Master in
Artificial Intelligence for Public Services
AI4Gov

UNIVERSIDAD POLITÉCNICA DE MADRID

POLITECNICO MILANO 1863
DIPARTIMENTO DI DESIGN

5th High-Level Meeting of the Expert Group in Public Administration and Governance

Dublin, 13th October 2023

What is AI and why it matters?

Exploring the Governance "of, with and by" AI

AI4GOV

Gianluca C. Misuraca

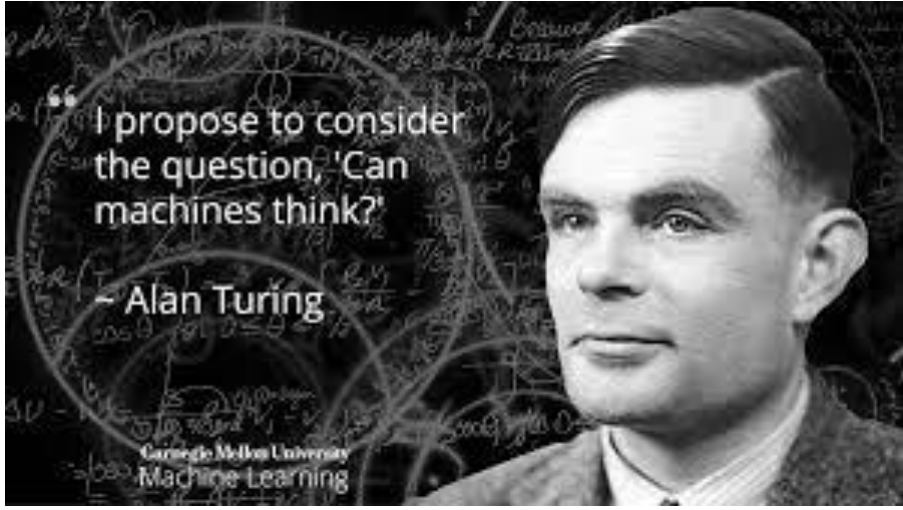
Executive Director, AI4GOV

Outline

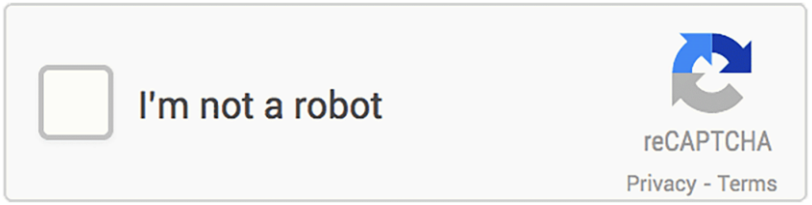
1. Foundations of AI – A brief history and basic concepts
2. Data and Metadata – How does AI work?
3. Impact of AI – potential benefits, limitations and challenges
4. Generative AI – why it is different and what this entails?
5. In search of the Governance “of, with and by AI”

1. Foundations of AI

The origins
Can machines think?

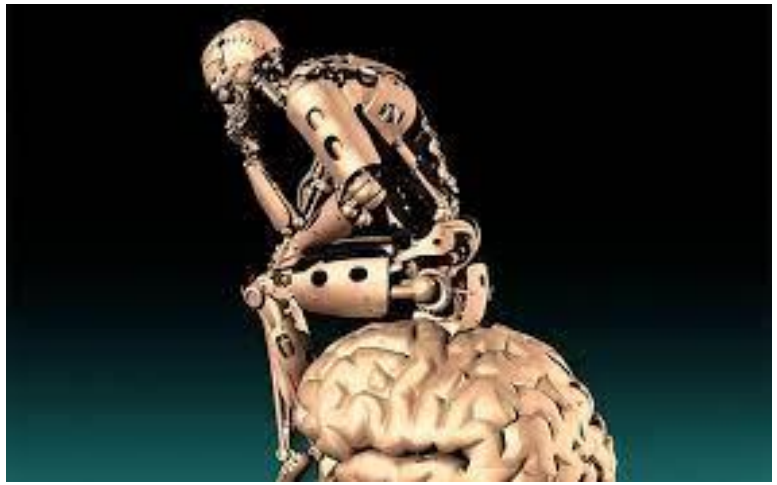


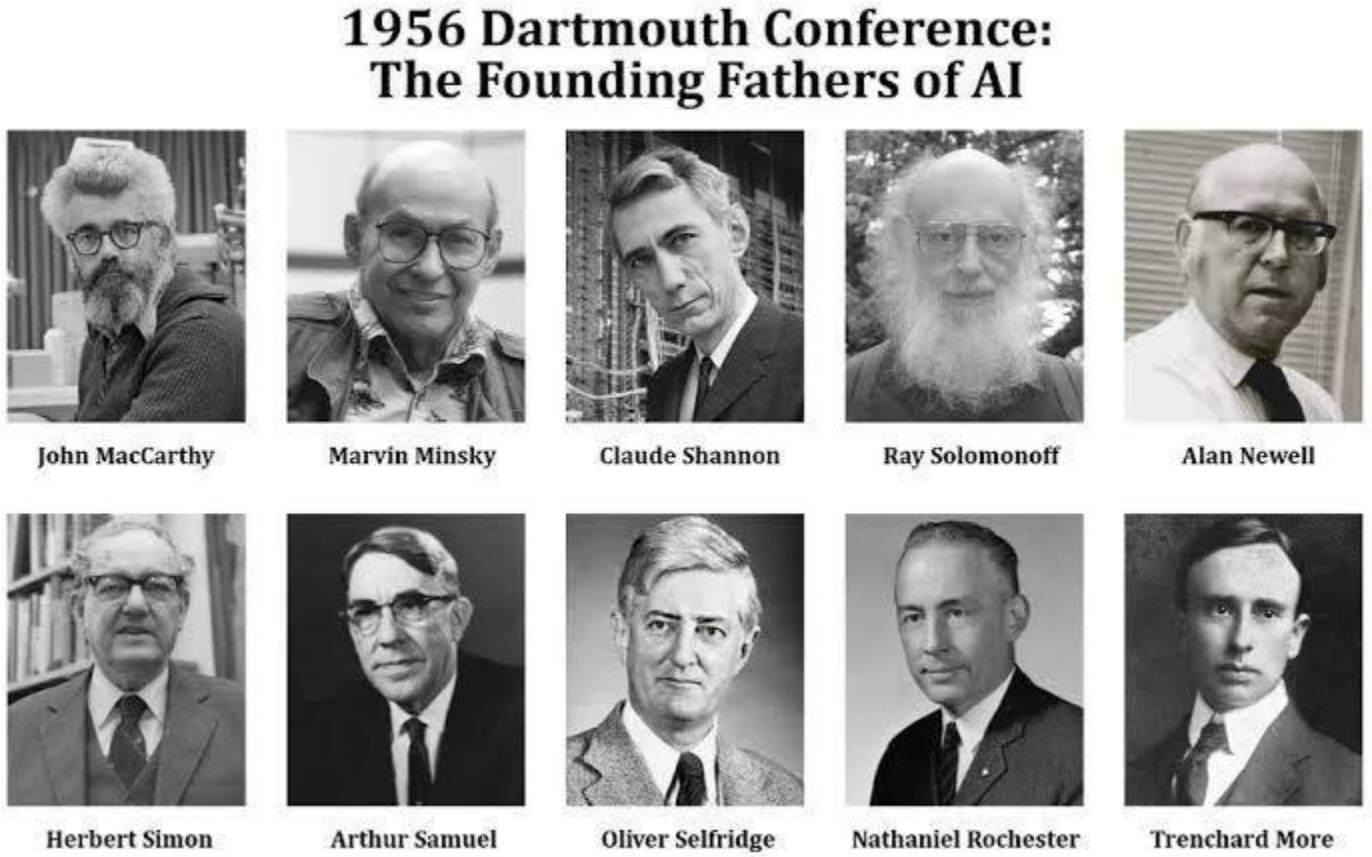
- **Turing Test (1950)**
- Basic questions to identify who is the human and who is the machine



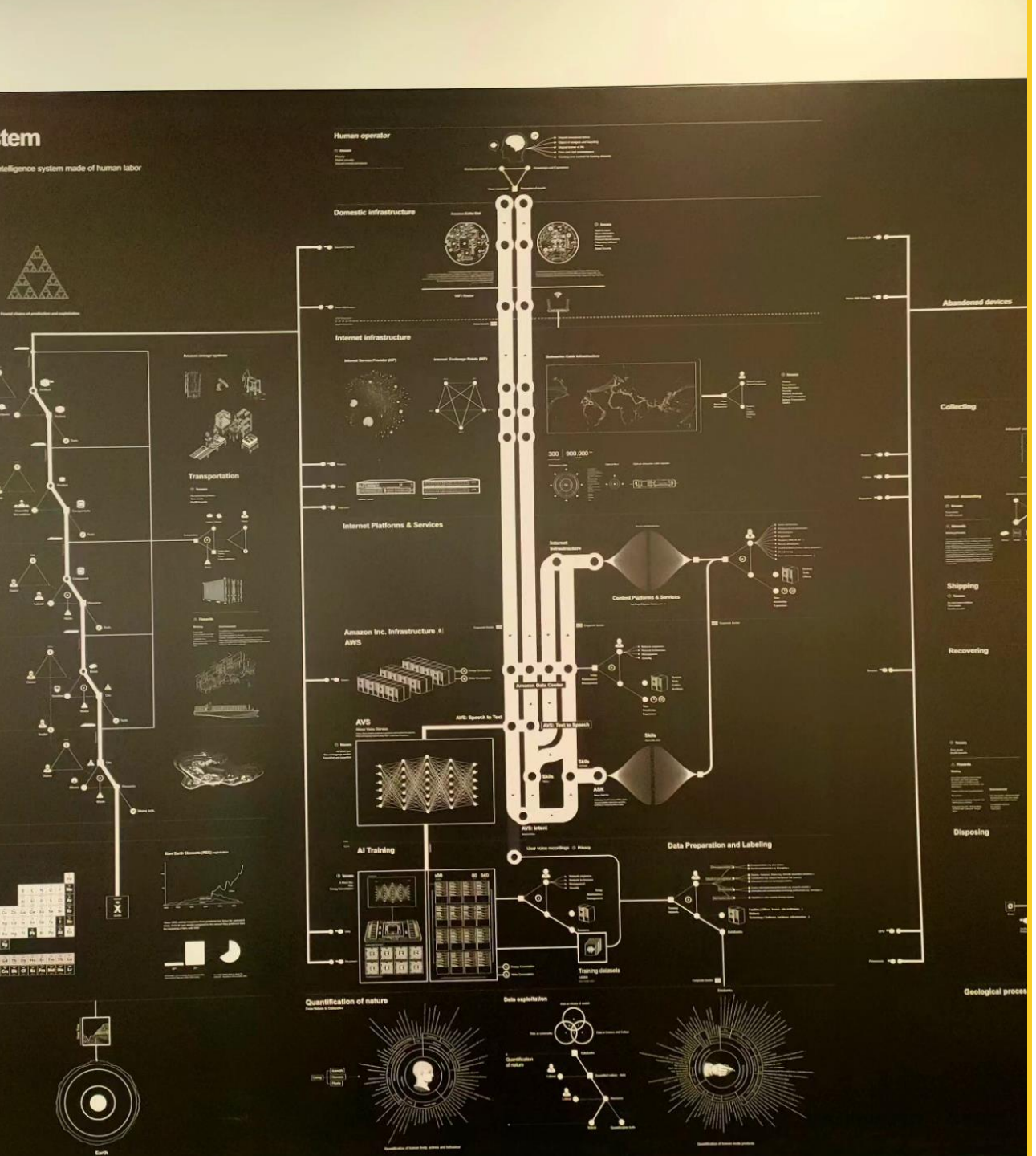
- Or the opposite today! Are you a human?

