Artificial Intelligence

INTRODUCTION TO ARTIFICIAL INTELLIGENCE

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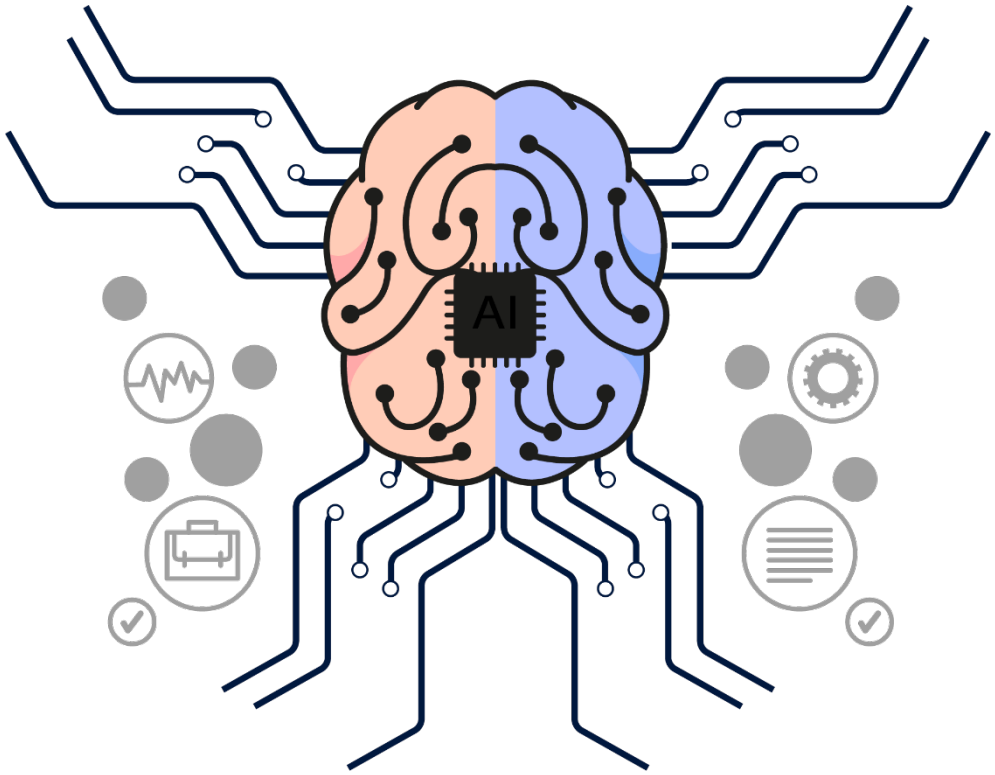
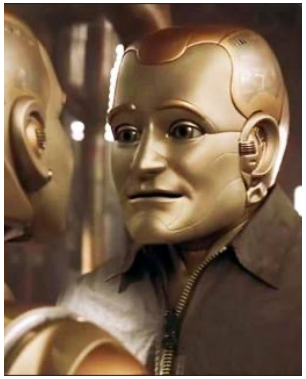
Outline

- What is Artificial Intelligence (AI)?
- The foundations of AI
- A brief history of AI
- AI applications in various fields
- What are we going to learn?

What is AI?



AI: A dream for everyone



AI Innovations: Personal robots

Source: https://www.youtube.com/watch?v=QdQL11uWWcI

AI Innovations: Humanoid robots

Source: https://www.youtube.com/watch?v=9DaTZQxg21U

AI Innovations: Deep Blue – AlphaGo

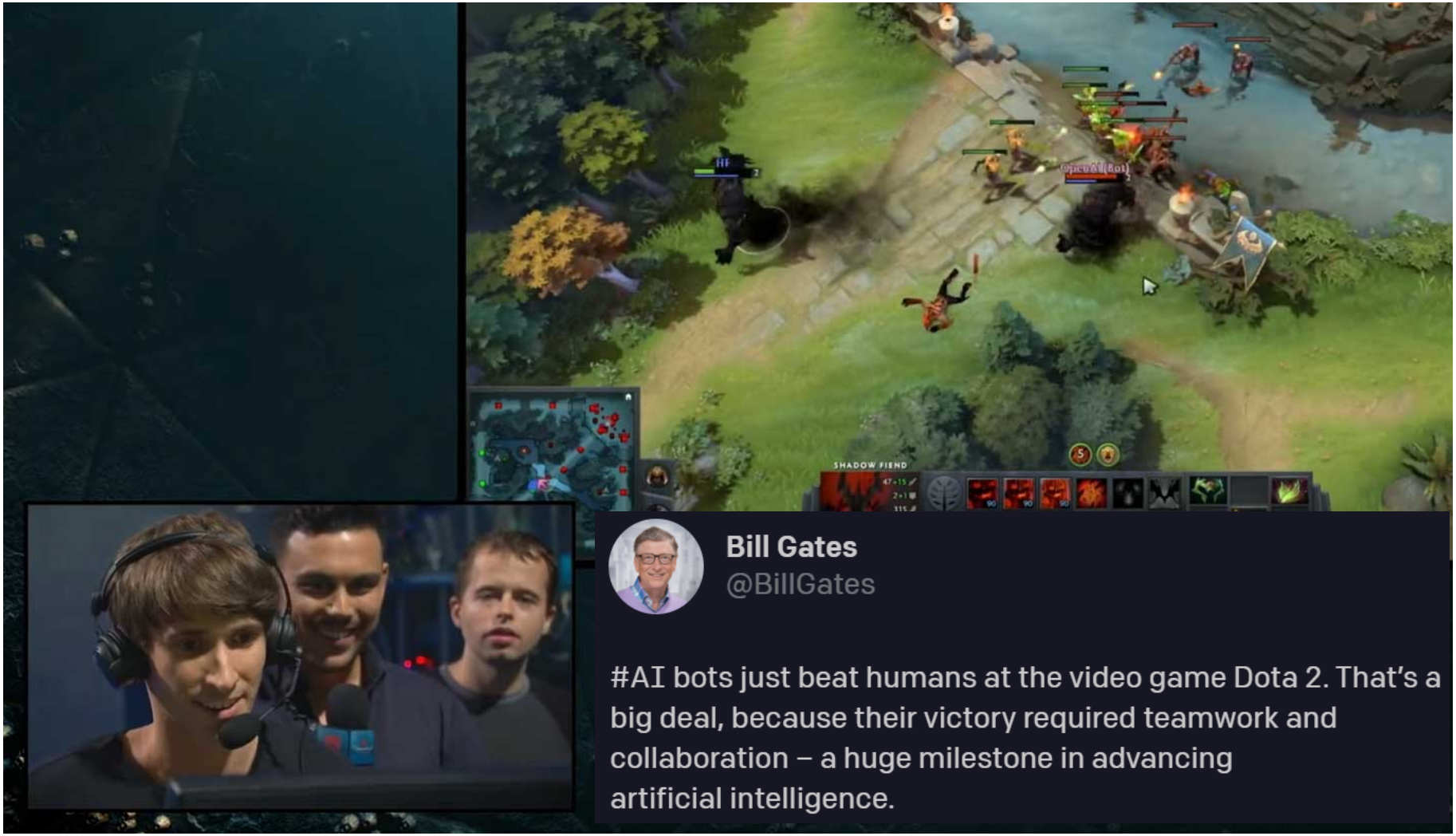
Deep Blue vs. Kasparov
(02/1996 and 05/1997)

AlphaGo vs. Lee Sedol
(03/2016)

The complexity of Chess and GO

Source: https://www.youtube.com/watch?v=SUbqykXVx0A

AI Innovations: OpenAI Five



Source: https://openai.com/projects/five/

Large Language Models

BD

What is chatGPT?

ChatGPT is a language model developed by OpenAI, and it is based on the GPT (Generative Pre-trained Transformer) architecture. It is designed to generate human-like text responses to user input, making it suitable for a wide range of natural language understanding and generation tasks, including answering questions, engaging in conversations, providing information, and more.

