

# Introducción a Deep Learning

## Deep Learning

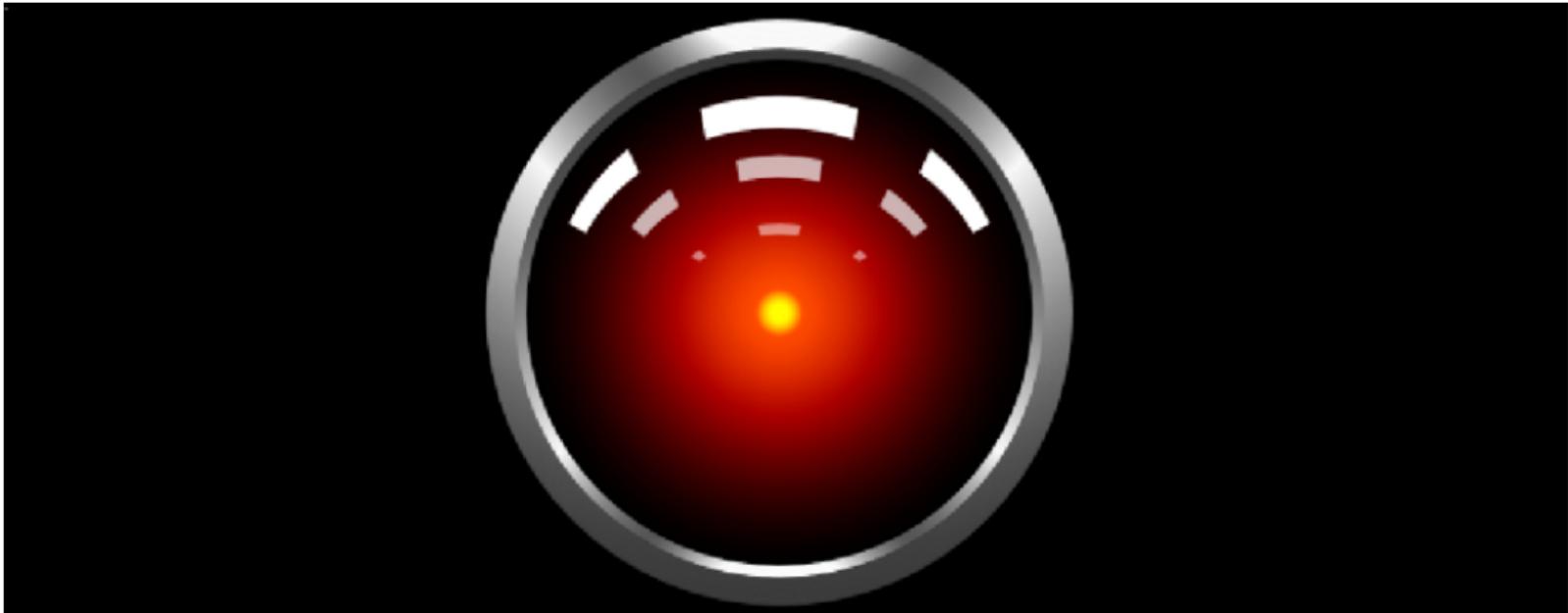


Marco Teran  
Universidad Sergio Arboleda

2023

# Contenido

- 1 Un poco de historia...
- 2 ¿Qué es la Ingeligencia Artificial?
- 3 Aprendizaje de Máquina
  - Redes Neuronales
- 4 Aplicaciones



► ver video

**Un poco de historia...**



# The thinking machine



▶ ver video

original EN

# DeepBlue vs Gasparov (1997)



► ver video

# DeepBlue vs Gasparov (1997)

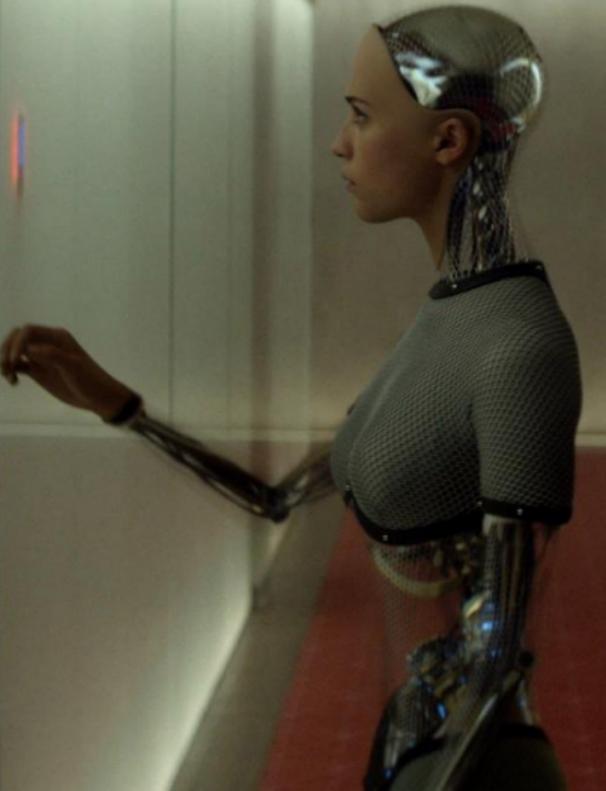


► ver video

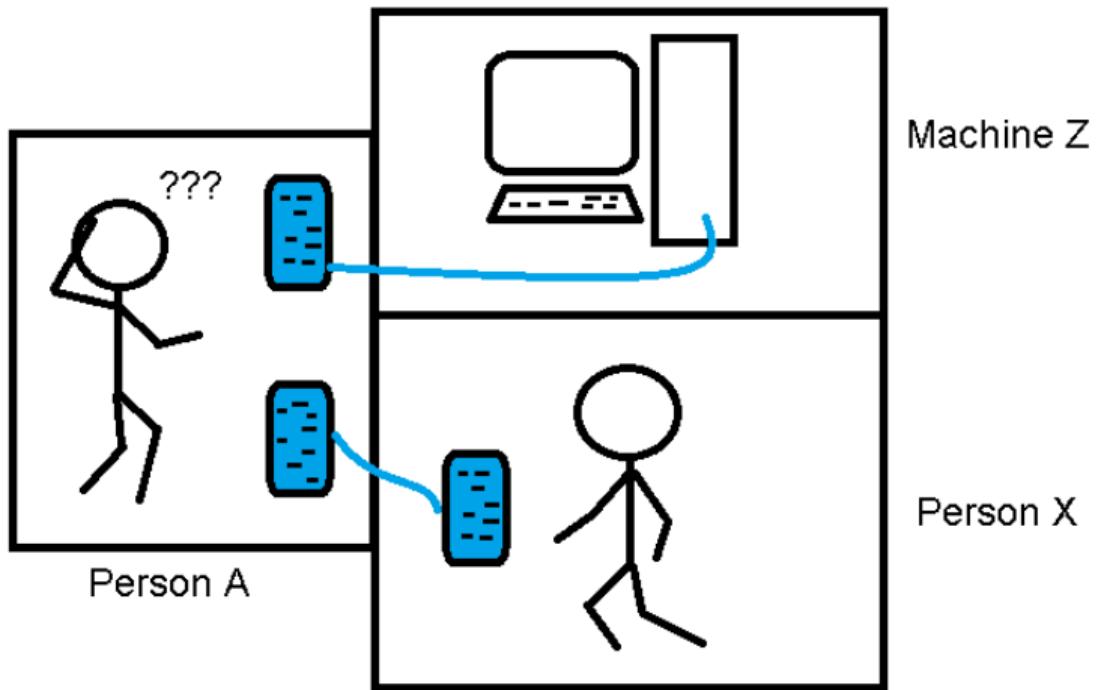
# computer chess



*¿Qué es la Ingelingencia Artificial?*

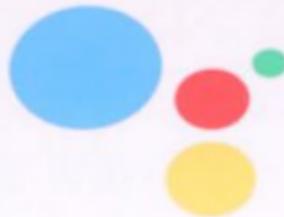


# El test de turing



# El test de turing





Hi, how can I help?



# Google Duplex (2018)



Google Duplex

Advancing AI for Everyone



► ver video

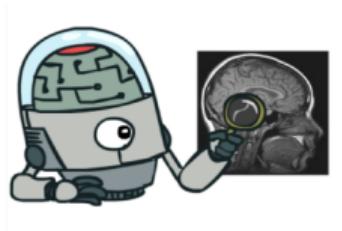
# Inteligencia Artificial

La noción de **inteligencia** puede ser definida de varias formas:

“the ability to take the right decisions, according to some criterion  
(e.g. survival and reproduction, for most animals)”

La toma de buenas decisiones requiere **conocimiento** en forma  
**operacional**.

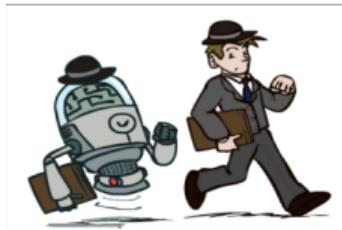
# Cuatro enfoques



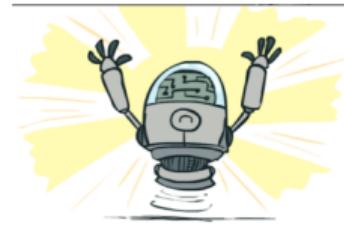
(a) Pensar como humano



(b) Pensar razonadamente



(c) Actuar como humano



(d) Actuar razonadamente

# ¿Qué es IA?

La ciencia de hacer máquinas que:

- Piensen como las personas.
- Actúen como las personas (acciones y comportamientos de humanos)
- Piensen y actúen racionalmente.

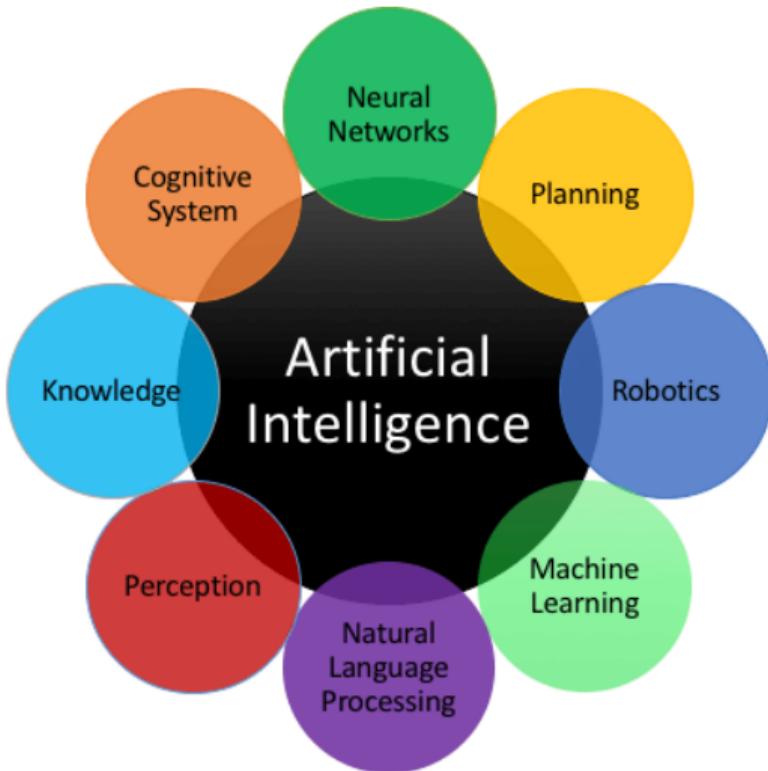
**Agente:** el software responsable por la inteligencia.

**Robot:** el hardware usado para reemplazar al humano.

# Inteligencia Artificial hoy en día:

## Racionalidad Computacional

- Racionalidad: Alcanzar, de manera óptima, objetivos predefinidos
- Objetivos → función de utilidad
- Actuar racionalmente → maximizar la utilidad



## Requerimientos para un agente ideal:

- Representación del Conocimiento/Razonamiento
- Aprendizaje computacional
- Percepción
- Planeación
- Robótica
- Lenguaje
- Planeación

# Aprendizaje de Máquina

Los computadores sólo pueden hacer lo que se les dice que hagan

¿Y qué tal si le decimos a la máquina que aprenda por si misma y mejore continuamente?

1993

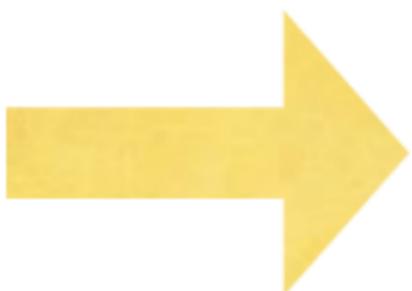
1997

1994

1968

1994

1995



1993

1997

1994

1968

1994

1945

# Aprendizaje de maquina

## Programación tradicional



## Machine Learning



# Aprendizaje de maquina

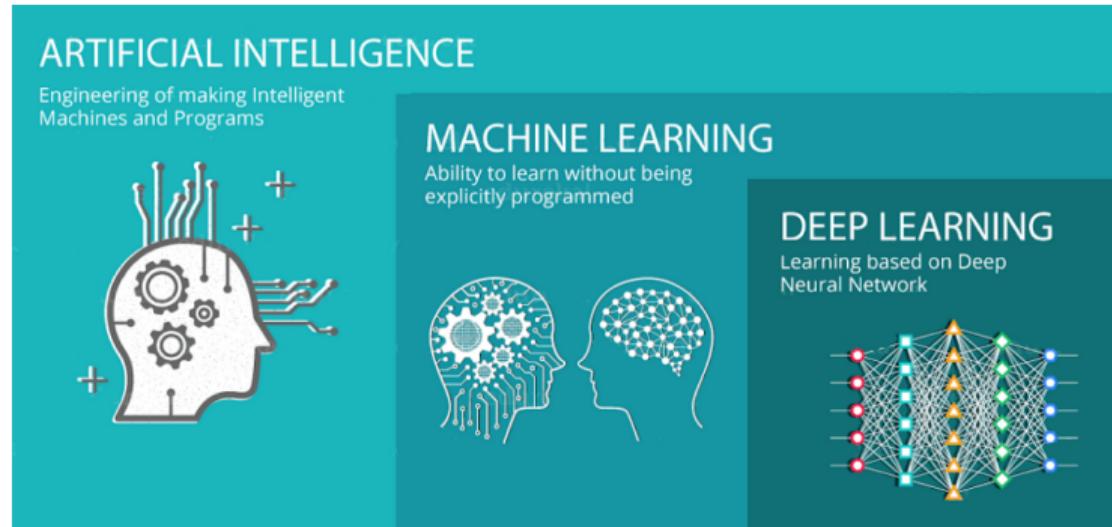
La noción de aprendizaje puede ser definida de varias formas:

“The acquisition of knowledge or skills through study, experience, or being taught”

“the act of acquiring new, or modifying and reinforcing, existing knowledge, behaviors, skills, values, or preferences”

El **aprendizaje de máquina (machine learning)** estudia algoritmos computacionales que permiten a un agente aprender a hacer cosas (acciones, decisiones, ... )

# Inteligencia Artificial



- **Inteligencia Artificial (Artificial Intelligence)**: Cualquier técnica que permita a los ordenadores imitar el comportamiento humano
- **Aprendizaje de maquina (Machine Learning)**: Capacidad de aprender sin ser programado explícitamente
- **Aprendizaje profundo (Deep Learning)**: Extraer patrones de datos utilizando redes neuronales (neural networks)