The Fathers of AI

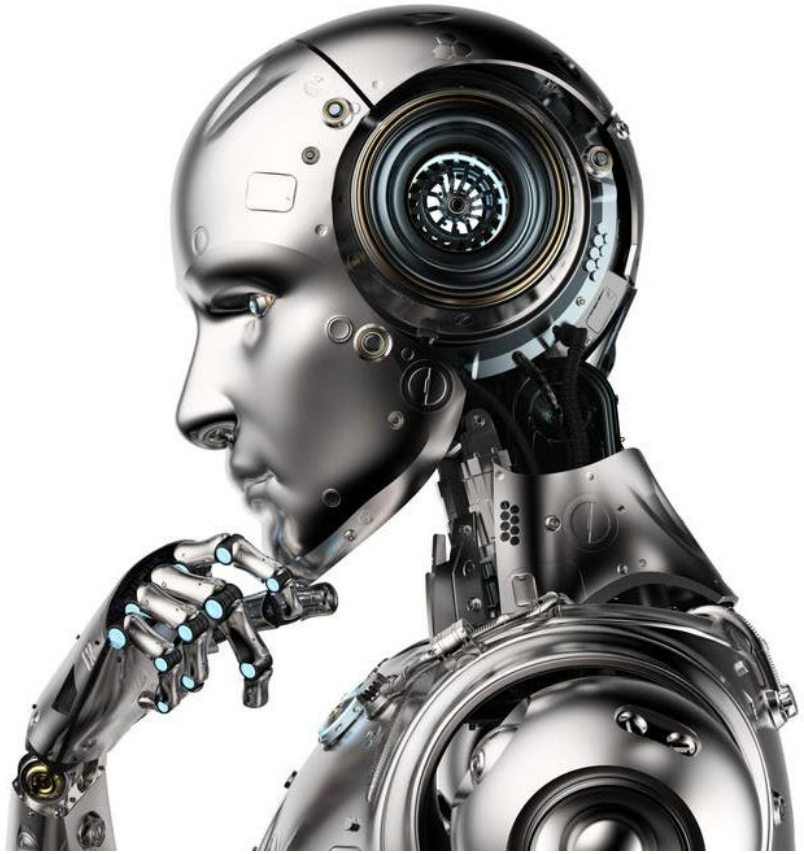




- "*The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it*. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves"



But what is AI?



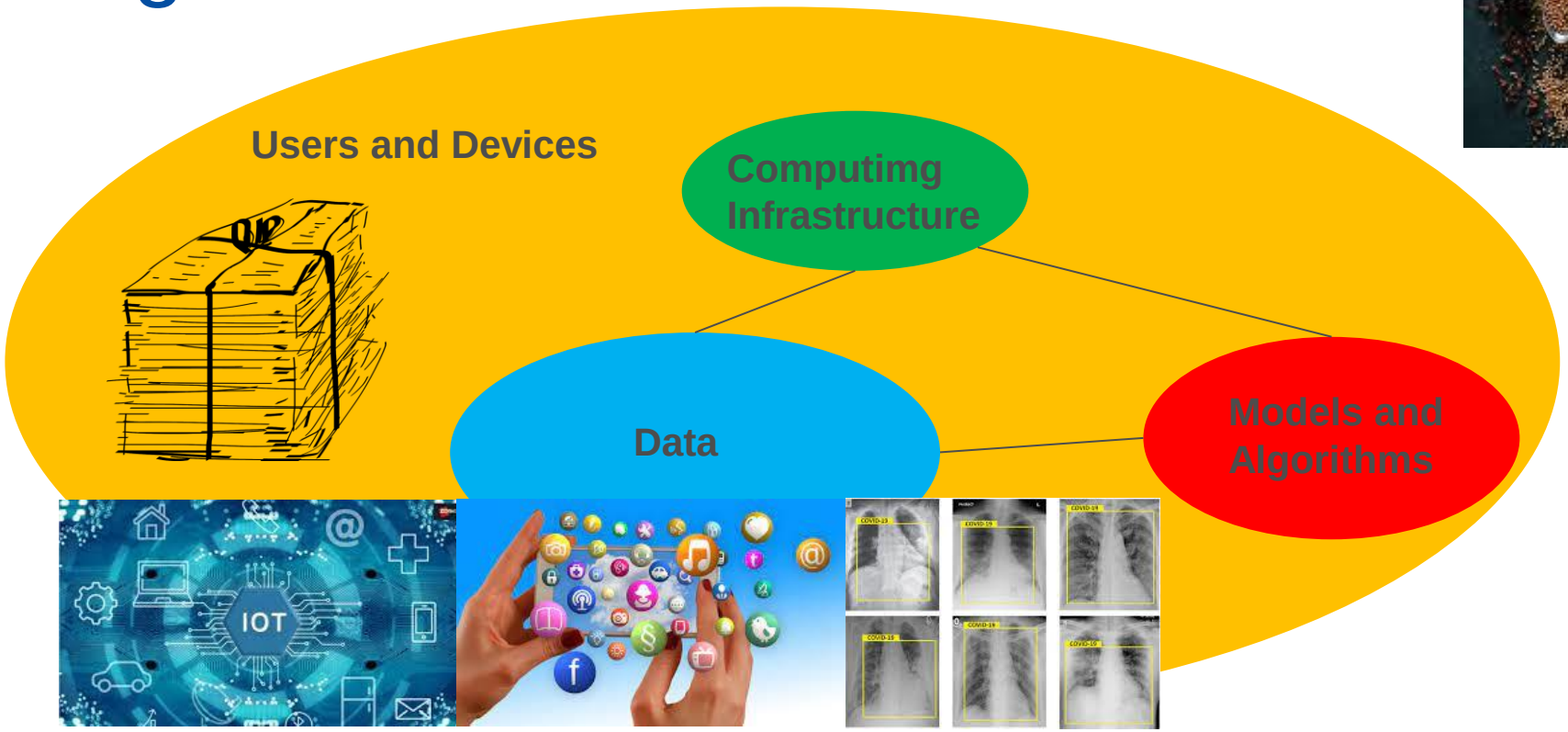
AI system – OECD Definition (2019)

- *"An AI system is a **machine-based system** that is **capable of influencing the environment by producing an output** (predictions, recommendations or decisions) **for a given set of objectives**. It uses machine and/or human-based **data and inputs to** (i) **perceive** real and/or virtual environments; (ii) **abstract these perceptions into models** through analysis in an automated manner (e.g., with machine learning), or manually; and (iii) **use model inference to formulate options for outcomes**. AI systems are designed to operate with **varying levels of autonomy.**"*

Source: OECD (2019), Artificial Intelligence in Society, OECD Publishing, Paris, https://doi.org/10.1787/eedfee77-en

AI ingredients

- Any AI system requires:



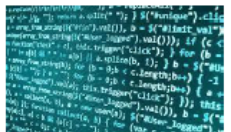
- An Algorithm requires **data** for:

Generating images

Generating videos

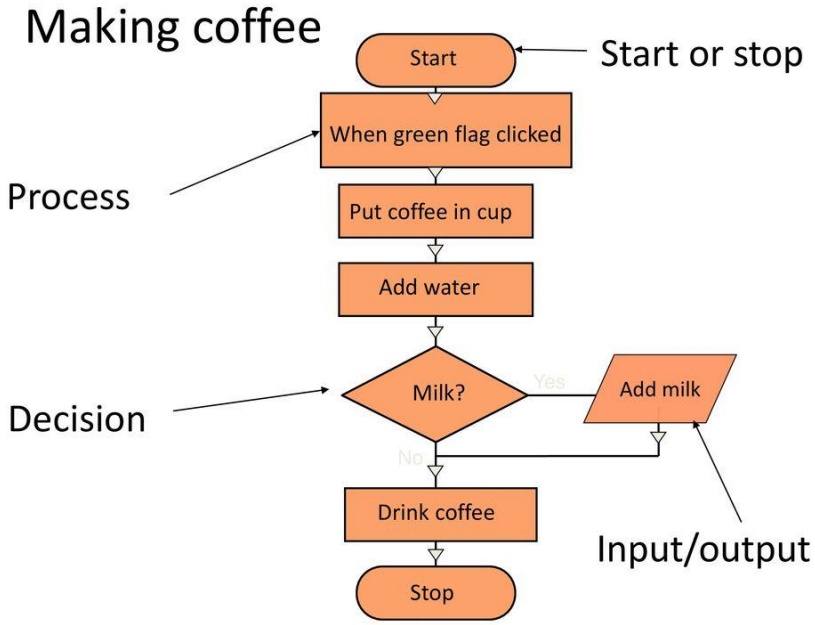
Generating texts

Translating to other lenguages

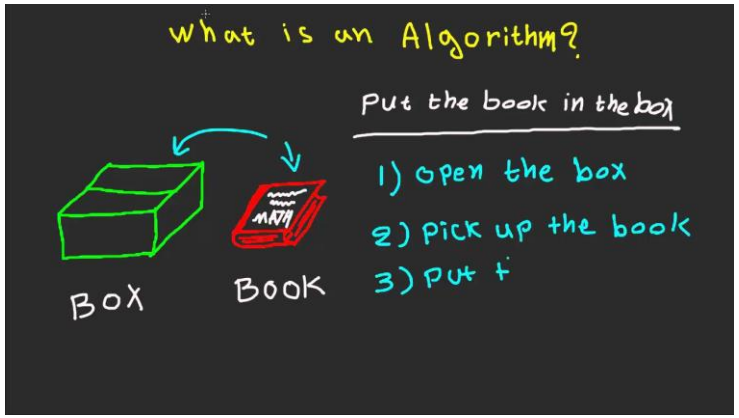


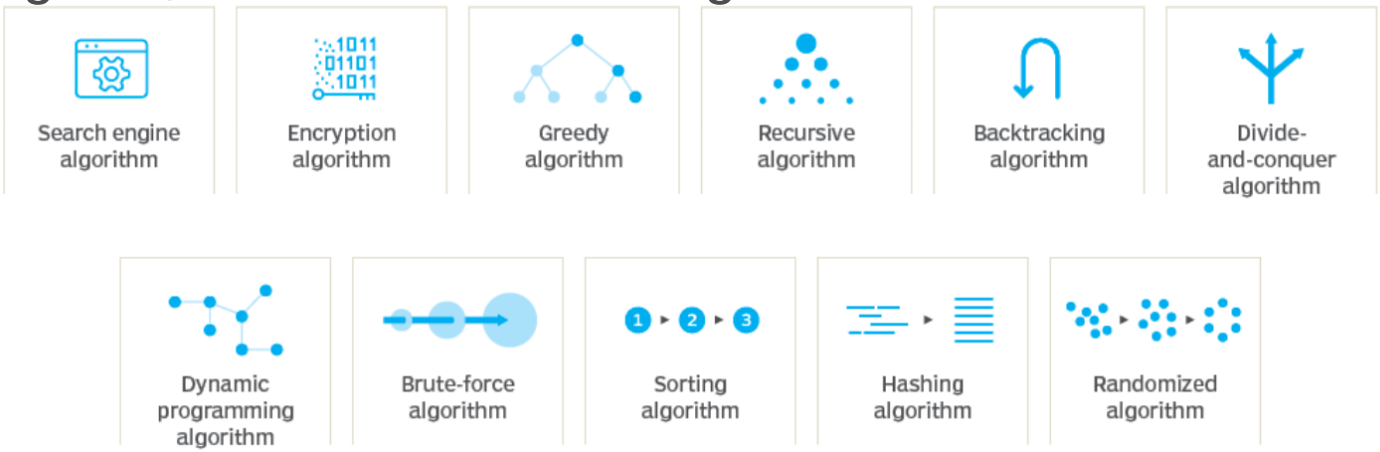
Writing computer programs

What is an Algorithm?

