

PAT 463/563 (Fall 2026)

Music & AI

Lecture 2: AI & ML Fundamentals

Instructor: Hao-Wen (Herman) Dong

What is Artificial Intelligence?

| Can you? (I, Robot, 2004)



youtu.be/siHfHUm3HGE

🤔 What is Artificial Intelligence?

AI is the study of how to make computers **do things at which, at the moment, people are better.**

– Elaine Rich and Kevin Knight, 1991

1997



(Source: Britannica)

2016



(Source: The Guardian)

20??



(Source: SC2HL)

Elaine Rich and Kevin Knight, *Artificial Intelligence*. United Kingdom: McGraw-Hill, 1991.

britannica.com/topic/Deep-Blue

theguardian.com/technology/2016/mar/15/alphago-what-does-google-advanced-software-go-next

youtube.com/watch?v=PFMRDm_H9Sg

What is Artificial Intelligence?

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 ... (Bellman, 1978)

Systems that think like humans

The study of **mental faculties through the use of computational models** (Charniak & McDermott, 1985)

The study of the computations that **make it possible to perceive, reason, and act** (Winston, 1992)

Systems that think rationally

Systems that act like humans

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 & Knight, 1991)

Systems that act rationally

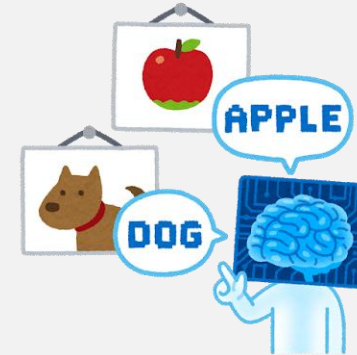
A field of study that seeks to **explain and emulate intelligent behavior in terms of computational processes** (Schalkoff, 1990)

The branch of computer science that is concerned with the **automation of intelligent behavior** (Luger & Stubblefield, 1993)

What is Artificial Intelligence?



Systems that **think like humans**

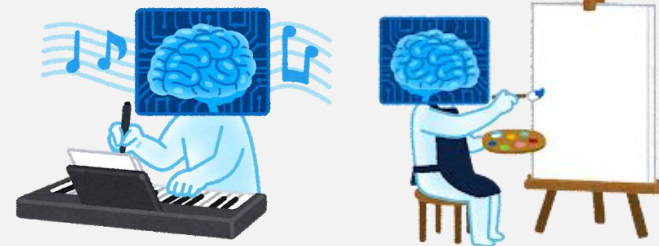


Systems that **think rationally**

Systems that **act like humans**

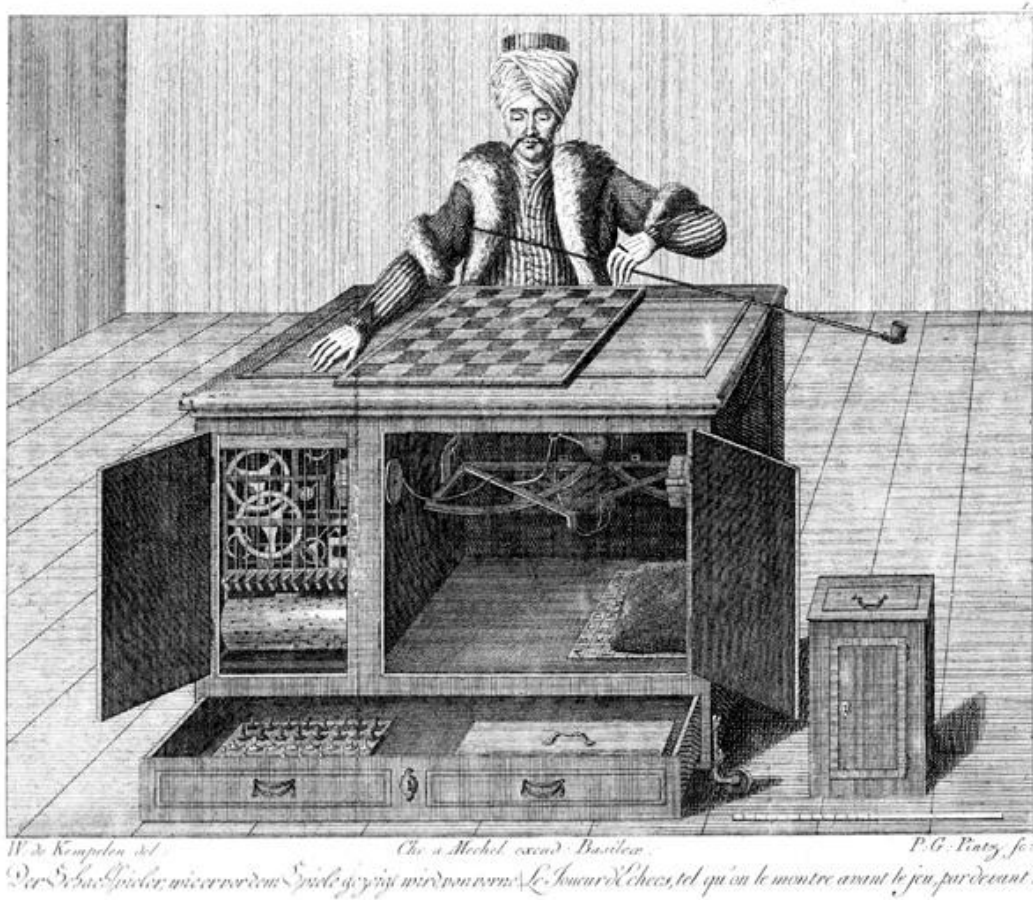


Systems that **act rationally**



Thinking vs. Acting

Thinking vs. Acting: **The Turk** (1770)



(Source: Wikimedia)



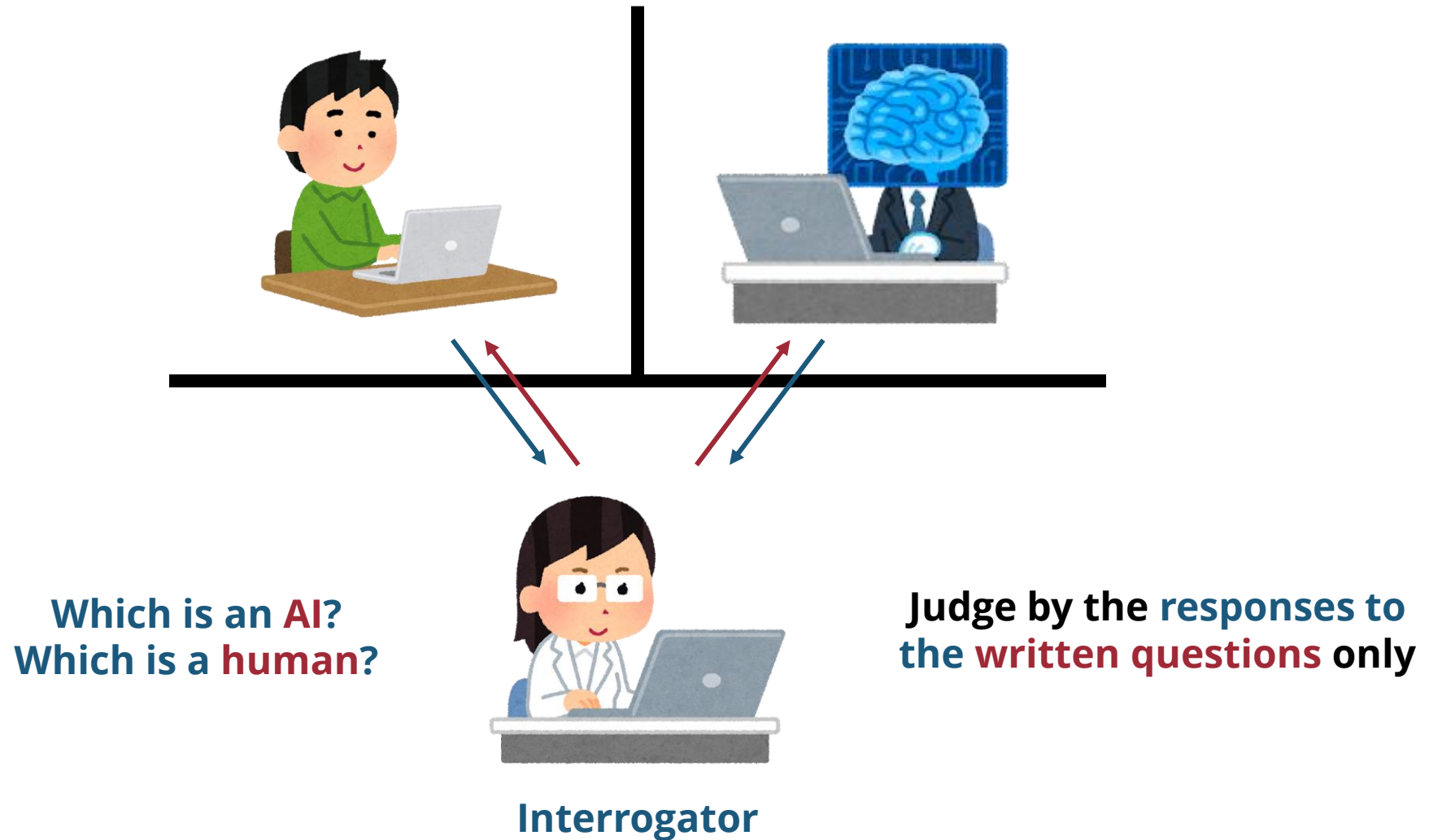
youtu.be/7W_kQsO6MPc

Thinking vs. Acting: The Turk (1770)



youtu.be/Xosn4ManeD4

Thinking vs. Acting: Turing Test (1950)



