

Redes Neurais

Prof. Filipe Mutz
Perspectiva História

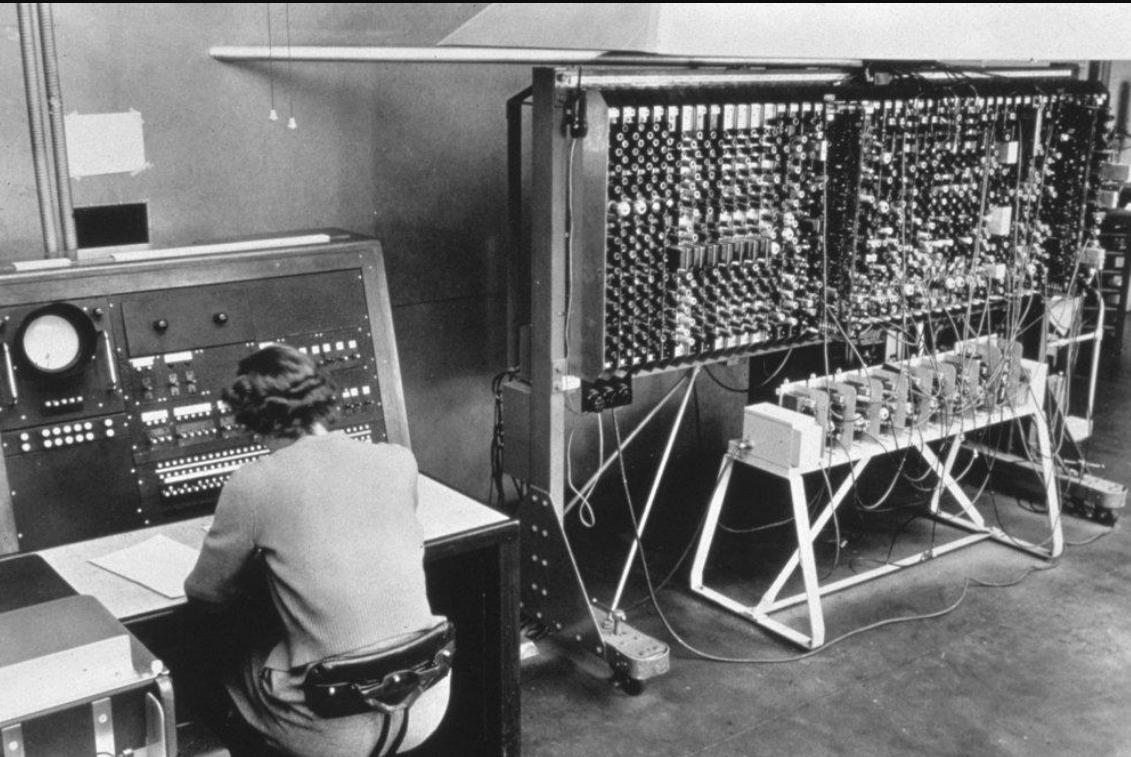
A humanidade cria tecnologias para tornar processos mais efetivo, eficientes e seguros



Um Caminho é a Automatização de Processos Repetitivos e Onerosos



Presa de Gutenberg
(1440)



1936: Alan Turing publishes 'On Computable Numbers, with an Application to the Entscheidungsproblem', which came to be seen as a theoretical basis for general-purpose computers.

1950: Alan Turing's Automatic Computing Engine (ACE) computer becomes one of the world's first digital programmable computers.

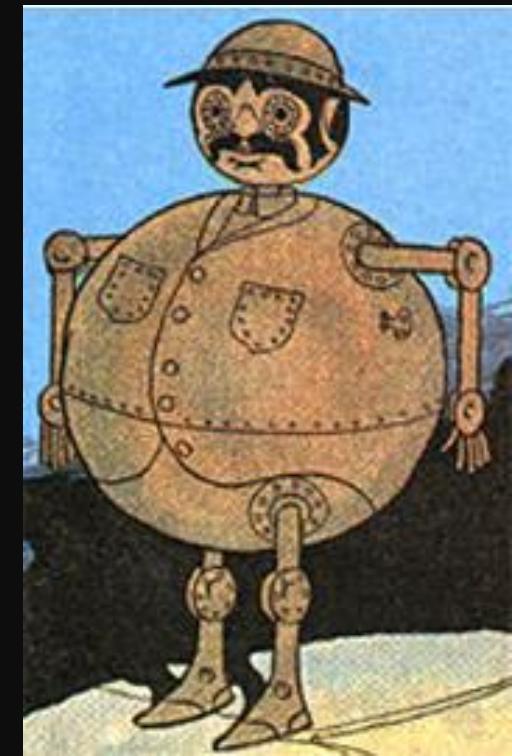
Androïdes e Robôs são um Sonho Antigo



The Steam Man of the Prairies (**1868**)
First portrayal in literature of a
'robot' or nonsentient automaton

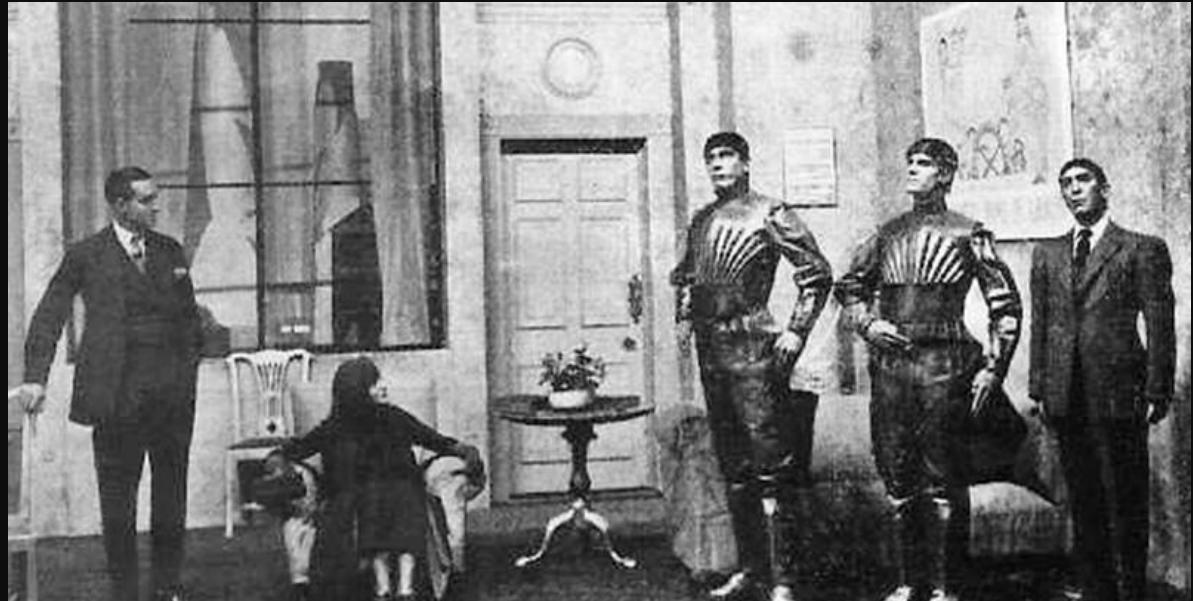


The Future Eve (**1886**)
popularized the term
"android."

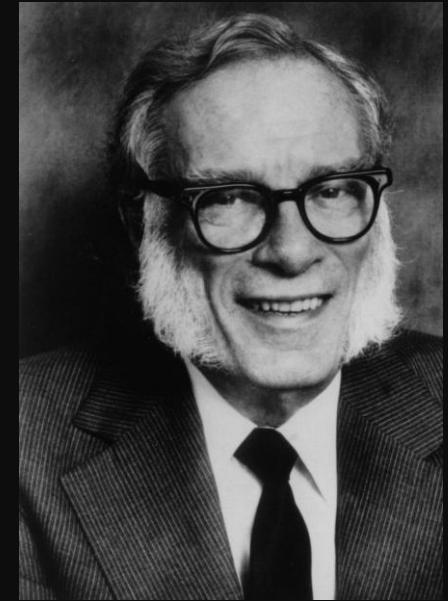
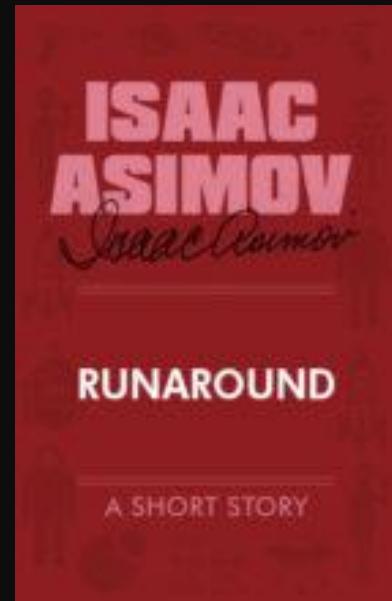


Tik-Tok in
Ozma of Oz (**1907**) –
Um homem mecânico

Androïdes e Robôs são um Sonho Antigo

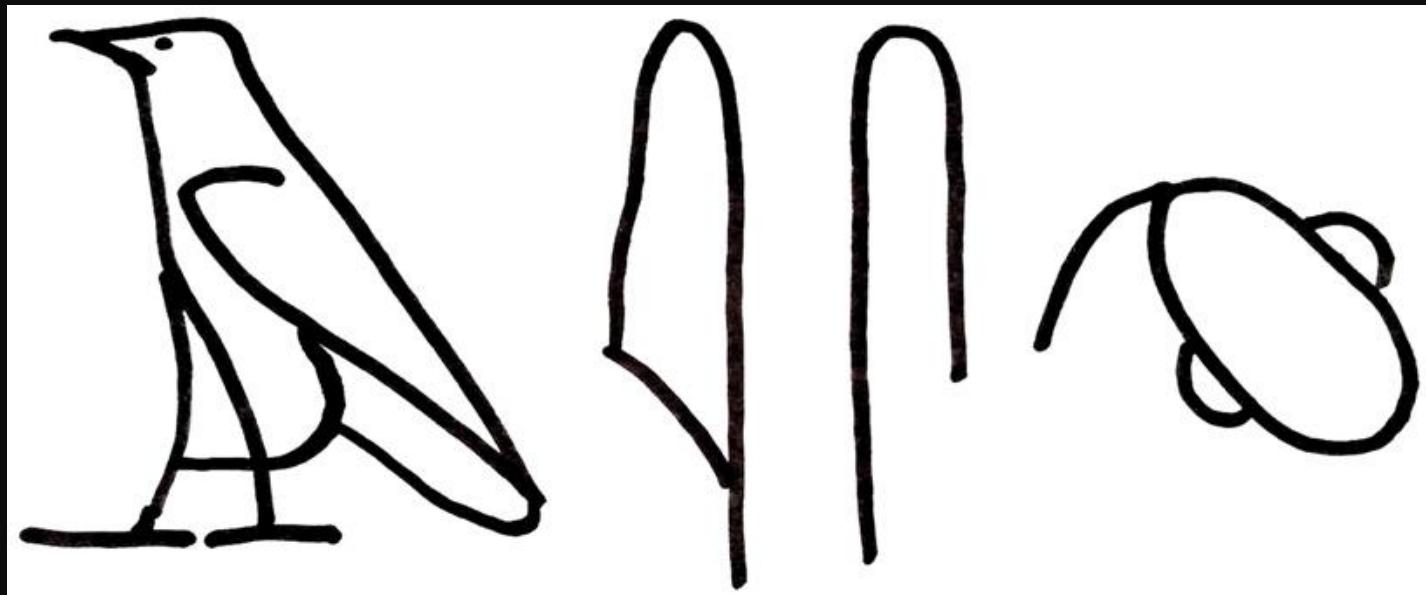


1921: The play R.U.R (Rossum's Universal Robots), by Karel Capek, marks the [first use of the word "robot"](#) to describe an artificial person. Capek invented the term, basing it on the Czech word for "forced labor."



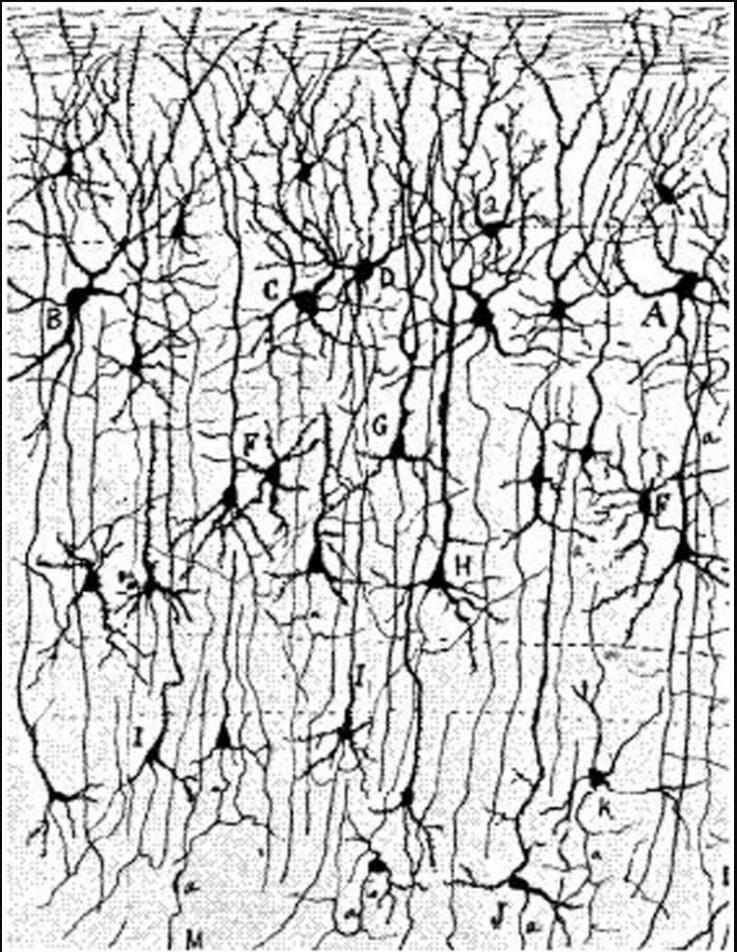
The [word "robotics"](#) was coined by Isaac Asimov in **1942** in his short story "Runaround." The story features the first explicit appearance of the Three Laws of Robotics.

Assim como compreender o “intelecto” e a consciência



A evidência mais antiga da palavra “cérebro” remonta a 3.500 anos no Edwin Smyth Papyrus que descrevia remédios para curar feridas na cabeça resultantes de batalhas.

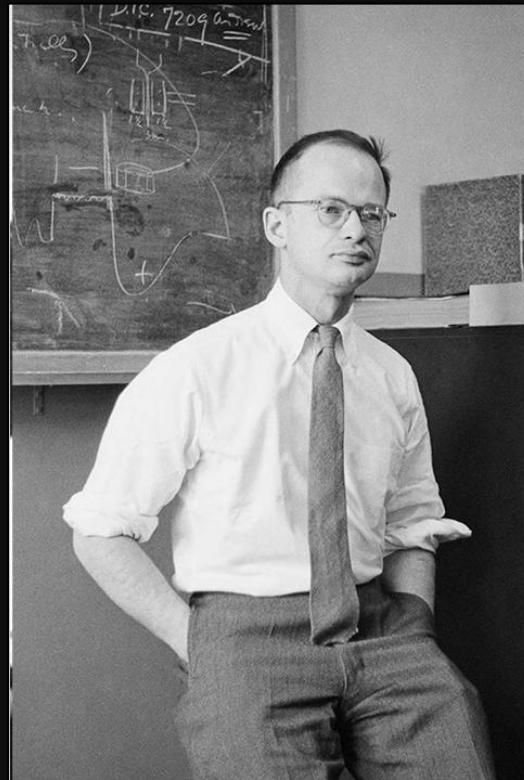
Assim como compreender o “intelecto” e a consciência



Camillo [Golgi](#) and Santiago Ramón y [Cajal](#) receberam o prêmio Nobel de Medicina em [1906](#) pelo desenvolvimento de uma [técnica histológica](#) para visualizar a morfologia tridimensional dos neurônios e pela [teoria neuronal](#) que descreve neurônios como [células discretas](#) e não como uma rede contínua de filamentos, como se acreditava na época.