## **ARTIFICIAL INTELLIGENCE**

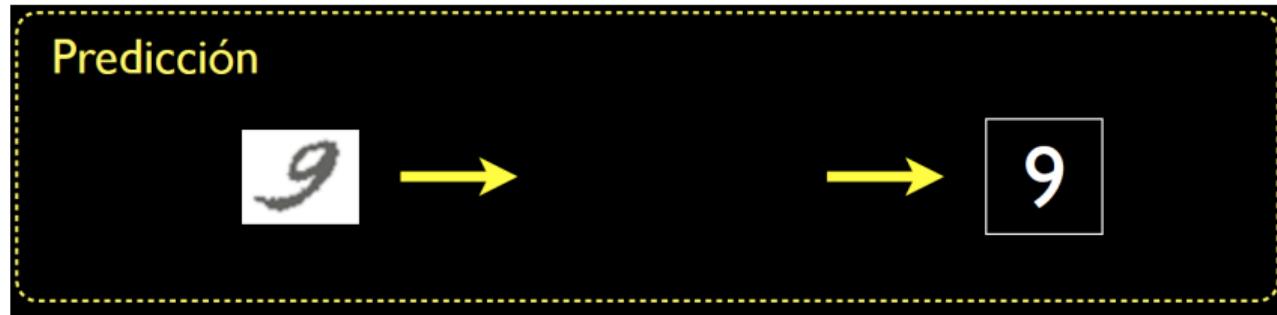
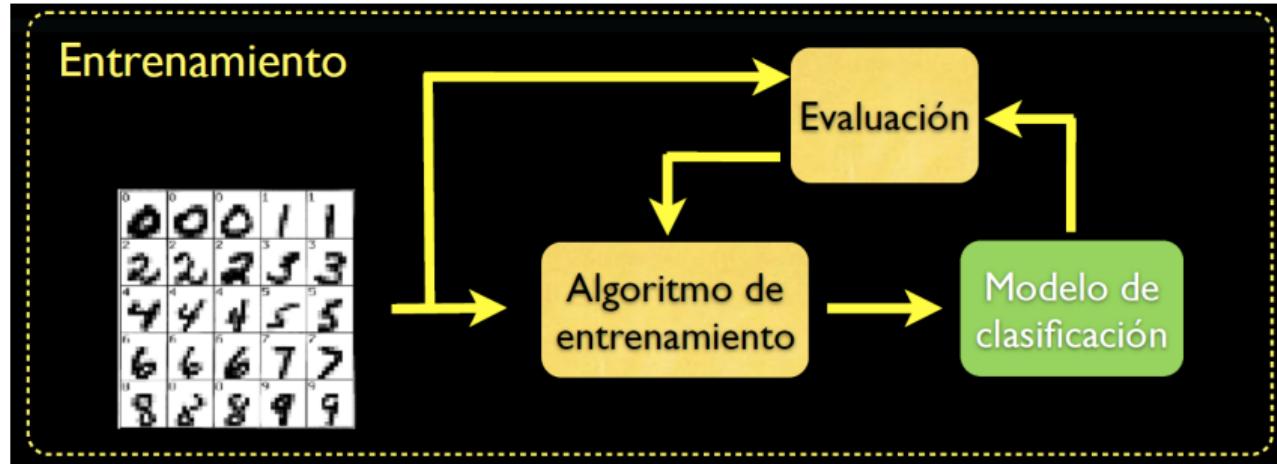
A program that can sense, reason,  
act, and adapt

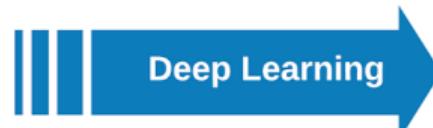
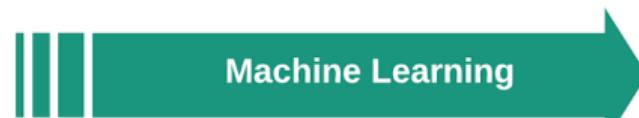
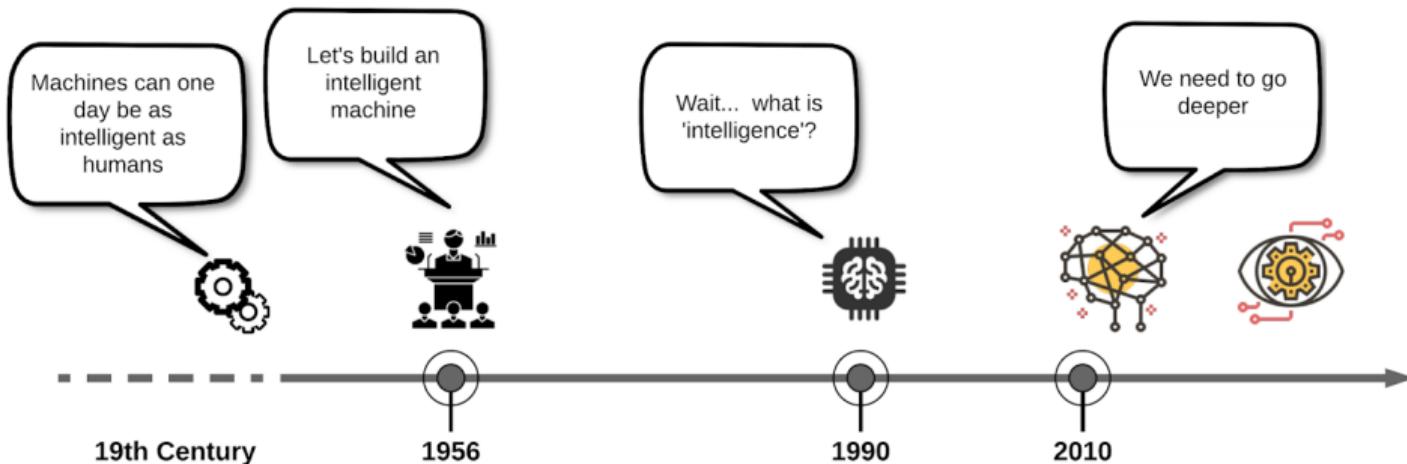
## **MACHINE LEARNING**

Algorithms whose performance improve  
as they are exposed to more data over time

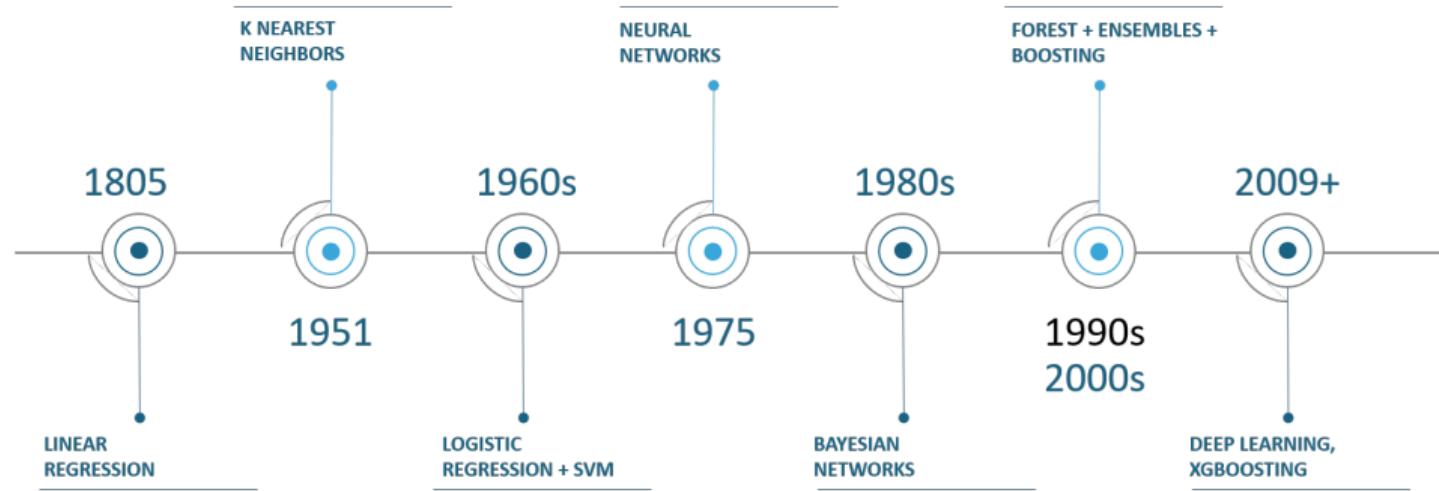
## **DEEP LEARNING**

Subset of machine learning in  
which multilayered neural  
networks learn from  
vast amounts of data





# Línea del tiempo del Machine Learning



# Redes Neuronales

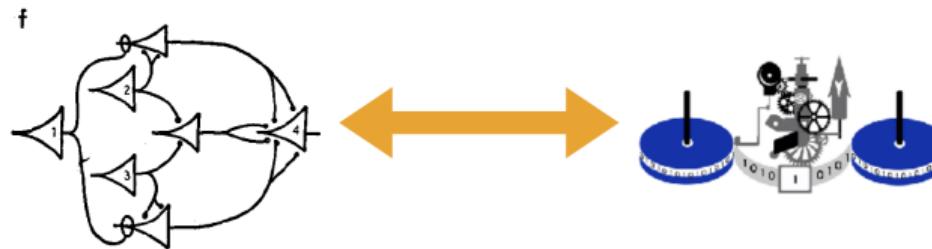
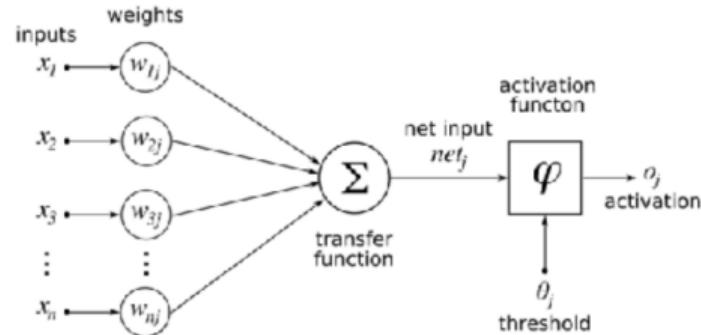
# McCulloch & Pitts Artificial Neuron

BULLETIN OF  
MATHEMATICAL BIOPHYSICS  
VOLUME 5, 1943

## A LOGICAL CALCULUS OF THE IDEAS IMMANENT IN NERVOUS ACTIVITY

WARREN S. McCULLOCH AND WALTER PITTS

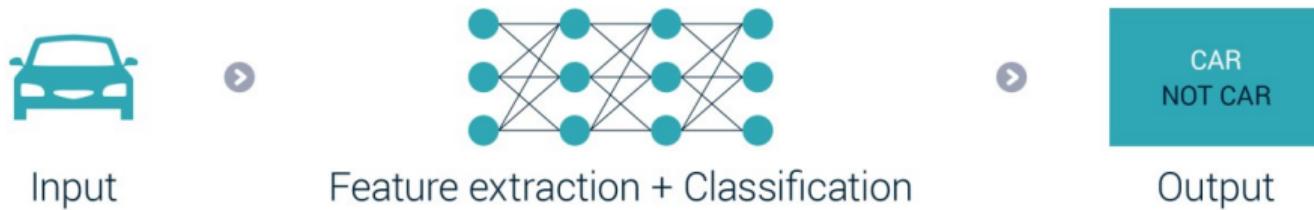
FROM THE UNIVERSITY OF ILLINOIS, COLLEGE OF MEDICINE,  
DEPARTMENT OF PSYCHIATRY AT THE ILLINOIS NEUROPSYCHIATRIC INSTITUTE,  
AND THE UNIVERSITY OF CHICAGO