Thinking vs. Acting: The Chinese Room (1980)

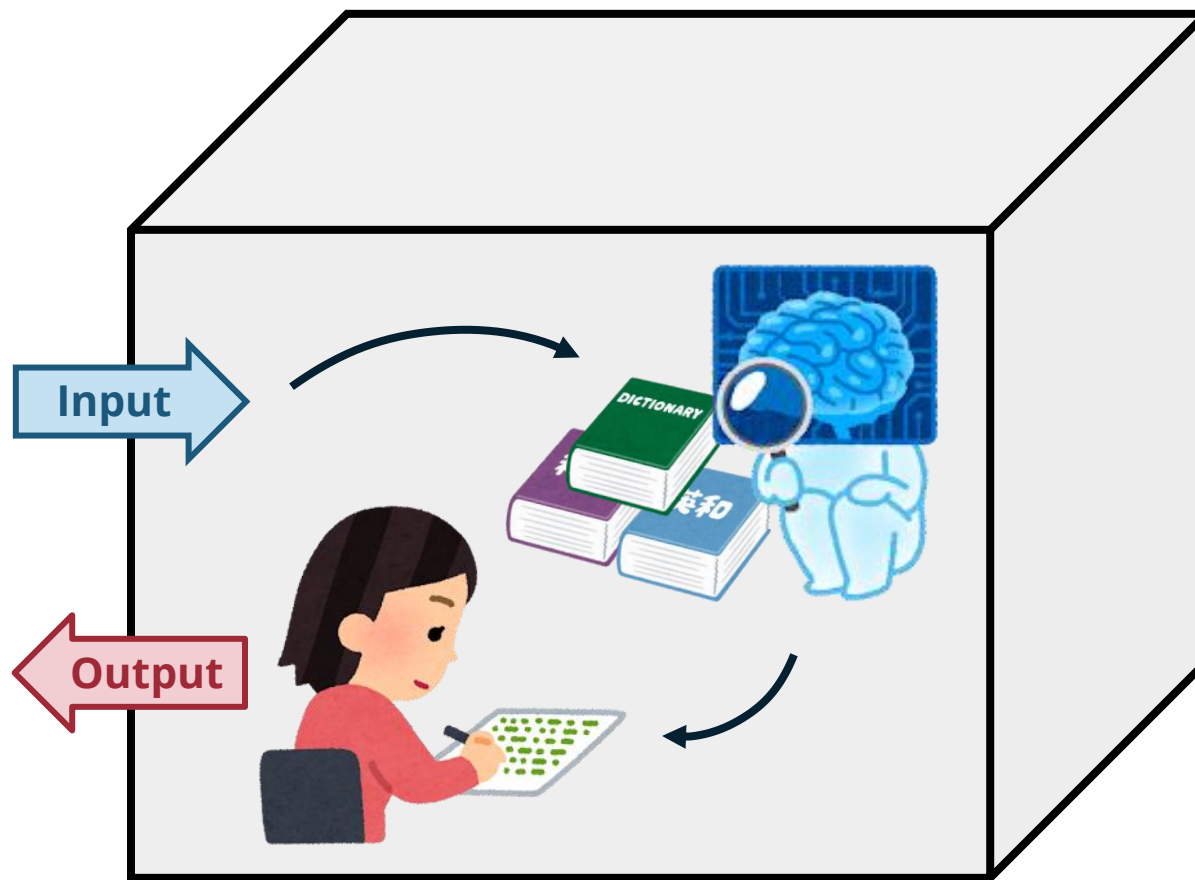
你會說中文嗎？
(Do you speak Chinese?)

會哦，我中文很流利！
(Yep, I speak fluent Chinese!)

你知道人工智慧是什麼嗎？
(Do you know what AI is?)

不知道耶，人工智慧是什麼？
(I don't know. What is AI?)

⋮



Is this considered intelligence?

Thinking vs. Acting: The Chinese Room (1980)

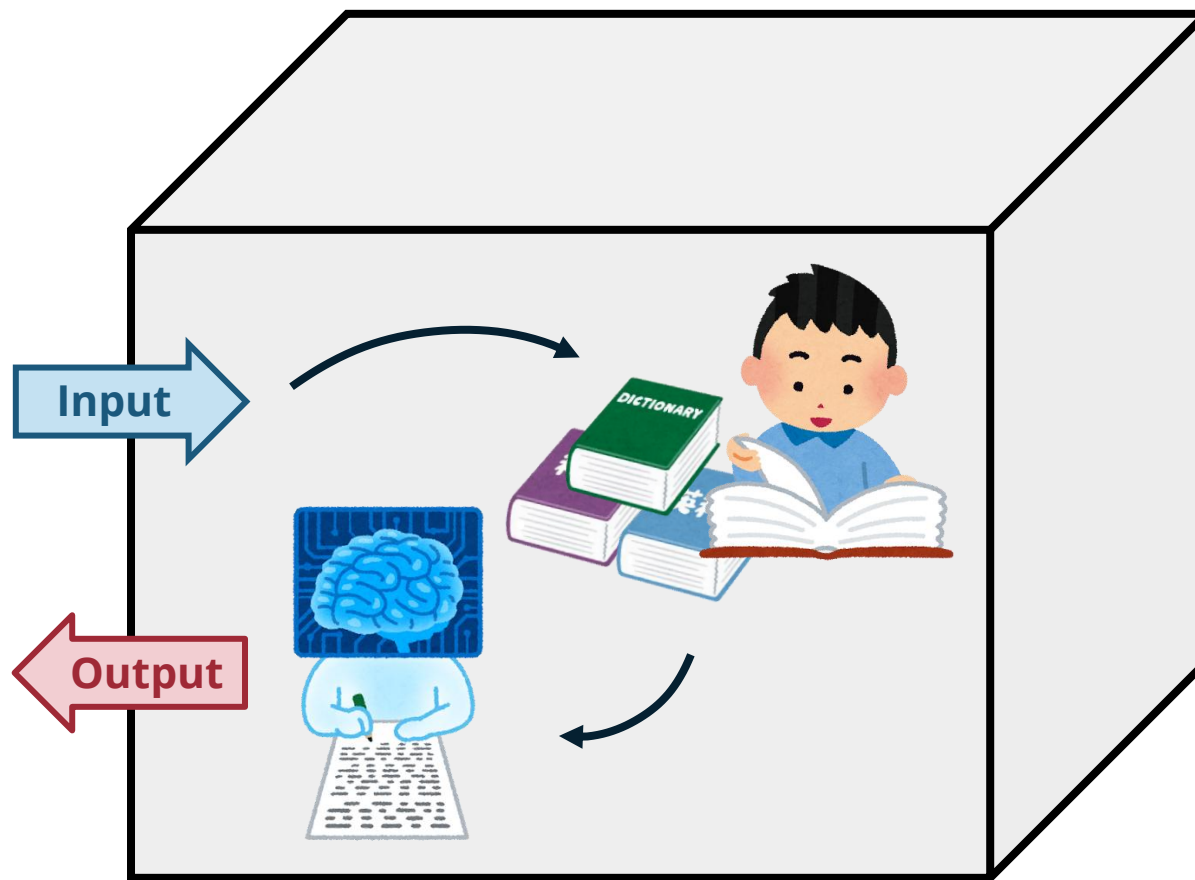
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⋮



Isn't this like the **Turk**?

Human vs. AI

| Can you? (I, Robot, 2004)



Can a robot write a Symphony?



Can a robot take a blank canvas
and turn it into a masterpiece?



Can you?

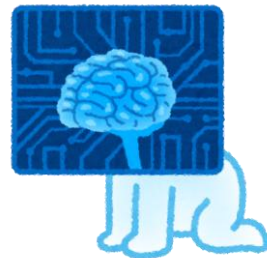


Human vs. AI: Weak AI vs Strong AI

Artificial General Intelligence (AGI)

Reaches human-level intelligence
Have a self-aware consciousness
Solve multiple tasks
Can learn and plan

Performs a single task
Cannot learn from experience
Cannot reason



Human vs. AI: The Many AGI Tests

- **The Coffee Test** (Steve Wozniak, 2010)
 - Can the AI **make a cup of coffee** after entering an average home: find the coffee machine and coffee, add water, find a mug, and brew the coffee by pushing the proper buttons?
- **The Robot College Student Test** (Ben Goertzel, 2012)
 - Can the AI enroll in a university, **take classes like humans**, and **earn its degree**?
- **The IKEA Test** (Gary Marcus, 2015)
 - Can the AI control a robot to **assemble an IKEA furniture** correctly by **reading the instructions**?
- **The Modern Turing Test** (Mustafa Suleyman, 2023)
 - Can the AI **make \$1M** on a retail web platform in a few months with a **\$100K investment**?

