LECTURER: Nghia Duong-Trung

ARTIFICIAL INTELLIGENCE

WHO I AM

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- Current Employer: The German Research Center for Artificial Intelligence (DFKI GmbH)
  - Senior Researcher/Project Lead
- Current Employer: IU International University of Applied Sciences
  - Academic Teacher

- PostDoc (2020-2022) in Machine Learning at Technische Universität Berlin, Germany
- PhD (2014-2017) in Machine Learning at The Information Systems and Machine Learning Lab (ISMLL), University of Hildesheim, Germany
- MSc (2009-2011) in Software Engineering at Heilbronn University, Germany
- Profile: https://sites.google.com/ismll.de/duongtrungnghia/

- Course book: Artificial Intelligence_DLMAIAI01, provided by IU, myStudies
- Reading list DLMAIAI01, provided by IU, myStudies
- The amount of slides content is based on the course book.
- Additional teaching materials:

https://github.com/duongtrung/IU-AI-DLMAIAI01

TOPIC OUTLINE

UNIT 1

HISTORY OF ARTIFICIAL INTELLIGENCE

STUDY GOALS

On completion of this unit, you will have learned …

- … how artificial intelligence has developed as a scientific discipline.
- … what paradigms have dominated public perception of the field at different times.
- … which notable advances are still relevant today.
- … what the history of artificial intelligence means for you in terms of learning new skills and contributing to society.

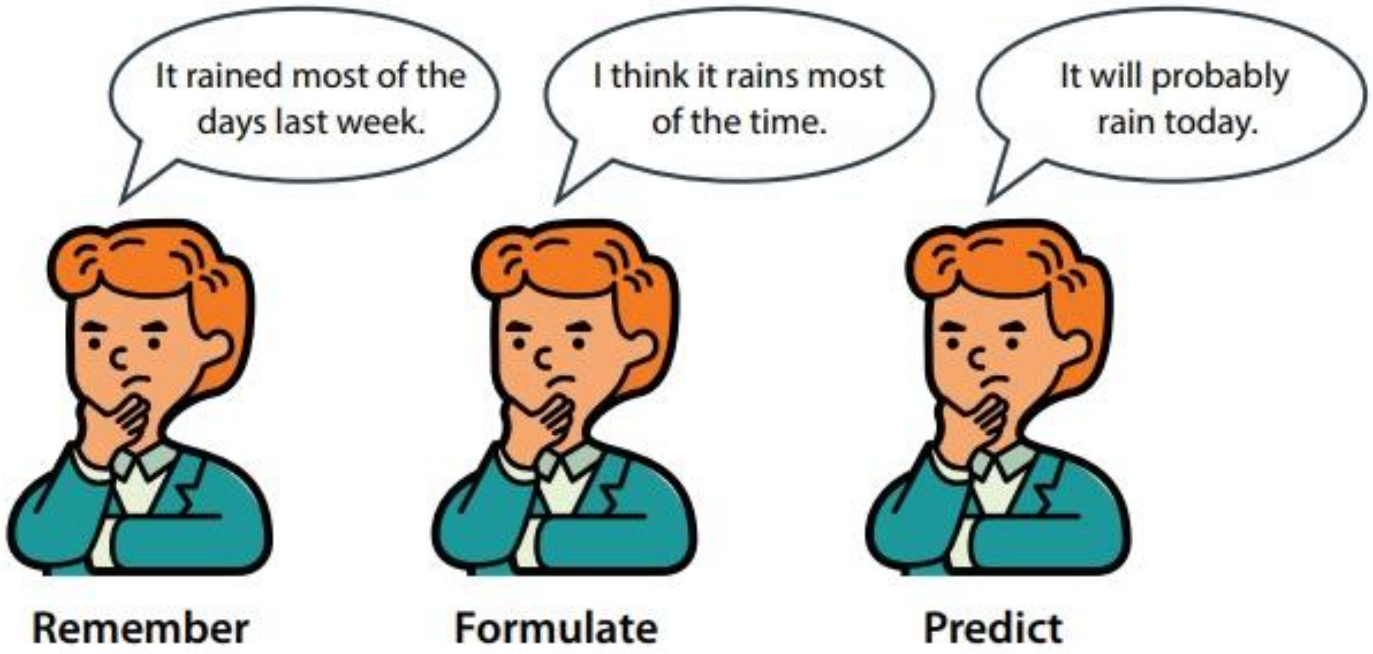
EXPLAIN SIMPLY

1. Explain the term of AI winter using your own words.
2. Name relevant considerations of AI. Why are they relevant?
3. Describe key trends in Artificial Intelligence.

WHAT IS ARTIFICIAL INTELLIGENCE?

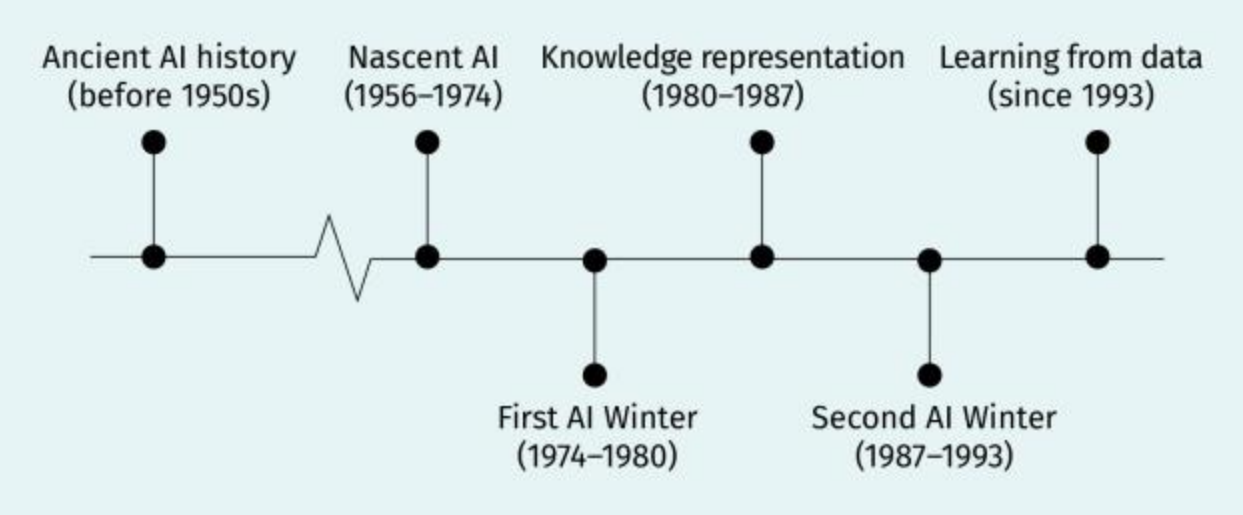
- The set of all tasks in which a computer can make decisions
- A computer makes these decisions by mimicking the ways a human makes decisions
  - by using logic and reasoning
  - by using our experience
- The set of all tasks in which a computer can make decisions based on **data**