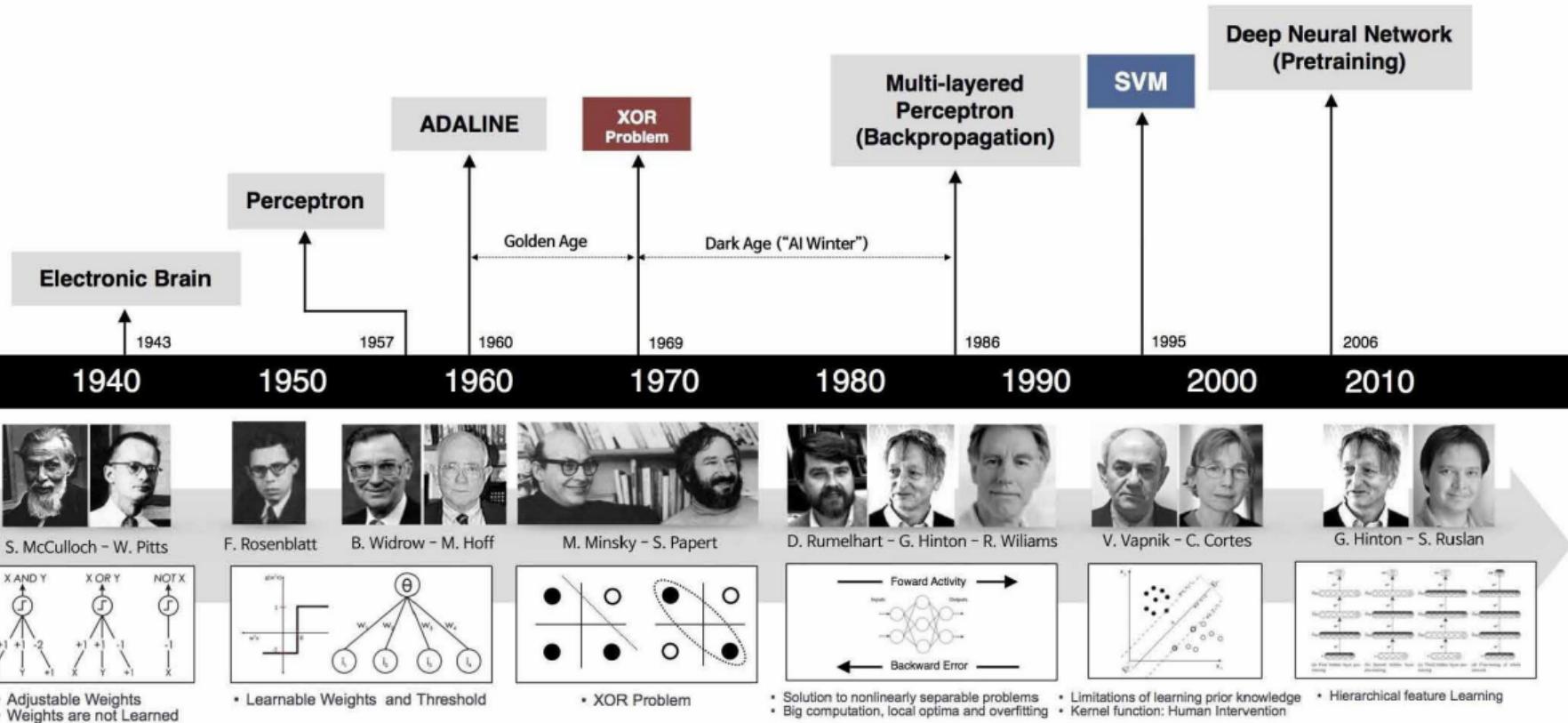


## Machine Learning

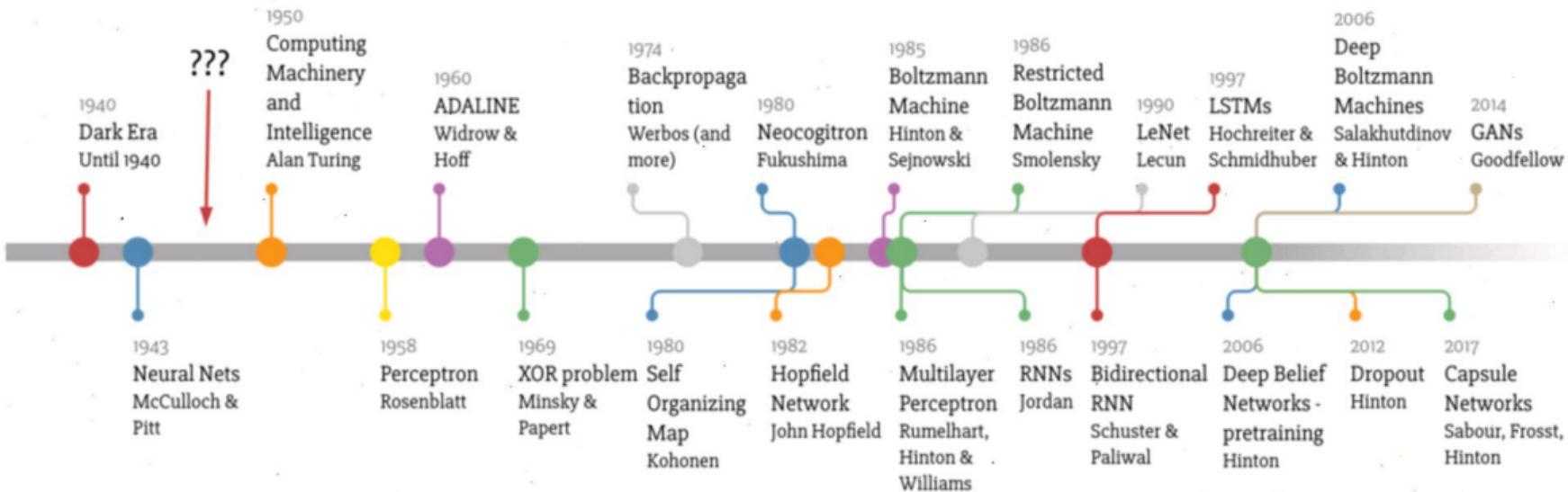


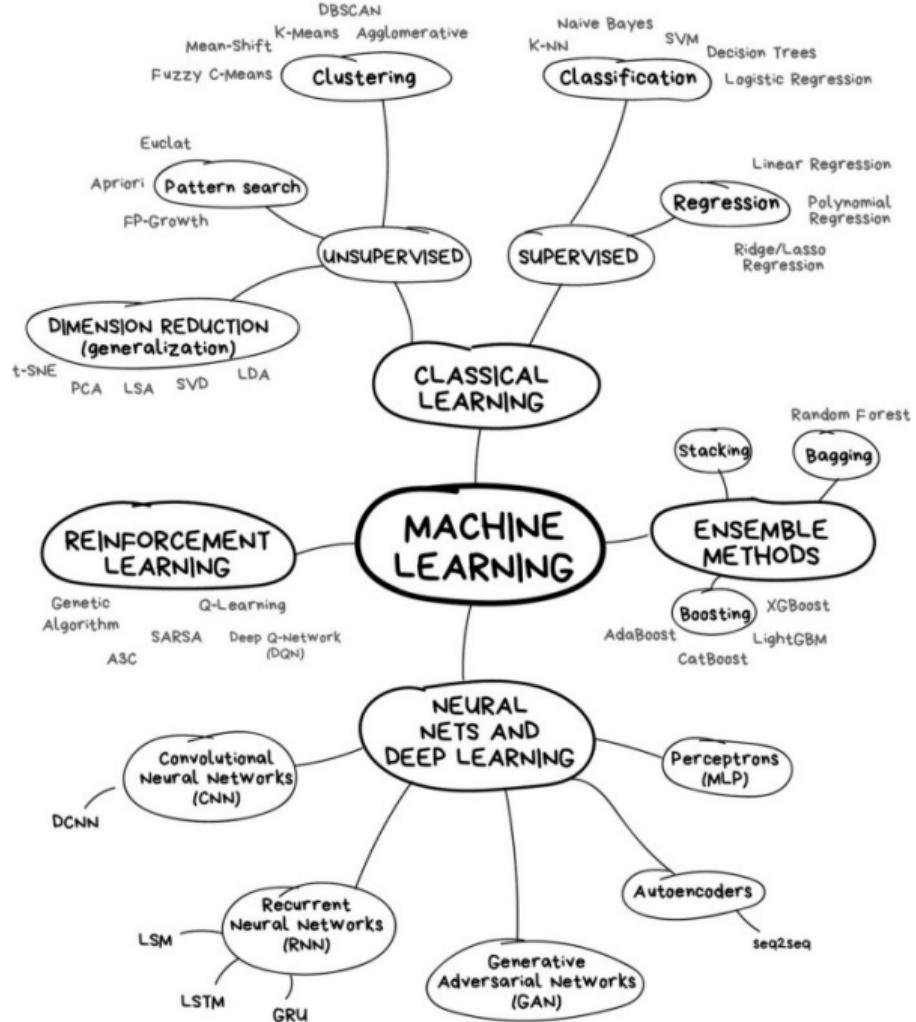
## Deep Learning

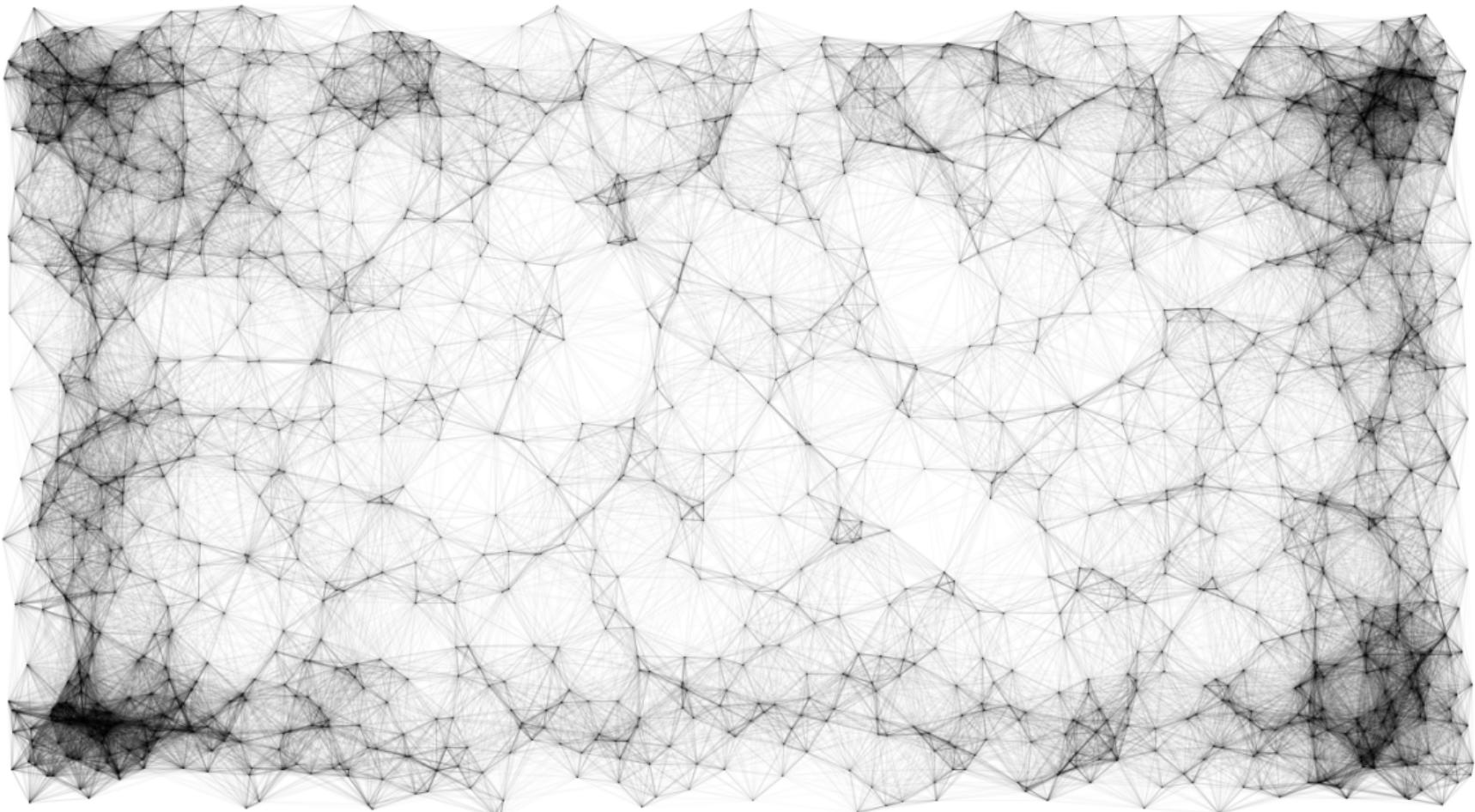




# Deep Learning Timeline



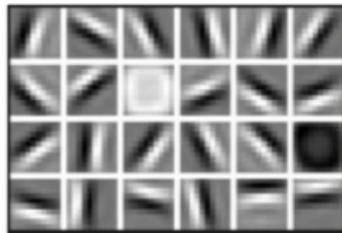




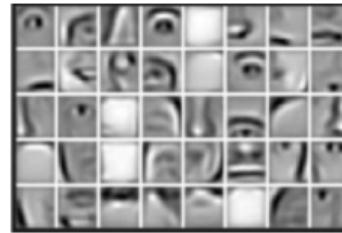
**¿Por qué Deep Learning y por qué ahora?**

# ¿Por qué el Deep Learning?

- Las características diseñadas a mano consumen mucho tiempo, son frágiles y no se pueden escalar en la práctica.
- ¿Podemos aprender las **características subyacentes** directamente de los datos?



(g) Características de bajo nivel: Líneas y bordes



(h) Características de nivel medio: Ojos, nariz y oídos



(i) Características de alto nivel: Estructura facial

# ¿Por qué ahora

1952	Stochastic Gradient Descent
1958	Perceptron <ul style="list-style-type: none"><li>• Learnable Weights</li></ul>
⋮	
1986	Backpropagation <ul style="list-style-type: none"><li>• Multi-Layer Perceptron</li></ul>
1995	Deep Convolutional NN <ul style="list-style-type: none"><li>• Digit Recognition</li></ul>
⋮	

Las redes neuronales se remontan a décadas atrás, así que ¿por qué el resurgimiento?

## 1. Big Data

- Conjuntos de datos más grandes
- Recolección y almacenamiento más fácil

IMagenet



## 2. Hardware

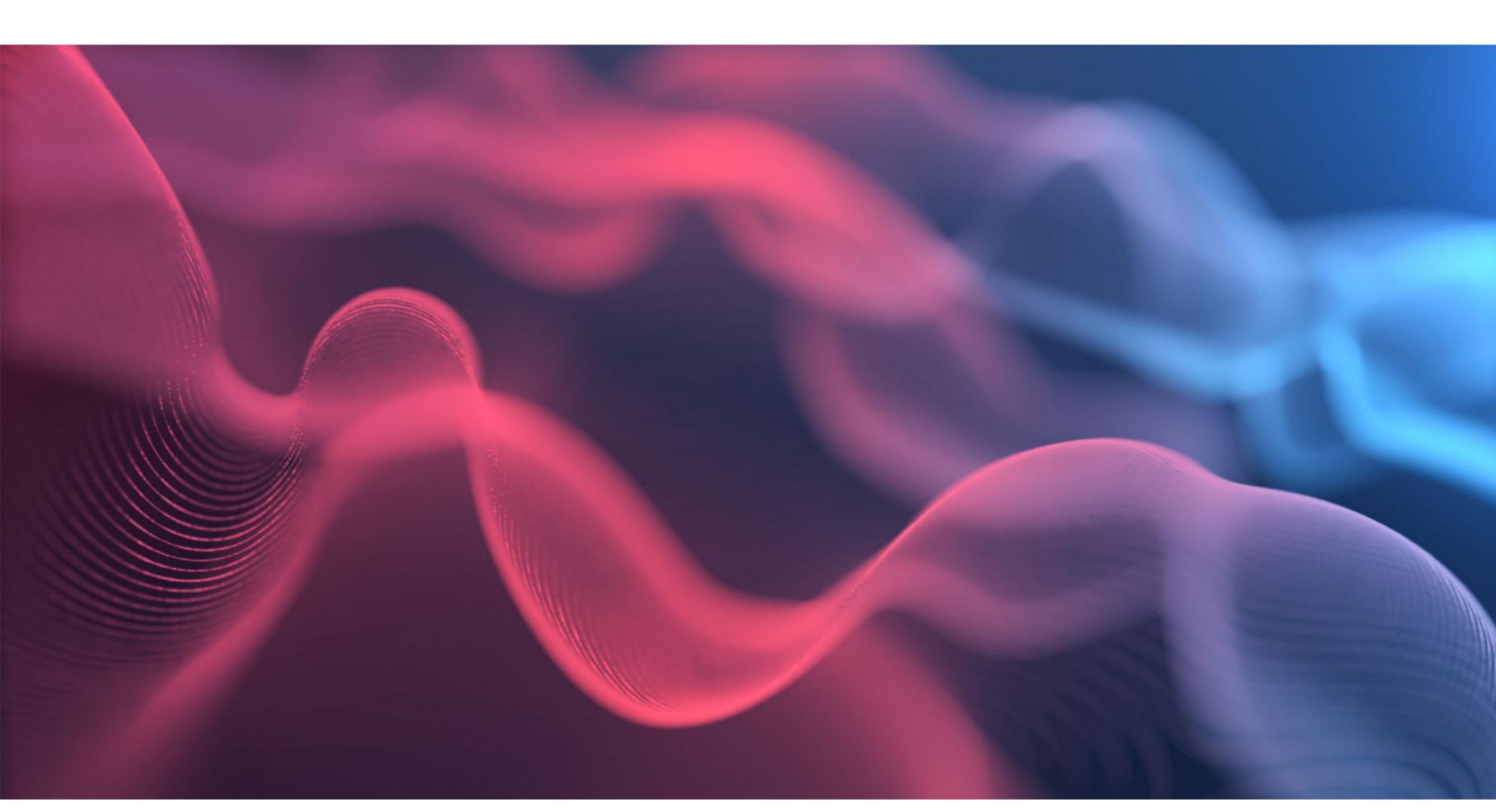
- Unidades de procesamiento gráfico (GPU)
- Masivamente paralelizable



## 3. Software

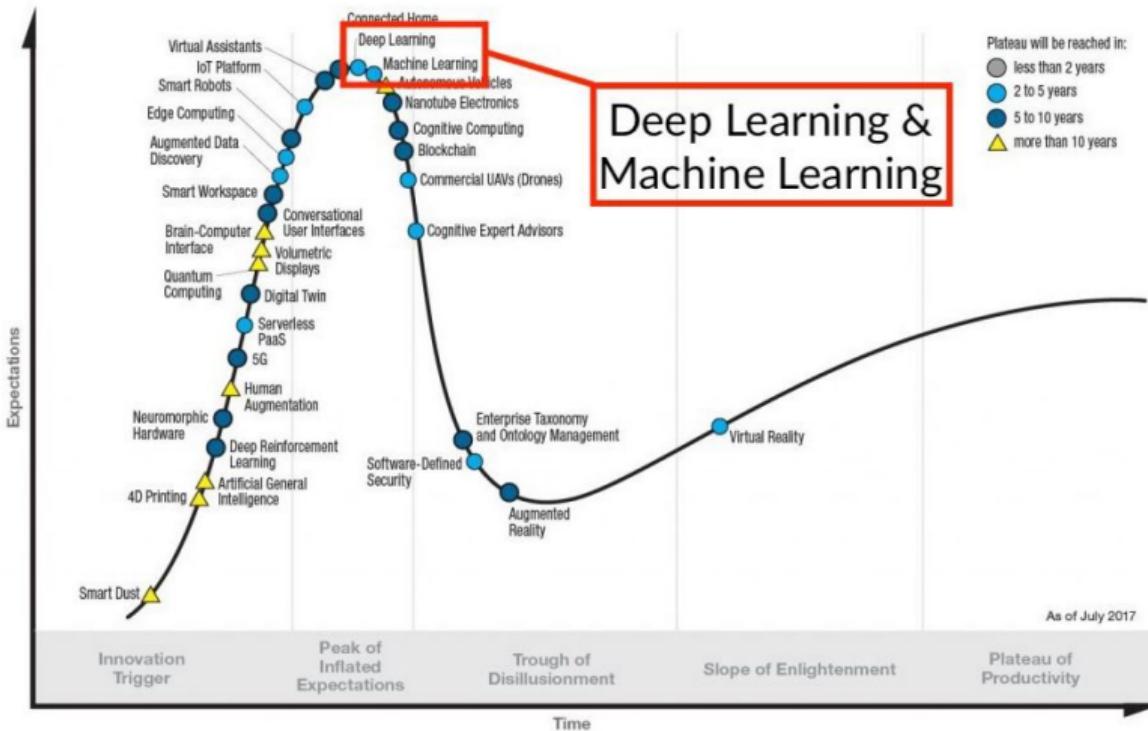
- Técnicas mejoradas
- Nuevos modelos
- Toolboxes