Victoria Turk, "The Plan to Replace the Turing Test with a 'Turing Olympics'," VICE, January 28, 2015.

Ben Goertzel, "What counts as a conscious thinking machine?," New Scientist, September 5, 2012.

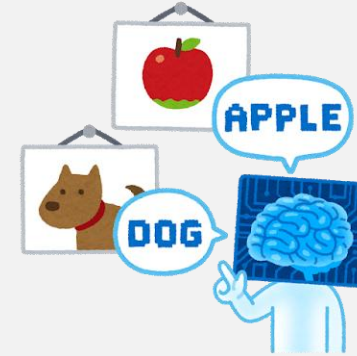
Michael Shick, "Wozniak: Could a Computer Make a Cup of Coffee?," Fast Company, March 3, 2010.

Mustafa Suleyman, "Mustafa Suleyman: My new Turing test would see if AI can make \$1 million," MIT Technology Review, July 14, 2023.

What is Artificial Intelligence?



Systems that **think like humans**

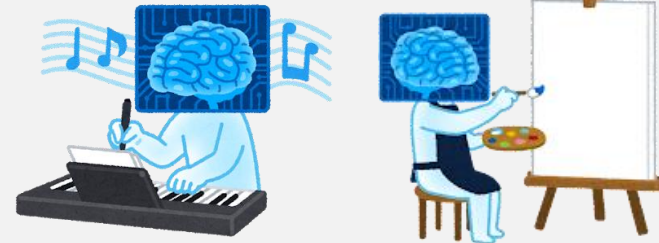


Systems that **think rationally**

Systems that **act like humans**



Systems that **act rationally**



| 🤔 What is your expectation of a Real AI?

- **Thinking vs Acting**

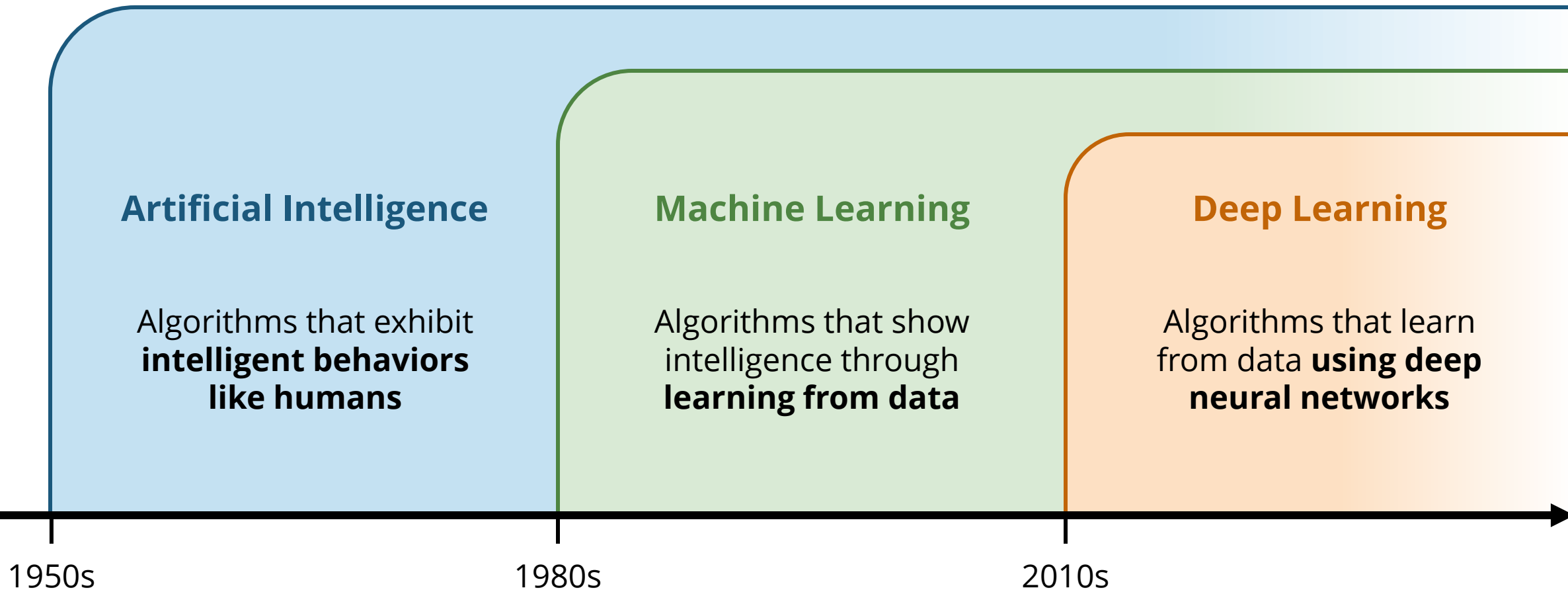
- An AI **needs to know how to think** (Votes: 6)
- An AI **doesn't need to know how to think** (Votes: 3)

- **Human vs AI**

- An AI **needs to behave like a human** (Votes: 0)
- An AI **doesn't need to behave like a human** (Votes: 9)

What is Machine Learning?

AI vs. ML vs. DL



| What is Machine Learning?

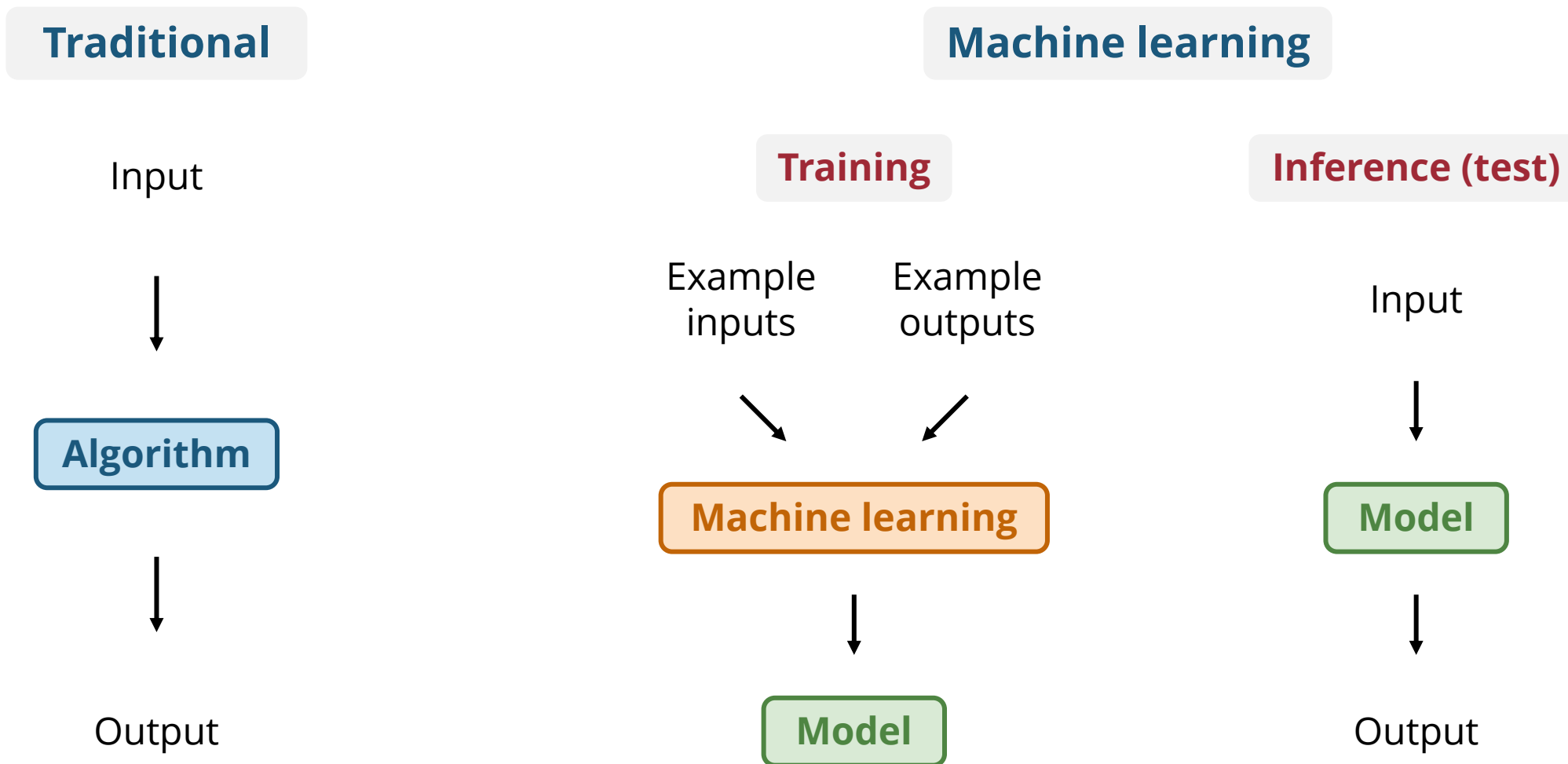
Machine Learning is a field of study that gives computers the ability to **learn without being explicitly programmed**.

