

LECTURER: Nghia Duong-Trung







ARTIFICIAL INTELLIGENCE

WHO I AM

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- Current Employer: The German Research Center for Artificial Intelligence
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- PostDoc in Machine Learning at Technische Universität Berlin
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- MSc in Software Engineering at Heilbronn University, Germany
- Profile: <https://sites.google.com/isml.de/duongtrungnghia/>
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TUTORING SCHEDULE

- 6 weeks, Monday evenings, virtual, BER Virtual Room 03

	Date	Time	Title	Event type	Planning status	Attendance
	17.10.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open
	24.10.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open
	07.11.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open
	14.11.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open
	21.11.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open
	28.11.2022	17:30 - 20:00	Artificial Intelligence - MSE_BER_DLBDSEAIS01_2022_WS_Q4_BAAI	Tutorial (Virtual)	4. Published	Open

PARTICIPANTS

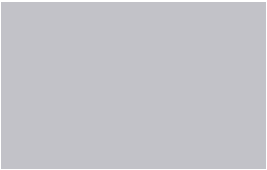
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- Course book: Artificial Intelligence_DLBDSEAIS01, provided by IU, myStudies
- Reading list DLBDSEAIS01, provided by IU, myStudies
- Additional teaching materials:

<https://github.com/duongtrung/IU-ArtificialIntelligenceCourse>

TOPIC OUTLINE

History of AI



Modern AI Systems



Reinforcement Learning



Natural Language Processing – Part 1



Natural Language Processing – Part 2



Computer Vision



UNIT 1

HISTORY OF AI

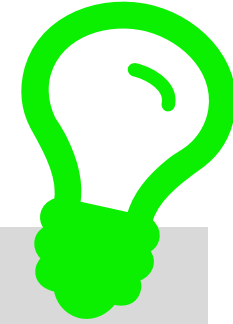
STUDY GOALS



- What is Artificial Intelligence (AI)?
- Developments of AI as a scientific discipline
- The AI winters
- Basics of expert systems
- Advances of AI



1. How did AI develop as a scientific discipline?
2. What are the main reasons for AI winters?
3. How does an expert system work?
4. What does the Gartner hype cycle curve reflect?



“The science and engineering
of making intelligent machines,
especially intelligent computer programs.”

WHAT IS ARTIFICIAL INTELLIGENCE?

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.*”

WHAT IS ARTIFICIAL INTELLIGENCE?

– Narrow AI:

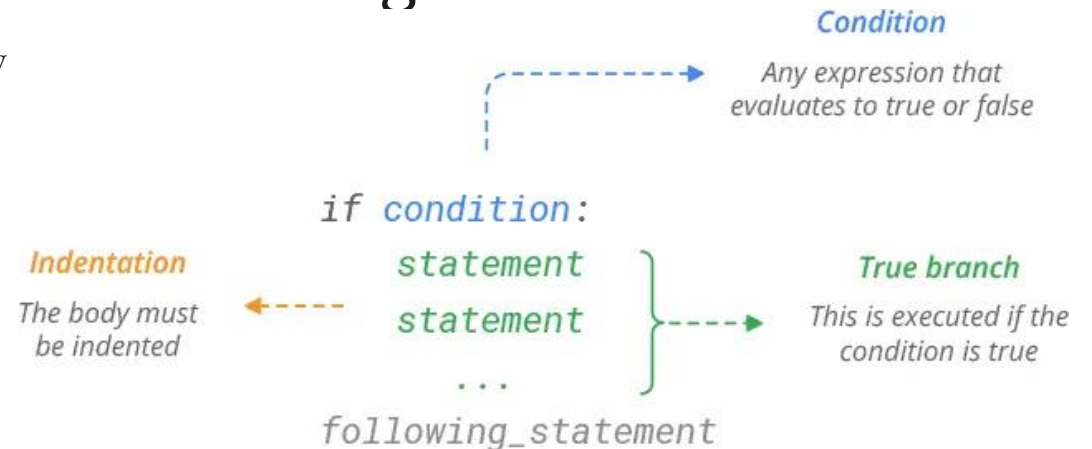
- Solving a single, well defined task
- It can be broad (recognizing objects from pictures) or extremely specific (predicting which customers who bought product A are more likely to purchase product B as well)