A Logical Calculus of the Ideas Imminent in Nervous Activity
Building on ideas of in Alan Turing's "On Computable Numbers"

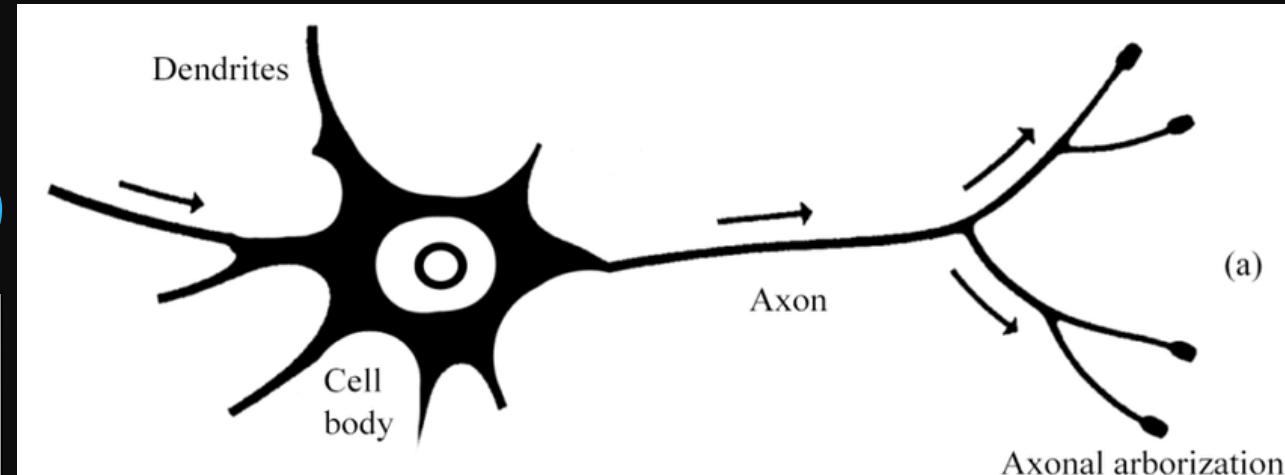
1943



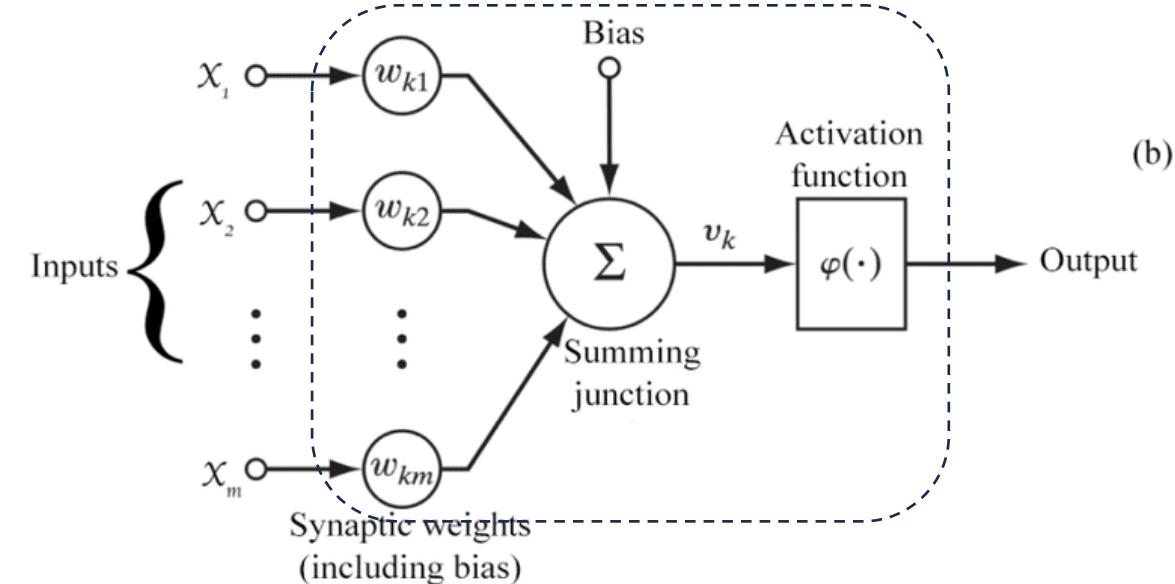
Walter Pitts
(logician)



Warren S. McCulloch
(neuroscientist)

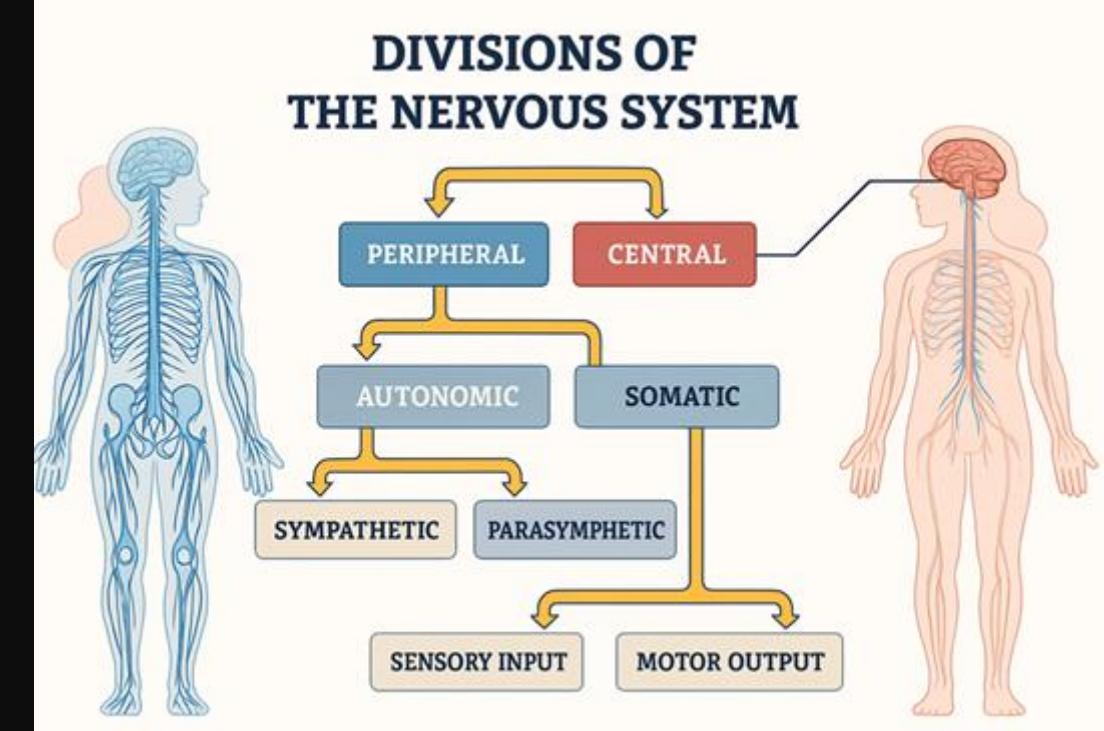
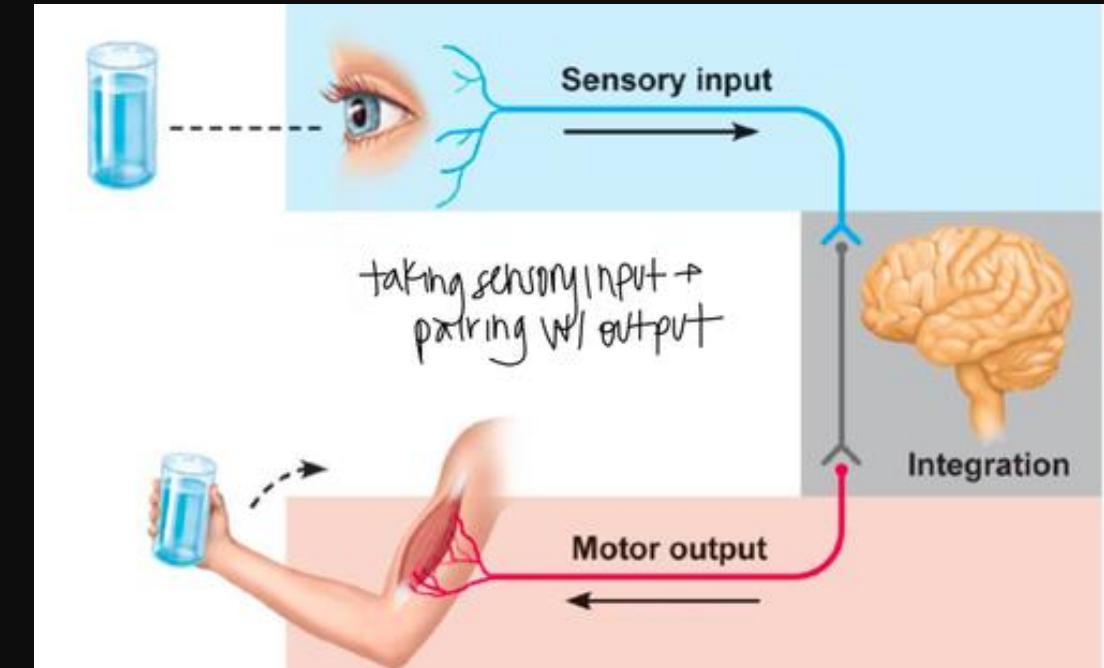


Mcculloch-Pitts Neuron



Primary functions of the nervous system

- **Sensation:** gathering information from your sensory organs.
- **Integration:** interpretation of sensory information and making decisions.
- **Response:** sending commands to initiate actions.



A faint, blurry background image of a human brain, showing various lobes and structures in a light blue-grey color.

Introduction to the brain

https://www.youtube.com/watch?v=MWVh7_6kTRM



Nerve cells

<https://www.youtube.com/watch?v=n0Zc01e1Frw>



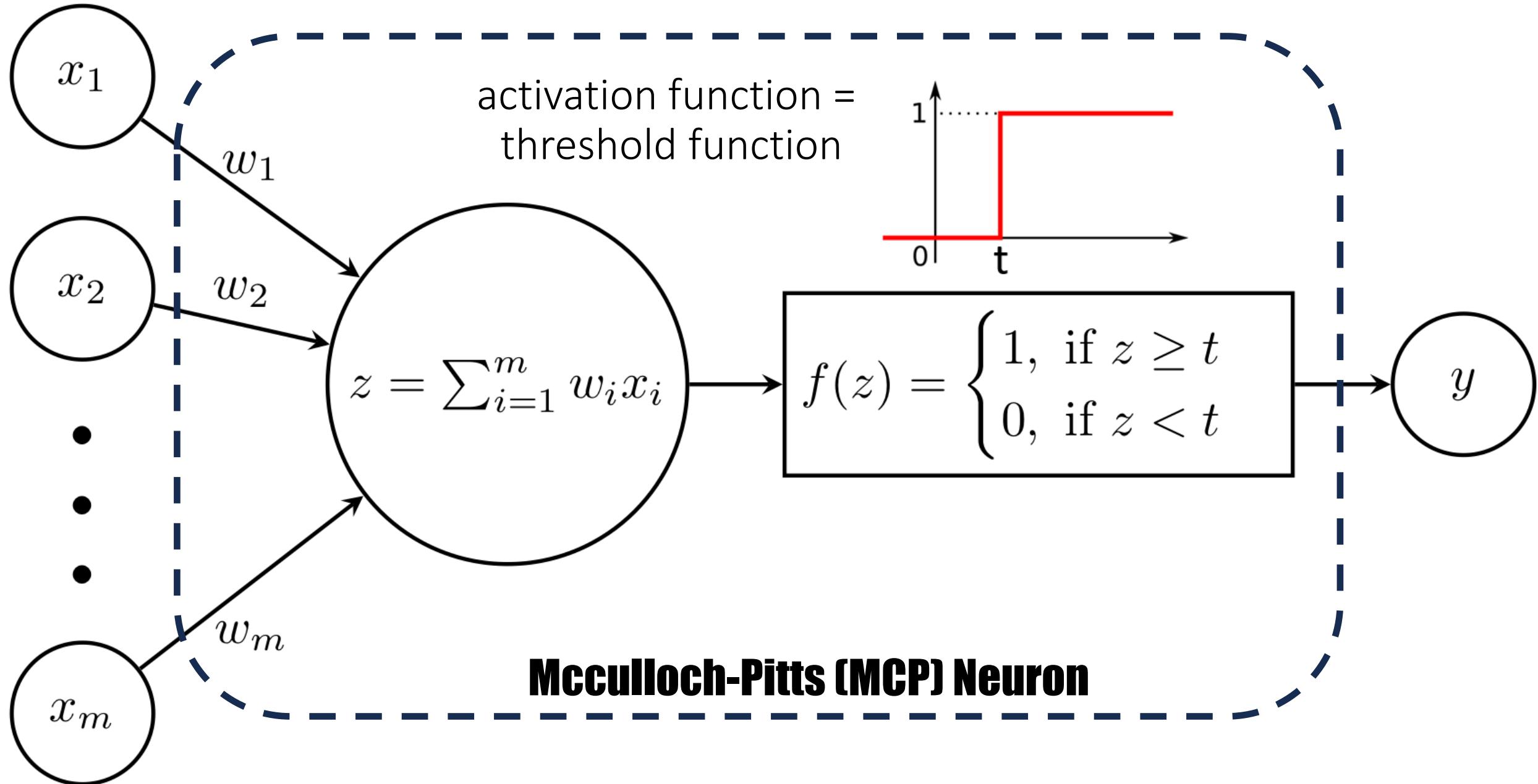
The eye

<https://www.youtube.com/watch?v=GfIMkCZUS6o>



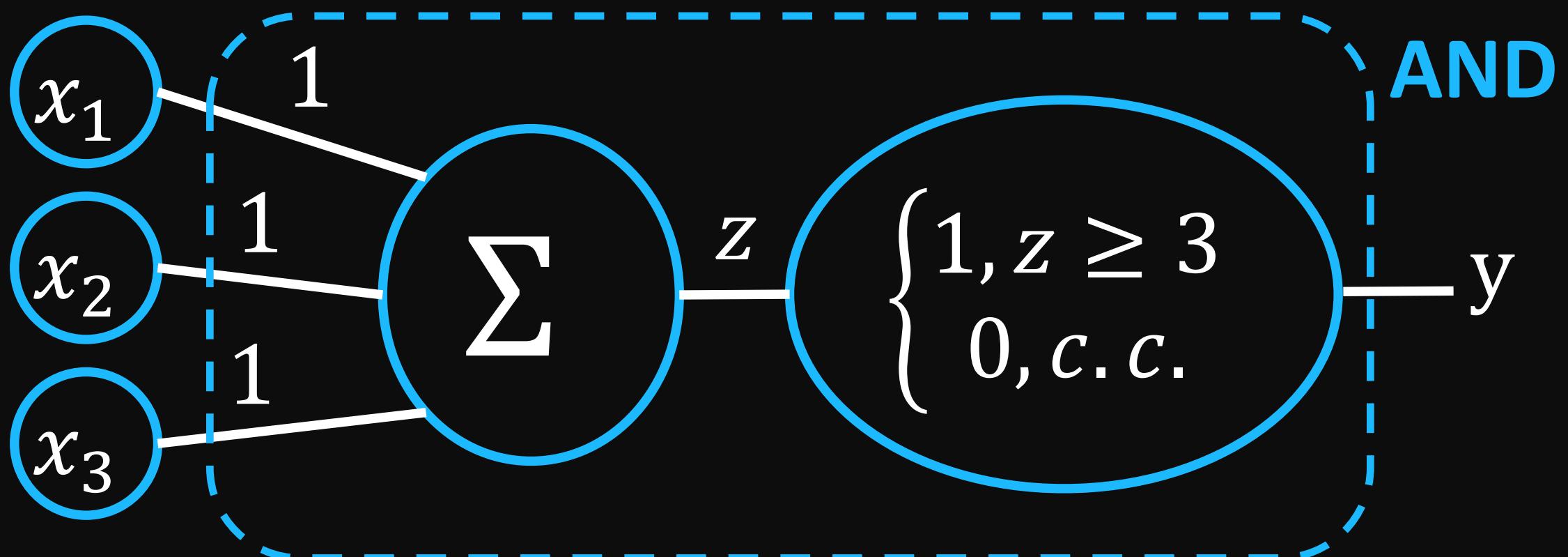
The reflex arc

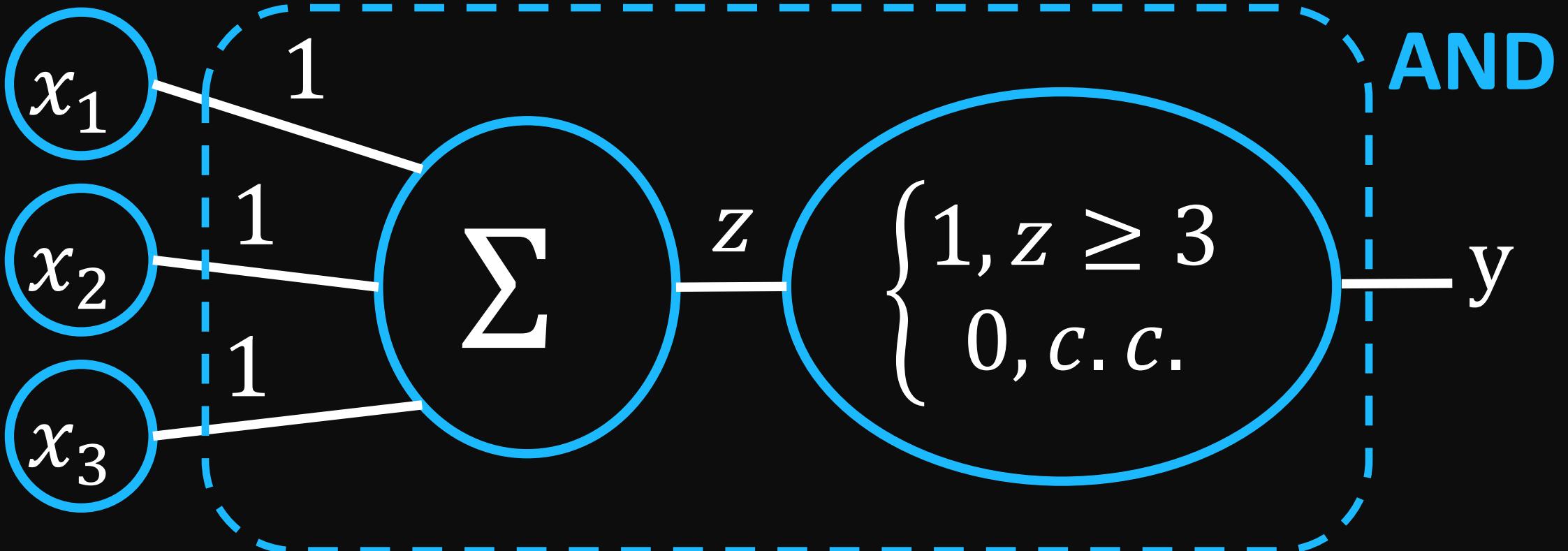
<https://www.youtube.com/watch?v=Nn2RHLWST-k>



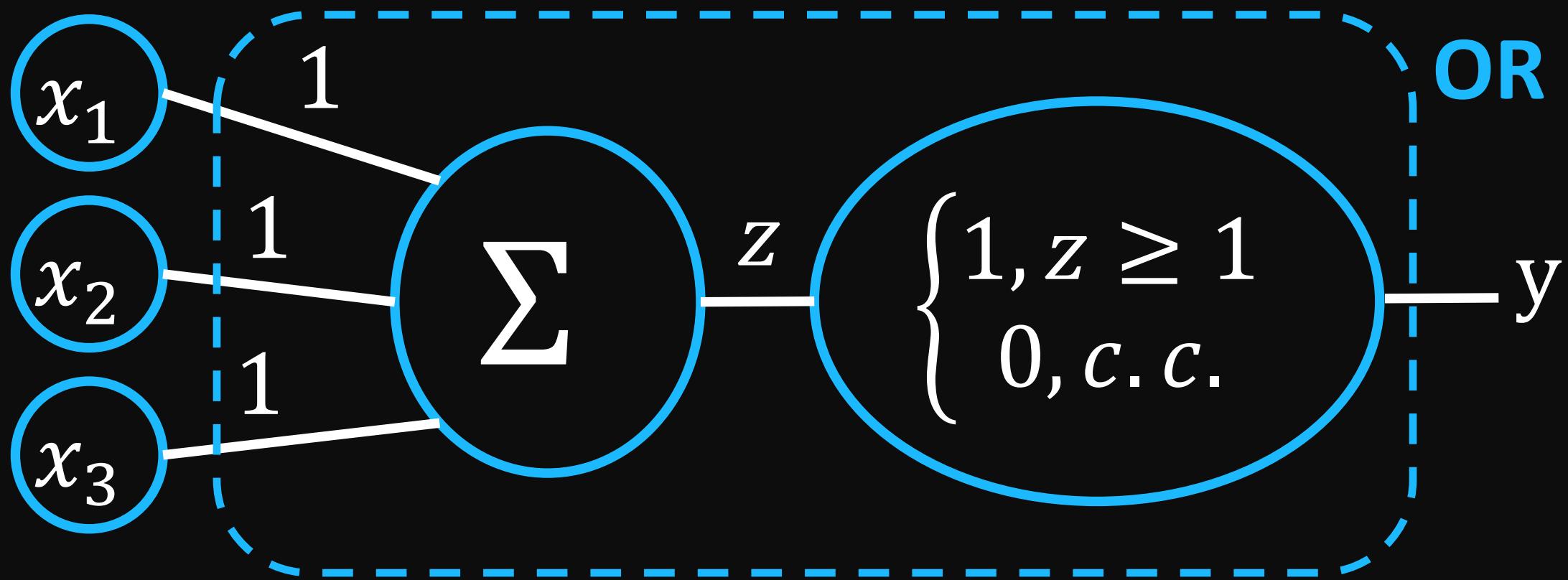
O Neurônio MCP Permite implementar algumas funções lógicas *