ChatGPT is trained on a diverse dataset of text from the internet, allowing it to have a broad understanding of various topics and languages. It can generate coherent and contextually relevant responses, making it useful for chatbots, virtual assistants, customer support applications, and other natural language processing tasks.

The model is fine-tuned and deployed in different applications and services to assist users in generating text-based content, answering queries, and engaging in text-based interactions. It can be integrated into websites, apps, and other platforms to provide natural language processing capabilities. Please note that my knowledge is based on information available up to September 2021, and there may have been updates or newer versions of ChatGPT developed since then.

Regenerate

Intelligence vs. Artificial Intelligence

Intelligence includes the capacity for logic, understanding, learning, reasoning, creativity, and problem solving, etc.

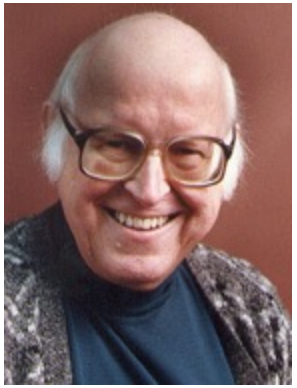
Artificial intelligence (AI) attempts not just to **understand** but also to **build intelligent entities**.

The field of Artificial Intelligence

- AI is one of the newest fields in science and engineering.
  - Work started in earnest soon after World War II
  - The name was coined at a conference at Dartmouth College in 1956.

John McCarthy (1927 – 2011)

Marvin Minsky (1927 – 2016)



Allen Newell (1927 – 1992)

Arthur Samuel (1901 – 1990)

Herbert Simon (1916 – 2001)

The field of Artificial Intelligence

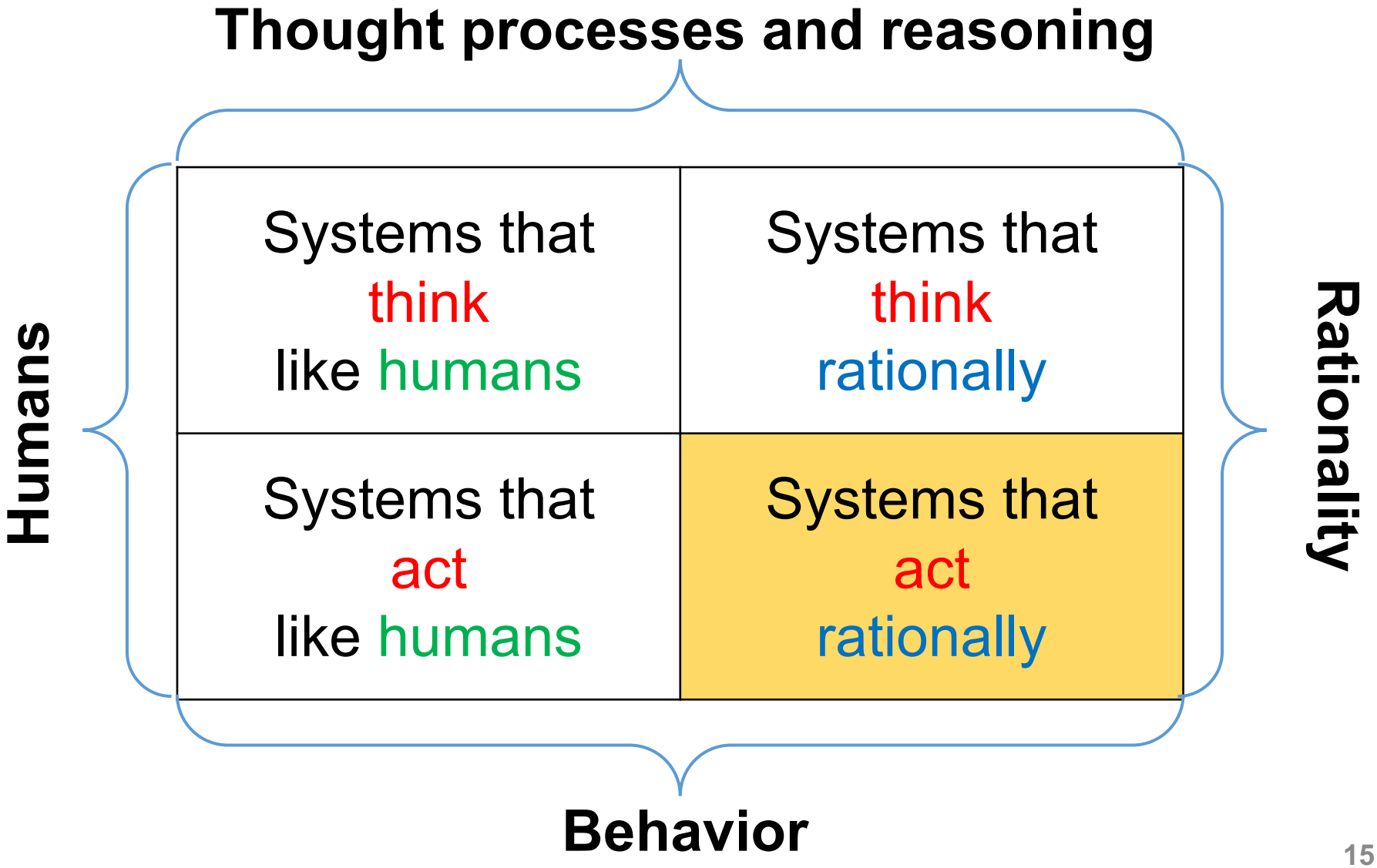
- AI research builds **intelligent entities** that **simulate humans** in different aspects.

- ✓ Thinking: learning, planning, and refining knowledge
- ✓ Perception: see, hear, feel, etc.
- ✓ Communication in natural languages
- ✓ Manipulation and moving objects

What is Artificial Intelligence?

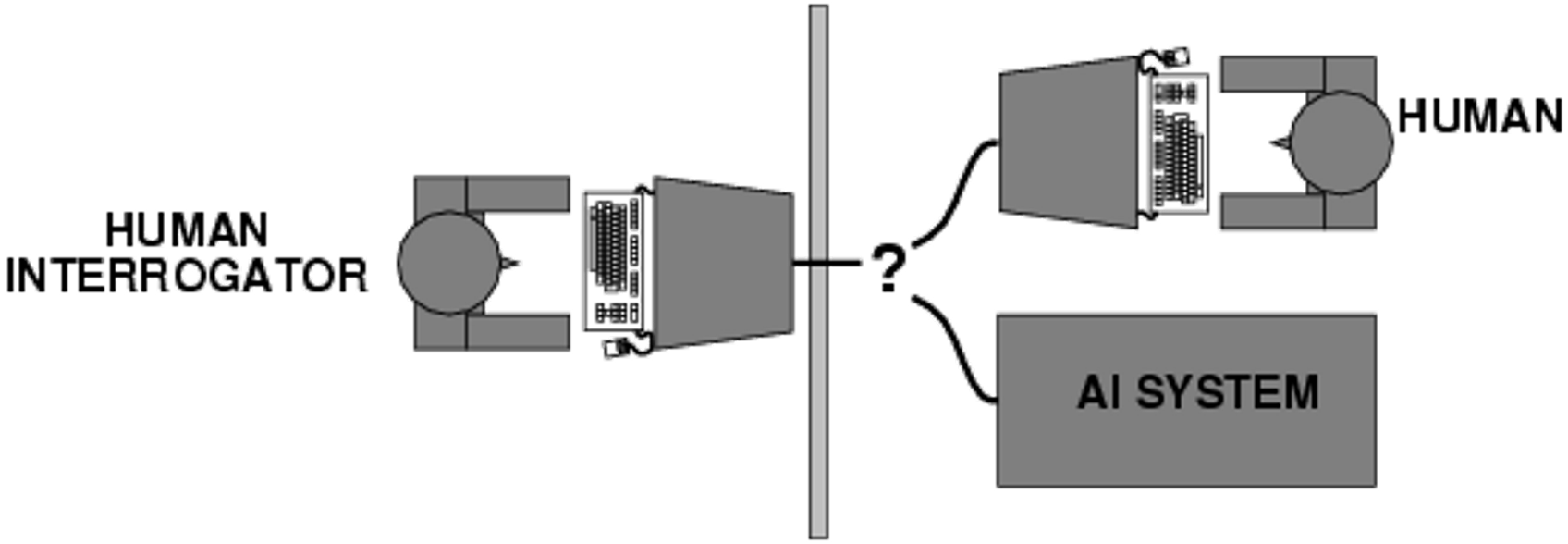
Thinking Humanly	Thinking Rationally
"The exciting new effort to make computers think . . . *machines with minds,* in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning .. ." (Hellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et at,* 1998) "Al . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

What is Artificial Intelligence?