– 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

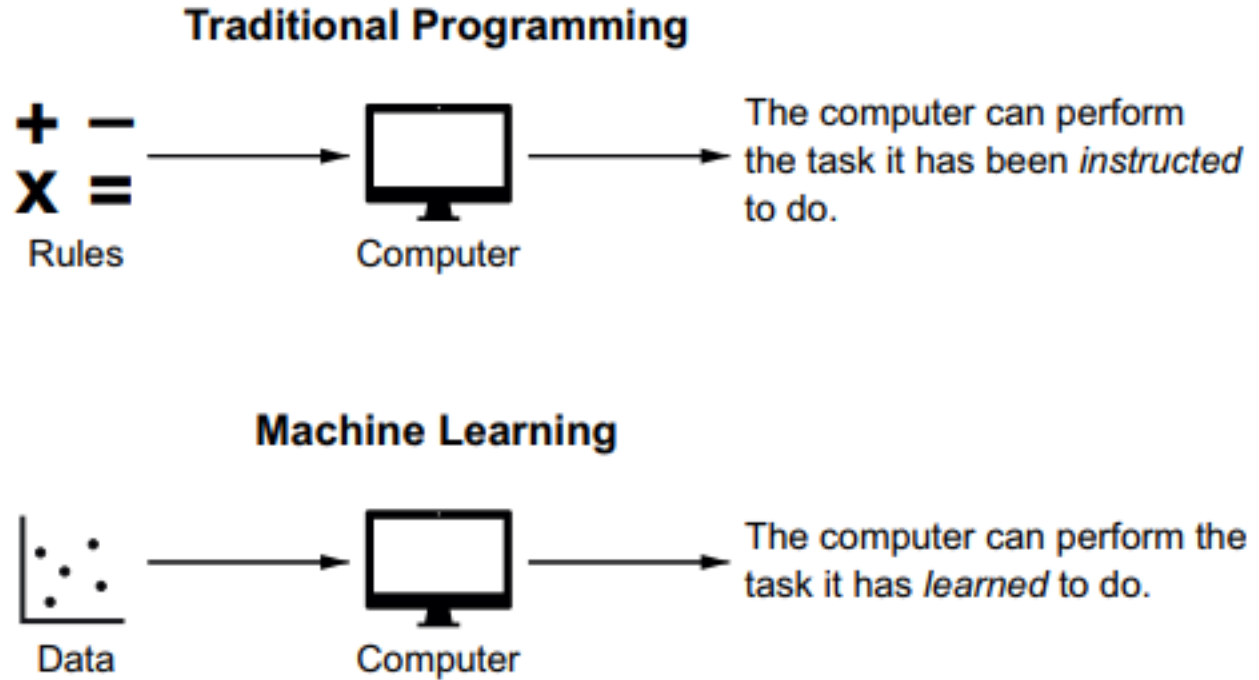


WHAT IS MACHINE LEARNING?

- 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.

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

Advancements in AI: A Timeline

1943

Evolution of Artificial Neurons

1950

Invention of Turing Machine

1956

Coinage of the word 'Artificial Intelligence'

