

Technical Introduction to AI in Industry

Applications of Artificial Intelligence

About the Teacher

Here's some information on the teacher for the 2nd part of the course

- name: Michele Lombardi
- email: michele.lombardi2@unibo.it
- You also book a Teams call via this booking page:



<https://book.morgen.so/michelelombardi03/student-hours>

This lecture material is available at:



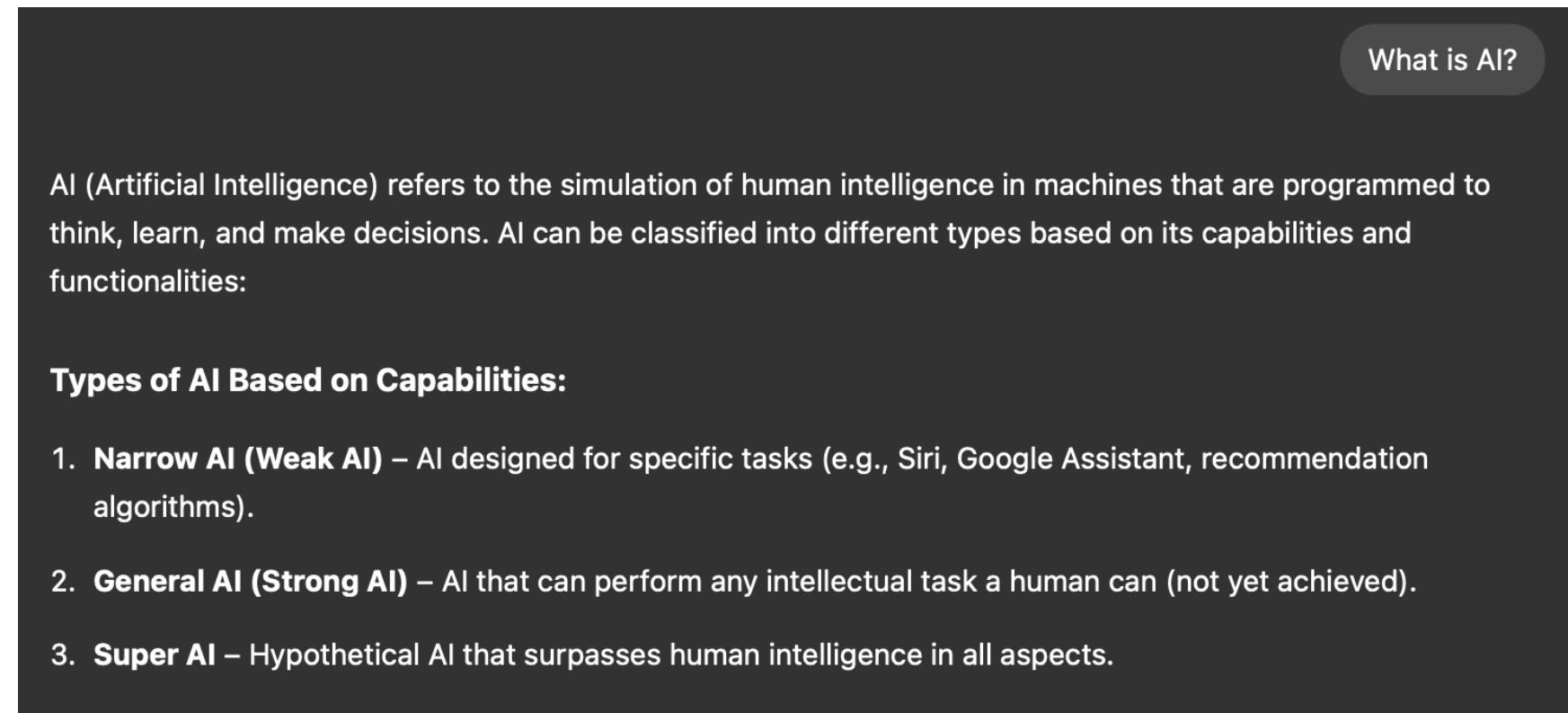
<https://github.com/COURSE>

Let's start with a question:

First, what do we mean by AI?

What is Artificial Intelligence?

This is what ChatGPT says about it



What is AI?

