

Deep Learning

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Escuela de Ciencias Aplicadas e Ingeniería

Introducción

Deep Learning

Artificial Intelligence, deep learning, machine learning—whatever you’re doing if you don’t understand it—learn it. Because otherwise you’re going to be a dinosaur within 3 years.

-Mark Cuban

➤ Modulo I → Fundamentos del Deep Learning (DL)

- Introducción a PyTorch
- Algebra Lineal (Producto punto y producto matricial)
- Tensores: creación y operaciones básicas
- Fundamentos del Aprendizaje Profundo: Neurona artificial, Perceptrón, Funciones de activación (ReLU, Sigmoid, Tanh, Softmax), Funciones de pérdida.
- Bases de datos (Kaggol)

Fundamentos

- Parcial 10% - Semana 4
- Laboratorio 10% - Semana 4

➤ Modulo II → Modelos Convolucionales

- Convolutional Neural Networks (CNN)
- AutoEncoders
- U-Net Neural Networks
- Optimizadores
- Overfitting y underfitting.
- Hiperparámetros
- Grid search vs Random search
- Early stopping
- PCA vs Autoencoders

Fundamentos

- Quiz 5% - Semana 7
- Laboratorio 15% - Semana 8

➤ Modulo III → Modelos Secuenciales

- RNN: idea básica
- Problema del gradiente
- U-Net Neural Networks
- LSTM y GRU
- Series temporales
- NLP básic

Fundamentos

- Laboratorio + Informe tipo paper -20% - Semana 12

➤ Modulo IV → Modelos Generativos y de Atención

- GANs y cGANs
- Motivación de la atención
- Atención vs RNN
- Self-AttentionTransformers (visión general)
- Encoder–Decoder
- Casos de uso: texto, imágenes, señales
- Limitaciones y costos computacionales

Fundamentos

- Quiz 10% - Semana 15
- Laboratorio 10% - Semana 16

Contenido y Evaluación

➤ Panorama global

Evento Evaluativo	Porcentaje	Semana
Parcial I	10 %	Semana 4
Laboratorio I	10 %	Semana 4
Quiz I	5 %	Semana 7
Laboratorio II	15 %	Semana 8
Laboratorio + paper	20 %	Semana 12
Quiz II	10 %	Semana 15
Laboratorio III	10 %	Semana 16
Proyecto Final	20 %	Semana 18

Nota: Todas las actividades se desarrollarán en grupos de máximo tres estudiantes. Los grupos se conformarán durante la primera clase y se mantendrán **sin cambios** durante todo el semestre.

Reglas generales

➤ Asistencia

La inasistencia se penalizará de la siguiente manera sobre la nota del proyecto final:

Inasistencia de 12 horas: penalización del 20 %.

Inasistencia de 9 horas: penalización del 10 %.

Inasistencia de 6 horas: penalización del 5 %.

Hasta 3 horas de inasistencia: se considerarán como margen de tolerancia y no tendrán penalización.

➤ Compromisos de los estudiantes

Realizar y entregar las actividades en las fechas definidas.

Aportar significativamente al equipo de trabajo.

Estar atento a sus calificaciones durante todo el semestre.

Leer y seguir los lineamientos del reglamento, el cual está disponible en

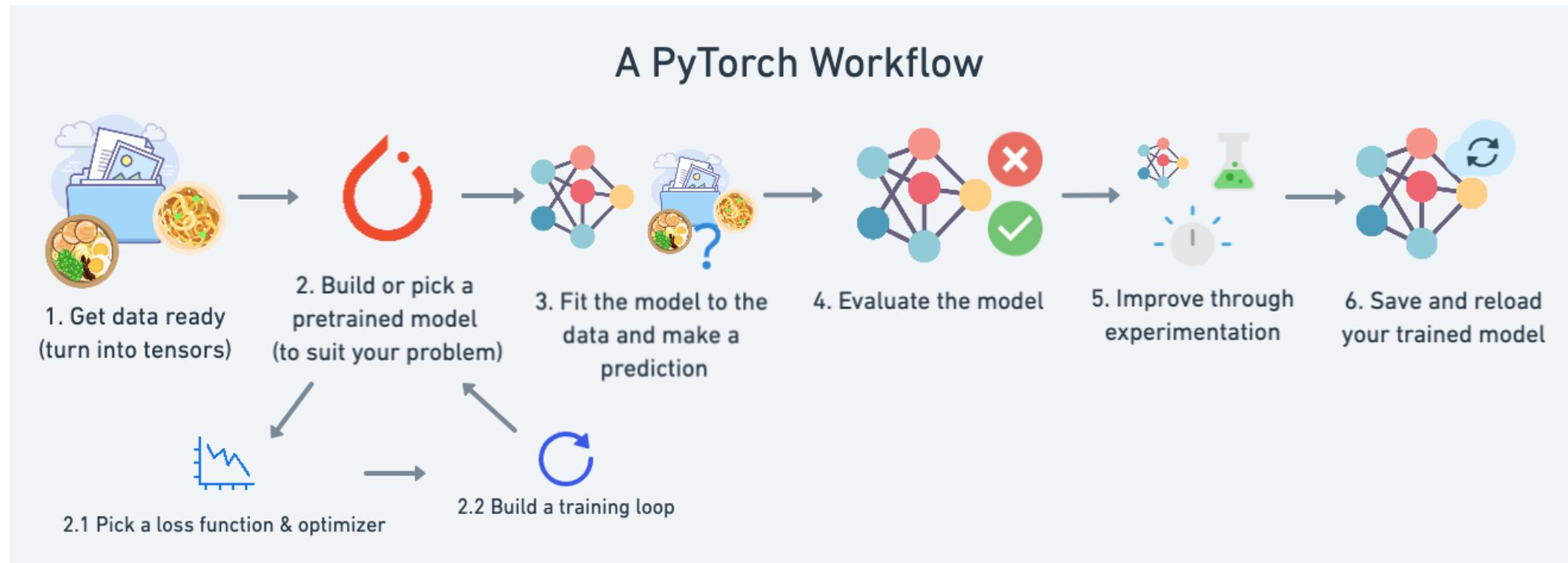
<https://www.eafit.edu.co/institucional/reglamentos/Documents/reglamento-academico-pregrado.pdf>.

Información Importante

Actividad	Fecha	Observaciones
Inicio y terminación de lases	Enero 19 - Mayo 16	La semana del 18 al 23 de mayo puede ser utilizada como semana de evaluaciones finales.
Asamblea General de Carreras	Marzo 4	No eventos evaluativos.
Semana Santa	Marzo 30 - Abril 5	No clases – No eventos evaluativos.
Fecha límite para reportar 70%	Mayo 13	En EAFIT Interactiva.
Fecha límite de cancelación de materias	Mayo 15	Consultar regularmente las solicitudes de cancelación.
Fecha límite para reportar 100%	Junio 2	En EAFIT Interactiva.

Framework

En Deep Learning no escribimos programas lineales; trabajamos con un *workflow experimental*.
PyTorch proporciona la estructura para definir, entrenar y evaluar modelos de forma iterativa.



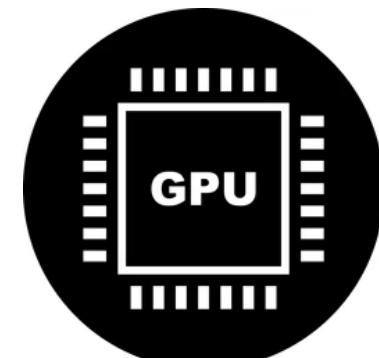
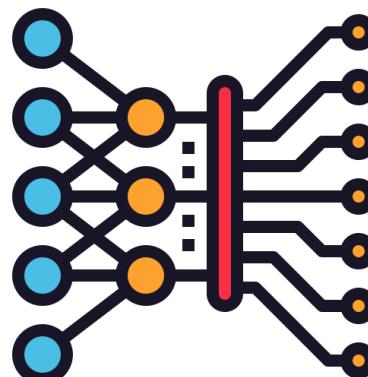
PyTorch



- PyTorch es un framework de **cómputo científico de código abierto**, basado en Python, diseñado para realizar **operaciones numéricas de alto rendimiento** y para el desarrollo de **modelos de Deep Learning**.
- Es ampliamente utilizado tanto en **investigación** como en **aplicaciones industriales**, debido a su flexibilidad, eficiencia y facilidad de uso.

Público Objetivo

- Usuarios de cómputo numérico: Funciona como un reemplazo de NumPy que permite ejecutar operaciones sobre tensores acelerados por GPU.
- Investigadores y desarrolladores en Deep Learning: Proporciona una plataforma flexible y eficiente para diseñar, entrenar y experimentar con redes neuronales.



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¿Qué necesitas para el curso?

➤ Python – IDE



Visual Studio Code



pandas

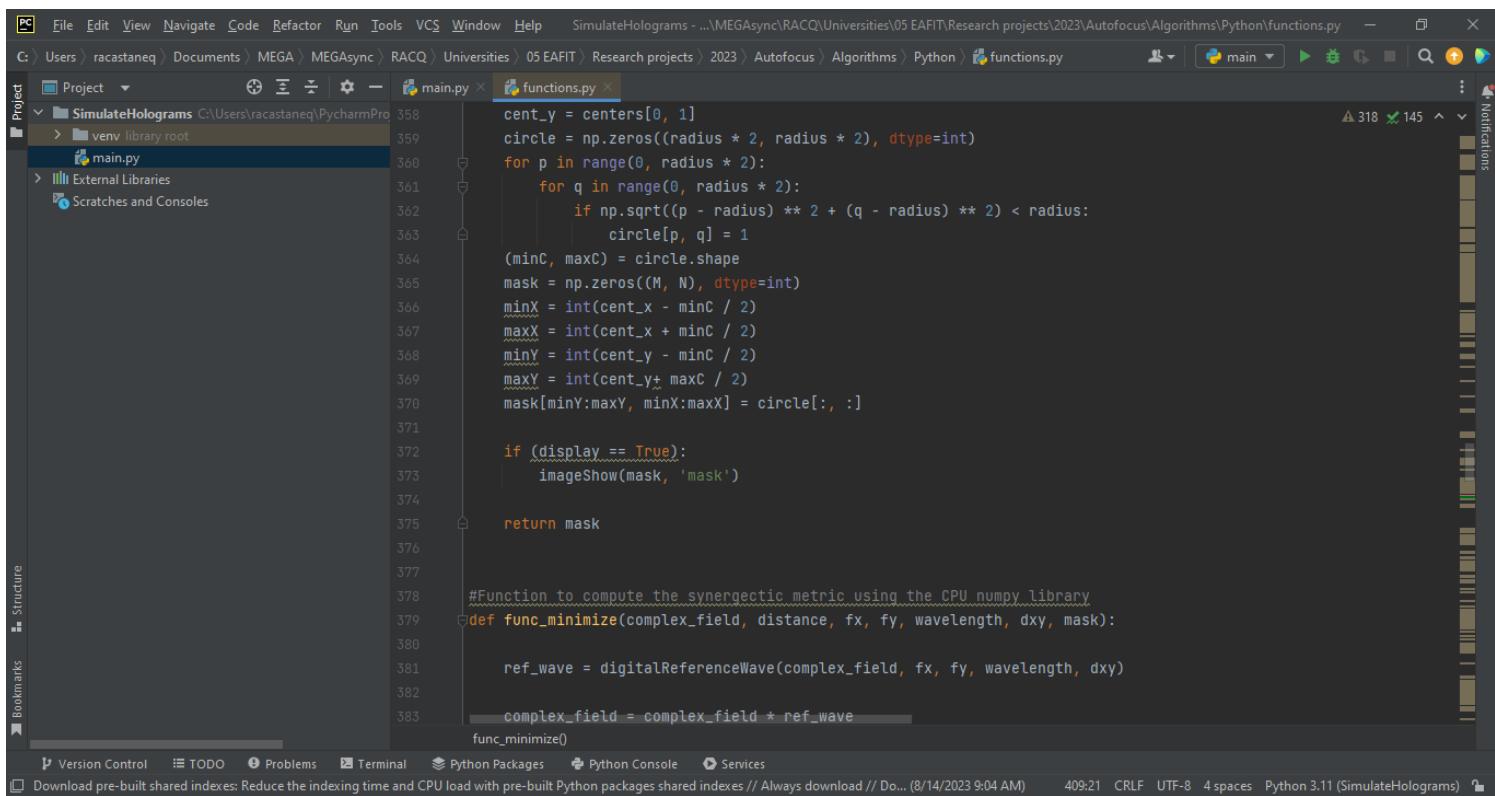


seaborn

➤ Python libraries

PyCharm

PyCharm es un Entorno de Desarrollo Integrado (IDE) diseñado específicamente para la programación en Python. Es desarrollado por JetBrains, una empresa reconocida por crear herramientas de desarrollo de software potentes y fáciles de usar. PyCharm ofrece una amplia variedad de funciones para mejorar la experiencia de desarrollo en Python y aumentar la productividad. Algunas de sus características principales incluyen:



The screenshot shows the PyCharm IDE interface. The top menu bar includes File, Edit, View, Navigate, Code, Refactor, Run, Tools, VCS, Window, Help. The title bar shows "SimulateHolograms - ...\\MEGAsync\\RACQ\\Universities\\05 EAFIT\\Research projects\\2023\\Autofocus\\Algorithms\\Python\\functions.py". The left sidebar has sections for Project, External Libraries, and Scratches and Consoles. The main area is the code editor with the following Python code:

```
cent_y = centers[0, 1]
circle = np.zeros((radius * 2, radius * 2), dtype=int)
for p in range(0, radius * 2):
    for q in range(0, radius * 2):
        if np.sqrt((p - radius)**2 + (q - radius)**2) < radius:
            circle[p, q] = 1
(minC, maxC) = circle.shape
mask = np.zeros((M, N), dtype=int)
minX = int(cent_x - minC / 2)
maxX = int(cent_x + minC / 2)
minY = int(cent_y - minC / 2)
maxY = int(cent_y + maxC / 2)
mask[minY:maxY, minX:maxX] = circle[:, :]

if (display == True):
    imageShow(mask, 'mask')

return mask

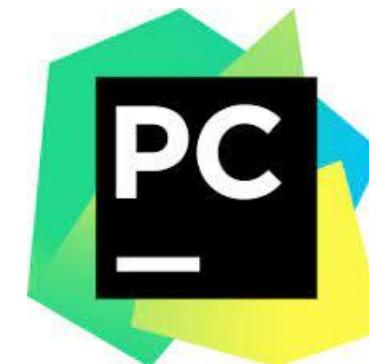
#Function to compute the synergistic metric using the CPU numpy library
def func_minimize(complex_field, distance, fx, fy, wavelength, dxy, mask):

    ref_wave = digitalReferenceWave(complex_field, fx, fy, wavelength, dxy)

    complex_field = complex_field * ref_wave
    func_minimize()
```

The bottom status bar shows "Download pre-built shared indexes: Reduce the indexing time and CPU load with pre-built Python packages shared indexes // Always download // Do... (8/14/2023 9:04 AM)" and file statistics: 409:21 CRLF UTF-8 4 spaces Python 3.11 (SimulateHolograms).

- Editor de código
- Análisis inteligente de código
- Debugger (Depurar)
- Gestión de Proyectos



Visual Studio Code

Visual Studio Code es un editor de código fuente multiplataforma, ligero y altamente configurable, utilizado para el desarrollo de software en múltiples lenguajes de programación, incluido Python. Es desarrollado por Microsoft y se destaca por su flexibilidad, rapidez y amplio ecosistema de extensiones. Visual Studio Code ofrece herramientas que facilitan la escritura, depuración y organización del código, permitiendo al desarrollador personalizar el entorno de trabajo según sus necesidades y mejorar su productividad.

The screenshot shows the Visual Studio Code interface. The Explorer sidebar on the left lists files and folders, including 'VS CODE' and various 'TS' files like 'actions.ts', 'arrays.ts', 'assert.ts', etc. The main Editor pane displays two files: 'arrays.ts' and 'package.json'. The 'arrays.ts' file contains TypeScript code for array manipulation functions. The 'package.json' file shows the project's metadata, including scripts for building and testing. The Terminal pane at the bottom shows recent command-line activity, including file operations like 'package.json', 'product.json', and 'yarn.lock'.

D Panel



Visual Studio Code

Fuentes – Bases de datos



[Link](#)

Kaggle es una plataforma en línea muy popular para competencias de **ciencia de datos y aprendizaje automático**, así como una comunidad para entusiastas y profesionales de los datos. Proporciona un espacio donde individuos y equipos pueden abordar desafíos de datos del mundo real, colaborar en proyectos y mostrar sus habilidades.

<https://www.youtube.com/c/kaggle>



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Join over 15M+ machine learners to share, stress test, and stay up-to-date on all the latest ML techniques and technologies. Discover a huge repository of community-published models, data & code for your next project.

Register with Google

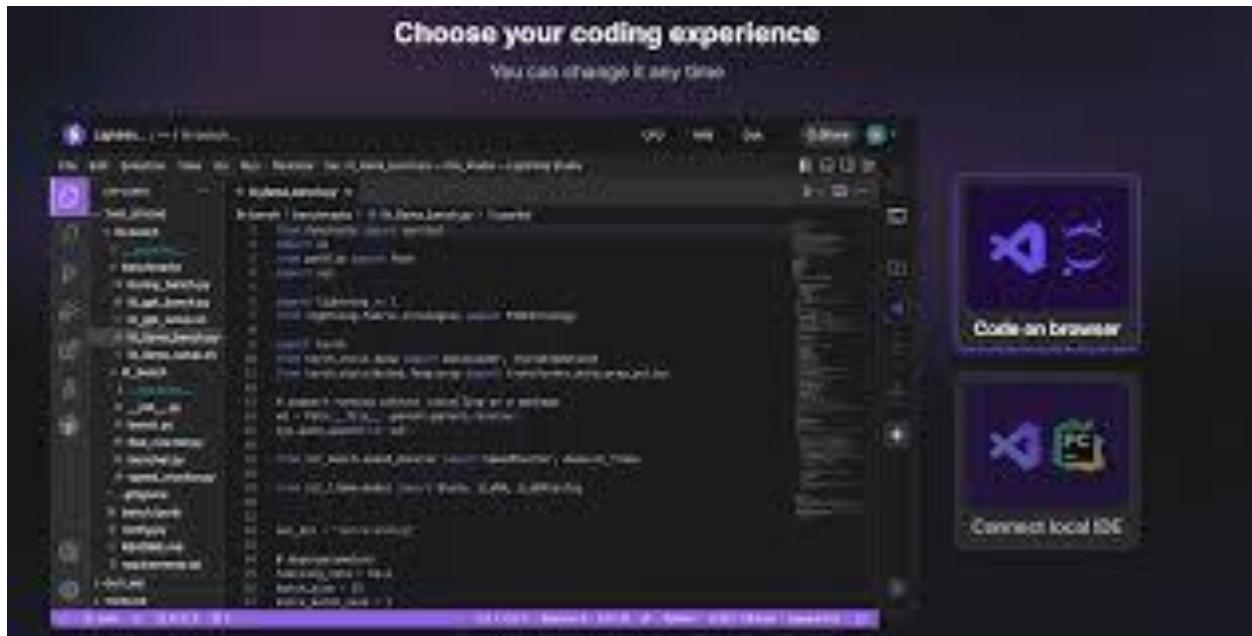
Register with Email





LightningAI es una plataforma en línea que permite entrenar y ejecutar modelos de deep learning de forma sencilla, sin preocuparse por la configuración del hardware. Ofrece entornos con GPU, facilita el trabajo con PyTorch y ayuda a organizar el código y los experimentos, lo que la hace ideal para aprender, practicar y desarrollar proyectos de inteligencia artificial.