1975 - 1980

First AI Winter

1972

First Intelligent Robot - WABOT 1

1966

First Chatbot - ELIZA

1987 - 1993

Second AI Winter

1997

First computer to beat a World chess champion

2002

AI enters Household - Roomba Vacuum

2019

Open AI - 'Dactyl' trains itself to solve a Rubik's Cube

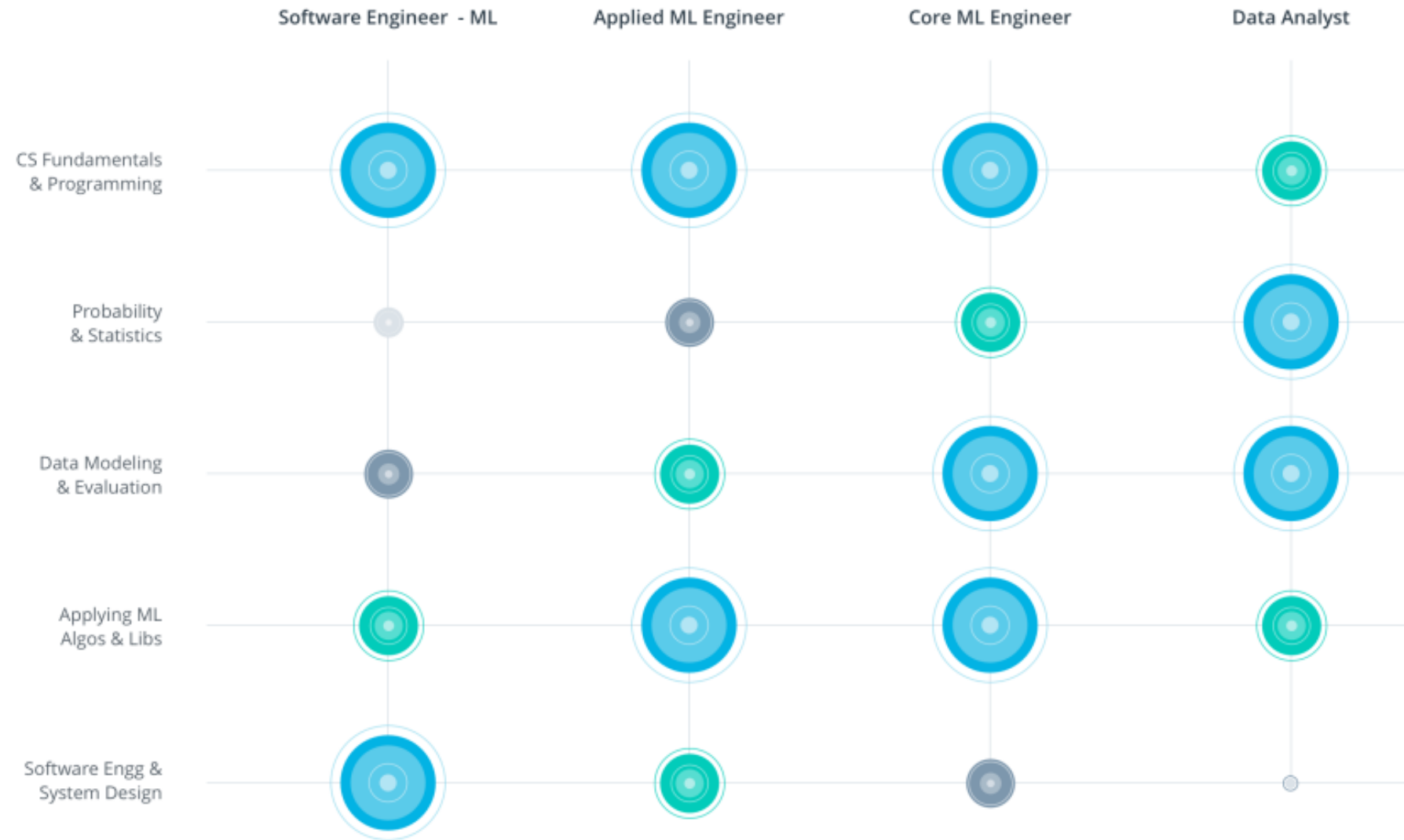
2018

Google Duplex - Formation of Virtual Assistants

2012

Launch of 'Google Now'

