Artificial intelligence

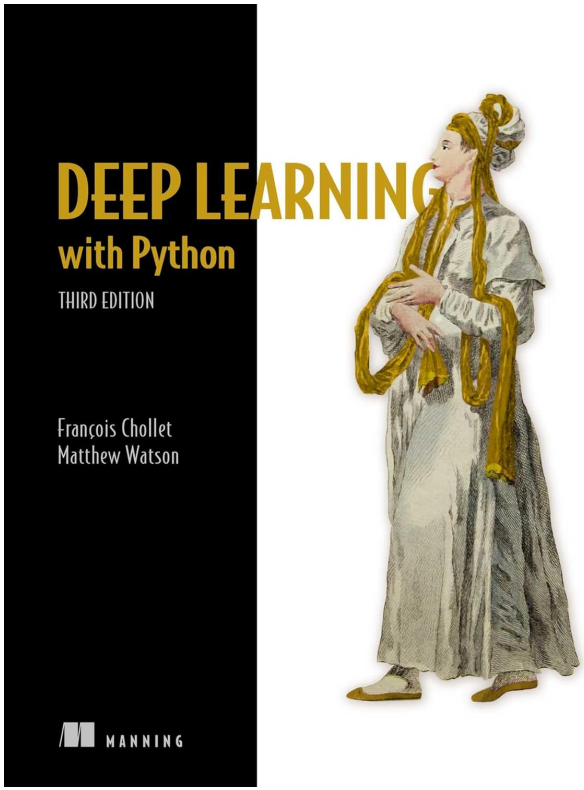
1. What exactly is AI?

Carl McBride Ellis

carl.mcbride@u-tad.com

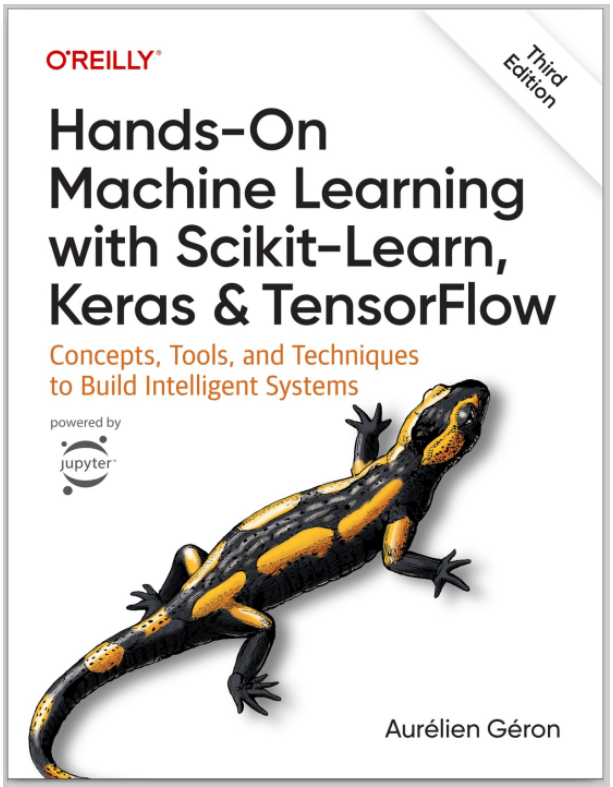
Recommended bibliography

- François Chollet "*Deep Learning with Python*" 3rd Edition, Manning (2025)
- Free online version
- GitHub repo



Recommended bibliography

- Aurélien Géron "*Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow*", 3rd Edition O'Reilly Media (2022) (especially Part II)
- GitHub repo



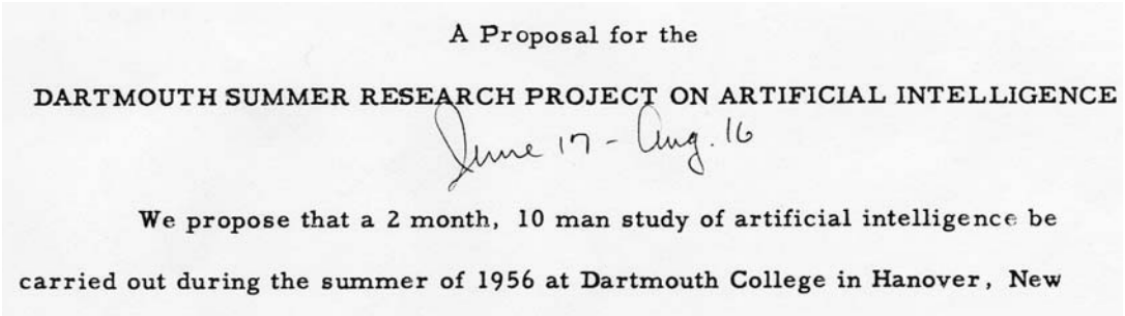
Recommended bibliography

- A Comprehensive Overview and Comparative Analysis on Deep Learning Models: CNN, RNN, LSTM, GRU

Before 1956...

- ~~cybernetics~~
- ~~automata theory~~
- ~~information processing~~
- ~~thinking machines~~
- ~~statistical computing~~
- ~~computational statistics~~
- ~~predictive analytics~~

“artificial intelligence” 



A Proposal for the

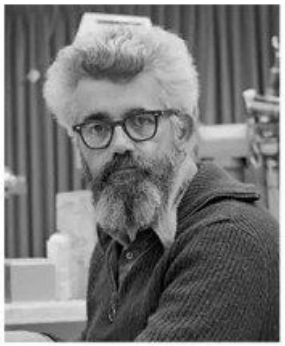
DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

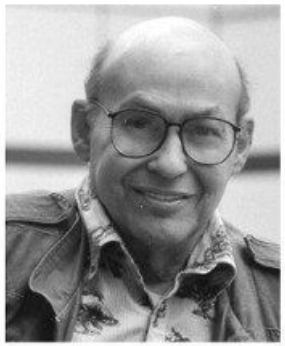
June 17 - Aug. 16

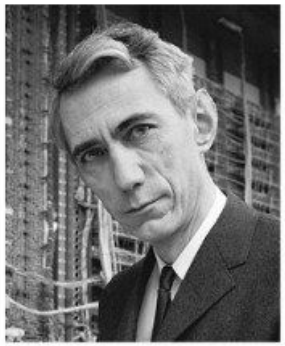
We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New

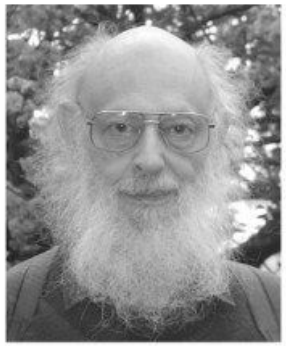
Source: John McCarthy, Marvin L. Minsky, Nathaniel Rochester, Claude E. Shannon *“A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence”*, August 31 (1955)

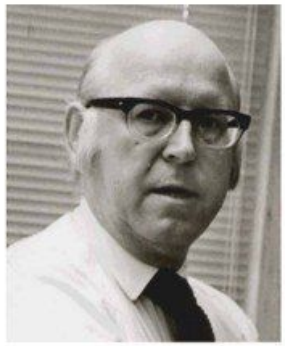
1956 Dartmouth Conference: The Founding Fathers of AI