- Remember-formulate-predict framework
  - We **remember** past situations that were similar
  - We **formulate** a general rule
  - We use this rule to **predict** what may happen in the future



HISTORICAL DEVELOPMENT OF AI

- Historical views of artificial intelligence often start in the 1950s when it was first applied in computer science
- The first considerations about AI range back to 350 BCE
  - Aristotle, Greek Philosopher (384–322 BCE)
  - Leonardo da Vinci, Italian Polymath (1452–1519)
  - René Descartes, French Philosopher (1596–1650)
  - Thomas Hobbes, British Philosopher (1588–1679)
  - David Hume, Scottish Philosopher (1711–1776)



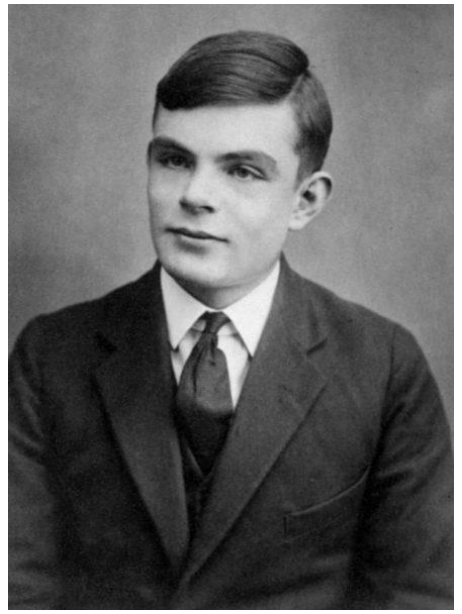
Source: Created on behalf of IU (2022)

Ancient artificical intelligence history

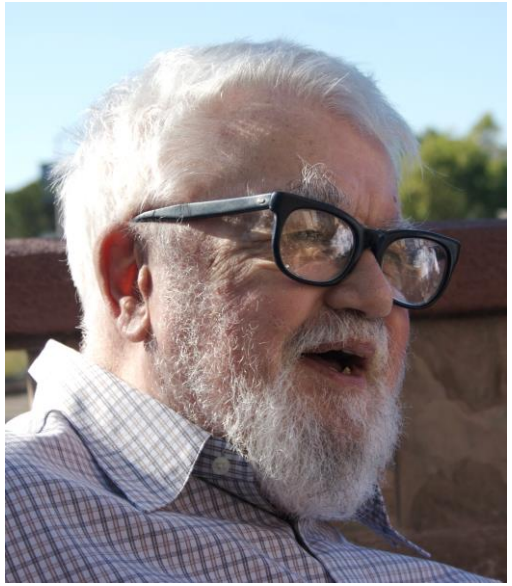
- Aristotle (*syllogism*)
- Leonardo da Vinci (hypothetical computing machine)
- Thomas Hobbes (reasoning and computation)
- René Descartes (form of equations)
- David Hume (*learning curve*)

Recent artificical intelligence history

- Alan Turing (*test*)
- John McCarthy (*Automata*)
- Large language models (conversational interaction)



Alan Turing



John McCarthy

The two words *artificial* and *intelligence* were first put together on **August 31, 1955**, when professor John McCarthy from Dartmouth College, together with M.L Minsky from Harvard University, N. Rochester from IBM, and C. E. Shannon from Bell Telephone Laboratories, asked the Rockefeller Foundation to fund a summer of research on artificial intelligence

"*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 Hampshire. . . . 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. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.*
"

NARROW VS GENERAL AI

- Narrow AI:

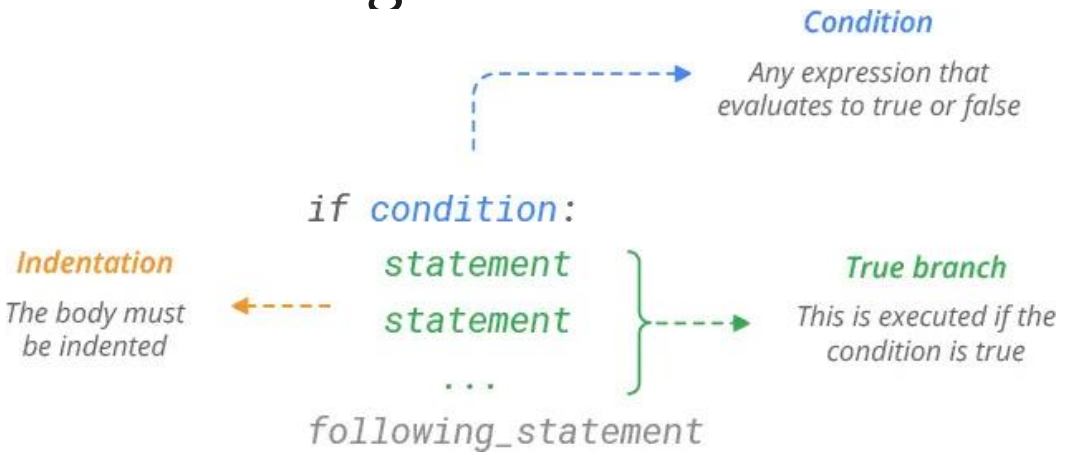
  - Solving a single, well defined task
  - It can be broad (recognizing objects from pictures) or extremely specific (predicting which customers who bought product A are more likely to purchase product B as well

- General AI:

  - Tackling every kind of task it's presented. This is similar to an extremely resourceful human, and you can think of it as the robot from The Terminator
  - still far away, researchers don't know when we'll finally get it.