**BLOG
TALK**



3 Key AI Trends You Should Know

1 Global AI revenue forecast by 2025, ranked by use case in millions US dollar

Source: Statista



2 Penetration of artificial intelligence skills, by country

Source: Dun & Bradstreet



3 Organizations deploying AI, by functional areas

Source: Medium

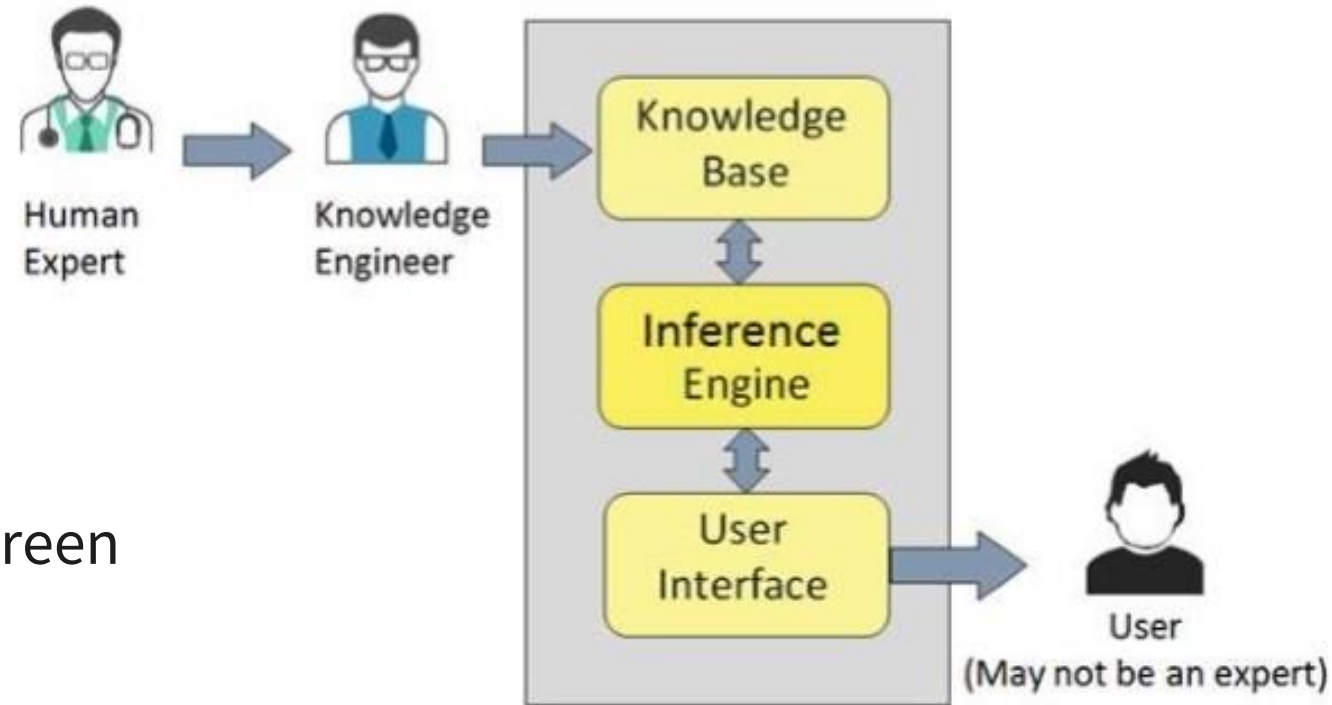


DEFINITIONS OF EXPERT SYSTEMS

- An expert system is a computer system that simulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning about knowledge like an expert.
- An expert system is a computer system that performs a task that would otherwise be performed by a human expert.

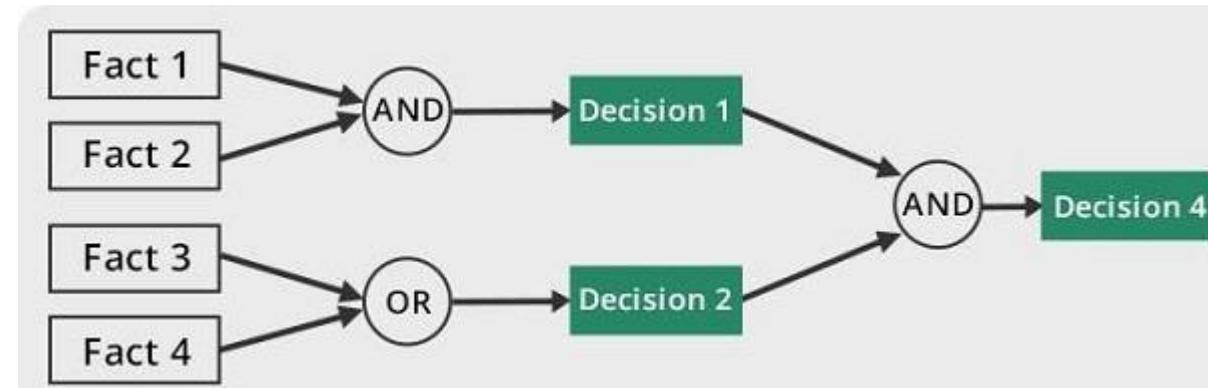
BASIC COMPONENTS OF EXPERT SYSTEMS

- Knowledge base
 - Data is collection of facts, experience
 - factual and heuristic knowledge
 - The form of IF-ELSE rules
- Inference engine
 - Forward and backward chaining
- User interface
 - Natural language displayed on the screen
 - Verbal narrations via speaker