Systems that act like humans

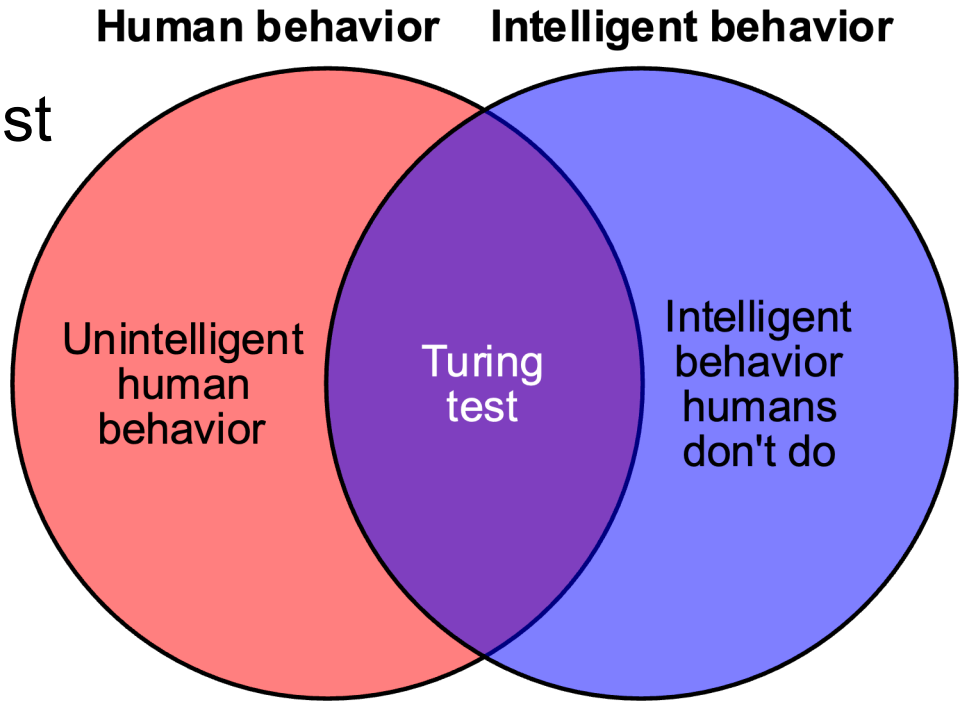
- **The Turing Test approach** (Alan Turing, 1950)



A computer passes the test if a human interrogator, after posing several written questions, cannot tell whether the written responses come from a person or from a computer.

Systems that act like humans

- Problems with the Turing Test



- Variations
  - Reverse Turing Test: CAPTCHA
  - Total Turing Test: additionally examine the perceptual (computer vision) and the objects manipulation (robotics) abilities of the subject.

A better Turing Test?

- AI researchers have devoted little effort to pass the test.
- It is more important to study the underlying principles of intelligence than to duplicate an exemplar.

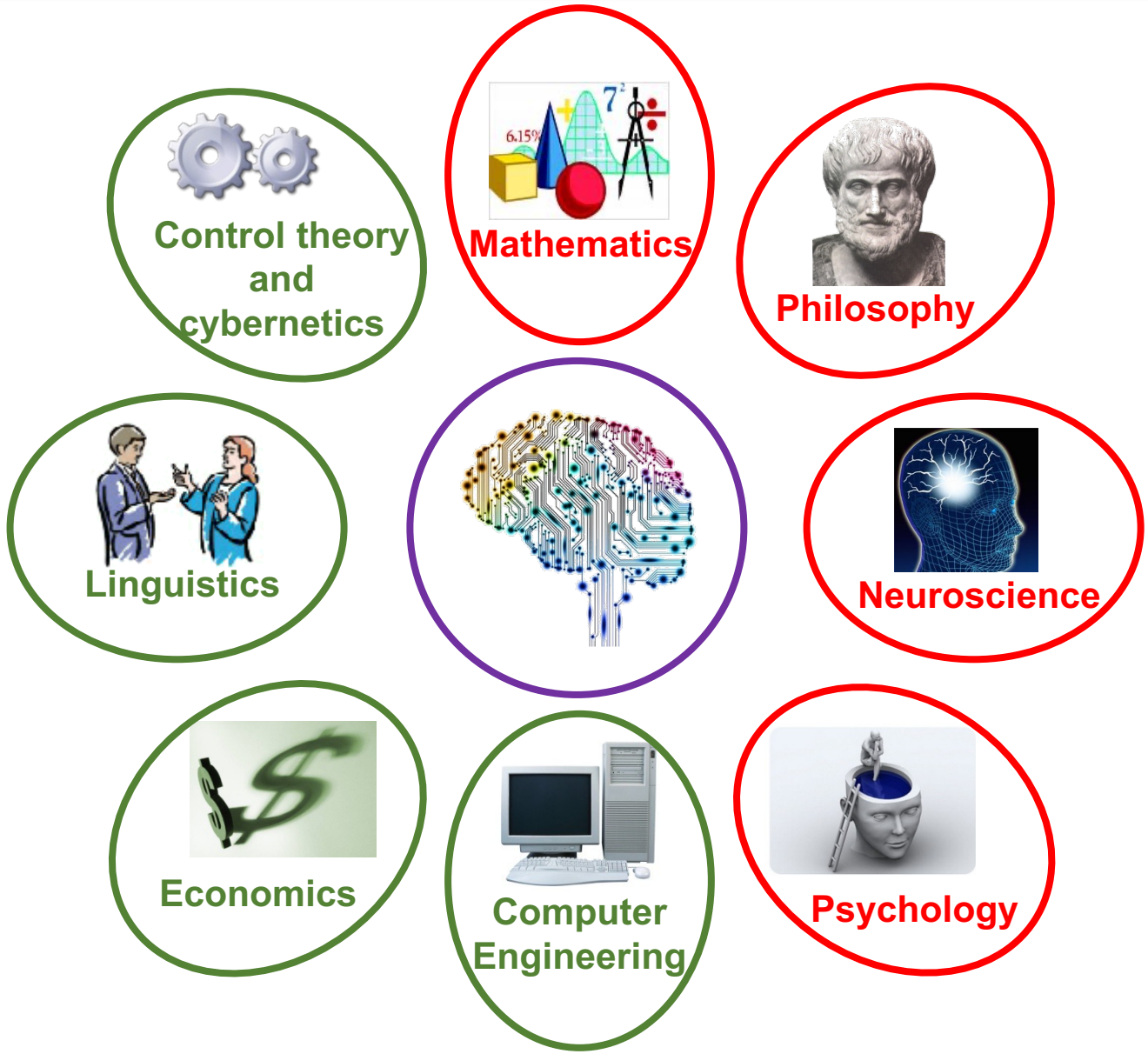
Major roles and Goals of AI

Goals of AI

AI studies the intelligent part concerned with human and represents those actions using computers.