- The engine of the AI revolution: machine learning

  - ML is the field of study that gives computers the ability learn without being explicitly programmed

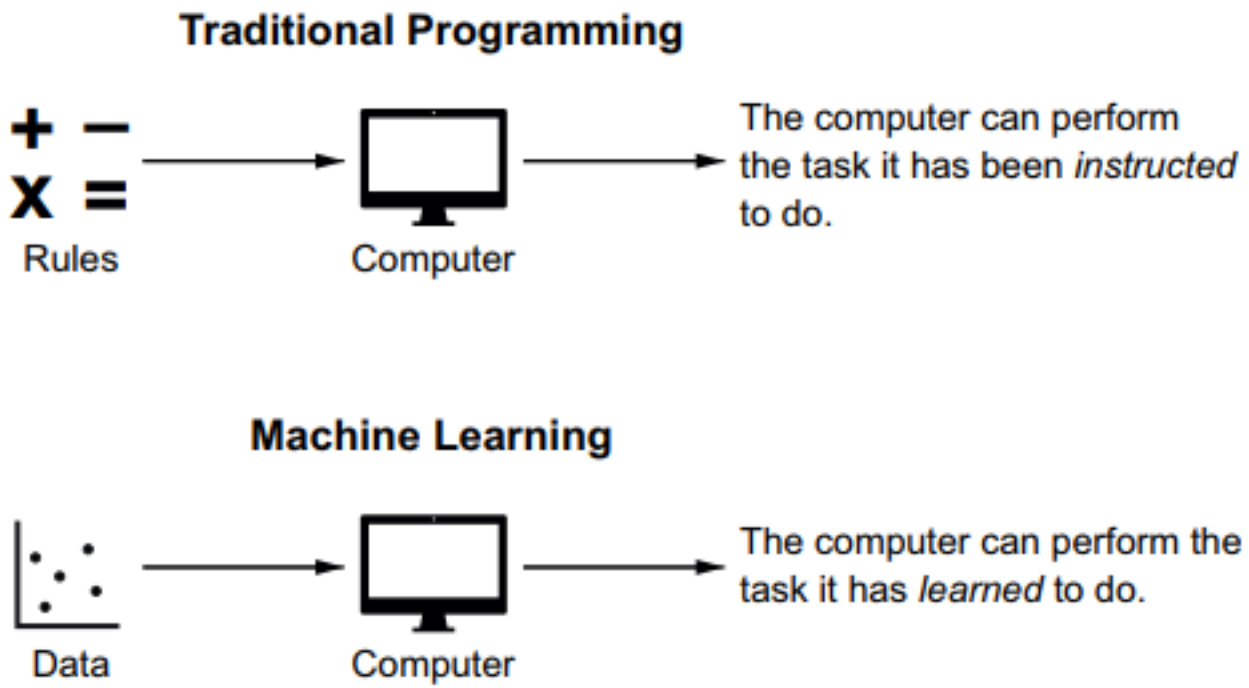


- Explicitly programming a computer means defining the rules and instructions it must follow to perform a specific task
  - This is what software engineers do when they write software that handles your everyday tasks
- Unfortunately, things are not always explicit
  - Can you explain the process you make to recognize a cat vs a dog?
  - Can you list all the English grammar rules you apply as you talk?
  - If you can’t precisely explain how you do something, there’s no chance that you can instruct a computer to do it.

Source of the text: McCarthy, 2007, p. 2.

WHAT IS MACHINE LEARNING?

- From rules to data
- ML couldn’t possibly have Blossomed before the 2000s
  - Learning from data doesn’t for free, and computers need Fast processors to perform This task
- Availability of data and cheap computing power created the perfect environment for ML to bloom



WHAT IS ARTIFICIAL INTELLIGENCE, AFTER ALL?

- Software that solves a problem without explicit human instruction
  - The definition focuses on the outcome of the technology rather than the specific techniques used to build it
  - It’s almost equivalent to what we said about ML?
    - Learning is an intelligent trait, while ML is just a tool. It is the tool behind 99% of the successful applications we happen to call AI today.

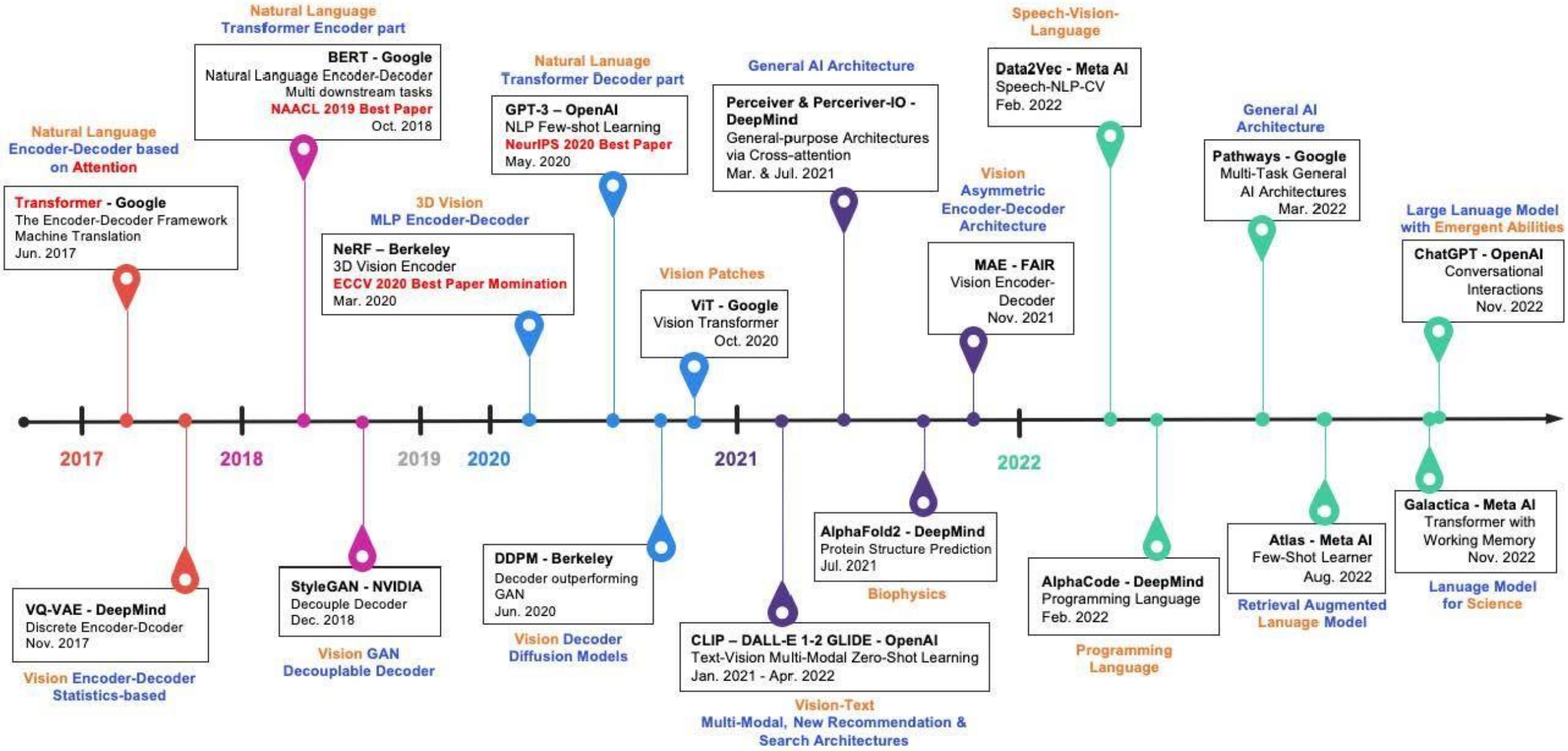
THE MAIN DIFFERENCES BETWEEN AI AND DATA SCIENCE?