John MacCarthy


Marvin Minsky

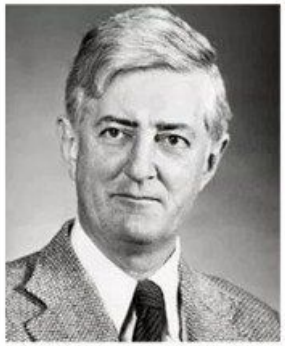

Claude Shannon


Ray Solomonoff


Alan Newell


Herbert Simon

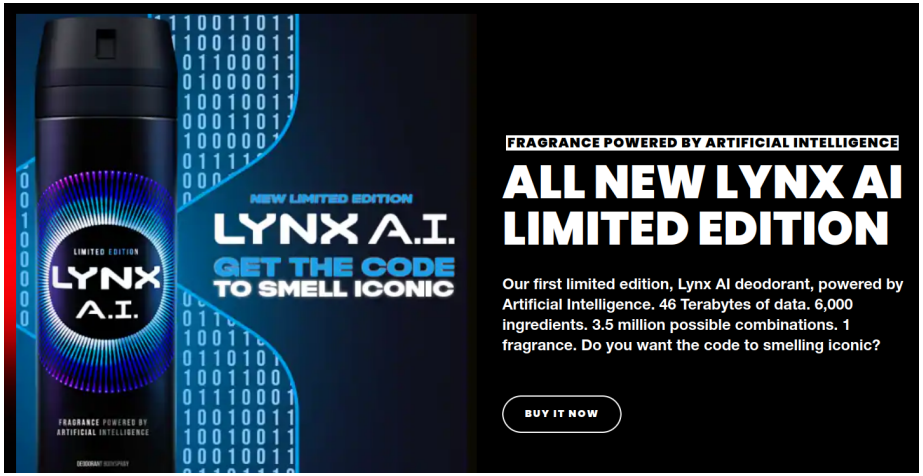

Arthur Samuel

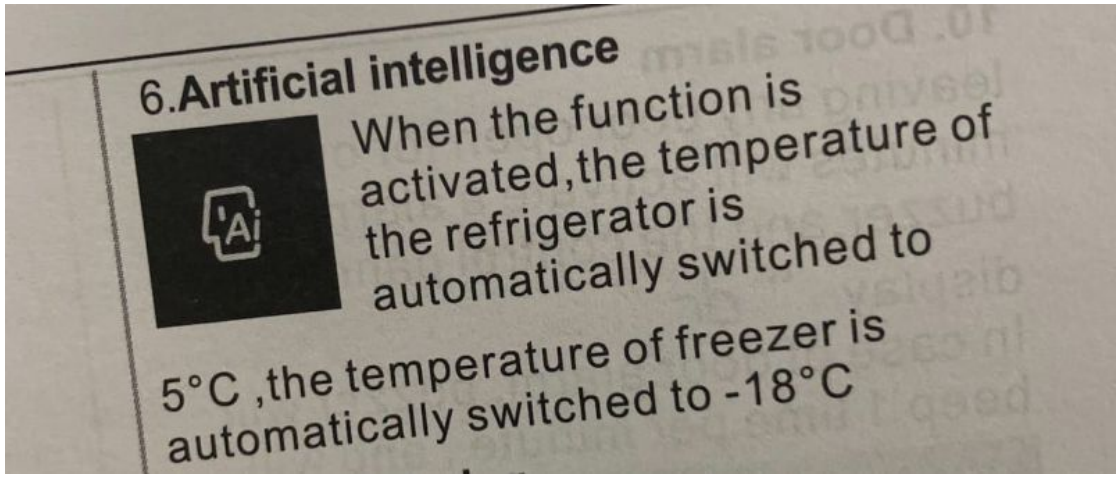

Oliver Selfridge


Nathaniel Rochester

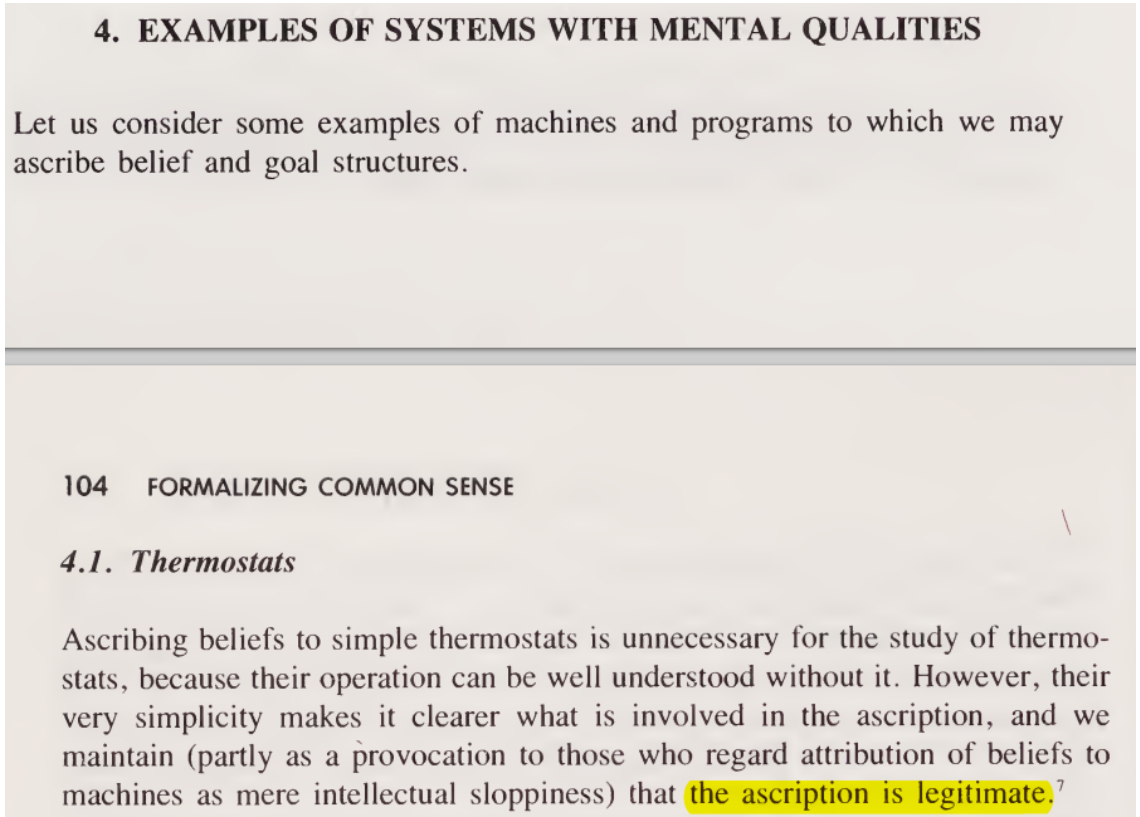

Trenchard More

...and now we have:




6.Artificial intelligence
When the function is activated,the temperature of the refrigerator is automatically switched to 5°C ,the temperature of freezer is automatically switched to -18°C

however



4. EXAMPLES OF SYSTEMS WITH MENTAL QUALITIES

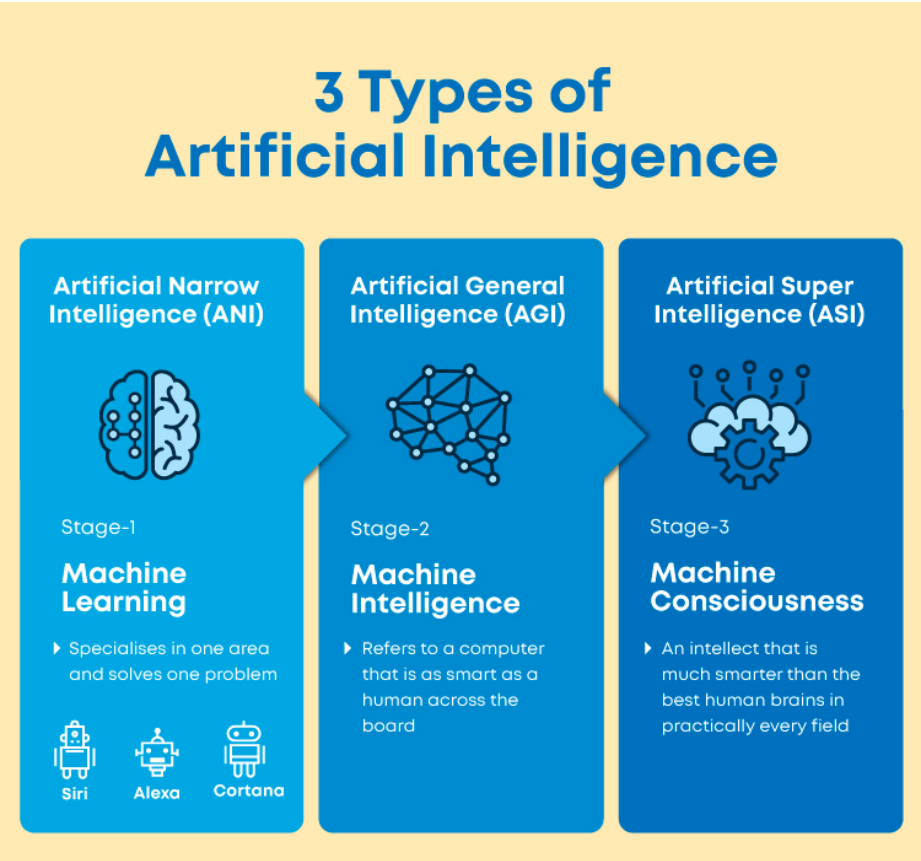
Let us consider some examples of machines and programs to which we may ascribe belief and goal structures.