Foundations of AI

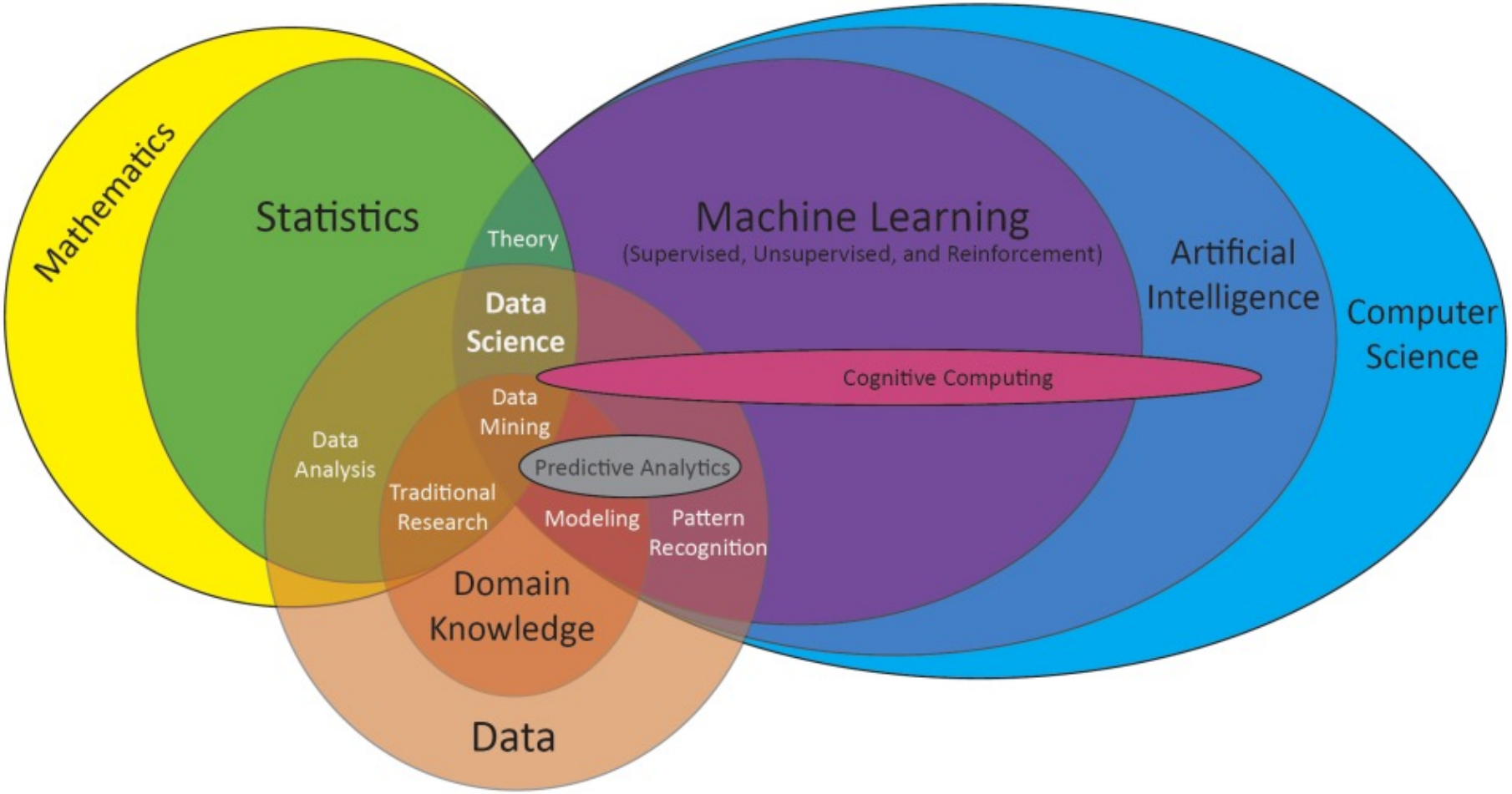
Research fields related to AI



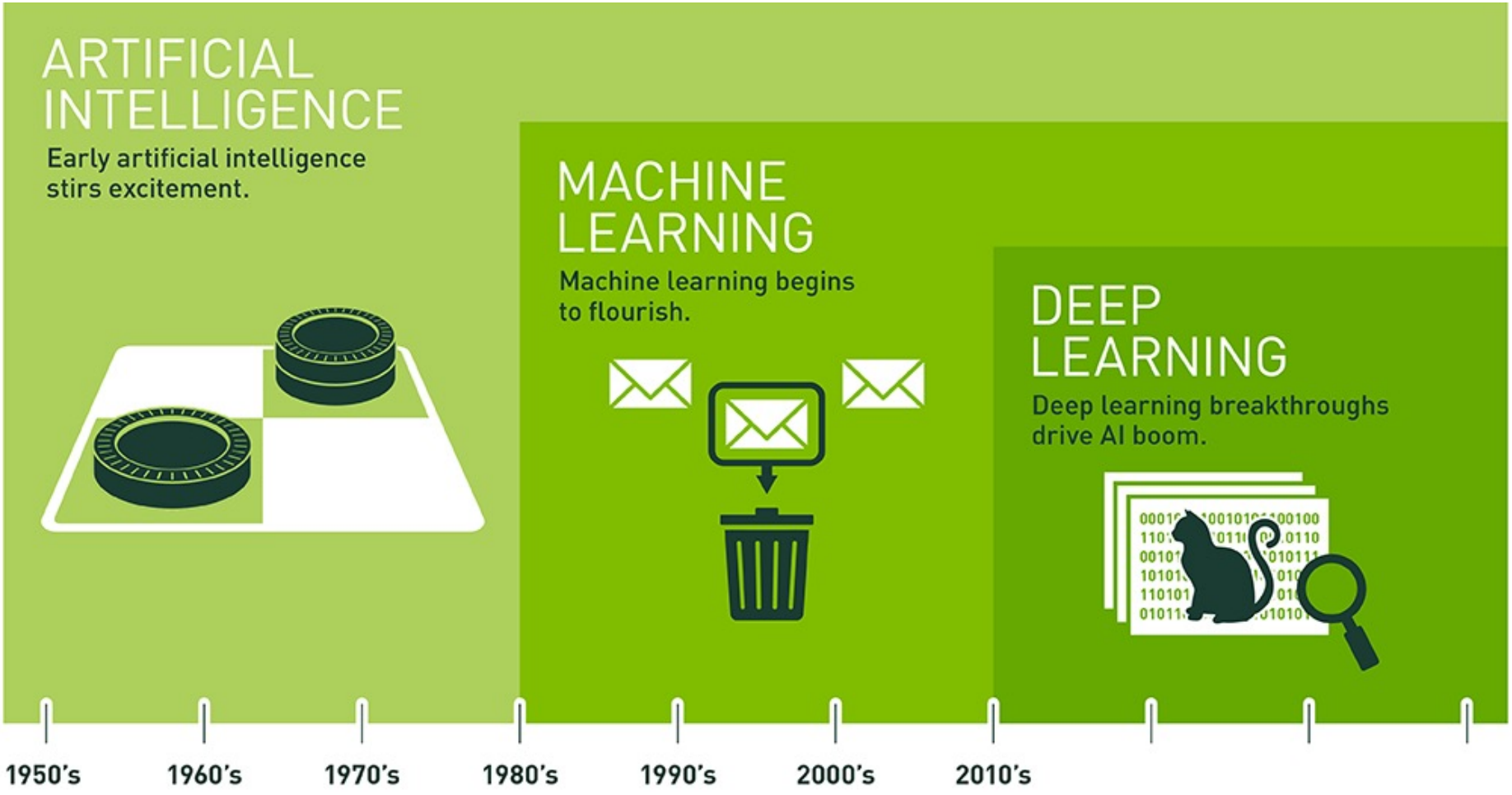
Research fields related to AI

Field	Description
Philosophy	Logic, methods of reasoning, mind as physical system, foundations of learning, language, rationality.
Mathematics	Formal representation and proof, algorithms, computation, (un)decidability, (in)tractability, probability.
Economics	Utility, decision theory, rational economic agents
Neuroscience	Neurons as information processing units.
Psychology/ Cognitive Science	How do people behave, perceive, process information, represent knowledge.
Computer Engineering	Building fast computers
Control Theory	Design systems that maximize an objective function over time
Linguistic	Knowledge representation, grammar