AI (Artificial Intelligence) refers to the simulation of human intelligence in machines that are programmed to think, learn, and make decisions. AI can be classified into different types based on its capabilities and functionalities:

Types of AI Based on Capabilities:

1. **Narrow AI (Weak AI)** – AI designed for specific tasks (e.g., Siri, Google Assistant, recommendation algorithms).
2. **General AI (Strong AI)** – AI that can perform any intellectual task a human can (not yet achieved).
3. **Super AI** – Hypothetical AI that surpasses human intelligence in all aspects.

- All true, though, though a bit too centered on OpenAI perspective
- ...And not so useful in practice

What is Artificial Intelligence?

This is from wikipedia:

Artificial intelligence (AI), in its broadest sense, is intelligence exhibited by machines, particularly computer systems.

- Even more vague
- ...Though the article becomes much more precise later on

What is Artificial Intelligence?

This is from wikipedia:

Artificial intelligence (AI), in its broadest sense, is intelligence exhibited by machines, particularly computer systems.

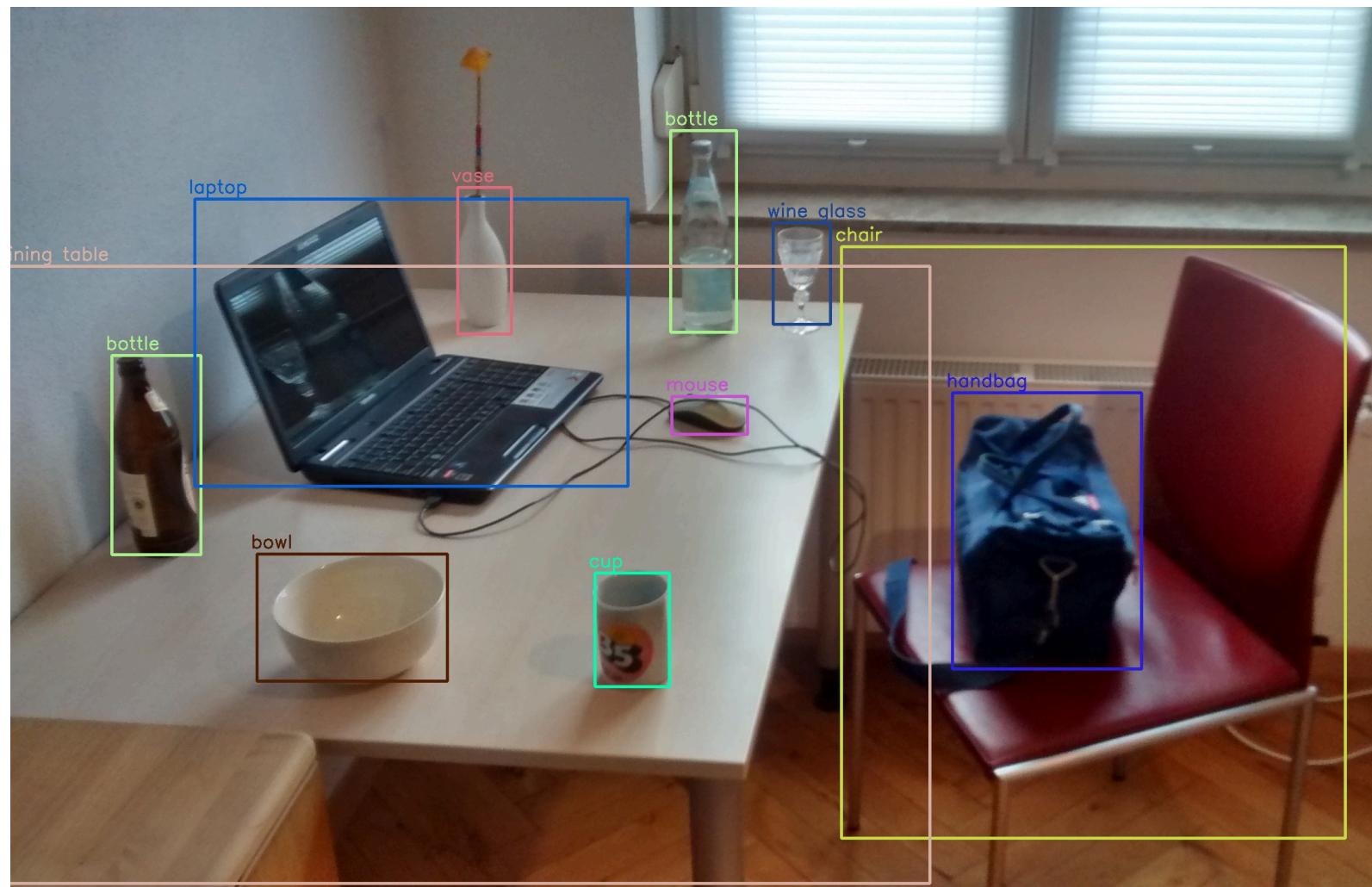
- Even more vague
- ...Though the article becomes much more precise later on
- There are actually multiple, slightly different definitions
- ...Which we ultimately care little about here