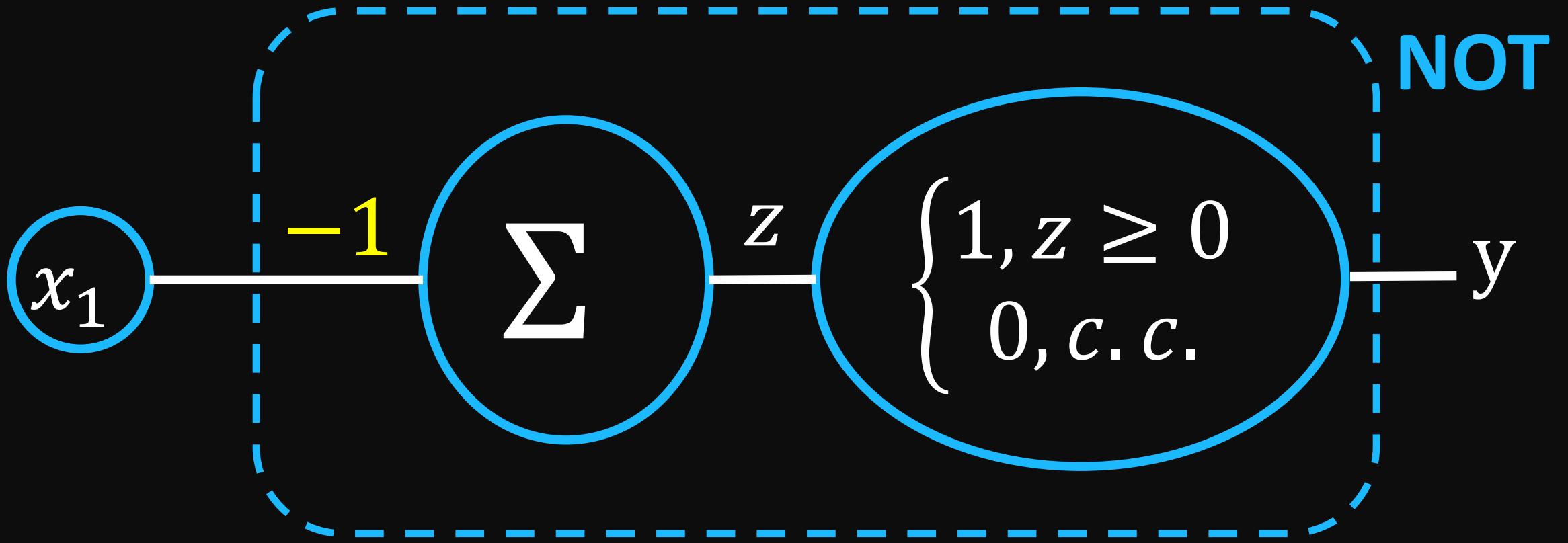
* mas não todas! Mais sobre isto depois...

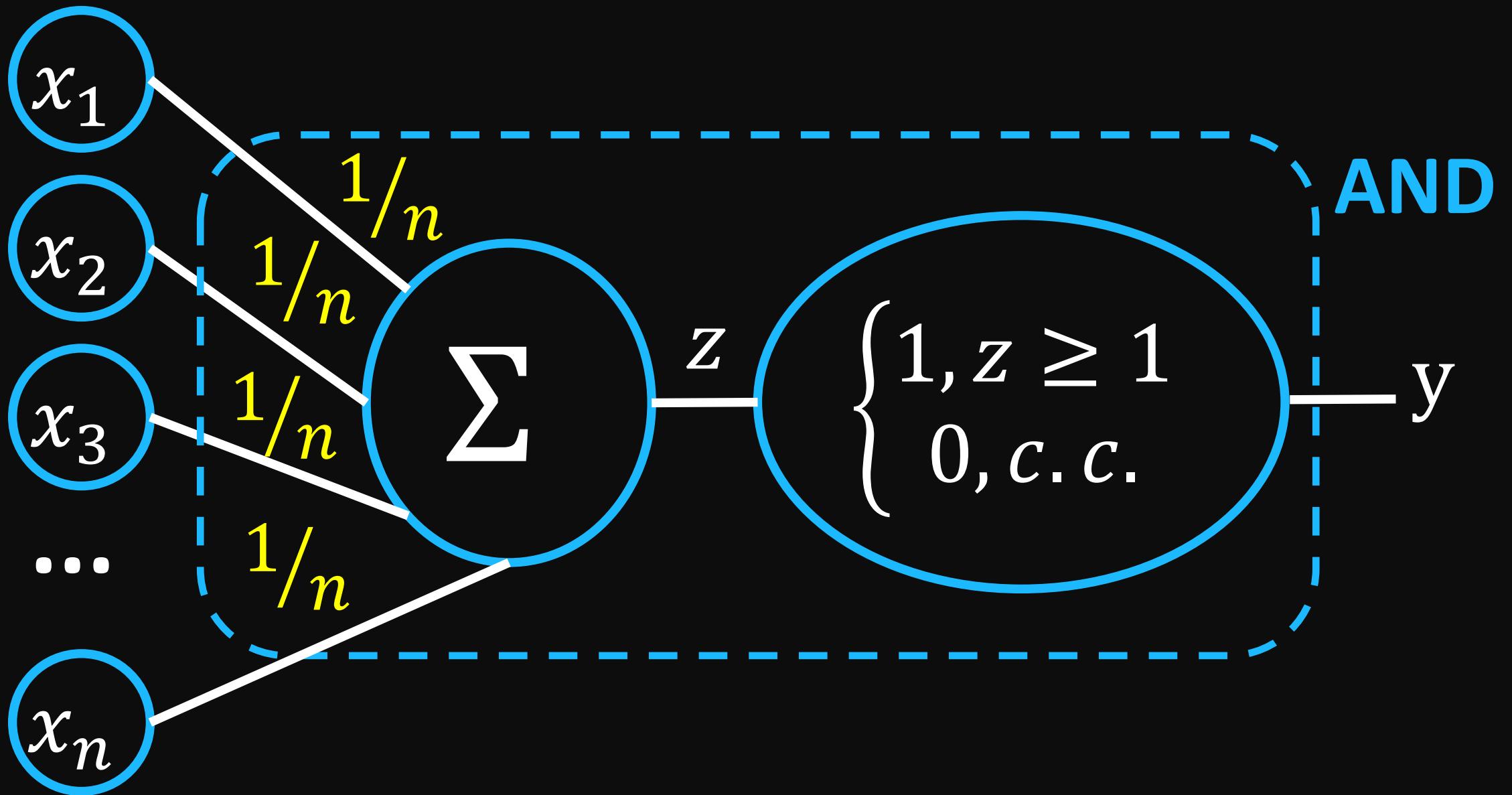




Questões: (1) Como implementar OR com 3 entradas? (2) Como implementar NOT? (3) Como generalizar o AND para n entradas?







M I N D
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND
INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

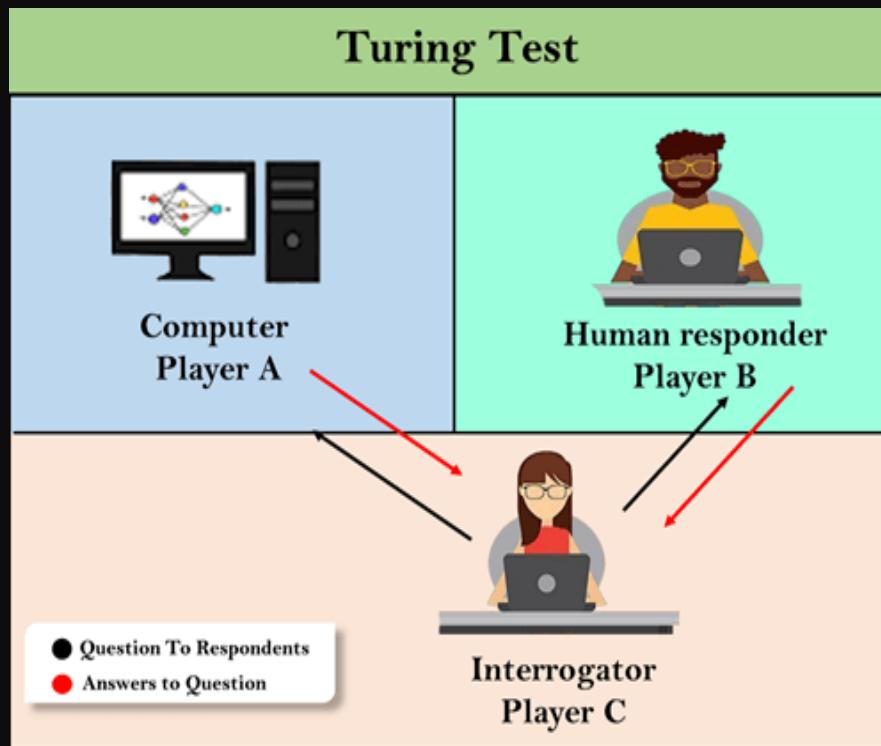
I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine' and 'think' are to be found by examining how they are commonly used it is difficult to escape the conclusion that the meaning and the answer to the question, 'Can machines think?' is to be sought in a statistical survey such as a Gallup poll. But this is absurd. Instead of attempting such a definition I shall replace the question by another, which is closely related to it and is expressed in relatively unambiguous words.

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. He knows them by labels X and Y, and at the end of the game he says either 'X is A and Y is B' or 'X is B and Y is A'. The interrogator is allowed to put questions to A and B thus:

C: Will X please tell me the length of his or her hair?



1950



Primeiro uso do termo Inteligência Artificial.

1956 Dartmouth Conference:



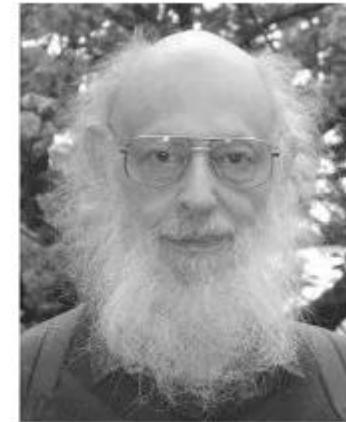
John MacCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



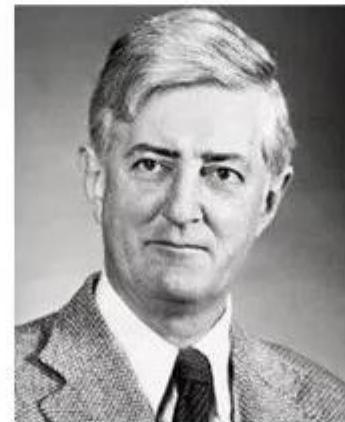
Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge



Nathaniel Rochester



Trenchard More

Artificial Intelligence

- Logic (propositional, predicate)
- Ontologies
- Planning systems
- Rule engines (if-then rules)

Symbolic AI (GOFAI),
Rule-Based

Expert
Systems

Machine
learning

A Venn diagram illustrating the relationships between different AI paradigms. The diagram consists of three overlapping circles. The largest circle, colored yellow, is labeled "AI". Inside it, the top-left region is labeled "Symbolic AI" and the bottom-right region is labeled "Expert Systems". The middle circle, colored light blue, is labeled "Rule-based Systems". The rightmost circle, colored green, is labeled "ML" at the top and "Redes Neurais" (Neural Networks) in the center. A small white square is positioned near the boundary of the blue and yellow circles.

AI

Symbolic AI

**Rule-based
Systems**

ML

**Redes
Neurais**

**Expert
Systems**

Other ES Genres

- Fuzzy ES
 - Applies Fuzzy Logic with Rules
- Frame-based ES
 - Uses frame representation
- Hybrid ES
 - Neural ES
 - Rules + Neural Networks
 - Neural Fuzzy ES
 - Fuzzy Rules + Neural Networks

Parameters	Rule based expert system	Fuzzy expert system	Frame based expert system	Neural expert system	Neuro-fuzzy expert system
Knowledge Representation	IF-THEN rules in the knowledge base	Based on degree of membership using fuzzy logic	Knowledge in frames using hierarchical structure	IF-THEN rules in the neural knowledge base	In linguistic variable and using IF-THEN rules in fuzzy structure
Learning ability	Cannot learn on its own, and update existing knowledge base	Lacks ability to learn from the experience	Cannot learn and adjust to the new environment	Neural network can learn but the learning is black box process for the user	Has learning ability because of neural network as one of the component
Uncertainty tolerance	Difficult to measure uncertainty	Probabilistic reasoning can deal with uncertainty	Not possible because of knowledge structure	Approximate reasoning	Using script value and probabilistic reasoning
Imprecision tolerance	Very low, required precise information	High, as fuzzy logic can deal with imprecision	Very low, imprecise data can lead to faulty output	Neural network component can deal with imprecise data	Very high because of combination of neural network and fuzzy logic
Explanation facility	Yes	Yes, using linguistic variable	Yes, good explanation for the output	Yes, because of rule based component	Yes, very effective
Inference Engine	Process rules and derive conclusion	Process rules using fuzzification and defuzzification	Search for goals using methods and demons	Three layer neural network combined with rule extraction	Fuzzy inference process using fuzzification and defuzzification
Knowledge update	Difficult to add new rules	Difficult to introduce new linguistic variables in existing structure	Not possible	Yes, With new knowledge, neural network component can learn	Yes, new linguistic variables can be added into existing knowledge structure
Maintainability	Moderately difficult	Very difficult	Easy	Easy	Difficult because of fuzzy component
Adaptability	No	No	No	Yes	Yes
Processing time	Very high due to each rule is processed	Processing time is reduced compare to rule base expert system	The knowledge stored in the frames can be processed very rapidly.	Learning for neural network takes time, but once knowledge is stored in neurons, then processing time for rule is fast.	Learning for neural network takes time, but then processing time is significantly reduced.
Knowledge Structure	Adhoc, cannot understand logical dependence of rules	Quite unstructured	Highly structured	Structured, but stored in neurons	Moderately structured

Sistemas Lógicos e Sistemas Especialistas

Base de Conhecimento:

1. consulta_clinico => ped_hemograma
2. ped_hemograma and fez_hemograma => tem_hemograma
3. tem_hemograma and consulta_anestesista => tem_laudo
4. tem_laudo and tem_hemograma => cirurgia_liberada

Conhecimento Observado:

consulta_clinico
fez_hemograma
consulta_anestesista

Pergunta (Query):

cirurgia_liberada?

Resposta:

True

Sistemas Lógicos e Sistemas Especialistas

- Requer conhecimento de especialistas
- Requer tempo e esforço de especialistas em modelagem
- Se torna muito complexo em alguns contextos como dados perceptuais complexos.

O que é uma cadeira?

**1) Algo com 4 pernas e uma
superfície plana em cima**





2) São coisas usadas para sentar em cima

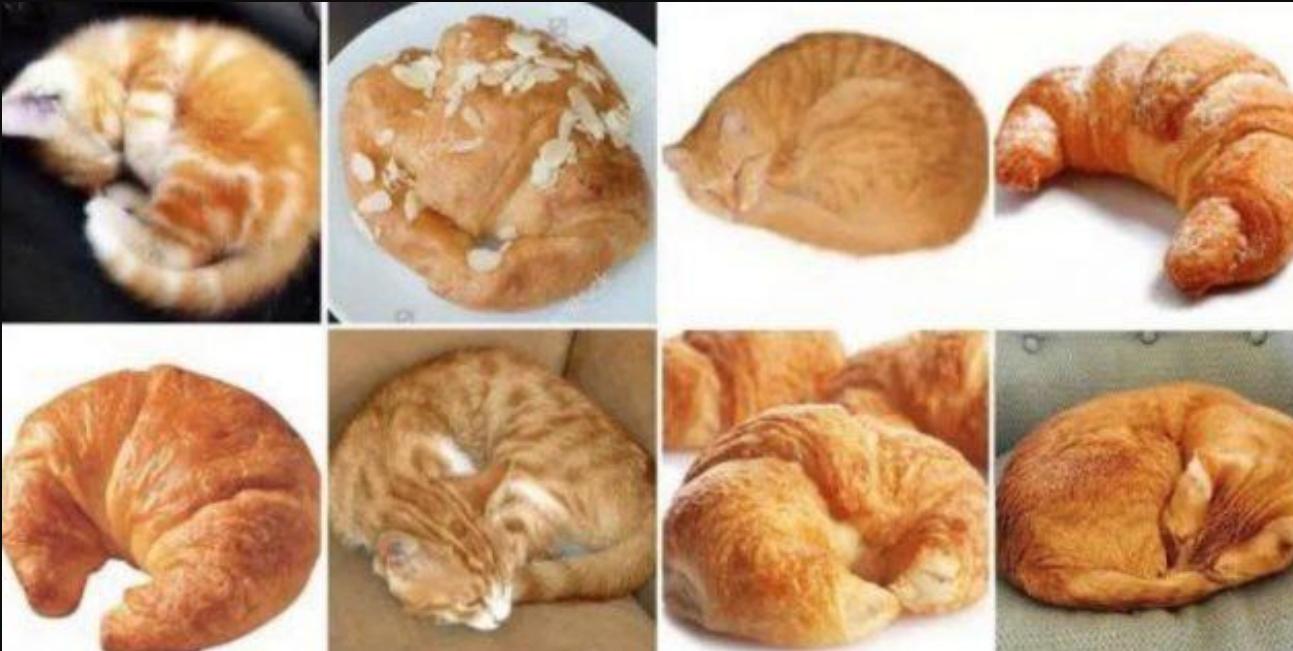




CHAIRS



CAT OR CROISSANT?



Shar Pei or Towel?



**É MUITO DIFÍCIL CRIAR REGRAS PARA LIDAR COM
DADOS PERCEPTUAIS (e.g., VISÃO)**

Como crianças aprendem?