Entorno de desarrollo para Deep Learning en la nube

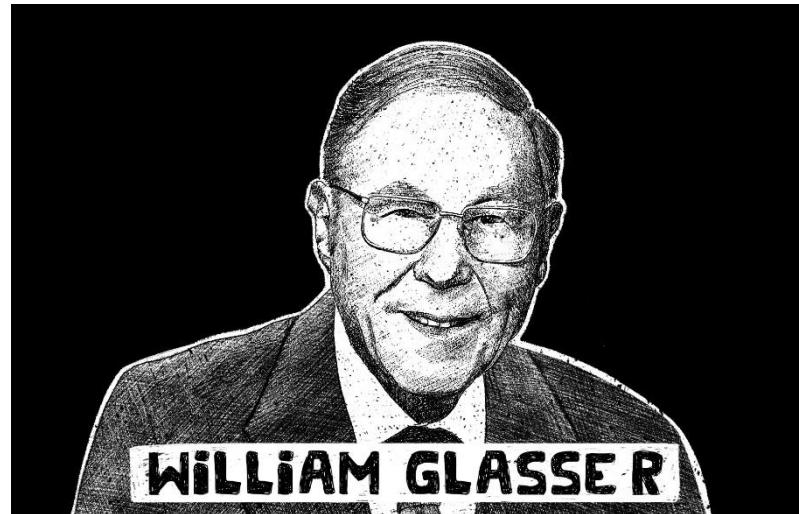


IMPORTANTE

```
Beautiful is better than ugly.  
Explicit is better than implicit.  
Simple is better than complex.  
Complex is better than complicated.  
Flat is better than nested.  
Sparse is better than dense.  
Readability counts.
```

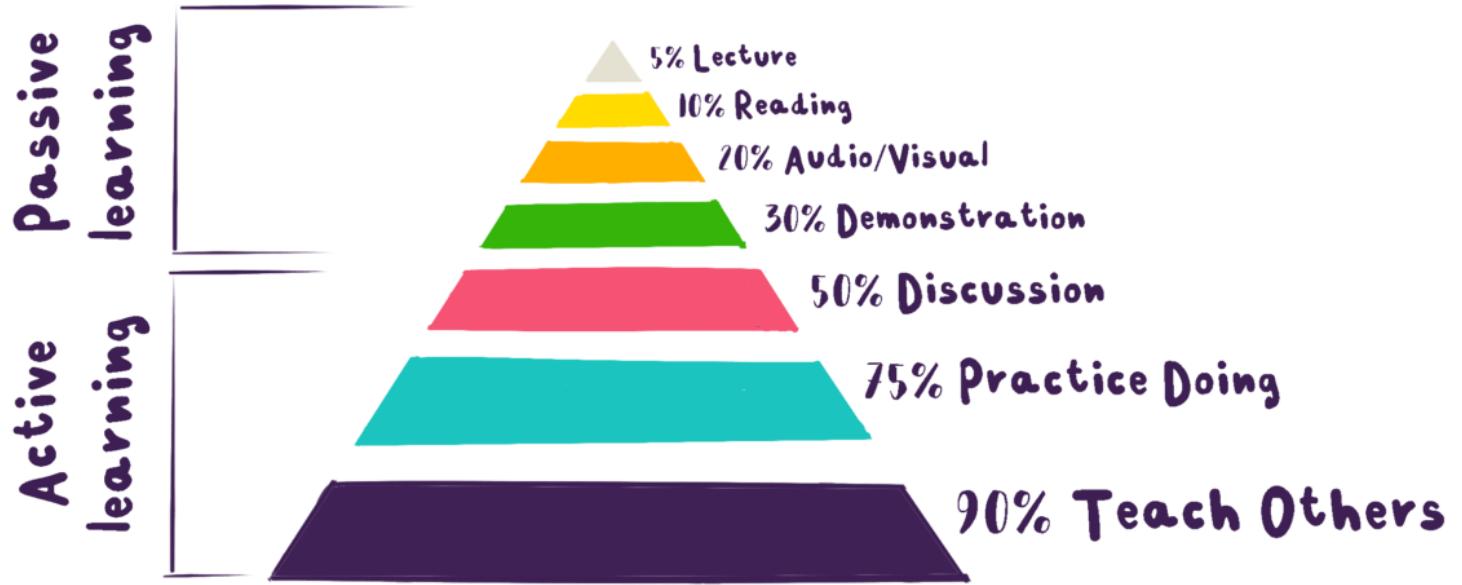
Listing 2.1: Sample of the Zen of Python.

Introducción



[Link](#)

Learning Pyramid



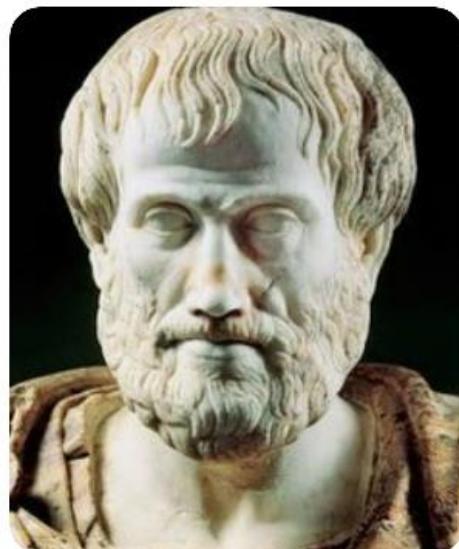
[Link](#)

• ¿Qué es la inteligencia?

La inteligencia es un concepto complejo que puede definirse como la **capacidad de aprender, comprender, razonar, resolver problemas y adaptarse a nuevas situaciones**.

Implica la habilidad de **percibir información, retenerla como conocimiento y aplicarla de manera efectiva**.

Does intelligence imply knowledge?

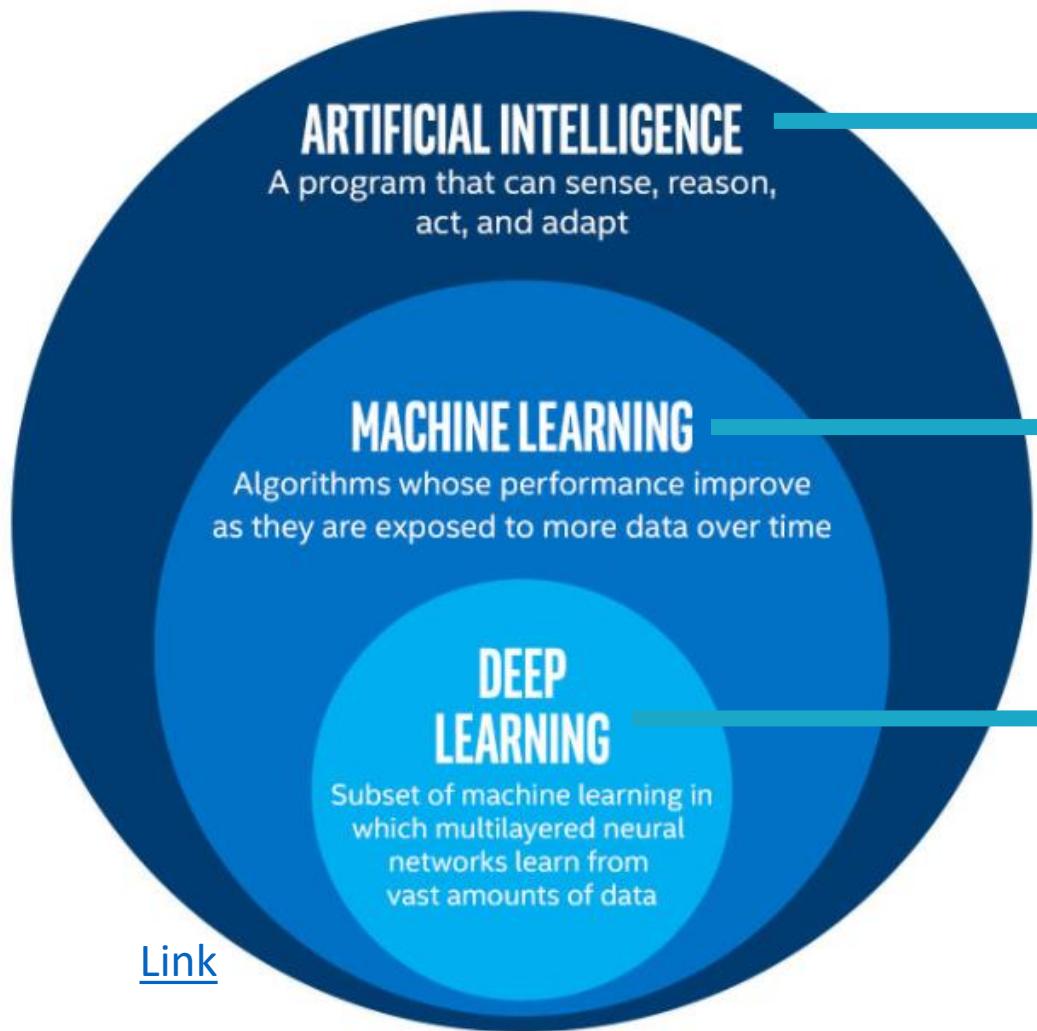


Aristotle

Understanding – awareness- be

The intelligence consists not only in the knowledge but also in the skill to apply the knowledge into practice.

Pequeñas o grandes diferencias!!!



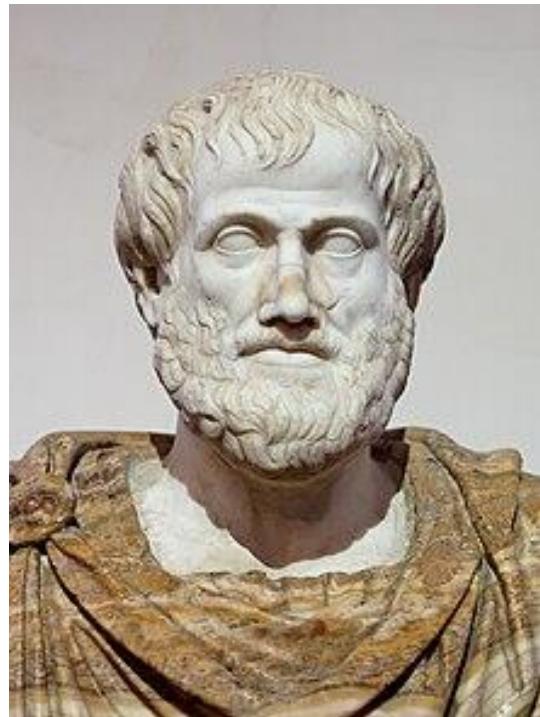
A technique which enables machine to mimic human behavior

Subset of AI technique which use statical models to enable machines to improve with experience

Subset of ML that uses neural networks to evaluate various factors with a similar framework to a human neural system. It has networks that can learn from unstructured or unlabeled data without supervision.

[Link](#)

Breve Historia y contexto



Aristotle 380 BC

Prior Analytics / syllogistic

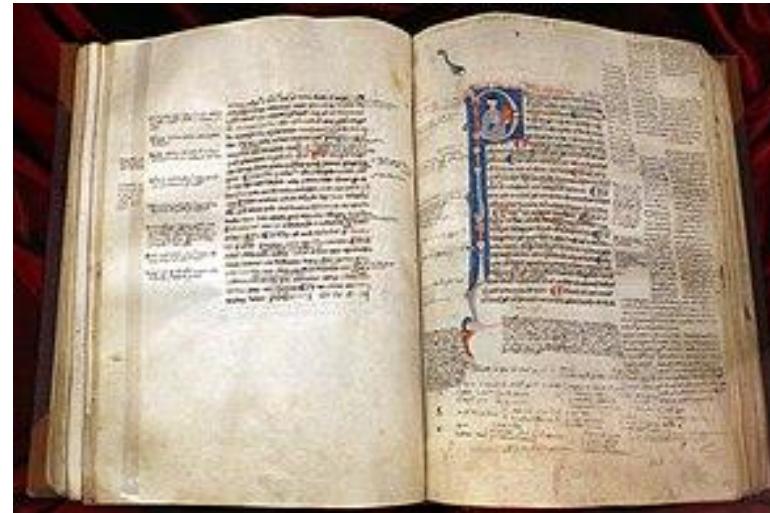
Un silogismo es un tipo de razonamiento lógico que consta de dos proposiciones llamadas premisas y una conclusión.

Por ejemplo:

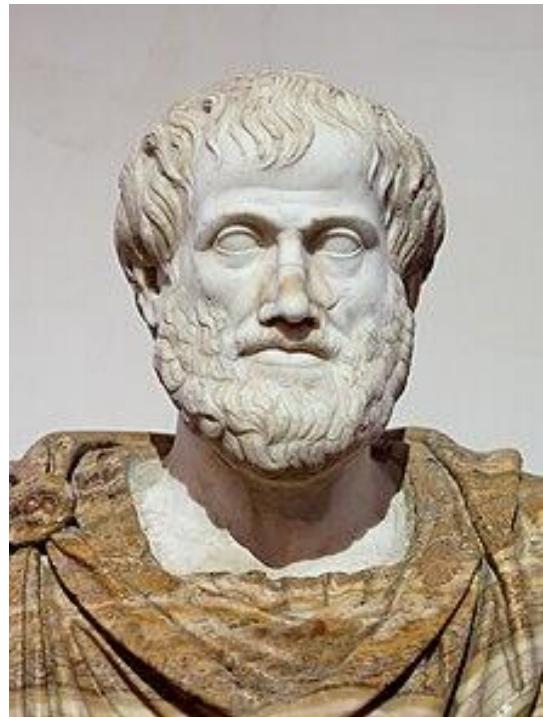
Premisa 1: Todos los seres humanos son mortales.

Premisa 2: Sócrates es humano.

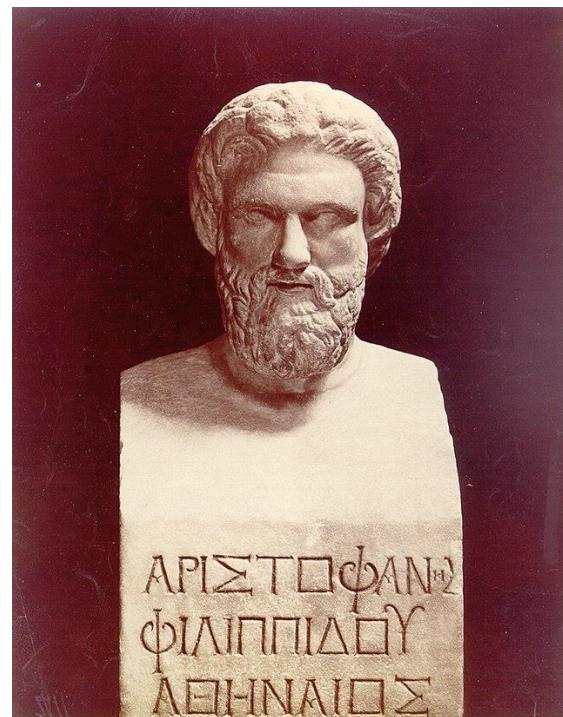
Conclusión: Por lo tanto, Sócrates es mortal.