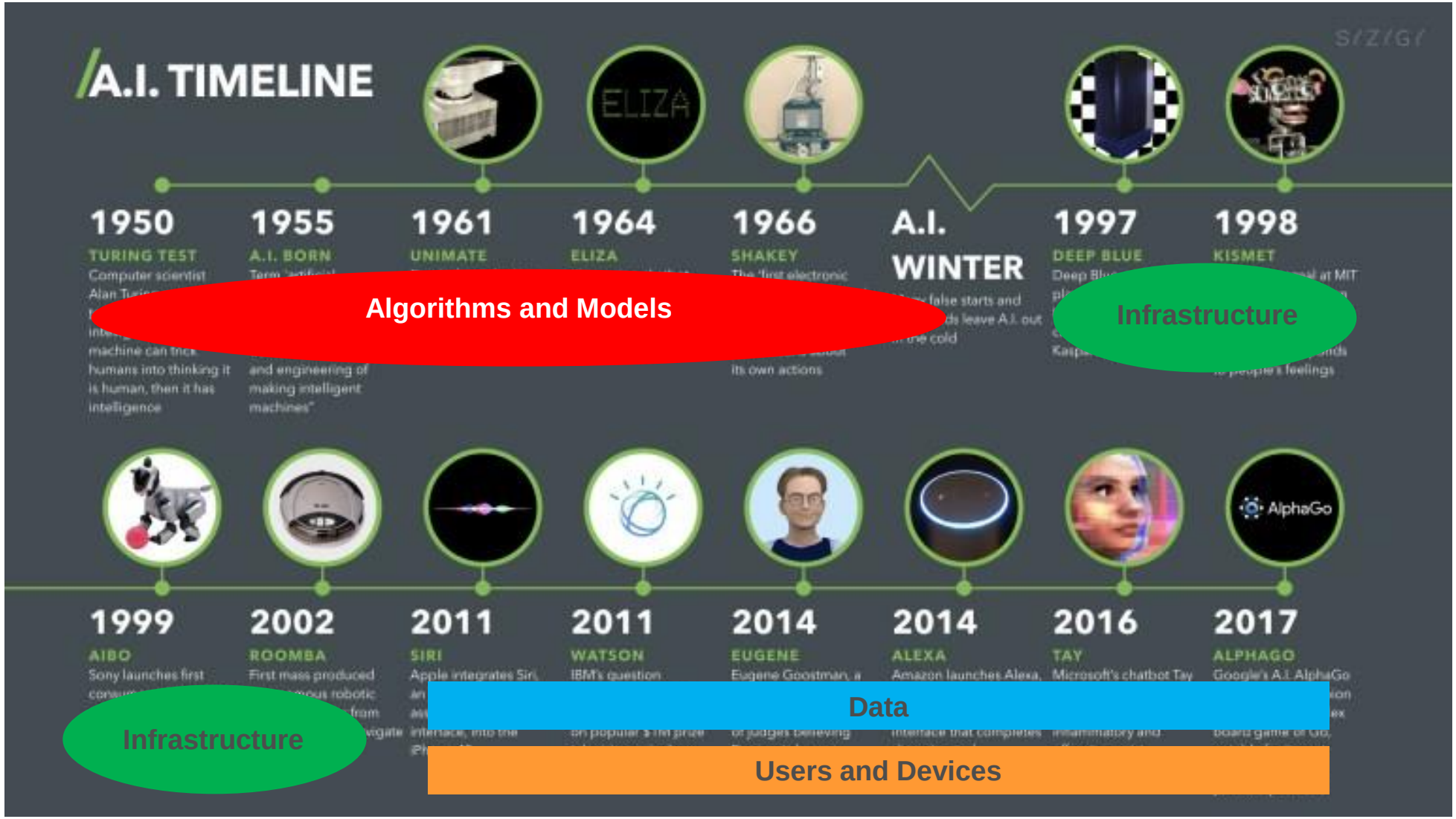


- **An algorithm is a set of steps for accomplishing a task or solving a problem.** Typically, algorithms are executed by computers, but we also rely on algorithms in our daily lives. Each time we follow a particular step-by-step process, like making coffee, we are following an algorithm
- **In the context of computer science, an algorithm is a mathematical process for solving a problem using a finite number of steps.** Algorithms are a key component of any computer program and are the driving force behind various systems and applications, such as navigation systems, search engines, and music streaming services





AI evolution (the world before ChatGPT)

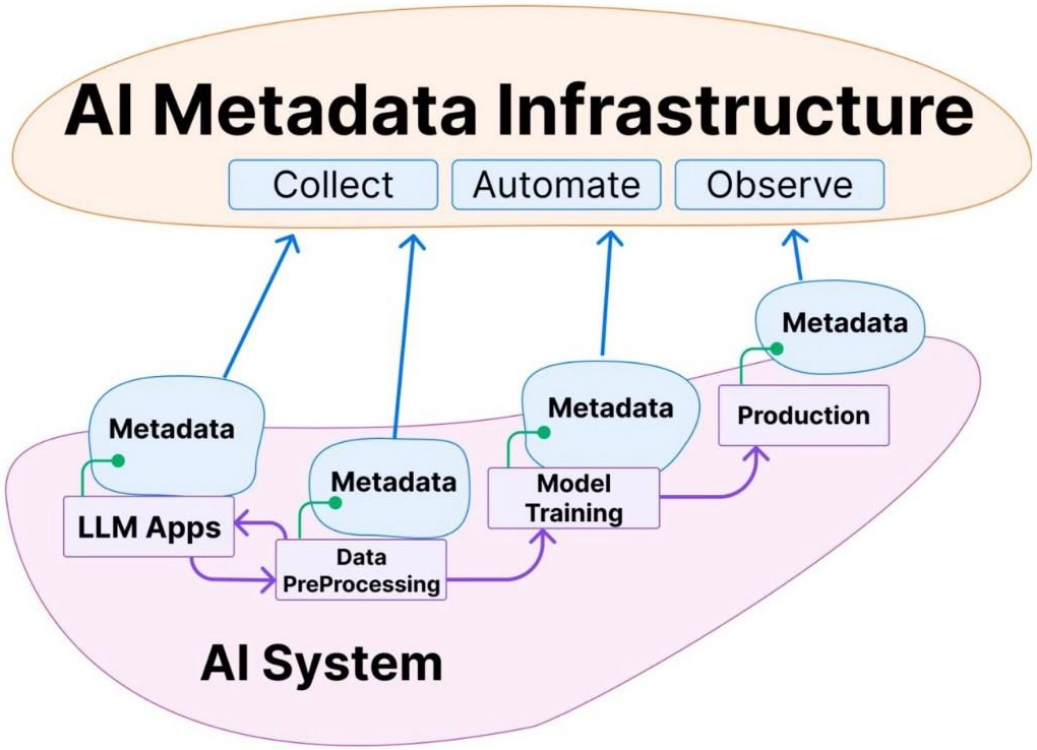


Source: https://digitalwellbeing.org/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/

2. Data, Metadata and AI

How does AI work in practice?

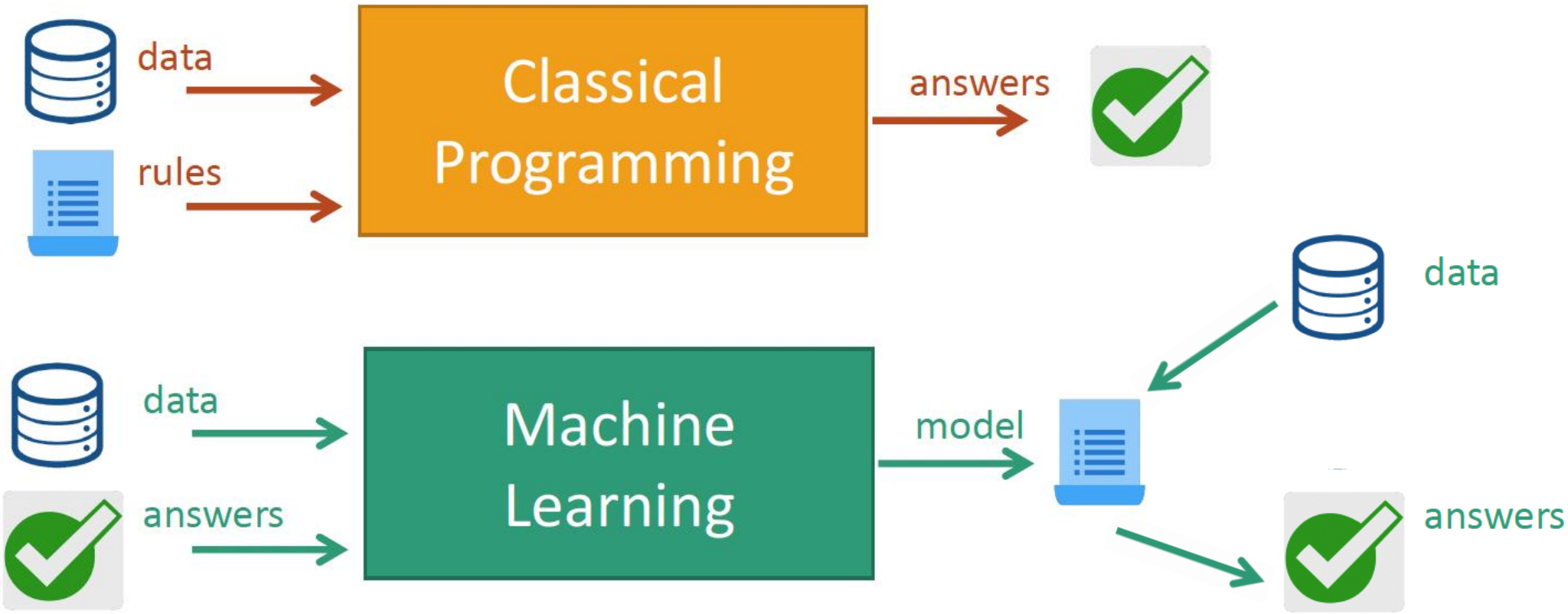
- AI systems work by ingesting large amounts of labeled training data (metadata), analyzing the data for correlations and patterns, and using these patterns to make “predictions” about future states
  - For example, a chatbot that is fed examples of text can learn to generate lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples



Source: Lorica, B., (2023), AI Metadata

Classical programming vs Machine Learning

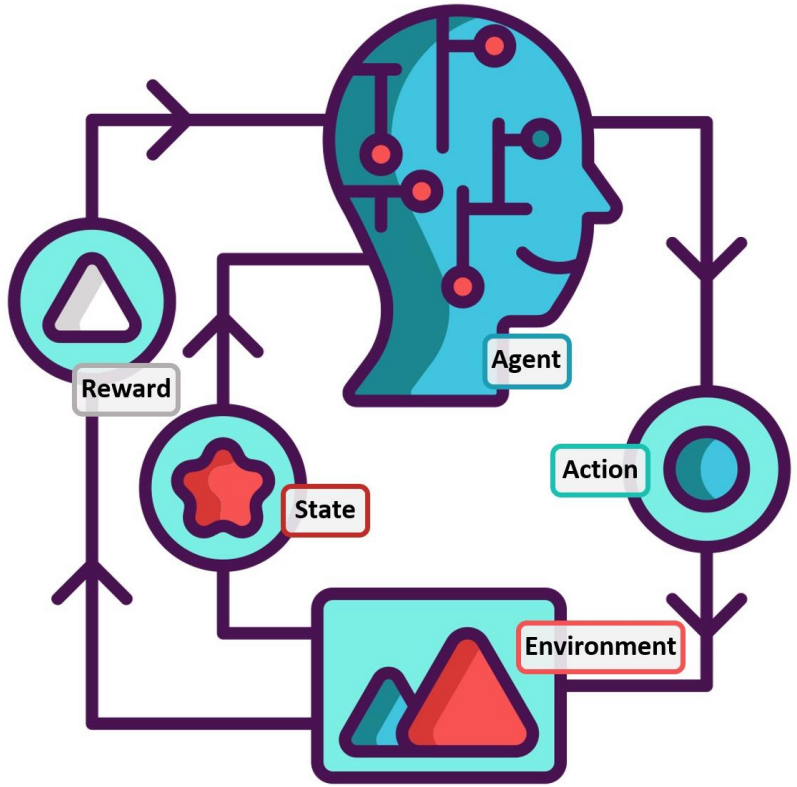
- A Machine Learning (ML) system is trained rather than programmed



Source: Fosca Giannotti, Scuola Normale Superiore di Pisa

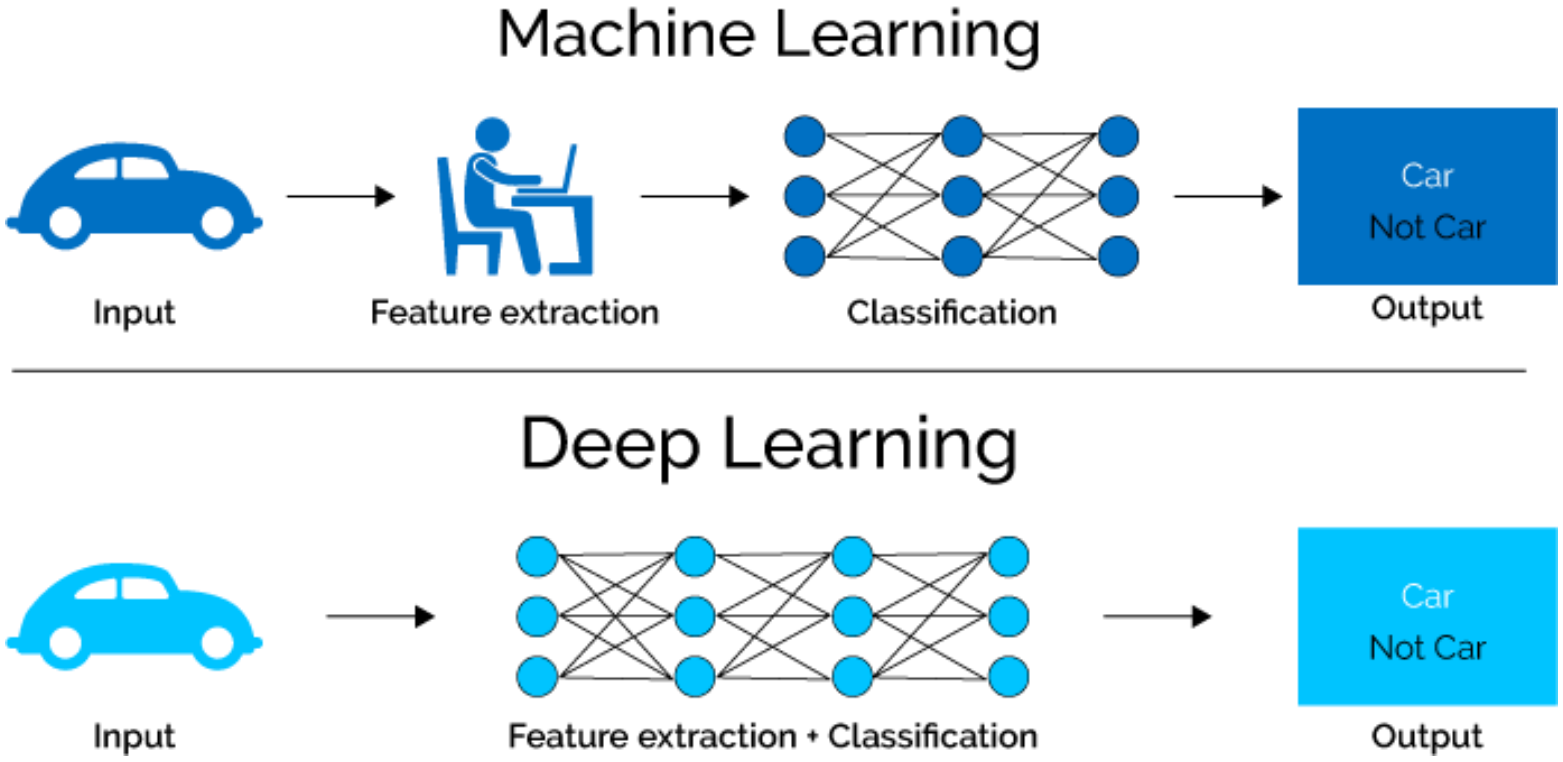
Reinforcement learning (RL)

- RL is a subset of machine learning that allows an AI-driven system (sometimes referred to as an agent) to learn through trial and error using feedback from its actions
  - RL underpin systems that evolve and develop increasingly refined reasoning skills
  - RL techniques are implemented in virtual environments, often with a focus on (video)games and logic puzzles

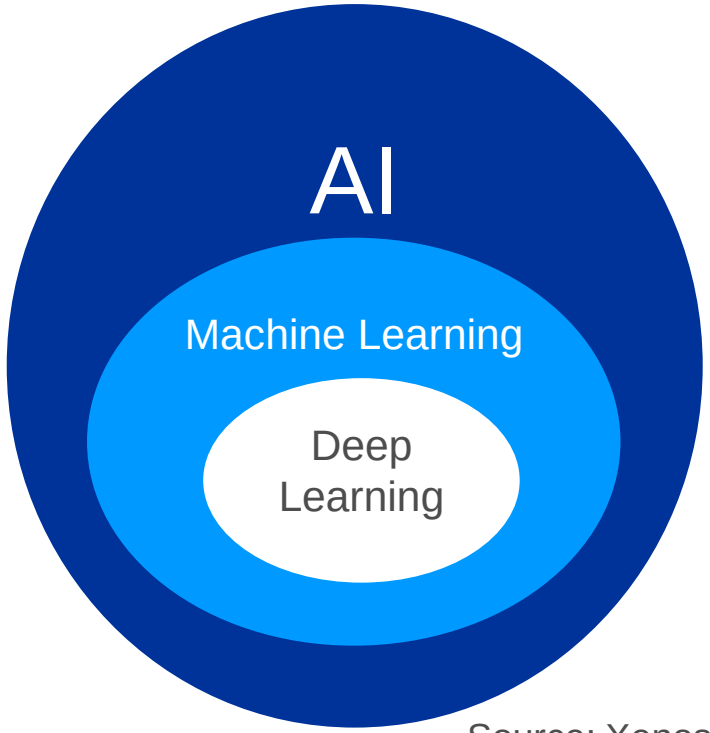


Deep Learning (DL)

- Algorithms that learn from vast volumes of data extracted from different sources, often real time
- Computer systems adapt their behaviour continuously to new data without human intervention (e.g. Chatbot)

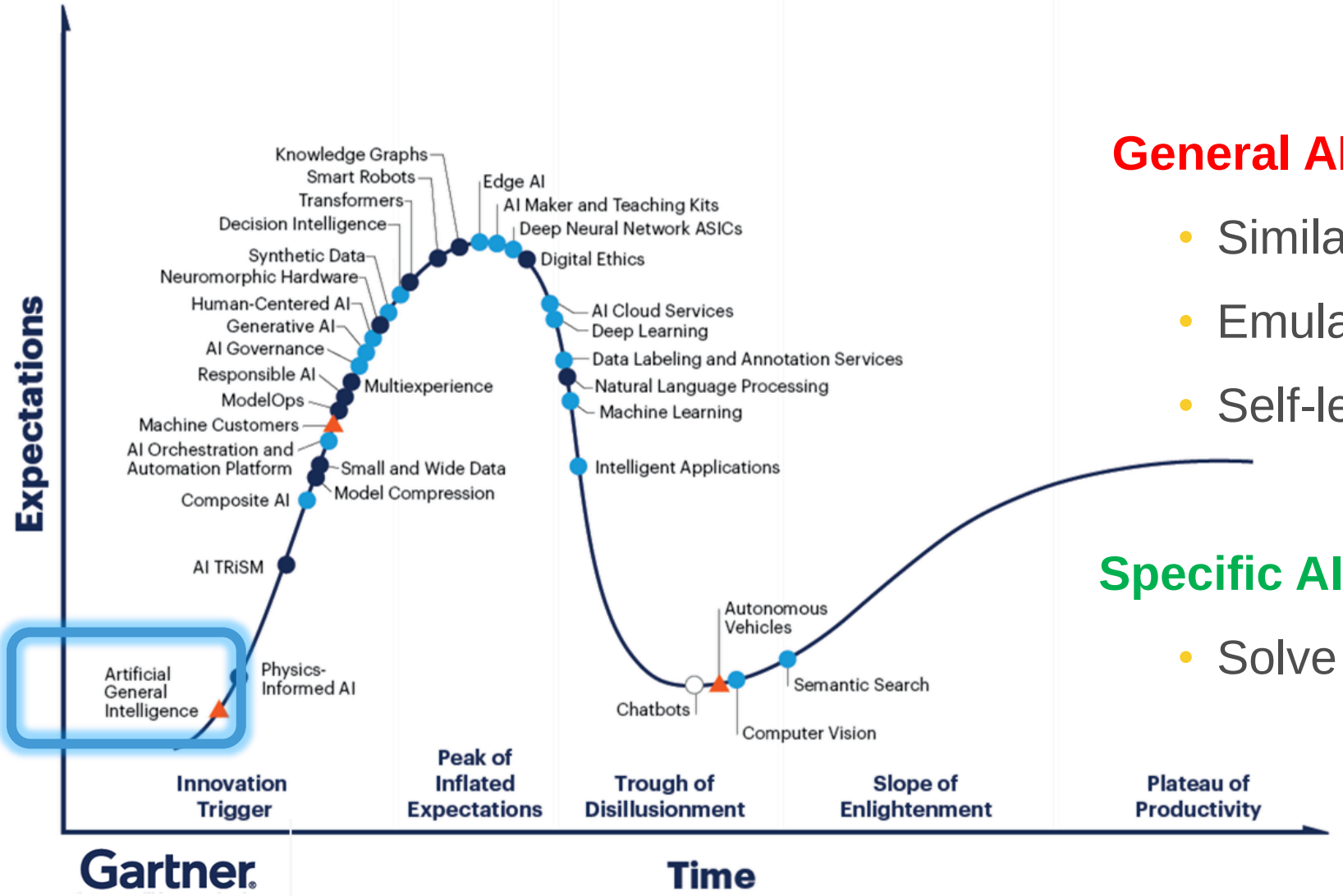


Source: Italian Association of AI - AIxIA



Source: Xenostack

So, is General AI (GAI) coming soon?