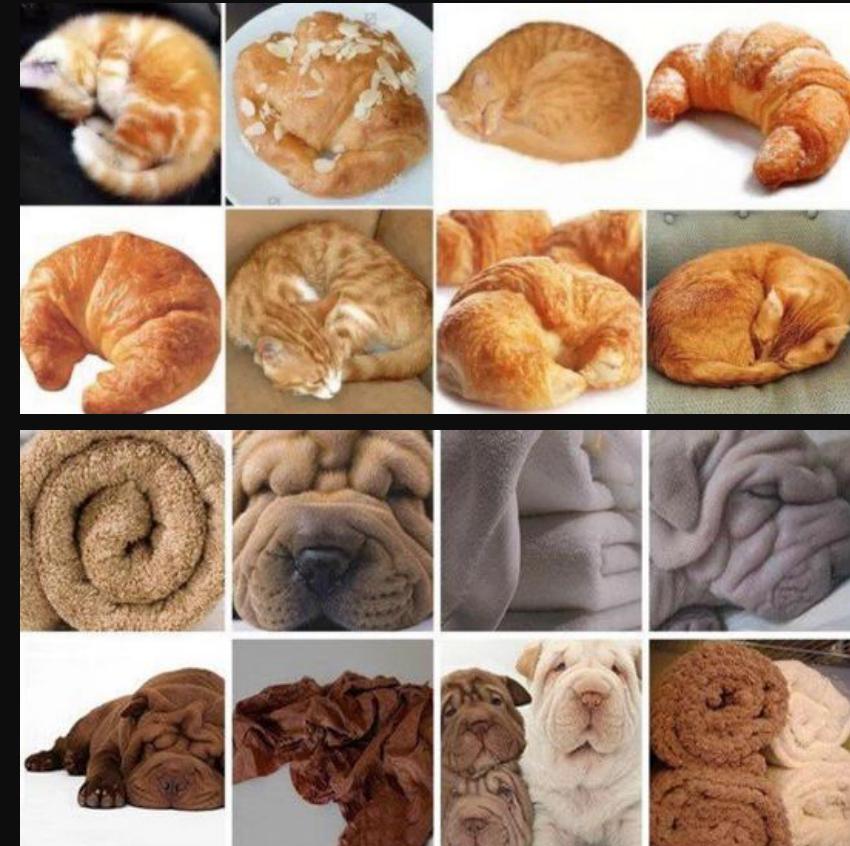
cadeiras



Como crianças aprendem?

cadeiras?

não!

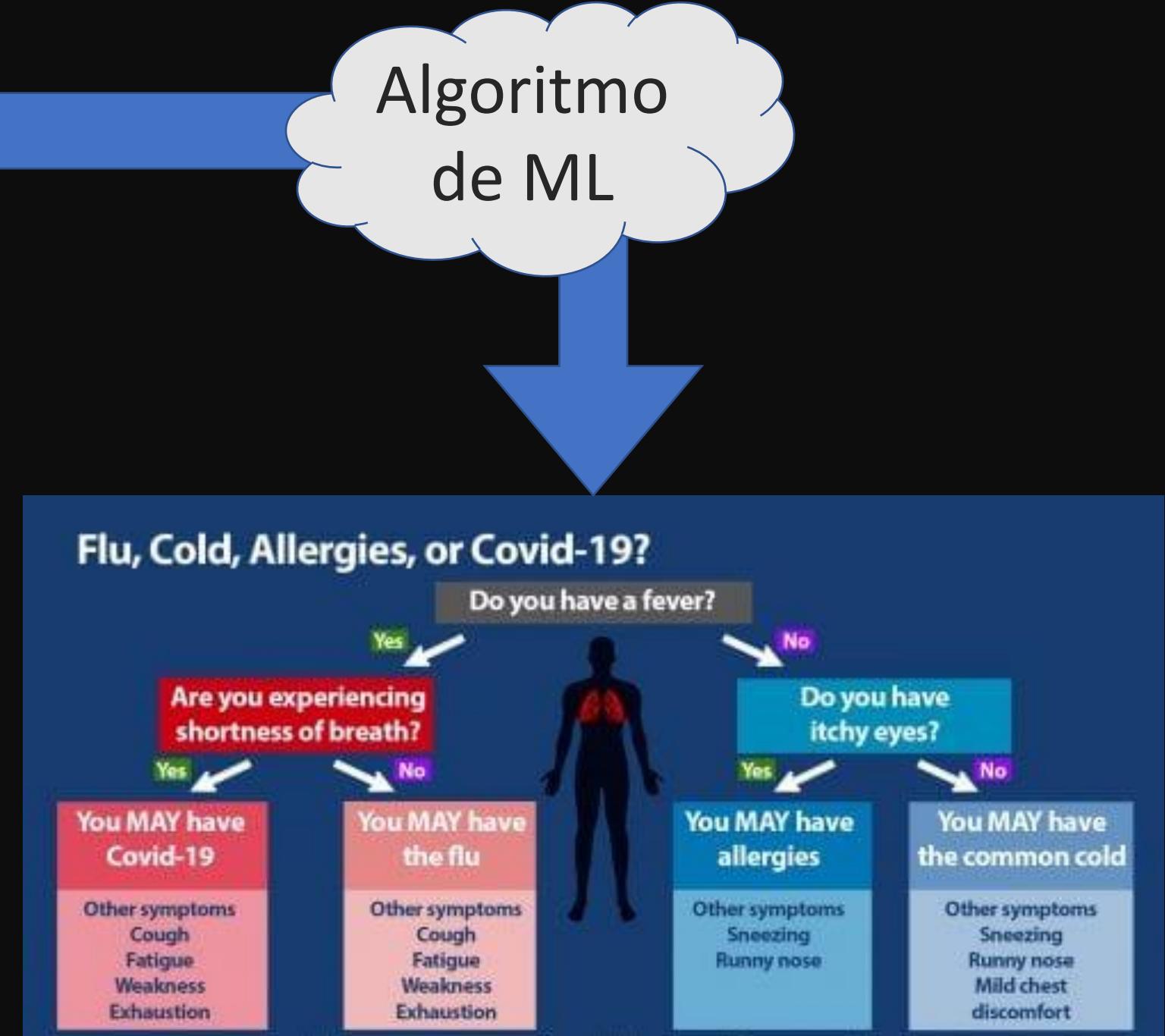


Aprendizado de Máquina

- Conhecimento nos dados
- Identificação de regularidades / padrões
- Tarefas como problemas de otimização
- Fundamentos em Estatística



Exames e Prontuários Médicos Passados



Principais Tipos de Aprendizado

Supervised learning

- Dados de treinamento consistem de pares entrada e saída esperada.
- Ex: (1) Entrada: raios-x. Saída: se o exame é saudável, com covid ou com pneumonia. (2) Ex: Entrada: foto da pessoa. Saída: altura.
- **Objetivo:** Encontrar padrões nos dados (uma função) que tornem o agente capaz de predizer corretamente as saídas a partir das entradas, tanto para os dados de treinamento, quanto para dados novos (generalização).

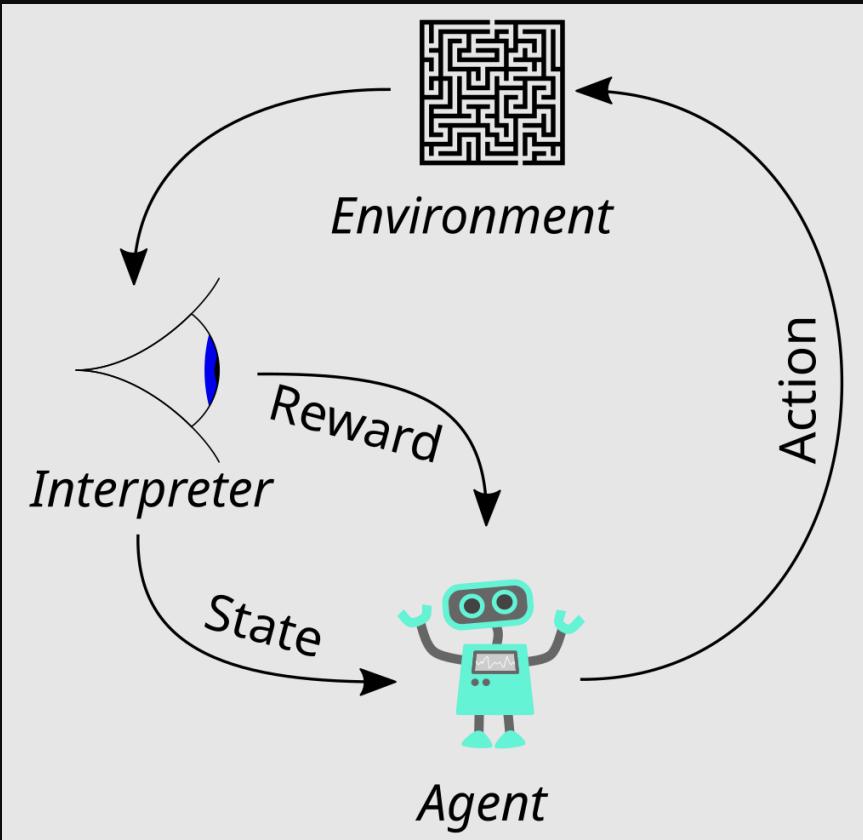
Principais Tipos de Aprendizado

Unsupervised learning

- Dados de treinamento: dados sem anotação.
- Objetivos: encontrar padrões e/ou criar representações *desejáveis* dos dados.
- Ex: Dados os likes de usuários do spotify, identificar grupos com gostos similares.
- Ex: Aprender a mapear fotos de pessoas em vetores invariantes a rotação, diferenças de iluminação e demais ruídos.

Principais Tipos de Aprendizado

Reinforcement learning



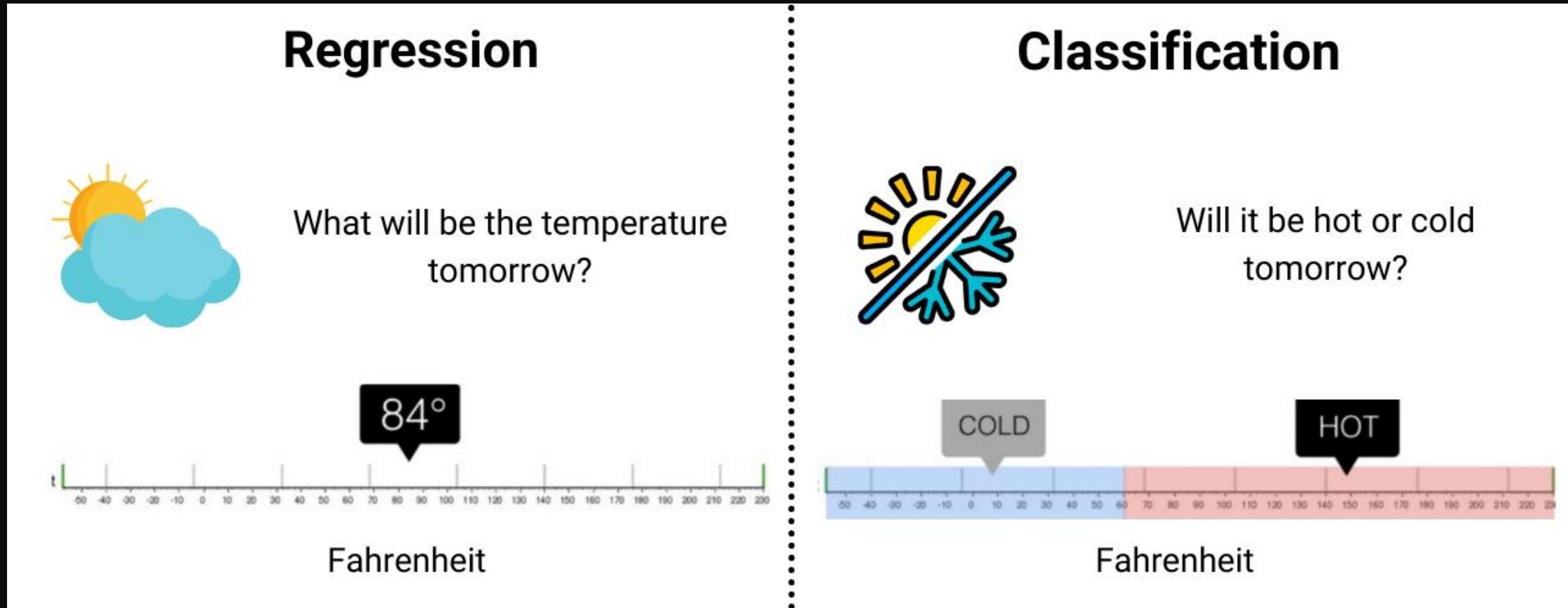
Agente em um loop em que a cada iteração:

1. um **estado** (percepto de parte ambiente) é recebido.
2. com base neste estado, o agente realiza uma **ação**.
3. o ambiente muda para um **novo estado**.
4. o agente recebe uma **recompensa imediata** que pode ser positiva, negativa ou nula.

Objetivo: Através da experiência coletada interagindo com o ambiente, aprender uma **política de ação ótima** que maximize a soma de recompensas no longo prazo.

Tarefas em aprendizado supervisionado

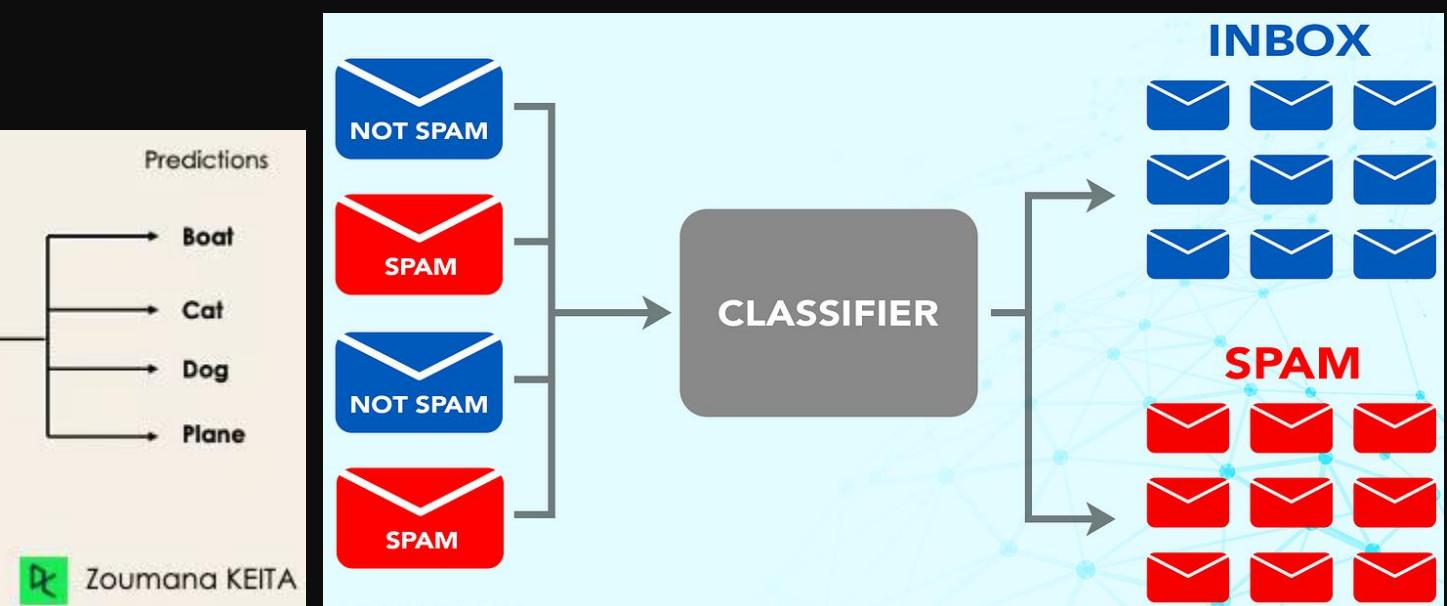
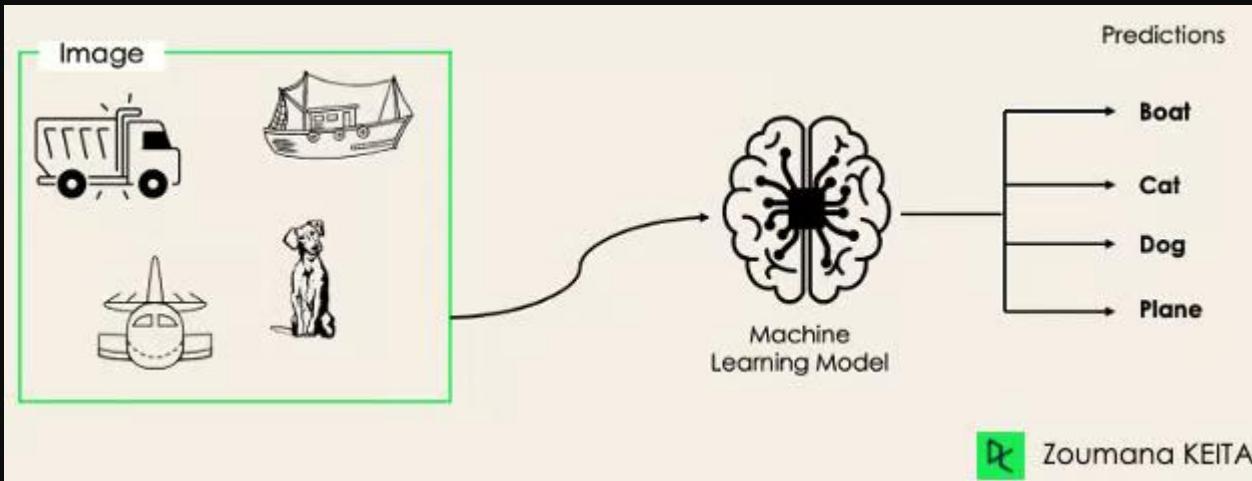
- **Classificação:** Variável de saída é categórica.
- **Regressão:** Variável de saída é contínua.



Regression

- Predicting the Number of Interactions of Social Media Posts
- Predicting House Prices
- Predicting Exam Scores Based on Study Time
- Forecasting Sales for a Business

Classification



Zoumana KEITA



A black and white portrait of Frank Rosenblatt, a young man with dark hair, wearing a suit jacket, white shirt, and patterned tie. A blue triangular callout points from the text below to his right ear.

Perceptrons (1962) are awesome

- Grupos de neurônios MPC com um algoritmo de treinamento e capazes de operar sobre dados perceptuais complexos (e.g., imagens).
- Resultados iniciais foram promissores e garantias de convergência foram demonstradas matematicamente.

Frank Rosenblatt

Did you come to me because you are not ?

>i dont know
What does that suggest to you?

>that i am unintelligent
How long have you been unintelligent?

>since i was born
I see.

>arent you supposed to cheer me up
You're not really talking about me, are you?