Breve Historia y contexto

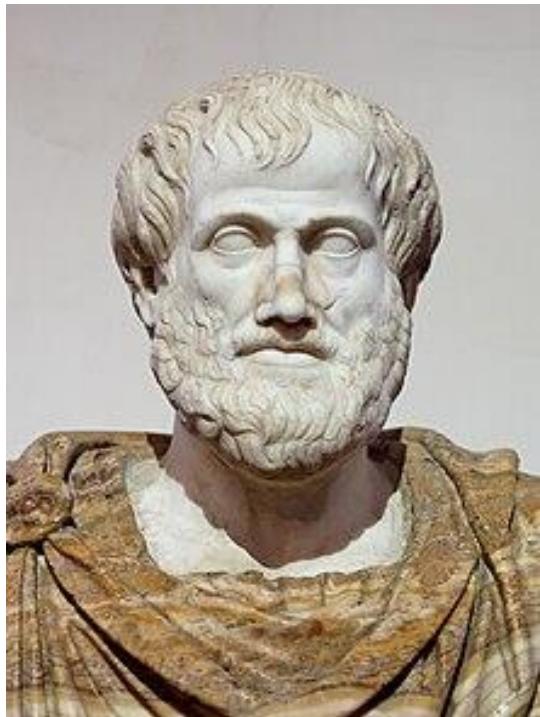


Aristotle 380 BC
Prior Analytics / syllogistic

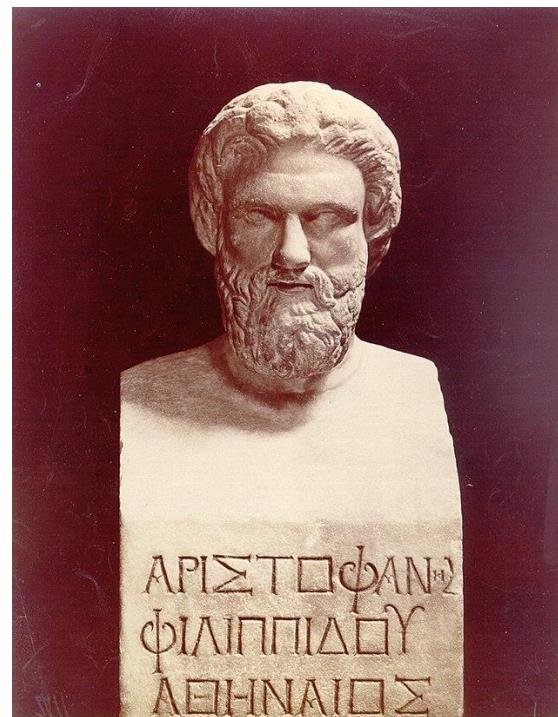


Aristophanes 300 BC
Machines that performed
tasks performed by humans

Breve Historia y contexto



Aristotle 380 BC
Prior Analytics / syllogistic

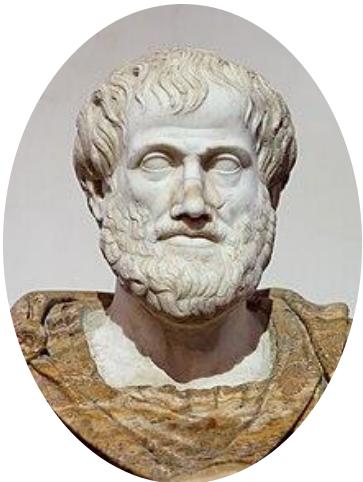


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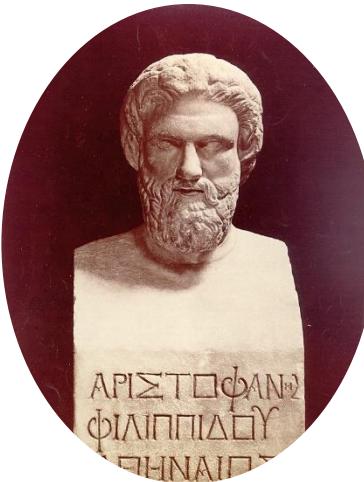


Ctesibio 200 BC
Horologium ex aqua /
clepsidra

Breve Historia y contexto



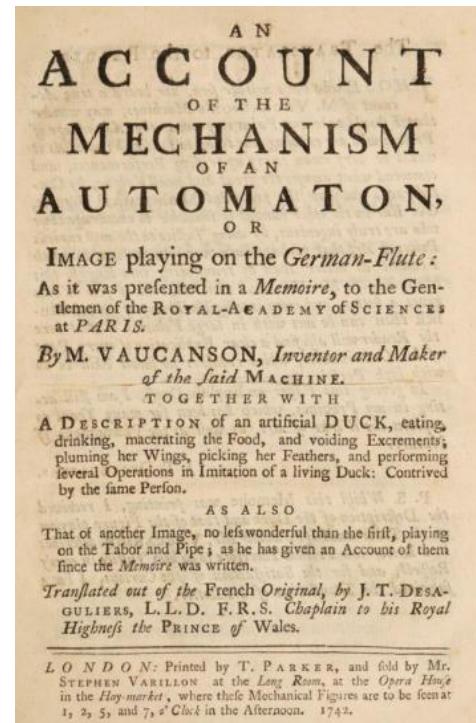
Aristotle 380 BC
Prior Analytics /
syllogistic



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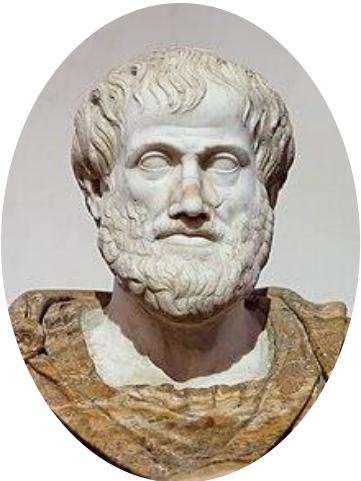


Ctesibio 200 BC
Horologium ex aqua /
clepsidra

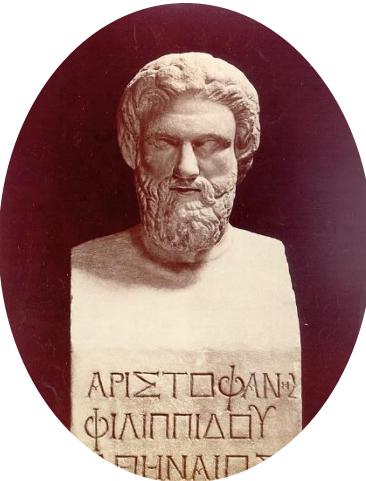


Jacques de Vaucanson
1764 Digesting Duck

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Aristotle 380 BC
Prior Analytics /
syllogistic



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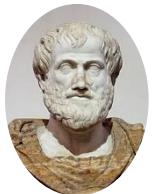


Jacques de Vaucanson
1764 Digesting Duck



Karel Čapek
1920 - Rossum's Universal
Robots

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Prior Analytics /
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Ctesibio 200 BC
Horologium ex aqua / clepsidra



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1920 - Rossum's
Universal Robots



Elektro 1939
First humanoid robot built
by the Westinghouse Electric
Corporation

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1920 - Rossum's
Universal Robots



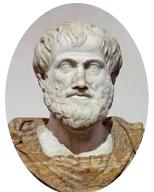
Elektro 1939
First humanoid robot

Ada Byron

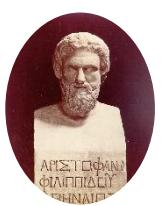
She wrote the first
algorithm designed to be
processed by a machine



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Aristotle 380 BC
Prior Analytics /
syllogistic



Aristophanes 300 BC
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Ctesibio 200 BC
Horologium ex aqua / clepsidra



Jacques de Vaucanson
1764 Digesting Duck



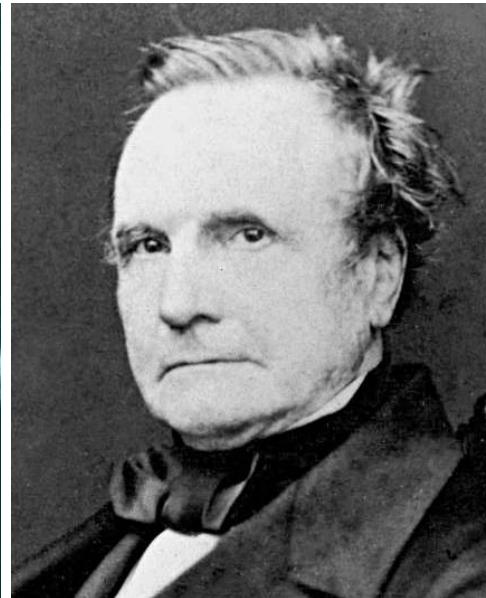
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1920 - Rossum's
Universal Robots



Elektro 1939
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processed by a machine



Charles Babbage

Pioneer of the Analytical Engine
1822 The beautiful Fragment



<https://computerhistory.org/blog/the-analytical-engine-28-plans-and-counting/>

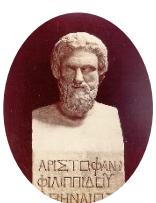
https://www.cs.virginia.edu/~robins/Ada_and_the_First_Computer.pdf

Breve Historia y contexto



Aristotle 380 BC

Prior Analytics / syllogistic



Aristophanes 300 BC
Machines that
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Ctesibio 200 BC Horologium ex aqua / clepsidra



Jacques de Vaucanson 1764 Digesting Duck



Karel Čapek

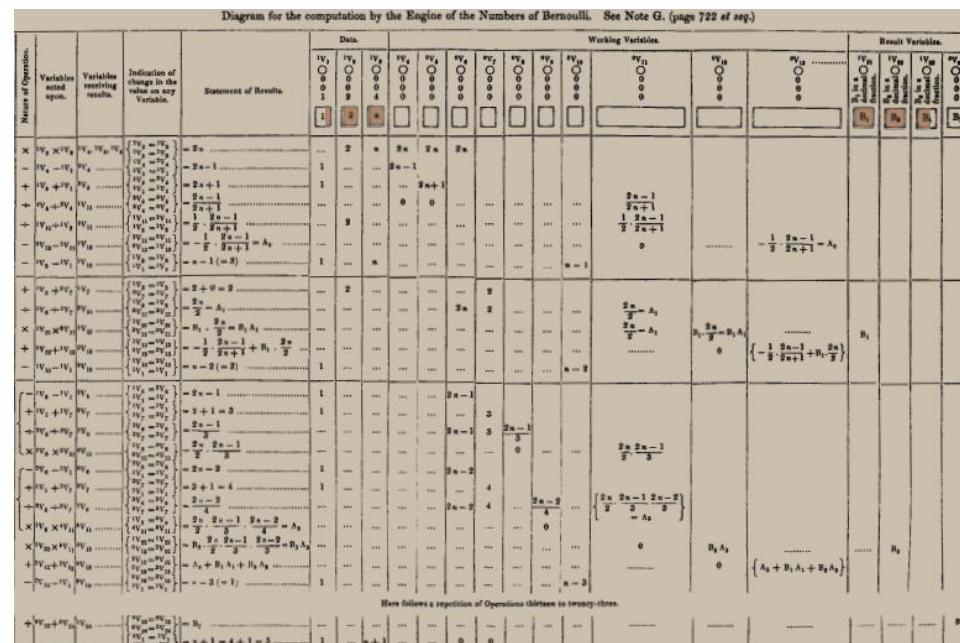
1920 - Rossum's Universal Robots



Elektro 1939
Firth humanoid robot

Ada Byron

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<https://computerhistory.org/blog/the-analytical-engine-28-plans-and-counting/>

https://www.cs.virginia.edu/~robins/Ada_and_the_First_Computer.pdf

Charles Babbage

Pioneer of the Analytical Engine 1822 The beautiful Fragment



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Aristophanes 300 BC
Machines that
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Ctesibio 200 BC
Horologium ex aqua / clepsidra



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1764 Digesting Duck



The beautiful Fragment



Karel Čapek
1920 - Rossum's
Universal Robots



Elektro 1939
First humanoid robot



Charles Babbage
Ada Byron
The beautiful
Fragment

VOL. LIX. No. 236.]

[October, 1950]

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

'Can machines think ?'
the meaning of the terms

The imitation game or Turing Test is a method of inquiry in artificial intelligence (AI) for determining whether or not a computer is capable of thinking like a human being

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syllogistic



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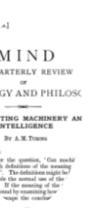
Karel Čapek
1920 - Rossum's
Universal Robots



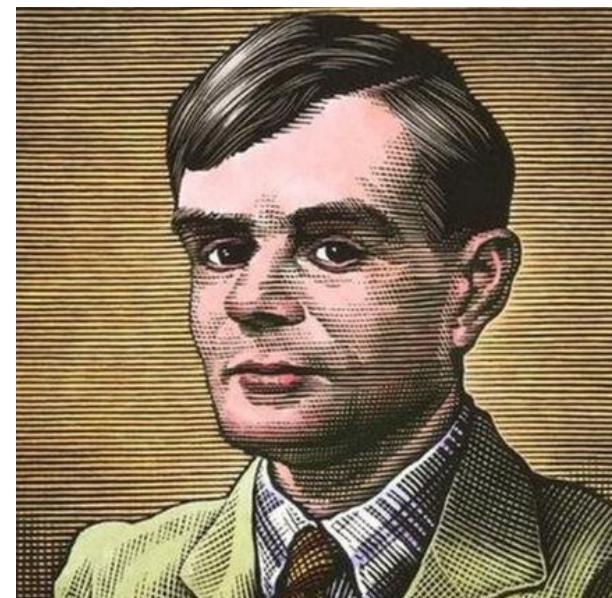
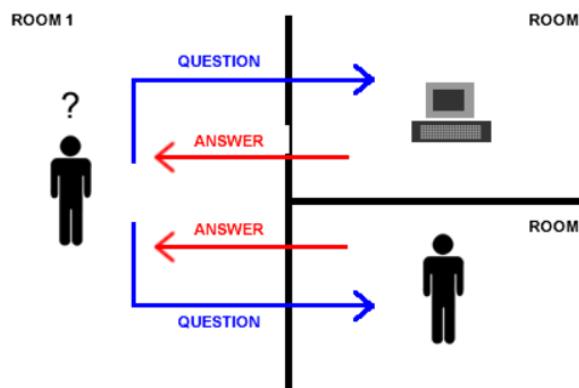
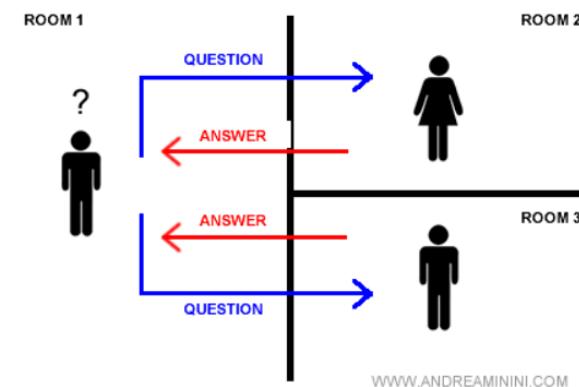
Elektro 1939
First humanoid robot



Charles Babbage
Ada Byron
The beautiful
Fragment



Turing Test 1950
Can Machines Think_

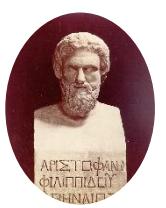


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The beautiful Fragment



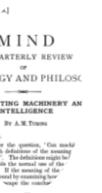
Karel Čapek
1920 - Rossum's
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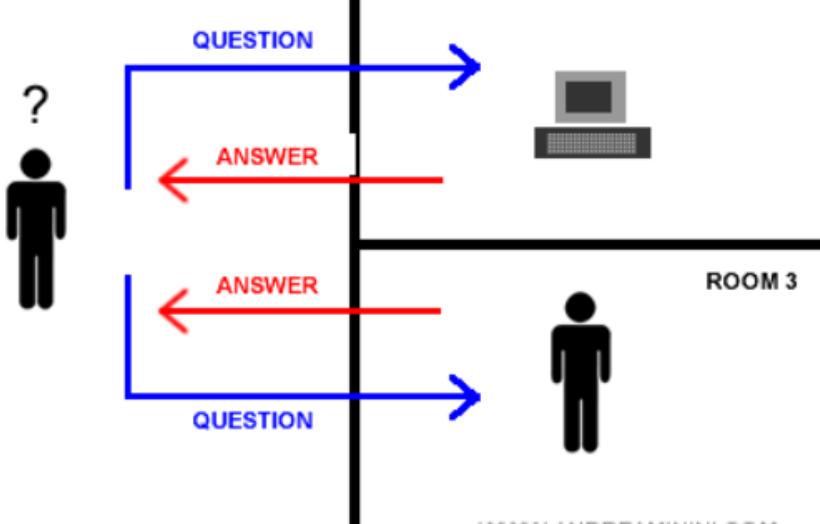


Charles Babbage
Ada Byron
The beautiful
Fragment



Turing Test 1950
Can Machines Think_

ROOM 1



<https://datatracker.ietf.org/doc/html/rfc439>

PARRY Encounters the DOCTOR
The session recorded below actually happened on 18 September 1972 and is herewith reproduced for your entertainment.
Good Evening.
Tell me your problems. Please terminate input with a period or a question mark.
*People get on my nerves sometimes.
I am not sure I understand you fully.
*You should pay more attention.
Suppose you should pay more attention.
*You're entitled to your own opinion.
What makes you think I am entitled to my own opinion?
*It bothers me just to be around people in general.
Please go on.



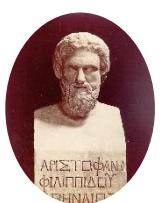
Joseph Weizenbaum

ELIZA — A Computer Program for
the Study of Natural Language
Communication between Man
and Machine in 1972

Breve Historia y contexto



Aristotle 380 BC
Prior Analytics /
syllogistic



Aristophanes 300 BC
Machines that
performed tasks
performed by
humans



Ctesibio 200 BC
Horologium ex aqua / clepsidra



Jacques de Vaucanson
1764 Digesting Duck



The beautiful Fragment



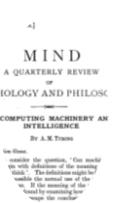
Karel Čapek
1920 - Rossum's
Universal Robots



Elektro 1939
First humanoid robot



Charles Babbage
Ada Byron
The beautiful
Fragment



Turing Test 1950
Can Machines Think_

Enigma machine



An electromechanical encryption device primarily used by the armed forces of Nazi Germany during World War II.

The **Turing machine** is a theoretical mathematical model of computation capable of performing any computation that can be carried out by any modern digital computer.

ON COMPUTABLE NUMBERS, WITH AN APPLICATION TO
THE ENTScheidungsproblem

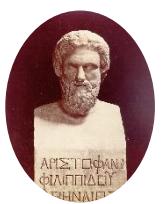
By A. M. TURING.

<https://www.youtube.com/watch?v=zCn3GCOwmel>

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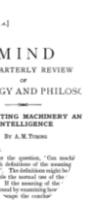
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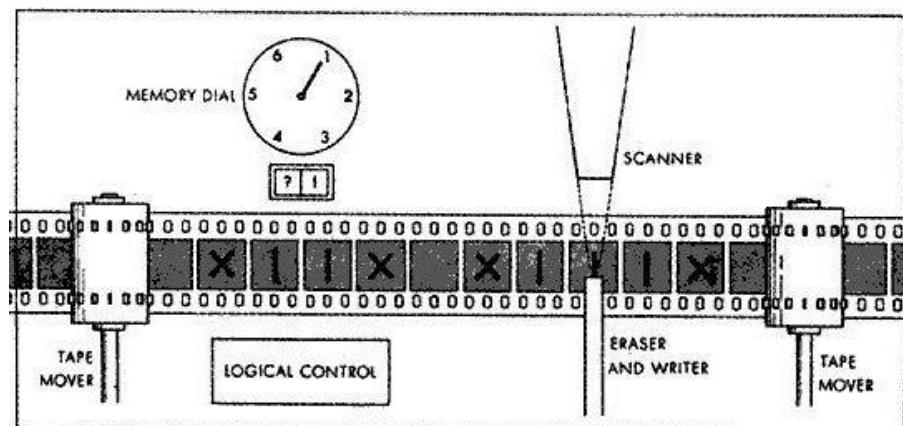
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By A. M. TURING.

[Received 28 May, 1936.—Read 12 November, 1936.]