General AI → Strong AI

- Similar to the human intelligence
- Emulate heterogeneous processes
- Self-learning

Specific AI → Narrow (or weak) AI

- Solve specific problems/tasks

AI today…

Wide access and use of specific technologies by society and companies

- Speech Recognition
- Image Recognition
- Natural Language Processing
- Machine translation
- Games
- Predictions

Devices performing tasks previously performed by humans

Devices performing tasks that humans cannot perform

Devices for humans that increase their physical or cognitive abilities

3. Impact of AI

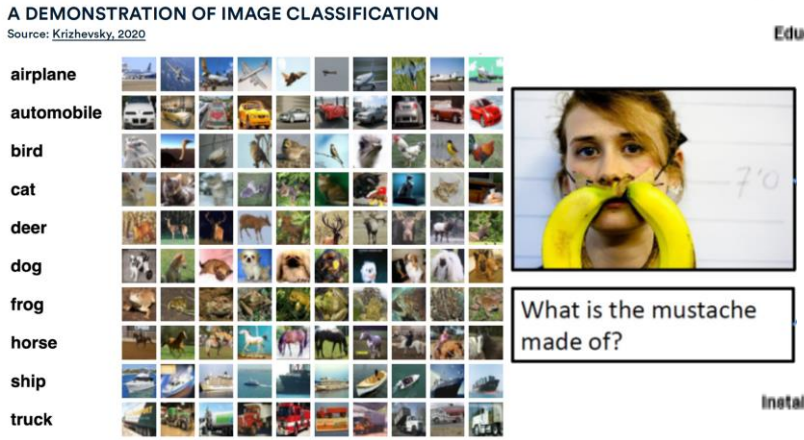
Potential benefits and risks of AI

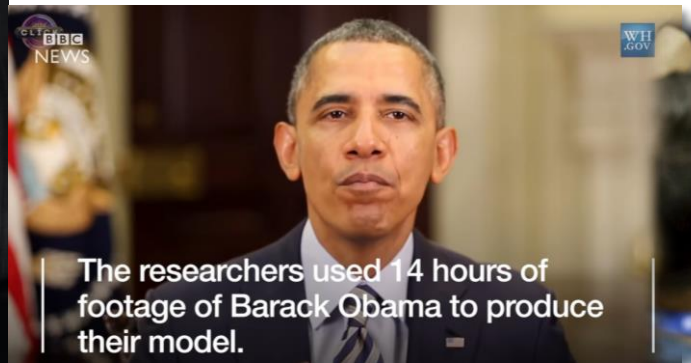
- “AI is a **General-Purpose Technology** that has the potential to **improve the welfare and well-being of people**, to contribute to **positive sustainable global economic activity**, to increase innovation and productivity, and to help **respond to key global challenges**. It is deployed in many sectors ranging from production, finance and transport to healthcare and security.”
- “Alongside benefits, **AI also raises challenges for our societies and economies**, notably regarding economic shifts and inequalities, competition, transitions in the labour market, and implications for democracy and human rights.”

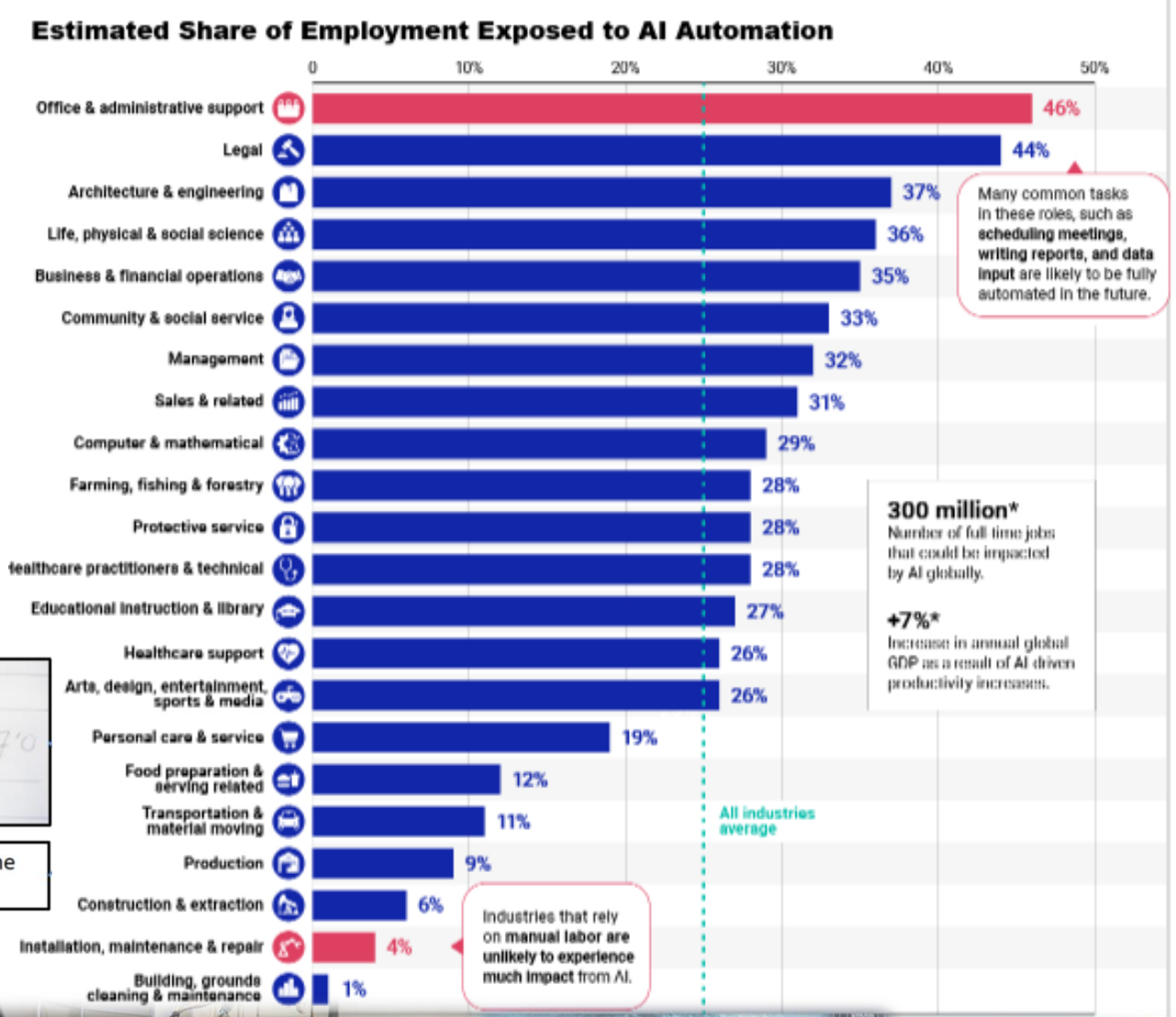
Source: OECD (2019), Artificial Intelligence in Society, OECD Publishing, Paris, https://doi.org/10.1787/eedfee77-en

Changing the nature of work and society

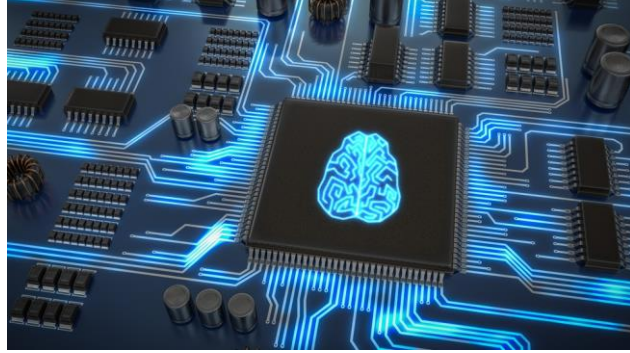
- Increased performance and accuracy
- Imitation, Automation and Augmentation