We'll take a **practical perspective instead**

So, let's start from a few high-profile things we can **do with AI**

Things We Can Do with AI

We can recognize objects in a picture



Things We Can Do with AI

We can identify areas in a picture



Things We Can Do with AI

We can drive a car



Things We Can Do with AI

We can translate text

The screenshot shows the Google Translate web interface. At the top, there's a navigation bar with a menu icon, the "Google Translate" logo, and three user icons (gear, dots, profile). Below the bar are four tabs: "Text" (selected), "Images", "Documents", and "Websites". The source language is set to "Italian - Detected" and the target language is "English". A dropdown menu for each language is open, showing options like English, Italian, Spanish, and others.

Source Text (Italian):

Michele Lombardi è Professore Associato presso il DISI, Università di Bologna, dall'Ottobre 2021, all'interno dle gruppo di Intelligenza Artificiale. La sua attività di ricerca riguarda l'integrazione di tecniche di Ottimizzazione ed Ingellenza Artificiale, in particolare Apprendimento Automatico (Machine Learning), Programmazione a Vincoli, Programmazione Matematica e SAT Modulo Theories.

Target Text (English):

Michele Lombardi is Associate Professor at DISI, University of Bologna, since October 2021, within the Artificial Intelligence group. His research activity concerns the integration of Optimization and Artificial Intelligence techniques, in particular Machine Learning, Constraint Programming, Mathematical Programming and SAT Modulo Theories.

At the bottom of each text area are small icons for microphone, speaker, and edit, along with a character count (394 / 5,000) and a pen icon. On the far right, there are icons for download, copy, and share, and a "Send feedback" link.