# Aplicaciones

# Gartner Hype Cycle for Emerging Technologies, 2017



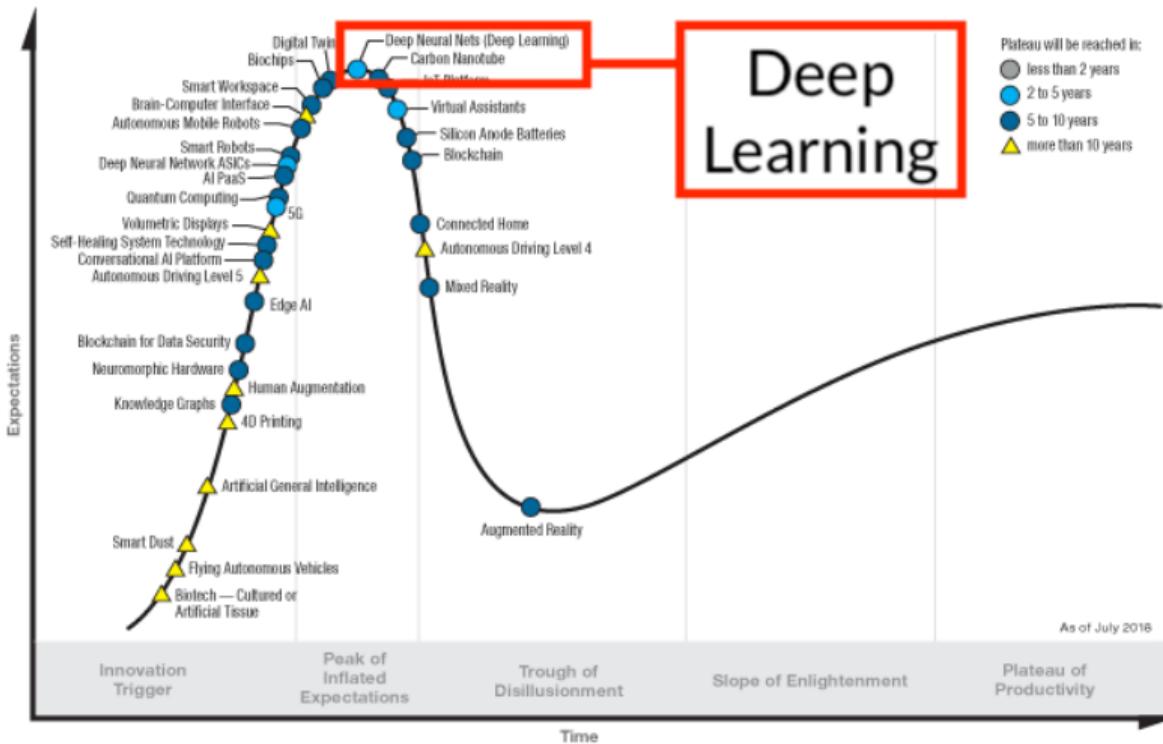
[gartner.com/SmarterWithGartner](http://gartner.com/SmarterWithGartner)

Source: Gartner (July 2017)

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**Gartner**

# Hype Cycle for Emerging Technologies, 2018



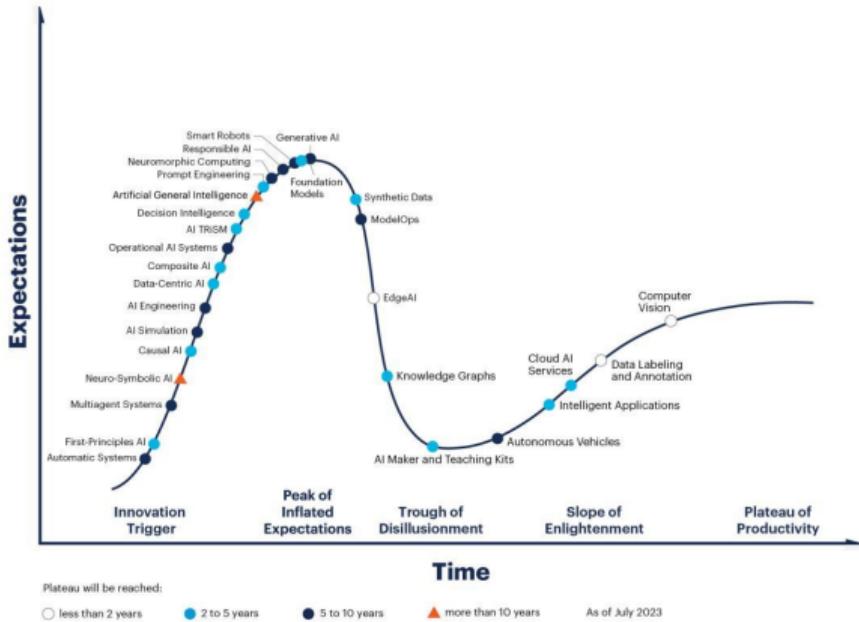
[gartner.com/SmarterWithGartner](http://gartner.com/SmarterWithGartner)

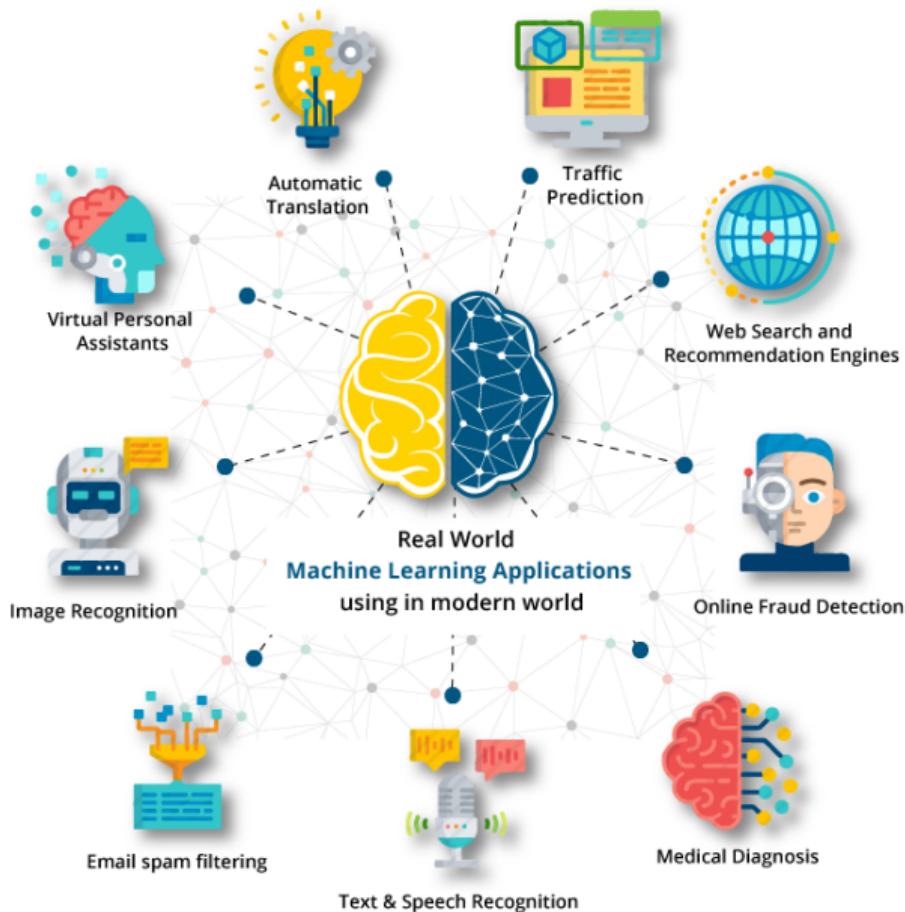
Source: Gartner (August 2018)

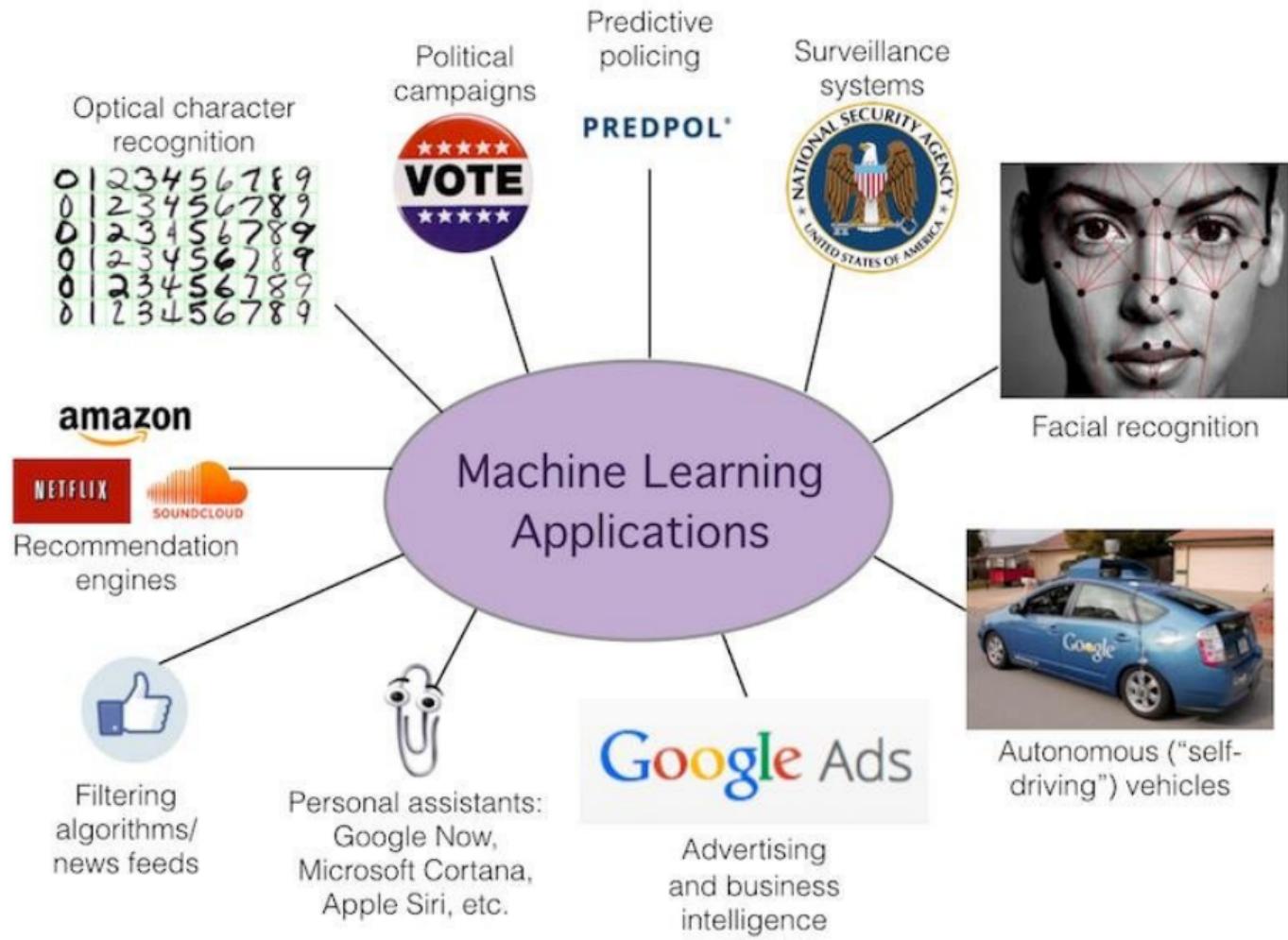
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Gartner

# Hype Cycle for Artificial Intelligence, 2023







# Procesamiento de lenguaje natural

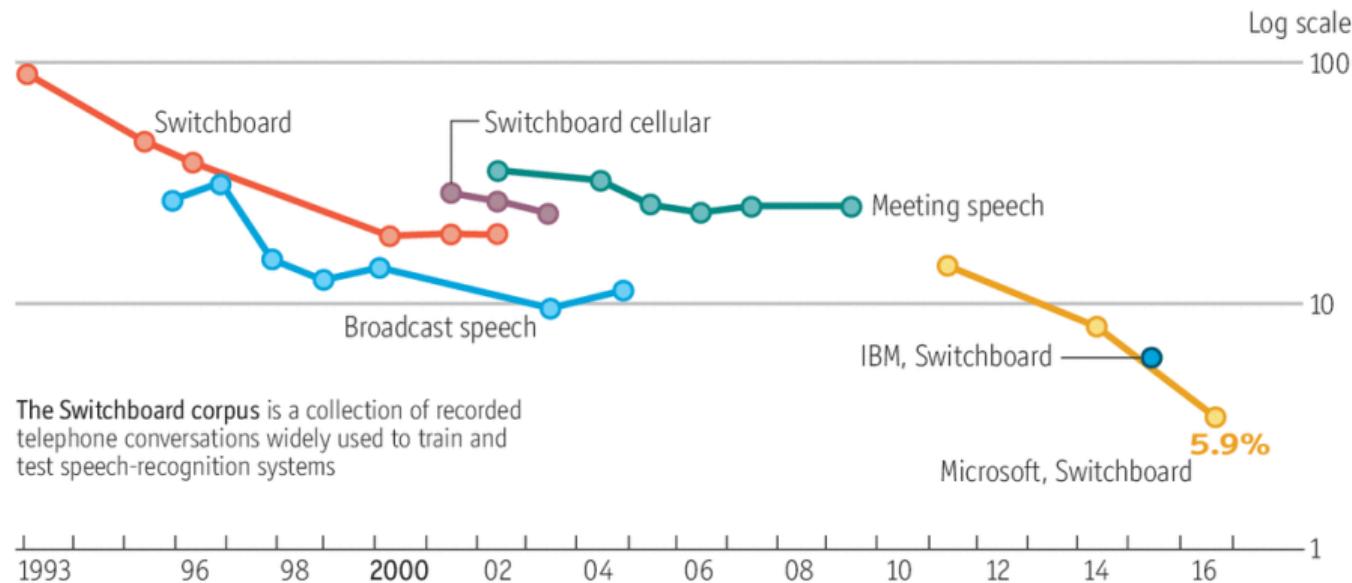
- Dado un texto, predecir la temática
- Dado un email, predecir si este es un spam
- Dado un texto, predecir el idioma y su traducción a otro lenguaje



# Reconocimiento de Voz

## Loud and clear

Speech-recognition word-error rate, selected benchmarks, %



The **Switchboard corpus** is a collection of recorded telephone conversations widely used to train and test speech-recognition systems