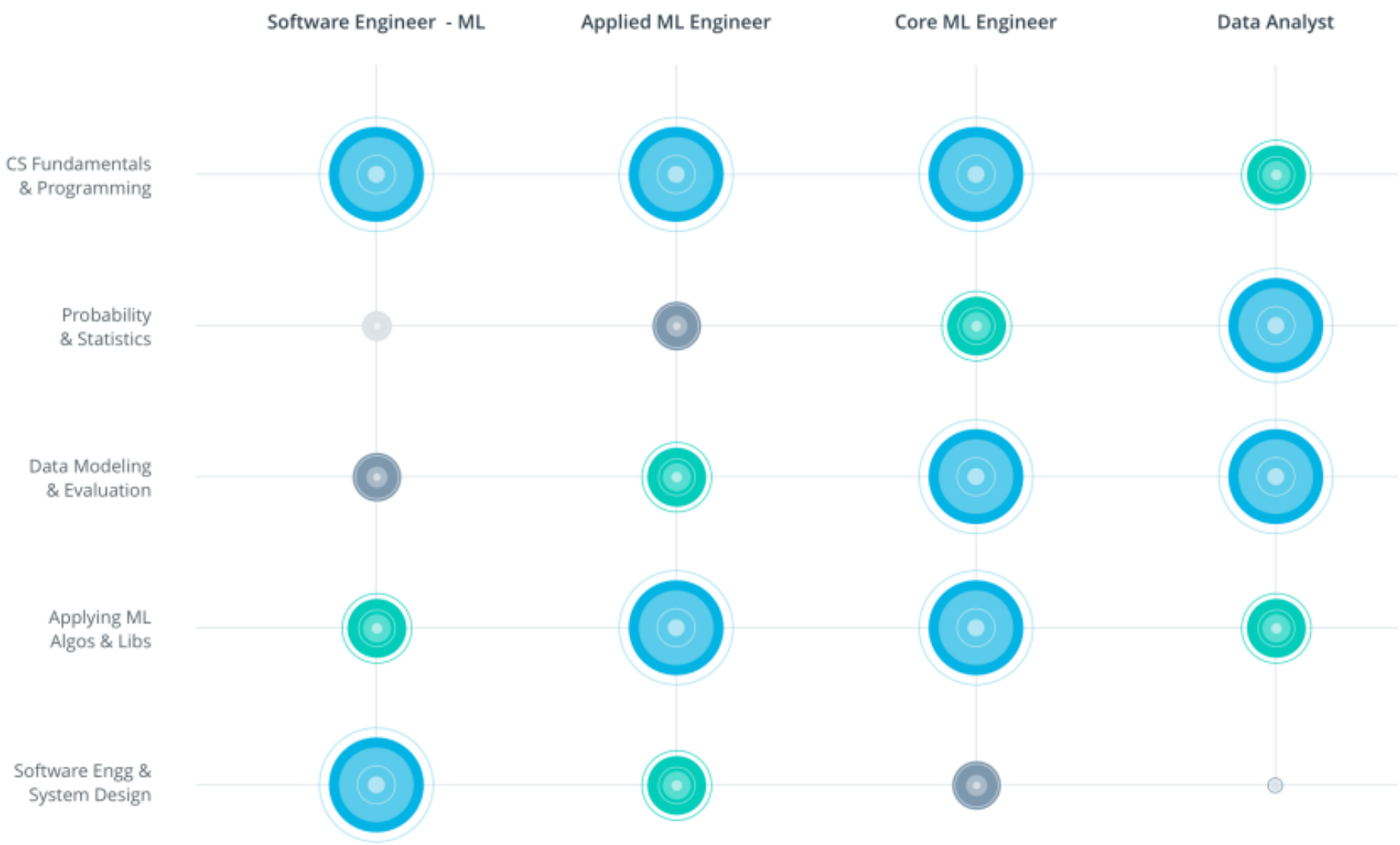
- Automates tasks or predicts future events based on data
- Is commonly used “live”: it continuously elaborates news data and produces answers
- It commonly has the form of software

- Produces insights based on data
- Is commonly “one-off”: it produces some insights that inform decisions
- It commonly has the form of a presentation or report

The Continuing Trend of AI:

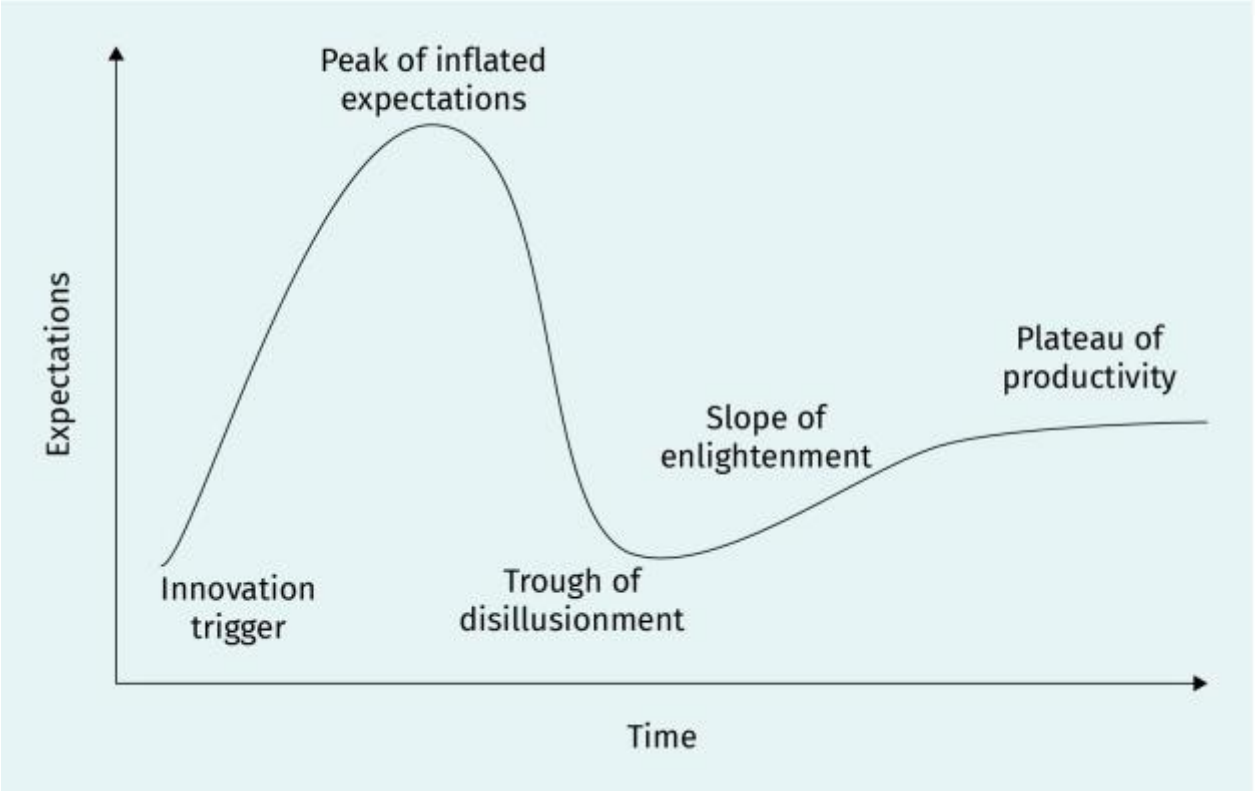
Developing General-purpose Architectures




Software Engineer - ML
Applied ML Engineer
Core ML Engineer
Data Analyst
CS Fundamentals & Programming
Probability & Statistics
Data Modeling & Evaluation
Applying ML Algos & Libs
Software Engg & System Design

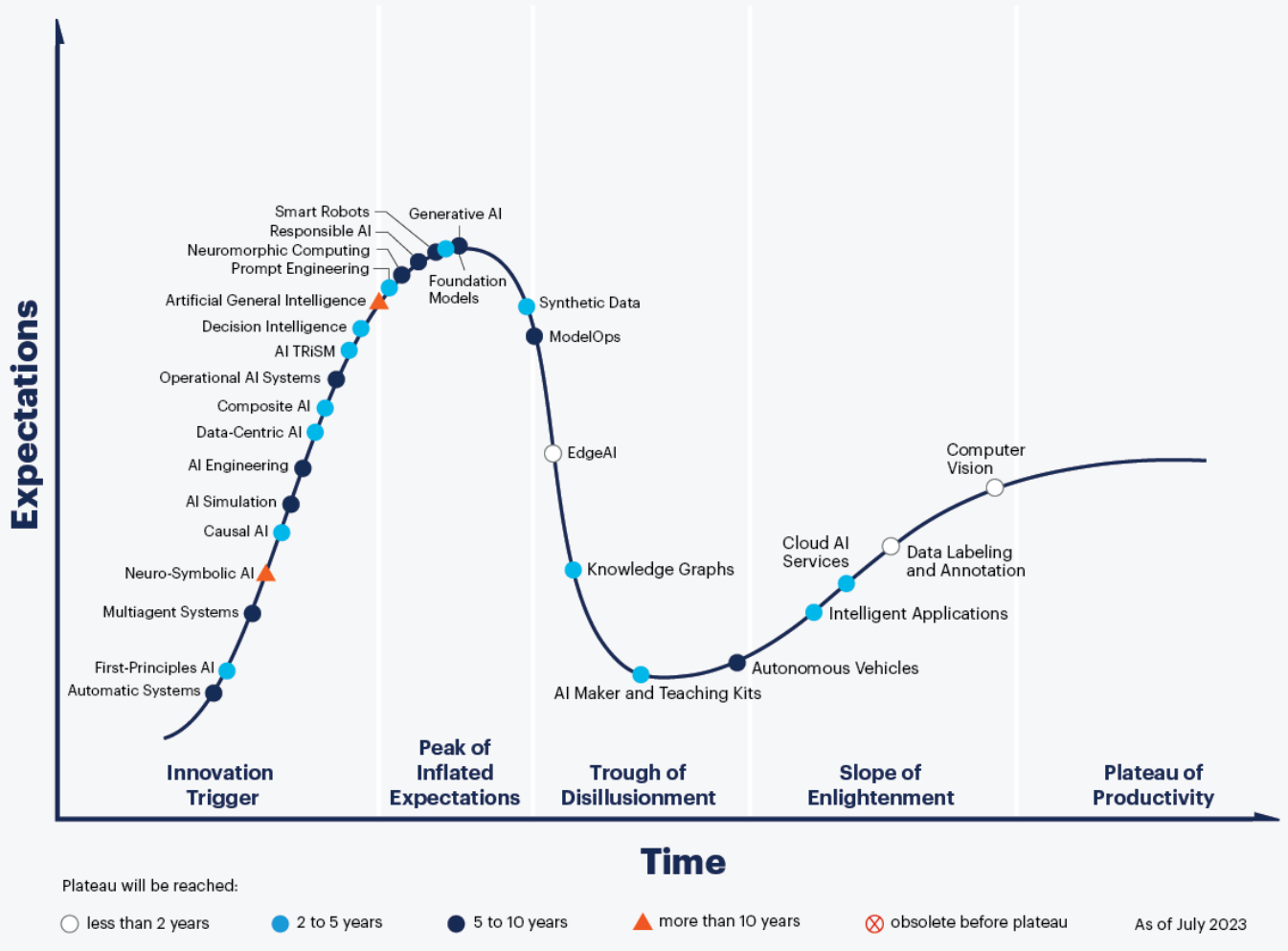
THE GARTNER HYPE CYCLE CURVE

https://www.gartner.com/en/research/methodologies/gartner-hype-cycle



Source: Created on behalf of IU (2022) based on (Gartner, 2018)

