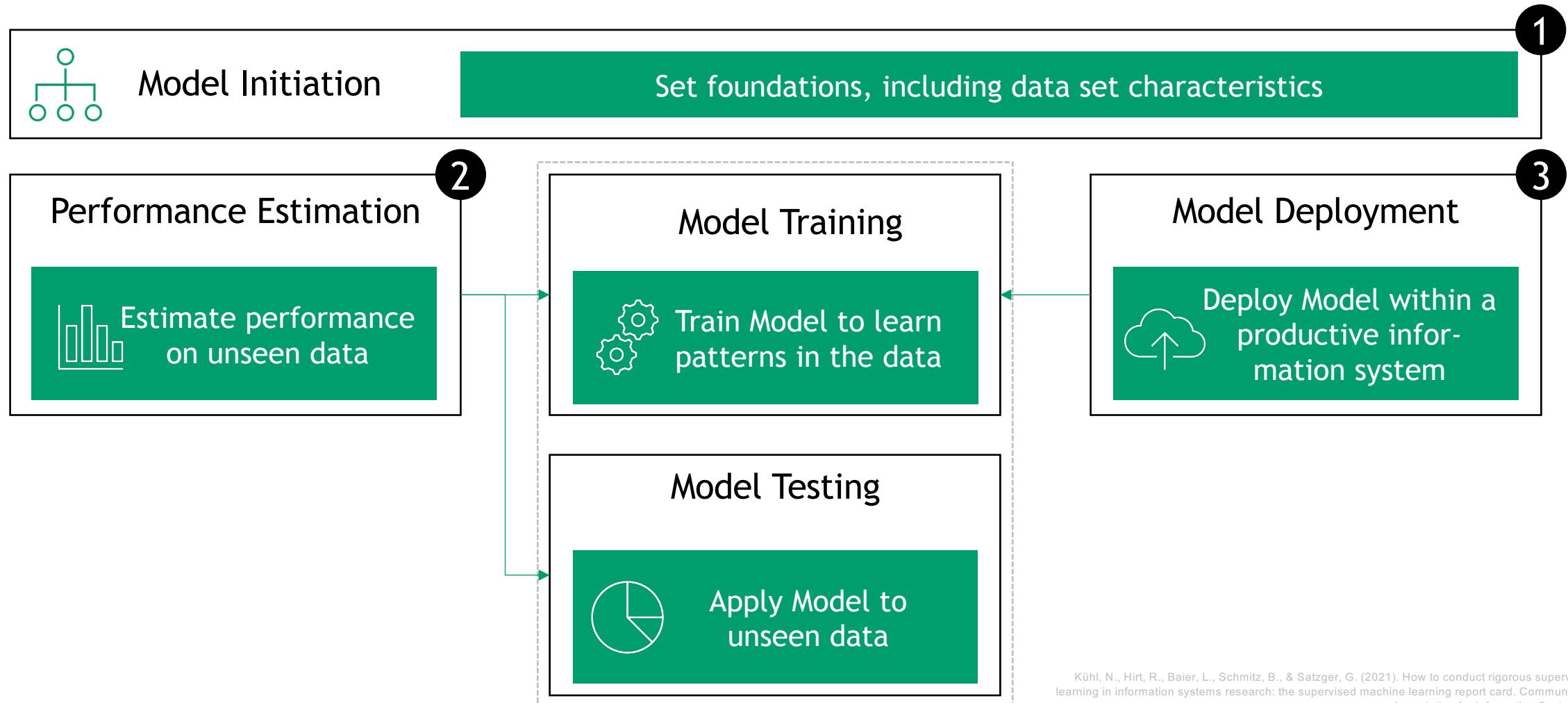
Smart Service Management: Design Guidelines and Best Practices. (2021). Deutschland: Springer International Publishing.[1]



- 1 Organizational
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# The AI Lifecycle

## Required steps for supervised machine learning



Kühl, N., Hirt, R., Baier, L., Schmitz, B., & Satzger, G. (2021). How to conduct rigorous supervised machine learning in information systems research: the supervised machine learning report card. Communications of the Association for Information Systems, 48(1), 46.

# The AI Lifecycle

Required steps for supervised machine learning.