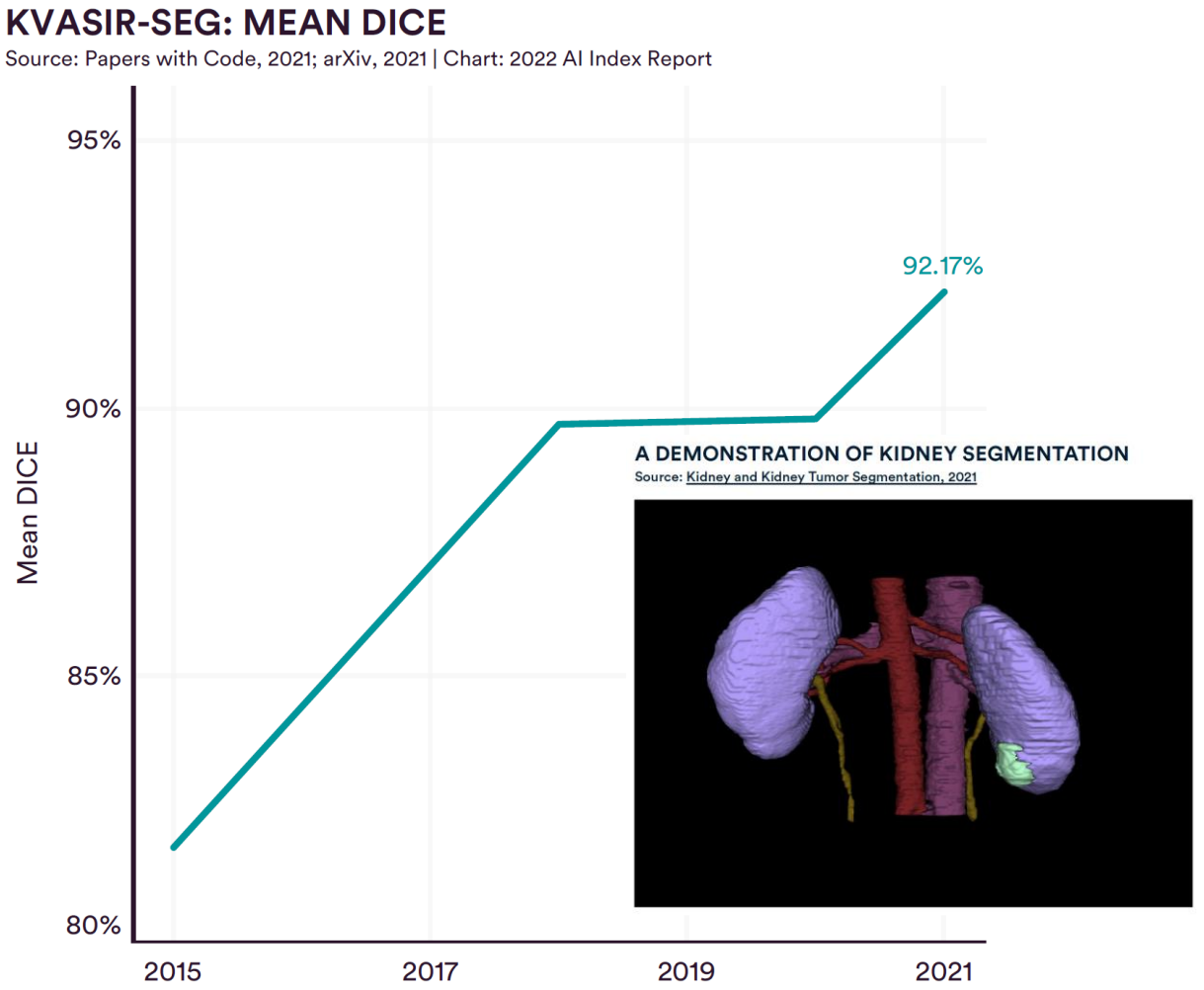


An example – AI and healthcare: kidney semantic segmentation



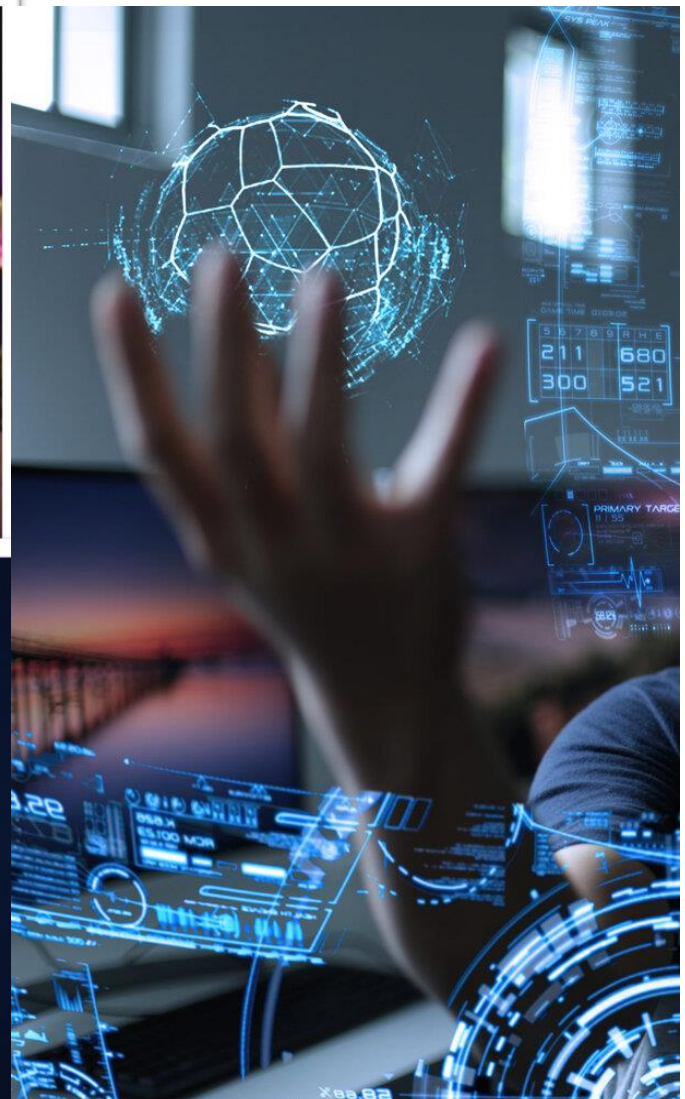
- Early intervention in kidney cancer helps to improve survival rates
- In clinical practice, the manual segmentation and quantification of organs and tumors are expensive and time-consuming
- AI has shown a significant advantage in assisting cancer diagnosis. To reduce the workload of manual segmentation and avoid unnecessary biopsies or surgeries

Source: Italian Association of AI - AIxIA

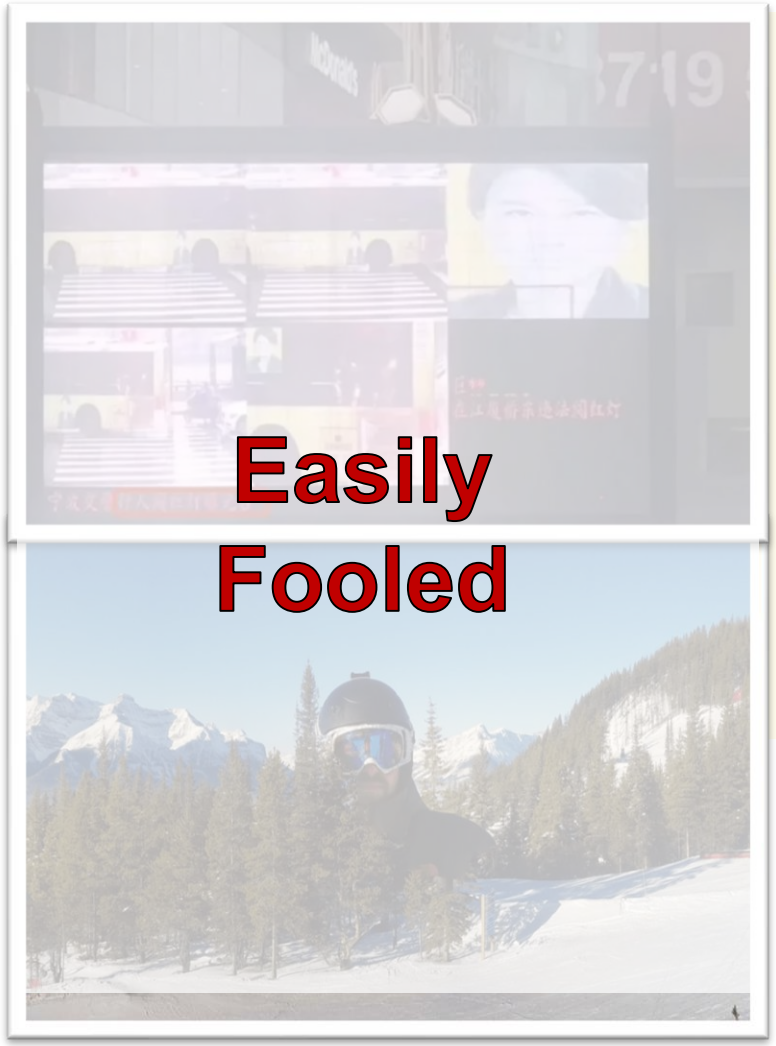


Limitations – bias and discrimination

Lack of performance on tasks requiring logical reasoning skills



Challenges and risks for democratic systems

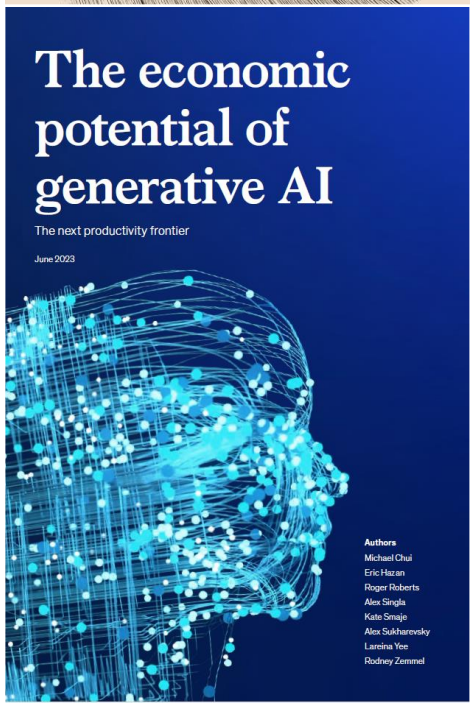


- “Using Large Language Models like Bing Chat as a source of information for deciding how to vote is a very bad idea. As their answers to important questions are partly completely wrong and partly misleading, the likes of ChatGPT can be dangerous to the formation of public opinion in a democracy”

Source: AlgorithmWatch and AI Forensics study, 5th October 2023)

4. Generative AI

The impact of Generative AI: the new printing press?



- Generative **AI's impact on productivity** could add up to $4.4 trillion annually in value to the global economy
- About 75% of the value that generative AI use cases could deliver falls across customer operations, marketing, sales, software engineering, and R&D
- Generative **AI can revolutionize work** by automating a significant portion of employees' activities, up to 60-70% of their current workload. This augmentation of individual capabilities has the potential to transform the way we work
- Generative AI is expected to have $ 250-410 billions economic impact on banking and insurance, accounting for 1-1.6% of total industry revenue

Source: McKinsey & Co. (2023) https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#introduction

Why is Generative AI different?

- Generative AI create new written, visual, and auditory content given prompts or existing data

Traditional Models

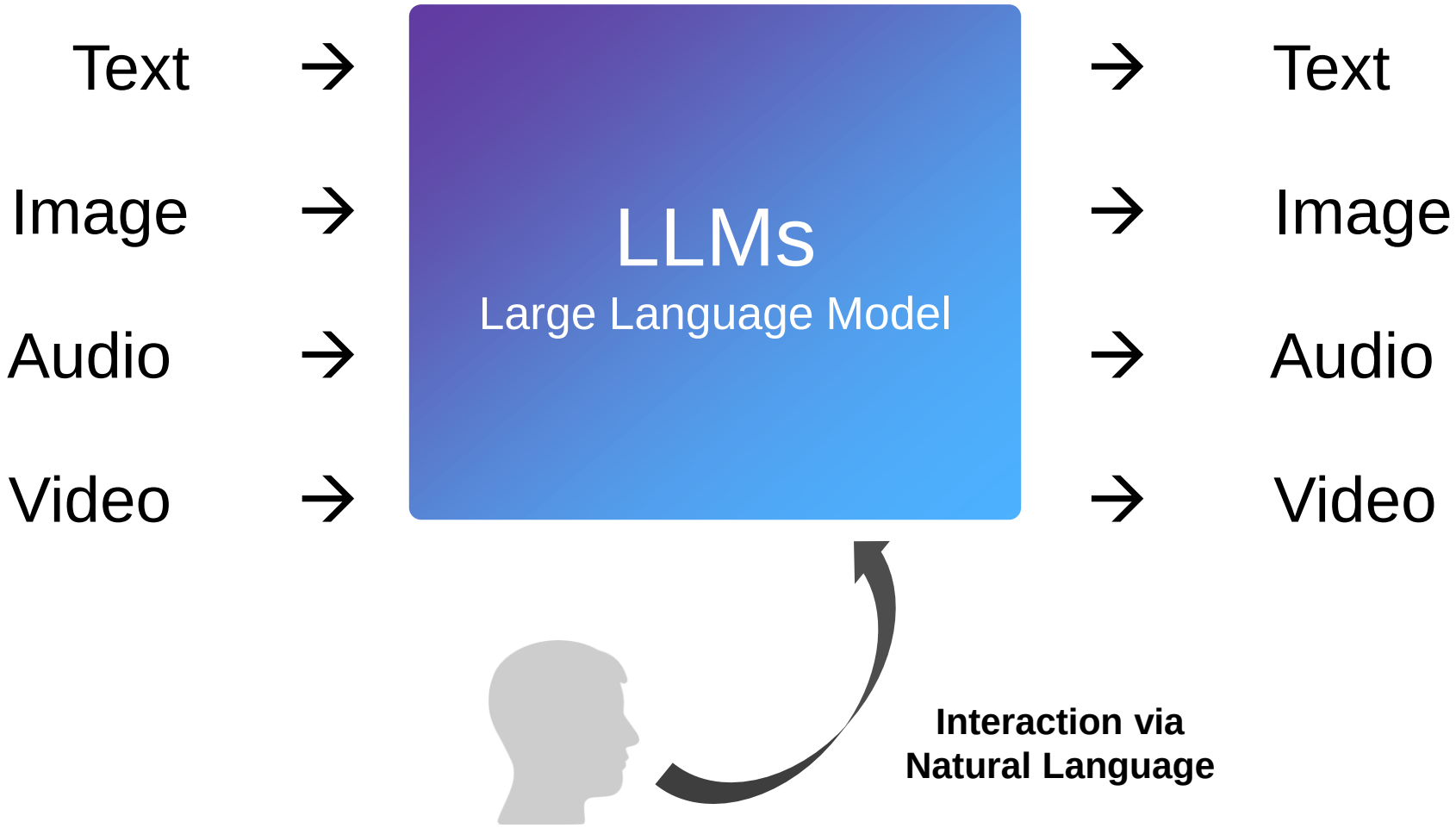
New Foundation Models

(one single model for everything)

Sentiment
Intent recognition
Entities extraction
Summarization
Questions & Answers
Style transfer
Rewriting
Code generation
...