Sources: Microsoft; research papers

Economist.com

# Reconocimiento de Voz

FAR-FIELD

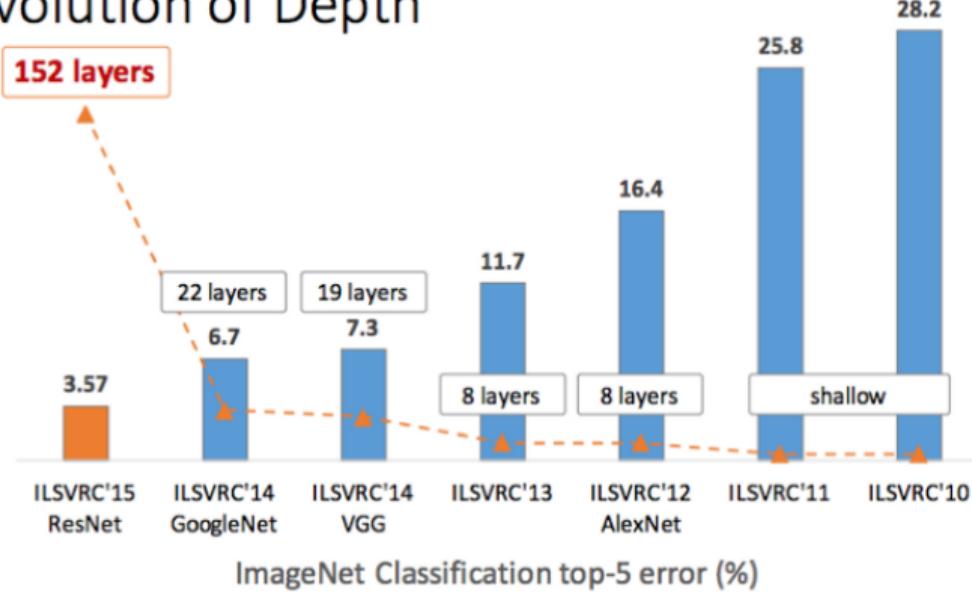
VOICE RECOGNITION



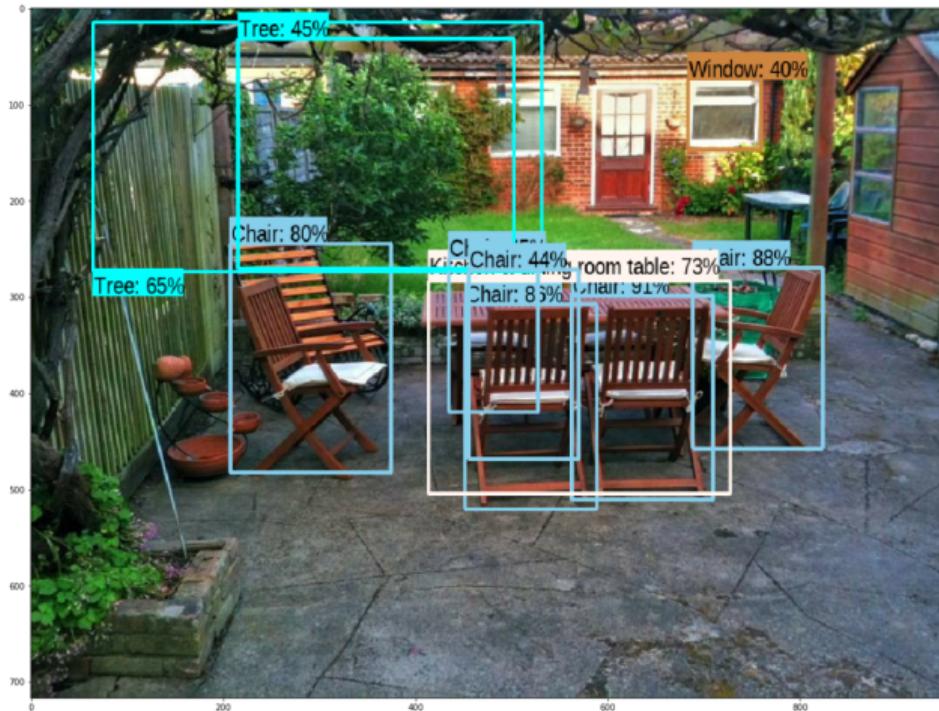
► ver video

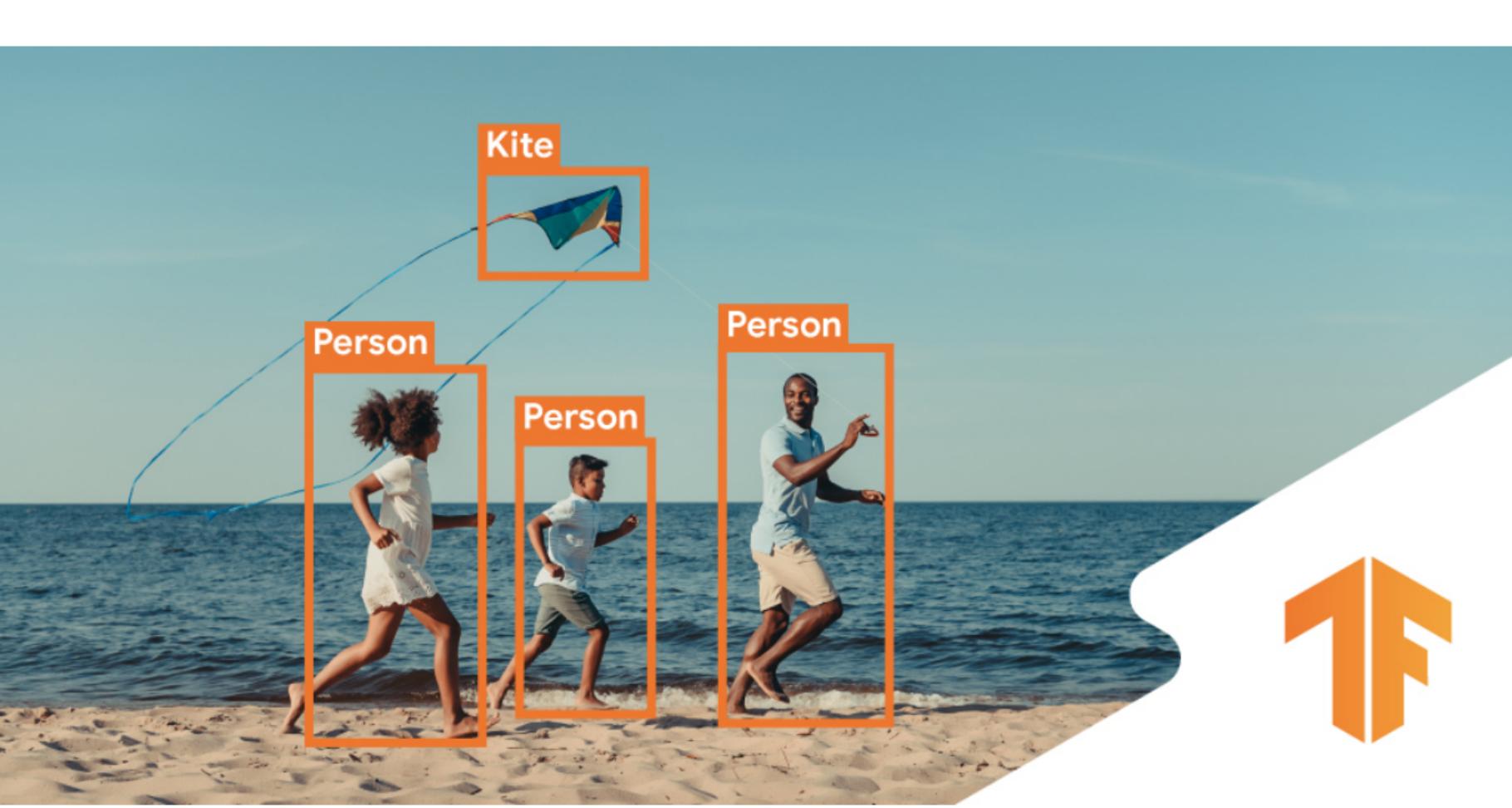
# Visión por Computador

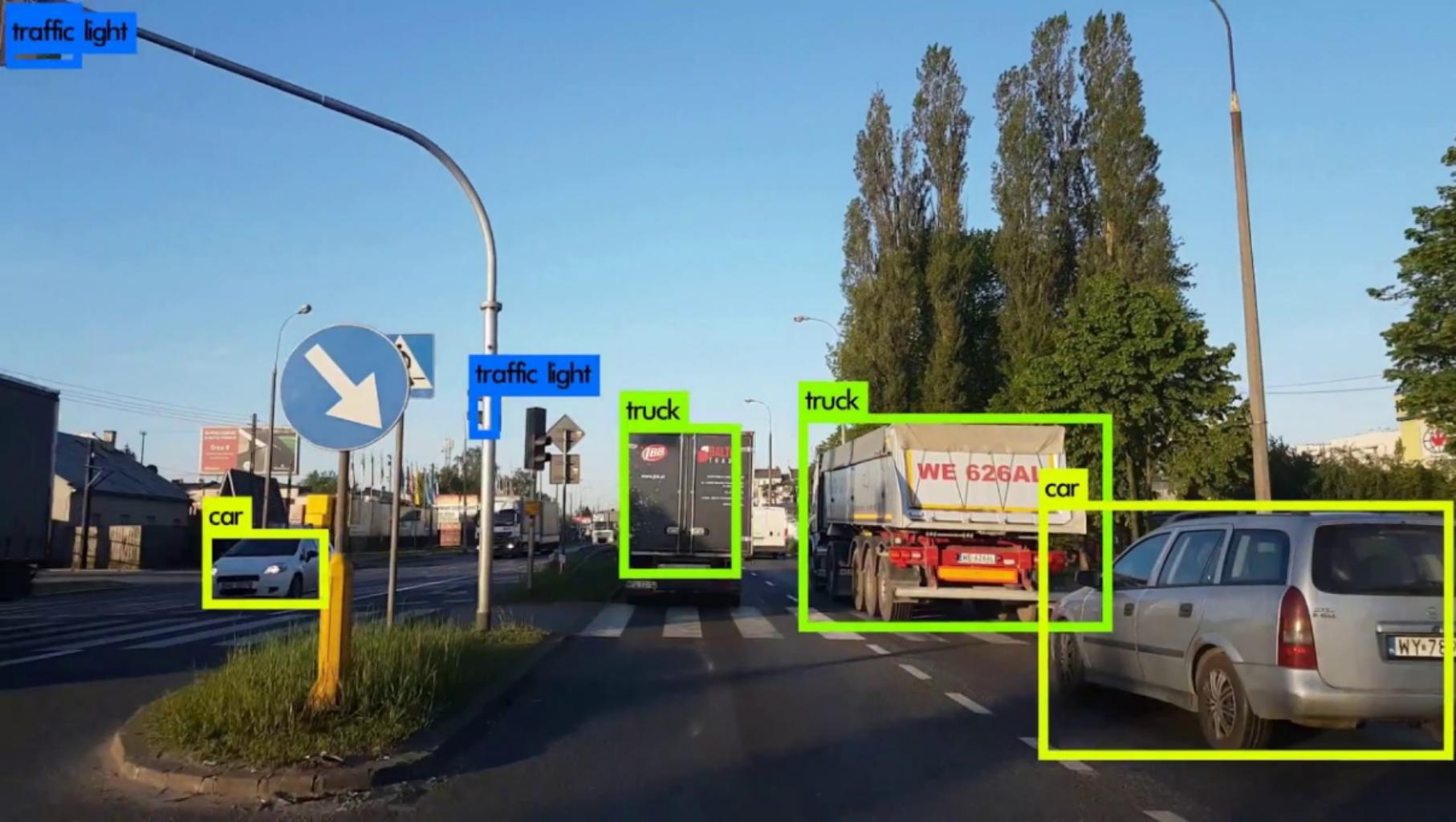
## Revolution of Depth



# Detección de objetos





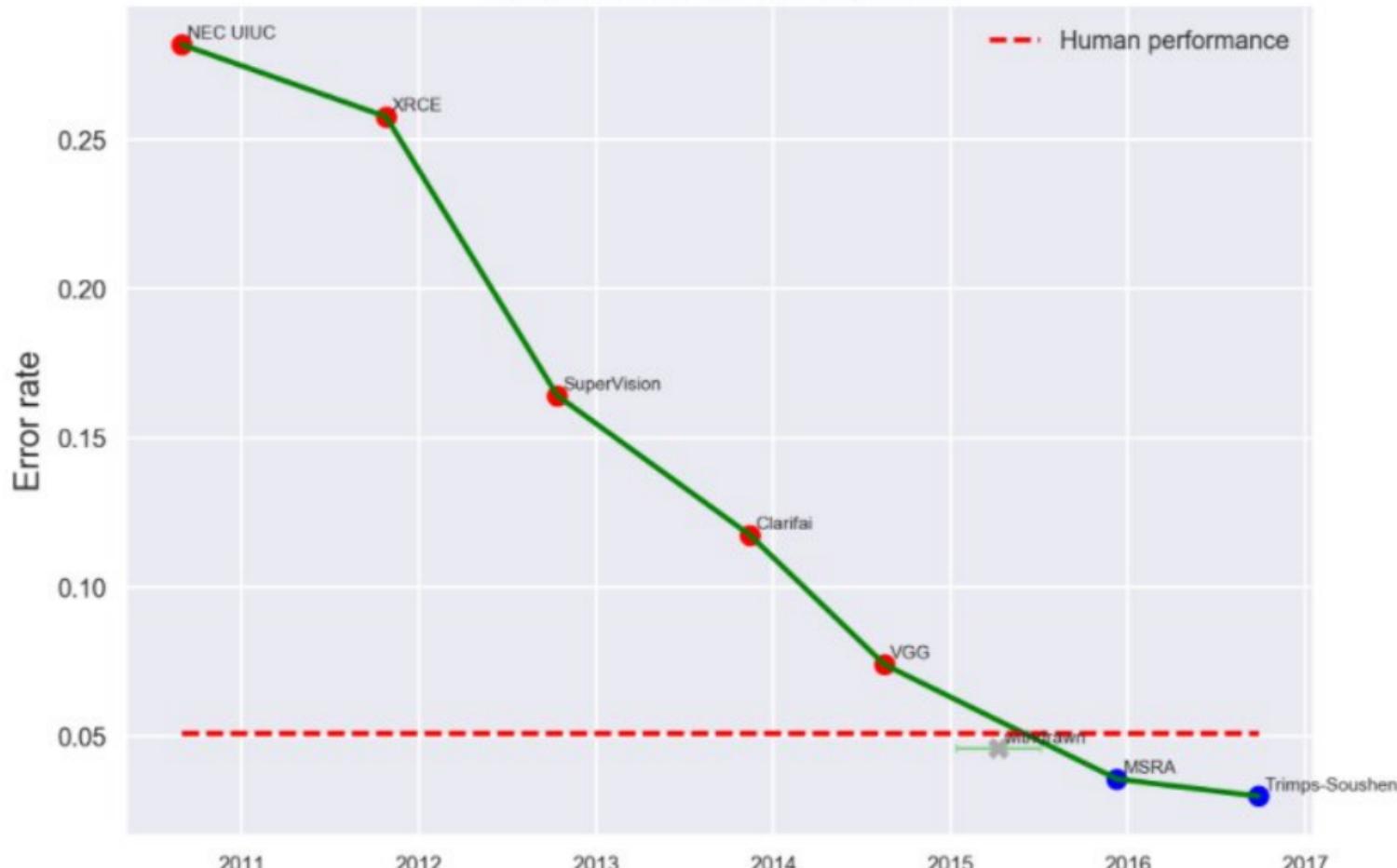


# Detección de objetos



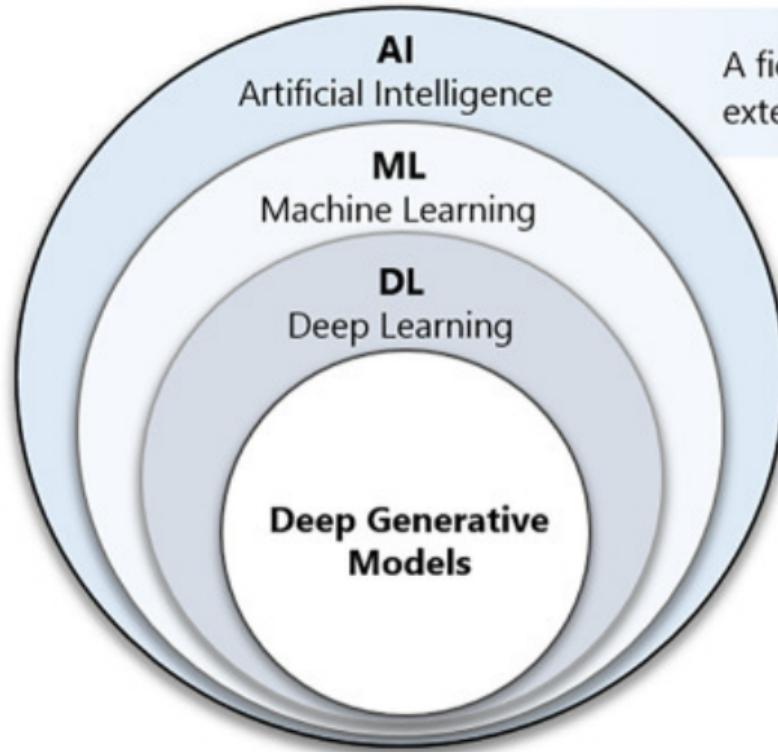
▶ demo

## Imagenet Image Recognition



# Semantic Segmentation





A field of science of creating intelligent agents to interpret external data, and use the learning to achieve specific tasks

Subset of AI techniques that learn to predict future outcomes without explicit programming

Subset of ML which make the computation of multi-layer neural networks from vast amounts of data