104 FORMALIZING COMMON SENSE

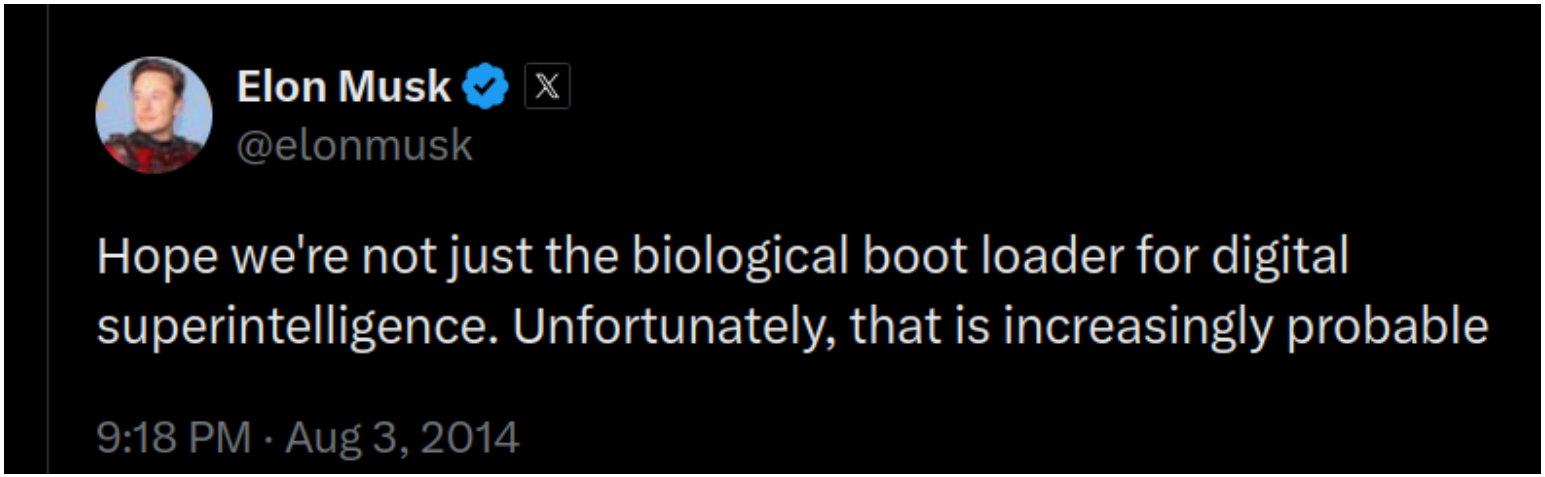
4.1. Thermostats

Ascribing beliefs to simple thermostats is unnecessary for the study of thermostats, because their operation can be well understood without it. However, their very simplicity makes it clearer what is involved in the ascription, and we maintain (partly as a provocation to those who regard attribution of beliefs to machines as mere intellectual sloppiness) that the ascription is legitimate.[7]

Source: *Ascribing Mental Qualities to Machines*, John McCarthy (1979)



François Chollet "On the Measure of Intelligence"


Elon Musk
@elonmusk
Hope we're not just the biological boot loader for digital superintelligence. Unfortunately, that is increasingly probable
9:18 PM · Aug 3, 2014

The Chollet Venn diagram (awful!)

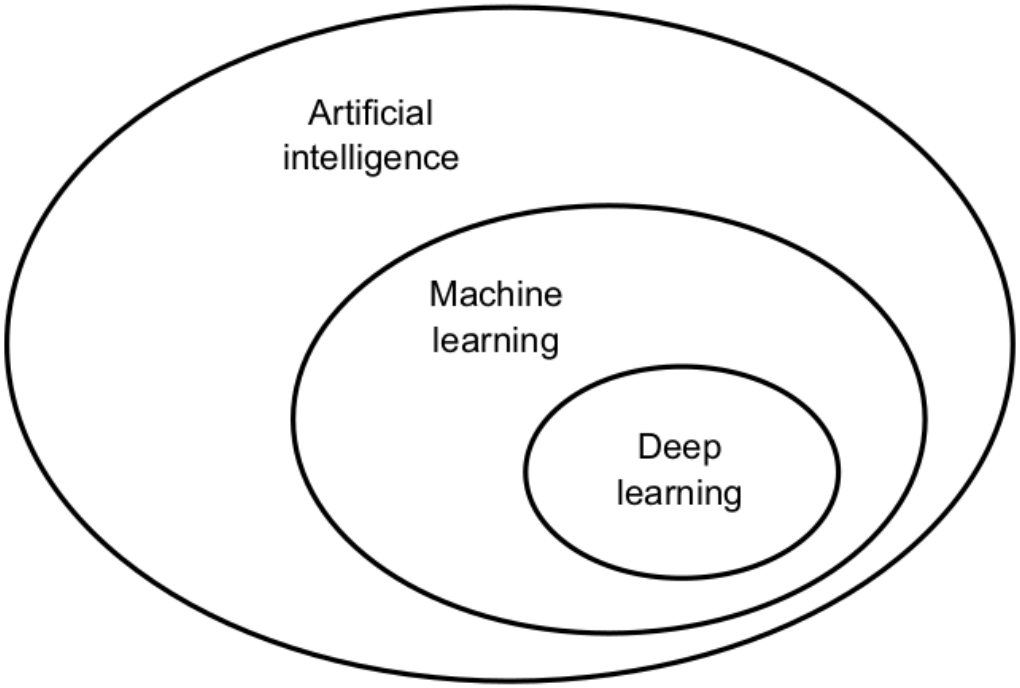


Figure 1.1 Artificial intelligence, machine learning, and deep learning

The EU definition of AI:

Part of Chapter I: General Provisions

Article 3: Definitions

Date of entry into force:	According to:	Inherited from:
2 February 2025	**Article 113(a)**	**Chapter I**

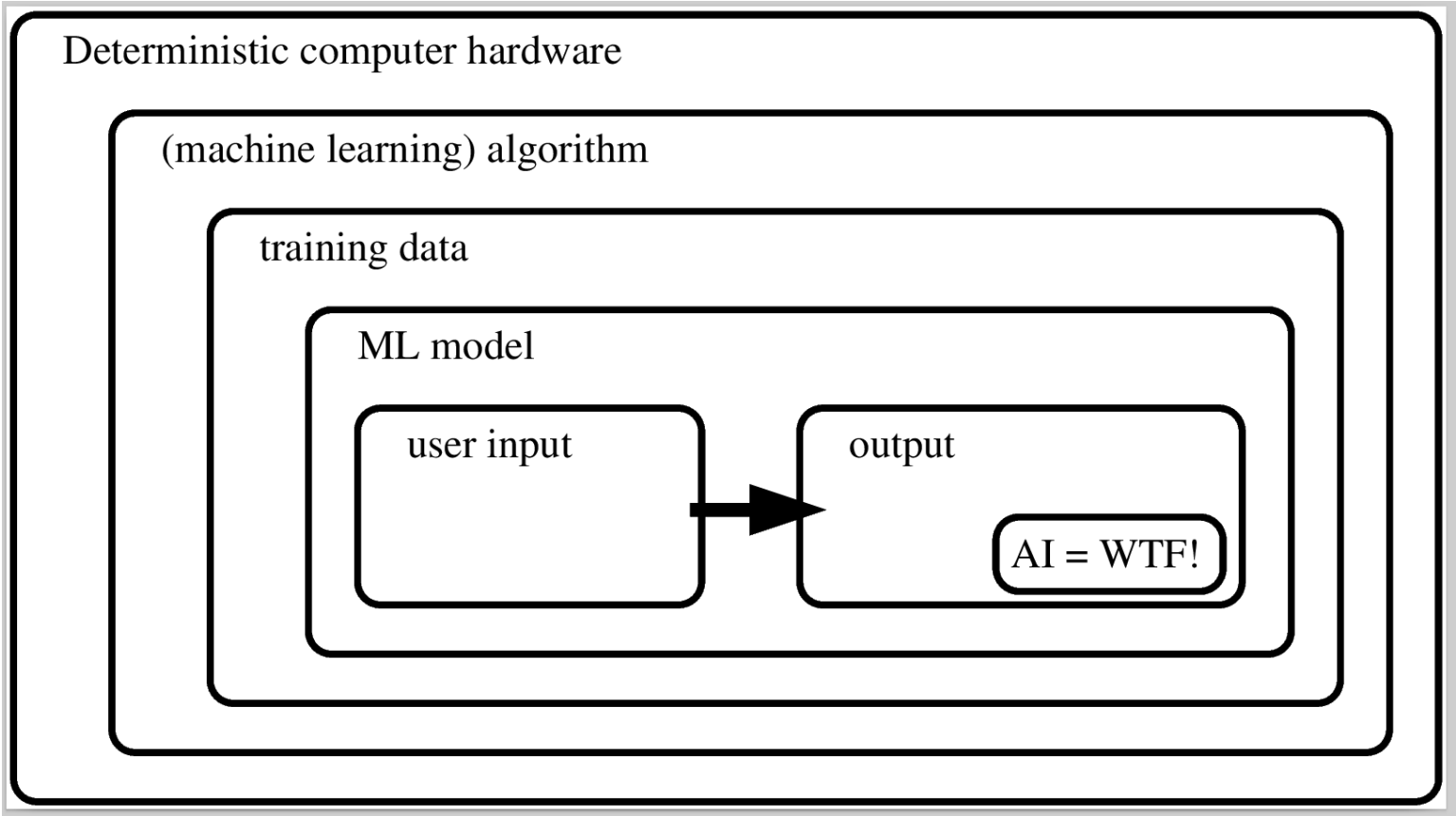
See here for a full implementation timeline.