Research fields related to AI



AI and related concepts



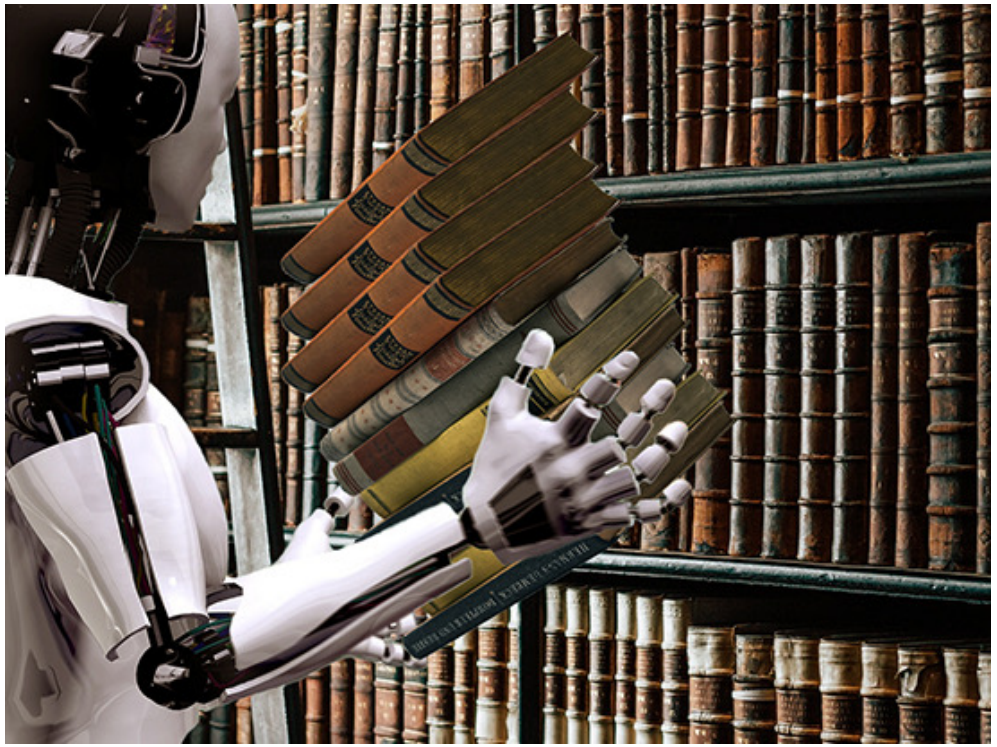
Source: https://blogs.nvidia.com/blog/2016/07/29/whats-difference-artificial-intelligence-machine-learning-deep-learning-ai/

Pros and Cons of AI

- More powerful and more useful computers
- New and improved interfaces
- Solve new problems
- Better handling of information
- Relieve information overload
- Conversion of information into knowledge

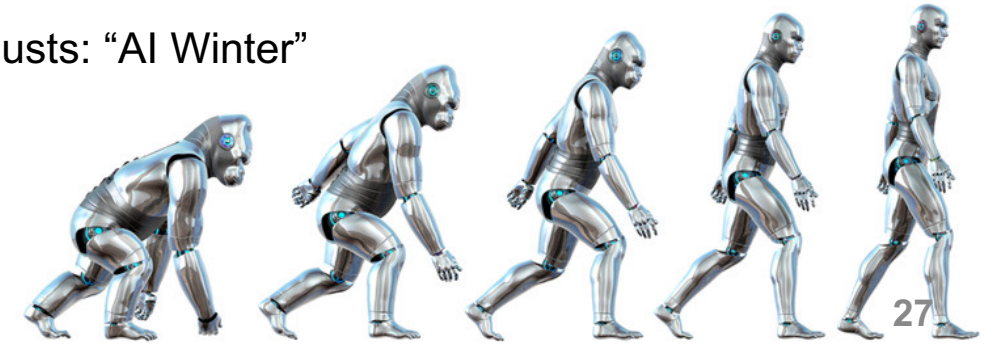
- Increased costs
- Difficulty with software development - slow and expensive
- Few experienced programmers

A brief history of AI



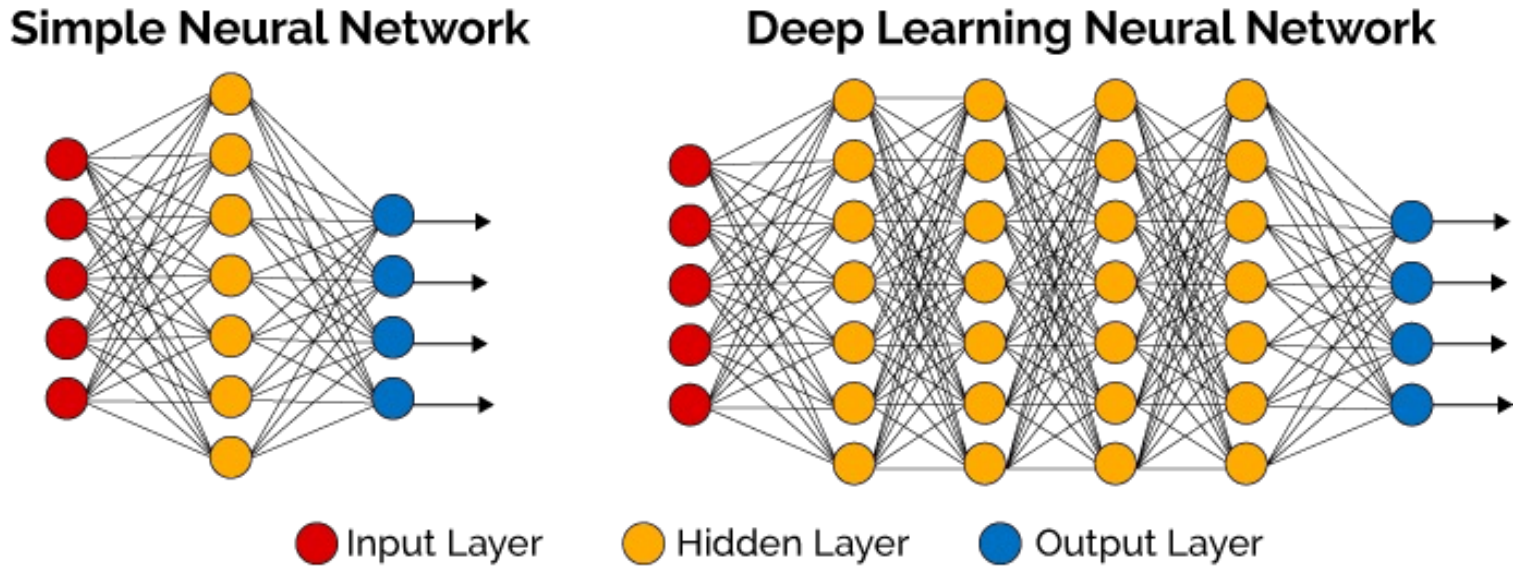
A brief history of AI

- 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's “Computing Machinery and Intelligence”
- 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: “Artificial Intelligence” adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches
  - 1969—79: Early development of knowledge-based systems
  - 1980—88: Expert systems industry booms
  - 1988—93: Expert systems industry busts: “AI Winter”