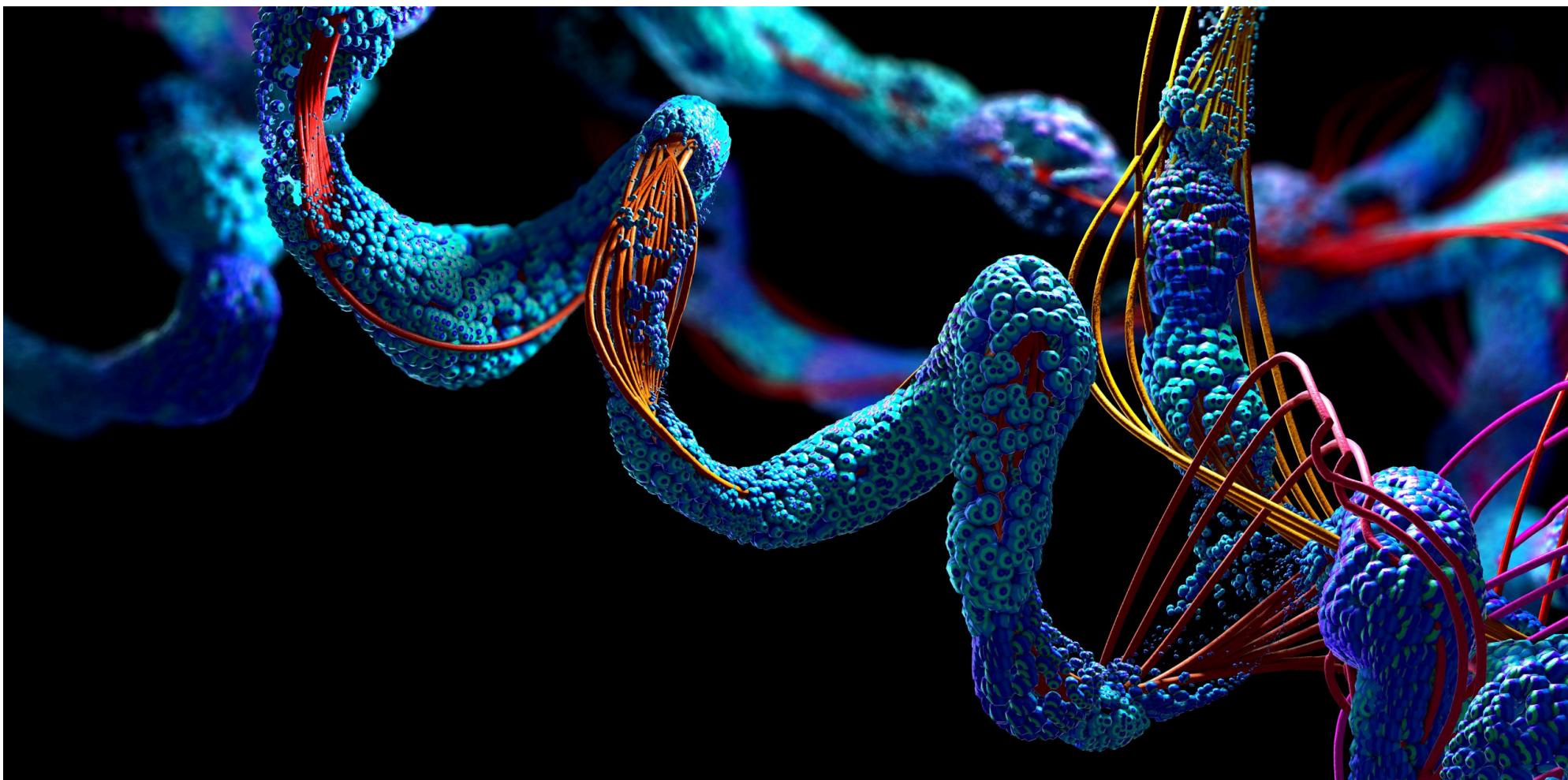
Things We Can Do with AI

We can compete at games with master players



Things We Can Do with AI

We can understand the structure of proteins



Things We Can Do with AI

We can save lives

ASIANSCIENTIST

TOP
NEWS

IN THE
LAB

HEALTH

TECHNOLOGY

PHARMA

ACADEMIA

FEATURES

VIDEO

IBM's Watson Detected Rare Leukemia In Just 10 Minutes

The supercomputer swiftly cross-referenced a patient's genetic data to make a diagnosis that would have taken a human doctor weeks.

SHARE



SHARE



TWEET



SHARE



What is Artificial Intelligence

We'll view AI as a field concerned with the construction of **models**

Models are abstract artefacts and can be:

- Descriptive
- Predictive
- Decisional
- Generative

Models are essentially tools

- It's up to us to build and use them correctly and ethically
- However, doing that is not always easy

To a large extent, this is problem of expectations and transparency

Inside AI

Some notable subfields within AI:

- Learning
- Natural Language Processing
- Computer Vision
- Automated Reasoning
- Automated Planning

Some related disciplines

- Computer Science
- Mathematics and statistics
- Phylosophy

Time for a few more questions:

What do we mean by "industry"?
...And what can AI do for an industrial process?

Industry

This is industry



Industry

This is also industry



Industry

This is also industry



Industry

This is also industry



Industry

We'll define "industry" as any activity that can generate **value**

Therefore we'll talk about industry in **very broad sense**

- Manufacturing, logistics, automation, energy systems, automation
- ...But also product design, healthcare, policy-making...