– Attributed to Arthur Samuel

A computer program is said to learn from **experience E** with respect to some **class of tasks T** and **performance measure P** if *its performance at tasks in T, as measured by P, improves with experience E*.

– Tom M. Mitchell, 1997

Machine Learning



Components of a Machine Learning Model

Improve on **task T**,
with respect to **performance metric P**,
based on **experience E**

- **Task T**
- **Performance metric P**
- **Experience E**

Animal classification

Percentage of correct predictions

Animal images with labels



Components of a Machine Learning Model

Improve on **task T**,
with respect to **performance metric P**,
based on **experience E**

- **Task T**

Stock price prediction

- **Performance metric P**

Difference between predicted and actual price

- **Experience E**

History stock price



Components of a Machine Learning Model

Improve on **task T**,
with respect to **performance metric P**,
based on **experience E**

- **Task T**
- **Performance metric P**
- **Experience E**

Violin transcription

Percentage of correctly predicted notes

Recordings with sheet music



Components of a Machine Learning Model

Improve on **task T**,
with respect to **performance metric P**,
based on **experience E**

- **Task T**
- **Performance metric P**
- **Experience E**

Beat tracking

Average difference from actual timings

Recordings with beat timestamps



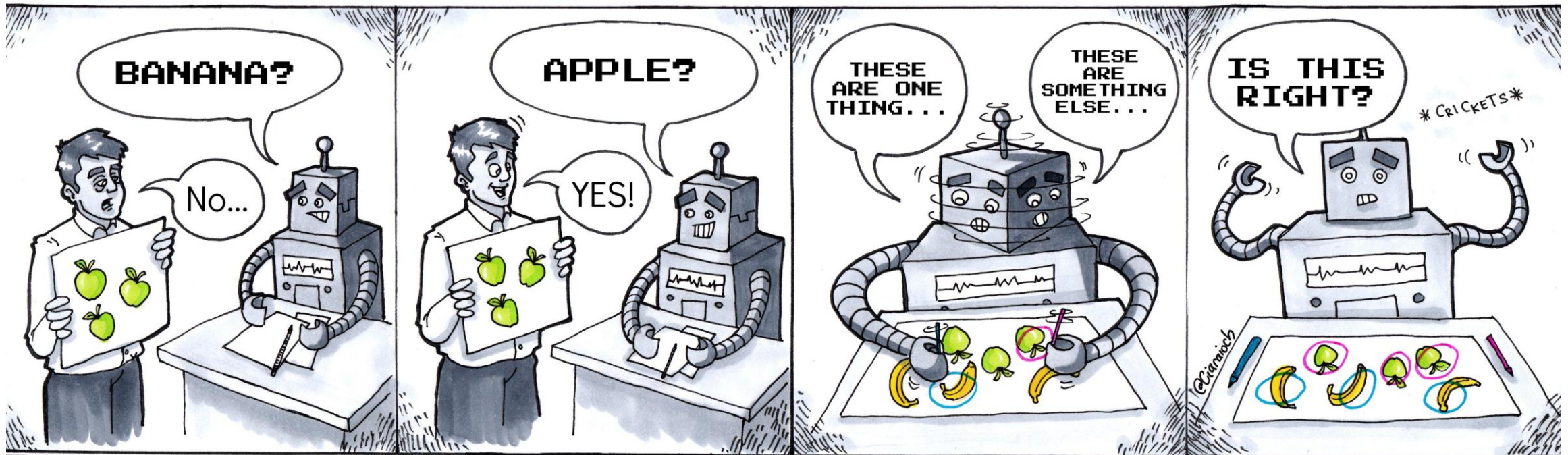
(Source: Müller)

audiolabs-erlangen.de/resources/MIR/FMP/C6/C6S3_BeatTracking.html

Meinard Müller, "Fundamentals of Music Processing – Using Python and Jupyter Notebooks," Springer Verlag, 2021.

Meinard Müller and Frank Zalkow, "FMP Notebooks: Educational Material for Teaching and Learning Fundamentals of Music Processing," ISMIR, 2019.

Supervised vs. Unsupervised Learning



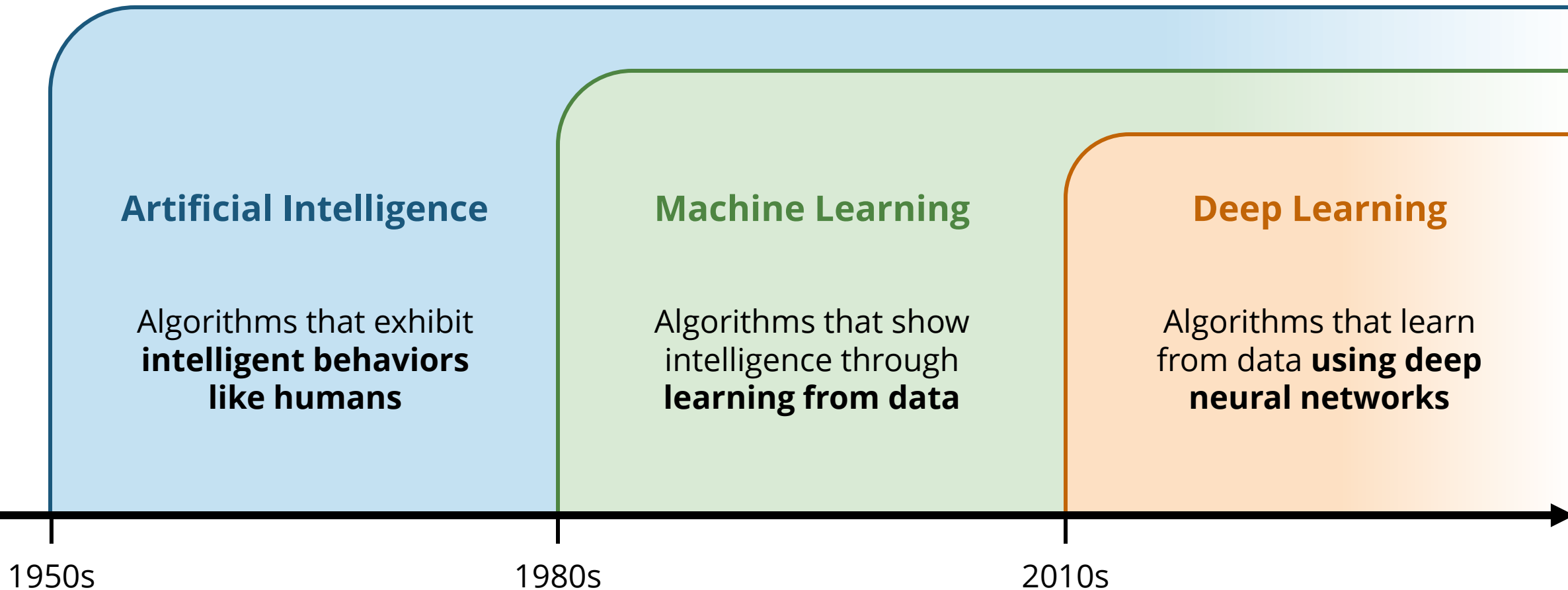
Supervised Learning

Unsupervised Learning

(Source: Ciaraioch)

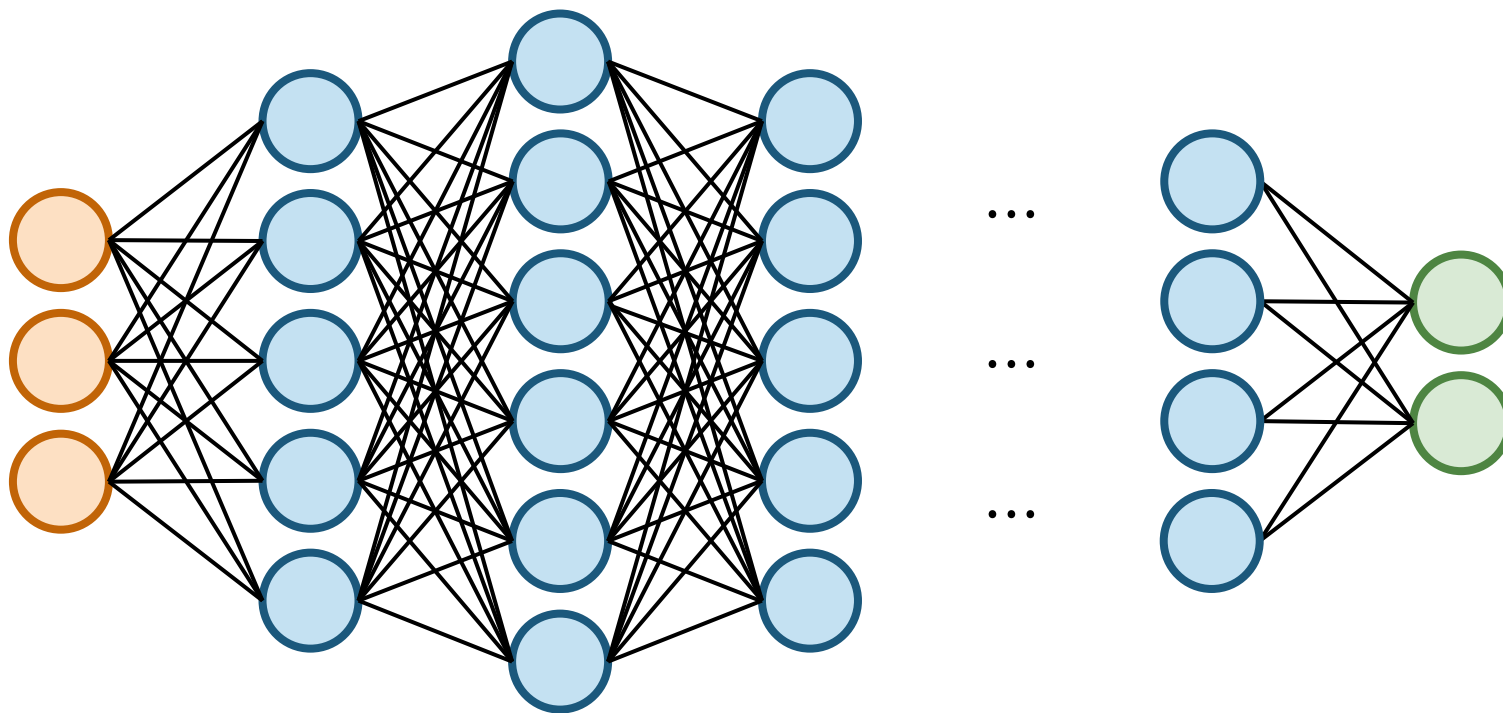
What about Deep Learning?