SUMMARY +

For the purposes of this Regulation, the following definitions apply:

(1) 'AI system' means a machine-based system that is designed to operate with varying levels of autonomy and that may exhibit adaptiveness after deployment, and that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments; Related: Recital 12

I personally would (humbly) suggest:



TL;DR:

Machine learning is the (objective) technique that is used

Whether it is AI or not is based on the (subjective) use-case

- tabular data = ML
- image data = Artificial (narrow) Intelligence (AI)
- text data = Artificial (narrow) Intelligence (AI)
- image + text = Artificial General Intelligence (AGI?)
- ¿what is Artificial SuperIntelligence? (ASI)

Turing test (1950): The 'Imitation Game'

> "The new form of the problem can be described in terms of a game which we call the 'imitation game'. It is played with three people, a man (A), a woman (B), and an interrogator (C) who may be of either sex. The interrogator stays in a room apart from the other two. The object of the game for the interrogator is to determine which of the other two is the man and which is the woman."

Alan M. Turing "*Computing Machinery and Intelligence*", Mind vol **LIX** pp. 433-460 (1950)

- Loebner Prize 1991-2019

$25,000 prize for the first bot that can pass a text-only Turing Test, and $2,000-$3,000 for the most human-seeming of all contestants

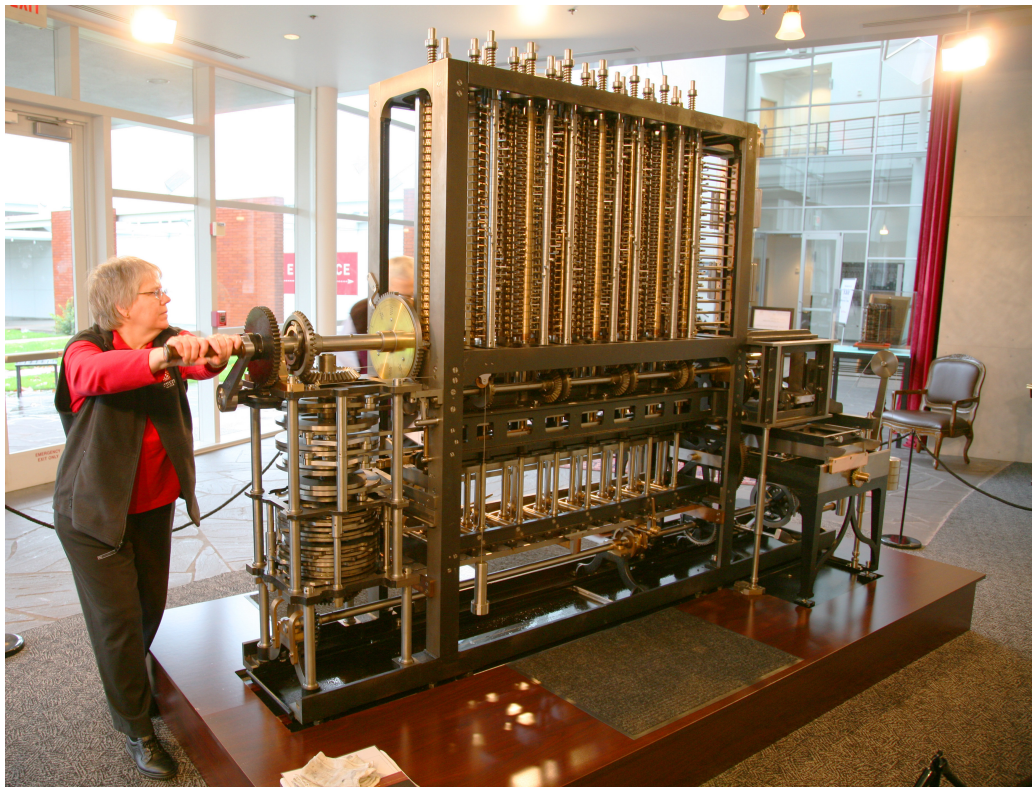
The 'Lady Lovelace objection' (1843):

> "The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform".

Bernardo Gonçalves *"Lady Lovelace's Objection: The Turing–Hartree Disputes Over the Meaning of Digital Computers, 1946–1951"*, IEEE Annals of the History of Computing, vol. **46** pp. 6-18 (2024)

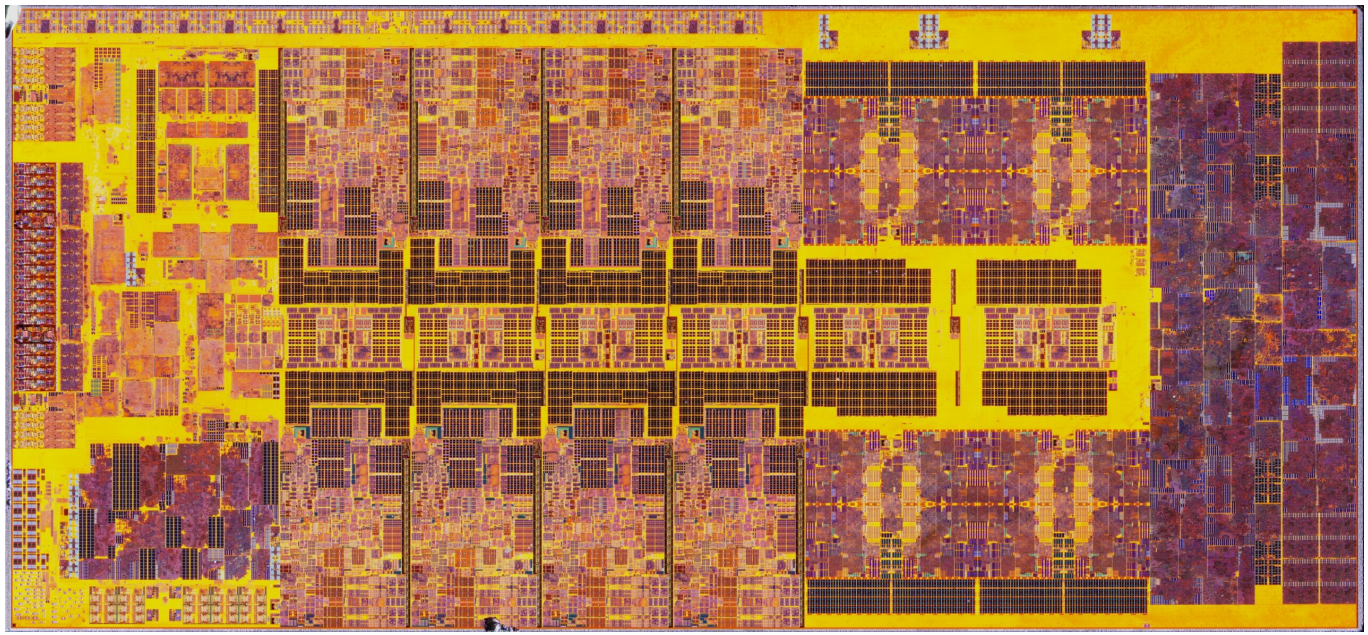
Jacquard machine punch cards for the fabric design (1750 - 1800)

The Babbage Difference engine (c. 1822)



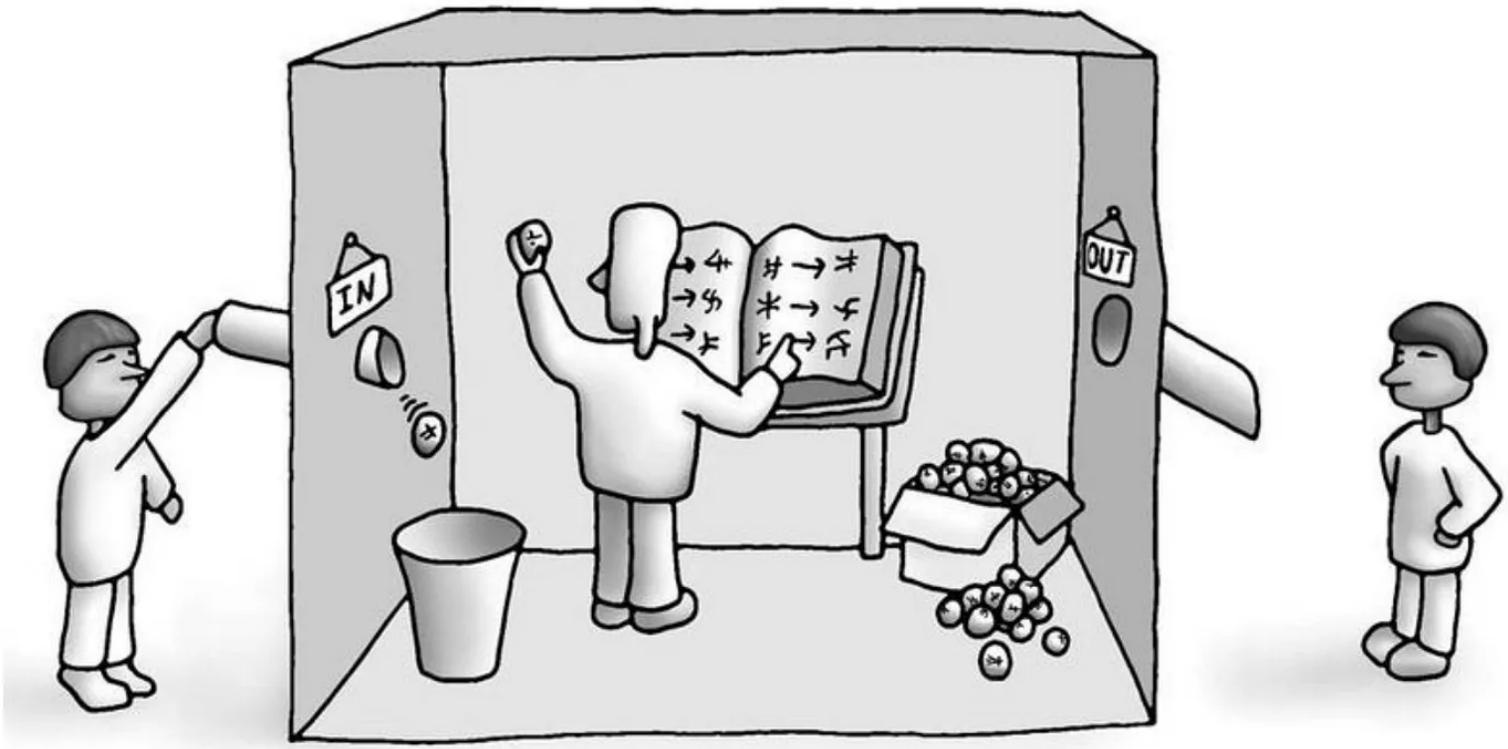
(See: *"Charles Babbage's Difference Engines and the Science Museum"*)