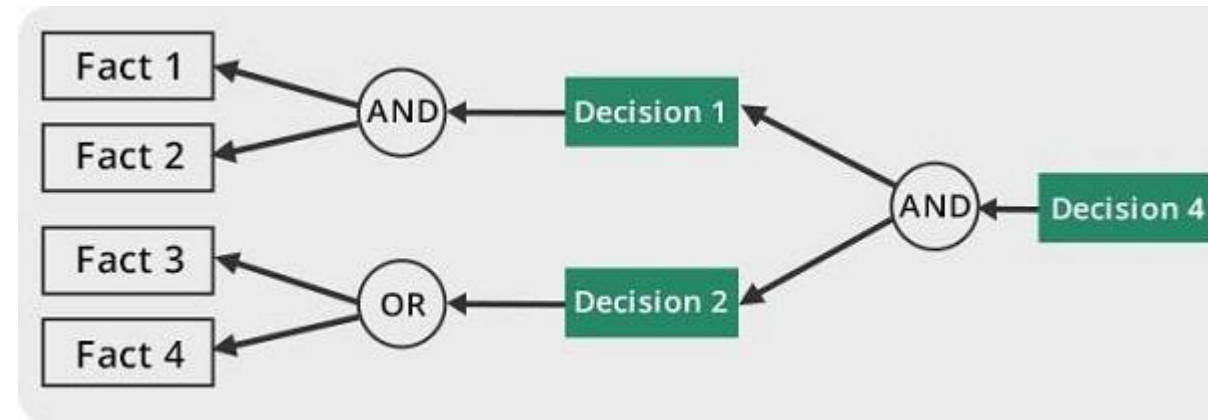


BASIC COMPONENTS OF EXPERT SYSTEMS

- Forward chaining
 - To answer the question „what can happen next?“
 - Follows the chain of conditions, derivations and finally deduces the outcome



- Backward chaining
 - To answer the question „why this happened?“
 - Finds out which conditions could have happened in the past for the current result