Breve Historia y contexto



Kurt Gödel

Incompleteness theorem "Any effectively generated formal system capable of expressing elementary arithmetic cannot be both consistent and complete. In particular, for any such consistent formal system, there will exist statements that are undecidable within the system." 1931

<https://www.youtube.com/shorts/A-GV6LduJNM>

David Hilbert

"**Decision problem**" is related to the question of whether there is an algorithm that can determine whether a given mathematical statement is true or false. 1928

Entscheidungsproblem



The halting problem is a fundamental question in the theory of computing. The problem refers to the impossibility of determining, by one algorithm, whether another algorithm will stop its execution or enter an infinite loop for any given input. 1936

Halting problem

Breve Historia y contexto

The halting problem is a fundamental question in the theory of computing. The problem refers to the impossibility of determining, by one algorithm, whether another algorithm will stop its execution or enter an infinite loop for any given input. 1936

WALK

```
Input: x  
  
steps = 0  
while steps != x:  
    move forward  
    turn right  
    steps = steps + 1
```

HALT

```
Inputs: program, input  
  
if program halts  
when given input:  
    return yes  
else:  
    return no
```

Halting problem

Proof by Contadiction

- 1. Assume there is a program that solves the halting problem.**
- 2. Show that the assumption leads to a contradiction, so the assumption must not be true.**

<https://www.youtube.com/watch?v=Kzx88YBF7dY>

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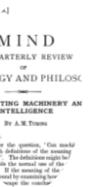
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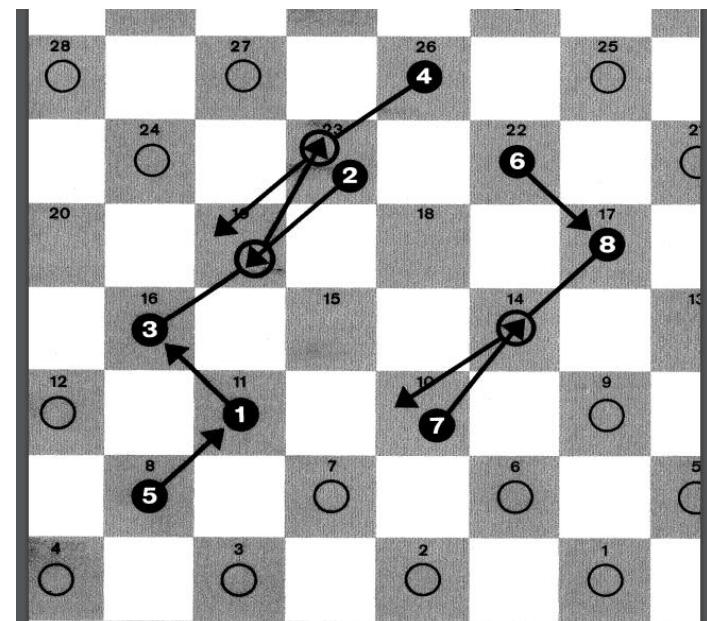
Joseph Weizenbaum
ELIZA — A Computer Program
for the Study of Natural
Language Communication



Arthur L. Samuel

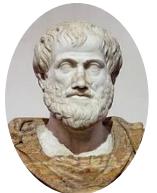
1948 / 1959 "Some Studies of
Machine Learning Using the
Game of Checkers"

The most interesting thing about this program is that it was able to improve its level of play as it played, adjusting the weights of the important variables for decision making.

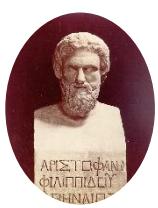


<https://ieeexplore.ieee.org/document/5392560?denied=>

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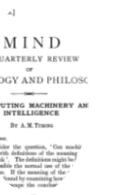
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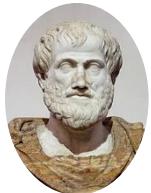
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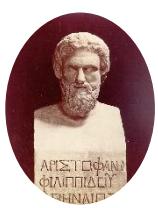
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Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, allowing them to perform tasks that typically require human intelligence, such as problem-solving, learning, reasoning, and decision-making.

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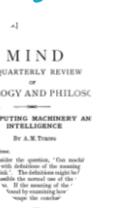
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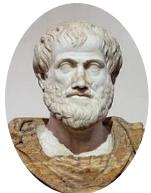


Arthur L. Samuel
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Artificial Intelligence (AI) refers to the simulation of human intelligence in machines, allowing them to perform tasks that typically require human intelligence, such as problem-solving, learning, reasoning, and decision-making.

Machine Learning is a subset of AI that involves the development of algorithms and statistical models that enable computers to learn and make predictions or decisions from data without being explicitly programmed..

Breve Historia y contexto



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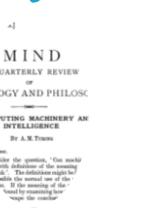
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Artificial Intelligence

Reasoning

Natural
Language
Processing
(NLP)

Planning

Machine Learning

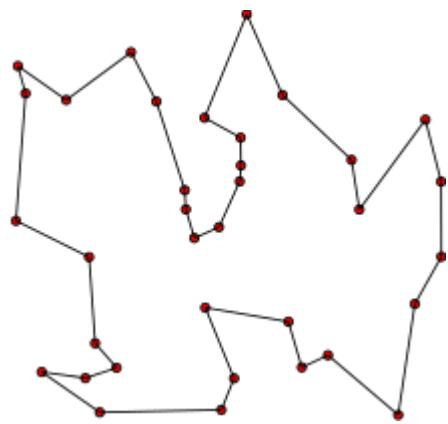
Supervised
Learning

Unsupervised
Learning

Reinforcement
Learning

Deep Learning
• Neural Networks

www.ibm.com/co-es/analytics/machine-learning



Nearest Neighbor

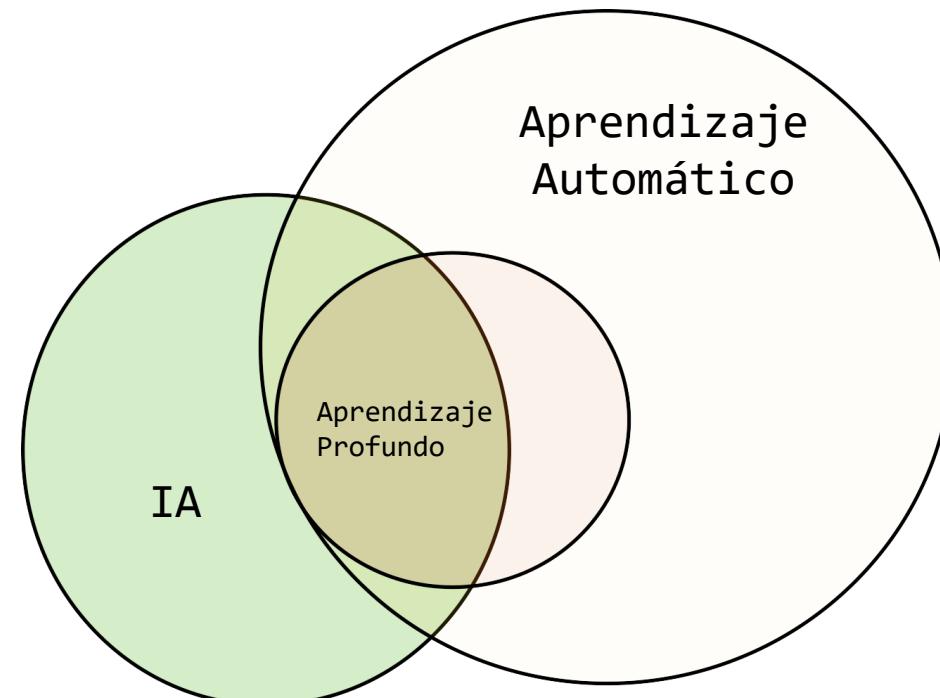
1967 It is considered the first
pattern recognition algorithm

Breve Historia y contexto

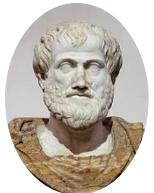
Inteligencia Artificial (IA): Subcampo de la informática centrado en resolver tareas que los humanos realizan con facilidad.

IA Estrecha (narrow): Diseñada para resolver tareas específicas de forma eficiente.

Inteligencia Artificial General (AGI): IA capaz de abordar múltiples tareas y comportarse como un humano en diversos contextos.



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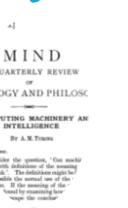
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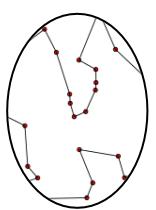
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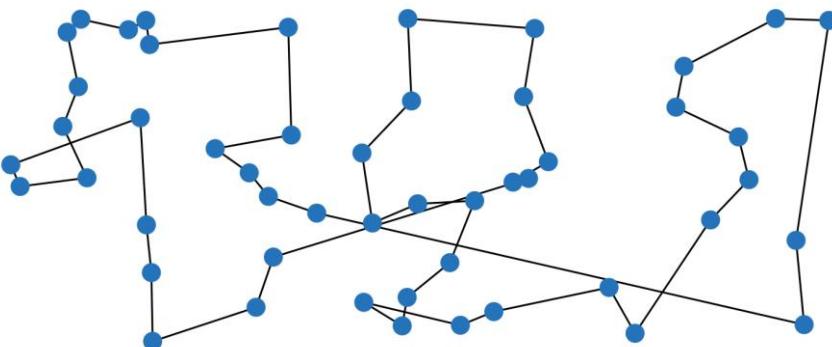
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Nearest Neighbor
1967 It is considered the
first pattern recognition
algorithm



The traveling salesman problem (TSP) asks the following question: "Given a list of cities and the distances between each pair of cities, what is the shortest possible route that visits each city exactly once and returns to the origin city?"

<https://www.math.uwaterloo.ca/tsp/>

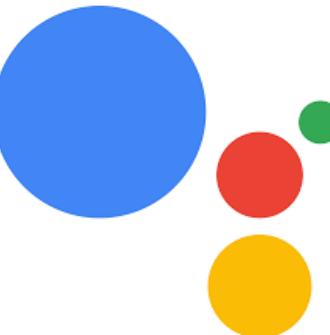
Breve Historia y contexto

Inteligencia Artificial

Input



Google assistant



Processing data

```
<!--shortcuts.xml-->
<capability>
  <intent>
    ...
  </intent>
</capability>
```

Output

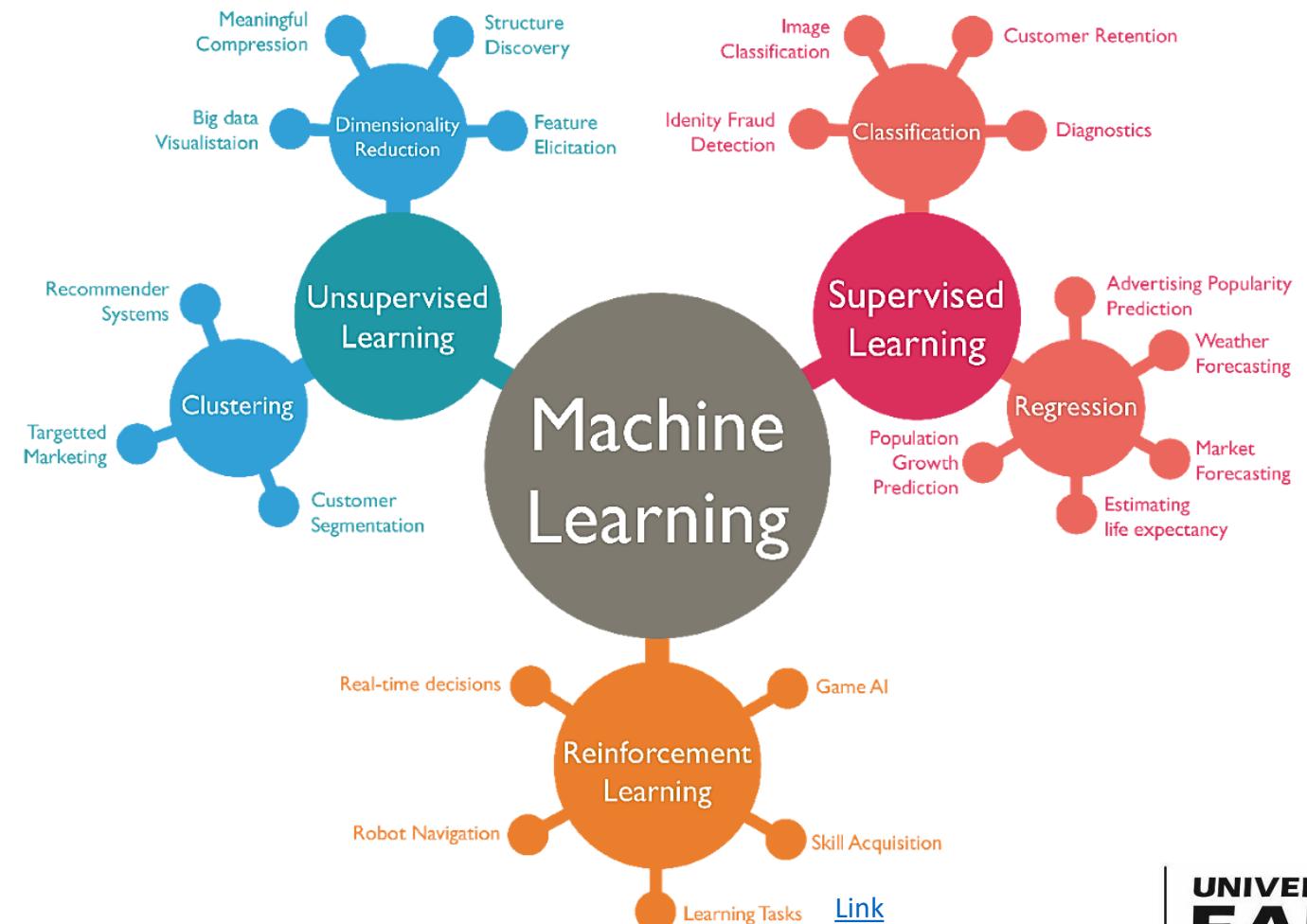


“Hey Google play some
music”

Qué es Machine Learning?

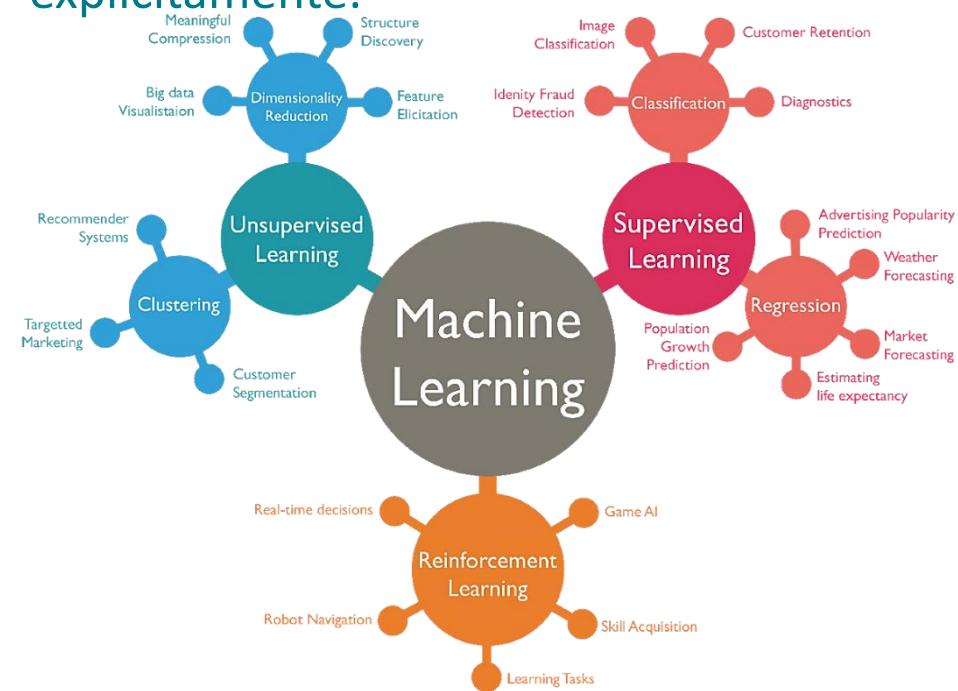
Machine Learning Es un subconjunto de la Inteligencia Artificial que implica el desarrollo de algoritmos y **modelos estadísticos** que permiten a las computadoras aprender y hacer predicciones o tomar decisiones a partir de datos, sin ser programadas explícitamente.

MATHEMATICAL REPRESENTATION OF A REAL DATA SYSTEM
OBTAINED USING STATISTICS.



Qué es Machine Learning?

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Qué es Machine Learning?