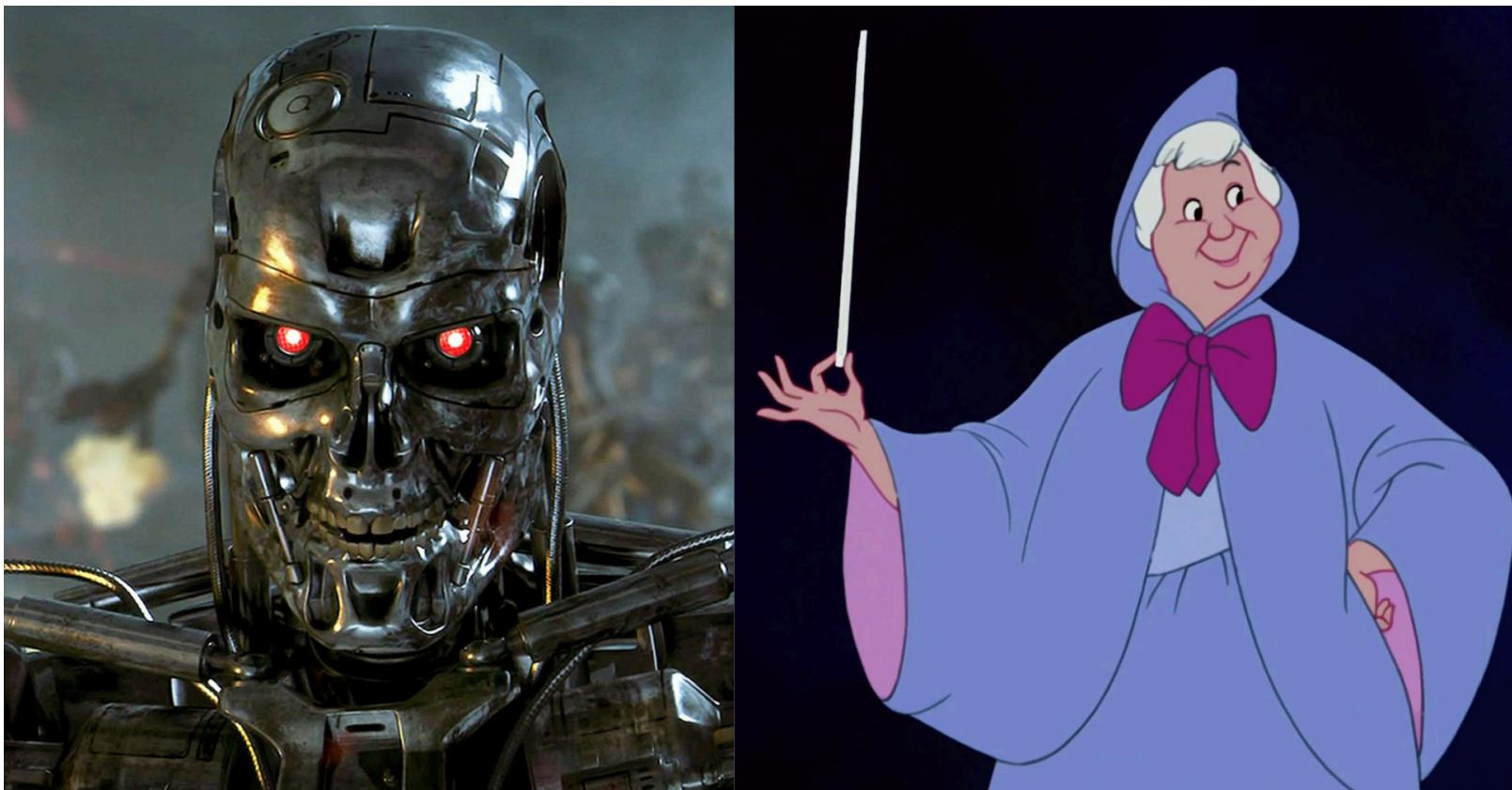
...And AI can help an industrial process to provide more value

- Whatever we our idea of "value" is (money, societal benefits, sustainability...)

But how?