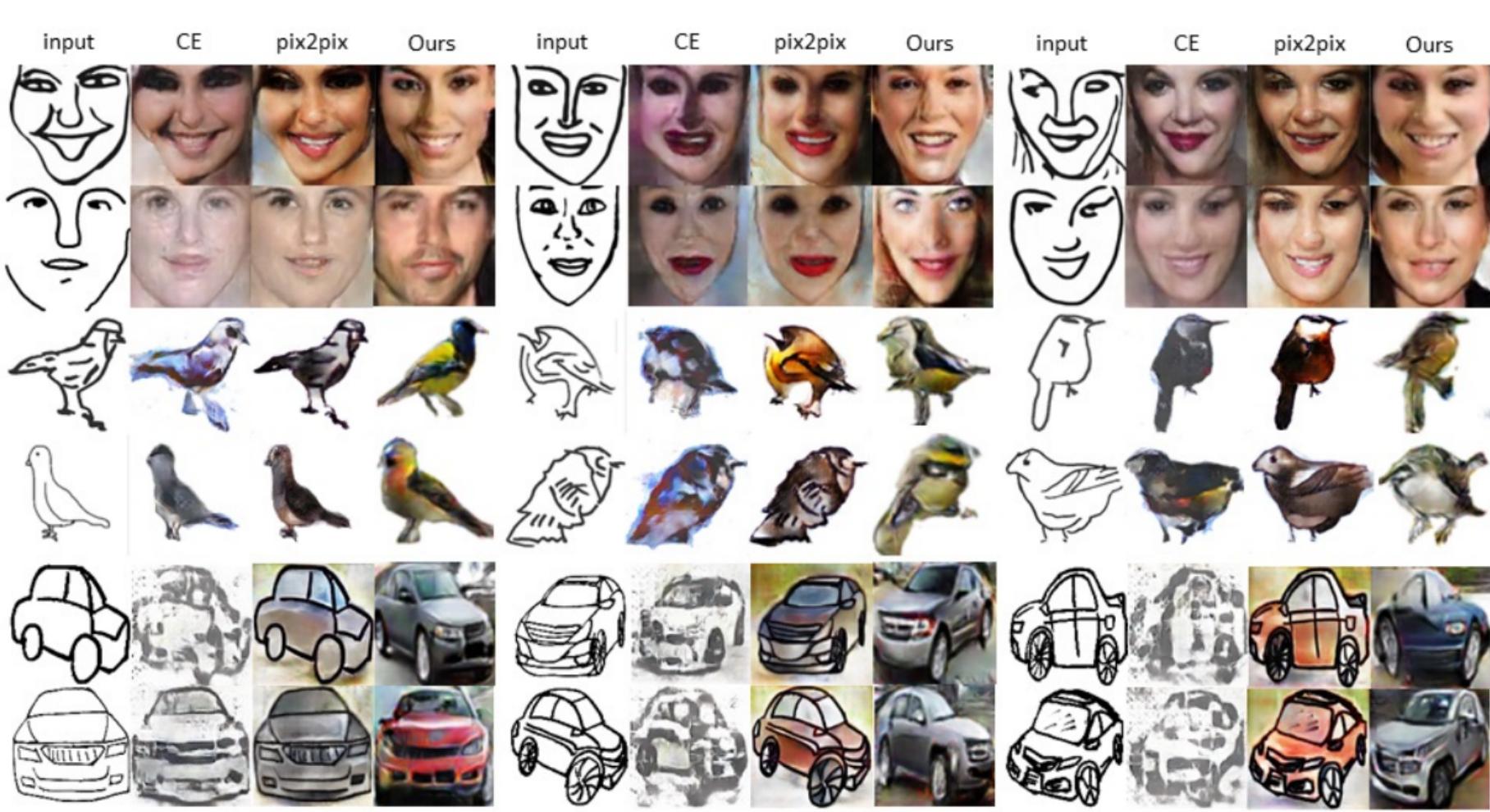
- |                  |  |
|------------------|--|
| Explicit Density | <ul style="list-style-type: none"><li>• Pixel RNN</li><li>• Variational Autoencoder</li></ul>  |
| Implicit Density | <ul style="list-style-type: none"><li>• Generative Adversarial Network</li><li>• GSN</li></ul> |

# Style transfer

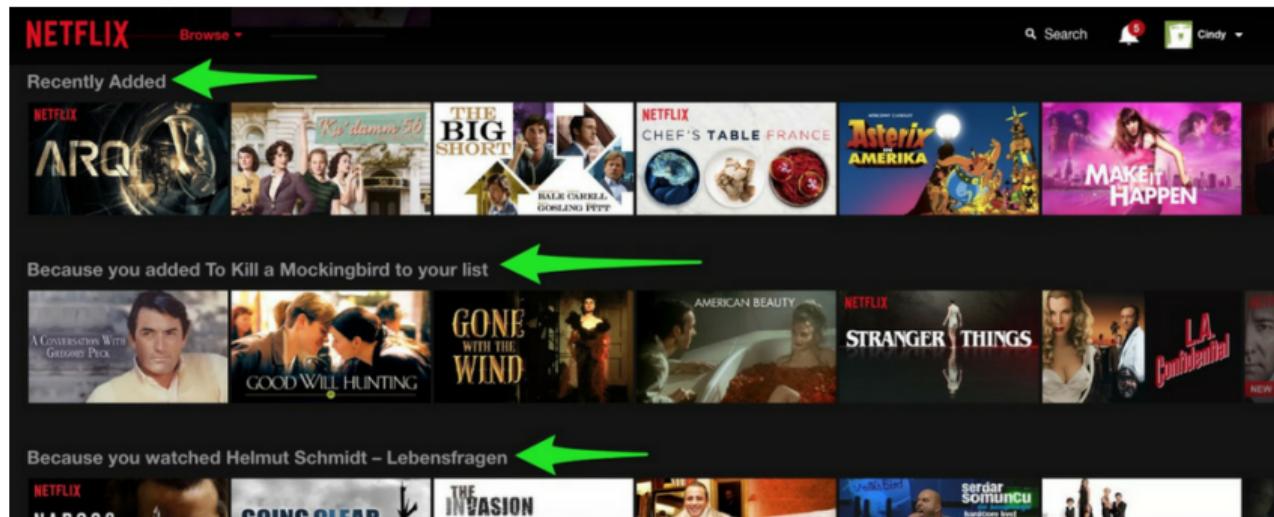
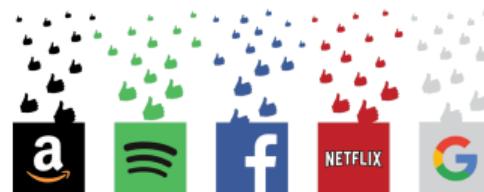


# Style transfer





# Recommender systems



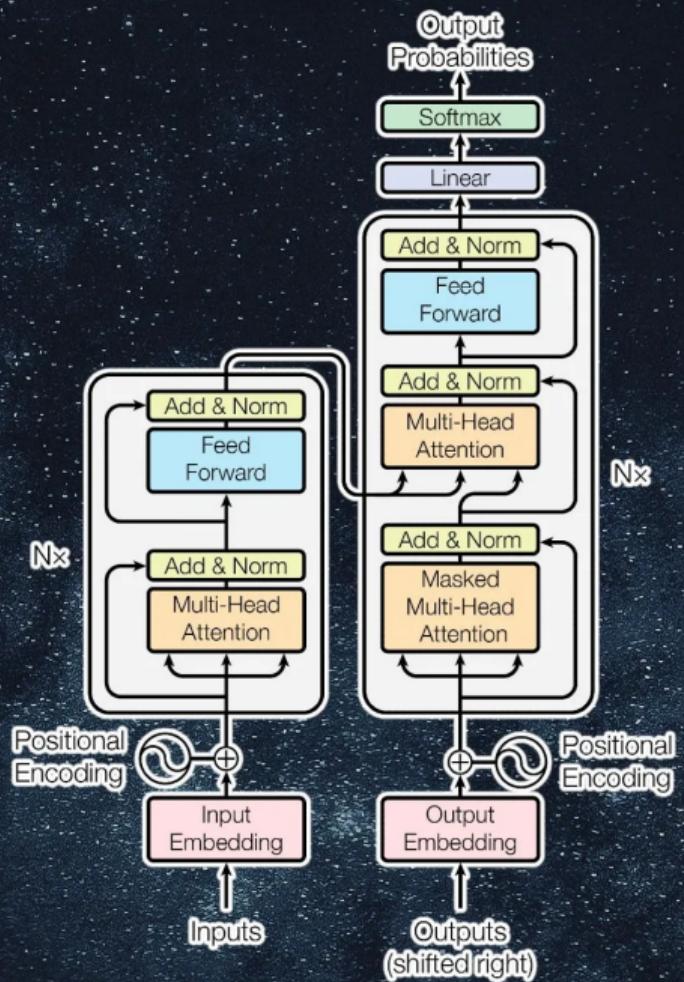
The screenshot shows the Netflix homepage with three examples of recommended content:

- Recently Added:** An arrow points to the "Recently Added" section at the top of the main movie grid.
- Because you added To Kill a Mockingbird to your list:** An arrow points to a row of movies recommended based on the user's previous list addition.
- Because you watched Helmut Schmidt – Lebensfragen:** An arrow points to a row of movies recommended based on the user's previous viewing history.

Coarse styles copied



# **Transformers: La nueva joya del aprendizaje profundo**



# GPT-3

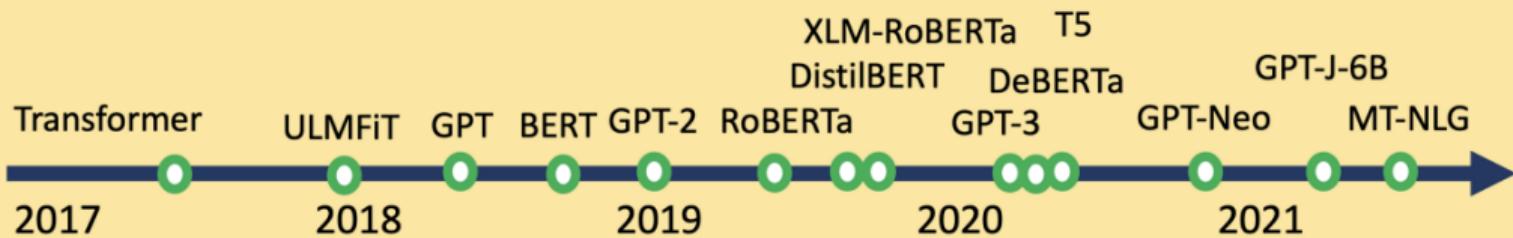
# DALL·E

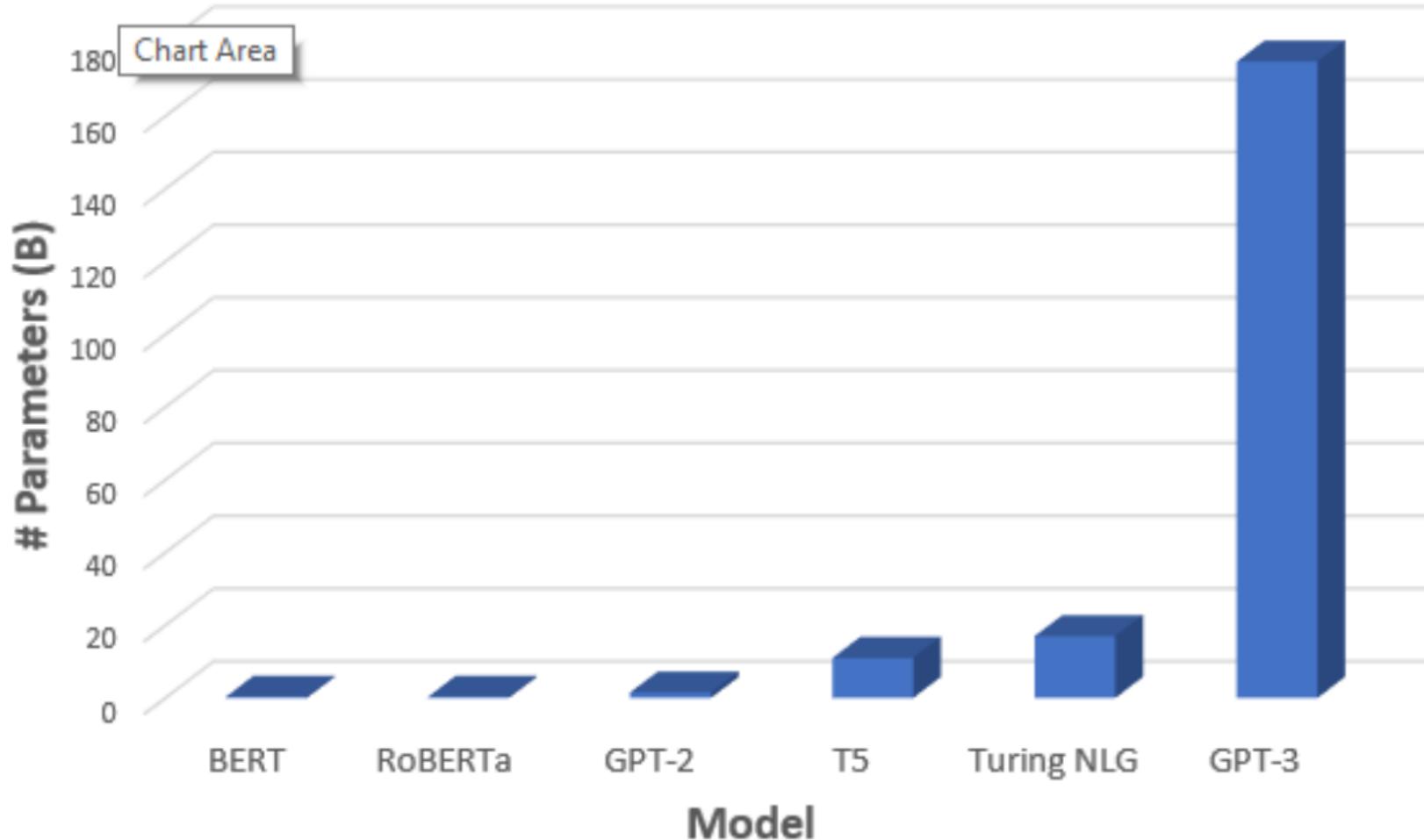
# BERT



# T5

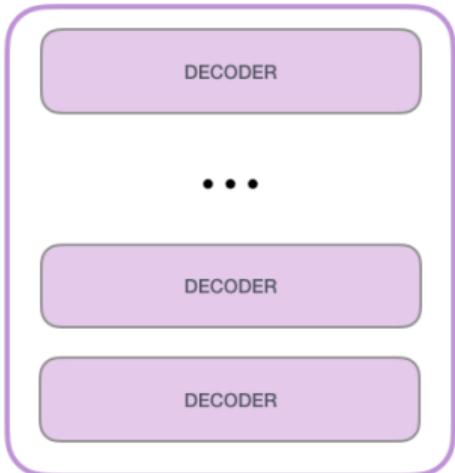
# TRANSFORMERS



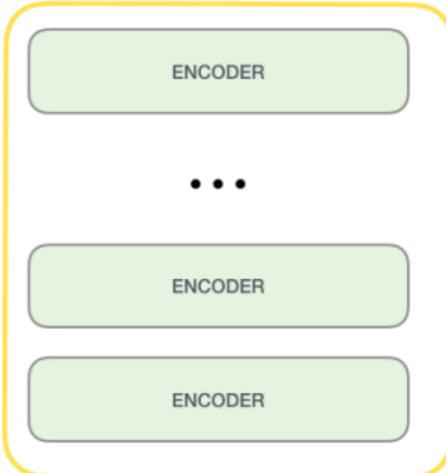




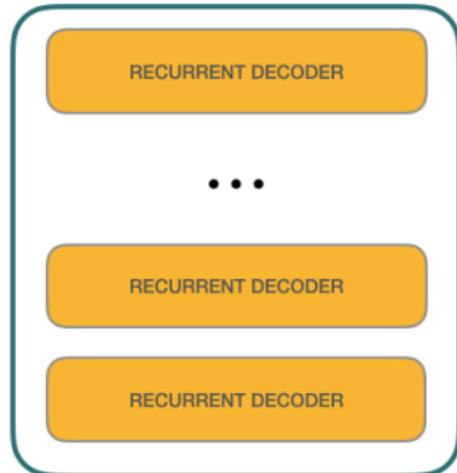
# GPT-2



# BERT



# TRANSFORMER XL



Numbers of Parameters (in Millions)