Traditional Programming:

1. Algorithm Development



2. Algorithm Implementation



3. Operation



Machine Learning:

1. Data Recollection and Processing



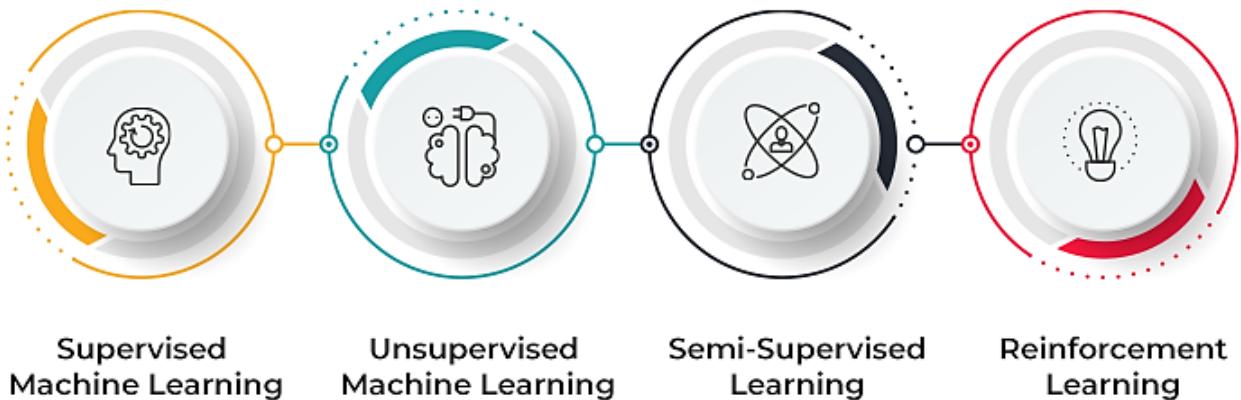
2. Model Experimentation



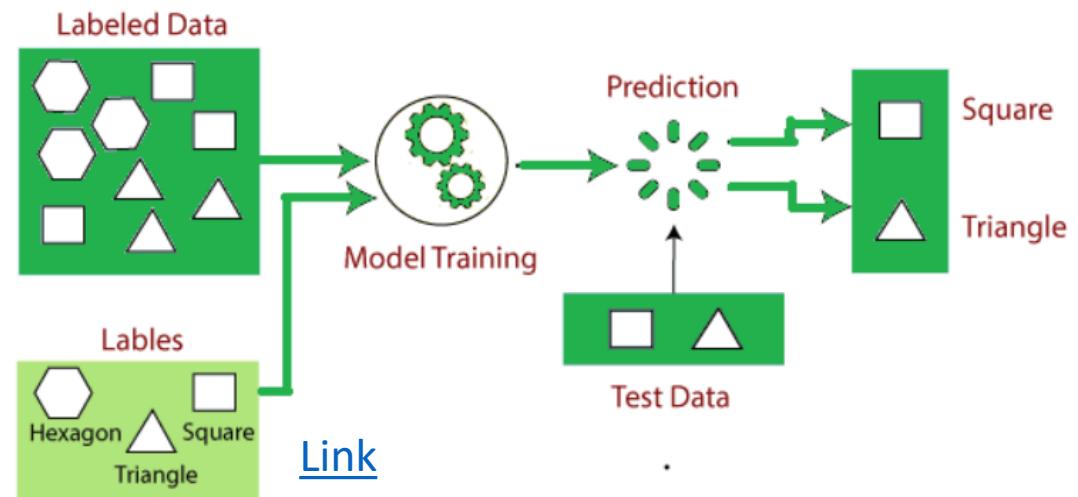
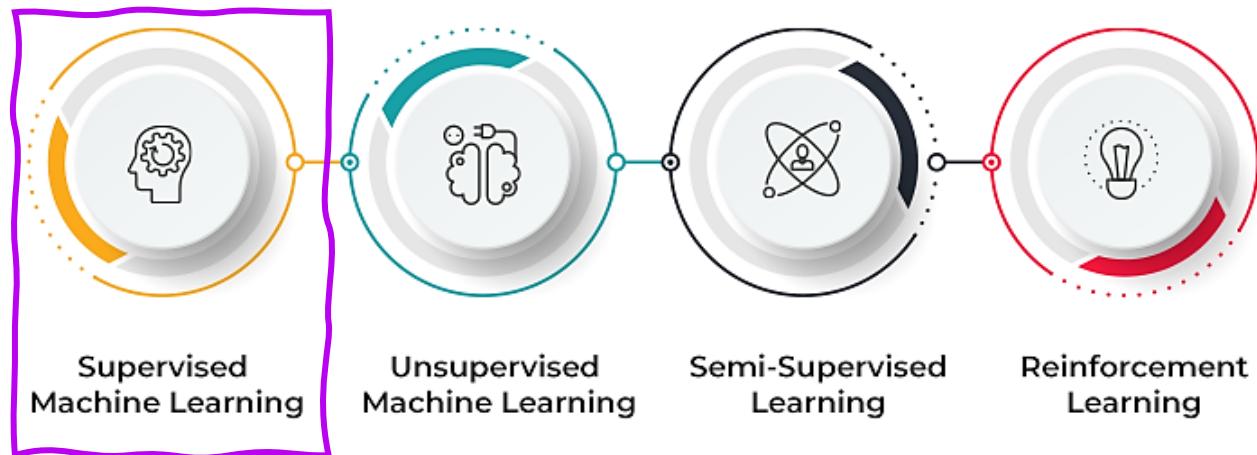
3. Operation



Qué es Machine Learning?



Qué es Machine Learning?

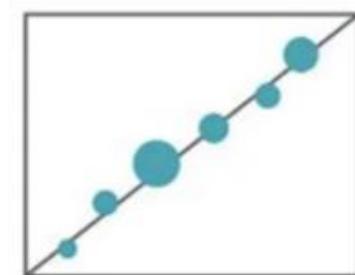


Se define por el uso de conjuntos de datos etiquetados para entrenar algoritmos **capaces de clasificar datos o predecir resultados de manera precisa**.

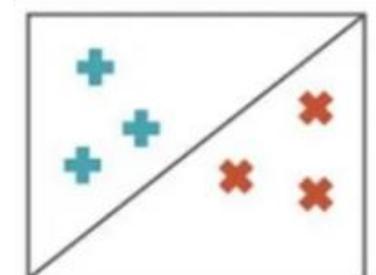
El algoritmo aprende a realizar predicciones o clasificaciones a partir de datos de entrenamiento y puede generalizar su conocimiento para hacer predicciones correctas sobre datos nuevos que no ha visto previamente.

Se denomina “supervisado” porque el proceso de entrenamiento del algoritmo está **guiado y supervisado** por las respuestas correctas conocidas en el conjunto de datos de entrenamiento.

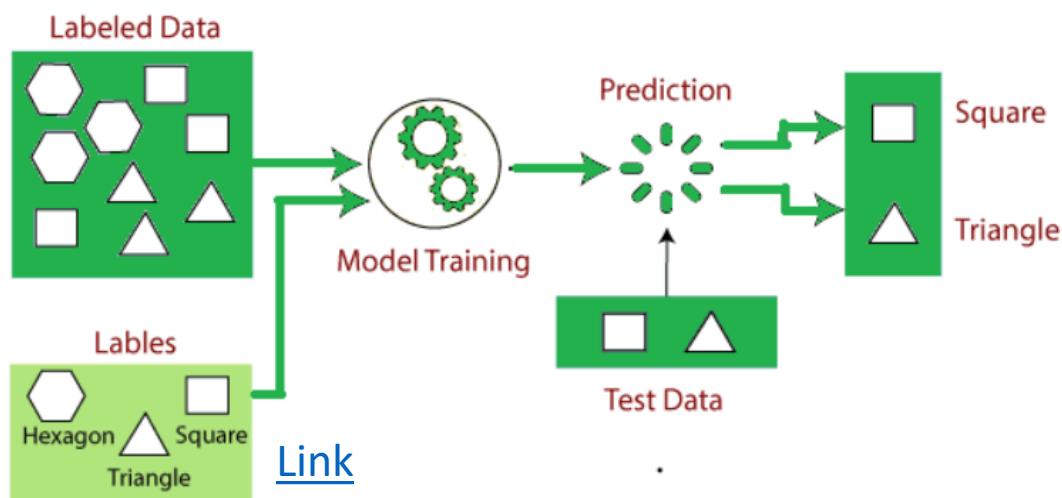
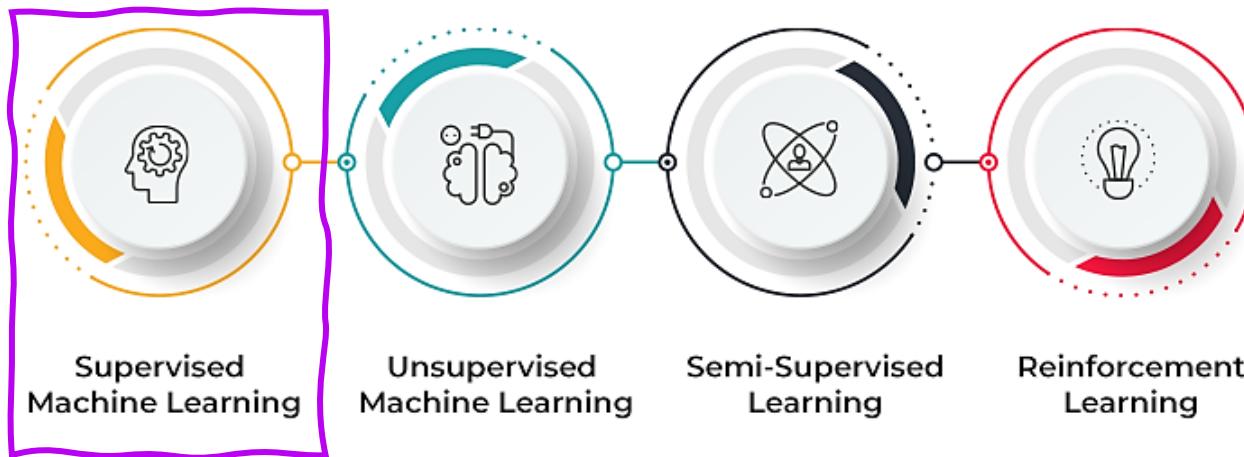
Regression



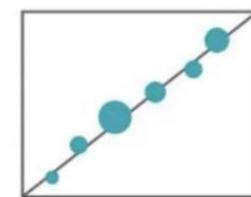
Classification



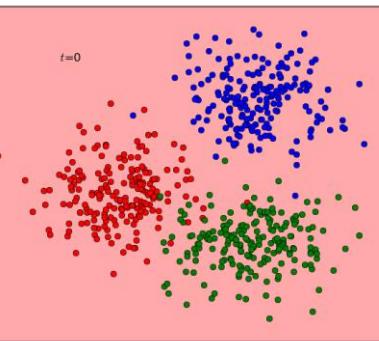
Qué es Machine Learning?



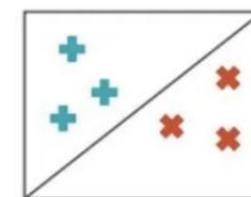
Regression



- Linear Regression
- Regression Trees
- Non-Linear Regression
- Bayesian Linear Regression
- Polynomial Regression

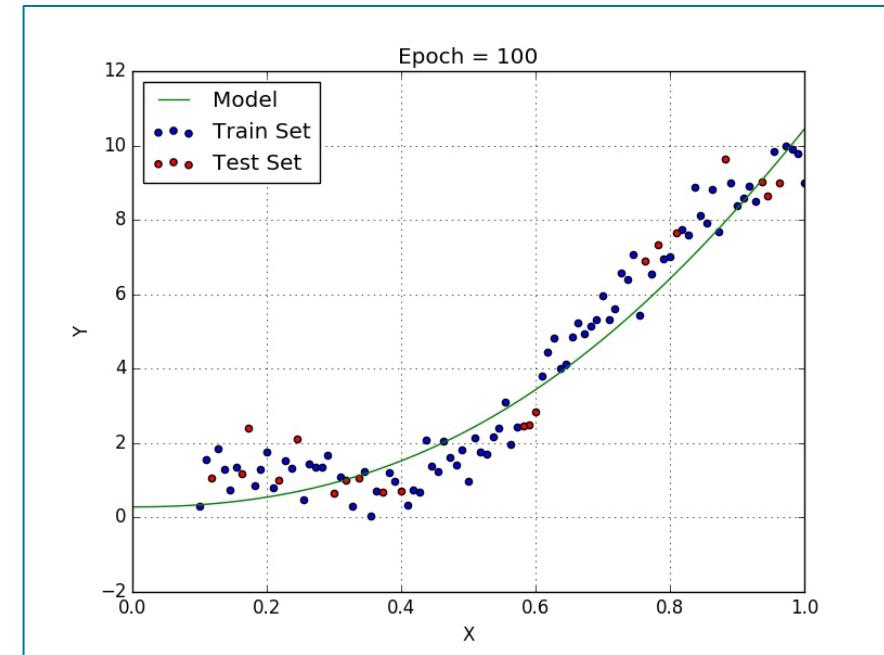
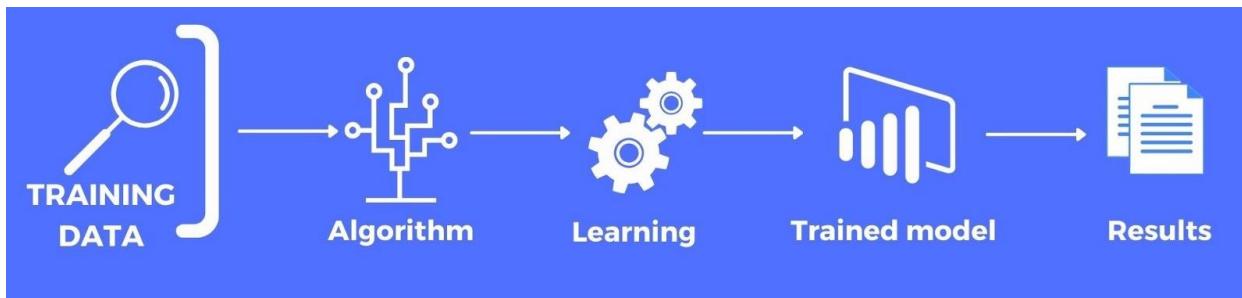
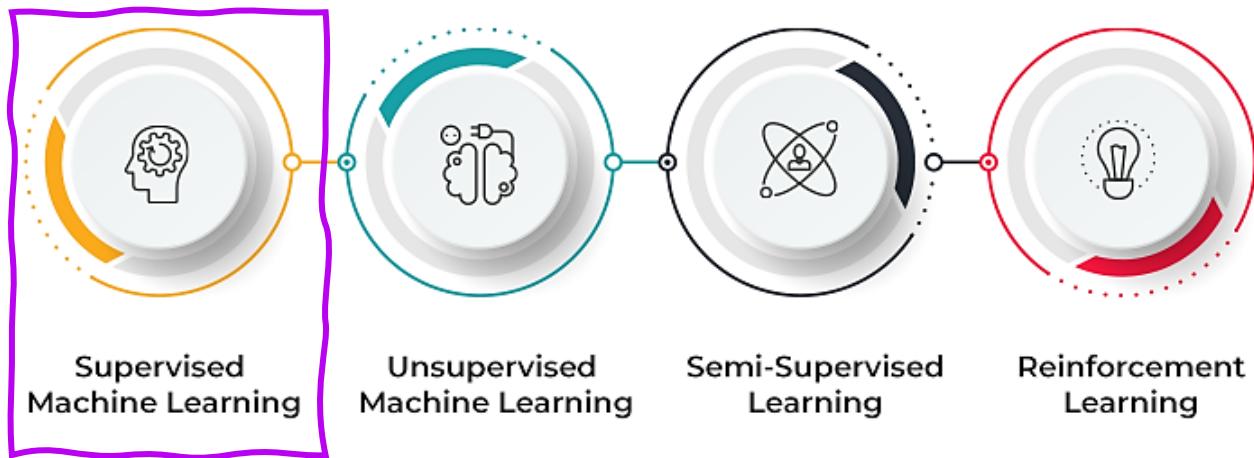


Classification



- Random Forest
- Decision Trees
- Logistic Regression
- Support vector Machines

Qué es Machine Learning?

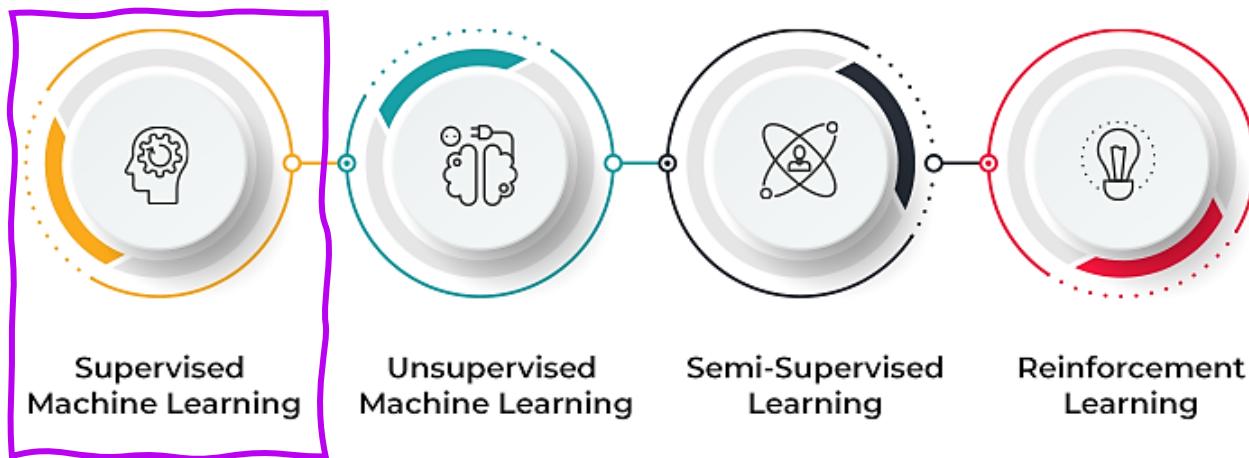


https://www.cs.toronto.edu/~frossard/post/multiple_linear_regression/

¿Cuál es la curva más eficiente que puede explicar la mayor parte de los datos?

¿Cuál es el mejor optimizador para el aproximador?

Qué es Machine Learning?



Requirements:

- No missing values
- Data in numeric format (Hot encoding)
- Data store in array

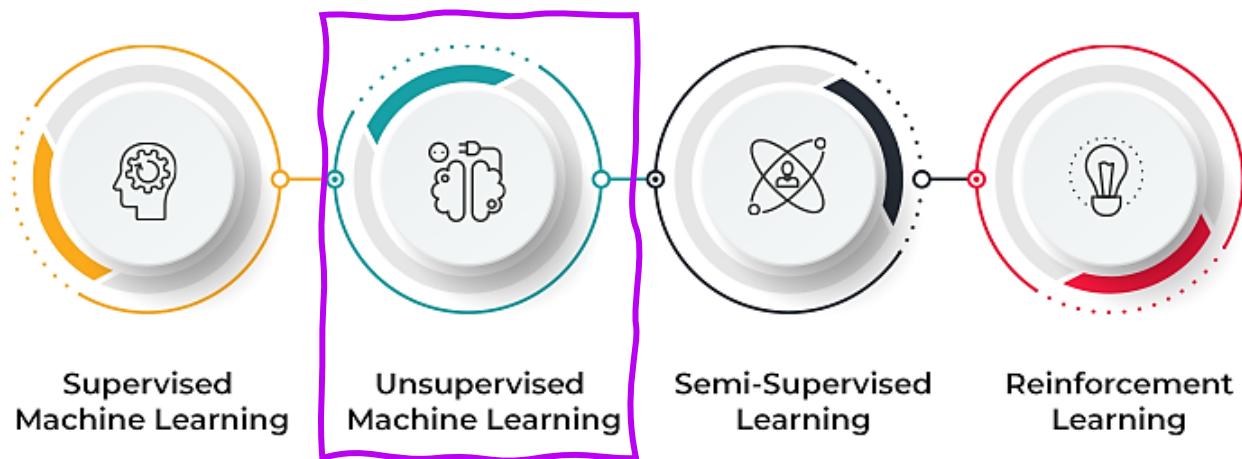
Pros:

- High Accuracy
- Easy Interpretability
- Data in numeric format (Hot encoding)
- Data store in array

Cons:

- Data Labeling
- Overfitting
- Not Scalability
- Human Intervention
- Data training period is longer, since supervised learning requires a lot of computation time.

Qué es Machine Learning?