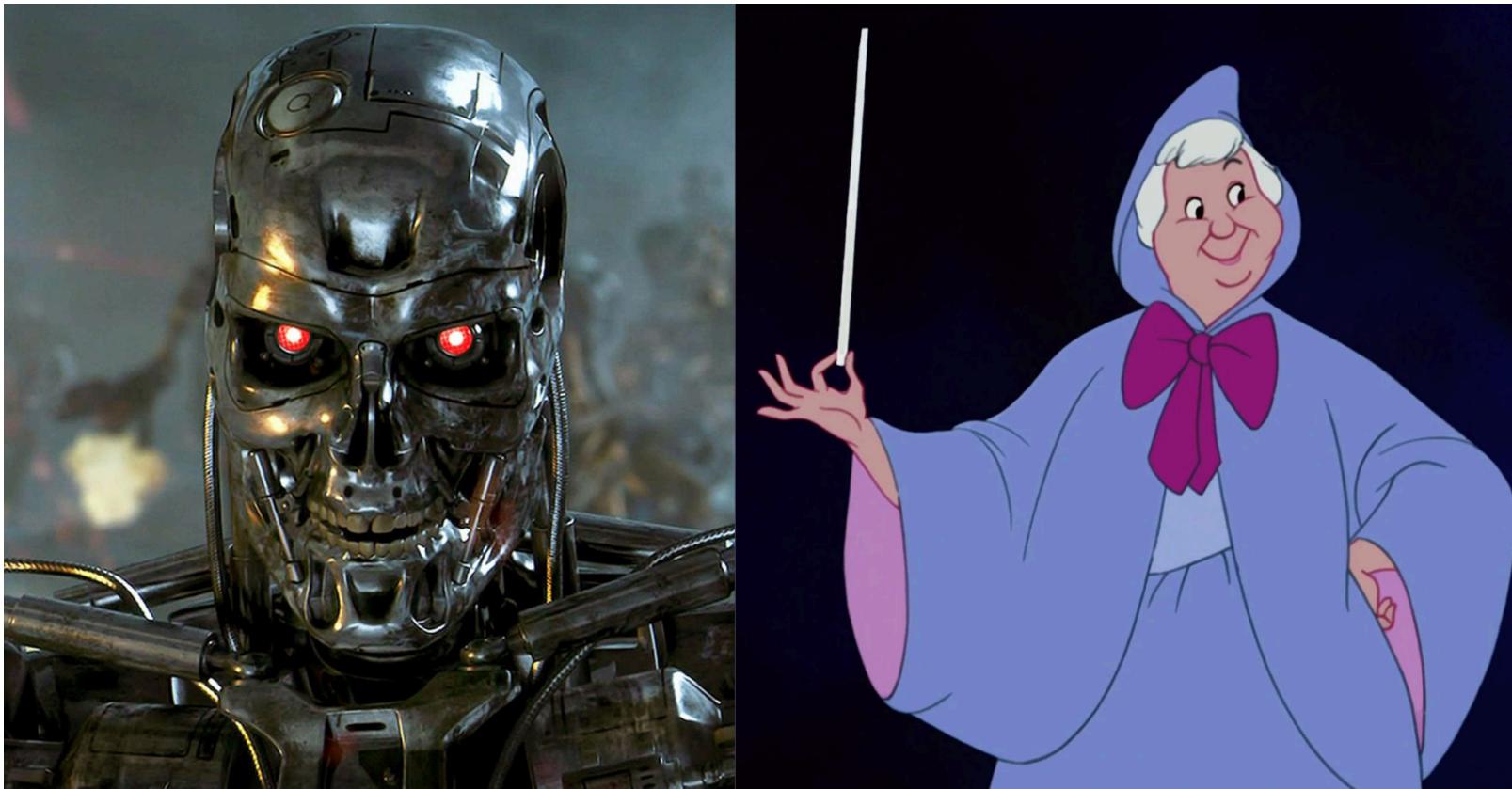
How So?

Right now, the discussion on AI is often very polarized



How So?