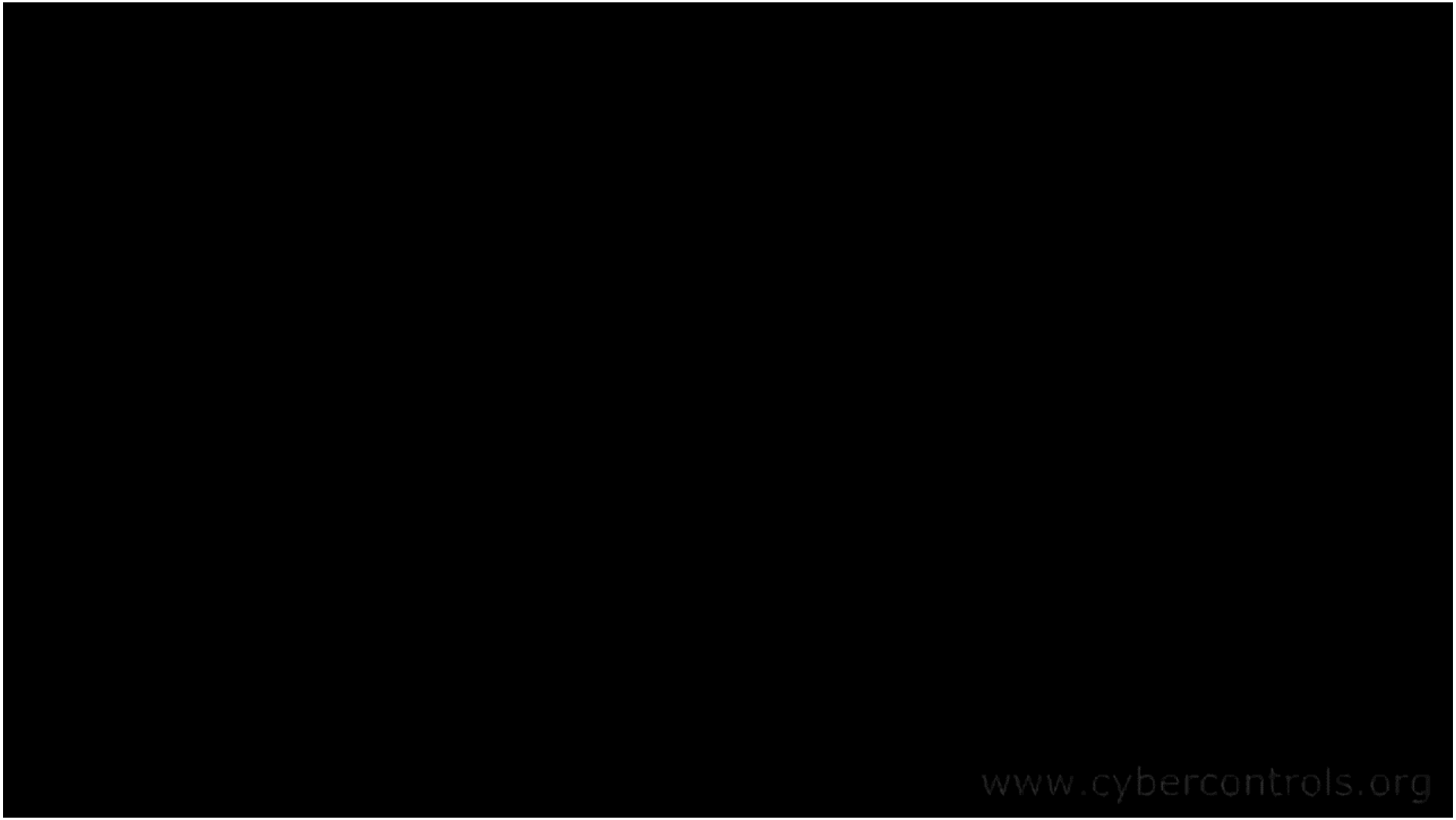


A brief history of AI

- 1990—: Statistical approaches
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems… “AI Spring”?
- 2000—: Where are we now?

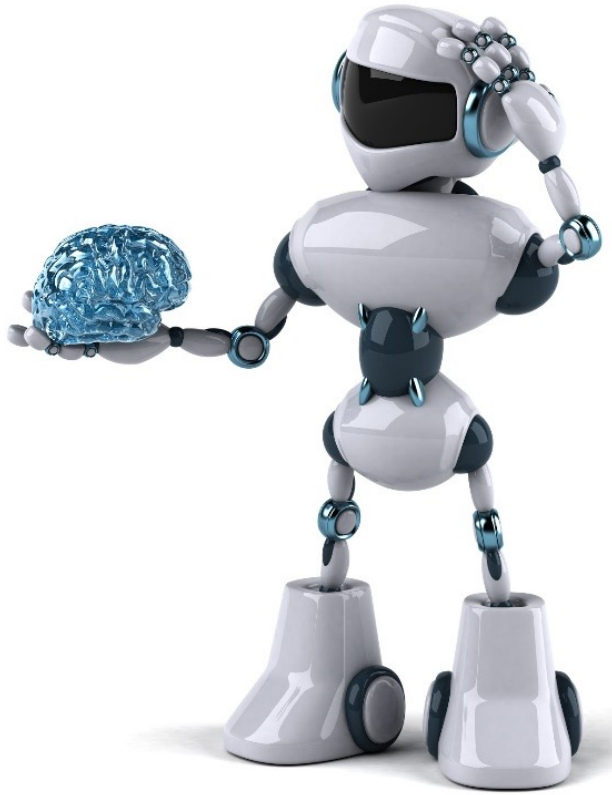


A demo of artificial neural network



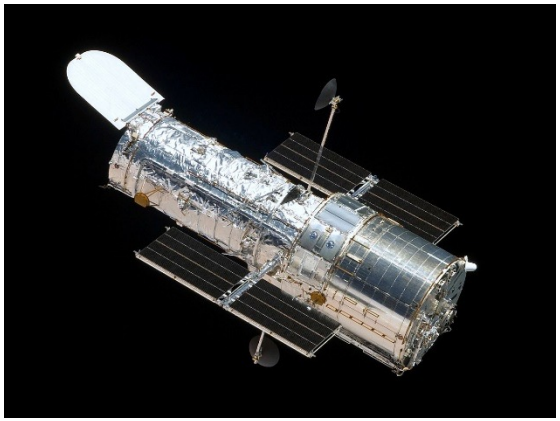
Source: https://www.youtube.com/watch?v=3JQ3hYko51Y

AI Applications



Autonomous Planning and Scheduling

Autonomous rovers

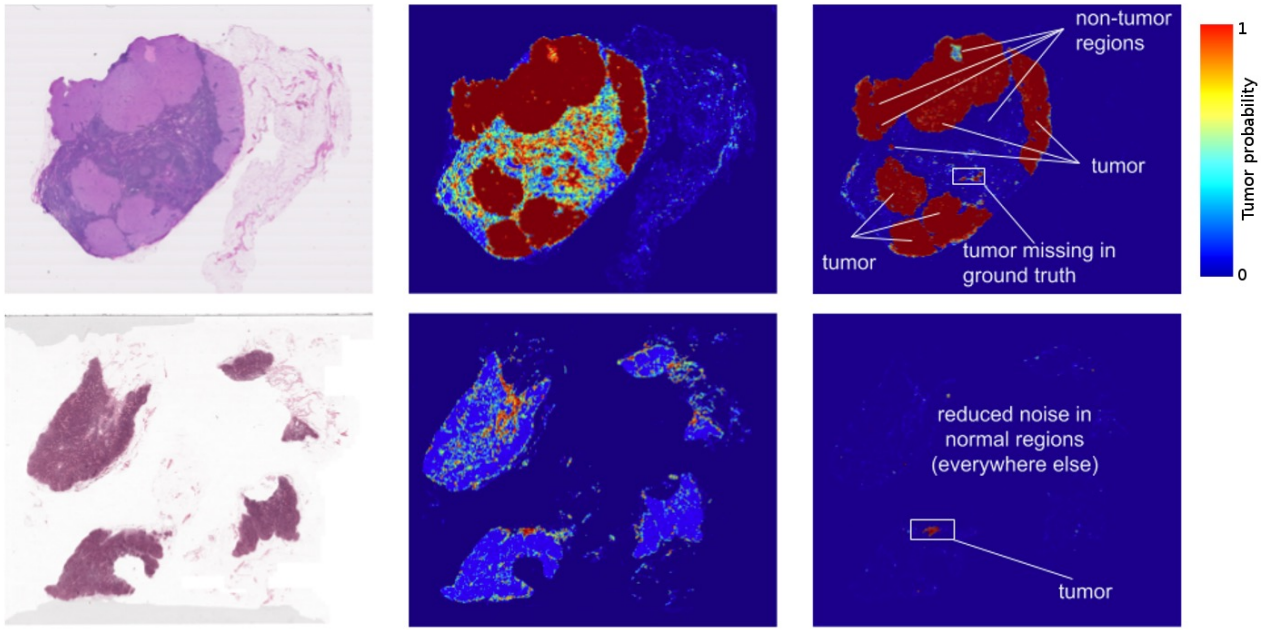


Telescope scheduling

Analysis of data

Medicine

Classification on medical images



Have you obtained positive cultures?
Yes.
What type of infection is it?
Primary bacteremia.
When did the symptoms first appear?
May 5
I recommend gentamycin using a doze of ...