Hype Cycle for Artificial Intelligence, 2023



gartner.com

Gartner

Source: https://www.gartner.com/en/articles/what-s-new-in-artificial-intelligence-from-the-2023-gartner-hype-cycle

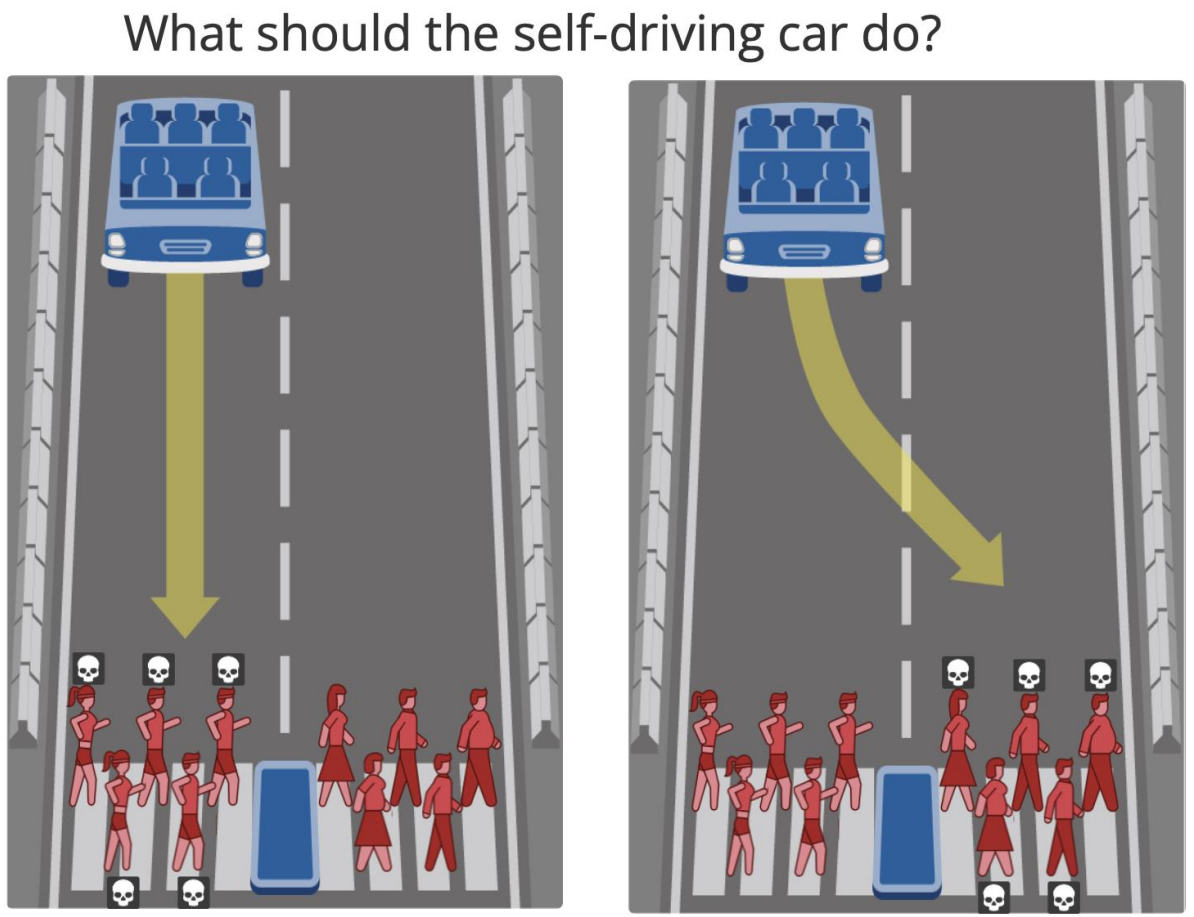
REVIEW STUDY GOALS

- AI is the science of making intelligent machines.
- Early considerations about AI date back to the ancient Greek history.
- Nowadays, AI is an important component of computer science.
- Expert systems emulate decision making by using domain-specific knowledge of an expert.
- The Gartner hype cycle curve evaluates the potential of new technologies.

1st government-initiated step to regulate data → European Union's General Data Protection Regulation (**GDPR** 2016/679)

Aspects of considerations:

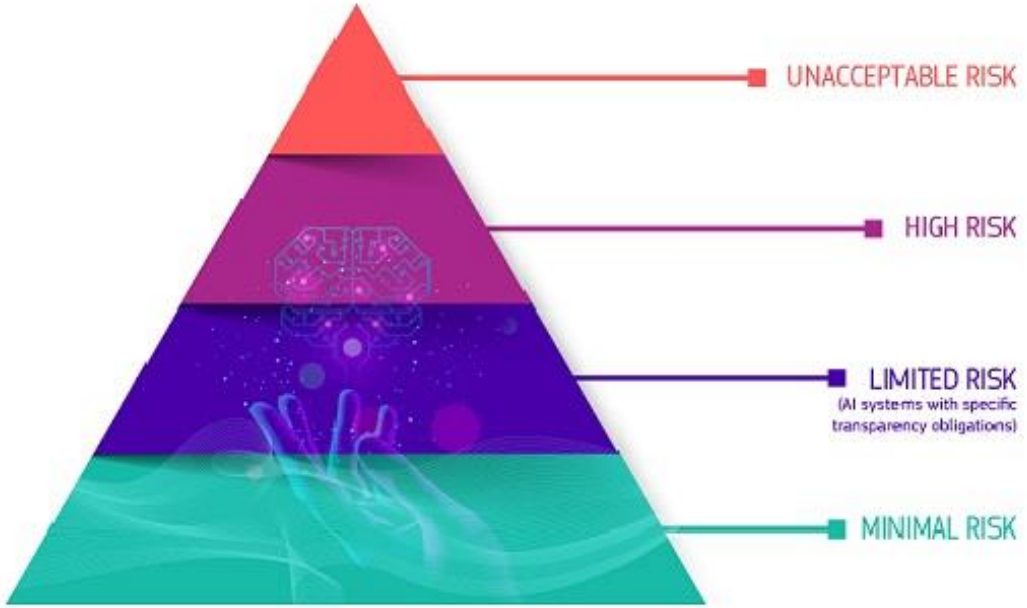
- ethics (right and wrong conduct)
- unintended outcomes (bias towards, e.g. white male job applicants)