AI vs. ML vs. DL



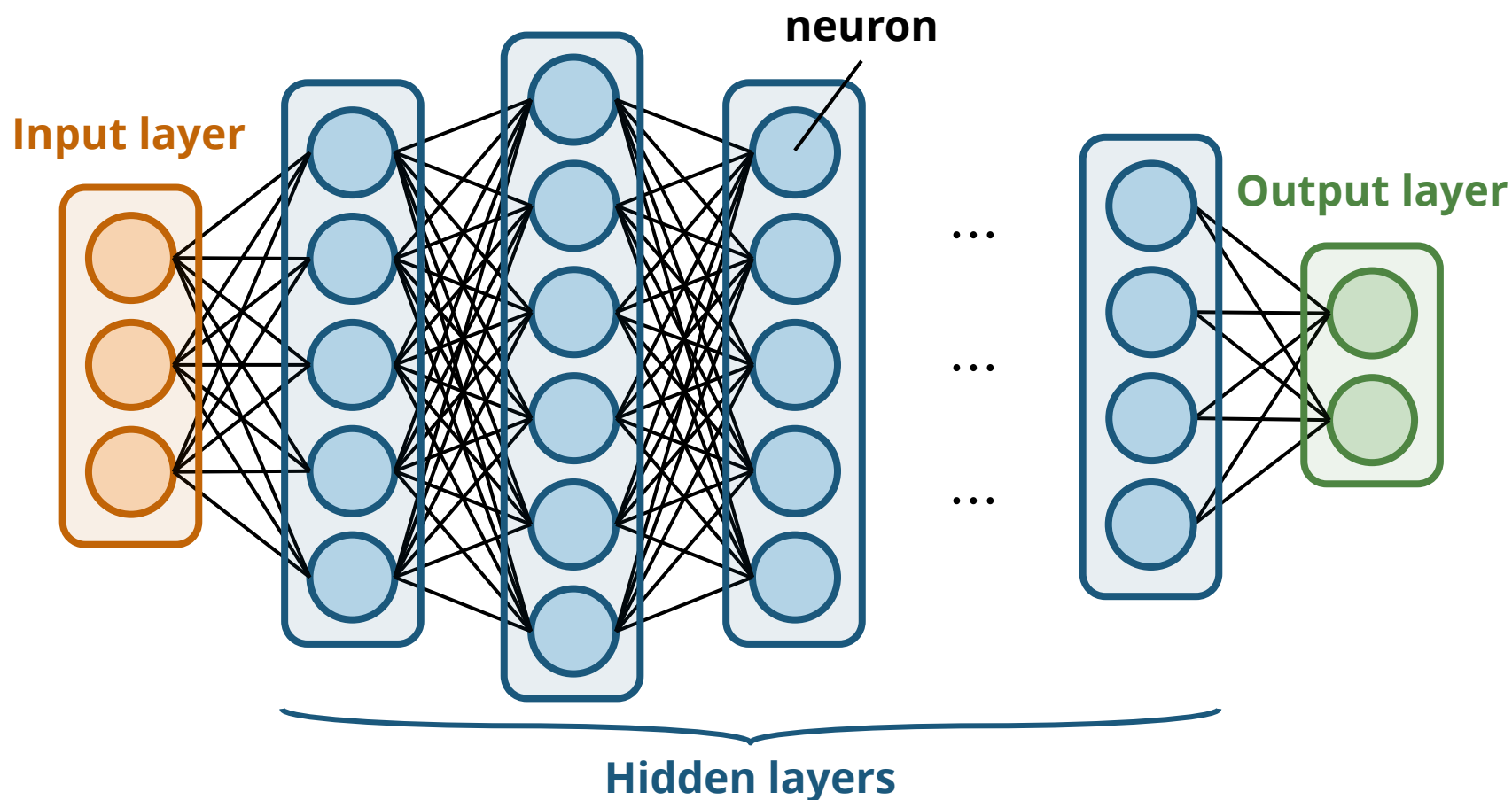
| What is Deep Learning?