Diagnosis system (e.g., MYCIN)

Games and Entertainment

	A	N	T	S		S	O	U	N	D		A	G	E	N	T
D			R			O				E			U			R
E			A		F	I	S	H		N	O	R	T	H		O
A	G	E	N	T		L				G			S			P
T			S		E					U		B		B	T	I
H	O	R	M	O	N	O	M	I	M	E	T	I	C			C
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H	O	S	T		M		P		R		A	L	G	A	E	
	R				I		A		I			O		T		
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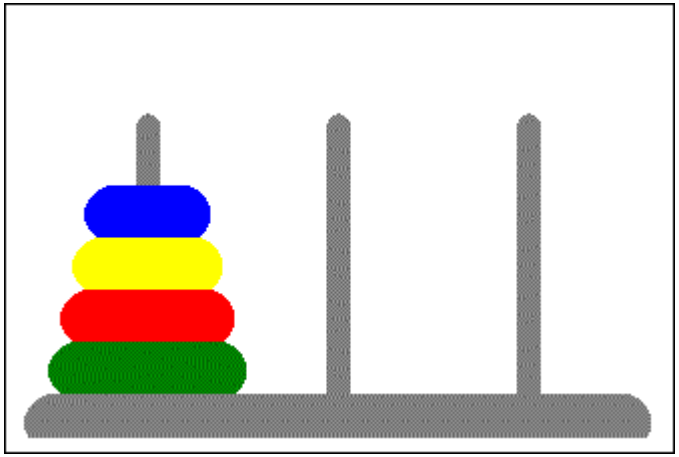
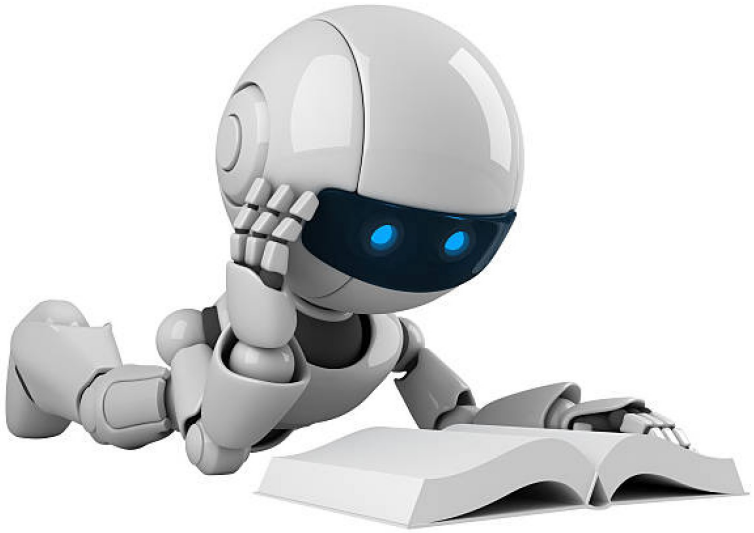


What are we going to learn?



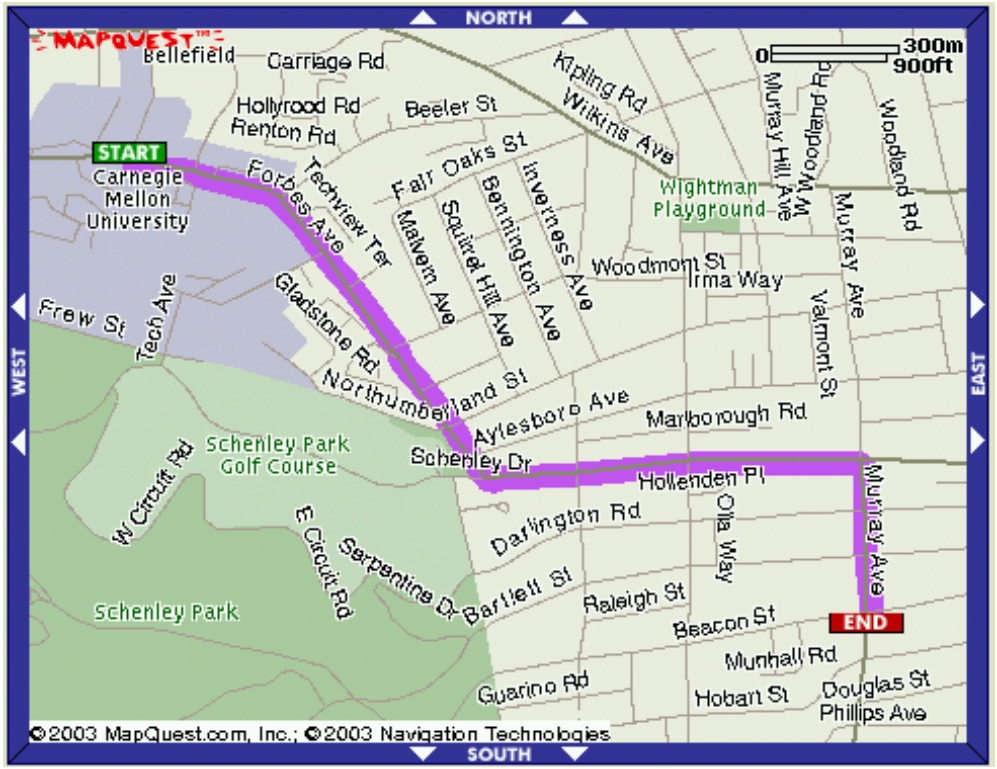
Main topics in AI

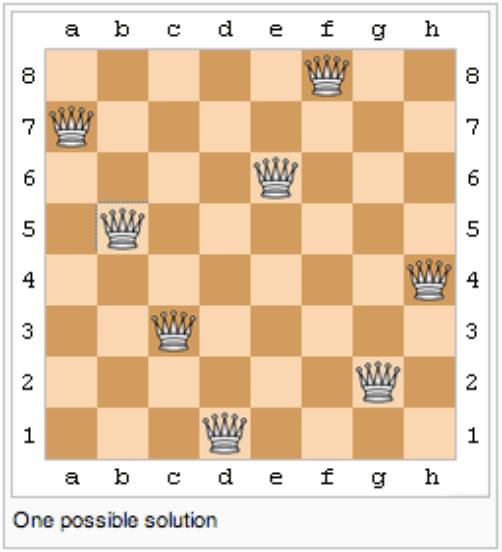
- Search (includes Game Playing)
- Representing knowledge and reasoning with it
- Planning
- Learning
- Natural language processing
- Expert systems
- Interacting with the Environment
  - E.g. Vision, Speech recognition, Robotics, etc.
- And more…

We won't have time in this course to consider all of these.