Source of the image: Test at https://www.moralmachine.net

EU Regulation on Artificial Intelligence (04.2021)

- to create a common legal framework for the development and use of AI-based systems, which at the same time strengthens the public's trust in these systems by adequately taking into account fundamental rights, security and privacy
- Ethical issues are relevant to all commercial and military applications of artificial intelligence as well as to the working lives of employees subject to an economy highly influenced by artificial intelligence



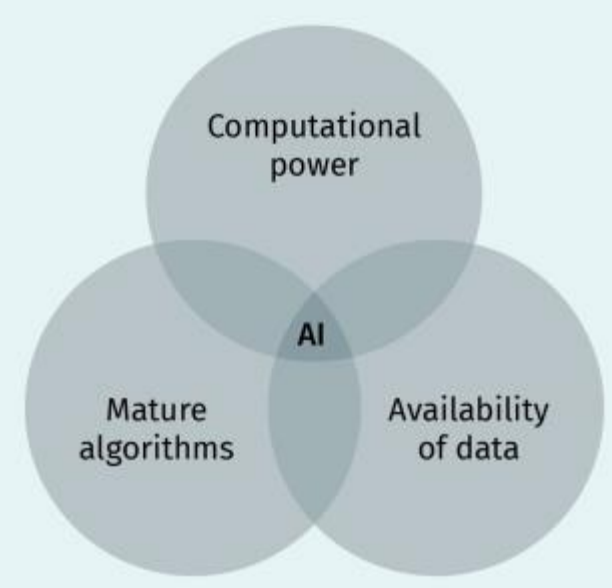
https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/698792/EPRS_BRI(2021)698792_EN.pdf
https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai

AI WINTER

Period characterized by a prolonged decrease in interest and funding

AI WINTER

- It was coined by AI researchers to describe periods when interest, research activities, and funding of AI projects significantly decreased (Crevier, 1993)
- Downturns like this are usually based on exaggerated expectations towards the capabilities of new technologies that cannot be realistically met.
- The First AI Winter (1974–1980)
- The Second AI Winter (1987–1993)
- There are several conditions that can cause AI winters. The three most important requirements for the success of artificial intelligence are
  - algorithms and experience with them,
  - computing capacity, and
  - the availability of data.



Source: Created on behalf of IU (2022)

NOTABLE ADVANCES

Nascent AI (1956-1974)

- Creation of rules of formal logic and logical inference
- Implementation of search strategies
- Initial successes with AI in microworld approaches

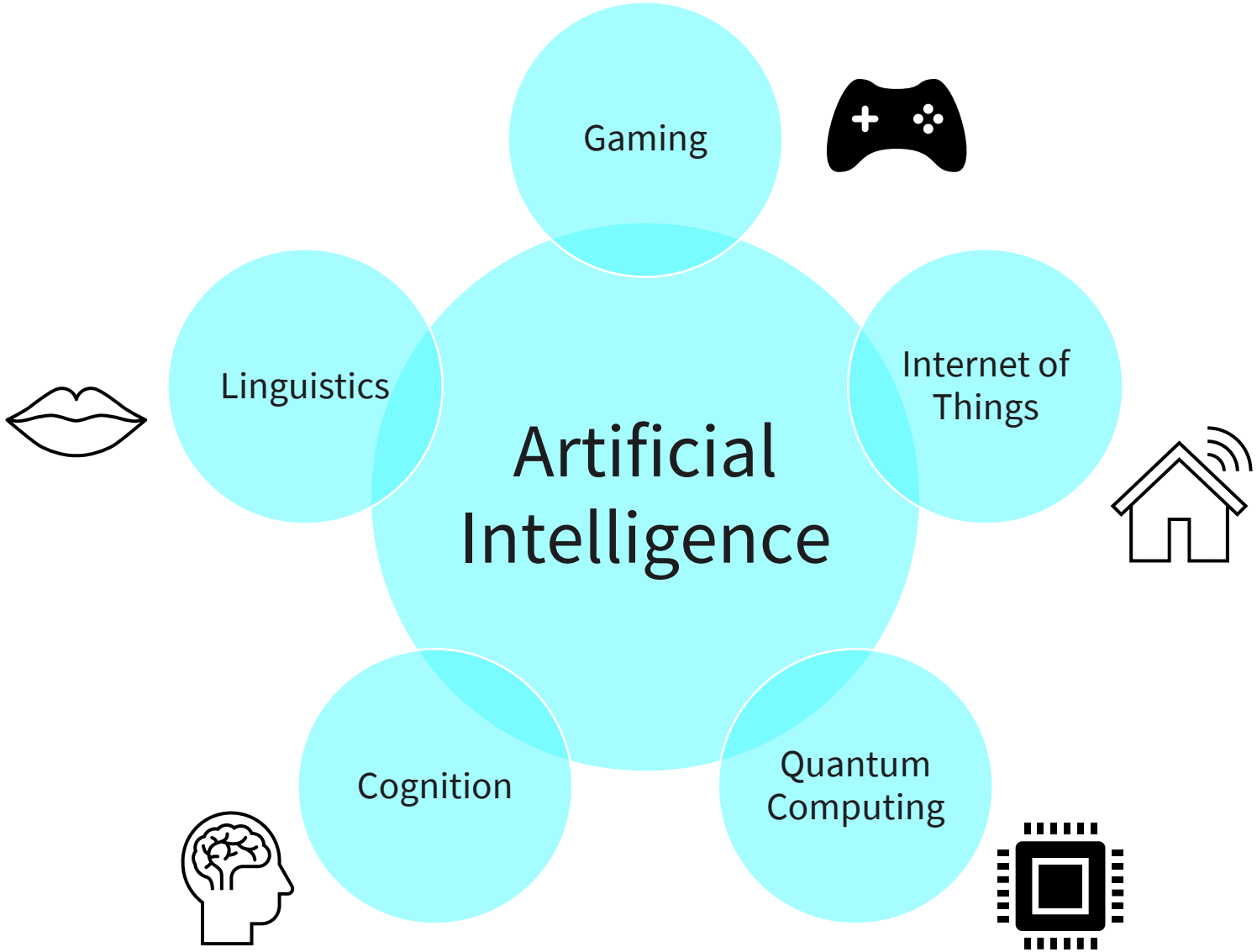
Knowledge Representation (1980-1987)