>no im talking about me
Why not?

>mrh
I'm not sure I understand you fully.

>rg
Come come elucidate your thoughts.

>what is elucidate
What do you think?

>to see
Can you elaborate on that?

>

1964

ELIZA A Computer Program For the
Study of Natural Language
Communication Between Man and
Machine

Joseph Weizenbaum

Perceptrons are not that awesome.



1969

O livro Perceptrons escrito por Minsky and Papert mostrou que perceptrons só eram capazes de resolver problemas linearmente separáveis.

1972

PROLOG is developed:
a logic programming
language influential in
expert systems.

```
?- human(socrates).
```

Yes

what things are humans?

```
?- human(X).
```

X = socrates

Clauses with bodies are called **rules**. An example of a rule is:

```
mortal(X) :- human(X).
```

If we add that rule and ask *what things are mortals?*

```
?- mortal(X).
```

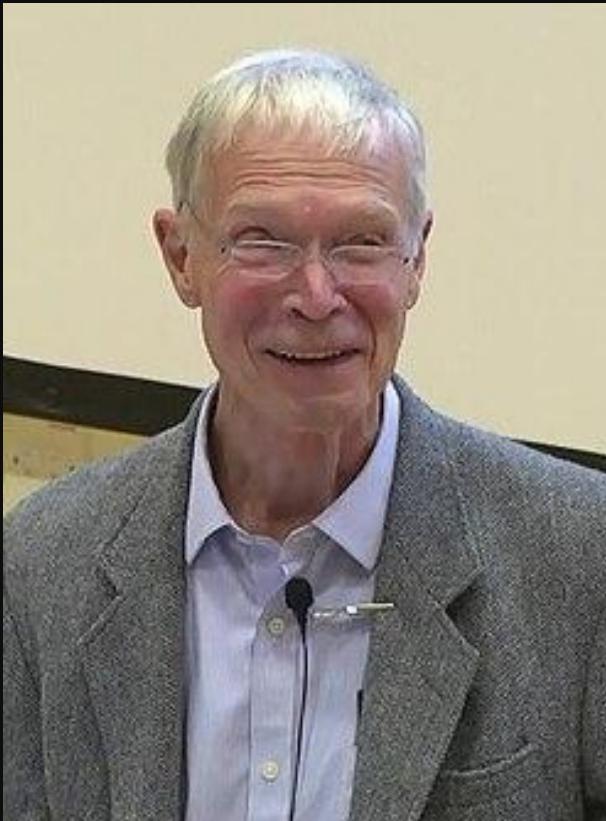
X = socrates



1974-1985 1st AI Winter

Performance aquém das expectativas e limitações teóricas causam redução de investimentos.

1982. Redes de Hopfield são uma memória associativa endereçada por conteúdo: Redes Neurais podem lembrar!



Original



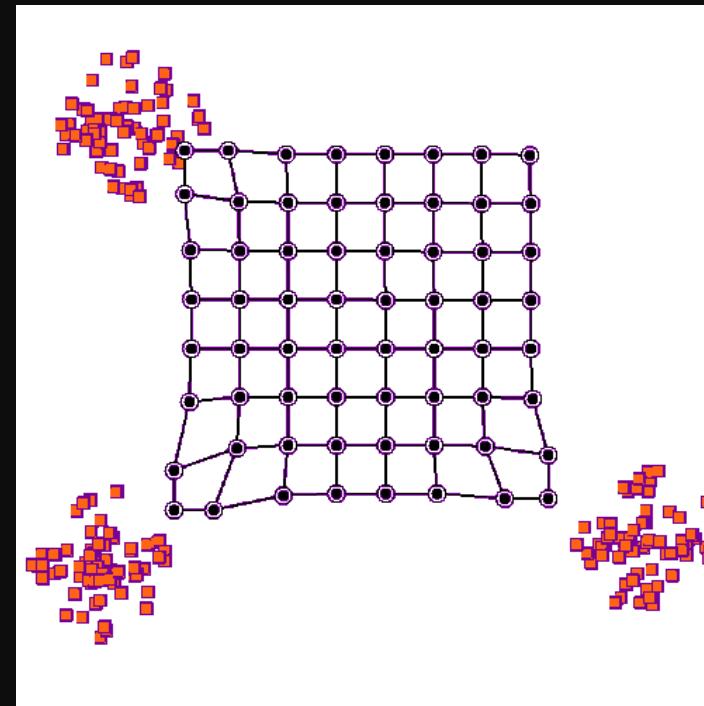
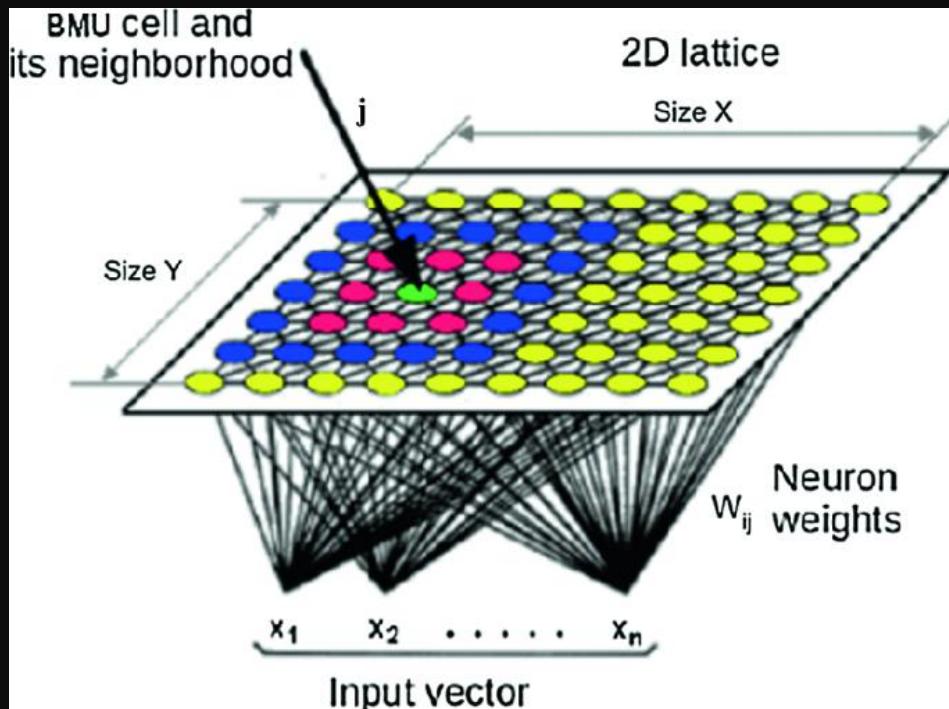
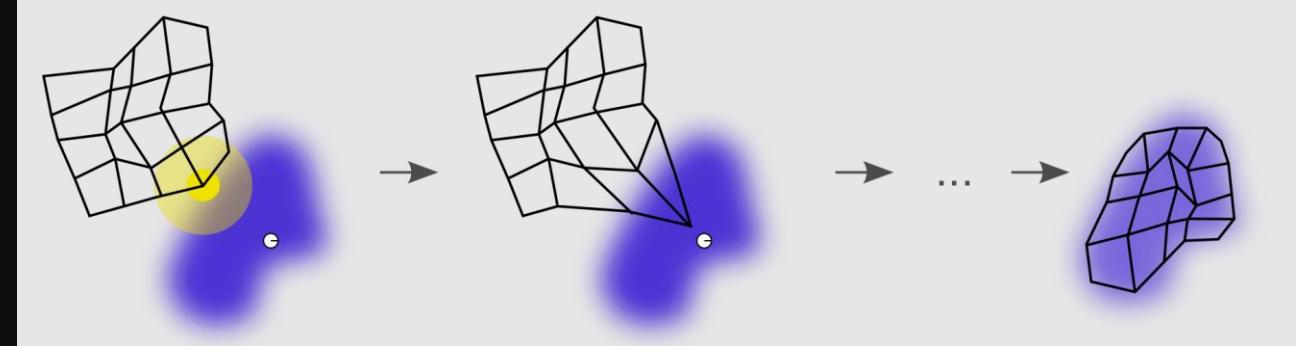
Degraded



Reconstruction

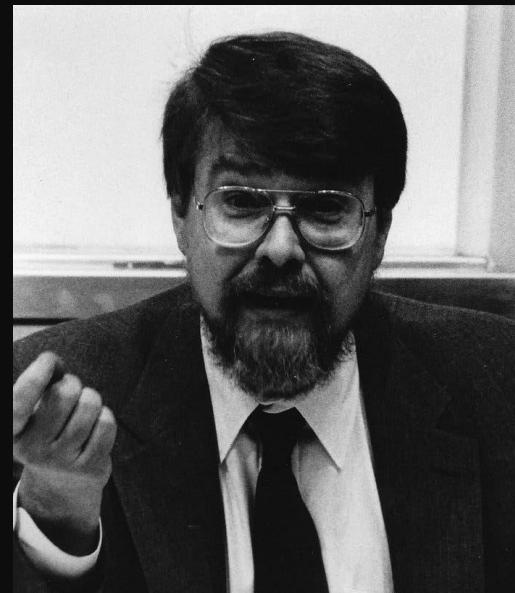
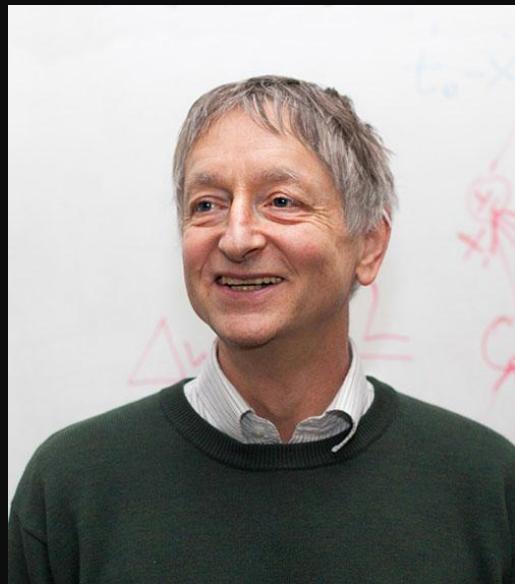
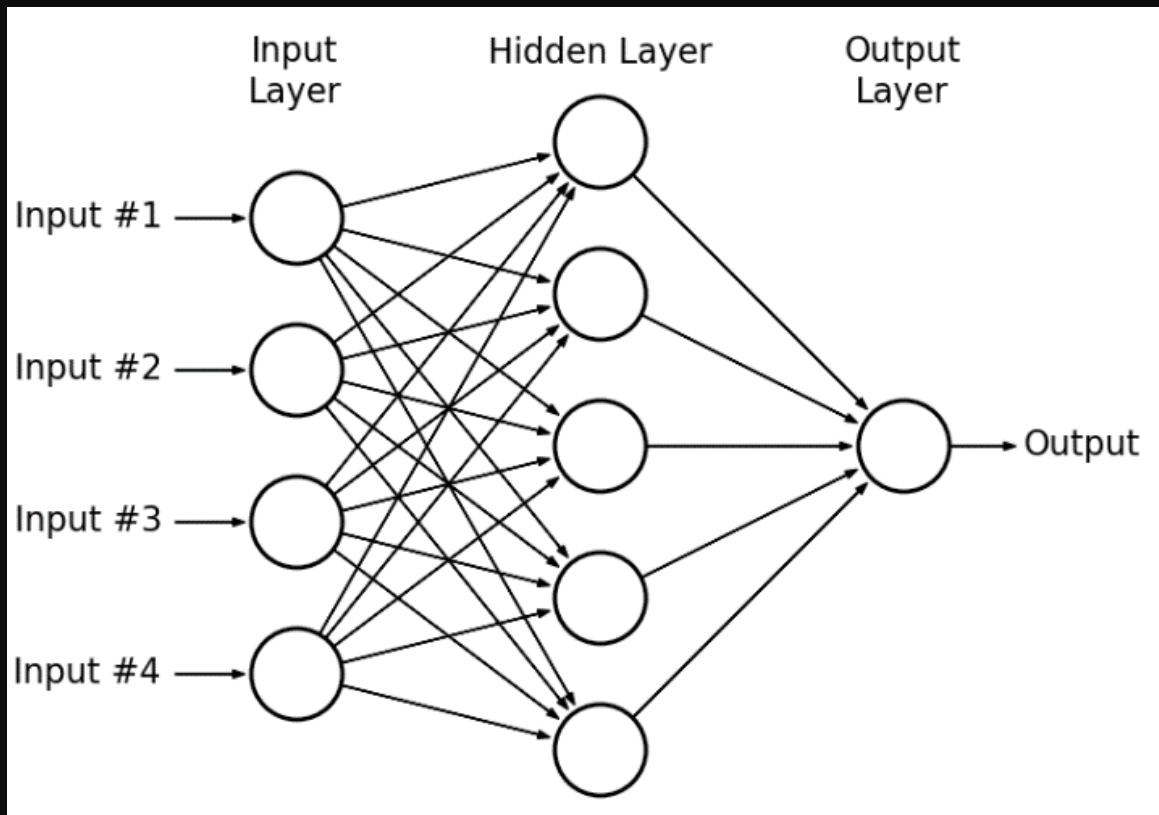
1982: Kohonen Self-Organizing Maps (SOMs)

Aprendizado competitivo

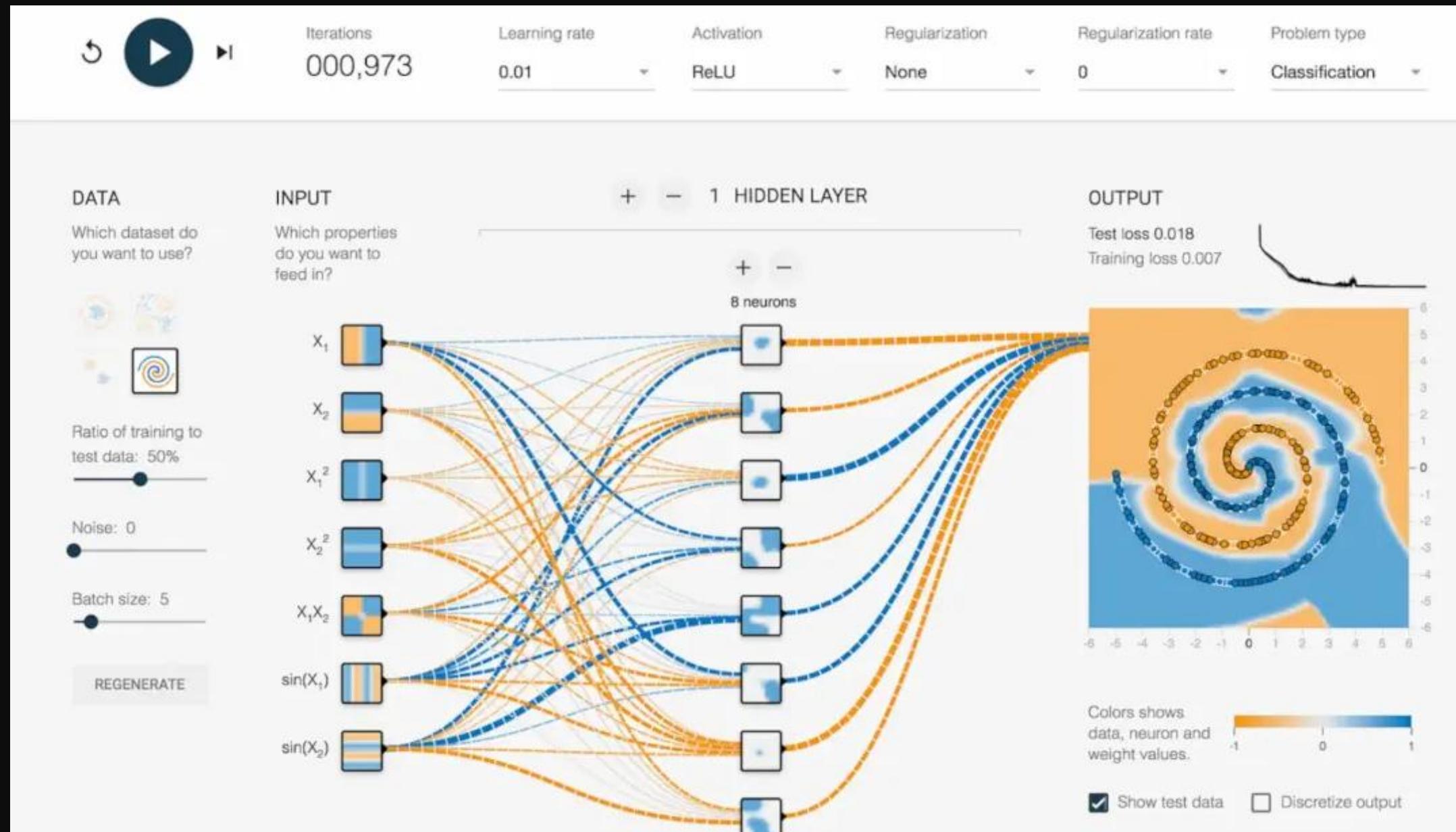


Teuvo Kohonen

1985. Perceptrons com múltiplas camadas são capazes de resolver problemas não linearmente separáveis. O algoritmo backpropagation é proposto.



Rumelhart, D. E., Hinton, G. E., & Williams, R. J. (1986). Learning representations by back-propagating errors. *nature*, 323(6088), 533-536.



<https://playground.tensorflow.org/>

Expert Systems passam a ser usados em empresas

Mas novamente expectativas são frustradas pela realidade

- Redes Neurais são famintas por computação e dados
- Sistemas são caros de construir e manter.
- Performance de sistemas especialistas não é tão boa quanto esperado.