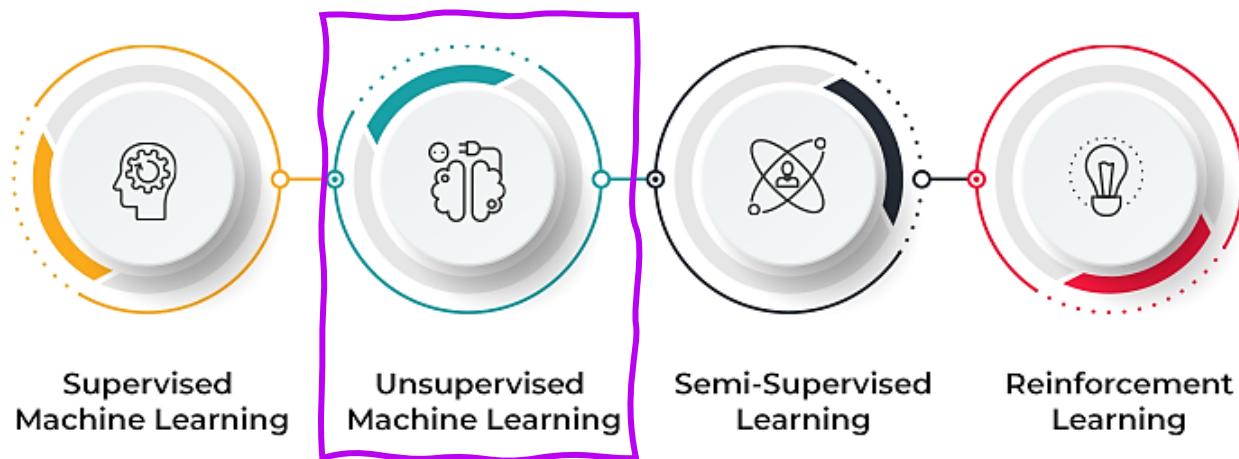


En el **aprendizaje automático no supervisado**, al algoritmo se le proporcionan datos de entrada sin ningún objetivo correspondiente o salida etiquetada. El objetivo del algoritmo es descubrir por sí mismo patrones, relaciones o estructuras dentro de los datos. Este enfoque se utiliza para tareas como la agrupación (clustering), que consiste en agrupar puntos de datos similares, y la reducción de dimensionalidad, que busca simplificar los datos preservando la información importante, sin necesidad de supervisión explícita ni de datos etiquetados.



• Clustering

Qué es Machine Learning?

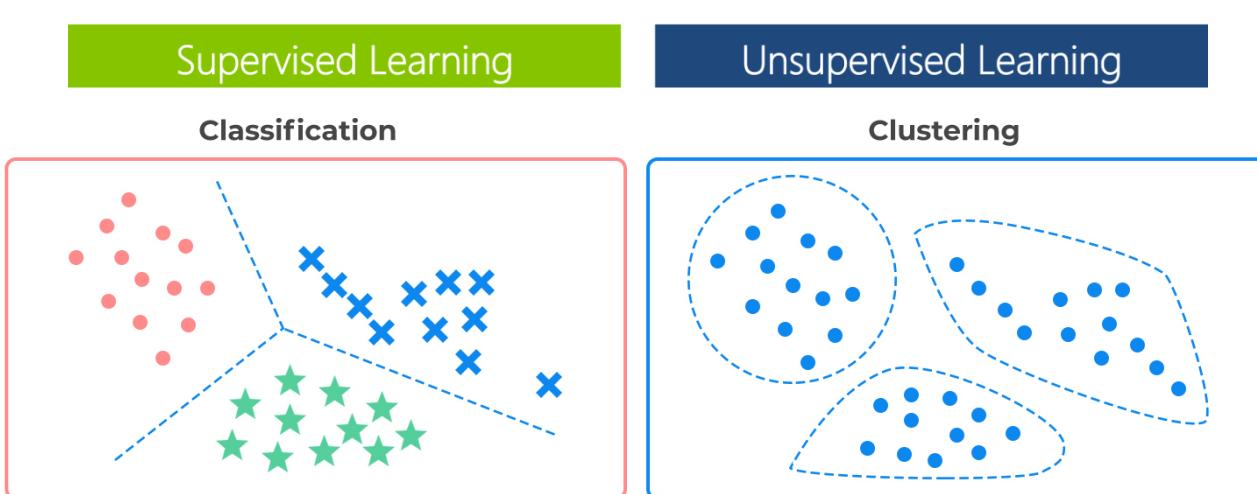
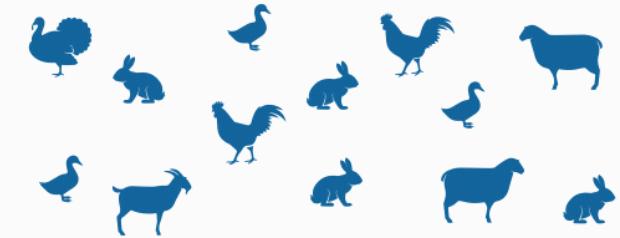
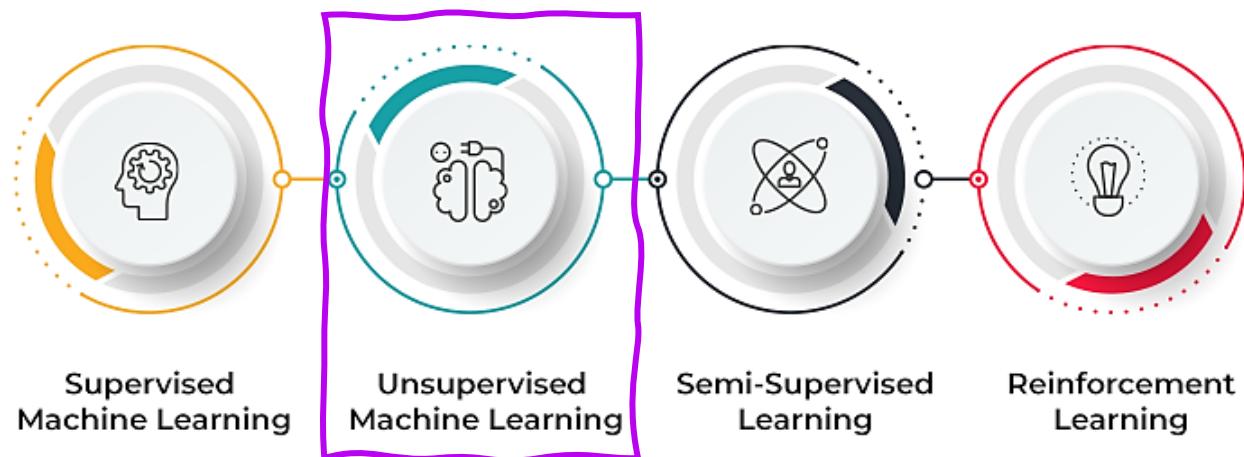


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- Clustering
- Association

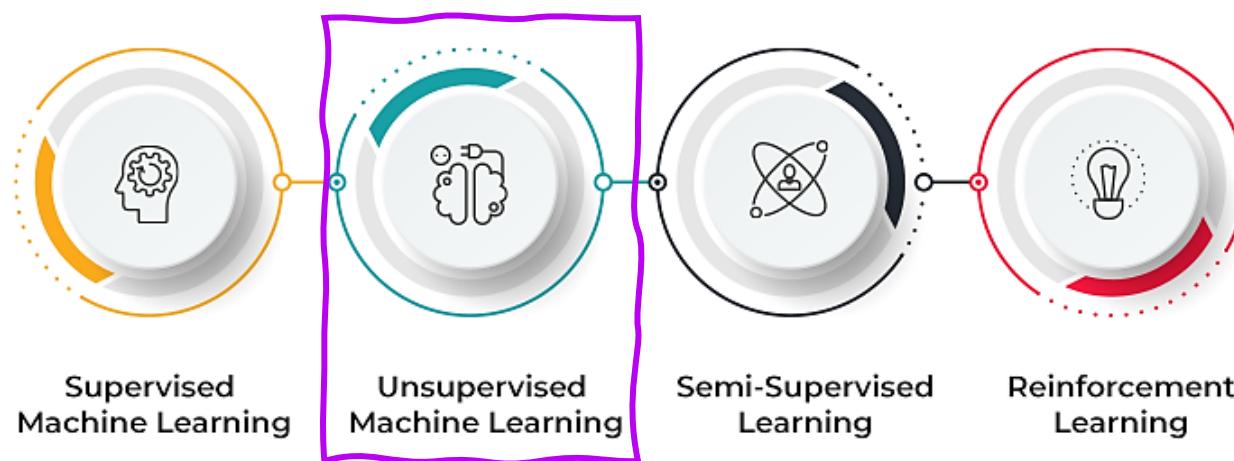
Qué es Machine Learning?



Clasificación: Predicción de etiquetas basada en características que ya han sido observadas en los datos. Permite encontrar patrones relacionados con la variable objetivo.

Clustering: Utiliza datos históricos no etiquetados para explorar y crear una estructura o forma que permita organizar dichos datos.

Qué es Machine Learning?



Requirements:

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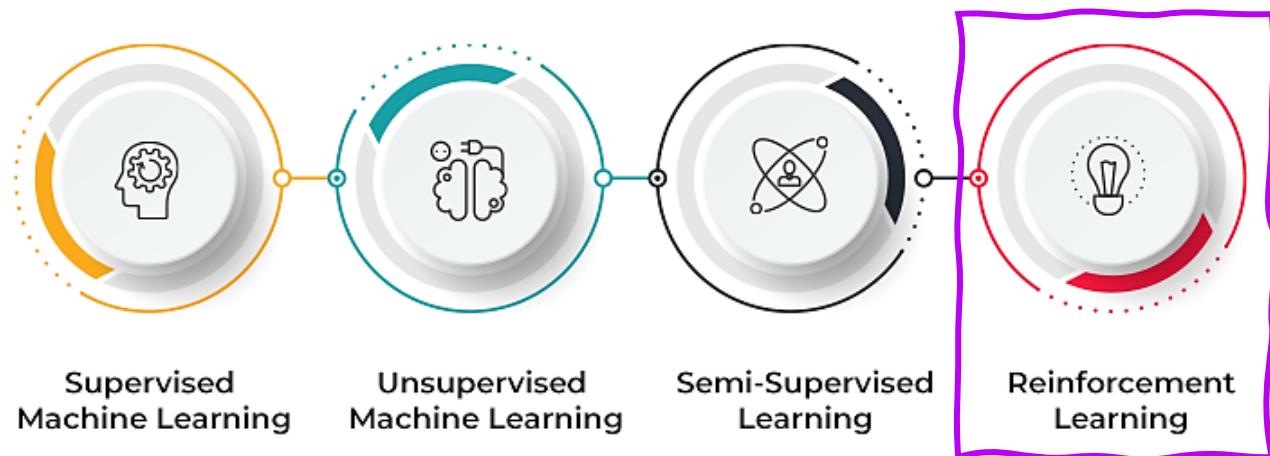
Pros:

- Learns and classifies data from no data labeling
- Requires fewer manual data preparation
- No Human Intervention
- Capable of finding previously unknown patterns in data
- Real time analysis

Cons:

- Not Well Accuracy
- Hard to interpret (Users need to manually interpret)
- Difficult to measure accuracy or effectiveness due to lack of predefined answers during training

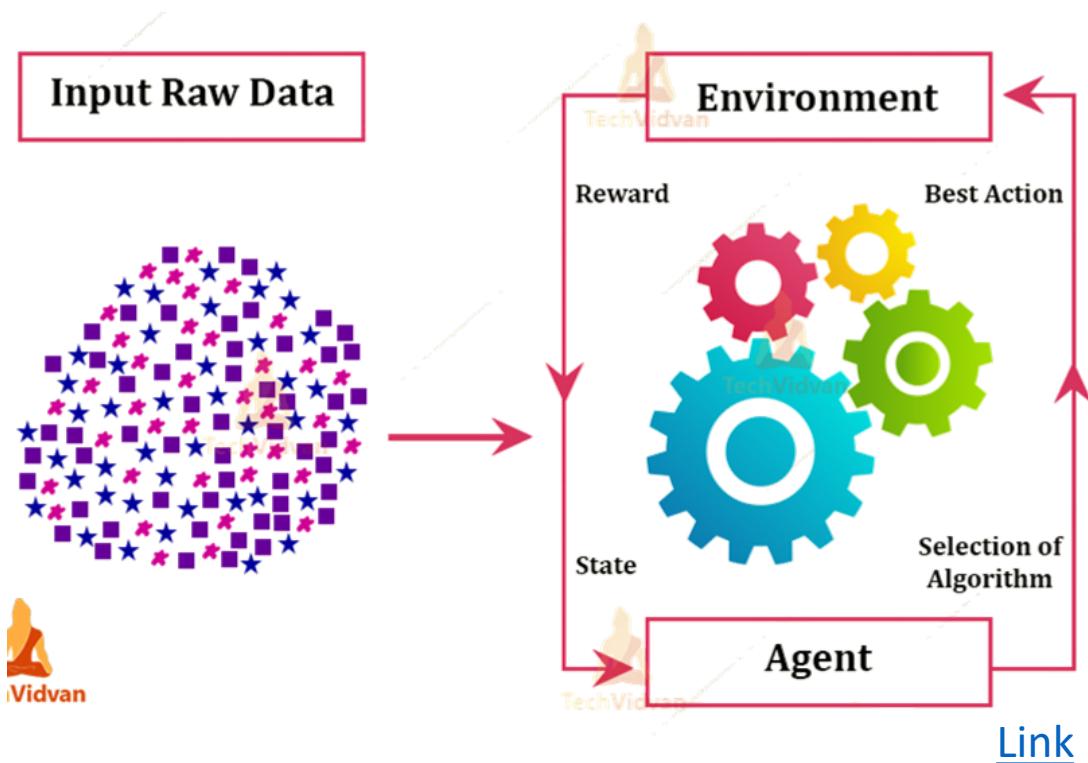
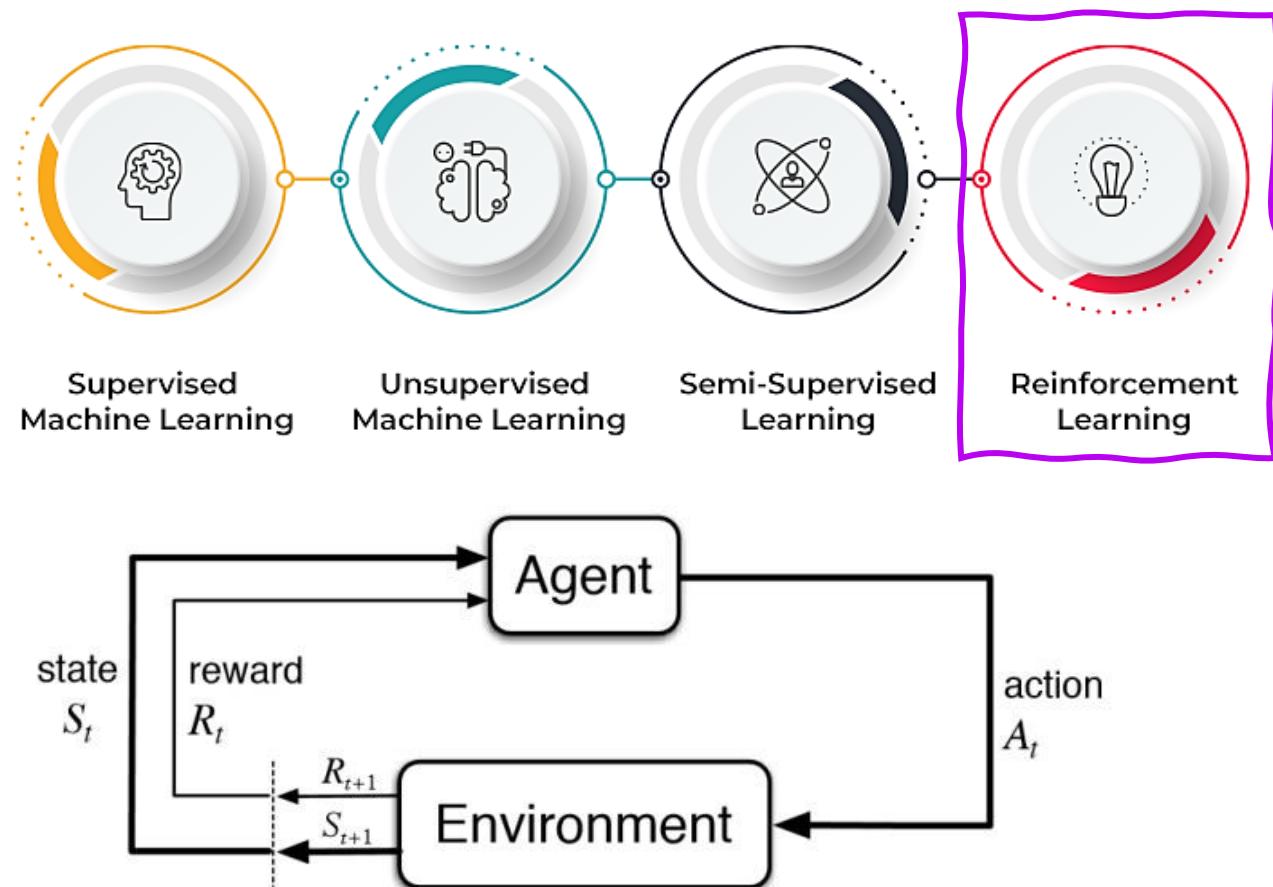
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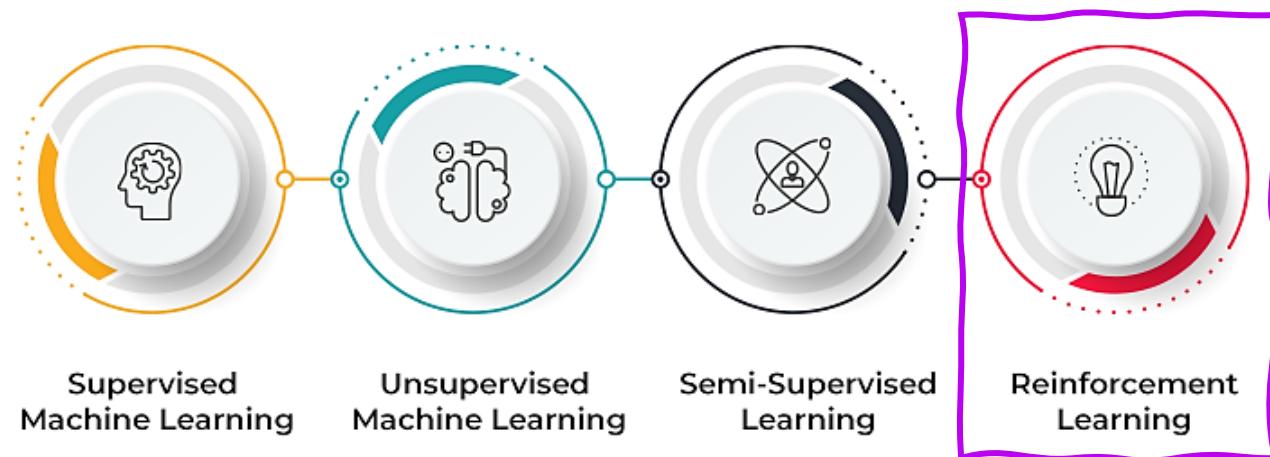
En el Aprendizaje por Refuerzo, un agente interactúa con su entorno produciendo acciones y descubriendo errores o recompensas. El Aprendizaje por Refuerzo está inspirado en la psicología conductual y consiste en tomar secuencias de decisiones con el objetivo de maximizar una recompensa acumulada.