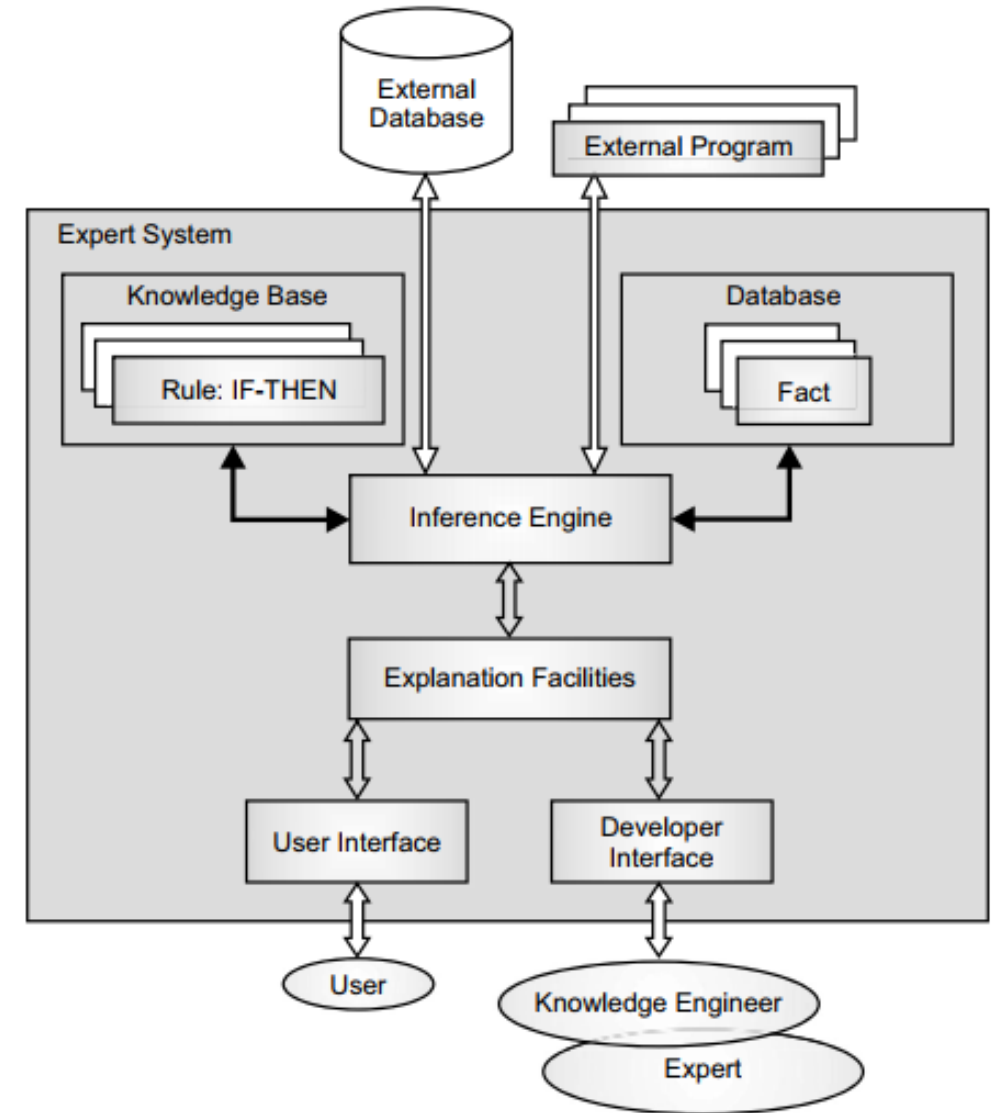


ADVANCED COMPONENTS OF EXPERT SYSTEMS

Krishnamoorthy, C. S., & Rajeev, S. (2018). *Artificial Intelligence and Expert Systems for Artificial Intelligence Engineers*. CRC press.

Gupta, I., & Nagpal, G. (2020). *Artificial Intelligence and Expert Systems*. Mercury Learning and Information.