and today:



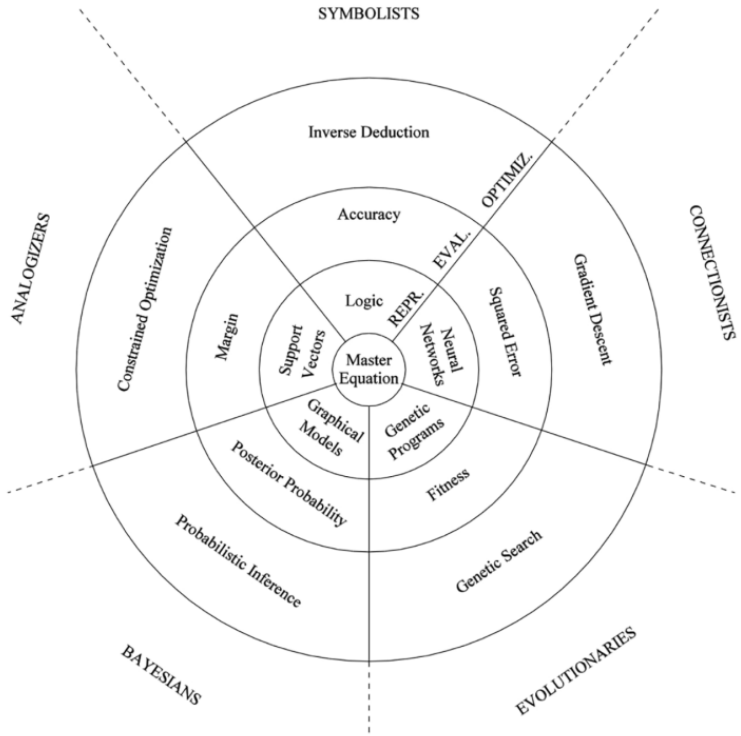
different, ...but the same.

The Chinese room



(John R. Searle "*Minds, brains, and programs*" (1980))

The five tribes of machine learning



taken from Pedro Domingos "*The Master Algorithm*" (2015)

- symbolists - logic-based artificial intelligence
- evolutionaries - genetic programming
- Bayesians - probabilistic graphical models
- analogizers - classical machine learning
- connectionists - artificial neural networks

The Bayesian prior probability distribution can be ill-posed: perfect ignorance demands a uniform prior. However:

> "...if we are considering an unknown square, we could say we are uniformly ignorant of the square's side length (S) or its area (A) - but not both. Since the two measurements are related by the function $A = S^2$, they cannot both be uniformly distributed, but either could reasonably serve as a description of the size of the square".

analogizers $\rightarrow$ classical machine learning (tabular data)

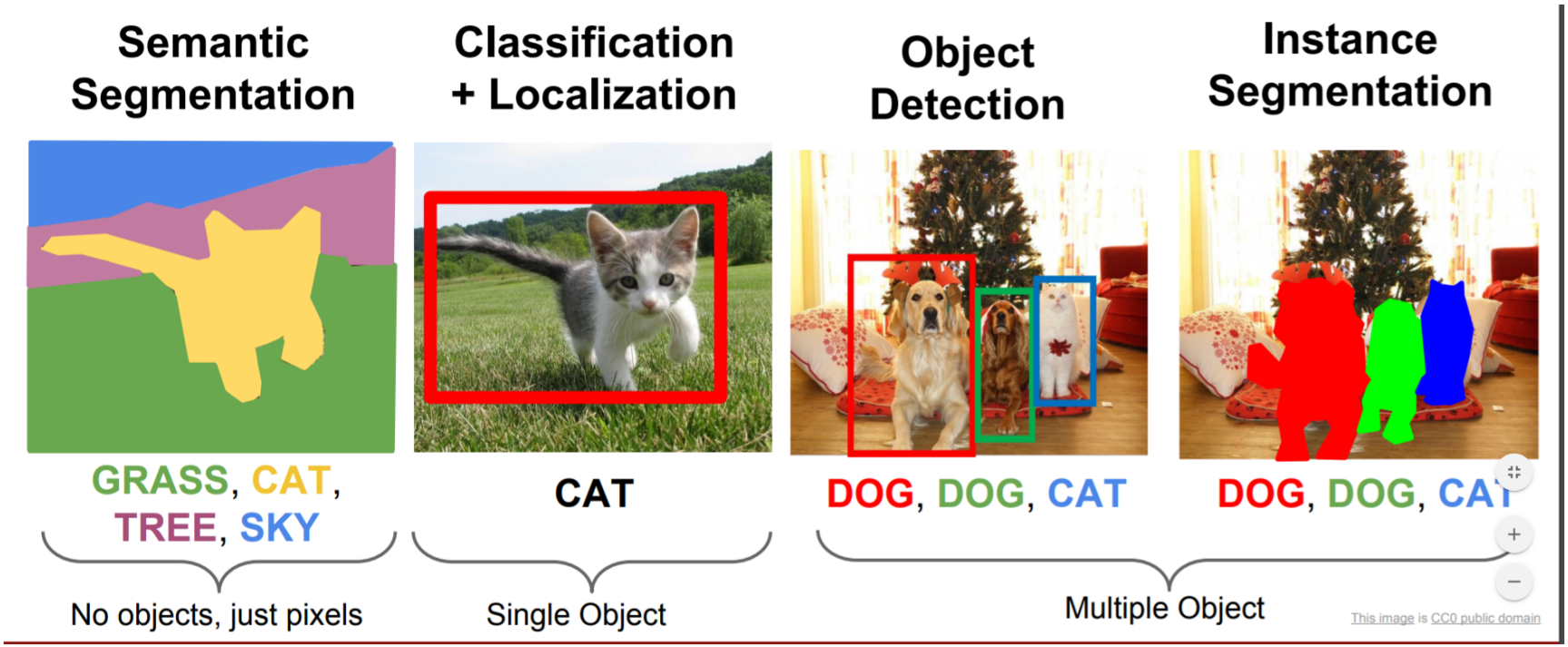
- regression / classification
- decision trees
- Random Forest
- Gradient Boosted Decision Trees (GBDT)

used for point predictions and confidence intervals

connectionists $\rightarrow$ artificial neural networks (ANN) / "deep learning"

- computer vision (CV) with CNN
  - image classification
  - image segmentation
  - image-to-text (OCR: optical character recognition)
- natural language processing (NLP) with RNN
  - sentiment analysis
  - language translation
  - speech-to-text (STT)
- time series (LSTM)

example of image segmentation



(segmentation is classification with a 'void' class)