Source: Courtesy of Adrian Gonzalez-Sanzhez, OdyseIA and Microsoft

How does Generative AI work?



Source: Courtesy of Adrian Gonzalez-Sanzhez, OdyseIA and Microsoft

The case of Alex

- Alex saw 17 doctors over 3 years for chronic pain. ChatGPT found the diagnosis
  - Alex experienced pain that stopped him from playing with other children but doctors had no answer
- His mother Courtney asked ChatGPT for help
  - The unexpected solution “Anchored spinal cord syndrome”, so replies the AI model.
- The doctor immediately confirms ChatGPT’s diagnosis by examining the MRI images

Focus on (Chat)GPT: A confusing open debate

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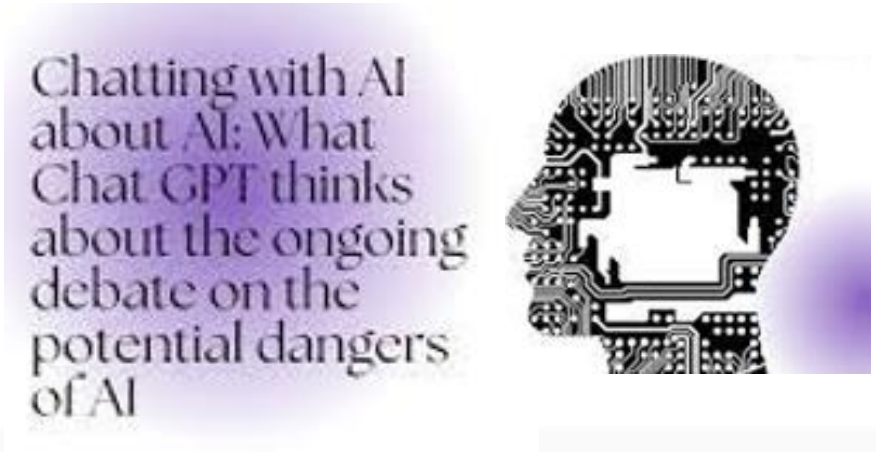
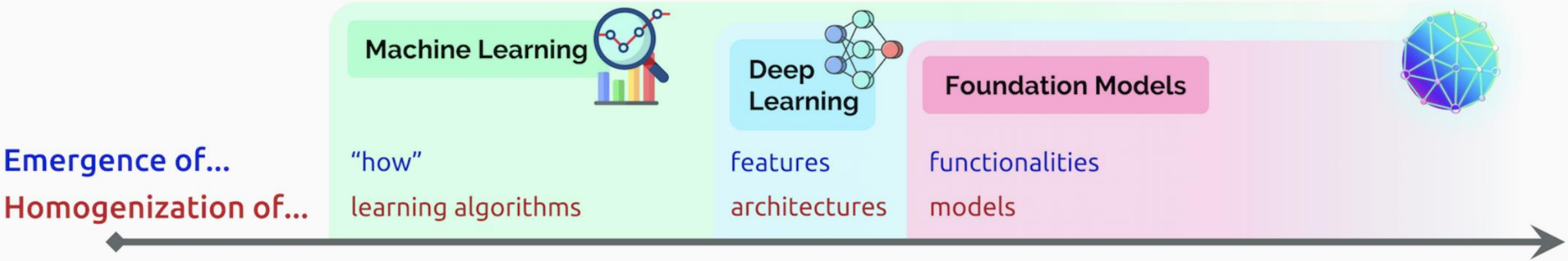
- Large Language Models / Foundation Models
- Generative Adversarial Networks (GAN) / Generative Pretrained Transformer (GPT)
- General Purpose AI / Generative AI
- …..





Traps of Generative AI

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- **“Prompting” issues and “question engineering”:** questioning skills and a critical sense is becoming THE skill to be acquired
- **“Robustness hallucinations”:** learn plausible but not necessarily correct statistical patterns (reminder: correlation is not causation)
- **Lack of transparency of training data:** legal use of sources and copyright
- **Autophagy:** distinction between human-and machine-generated content
- **Lack of diversity and multi-linguality:** bias, stereotypes and value-judgment mostly dominated by “global North” and English and Chinese languages with increasing discrimination in access for the global South as well as between different social groups and minorities

5. Governance “of, with and by” AI

Humans and Machines: an evolving relationship

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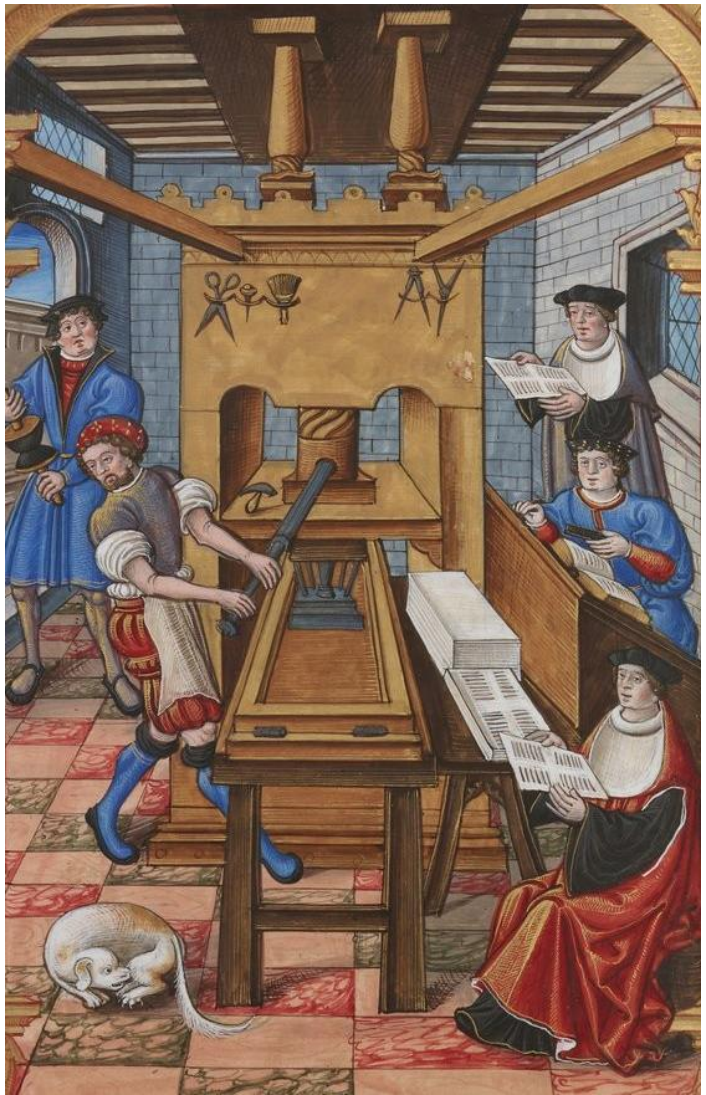
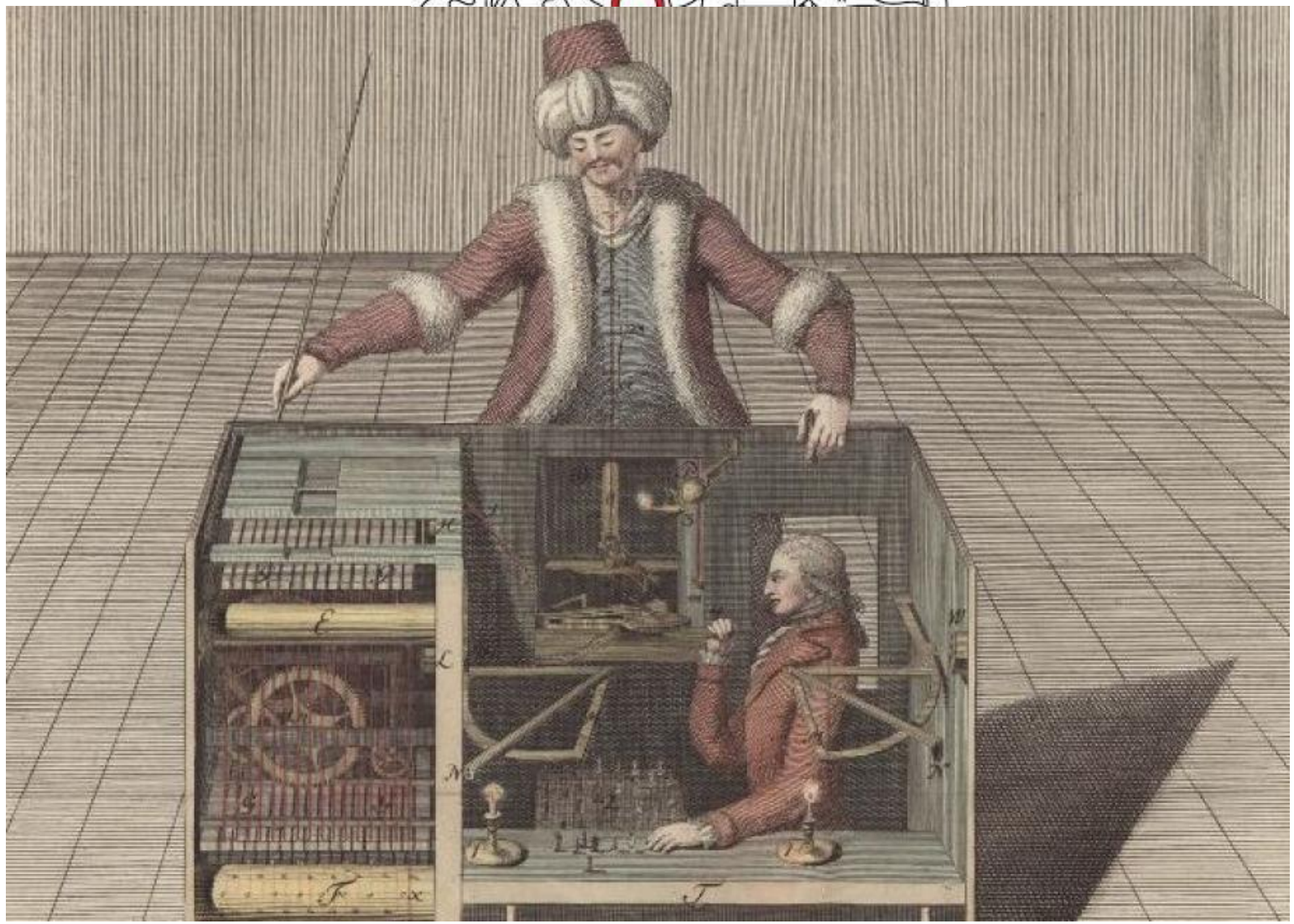




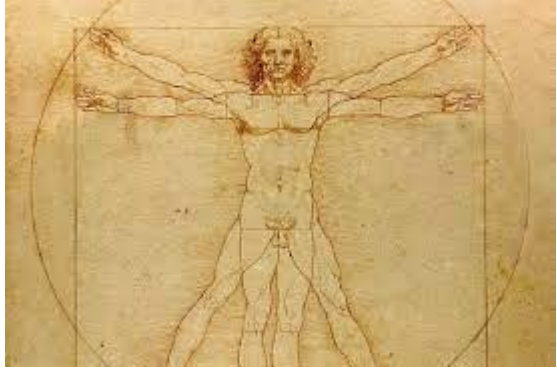
Are we going too fast?