In short: expert system = knowledge base + inference engine

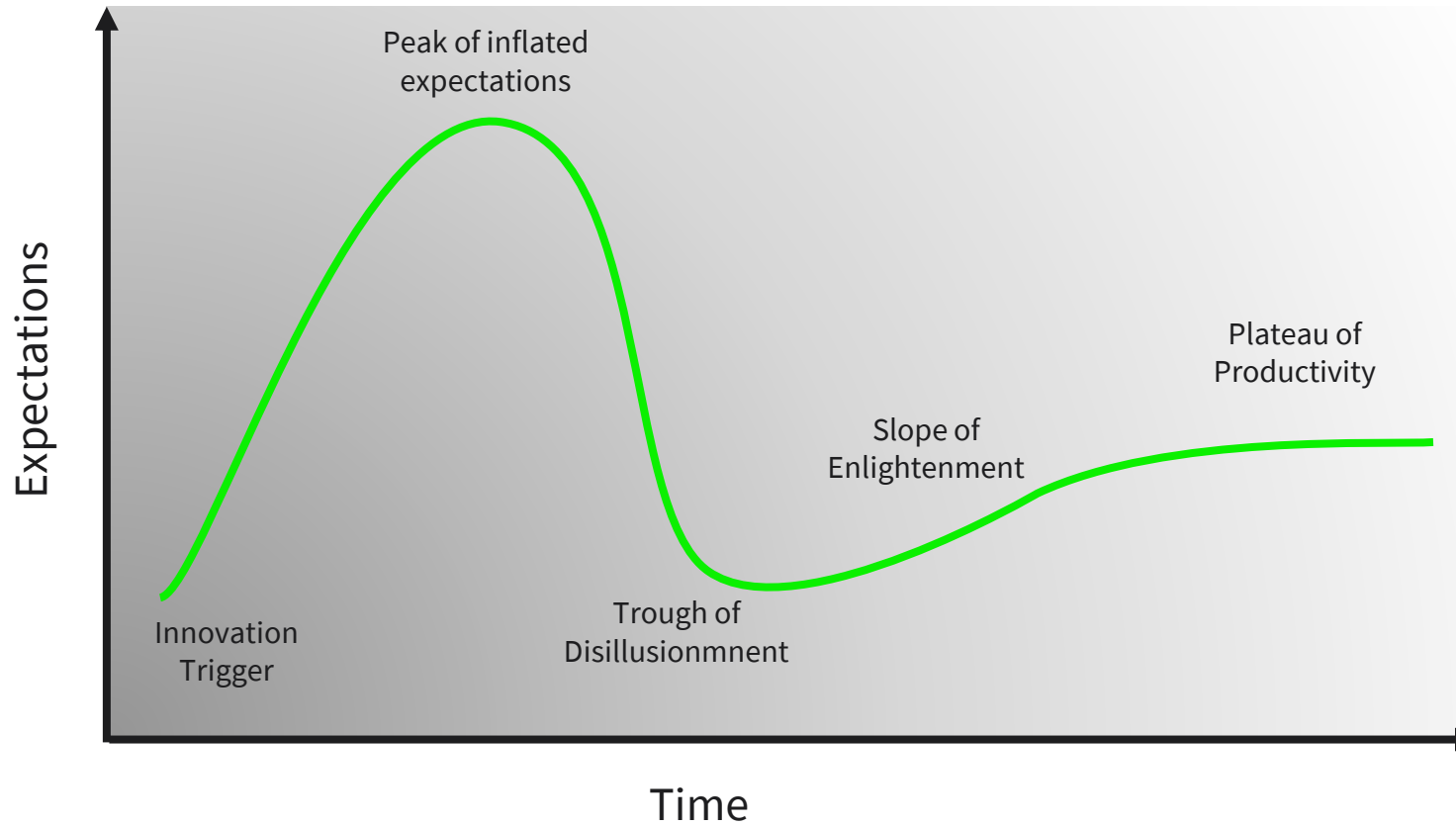


FEATURES OF GOOD EXPERT SYSTEMS

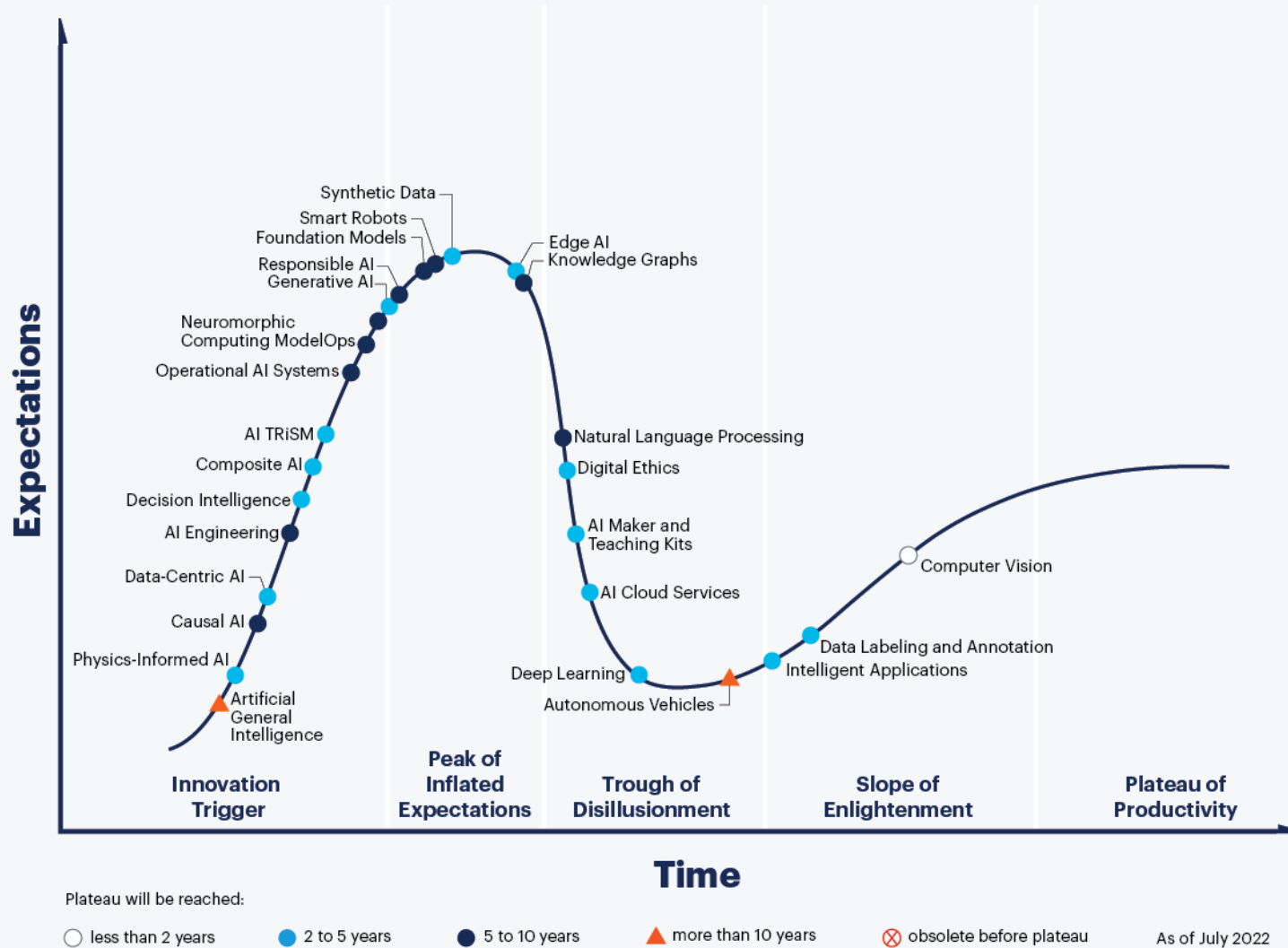
- Useful: meet a specific need
- Usable: even a novice computer user finds them easy to use
- Educational: an expert system may be used by non-experts who can then increase their own expertise by using it
- Able to explain the given advice: explain the reasoning process
- Able to learn new knowledge: ask questions to gain additional knowledge
- Exhibit a high performance: high quality output -> satisfy users
- Make timely decisions: able to produce decisions on time