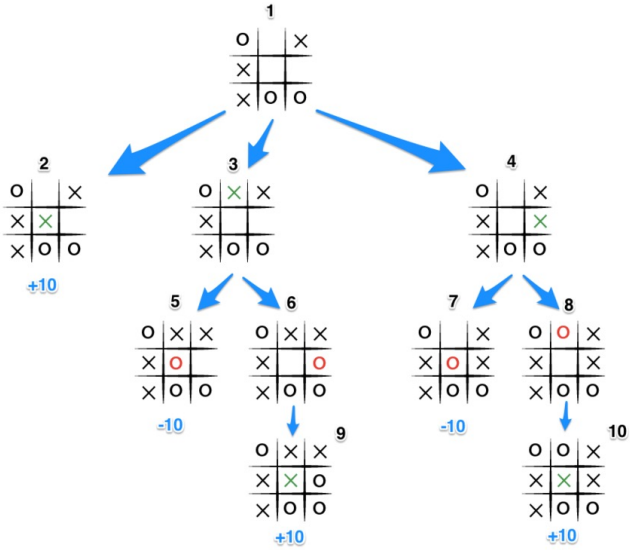
Solving problems by searching

- Uninformed and informed strategies
- Global vs. local search





One possible solution

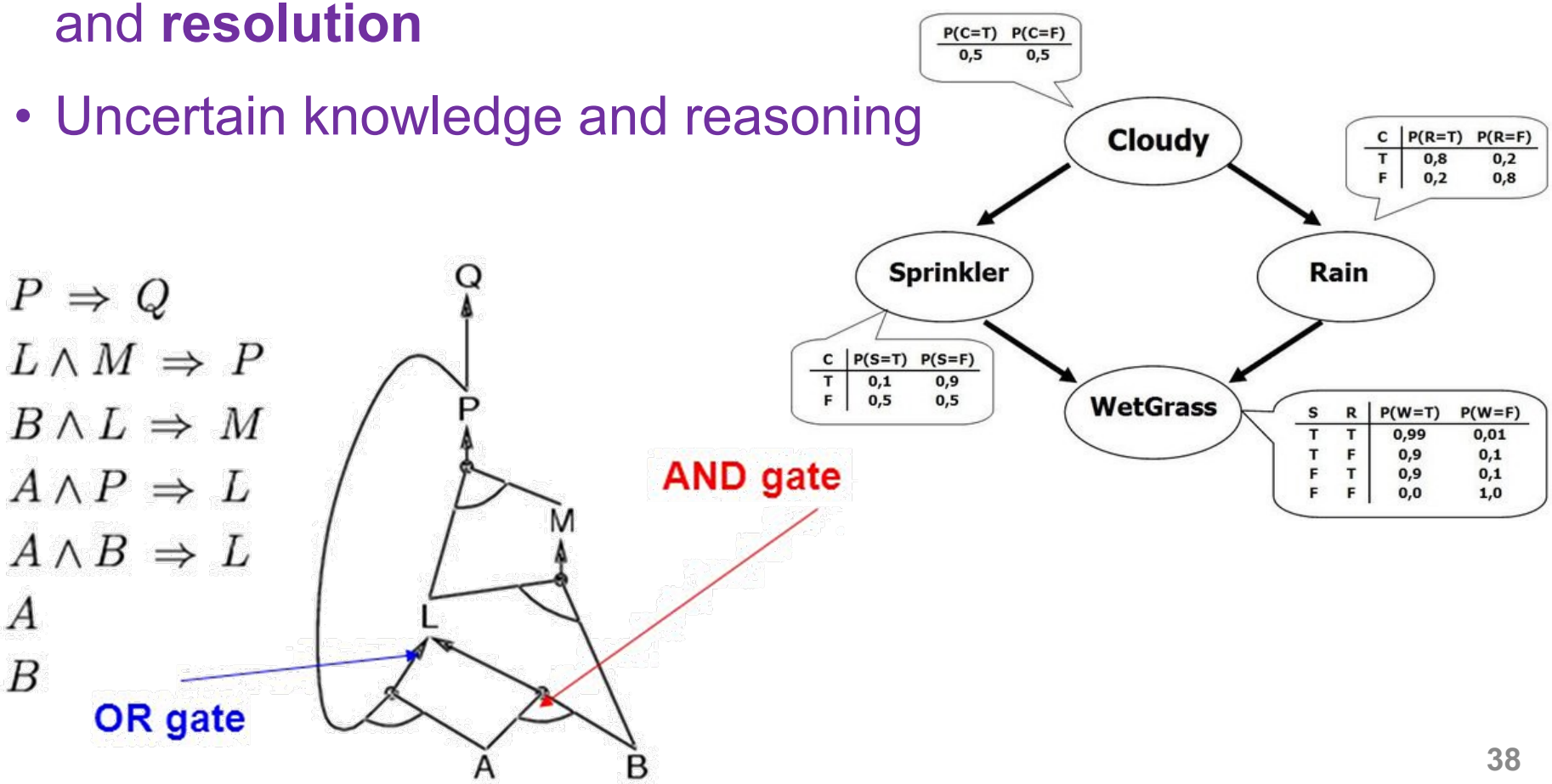


Knowledge and reasoning

- The second most important concept in AI
- If we are going to act rationally in our environment, then we must have some way to describe the given environment and draw inferences from that representation.
  - How do we describe what we know about the world ?
  - How do we describe it concisely ?
  - How do we describe it so that we can get hold of the right piece of knowledge when we need it ?
  - How do we generate new pieces of knowledge ?
  - How do we deal with uncertain knowledge ?

Knowledge and reasoning

- Propositional logic and predicate logic
- Inference techniques: forward chaining, backward chaining, and **resolution**
- Uncertain knowledge and reasoning

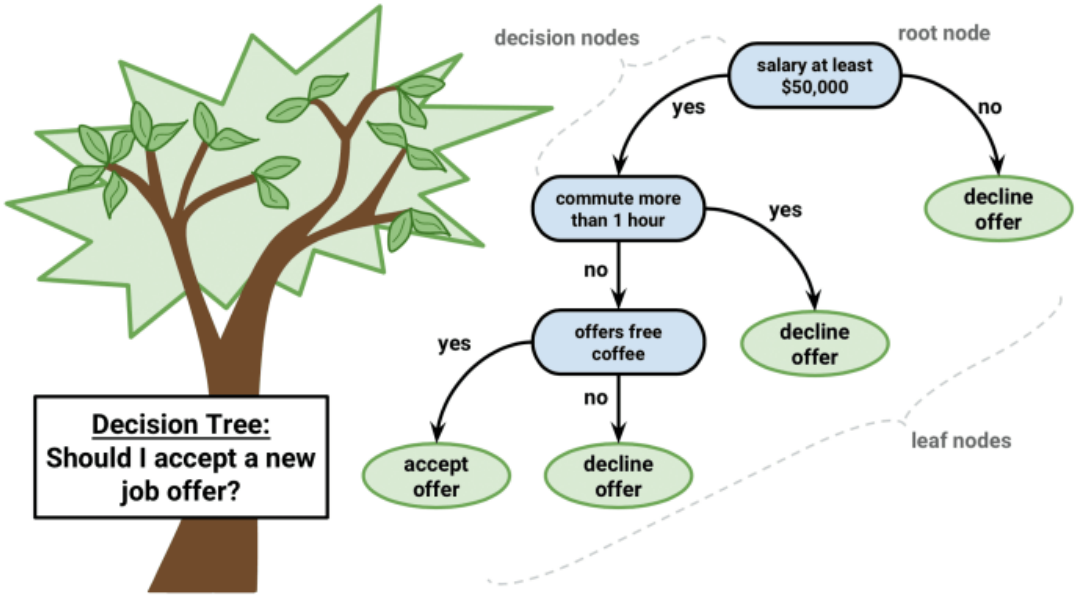


Machine learning

- Let machine learn rules/pattern from data
  - Classification with ID3 Decision tree and Naïve Bayes
  - Artificial neural networks

Machine learning

- Classification with ID3 Decision tree and Naïve Bayes
- Artificial neural networks



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