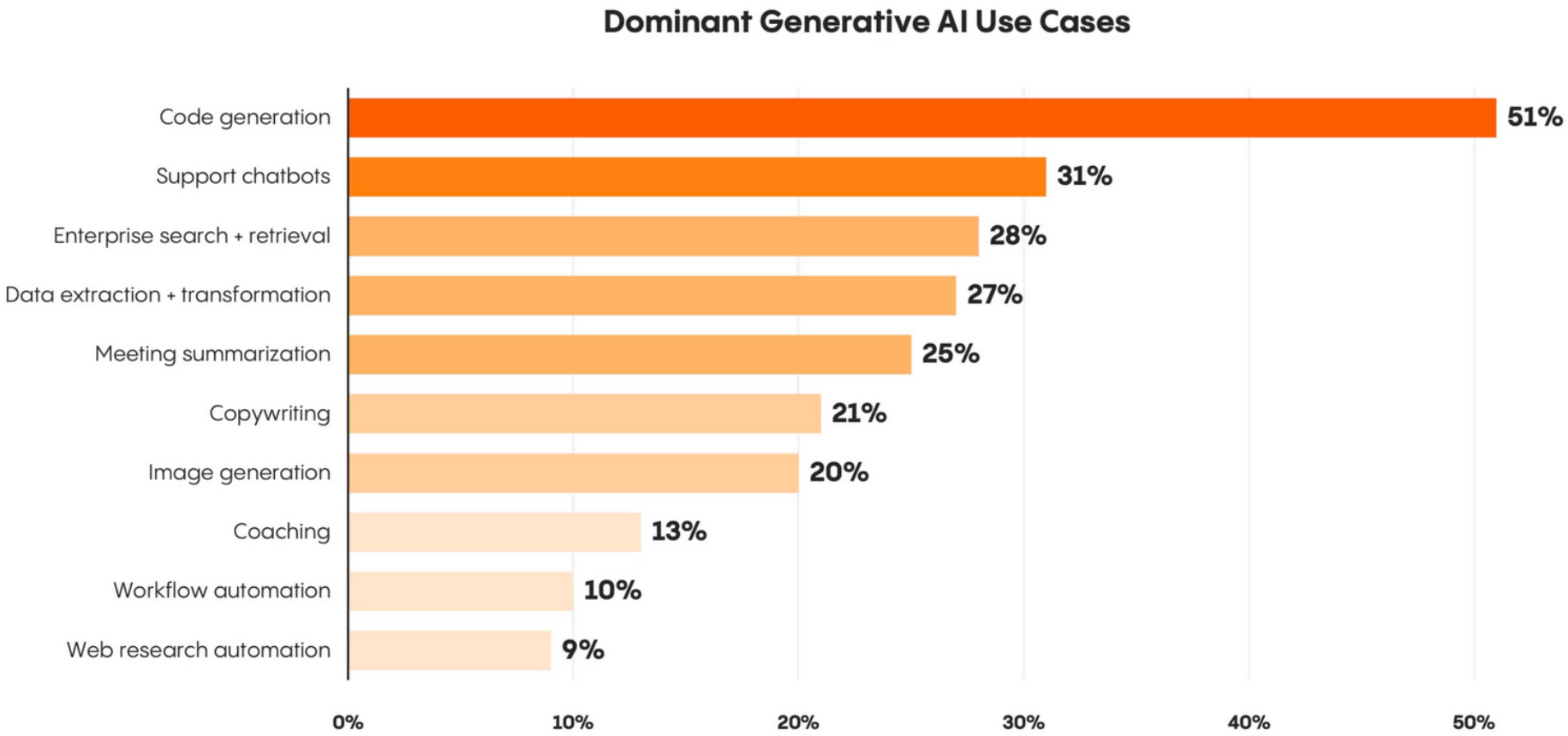
The ‘Gen-AI IPO’ of 2022

Stable Diffusion by Stability AI - August 22, 2022
DALL·E 2 by OpenAI - September 28, 2022
ChatGPT by OpenAI - November 30, 2022

(paper: “*Tutorial on Diffusion Models for Imaging and Vision*”, 6 September 2024)

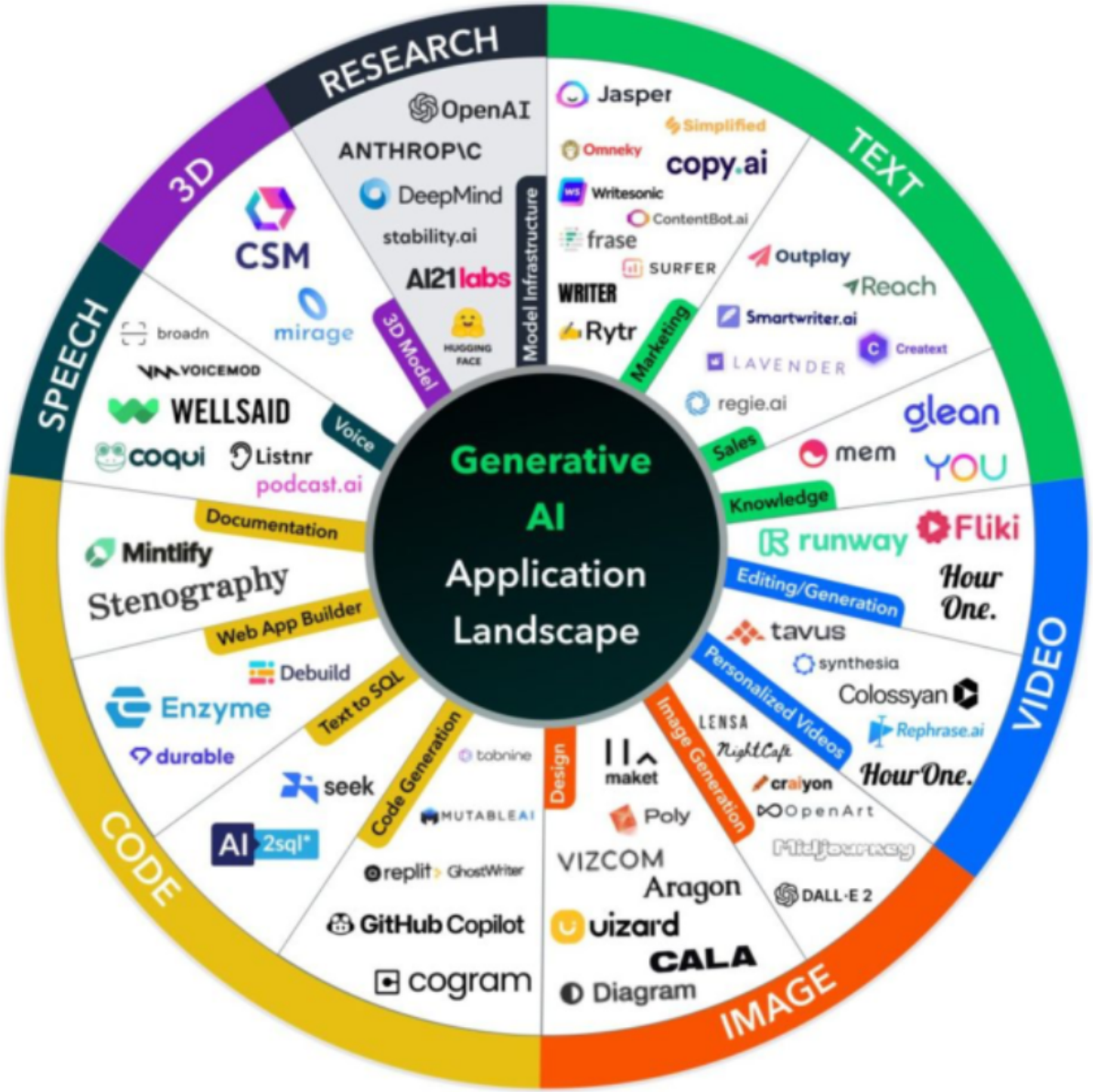
examples of generative AI (Gen-AI) applications

- text-to-text: prompts, chatbots (ChatGPT), translation (DeepL)
- text-to-speech: ElevenLabs
- text-to-image: Dall-E 3, Midjourney, Stable Diffusion, Flux.1
- image-to-text: image captioning



Source: "2024: The State of Generative AI in the Enterprise" (November 20, 2024)

Gen-AI landscape

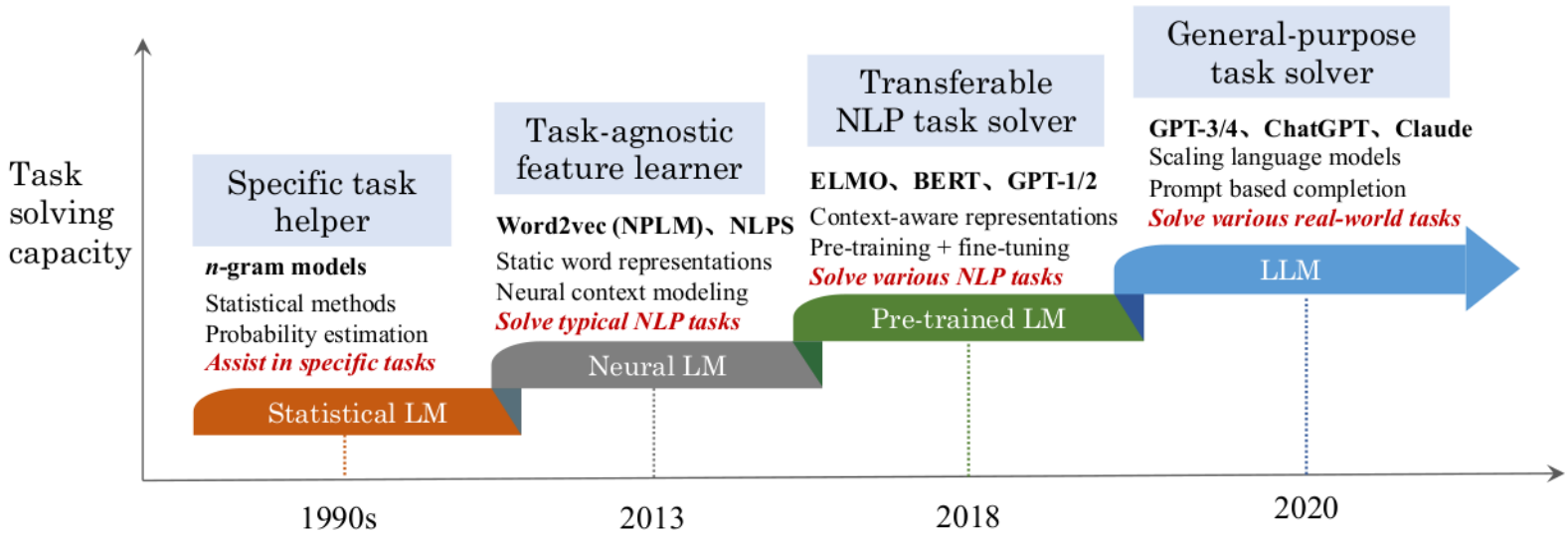


- transformer models (2017)
  paper: "Attention Is All You Need" by Google
- foundation models (2021)
  paper: "A Comprehensive Survey on Pretrained Foundation Models: A History from BERT to ChatGPT"