Qué es Machine Learning?



Qué es Machine Learning?



[Link](#)

Agente: El aprendiz que interactúa con el entorno. El agente realiza acciones basándose en su estado actual y en sus observaciones.

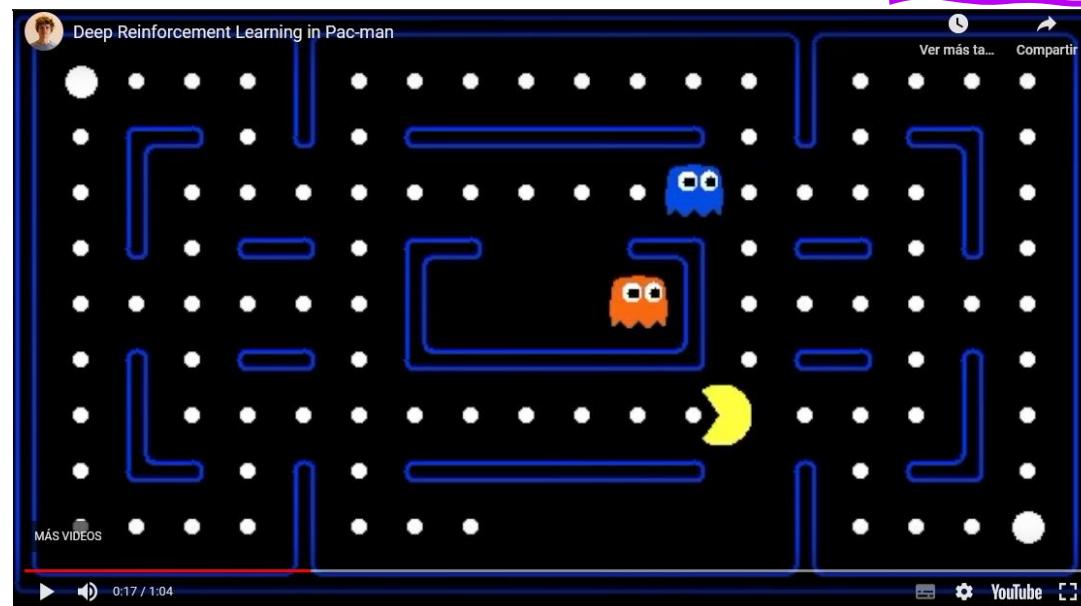
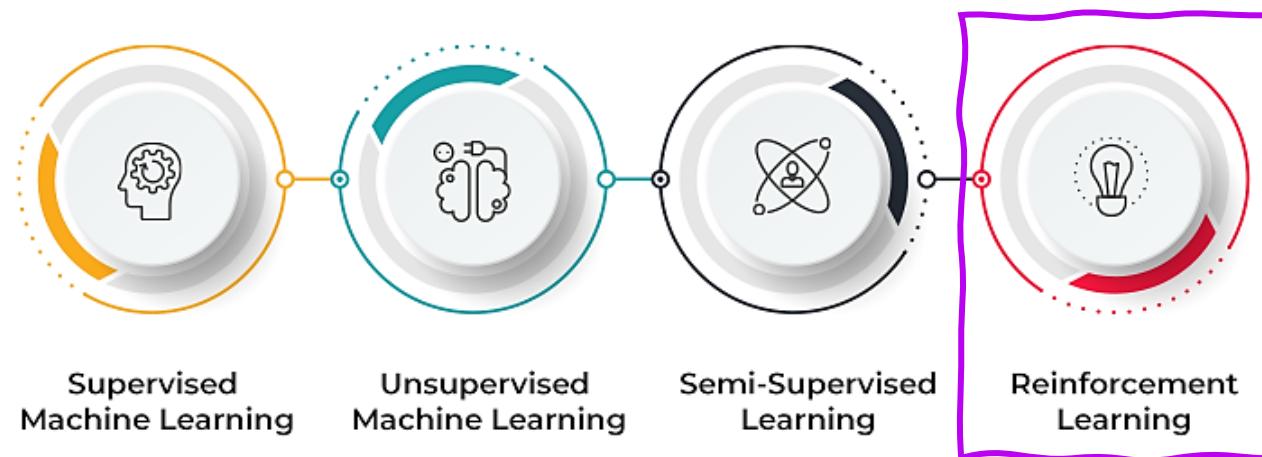
Entorno: El sistema externo con el que interactúa el agente. El entorno es responsable de proporcionar retroalimentación al agente en forma de recompensas y transiciones de estado.

Estado: Una representación de la situación o configuración actual del entorno. El estado ayuda al agente a comprender su posición y a tomar decisiones.

Acción: Las elecciones o decisiones que toma el agente en cada instante de tiempo. Las acciones se seleccionan a partir de un conjunto de acciones posibles disponibles para el agente en el estado actual.

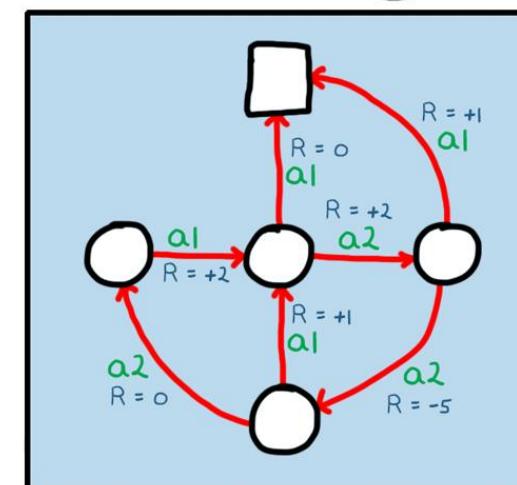
Recompensa: Un valor escalar que el agente recibe del entorno después de realizar una acción en un estado determinado.

Qué es Machine Learning?



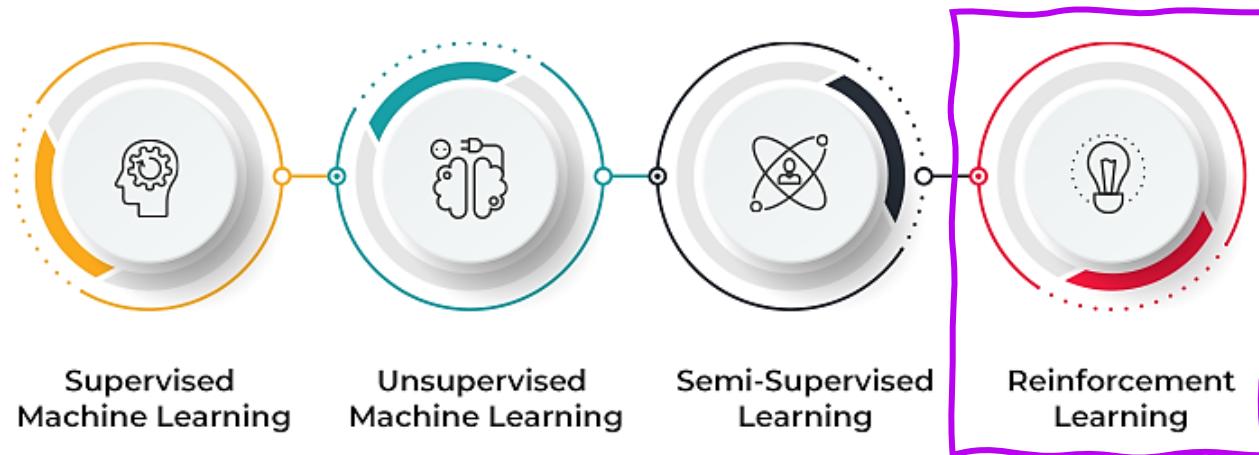
The agent determine by own what information is relevant and how to implement to learn.

reinforcement
learning



<https://www.youtube.com/watch?v=QilHGSYbjDQ&t=17s>

Qué es Machine Learning?



Requirements:

- Data in numeric format (Hot encoding)
- Data store in array

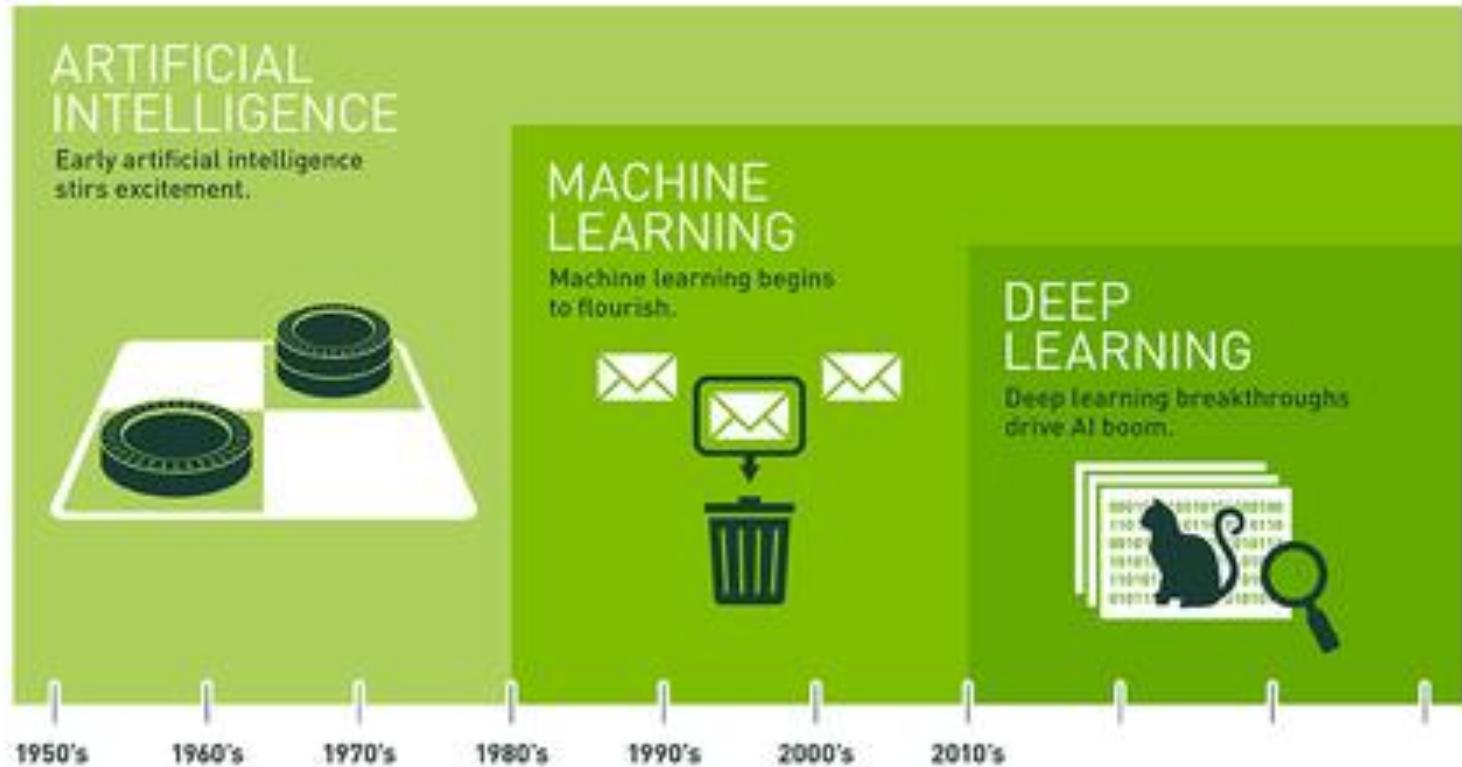
Pros:

- Reinforcement learning can be used to solve very complex problems that cannot be solved by conventional techniques
- The model can correct the errors that occurred during the training process
- In the absence of a training dataset, it is bound to learn from its experience
- Capable of finding previously unknown patterns in data
- Real time analysis

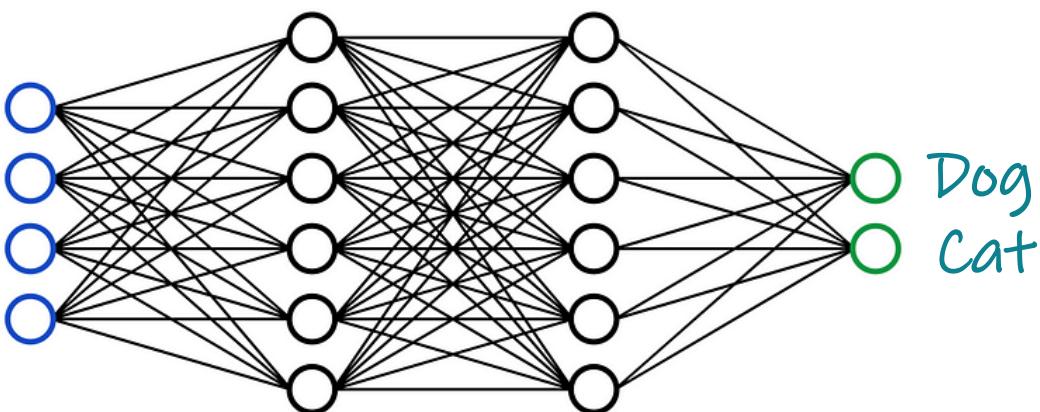
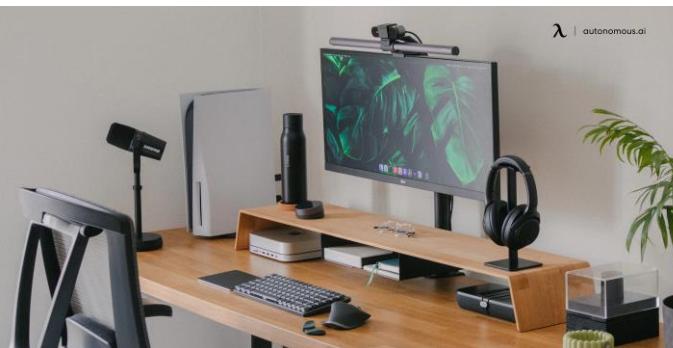
Cons:

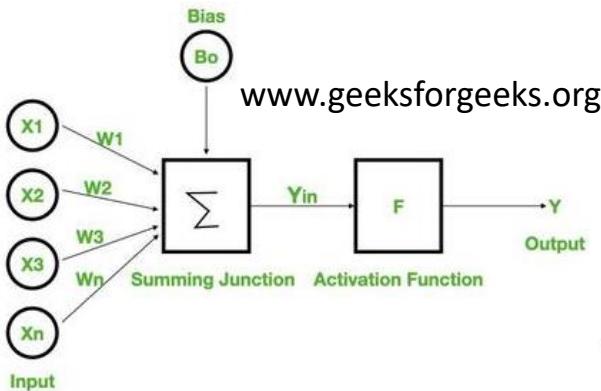
- Demands a lot of data and a lot of computation.
- Too much of reinforcement may cause an overload which could weaken the results.

Deep Learning

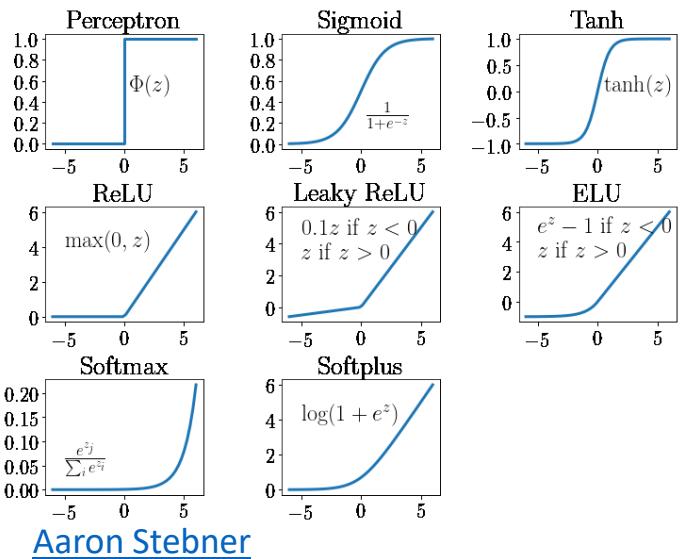
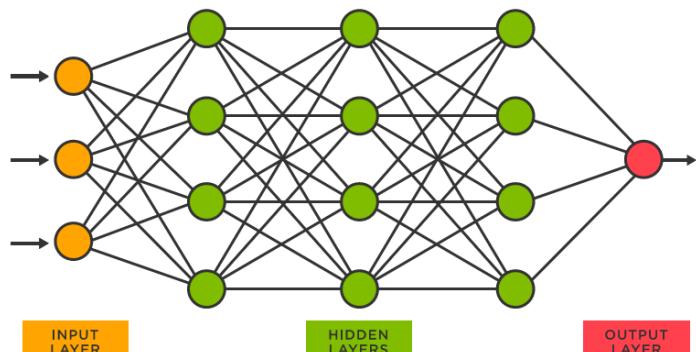
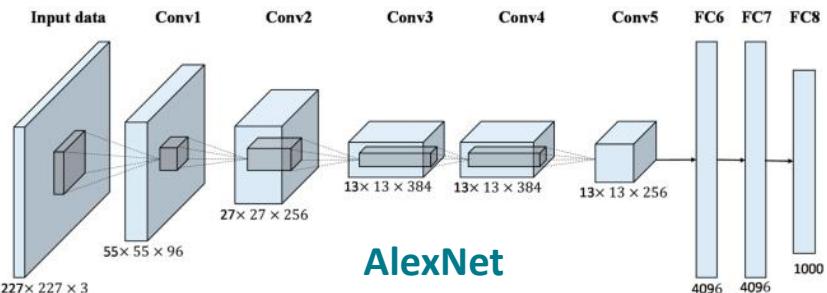


Deep Learning

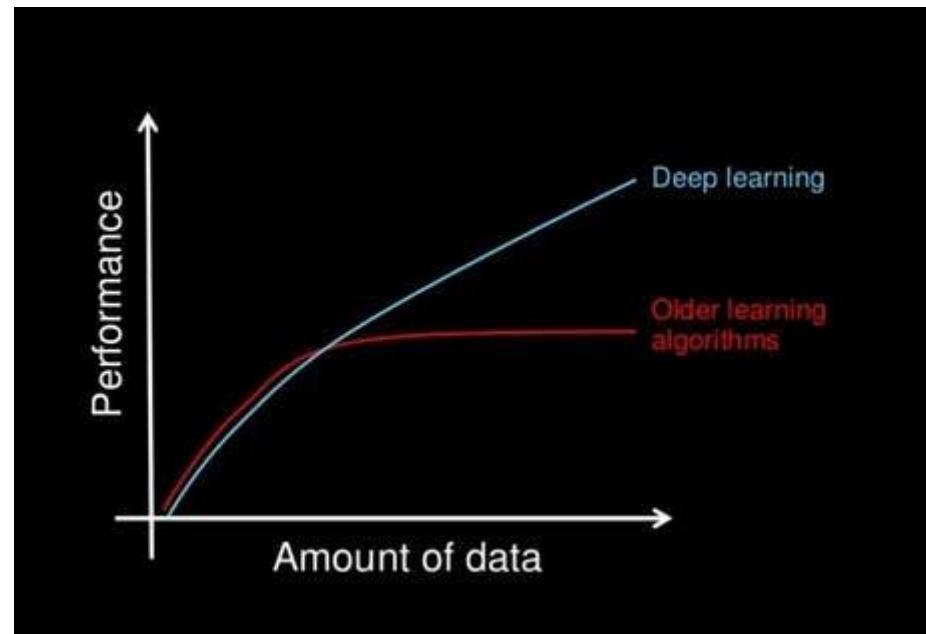




DOI:doi.org/10.3390/rs9080848



Why to use Deep Learning?