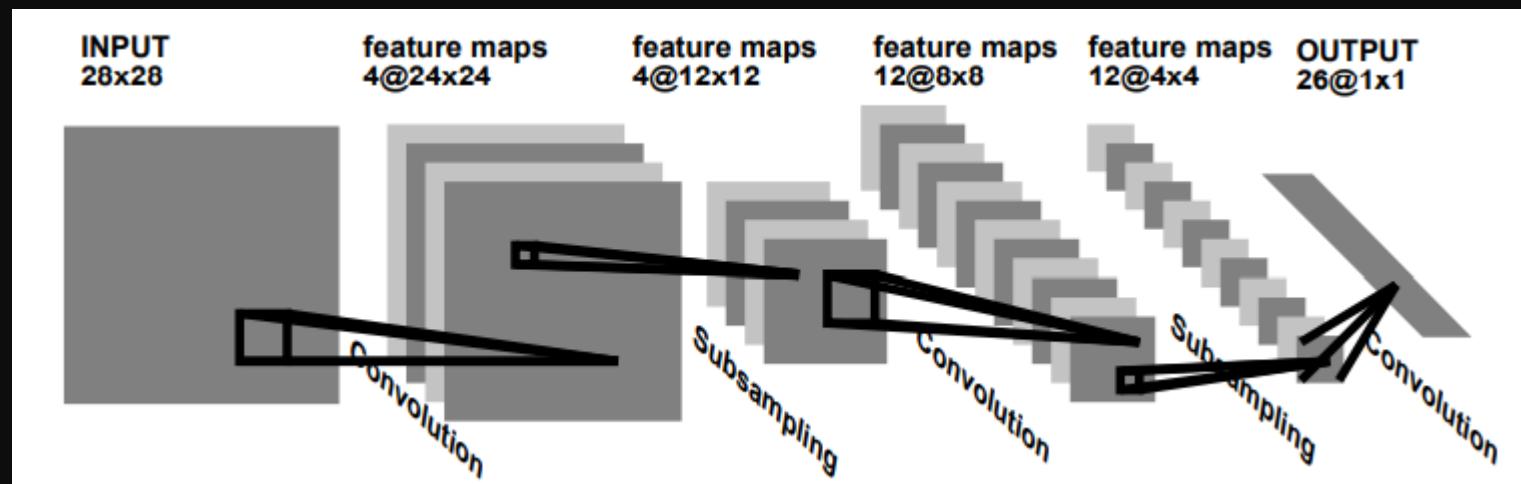
2nd AI Winter (1987-1993/2000/2012)



Progressos e tentativas foram feitos

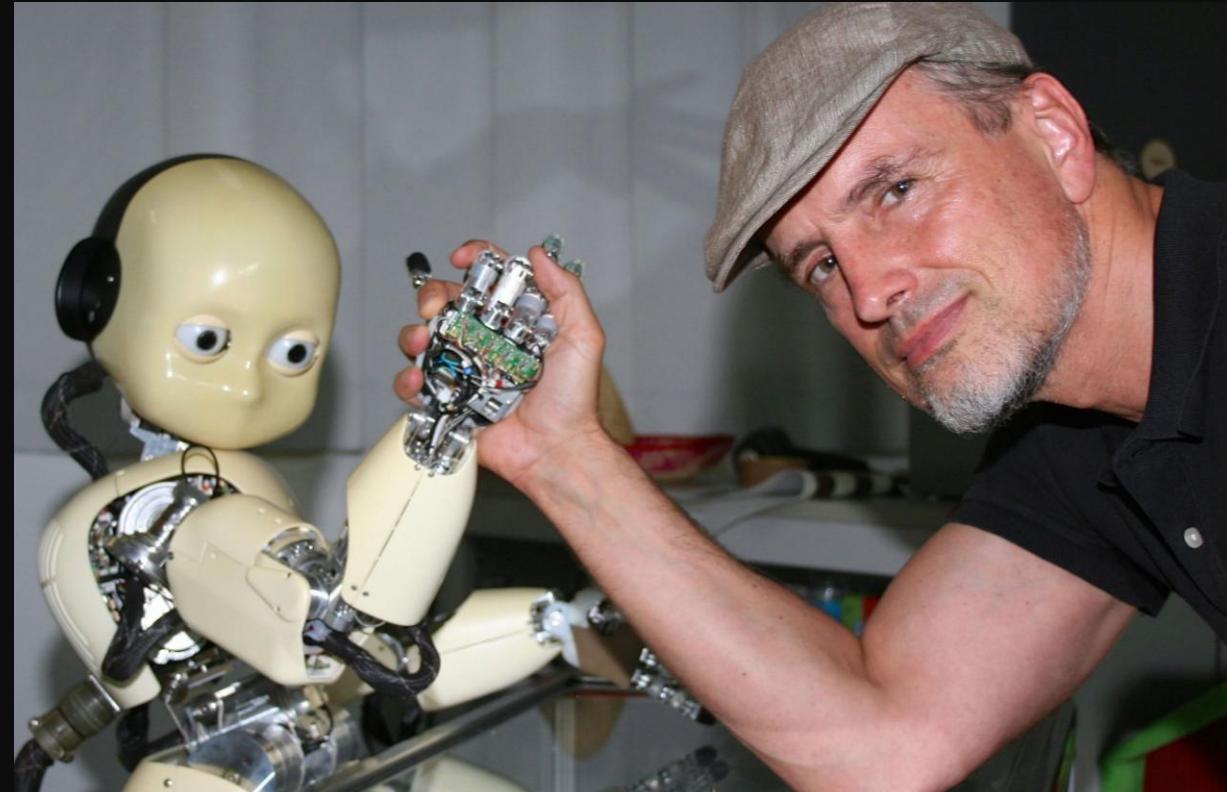


1989: CNNs



Progressos e tentativas foram feitos

1996:
LSTMs



- Layerwise pretraining
- Restricted Boltzmann Machines

...

**Mas no fim do dia, outros métodos dominavam a arena dos anos 2000:
SVMs e Random Forests**

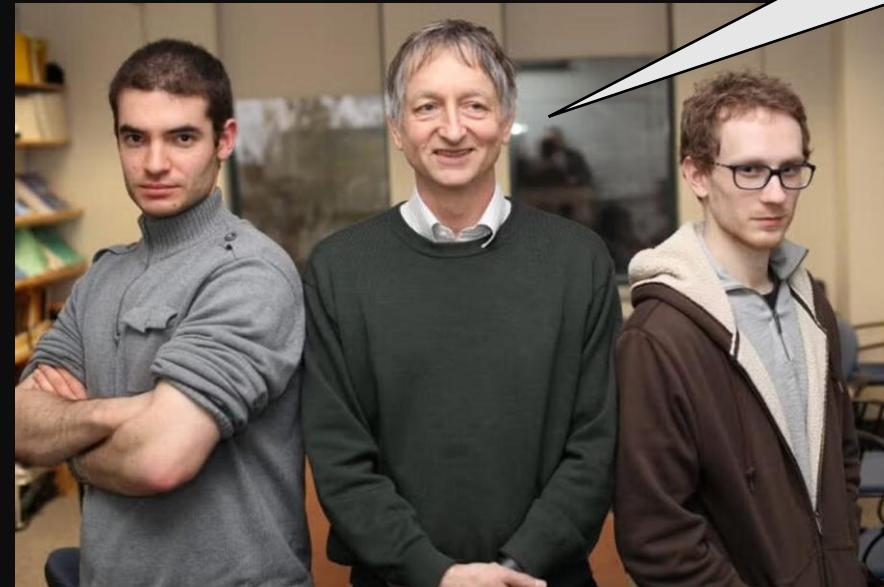
1997

IBM Deep Blue
vence o campeão
mundial de xadrez
Garry Kasparov
(via planning)



A WEB possui muitos dados e GPUs podem ser usadas para Computação

Let's go Deep!



2012

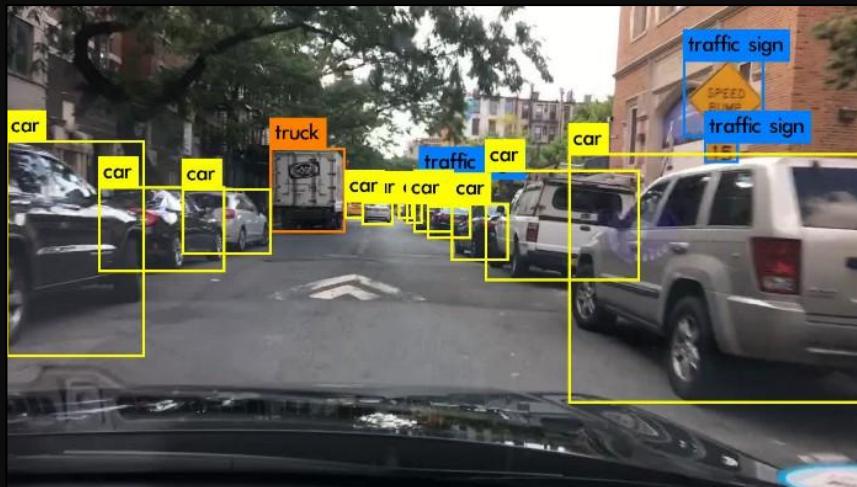
Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. *Advances in neural information processing systems*, 25.

The Deep Learning Revolution

- Redes neurais são utilizadas em diversas áreas, tanto na academia quanto em empresas.
- Investimentos são abundantes.
- CNNs dominam tarefas de visão.
- LSTMs e outras RNNs dominam aplicações com dados sequenciais.

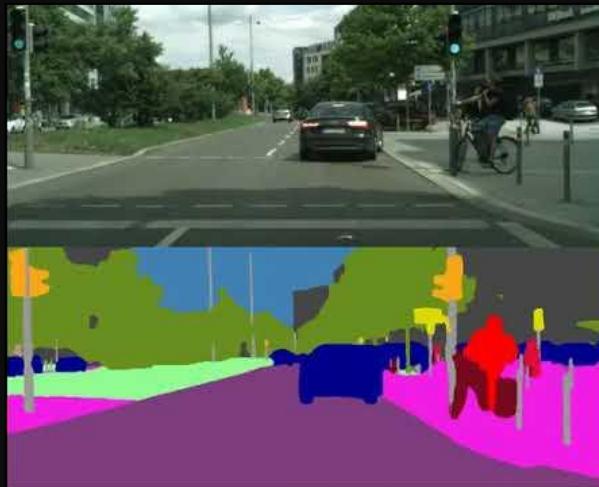
Other Applications of DL

Deep learning have been used for in several robot perception tasks



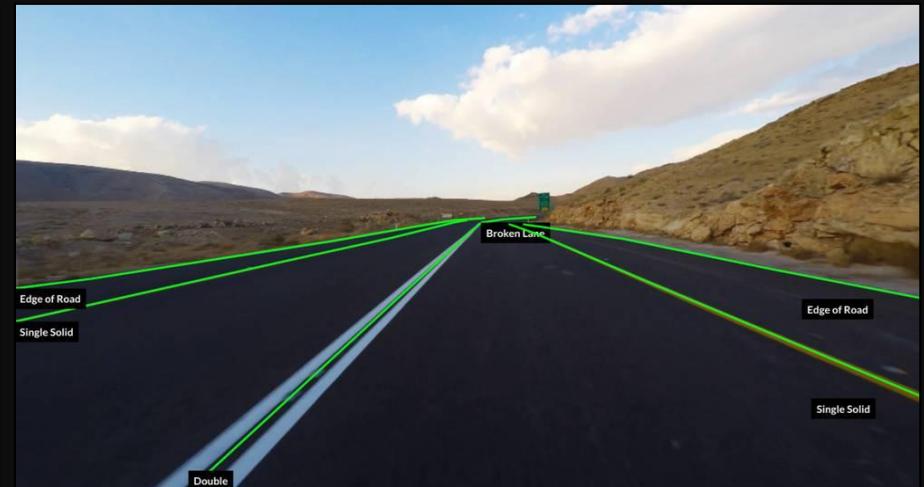
Object Detection

Redmon, J., & Farhadi, A. (2018). Yolov3: An incremental improvement. *arXiv preprint arXiv:1804.02767*.



Semantic Segmentation

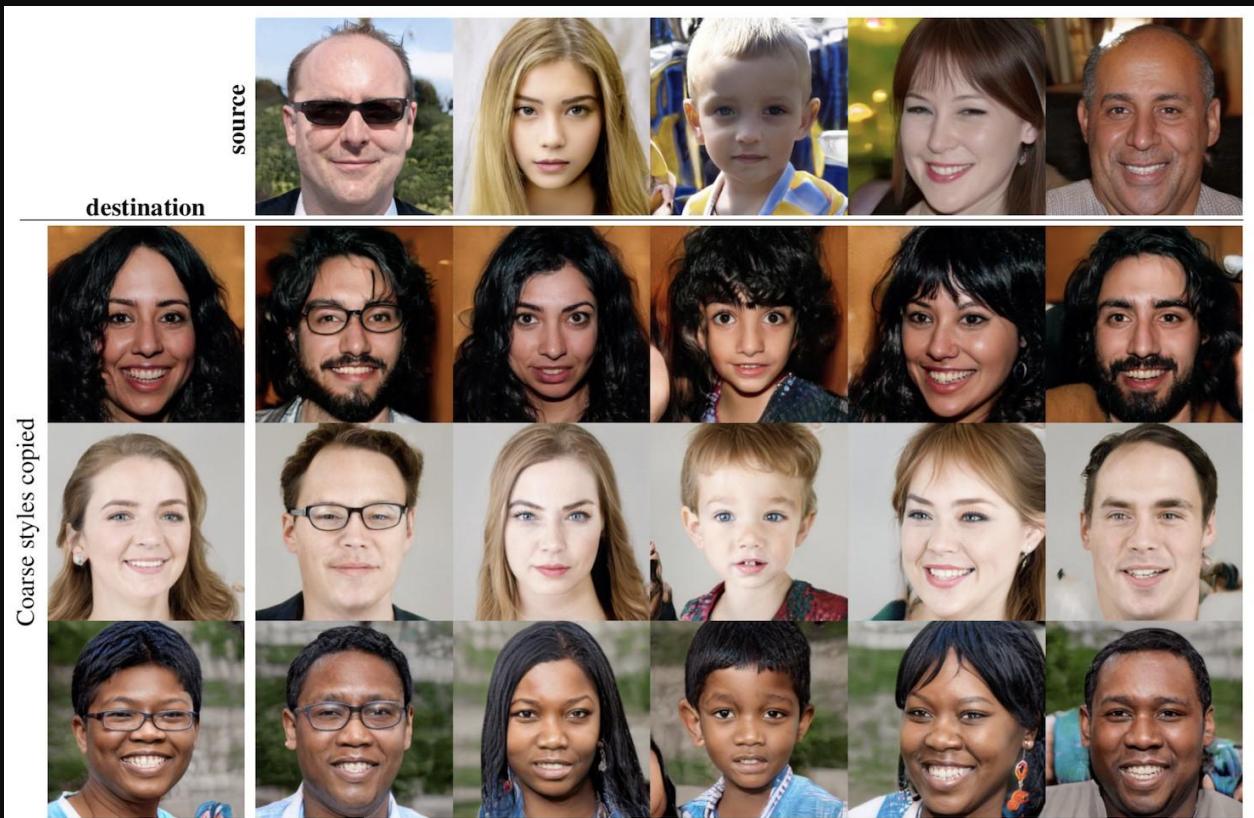
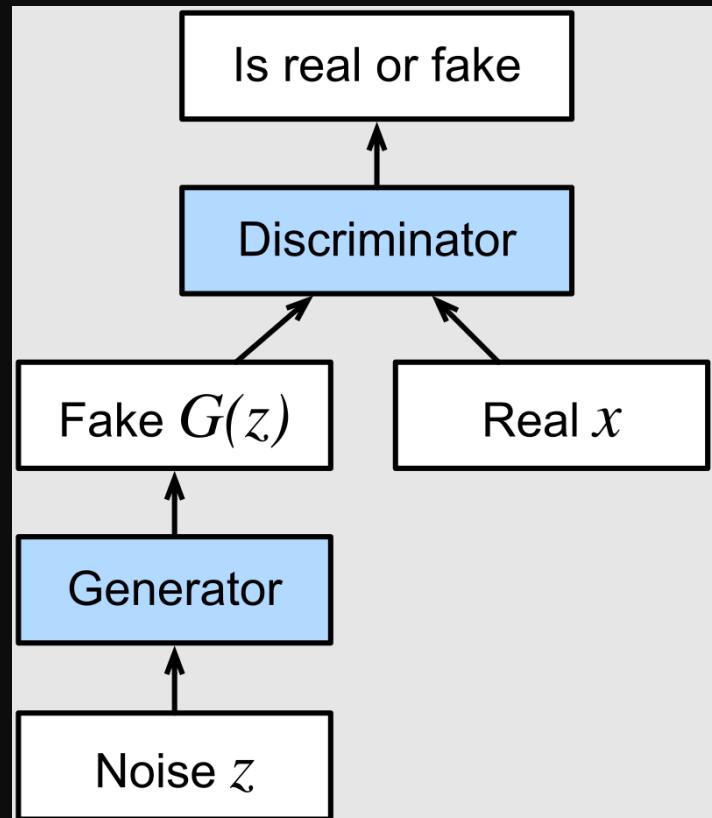
Chen, L. C., Zhu, Y., Papandreou, G., Schroff, F., & Adam, H. (2018). Encoder-decoder with atrous separable convolution for semantic image segmentation. In *Proceedings of the European conference on computer vision (ECCV)* (pp. 801-818).



Lane Detection and Classification

Berriel, R. F., de Aguiar, E., De Souza, A. F., & Oliveira-Santos, T. (2017). Ego-lane analysis system (elas): Dataset and algorithms. *Image and Vision Computing*, 68, 64-75.