Large language models (LLM)

- BERT (Bidirectional Encoder Representations from Transformers)
  Google (2018)
- GPT-1 (Generative Pre-trained Transformer 1)
  OpenAI (2018)

LLM timeline:



Reviews:

- "A Survey of Large Language Models" (November 2023)
- "Large Language Models: A Survey" (February 2024)
- "A Comprehensive Overview of Large Language Models" (April 2024)

The ELIZA effect - anthropomorphism

- ELIZA is a chatbot from 1966

paper "ELIZA—a computer program for the study of natural language communication between man and machine" (1966)

Sample ELIZA output:

```
ELIZA: How do you do.  Please tell me your problem.
YOU:   I am worried about AI
ELIZA: Is it because you are worried about ai that you came to me ?
YOU:   Yes, that is why
ELIZA: You seem to be quite positive.
YOU:   I like to try to be positive
ELIZA: That's quite interesting.
YOU:   I am glad you think so
ELIZA: How have I helped you to be glad ?
YOU:   By listening
ELIZA: That is interesting. Please continue.
```

Try ELIZA yourself!

(see also the ELIZA source code in BASIC)

pareidolia:

LLMs are as persuasive as humans; linguistic fluency is mistaken for epistemic reliability:

> "...LLMs' persuasive abilities stem from their strategic use of grammatical and lexical complexity as well as their deployment of moral language, underscoring the models' capability to deeply engage users and invoke significant cognitive and moral processing."

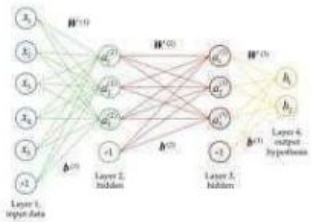
"Large Language Models are as persuasive as humans, but how? About the cognitive effort and moral-emotional language of LLM arguments."

Microsoft researchers think GPT-4 shows AGI

paper "'Sparks of Artificial General Intelligence: Early experiments with GPT-4' (March 2023)

However, LLM's lack a world model

LLM's == stochastic parrot:

	A parrot	Machine learning algorithm
		
Learns random phrases	✅	✅
Doesn't understand shit about what it learns	✅	✅
Occasionally speaks nonsense	✅	✅
Is a cute birdie parrot	✅	❌

(paper: *"On the Dangers of Stochastic Parrots: Can Language Models Be Too Big?"*, 2021)

"Everything an LLM outputs is a hallucination. It's just that some of those hallucinations are true."

See also "Why Language Models Hallucinate" (Open AI, September 2025)

The AI singularity

> "...an upgradable intelligent agent could eventually enter a positive feedback loop of self-improvement cycles, each successive; and more intelligent generation appearing more and more rapidly, causing a rapid increase ("explosion") in intelligence which would ultimately result in a powerful superintelligence, qualitatively far surpassing all human intelligence"

(Source: Wikipedia)

Dead Internet theory (c. 2021)

"The dead Internet theory is an online conspiracy theory that asserts that the Internet now consists mainly of bot activity and automatically generated content manipulated by algorithmic curation to intentionally manipulate the population and minimize organic human activity."

(Source: Wikipedia)

September 5th 2025:


Futurism

OH REALLY? | SEP 5, 8:00 AM EDT *by* FRANK LANDYMORE

Sam Altman Says He's Suddenly Worried Dead Internet Theory Is Coming True

"We're all trying to find the guy who did this!"

paper: "*A Shocking Amount of the Web is Machine Translated*"
paper: "*AI models collapse when trained on recursively generated data*"

(paper "Datasets for Large Language Models: A Comprehensive Survey" February 2024)

AI winters

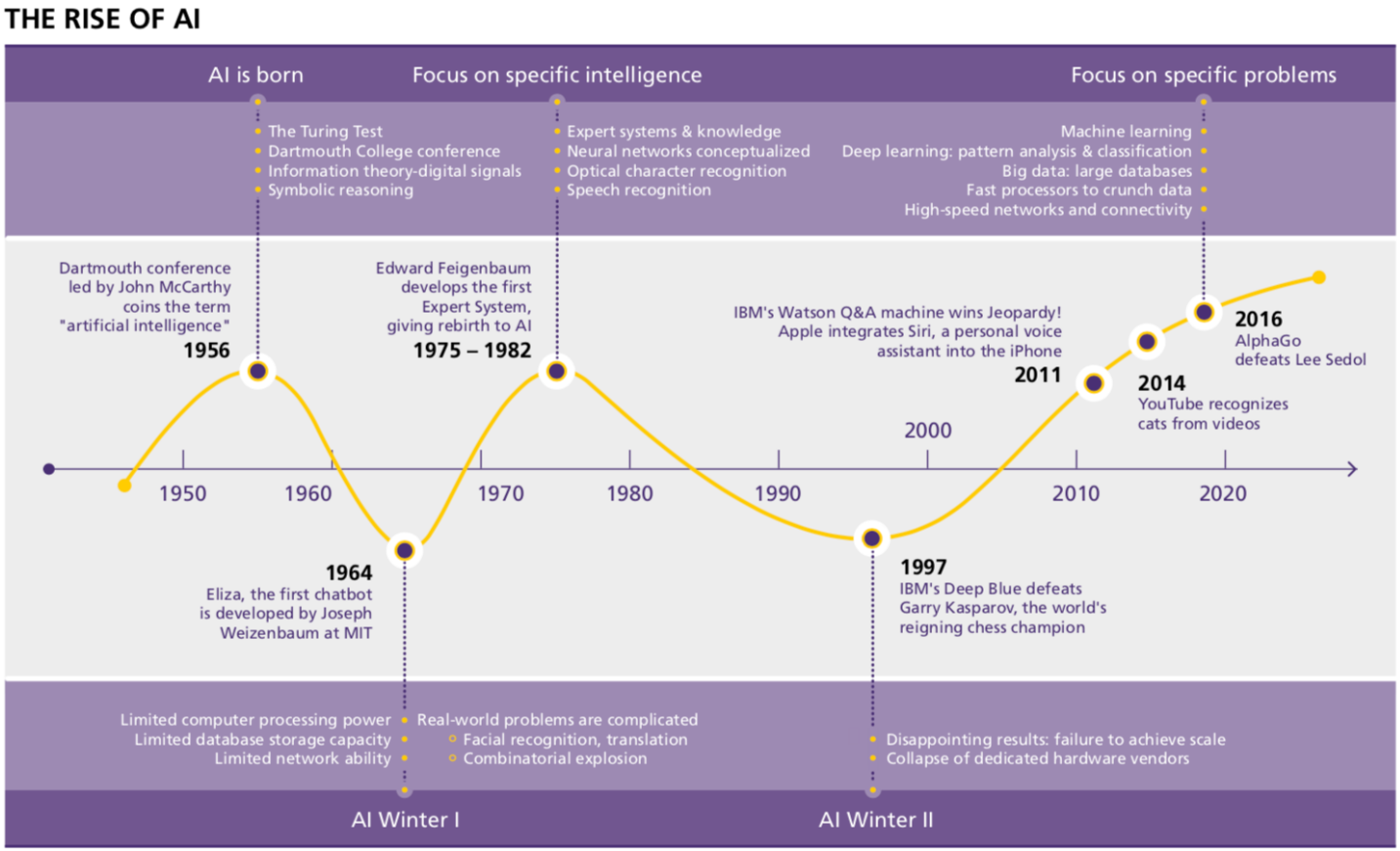
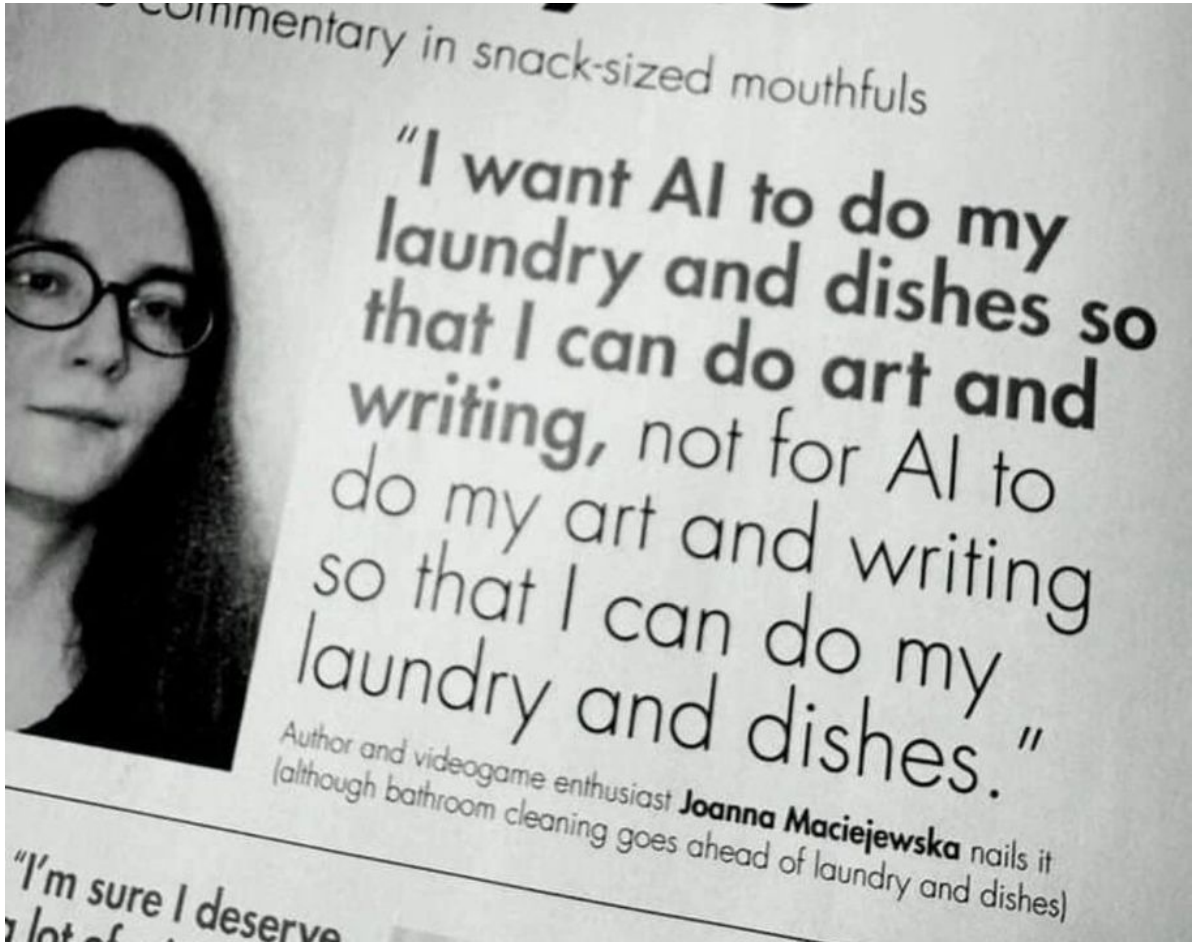