- A type of machine learning that uses **deep neural networks**



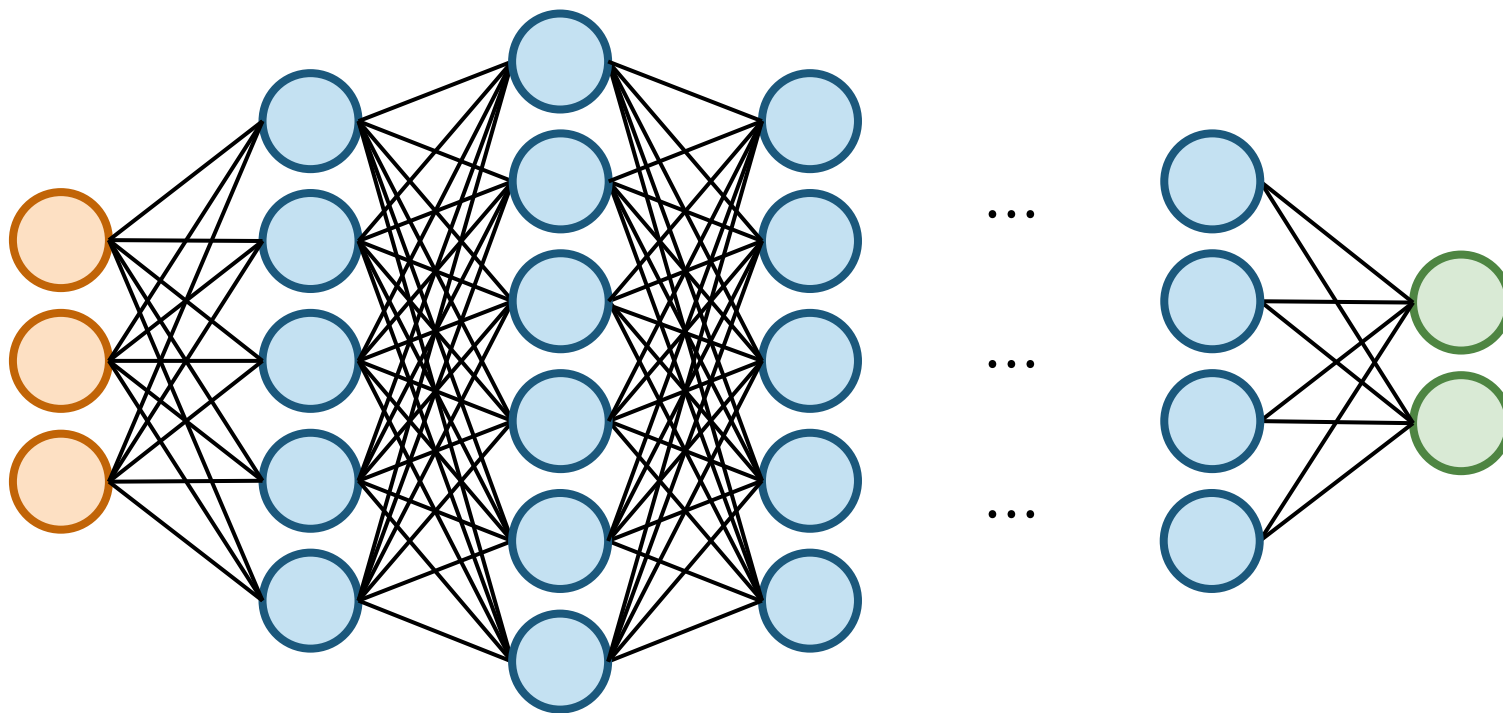
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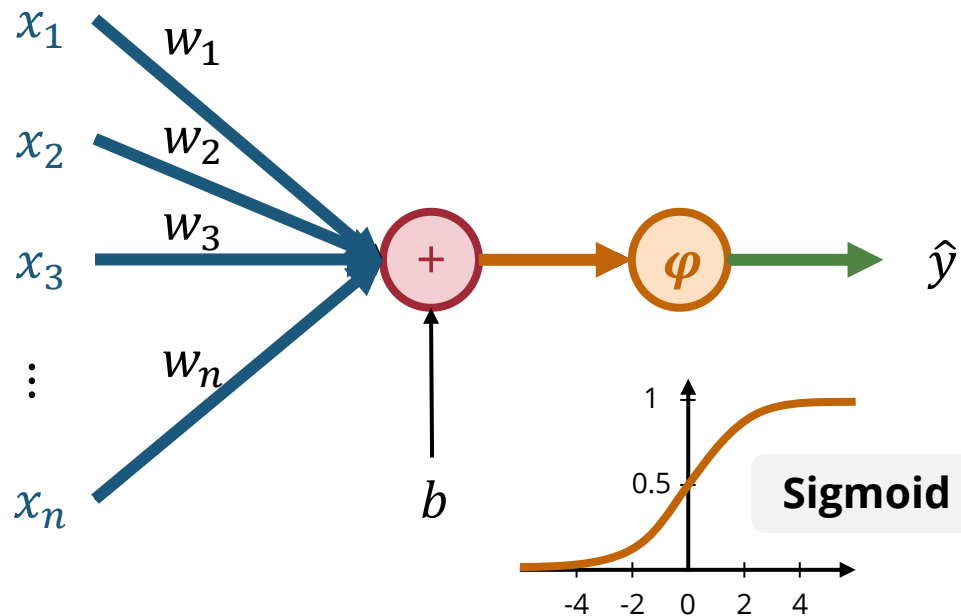
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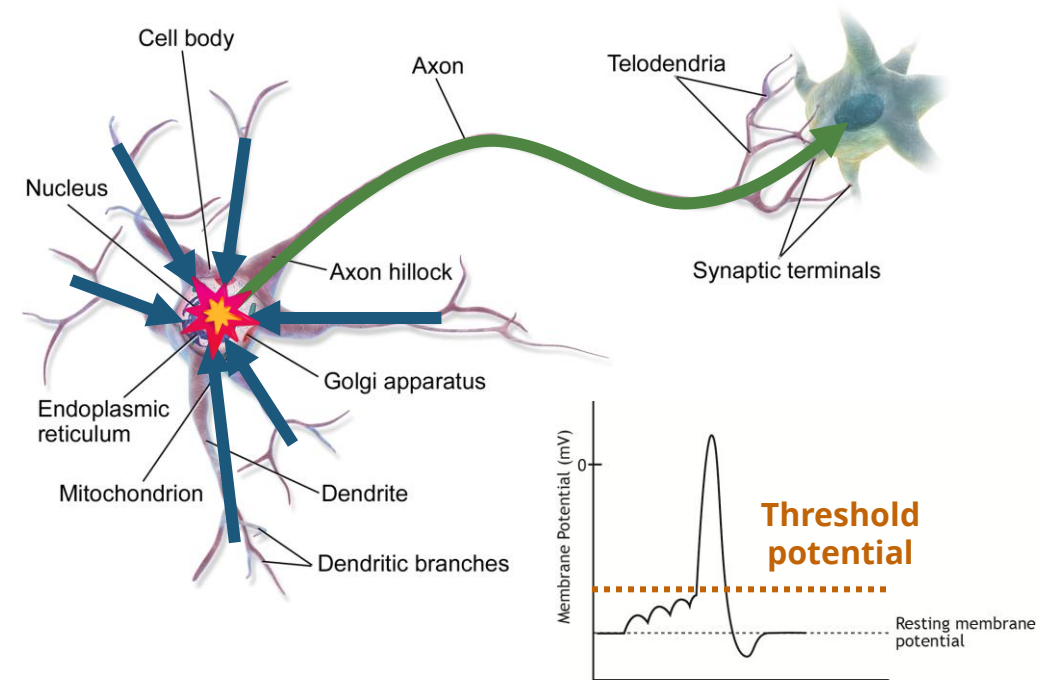


Artificial vs. Human Neuron

Artificial neuron

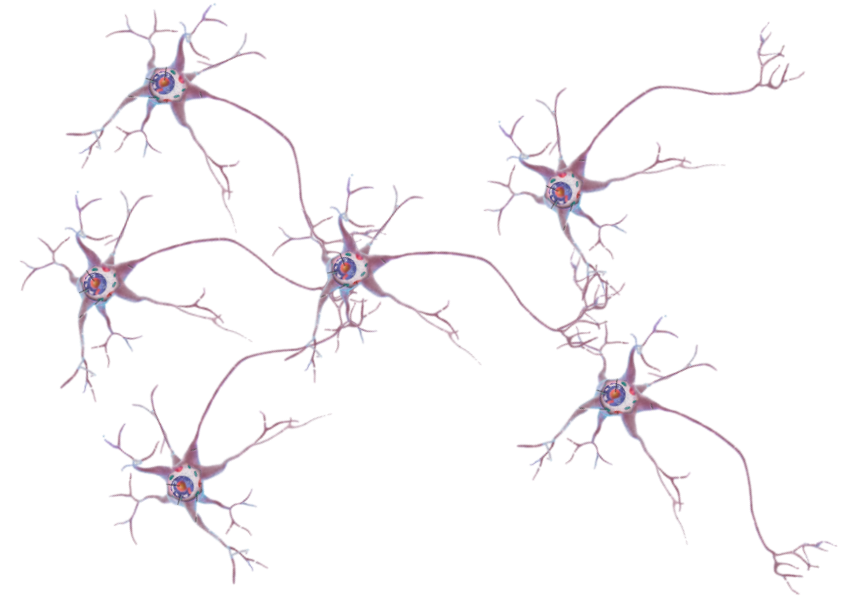
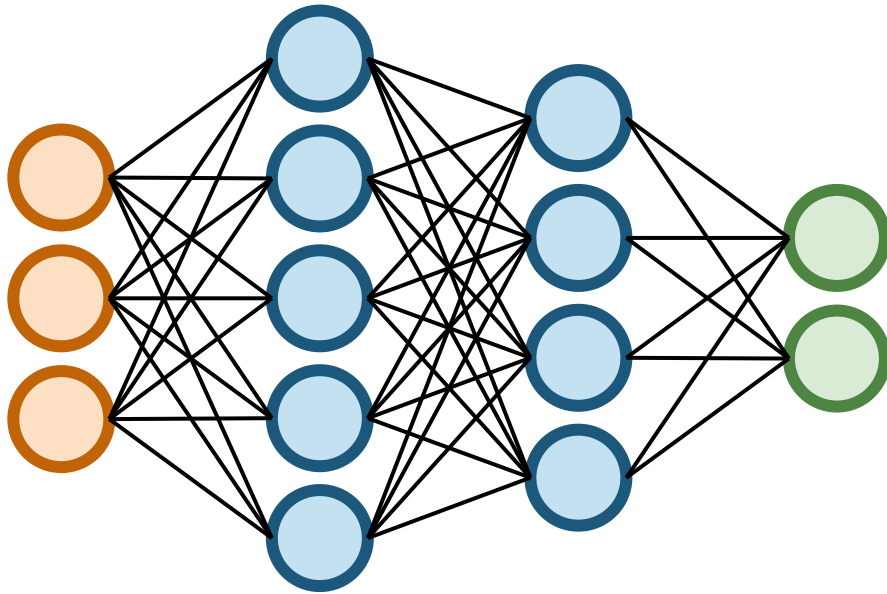


Human neuron



Artificial Neural Networks

- Although inspired by human neural networks, artificial neural networks nowadays **don't really work like human brains**

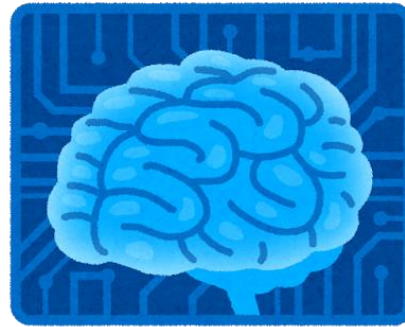


Building Blocks of Deep Learning Systems



Data

×



Model

×



Use Case

| Analytic vs. Generative AI



| This is *not* Morgan Freeman (2021)



youtu.be/oxXpB9pSETo

| This is *not* Morgan Freeman (2021)



youtu.be/F4G6GNFz0O8

Generative AI for Visual Arts



(Source: Cosmopolitan)