2014. Generative Adversarial networks (GANs)





**2015. Neural
Style Transfer
with CNNs**

[nature](#) > [letters](#) > [article](#)

Published: 25 February 2015

Human-level control through deep reinforcement learning

Volodymyr Mnih, Koray Kavukcuoglu✉, David Silver, Andrei A. Rusu, Joel Veness, Marc G. Bellemare, Alex Graves, Martin Riedmiller, Andreas K. Fidjeland, Georg Ostrovski, Stig Petersen, Charles Beattie, Amir Sadik, Ioannis Antonoglou, Helen King, Dharshan Kumaran, Daan Wierstra, Shane Legg & Demis Hassabis✉

[Nature](#) 518, 529–533 (2015) | [Cite this article](#)

421k Accesses | 9515 Citations | 1553 Altmetric | [Metrics](#)

Abstract

The theory of reinforcement learning provides a normative account¹, deeply rooted in

2015

Google Deep Mind uses CNNs and RL to learn how to play Atari Games from Images

2015. ResNets

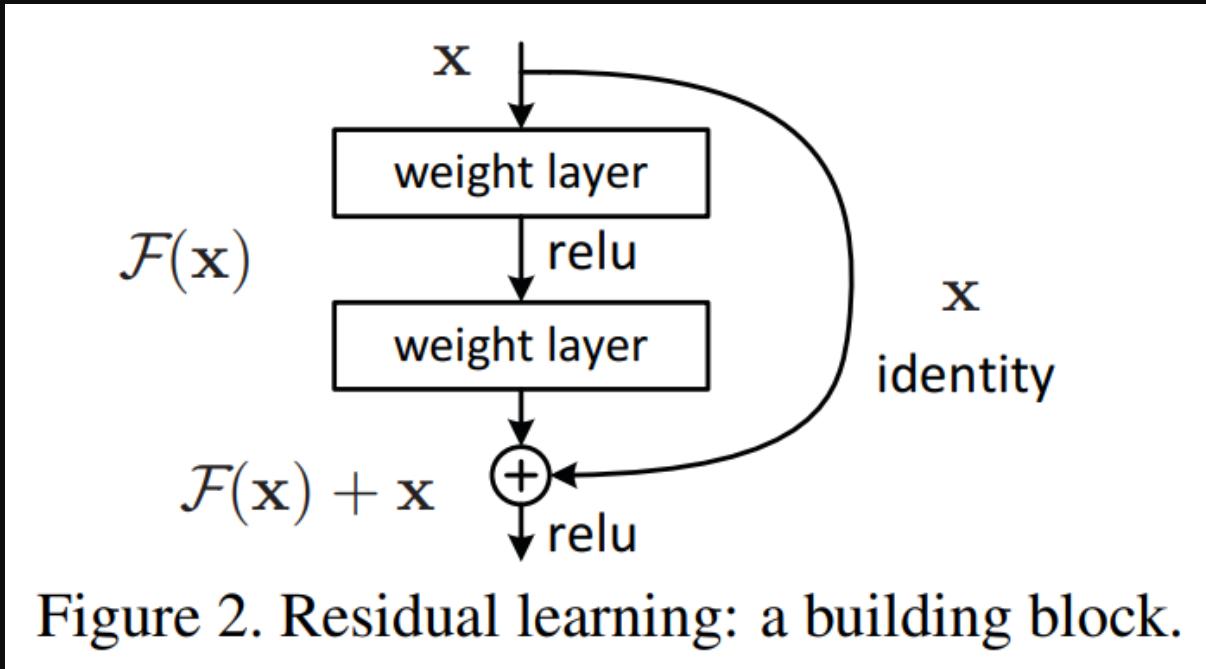
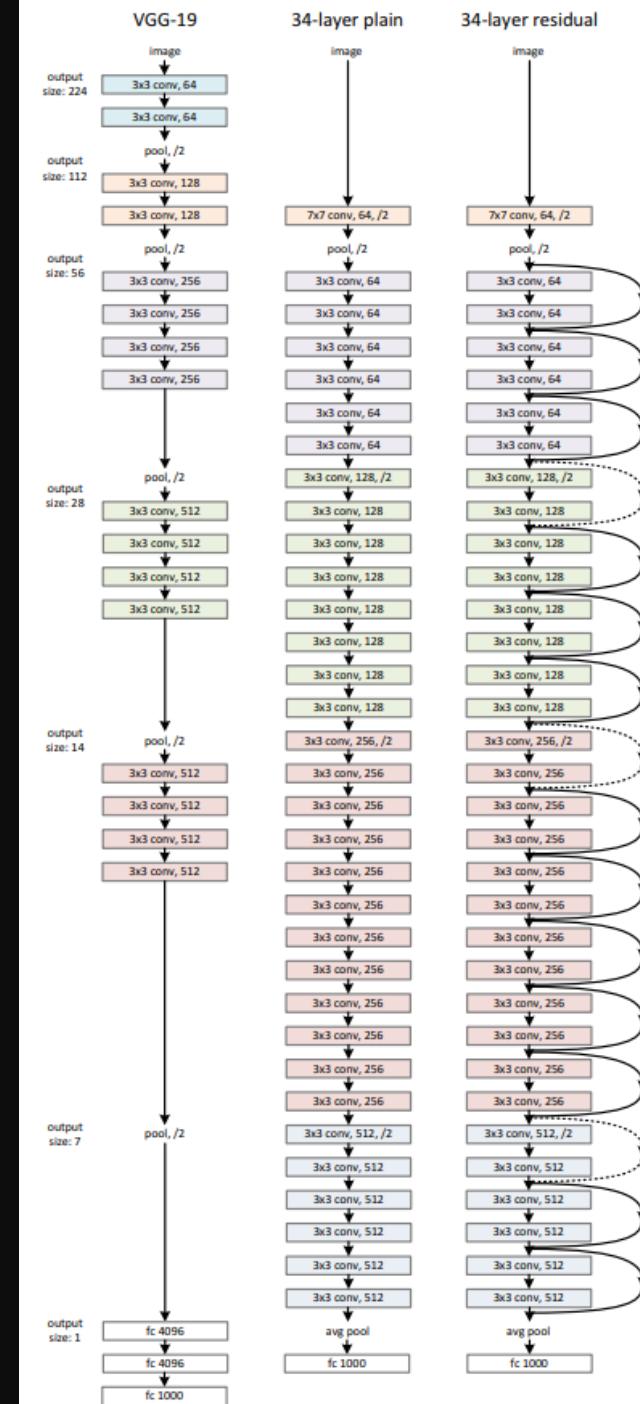


Figure 2. Residual learning: a building block.



AlphaGo wins 4/5 games
against Mr Lee Sedol, the
winner of 18 world titles
of in the game of Go.

2016



<https://deepmind.com/research/case-studies/alphago-the-story-so-far>

Silver, D., Huang, A., Maddison, C. J., Guez, A., Sifre, L., Van Den Driessche, G., ... & Dieleman, S. (2016). Mastering the game of Go with deep neural networks and tree search. *nature*, 529(7587), 484.



2016

NVIDIA presented a neural network that was able of driving a car in diverse types of terrain and weather conditions.

<https://www.youtube.com/watch?v=qhUvQiKec2U>

<https://www.nvidia.com/pt-br/self-driving-cars/drive-platform/>

2017

**AlphaZero taught
itself Chess, Shogi,
and Go, beating a
world-champion
program in each
case.**



<https://deepmind.com/research/case-studies/alphago-the-story-so-far>

Attention Is All You Need

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Abstract

The dominant sequence transduction models are based on complex recurrent or convolutional neural networks that include an encoder and a decoder. The best performing models also connect the encoder and decoder through an attention mechanism. We propose a new simple network architecture, the Transformer, based solely on attention mechanisms, dispensing with recurrence and convolutions entirely. Experiments on two machine translation tasks show these models to be superior in quality while being more parallelizable and requiring significantly less time to train. Our model achieves 28.4 BLEU on the WMT 2014 English-to-German translation task, improving over the existing best results, including ensembles, by over 2 BLEU. On the WMT 2014 English-to-French translation task, our model establishes a new single-model state-of-the-art BLEU score of 41.0 after training for 3.5 days on eight GPUs, a small fraction of the training costs of the best models from the literature.

1 Introduction

Recurrent neural networks, long short-term memory [12] and gated recurrent [7] neural networks in particular, have been firmly established as state of the art approaches in sequence modeling and transduction problems such as language modeling and machine translation [29, 2, 5]. Numerous efforts have since continued to push the boundaries of recurrent language models and encoder-decoder architectures [31, 21, 13].

*Equal contribution. Listing order is random. Jakob proposed replacing RNNs with self-attention and started the effort to evaluate this idea. Ashish, with Illia, designed and implemented the first Transformer models and has been crucially involved in every aspect of this work. Noam proposed scaled dot-product attention, multi-head attention and the parameter-free position representation and became the other person involved in nearly every detail. Niki designed, implemented, tuned and evaluated countless model variants in our original codebase and tensor2tensor. Llion also experimented with novel model variants, was responsible for our initial codebase, and efficient inference and visualizations. Lukasz and Aidan spent countless long days designing various parts of and implementing tensor2tensor, replacing our earlier codebase, greatly improving results and massively accelerating our research.

†Work performed while at Google Brain.

‡Work performed while at Google Research.

2017

Transformers são introduzidos
e suas variações (e.g., ViT)
gradualmente passam a
dominar aplicações de visão e
de aprendizado de sequências

Turing Award 2018



Yoshua Bengio



Geoffrey Hinton



Yann LeCun

2019

OpenAI Five, wins Dota 2 world champions OG at Finals. OpenAI Five learned by playing over 10.000 years of games against itself.

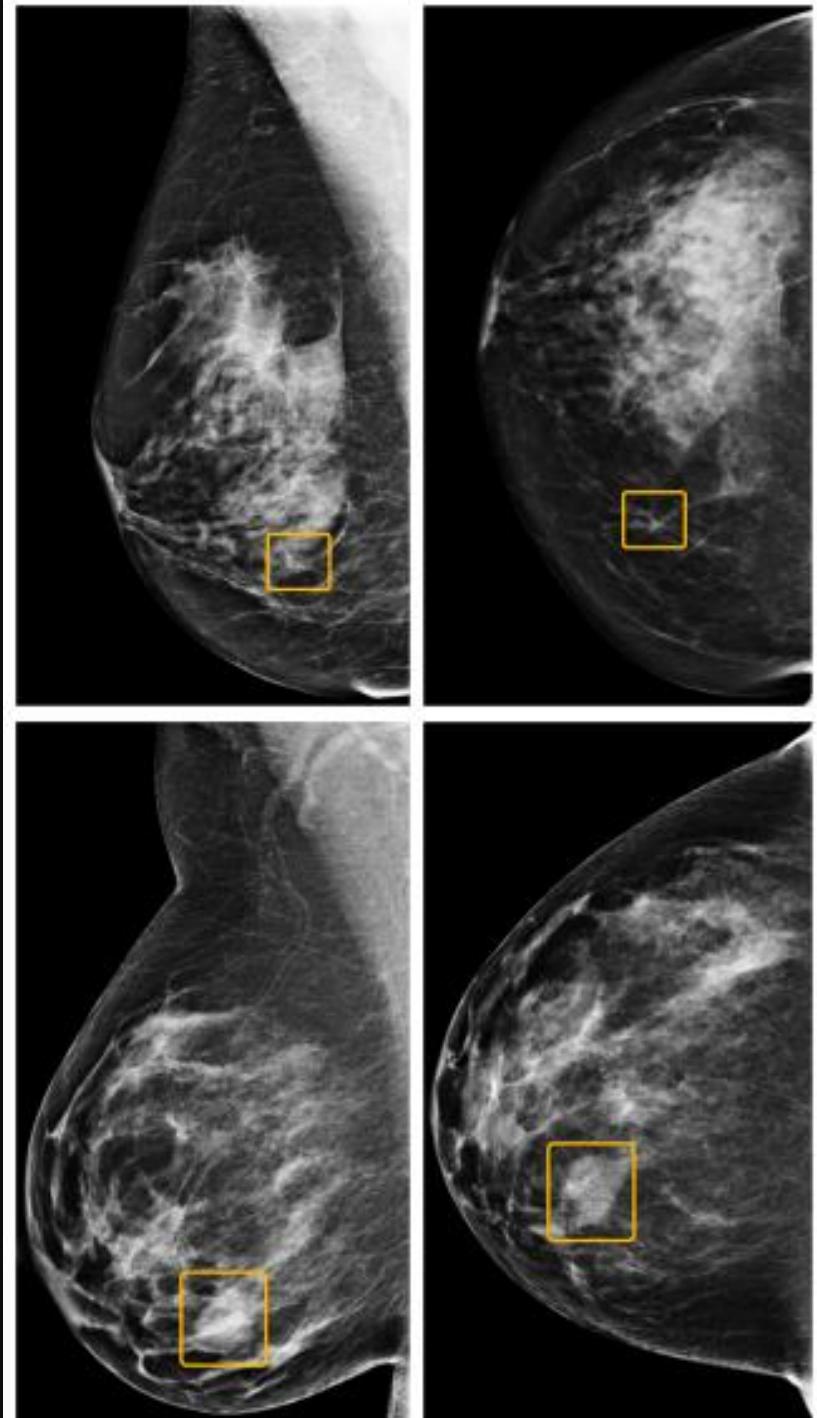


<https://openai.com/projects/five/>



Google DeepMind's **Agent57** achieved superhuman performance in all 57 Atari 2600 games.

2020



2020

**Google presented an AI based
on convolutional neural
networks that outperformed all
of the human readers in the
analysis of mammograms.**

<https://www.nature.com/articles/s41586-019-1799-6#Abs1>

Language Models are Few-Shot Learners

Tom B. Brown* Benjamin Mann* Nick Ryder* Melanie Subbiah*

Jared Kaplan[†] Prafulla Dhariwal Arvind Neelakantan Pranav Shyam Girish Sastry

Amanda Askell Sandhini Agarwal Ariel Herbert-Voss Gretchen Krueger Tom Henighan

Rewon Child Aditya Ramesh Daniel M. Ziegler Jeffrey Wu Clemens Winter

Christopher Hesse Mark Chen Eric Sigler Mateusz Litwin Scott Gray

Benjamin Chess Jack Clark Christopher Berner

Sam McCandlish Alec Radford Ilya Sutskever Dario Amodei

OpenAI

Abstract

Recent work has demonstrated substantial gains on many NLP tasks and benchmarks by pre-training on a large corpus of text followed by fine-tuning on a specific task. While typically task-agnostic in architecture, this method still requires task-specific fine-tuning datasets of thousands or tens of thousands of examples. By contrast, humans can generally perform a new language task from only a few examples or from simple instructions – something which current NLP systems still largely struggle to do. Here we show that scaling up language models greatly improves task-agnostic, few-shot performance, sometimes even reaching competitiveness with prior state-of-the-art fine-tuning approaches. Specifically, we train GPT-3, an autoregressive language model with 175 billion parameters, 10x more than any previous non-sparse language model, and test its performance in the few-shot setting. For all tasks, GPT-3 is applied without any gradient updates or fine-tuning, with tasks and few-shot demonstrations specified purely via text interaction with the model. GPT-3 achieves strong performance on many NLP datasets, including translation, question-answering, and cloze tasks, as well as several tasks that require on-the-fly reasoning or domain adaptation, such as unscrambling words, using a novel word in a sentence, or performing 3-digit arithmetic. At the same time, we also identify some datasets where GPT-3's few-shot learning still struggles, as well as some datasets where GPT-3 faces methodological issues related to training on large web corpora. Finally, we find that GPT-3 can generate samples of news articles which human evaluators have difficulty distinguishing from articles written by humans. We discuss broader societal impacts of this finding and of GPT-3 in general.

*Equal contribution
†Johns Hopkins University, OpenAI

Author contributions listed at end of paper.

2020: GPT-3 LLMs Wave

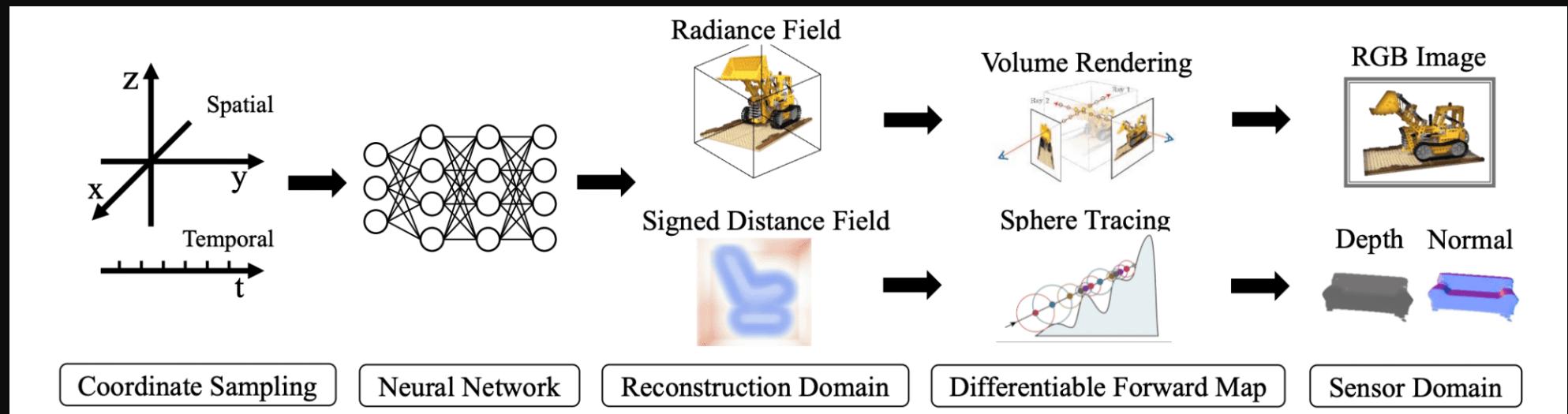
Title: United Methodists Agree to Historic Split

Subtitle: Those who oppose gay marriage will form their own denomination

Article: After two days of intense debate, the United Methodist Church has agreed to a historic split – one that is expected to end in the creation of a new denomination, one that will be "theologically and socially conservative," according to The Washington Post. The majority of delegates attending the church's annual General Conference in May voted to strengthen a ban on the ordination of LGBTQ clergy and to write new rules that will "discipline" clergy who officiate at same-sex weddings. But those who opposed these measures have a new plan: They say they will form a separate denomination by 2020, calling their church the Christian Methodist denomination.

The Post notes that the denomination, which claims 12.5 million members, was in the early 20th century the "largest Protestant denomination in the U.S.," but that it has been shrinking in recent decades. The new split will be the second in the church's history. The first occurred in 1968, when roughly 10 percent of the denomination left to form the Evangelical United Brethren Church. The Post notes that the proposed split "comes at a critical time for the church, which has been losing members for years," which has been "pushed toward the brink of a schism over the role of LGBTQ people in the church." Gay marriage is not the only issue that has divided the church. In 2016, the denomination was split over ordination of transgender clergy, with the North Pacific regional conference voting to ban them from serving as clergy, and the South Pacific regional conference voting to allow them.

Figure 3.14: The GPT-3 generated news article that humans had the greatest difficulty distinguishing from a human written article (accuracy: 12%).