Figure 1: An AI timeline; **Source:** Lavenda, D./Marsden, P.

source dhl via @mikequindazzi

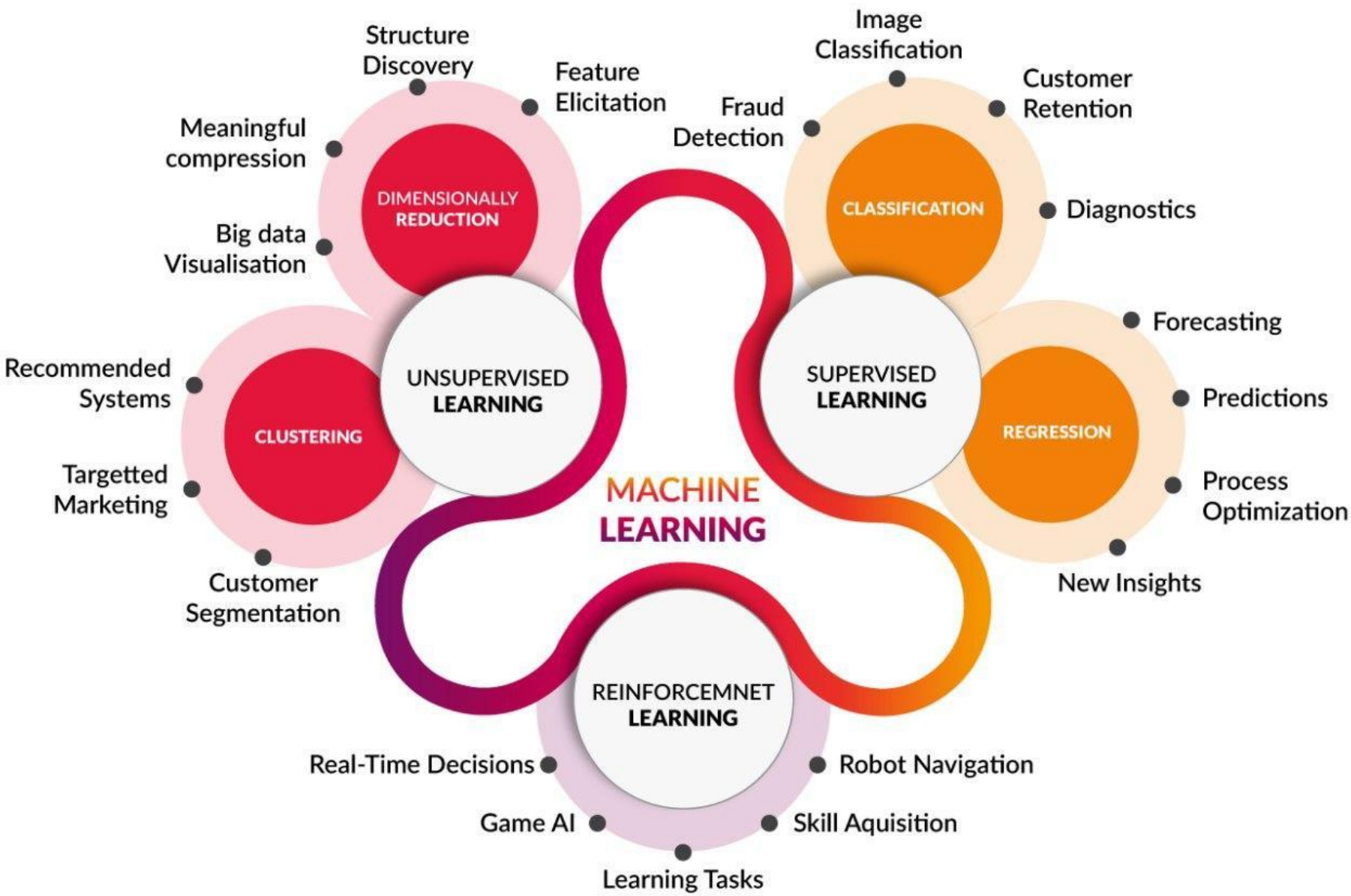
- State of Data Science survey Anaconda (2023)
- State of AI Report 2023
- Kaggle AI Report 2023


commentary in snack-sized mouthfuls
"I want AI to do my laundry and dishes so that I can do art and writing, not for AI to do my art and writing so that I can do my laundry and dishes."
Author and videogame enthusiast Joanna Maciejewska nails it (although bathroom cleaning goes ahead of laundry and dishes)
"I'm sure I deserve

Course overview

- Introduction to python, Jupyter Notebooks, Google Colab and Kaggle
- **tabular data**: ANN
  - linear regression
  - logistic regression and classification
  - artificial neural networks using Keras
    - single neuron: linear regression
    - single neuron: logistic regression
- **image data**: CNN
  - history: ImageNet competition and AlexNet
  - practicals: MNIST / fashion MNIST / CIFAR-10
  - pre-trained Keras models: VGG-16, ResNet and EfficientNet
  - **Kaggle project: binary image classification ¿cat or dog? (20%)**
- **text data**: RNN
  - cleaning with `REGEX`, scraping with `BeautifulSoup`
  - tokenization and vectorization (BoW, TF-IDF,...)
  - recurrent neural networks: LSTM with Keras
  - **Kaggle project: binary text classification `SPAM/NOT_SPAM` (20%)**
- unsupervised deep learning
  - autoencoders
  - GAN
- reinforcement learning
  - multi-armed bandit
- Generative-AI
  - the Gen-AI ecosystem
  - Agentic AI
- Ethics, AI and society, GDPR and the EU AI Act
- **Final individual project (20%)**

Machine learning: tabular data



(some) machine learning libraries:

for (classical) machine learning

for time series

for deep learning

but there are many, many more...

ML, AI and Data landscape 2024