20000

15000

10000

5000

0

AI2  
ELMo  
94

OpenAI  
GPT  
110

BERT  
340

Ai2  
Transformer  
ELMo  
465

OpenAI  
GPT-2  
1500

MT-DNN  
330

XLM  
665

UNIVERSITY of WASHINGTON  
Grover  
1500

Carnegie  
Mellon  
University  
340

DistilBERT  
66

RoBERTa  
355

NVIDIA.  
MegatronLM  
8300

BART  
400

XLM-R  
550

Turing-NLG  
17000

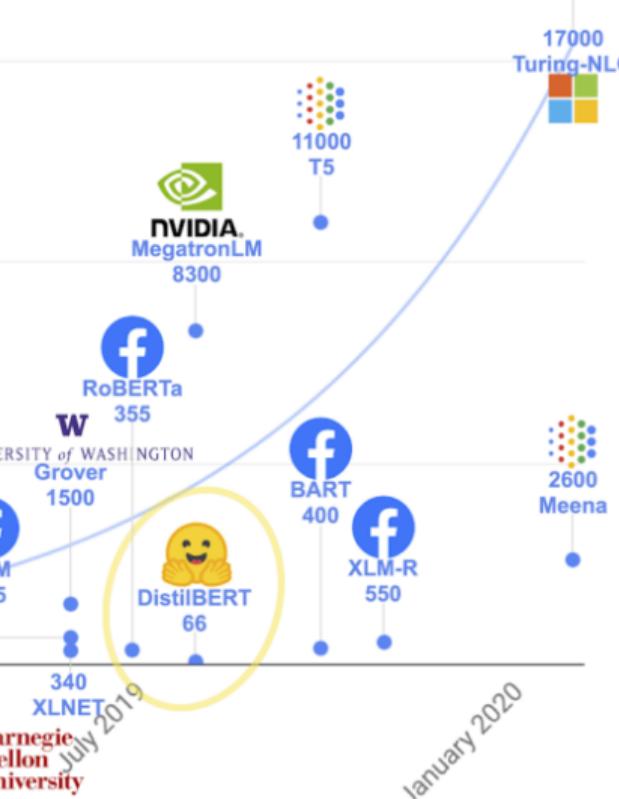
Meena  
2600

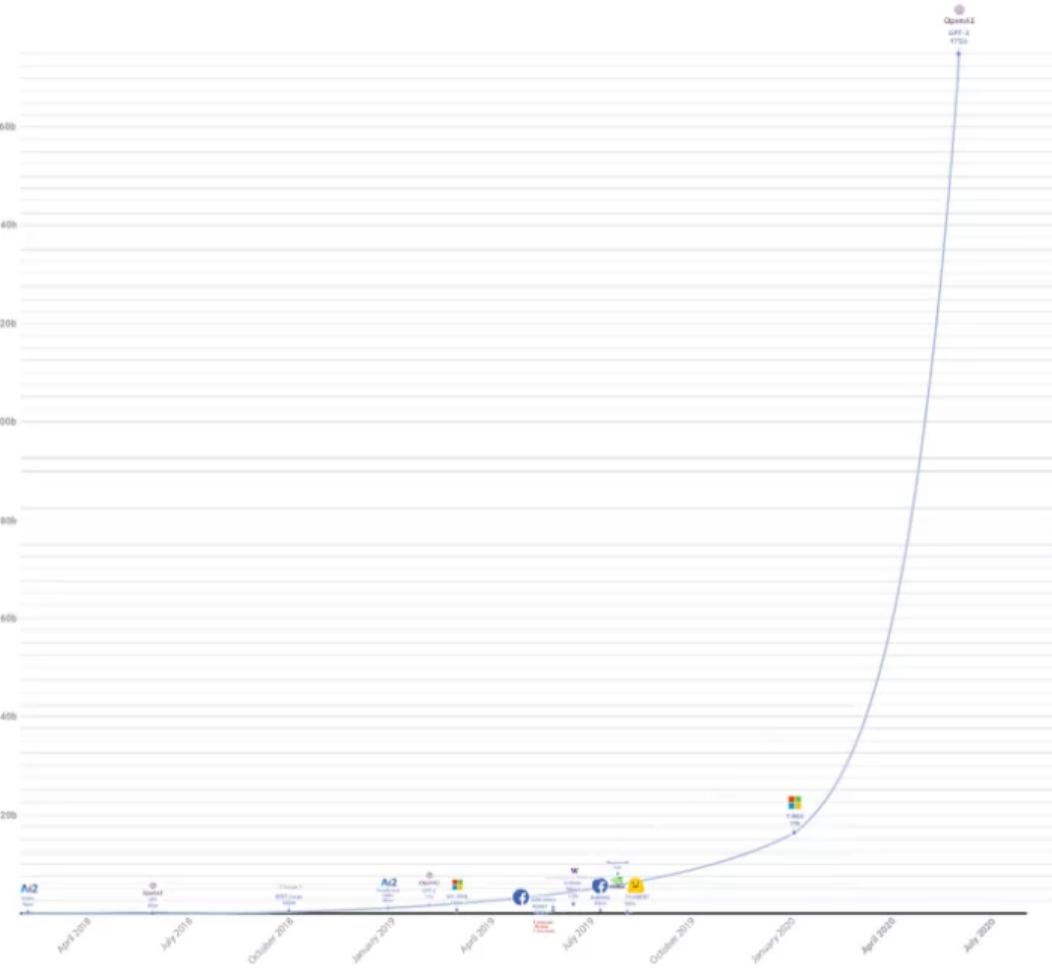
July 2018

January 2019

July 2019

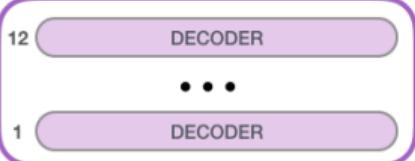
January 2020







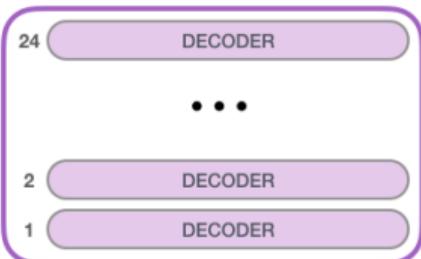
GPT-2  
SMALL



Model Dimensionality: 768



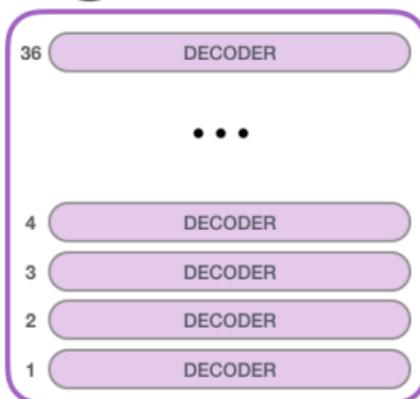
GPT-2  
MEDIUM



Model Dimensionality: 1024



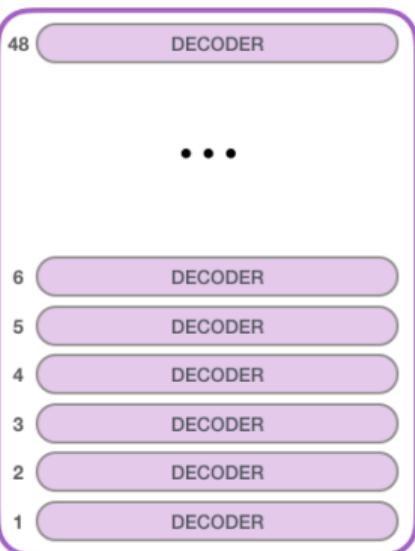
GPT-2  
LARGE



Model Dimensionality: 1280



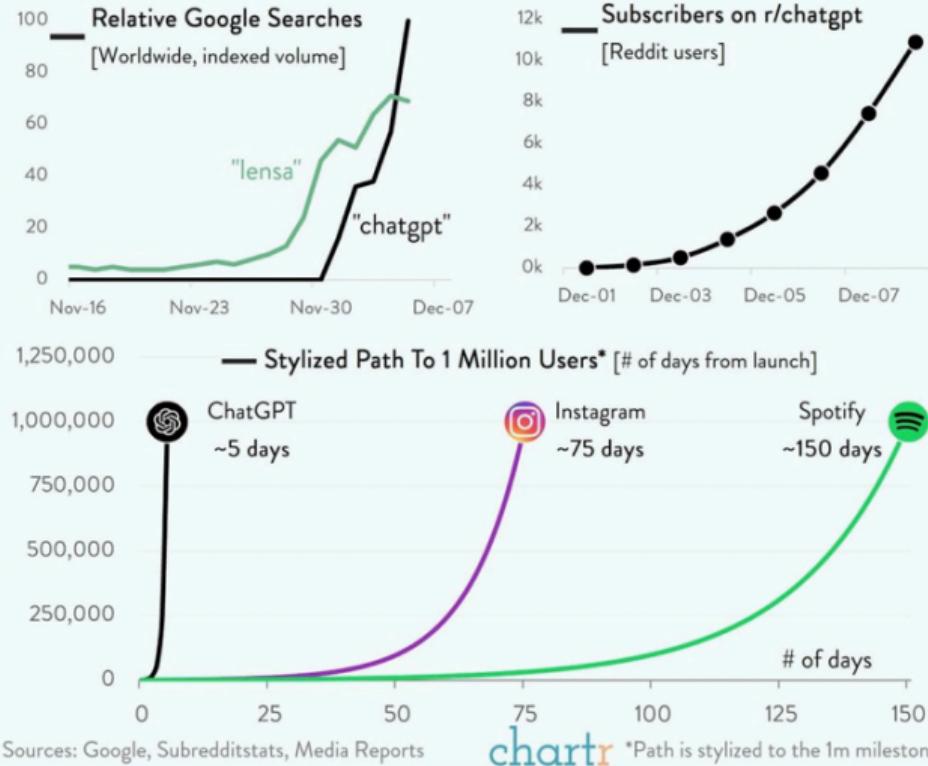
GPT-2  
EXTRA  
LARGE



Model Dimensionality: 1600

Model Name	$n_{\text{params}}$	$n_{\text{layers}}$	$d_{\text{model}}$	$n_{\text{heads}}$	$d_{\text{head}}$	Batch Size	Learning Rate
GPT-3 Small	125M	12	768	12	64	0.5M	$6.0 \times 10^{-4}$
GPT-3 Medium	350M	24	1024	16	64	0.5M	$3.0 \times 10^{-4}$
GPT-3 Large	760M	24	1536	16	96	0.5M	$2.5 \times 10^{-4}$
GPT-3 XL	1.3B	24	2048	24	128	1M	$2.0 \times 10^{-4}$
GPT-3 2.7B	2.7B	32	2560	32	80	1M	$1.6 \times 10^{-4}$
GPT-3 6.7B	6.7B	32	4096	32	128	2M	$1.2 \times 10^{-4}$
GPT-3 13B	13.0B	40	5140	40	128	2M	$1.0 \times 10^{-4}$
GPT-3 175B or “GPT-3”	175.0B	96	12288	96	128	3.2M	$0.6 \times 10^{-4}$

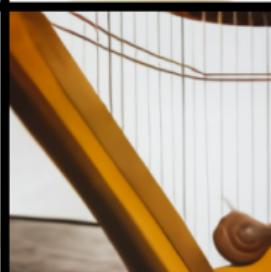
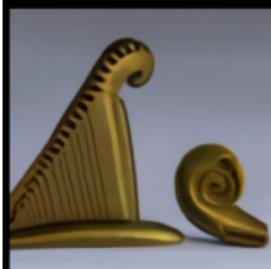
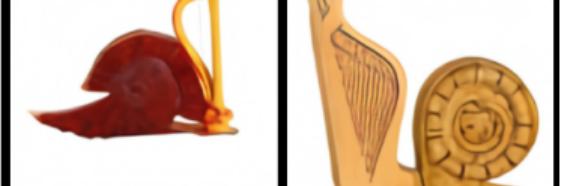
# ChatGPT From OpenAI Is A Bot Taking The Tech World By Storm





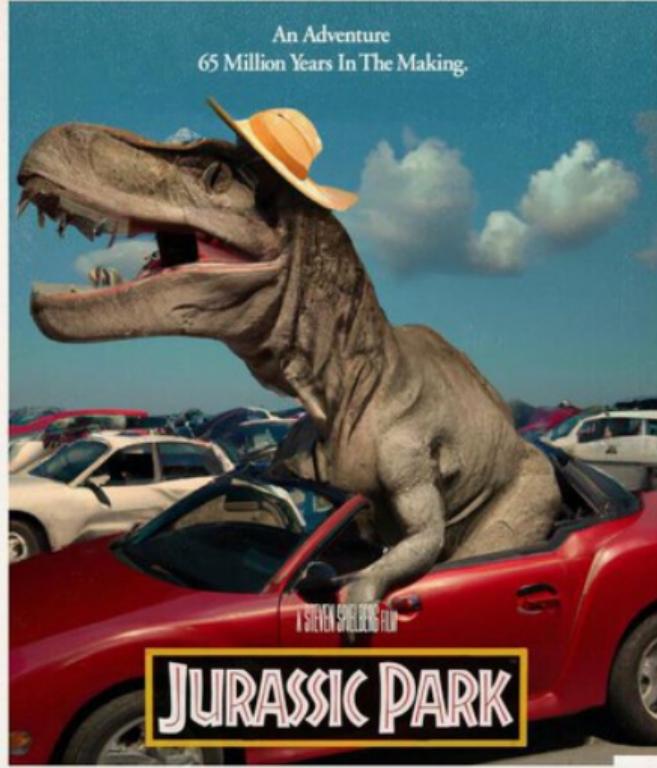
# DALL-E











UNIVERSAL PICTURES PRESENTS AN AMBLIN ENTERTAINMENT PRODUCTION SAM NEILL LAURA DERN JEFF GOLDBLUM  
AND RICHARD ATTENBOROUGH "JURASSIC PARK" BOB PECK MARTIN FERERO BD WONG SAMUEL L. JACKSON WAYNE KNIGHT  
JOSEPH MAZZELLO ARIANA RICHARDS MUSIC BY STAN WINSTON DIRECTED BY DENNIS MUREN EDIT. ANDREW PHIL TIPPETT  
SPECIAL EFFECTS MICHAEL LANIER PROPS JOHN WILLIAMS TECH. COORD. MICHAEL KAHN PROPS RICK CARTER DIRECTED BY DEAN CUNDY  
BASED ON THE MICHAEL CRICHTON STORY BY MICHAEL CRICHTON AND DAVID KROHN PROPS KATHLEEN KENNEDY AND GERALD R. MARDEN  
DIRECTED BY MICHAEL CRICHTON STYLING BY MICHAEL CRICHTON AND DAVID KROHN PROPS KATHLEEN KENNEDY AND GERALD R. MARDEN  
MUSIC BY JOHN WILLIAMS