THE GARTNER HYPE CYCLE CURVE

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



Hype Cycle for Artificial Intelligence, 2022



[gartner.com](https://www.gartner.com)

Source: Gartner
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Gartner



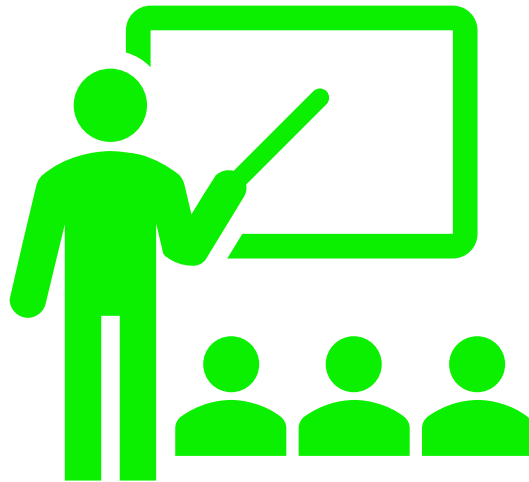
- AI is the science of making intelligent machines.
- Early considerations about AI date back to the ancient Greek history.
- Nowadays, AI is an important component of computer science.
- Expert systems emulate decision making by using domain-specific knowledge of an expert.
- The Gartner hype cycle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

SESSION 1

TRANSFER TASK

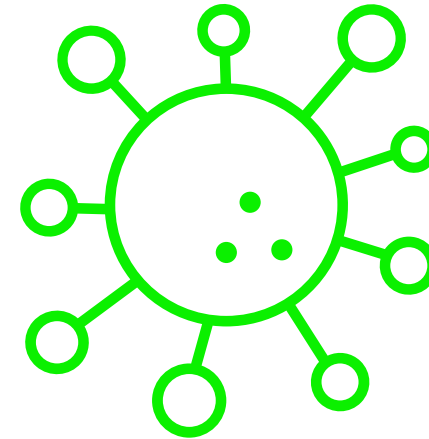
TRANSFER TASK

1. Describe how artificial intelligence can affect the future of learning.



TRANSFER TASKS

2. Outline how the knowledge base for an expert system to detect COVID-19 could look like.



3. How would you assign the following technologies on the hype cycle curve?

- Chatbots
- Smart robots
- Deep learning
- Autonomous vehicles
- Artificial general intelligence

How long do you think it will take until the plateau of productivity is reached?

TRANSFER TASK
PRESENTATION OF THE RESULTS

Please present your
results.

The results will be
discussed in plenary.





1. Which event was key for the recent history of AI?
2. For which group of end users are expert systems developed?
3. What proportion of AI systems have already reached the plateau of productivity at the Gartner hype cycle?

LIST OF SOURCES

McCarthy, J. (2007). *What is Artificial Intelligence?* Stanford University. <http://jmc.stanford.edu/articles/whatisai/whatisai.pdf>

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