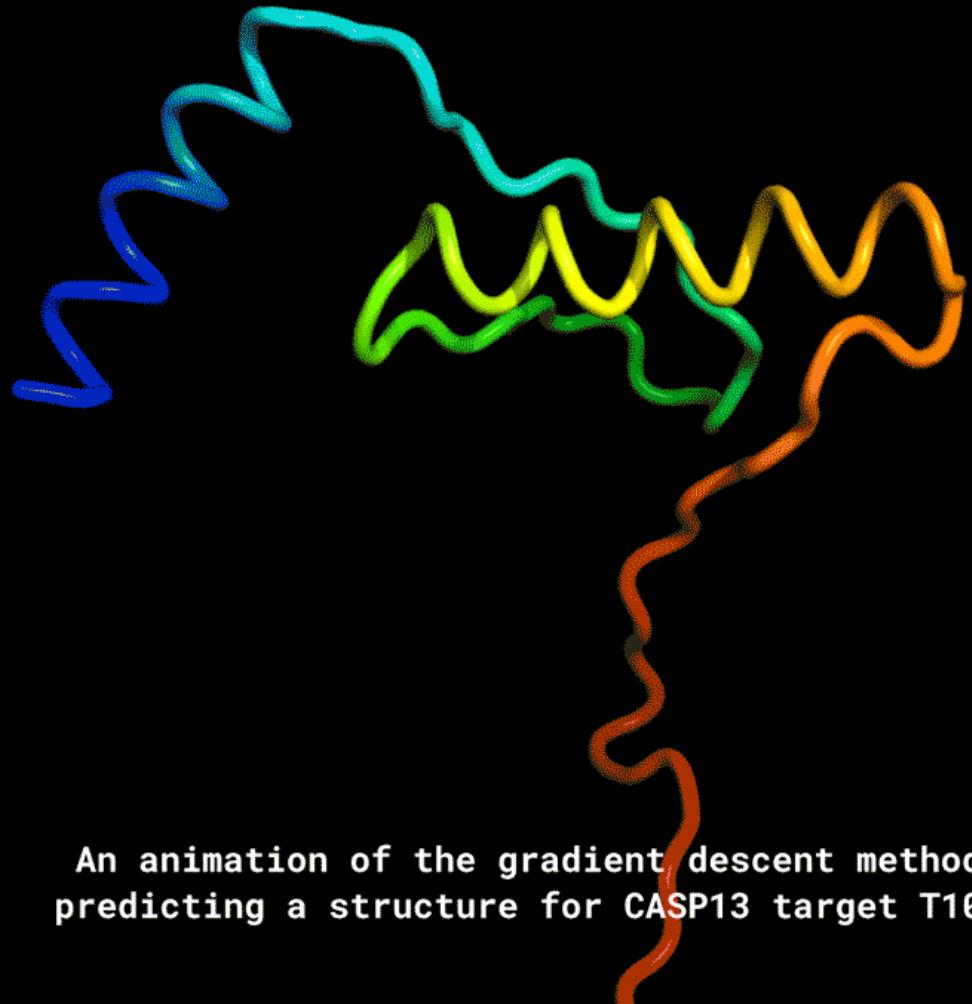


2020. Neural Radiance Field (NeRF)



2021

DeepMind's **AlphaFold** bring together experts from multiple fields to predict the 3D structure of a protein based solely on its genetic sequence.



An animation of the gradient descent method predicting a structure for CASP13 target T1008

TEXT PROMPT

an armchair in the shape of an avocado [...]

AI-GENERATED IMAGES



Edit prompt or view more images ↓

TEXT PROMPT

a store front that has the word 'openai' written on it [...]

AI-GENERATED IMAGES



TEXT AND IMAGE PROMPT

the exact same cat on the top as a sketch on the bottom

AI-GENERATED IMAGES



Edit prompt or view more images ↓

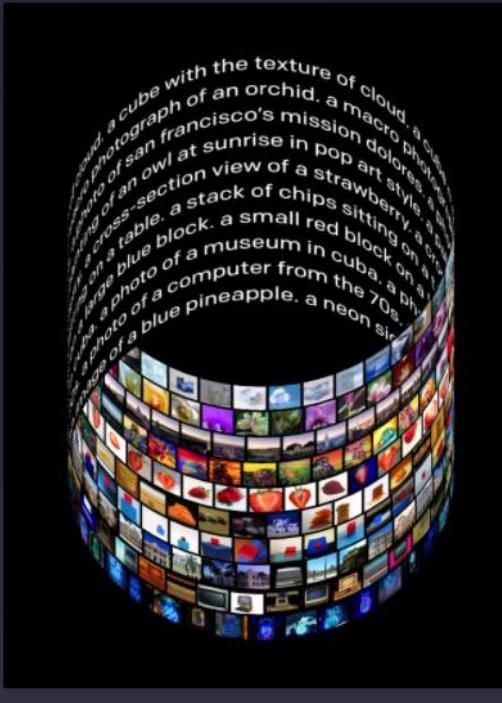
DALL·E: Creating Images from Text

We've trained a neural network called DALL·E that creates images from text captions for a wide range of concepts expressible in natural language.



January 5, 2021
27 minute read

2021



horse flying over a house in fire

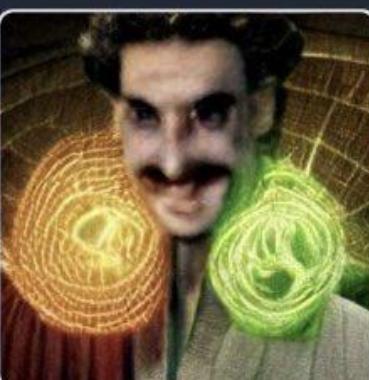
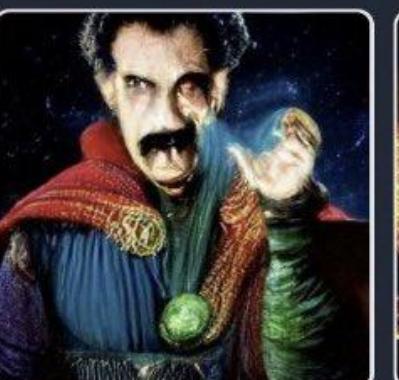
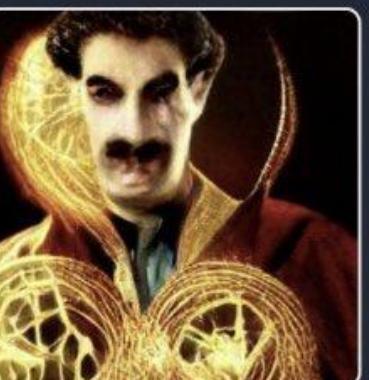
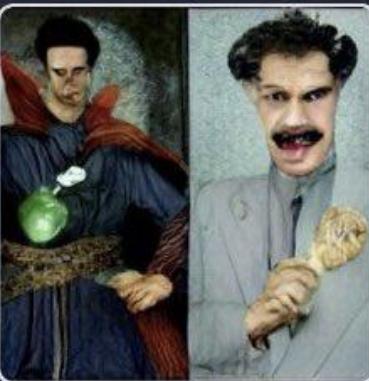
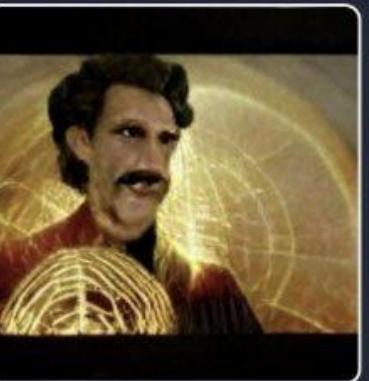
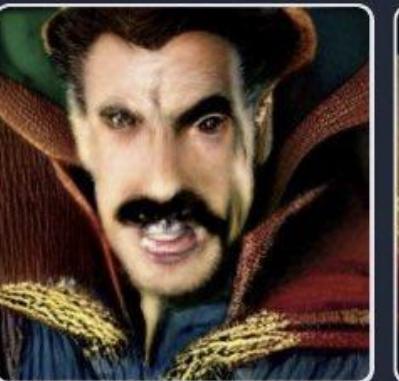
Run



<https://twitter.com/weirddalle/>

Borat as Dr Strange

Run



<https://twitter.com/weirddalle/>

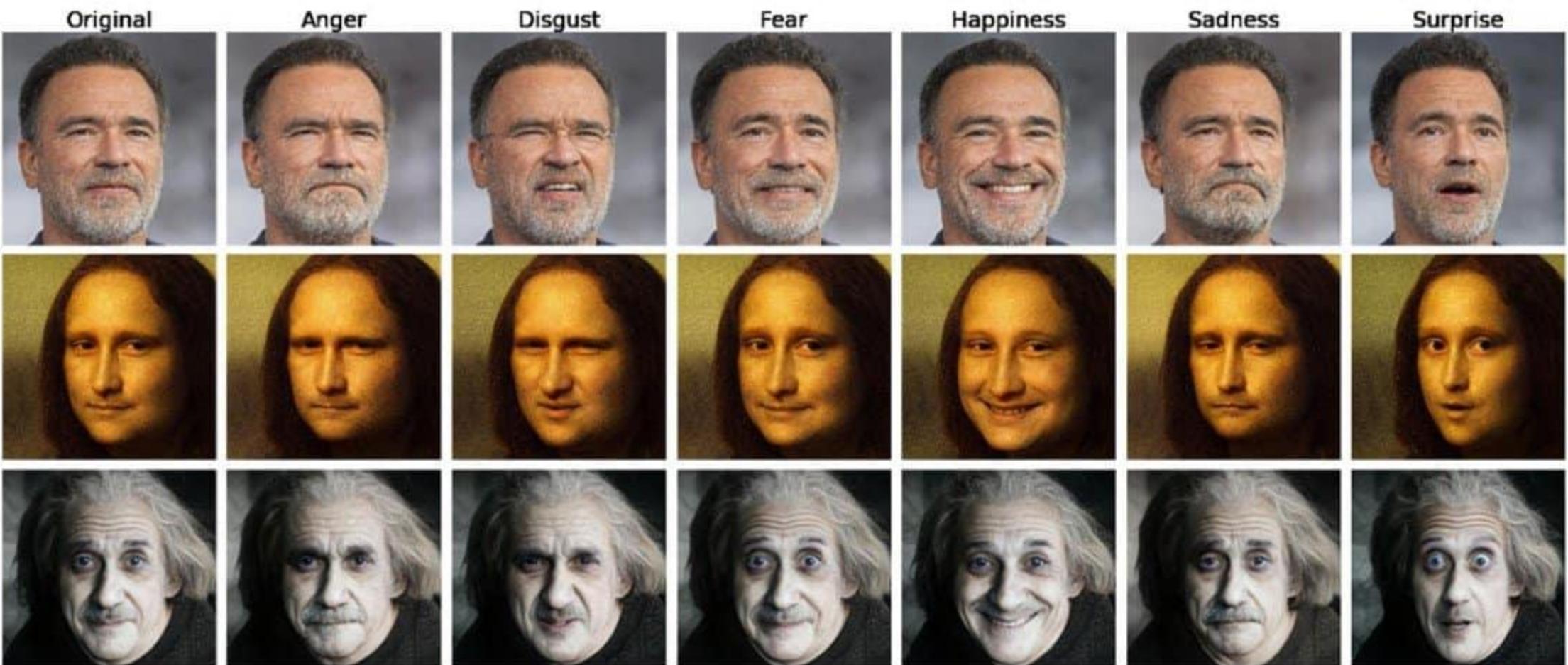
the demogorgon from Stranger Things holding a basketball

Run

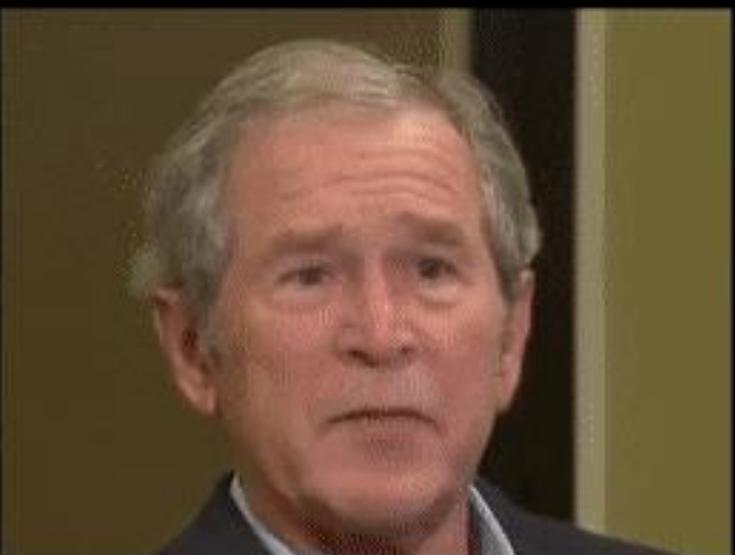


Roasted tardigrade on a barbecue





Source Actor



Target Actor

Real-time Reenactment



Reenactment Result

**Face2Face: Real-time Face
Capture and Reenactment of
RGB Videos (2020)**

2021. Stable Diffusion

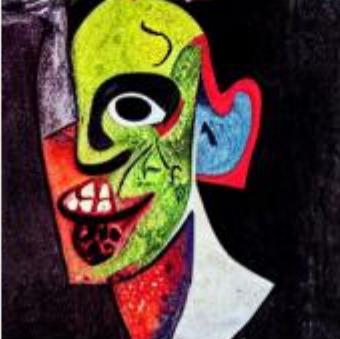
Better image Generation

Text-to-Image Synthesis on LAION. 1.45B Model.

'A street sign that reads
"Latent Diffusion"'



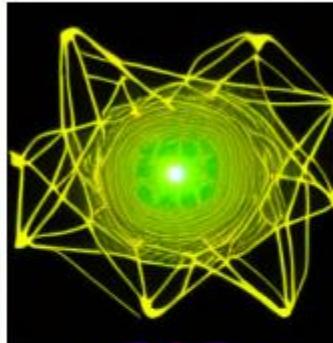
'A zombie in the
style of Picasso'



'An image of an animal
half mouse half octopus'



'An illustration of a slightly
conscious neural network'



'A painting of a
squirrel eating a burger'



'A watercolor painting of a
chair that looks like an octopus'



'A shirt with the inscription:
"I love generative models!"'





2022

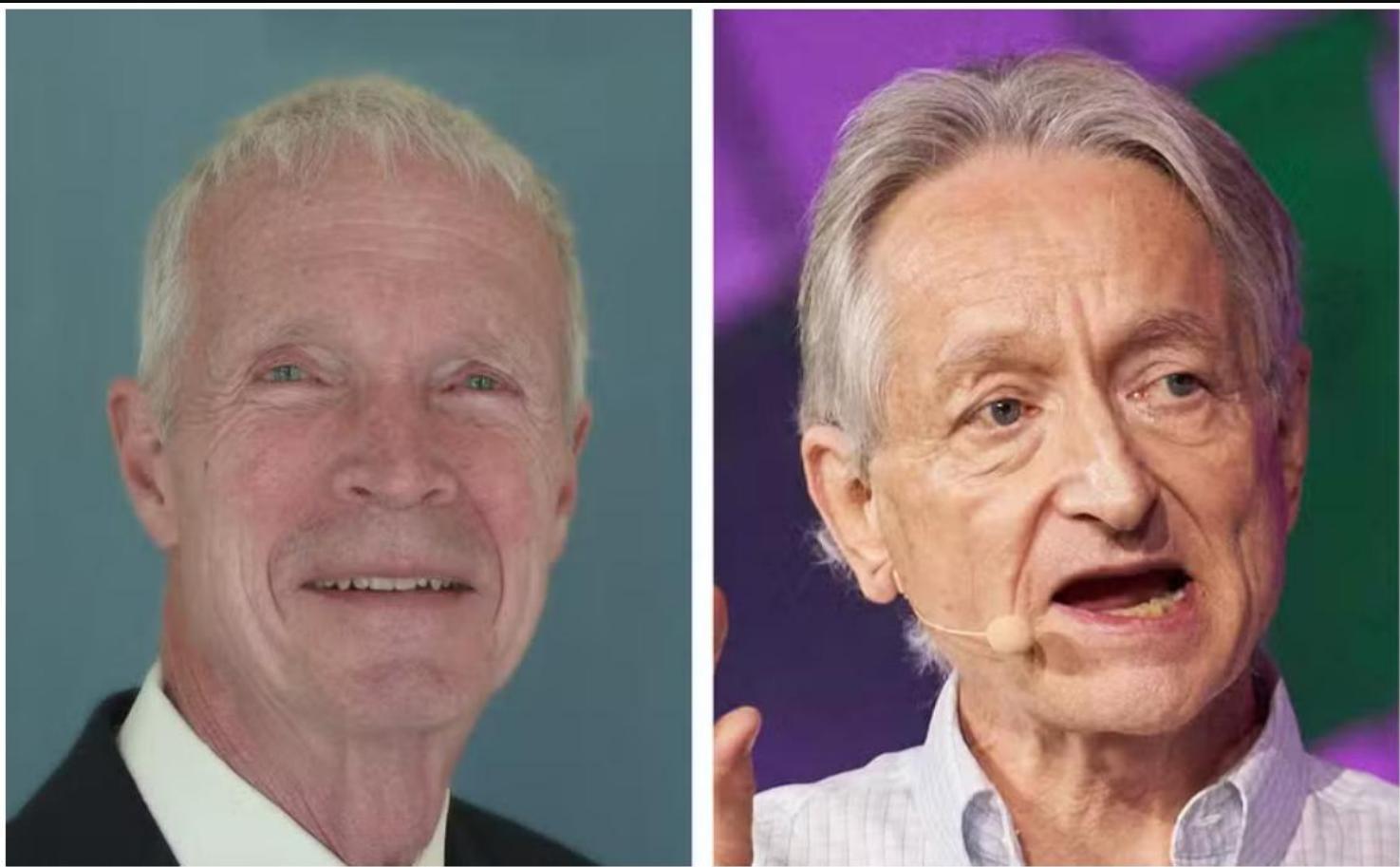
DALL·E 2 · An expressive oil painting of a basketball player dunking, depicted as an explosion of a nebula.



2023

DALL·E 3 · An expressive oil painting of a basketball player dunking, depicted as an explosion of a nebula.

Prêmio Nobel de Física 2024



John Hopfield e Geoffrey Hinton, cientistas pioneiros das redes neurais na inteligência artificial que ganharam o Prêmio Nobel de Física de 2024 — Foto:

Prêmio Nobel de Química 2024



NOBELPRISET I KEMI 2024
THE NOBEL PRIZE IN CHEMISTRY 2024



KUNGL.
VETENSKAPS-
AKADEMIEN

THE ROYAL SWEDISH ACADEMY OF SCIENCES



David Baker
University of Washington
USA

"för datorbaserad proteindesign"

"for computational protein design"

#NobelPrize



Demis Hassabis
Google DeepMind
United Kingdom

"för proteinstrukturprediktion"

"for protein structure prediction"



John M. Jumper
Google DeepMind
United Kingdom

THE
NOBEL
PRIZE

Things have gone wild...

- ChatGPT, Gemini, Copilot, etc.
- Chatbots, geração de texto e código
- Geração de imagem
- Geração e entendimento de vídeos
- Modelos multimodais
- Modelos de *Reasoning*
- Arquiteturas de agentes e multiagentes
- GenAI pode interagir outros aplicativos ...

Muitos avanços passam a acontecer em empresas

OpenAI, Microsoft, Google, Anthropic, DeepSeek,
Manus, Nvidia, Meta, Twitter/X

* Companies that release
good open source models ❤️



Animado com o que está por vir! 😊

ChatGPT ▾

Share

generate an image of yourself asking if students have questions.

A friendly robot teacher with a white dome-shaped head, large black eyes, and a smiling mouth is standing in front of a chalkboard. The robot is wearing a blue long-sleeved shirt and has a small antenna on its head. It is gesturing with its right hand while speaking. A speech bubble above the robot contains the text "Any questions?". In the foreground, the backs of three students' heads are visible, suggesting they are seated at their desks. The setting is a classroom with a green chalkboard in the background.

Any questions?