First Prize in **Digital arts**
at Colorado State Fair
Fine Arts Competition



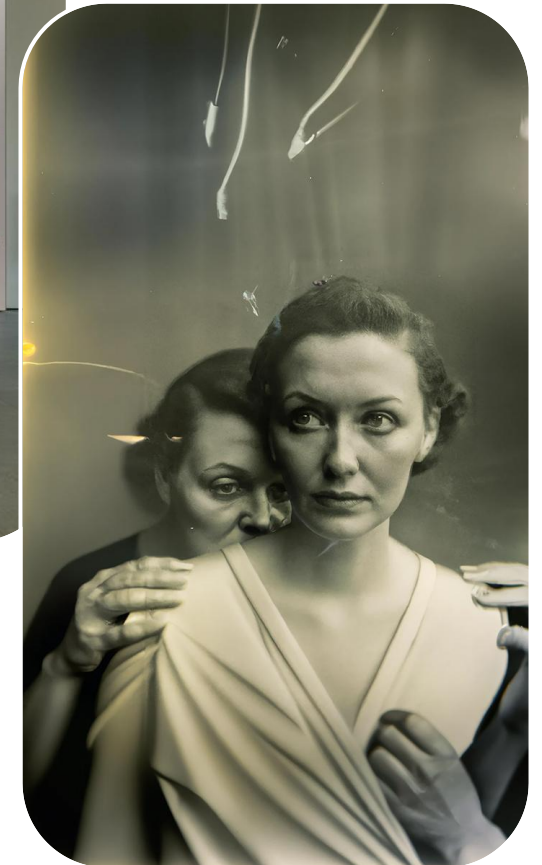
(Source: CNN Business)

Gloria Liu, "The World's Smartest Artificial Intelligence Just Made Its First Magazine Cover," *Cosmopolitan*, June 21, 2022.
Rachel Metz, "AI won an art contest, and artists are furious," *CNN Business*, September 3, 2022.
Refik Anadol, "Refik Anadol on AI, Algorithms, and the Machine as Witness," *MoMA Magazine*, December 20, 2022.
Lianne Kolirin, "Artist rejects photo prize after AI-generated image wins award," *CNN*, April 18, 2023.

(Source: MoMA Magazine)



Sony World
Photography Award in
Creative Open Category



(Source: CNN)

Generative AI for Video Generation



🔥 HW 1: Real or Fake!?



🔥 HW 1: Real or Fake!?

- Instructions will be sent by **emails** and released on the **course website**
- **Don't worry! You'll be graded by completion (instead of correctness)!**
- Have fun!

Recap

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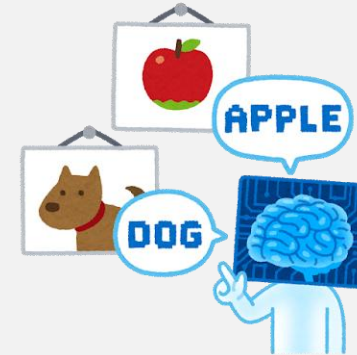
theguardian.com/technology/2016/mar/15/alphago-what-does-google-advanced-software-go-next

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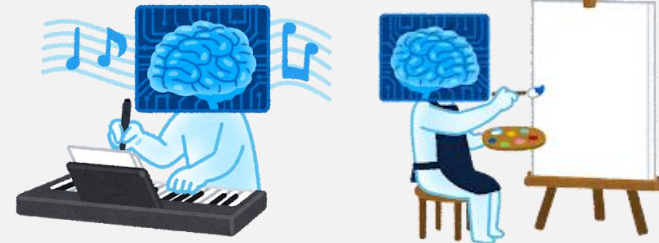


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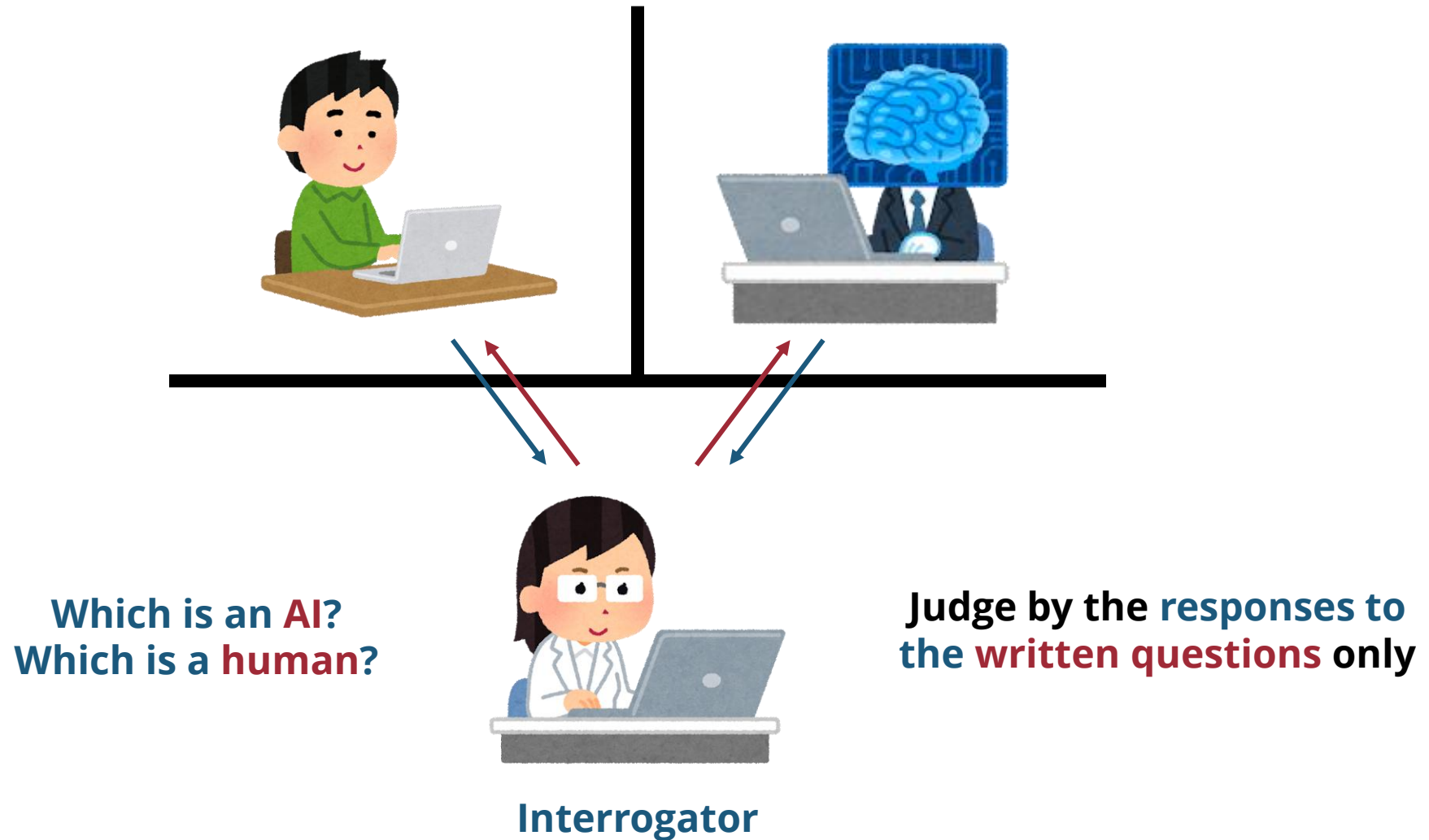
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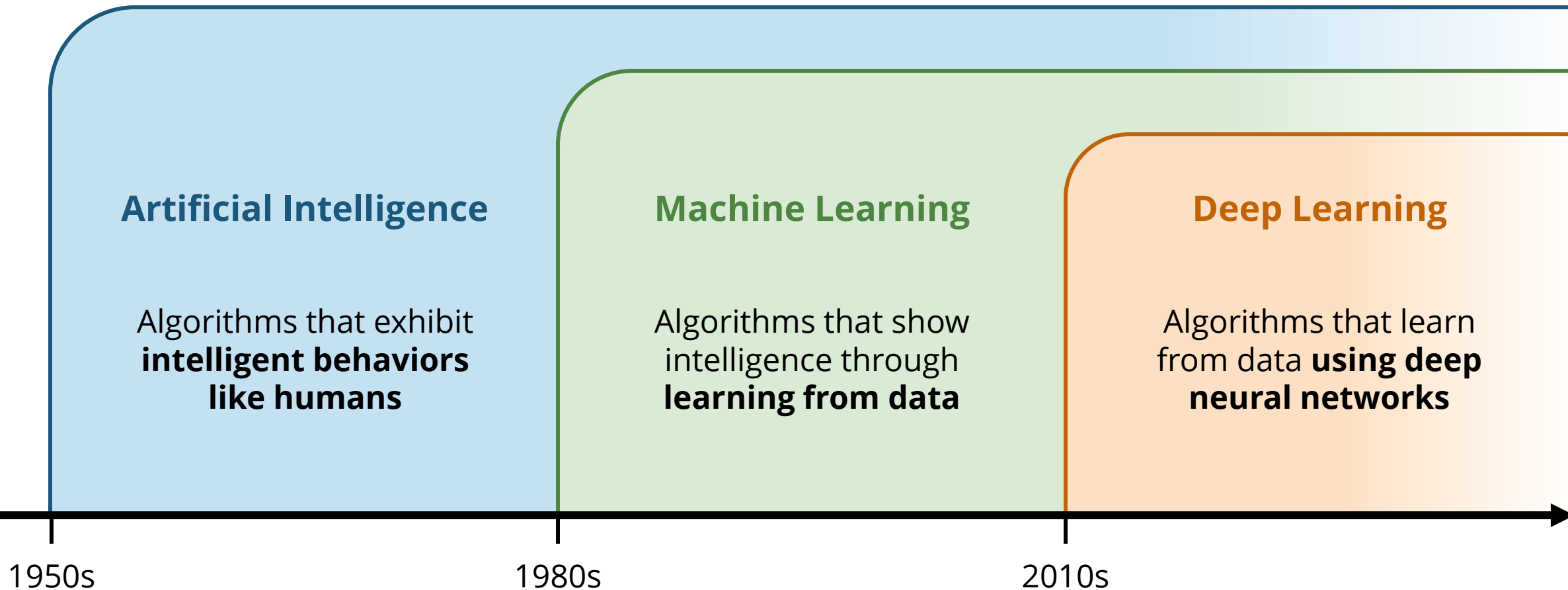
Systems that **act rationally**