- From a time when humans code algorithms and take responsibility for the quality and correctness of the resulting software…

1950

- … to a time when machines automatically learn algorithms from a sufficient number of examples of the input/output behaviour predicted by the algorithms

Towards human-centric AI…



- *“An approach to AI that prioritises human ethical responsibility, dynamic qualities, understanding and meaning. [….]*
- *Human-Centric AI systems are built on the recognition of a meaningful human-technology interaction […] in which humans assume agency and oversight*
- *Human-Centric AI is designed as tools to serve people with the ultimate aim of increasing human and environmental well-being with respect for the rule of law, human rights, democratic values and sustainable development”.*

Source: EU-U.S. TTC Terminology and Taxonomy for AI (2023), (based on Hasselbalch, G., 2021) and developed with support from InTouchAI.eu for the EU

International Outreach for Human-Centric InTouch AI.EU

https://digital-strategy.ec.europa.eu/en/policies/international-outreach-ai

Turning away from dystopian futures

- **Beware of techno-solutionism:** avoid thinking of AI as some sort of super-agent able to do more or less everything
- **Be suspicious of ethical shortcuts:** if superficially handled, AI systems may infringe upon the principles of privacy and data protection
- **Adopt a public value perspective:** focusing on the effective implementation of AI to address the complex challenges government must solve
- **Be ready to handle disruption:** experimenting with AI considering both tangible changes in procedures, as well as the need of “cognitive restructuring”
- **Design new models of governance:** rethink how services are delivered, data is managed, and the way algorithmic decision-making is implemented

Governance “of, with & by” AI
Policy-maker’s dilemmas in the digital age

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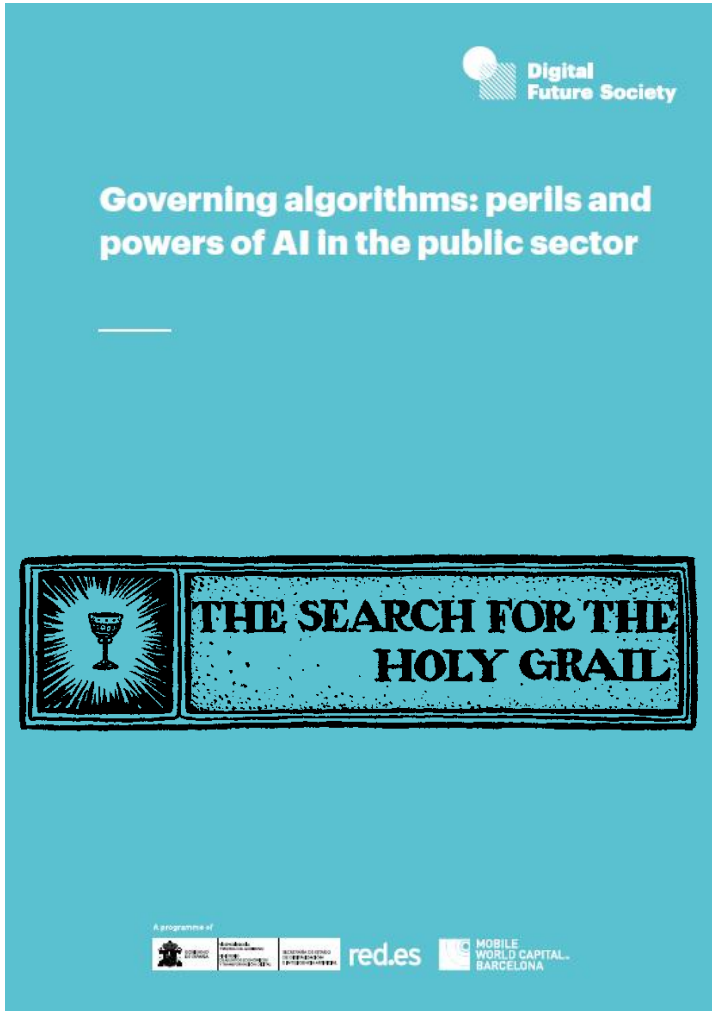
“the obligation to protect citizens from potential algorithmic harms is at odds with the temptation to increase efficiency and enhance quality of digital services”, [Misuraca, DFS, 2021]

- **Governance of AI:** introducing AI into the public sector must not override existing governance mechanisms and institutional barriers need to be addressed
- **Governance with AI:** humans should remain in control of a set of technologies that reinforce human capacity, safeguarding human rights and deploying AI ethically
- **Governance by AI:** the true power and risk of AI use in the public sector emerge when human decision makers would surrender to the “superhuman” capacities of AI



https://digitalfuturesociety.com/report/governing-algorithms

AI can indeed help augmenting human-capacities…

Image Credits: How are Humans Evolving in the Digital Age?, Ivan Ferrero, Blog, 2018

… if ethically designed and mastered!

But are we ready for mastering AI?

- According to the latest ITU data (March 2023), half of all countries in the world (94) have adopted overarching, cross-sectoral digital policies or strategies:
  - However, only 9 countries – less than 5% of countries worldwide – are currently equipped with mature national frameworks for digital markets geared at transformational development of digital economies and societies.
  - Additionally, just 30% of countries globally have made progress in establishing advanced national digital policy, legal and governance frameworks.

"***Government should have the right skills for the digital future***. *The success of digital transformation depends on equipping senior business leaders to make informed decisions and acquiring and keeping enough skilled specialists on board*".

National Audit Office of the UK Cabinet Office (March 2023)

AI4Gov Master: training “functional specialists”

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European Commission

Master in
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Digital Skills & Jobs Platform

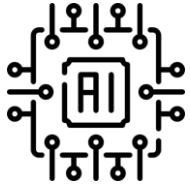
- Integral curriculum teaching the technical, service design and policy aspects of applied Artificial Intelligence in the public sector

https://ai4gov-master.eu

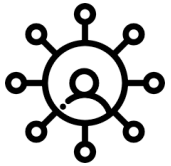
Governance and policy aspects of AI

Human-centric principles for AI systems and service design

Focus on use cases of AI in the public sector



Technical knowledge in on-demand AI techniques



Networking with a world-class executive group

AI4Gov: Building the European ecosystem on AI for public services

1. Design a world-class international master on AI in public services rooted in blended learning and project-based work
2. Develop an ecosystem and network of excellence on AI for government across the EU
3. Establish an EU Knowledge Hub of Excellence on AI for the public sector recognized worldwide

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TAL TECH

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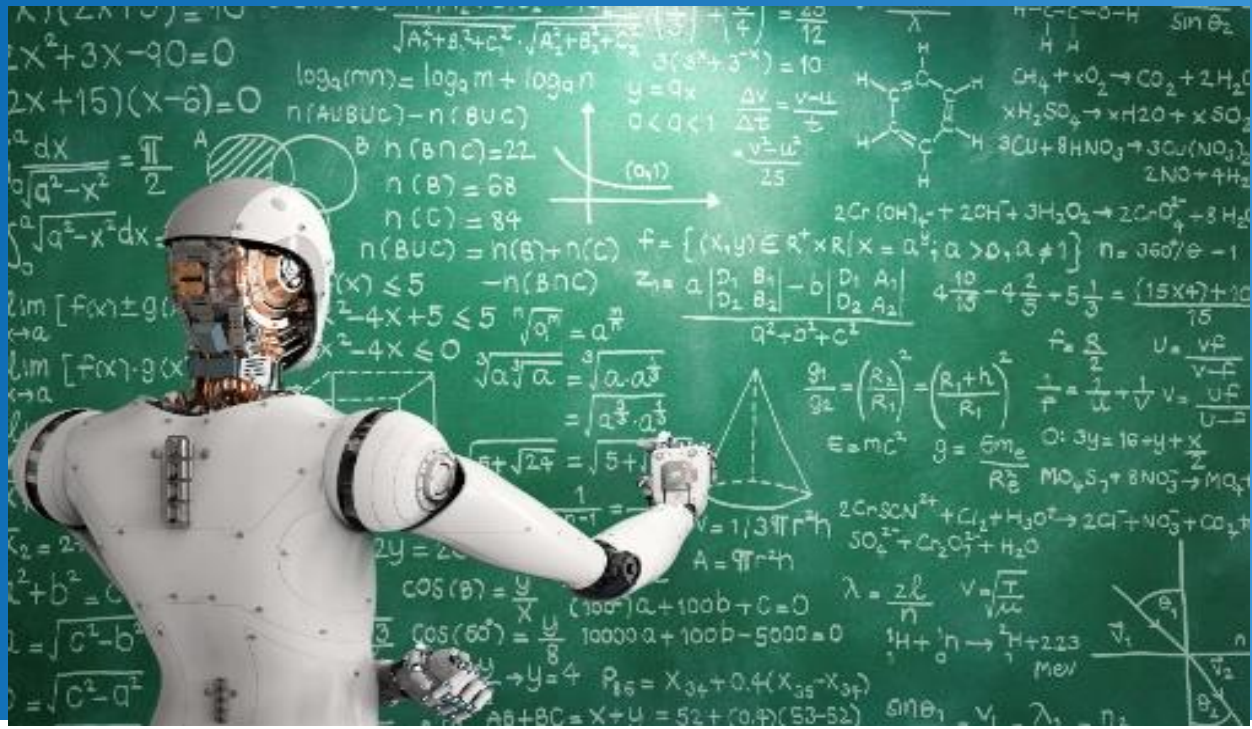
European Commission

The AI4GOV Project is co-financed by the EU

CEF programme

https://www.ai4gov-hub.eu

Thanks!



Master in
Artificial Intelligence for Public Services
AI4Gov https://ai4gov-master.eu

info@ai4gov-master.eu

gianluca.misuraca@upm.es

https://www.linkedin.com/company/ai4gov-eu

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