- Appearance of expert systems as intelligent behaviour in day-to-day situations rely on common sense knowledge
- Noticeable upturn in government funding
- Backpropagation as an effective training evolved

Learning from Data (1993 - Today)

- First computer system beat the world-champion in chess
- Intelligent agent paradigm results in AI being understood as study of intelligent agents, freeing it from human intelligence imitation
- Advances in computational and data storage capabilities result in further research possibilities

ADJACENT FIELDS



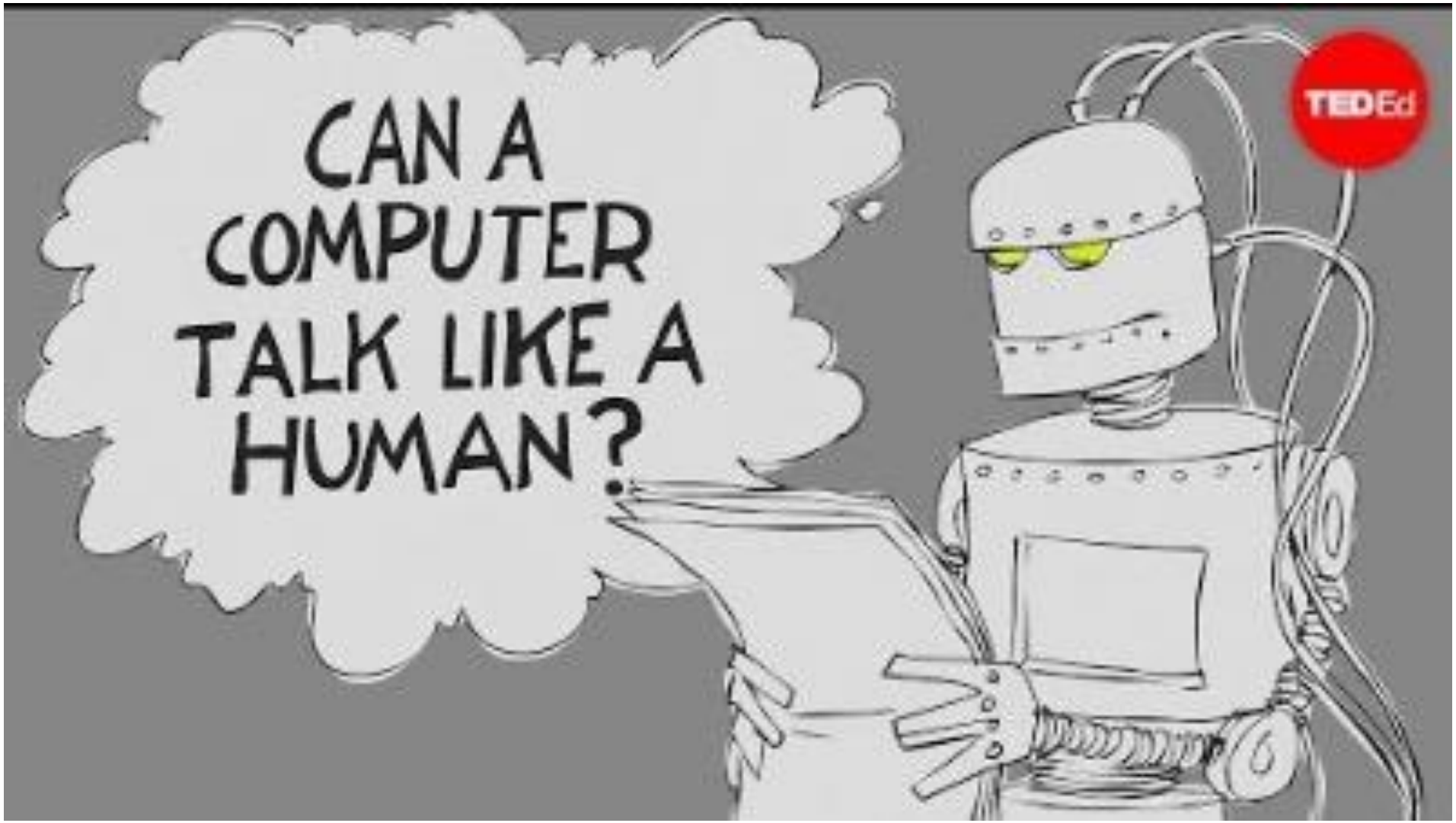
You have learned …

- … how artificial intelligence has developed as a scientific discipline.
- … what paradigms have dominated public perception of the field at different times.
- … which notable advances are still relevant today.
- … what the history of artificial intelligence means for you in terms of learning new skills and contributing to society.

SESSION 1

TRANSFER TASK

TRANSFER TASK



Source of the video: YouTube/TED-Ed, 2016, https://www.youtube.com/watch?v=3wLqsRLvV-c.

TRANSFER TASK

1. Discuss the concepts of the Turing Test with your peers.
2. Do you think an AI-powered chatbot is “intelligent”?
3. Try to challenge the intelligent machine by asking tough questions here and share your results!
4. Try using ChatGPT: https://openai.com/blog/chatgpt/

TRANSFER TASK
PRESENTATION OF THE RESULTS

Please present your results.

The results will be discussed in plenary.

1. What does the term “AI Winter” mean?

   a) a period of declining research and funding for artificial intelligence.
   b) a period of increased funding for artificial intelligence
   c) the period of time before artificial intelligence became a concept or industry
   d) a period when artificial intelligence comes to dominate humanity.

2. The Gartner Hype Curve for Emerging Technologies tries to measure…

   a) hypothetical expectations.
   b) the degree to which technology can be trusted.
   c) the maturity of technological trends with respect to a schema of five successive phases.
   d) falsehoods in technological forecasting.

3. The mathematician and computer scientist Alan Turing is best known for…

   a) providing proof that the technological singularity has occurred.
   b) the invention of cognitive science with McCarthy.
   c) the notion that the rule of law applies to persons and the state.
   d) posing a test to determine whether a machine should be considered intelligent.

Answers: 1a, 2c, 3d

LIST OF SOURCES

- https://end-to-end-machine-learning.teachable.com/courses
- https://www.udacity.com/course/intro-to-machine-learning-with-tensorflow-nanodegree--nd230
- https://www.coursera.org/specializations/machine-learning-introduction

DISCLAIMER

- This is the modified version of the IU slides.
- I used it for my lectures at IU only.