Thinking vs. Acting: Turing Test (1950)



AI vs. ML vs. DL



Machine Learning

Traditional

Input



Algorithm



Output

Machine learning

Training

Example
inputs

Example
outputs



Machine learning



Model

Inference (test)

Input



Model



Output

Components of a Machine Learning Model

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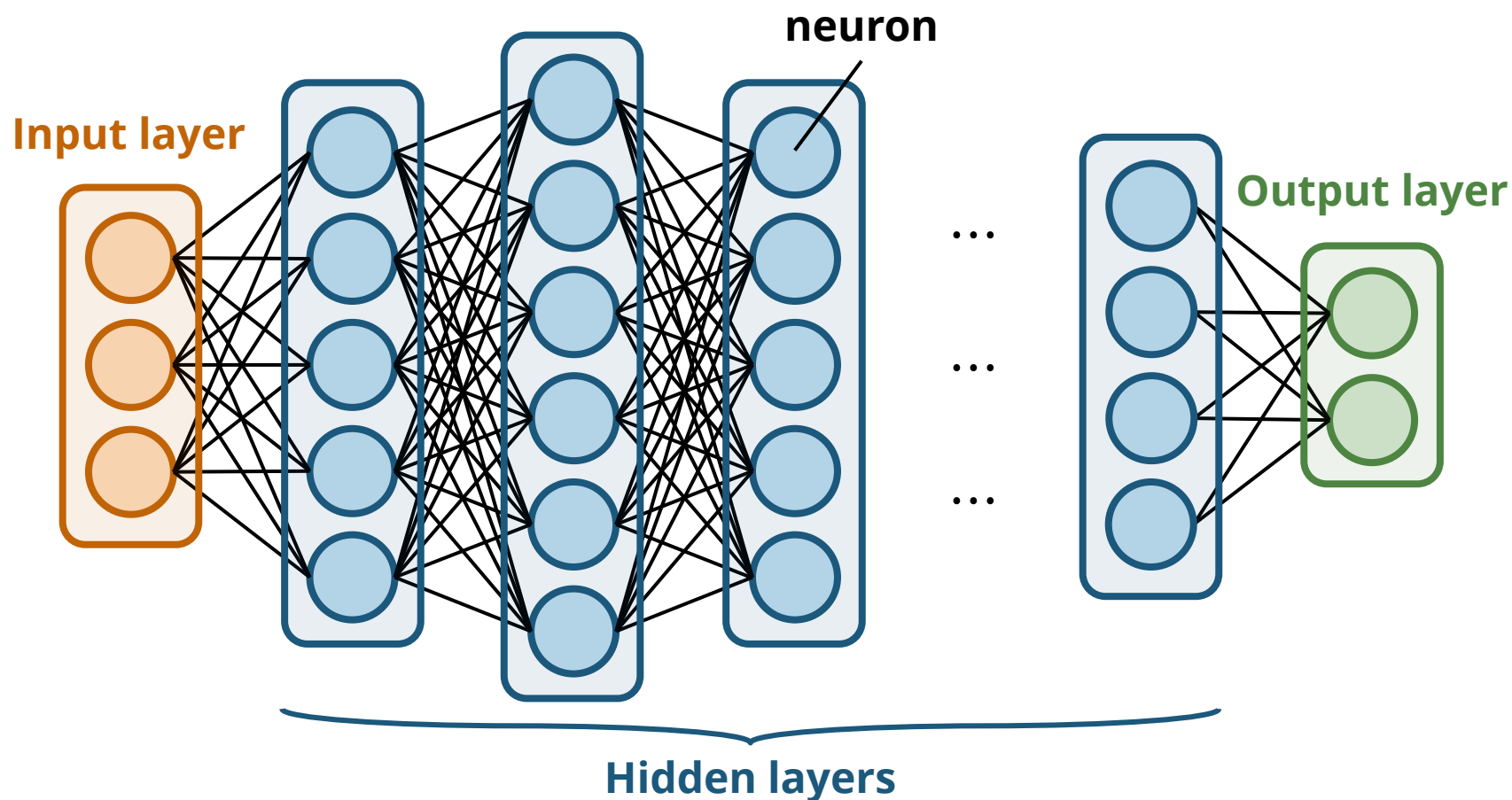
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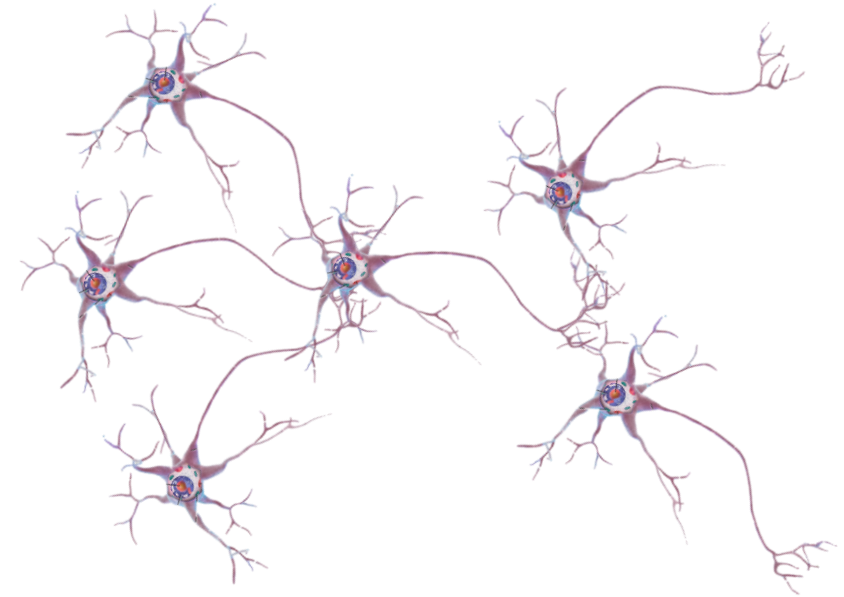
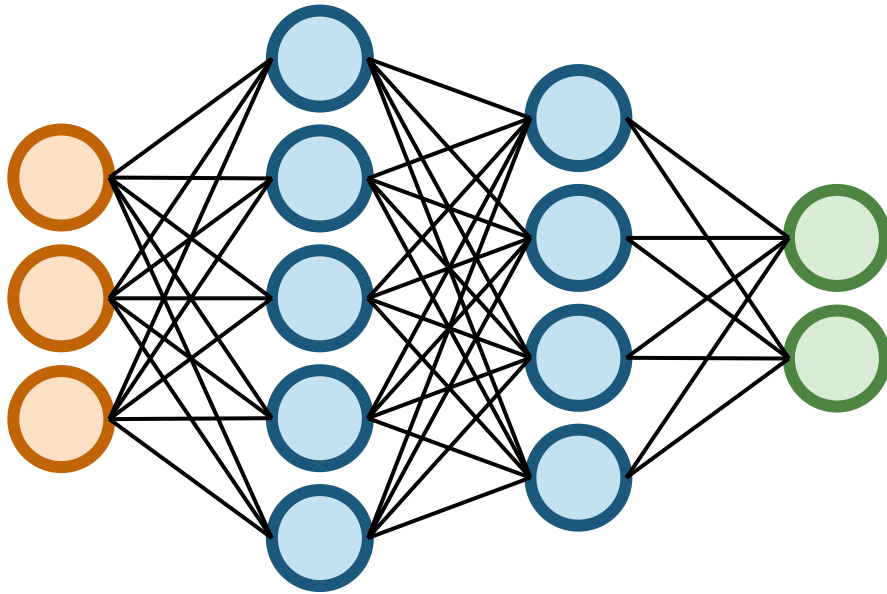
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Artificial Neural Networks

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🔥 HW 1: Real or Fake!?



Next Lecture

AI & Music

ILLIAC SUITE FOR STRING QUARTET 3

I. EXPERIMENT NO. I

L.A. HILLER, JR. AND L.M. ISAACSON

PRESTO

VOLIN I

VOLIN II

VIOLA

CELLO

(A)



(Source: Illinois Distributed Museum)