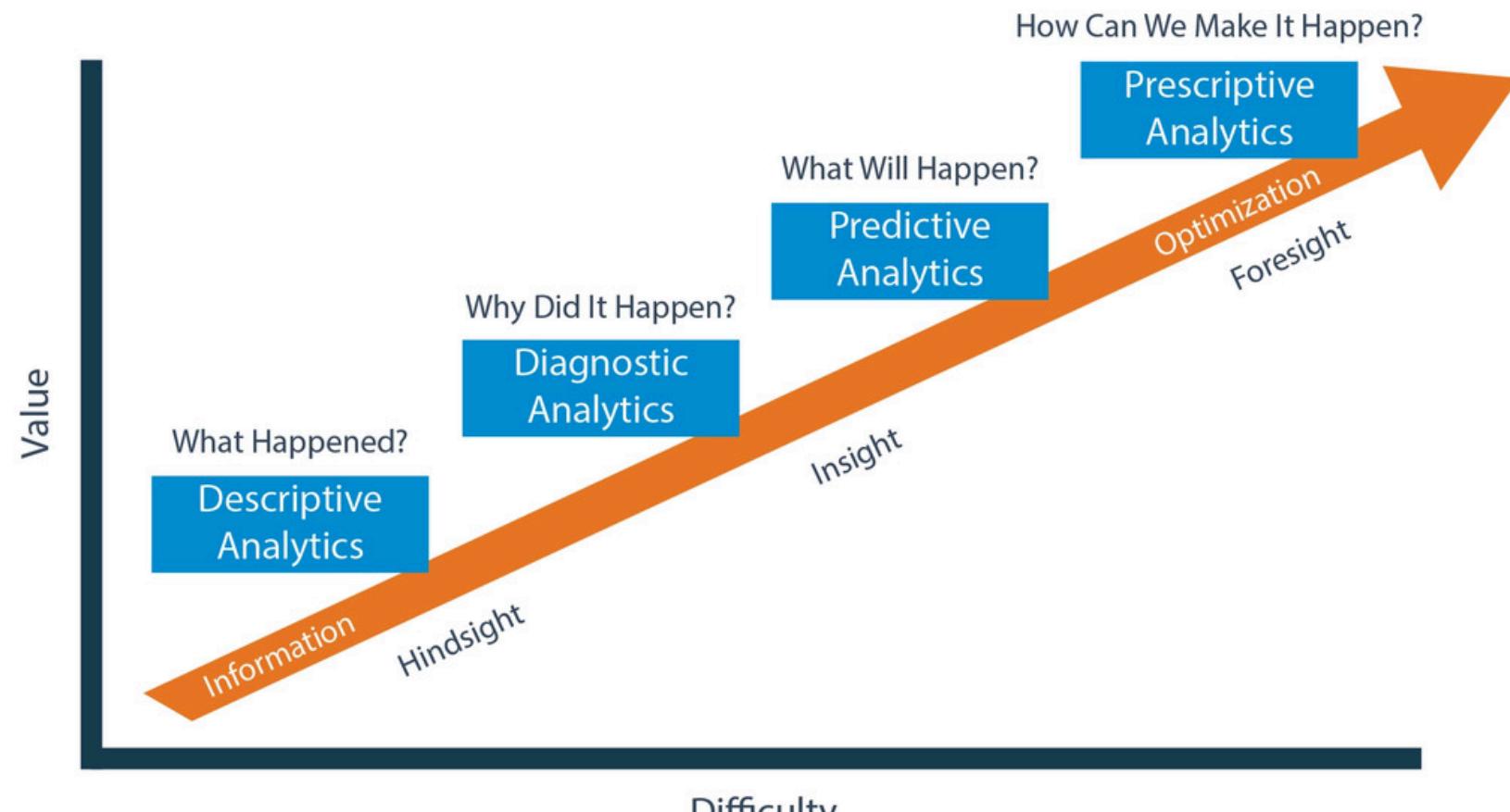
Right now, the discussion on AI is often very polarized