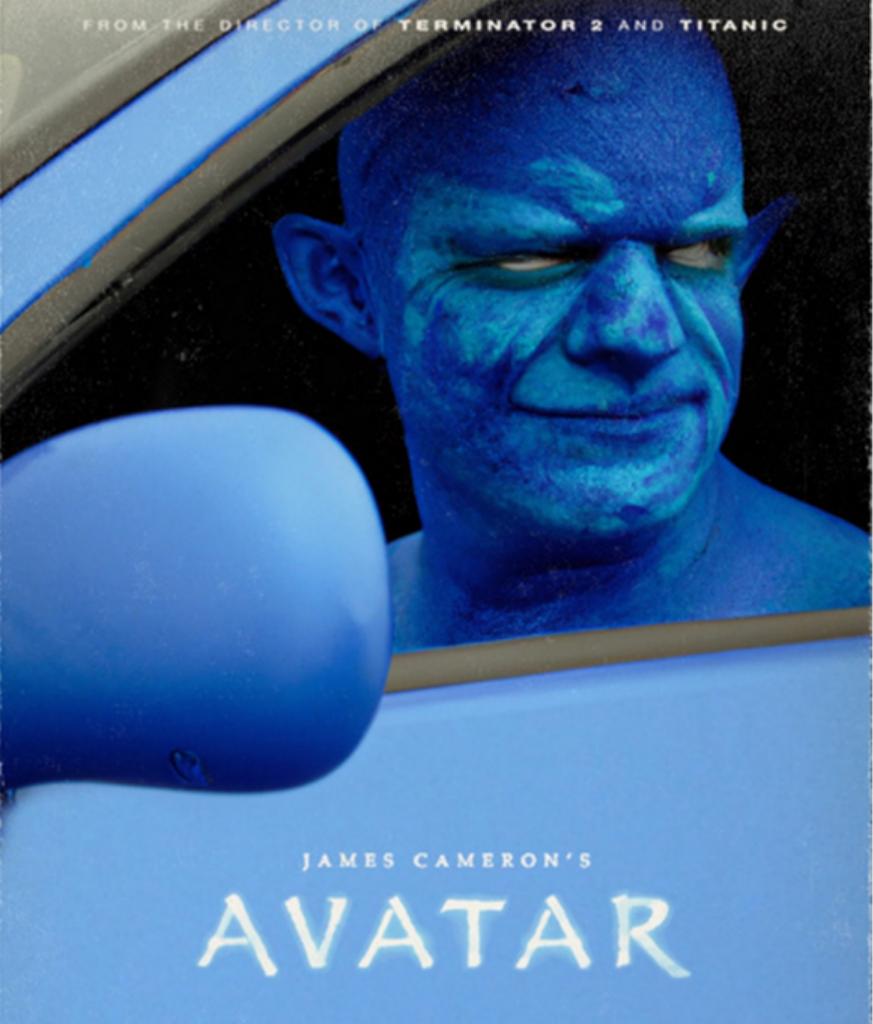
# E.T. THE EXTRA-TERRESTRIAL

IN HIS ADVENTURE ON EARTH

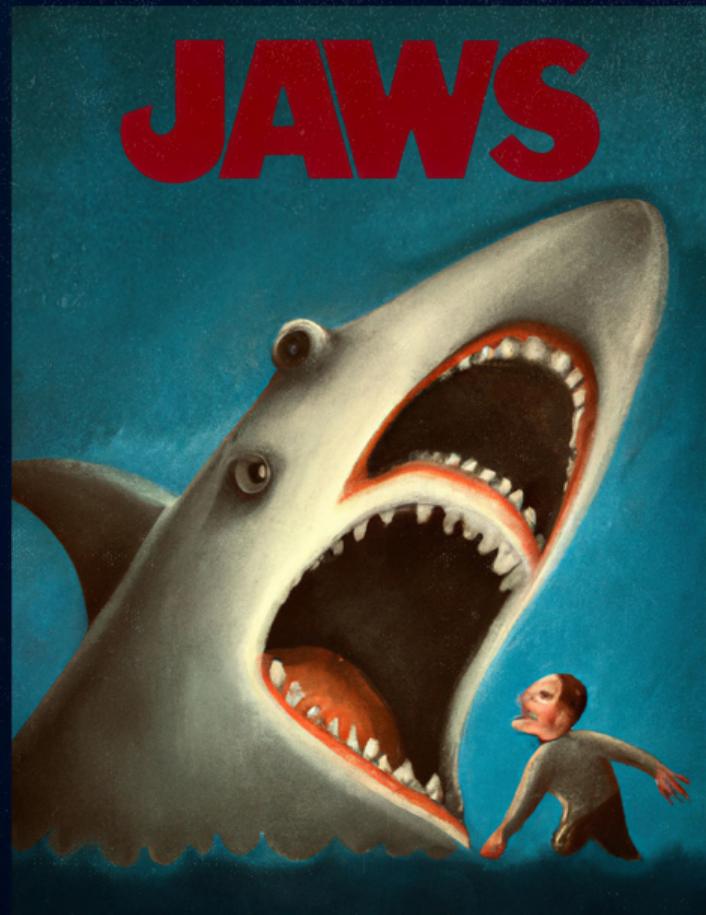
A STEVEN SPIELBERG FILM E.T. THE EXTRA-TERRESTRIAL  
DEE WALLACE · PETER COYOTE · HENRY THOMAS AS ELLIOTT · MUSIC BY JOHN WILLIAMS  
WRITTEN BY MELISSA MATHISON · PRODUCED BY STEVEN SPIELBERG & KATHLEEN KENNEDY  
DIRECTED BY STEVEN SPIELBERG · A UNIVERSAL PICTURE  
RATED PG-13 © 1982 UNIVERSAL CITY STUDIOS INC. MCMLXXXII  
MCMLXXXII



FROM THE DIRECTOR OF TERMINATOR 2 AND TITANIC



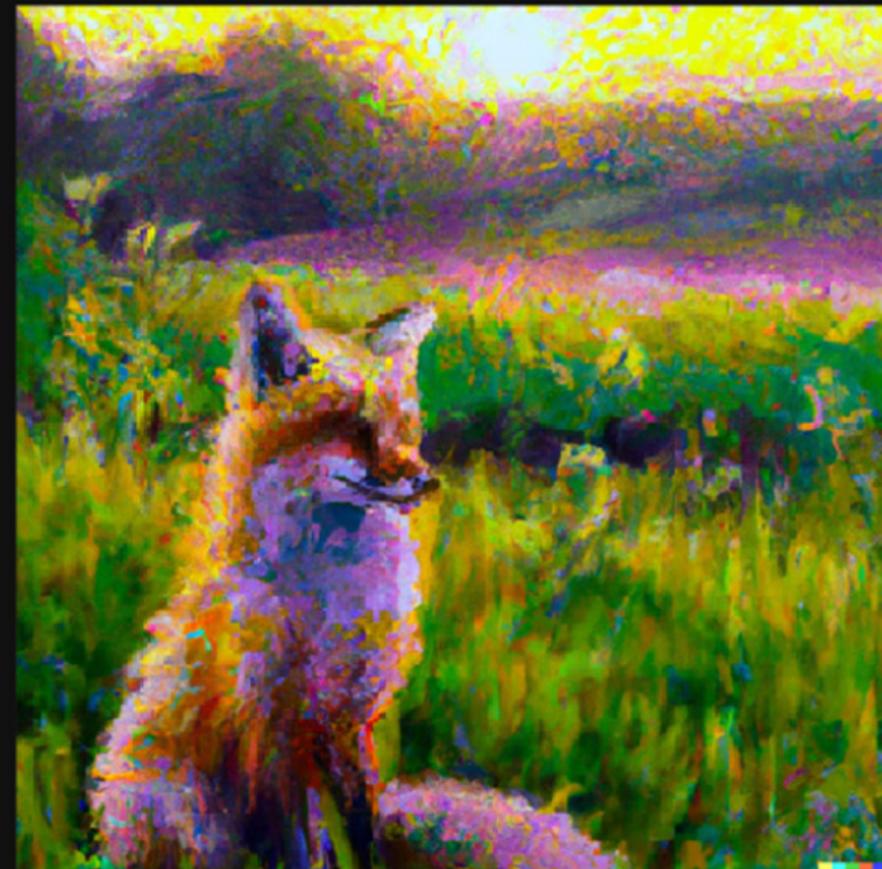
JAMES CAMERON'S  
**AVATAR**



DALL·E 1



DALL·E 2



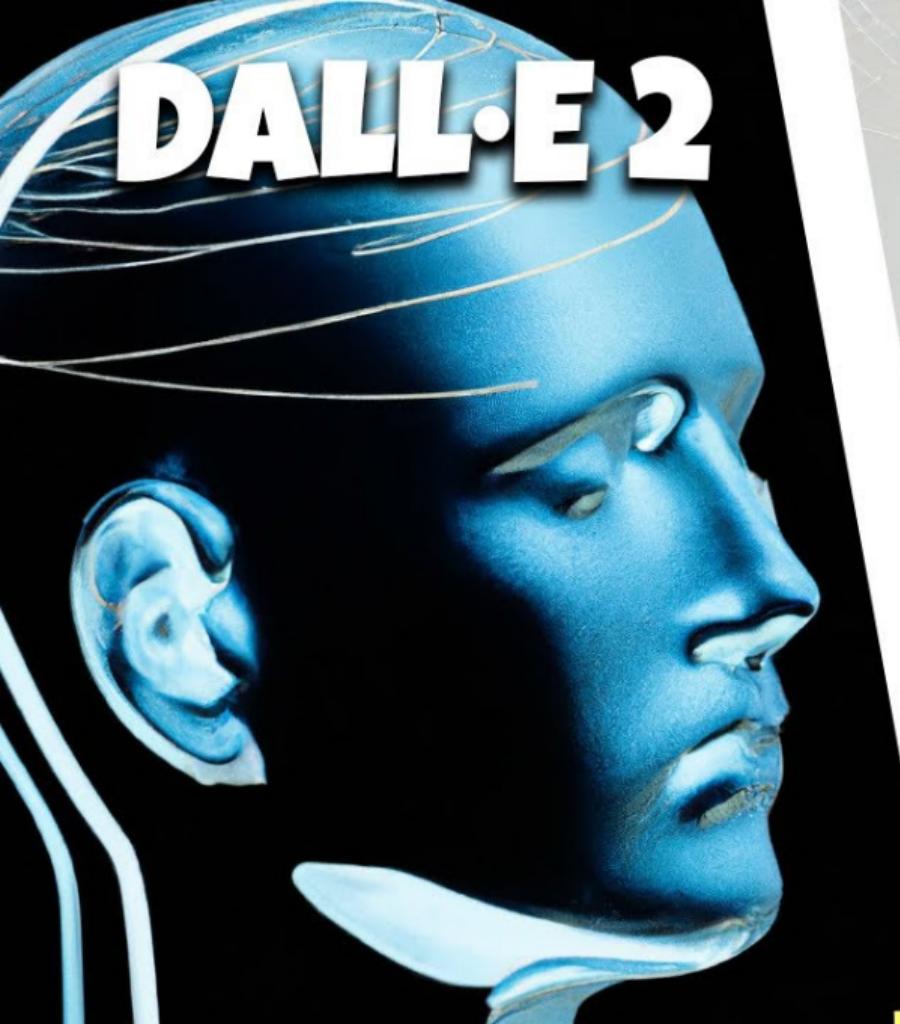


# DALL-E 2 AI IMAGE GENERATORS

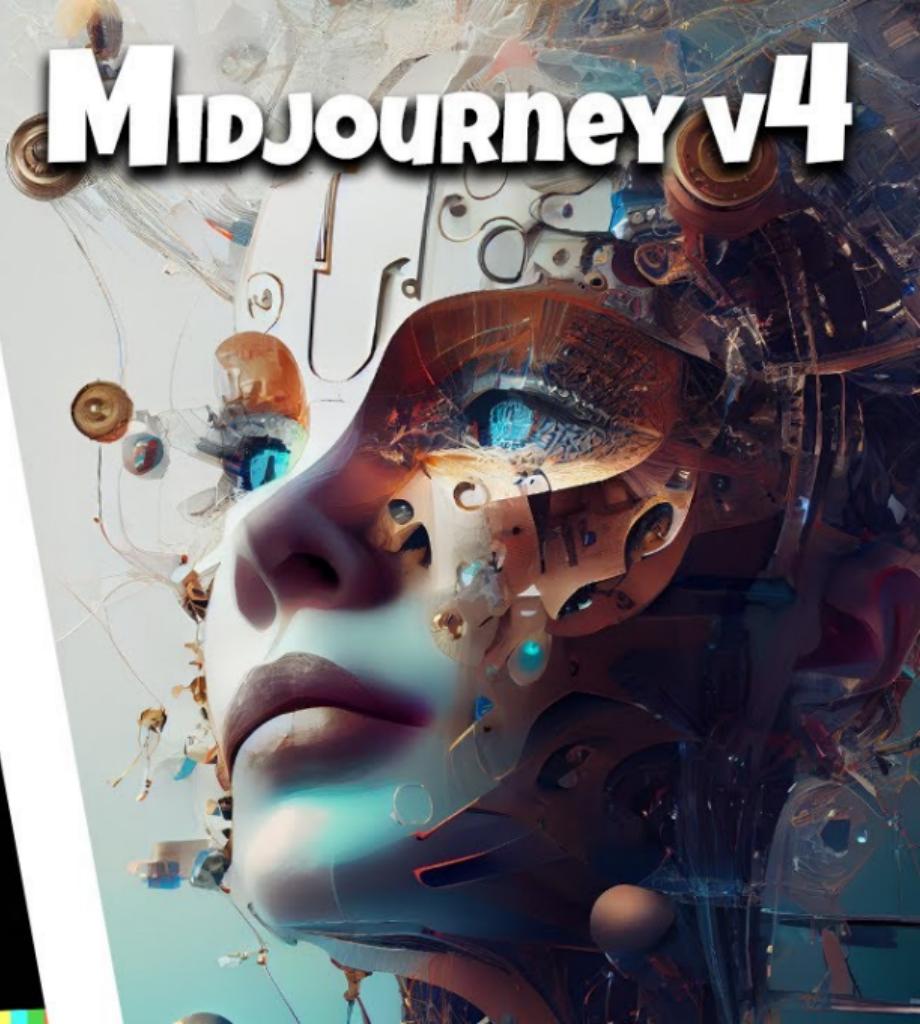


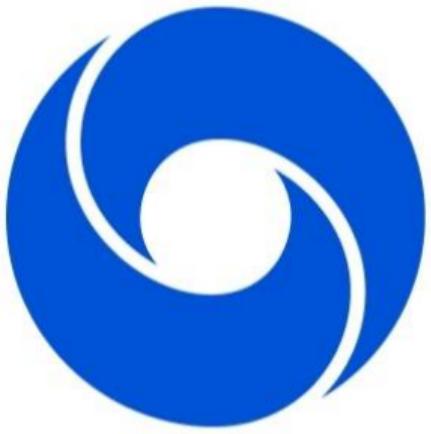


# DALL·E 2

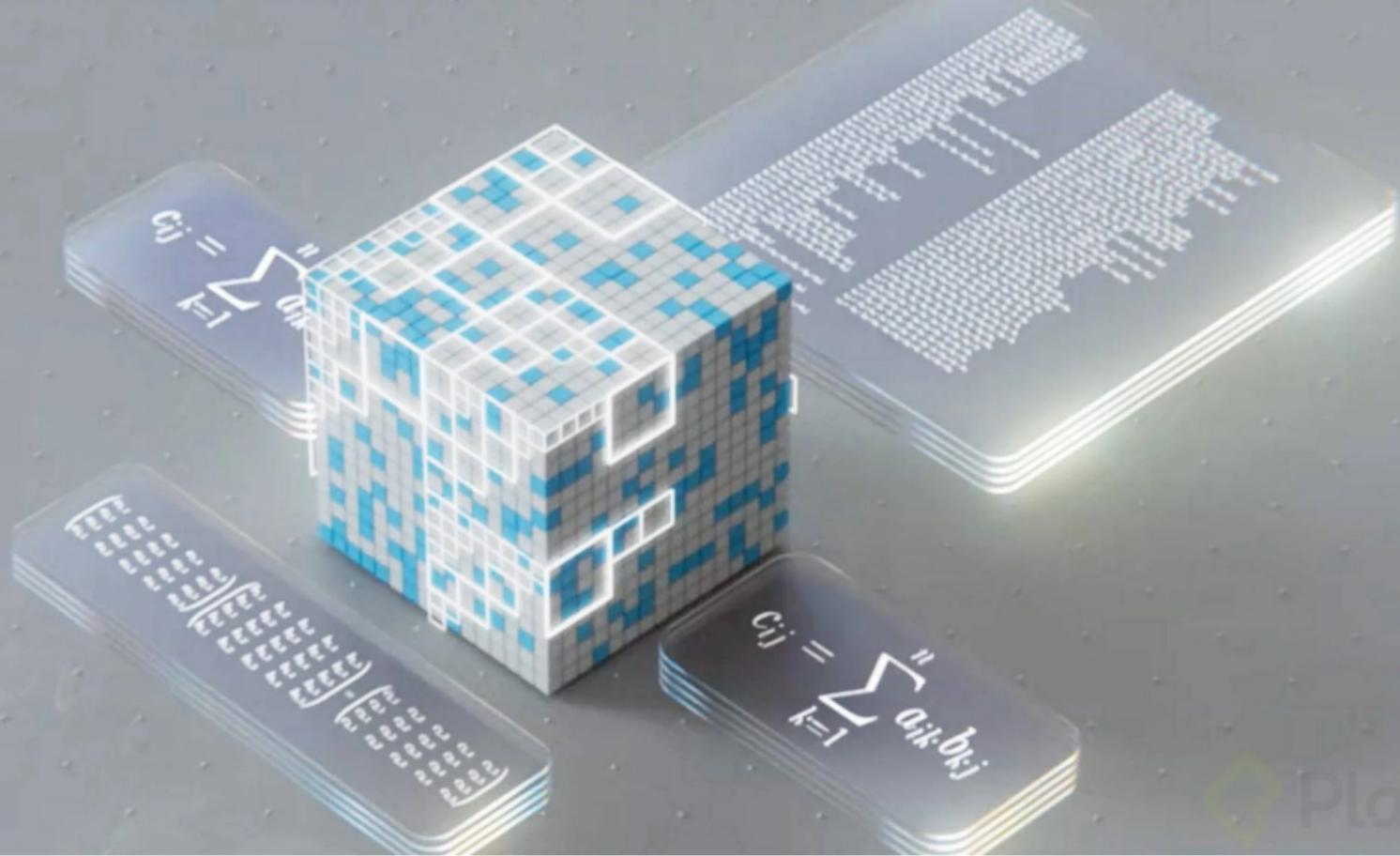


# MIDJOURNEY v4





DeepMind



# ¡Muchas gracias por su atención!

*¿Preguntas?*



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