So, let's make it more grounded

Business Analytics

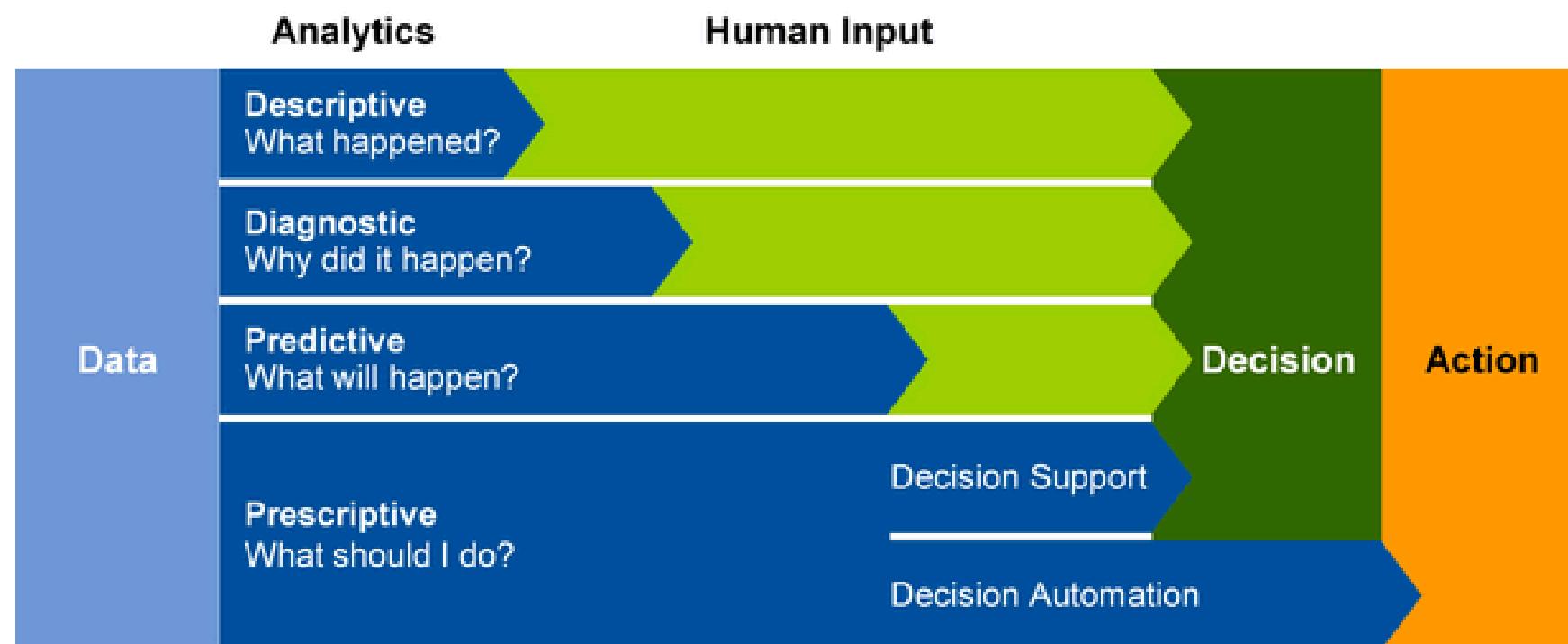
Let's revive a bunch of old buzzwords:



Source: Gartner Analytic Ascendancy Model (March 2012)

Business Analytics

In terms of how far we push automation:



Order and Chaos

BA is a nice framework to characterize what AI can do for a business

...But the truth is more like this!



Order and Chaos

Industrial applications are **complicated**

- The problems are not well defined
- Similar techniques may be applied in multiple settings
- Classical tasks form typically only part of the whole problem
- It is often necessary to combine problems/techniques
- ...

Order and Chaos

Industrial applications are **complicated**

- The problems are not well defined
- Similar techniques may be applied in multiple settings
- Classical tasks form typically only part of the whole problem
- It is often necessary to combine problems/techniques
- ...

A common opinion:

Just come up with a quick solution

...we'll work on fixing it later

Order and Chaos

...But this is **evil!**



Order and Chaos

Specifically, it reaches a plateau real quick:

Sometimes, you solve your problem and you do it fast. But more often:

- You fail, and you don't understand why
- You end up with a much messier solution than needed
- You approach works in controlled conditions, but not in the field

Order and Chaos

Specifically, it reaches a plateau real quick:

Sometimes, you solve your problem and you do it fast. But more often:

- You fail, and you don't understand why
- You end up with a much messier solution than needed
- You approach works in controlled conditions, but not in the field

Our goal will be to bring (some) order to the chaos

- We'll try to be more systematic
- ...And to understand what is going on
- ...So that we can make more informed choices

It's not always doable, but it's a worthy goal!

Our Plan

The main goal is starting to learn a method

- Formalize the problem
- Build a baseline solution
- Interpret the results
- Repeat the process, introducing complexity as needed

Our Plan

The main goal is starting to learn a method

- Formalize the problem
- Build a baseline solution
- Interpret the results
- Repeat the process, introducing complexity as needed

We'll learn primarily by example

- Some key techniques will be covered
- ...But mostly we'll encounter multiple, simplified, use cases
- We'll emphasize **analysis** and **formalization**
- We'll cover code and techniques, but never in detail