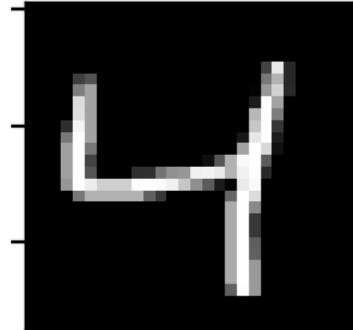


<https://www.youtube.com/watch?v=O0VN0pGgBZM&t=35s>

Deep Learning

0	8	7	6	4	6	9	7	2	1	5	1	4	6	
0	1	2	3	4	4	6	2	9	3	0	1	2	3	4
0	1	2	3	4	5	6	7	0	1	2	3	4	5	0
7	4	2	0	9	1	2	8	9	1	4	0	9	5	0
0	2	7	8	4	8	0	7	7	1	1	2	9	3	6
5	3	9	4	2	7	2	3	8	1	2	9	8	8	7
2	9	1	6	0	1	7	1	1	0	3	4	2	6	4
7	7	6	3	6	7	4	2	7	4	9	1	0	6	8
2	4	1	8	3	5	5	5	3	5	9	7	4	8	5

What number is this?



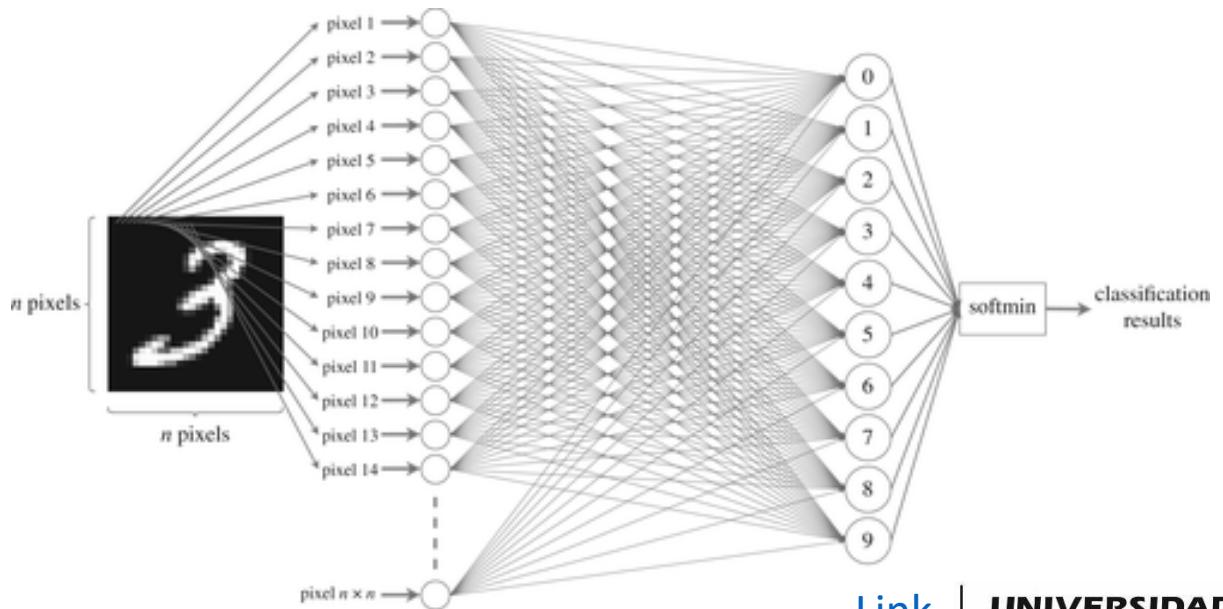
Write a code to determine what number is this



0	2	15	0	0	11	10	0	0	0	0	9	0	0	29	
0	0	0	4	60	157	236	255	255	177	96	61	32	0	0	29
0	10	16	115	238	255	244	245	243	250	249	255	222	103	10	0
0	14	170	255	255	244	254	255	253	245	255	249	253	251	124	1
2	98	255	228	255	251	254	211	141	116	122	215	251	238	255	49
13	217	243	255	155	38	226	52	2	0	10	13	232	255	36	62
16	223	252	254	49	12	0	0	7	7	0	70	237	252	235	62
6	41	245	255	212	25	11	9	3	0	115	236	243	255	137	0
0	87	252	250	248	215	60	0	1	121	252	255	248	144	6	0
0	13	113	255	255	245	255	182	181	248	252	242	208	36	0	19
1	0	5	111	251	255	241	255	247	255	241	162	17	0	7	0
0	0	0	4	58	251	255	246	254	253	255	120	11	0	1	0
0	0	4	91	255	255	255	248	252	255	244	255	182	10	0	4
0	22	206	252	246	251	241	100	24	13	118	255	245	255	194	9
0	111	255	242	255	158	24	0	0	6	39	255	232	230	56	0
0	218	251	250	137	7	11	0	0	0	2	62	255	250	125	3
0	175	255	256	101	9	20	0	13	3	19	182	251	245	61	0
0	107	251	241	255	230	98	55	19	18	217	248	253	255	52	4
0	18	146	250	255	247	255	255	255	249	255	240	255	129	0	5
0	0	23	113	215	255	250	248	255	255	248	245	116	14	12	0
0	0	6	1	0	52	153	233	255	252	147	37	0	0	4	1
0	0	5	5	0	0	0	0	0	14	1	0	6	6	0	0

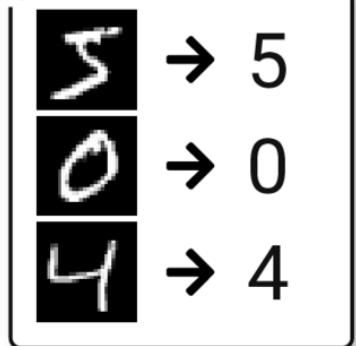
Discretizing the information by pixels

Processing all pixel together

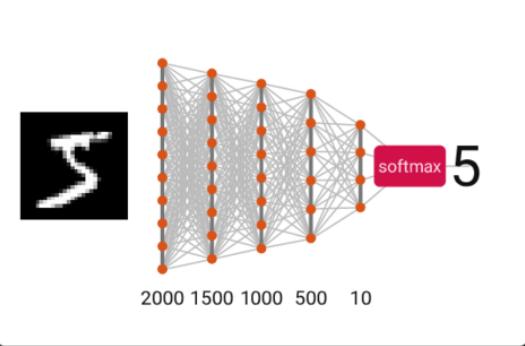


Deep Learning

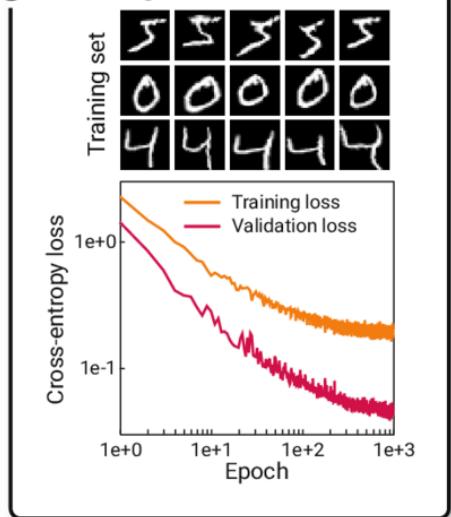
A - Problem: MNIST



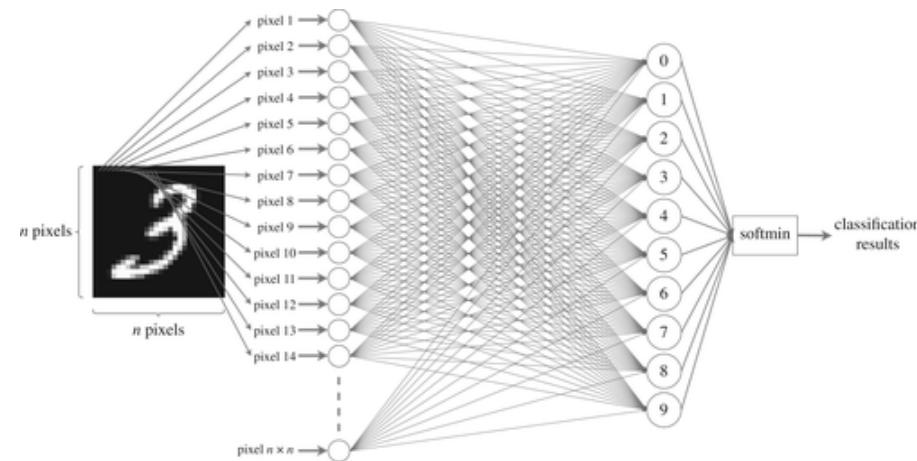
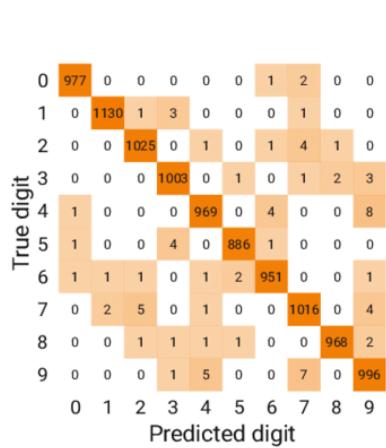
B - Model: DNN



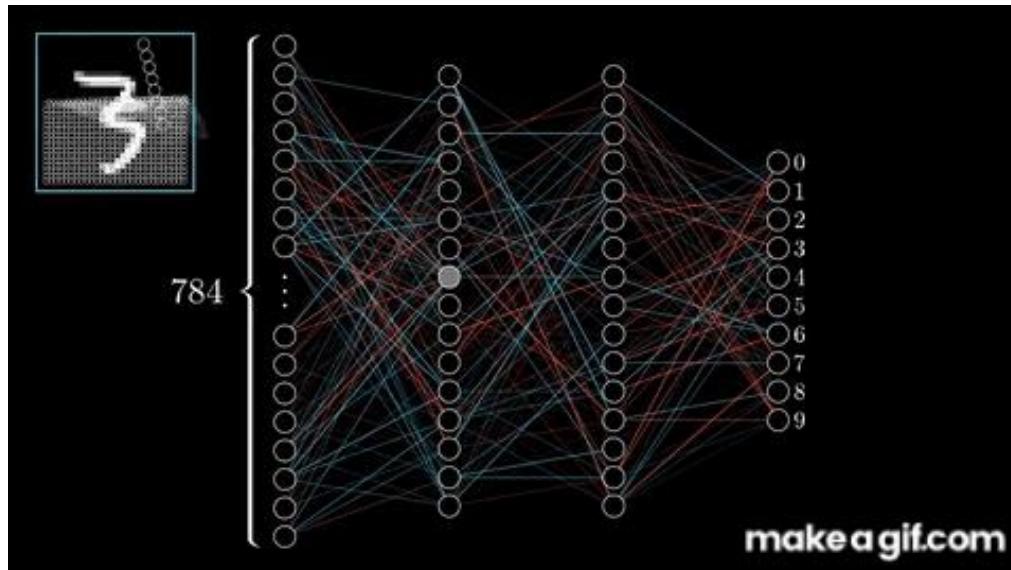
C - Training



D - Results

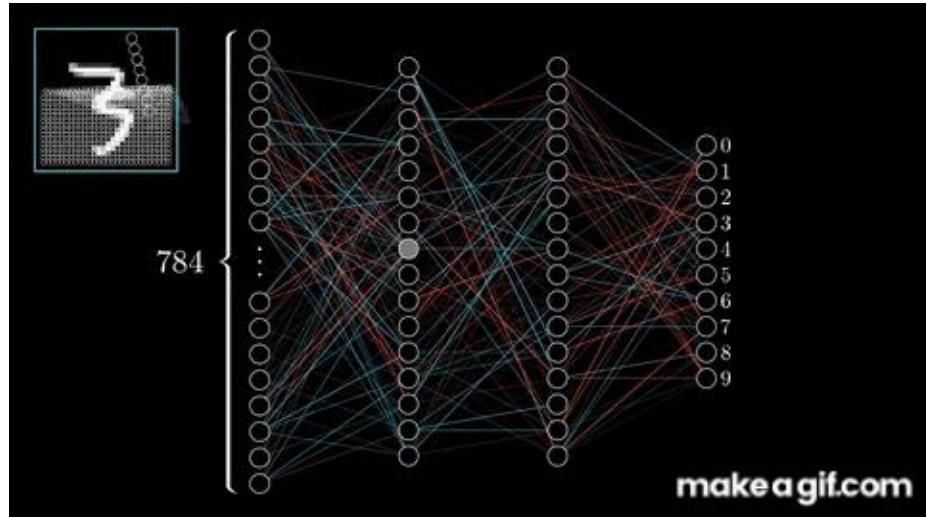


Activations in the hidden layer that follows a specific behavior



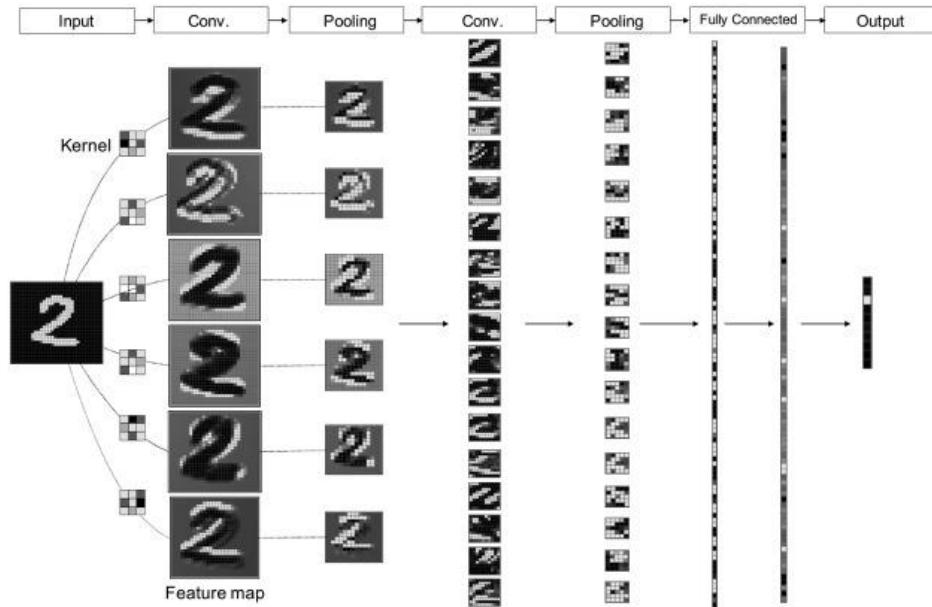
Deep Learning

Activations in the hidden layer that follows a specific behavior

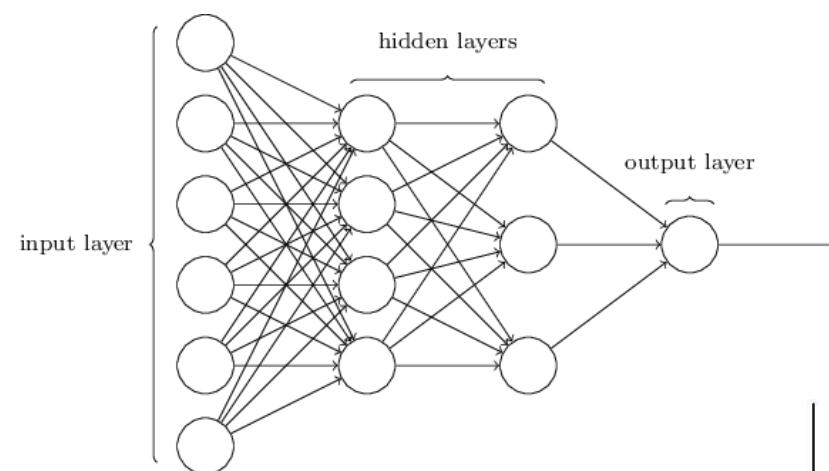


Extract the most important features

Adjust weights

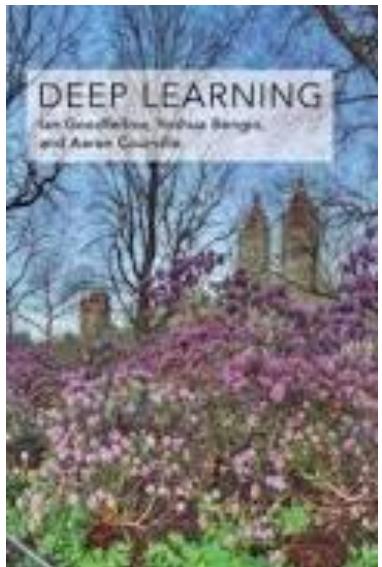


<https://doi.org/10.1016/j.iatssr.2019.11.008>

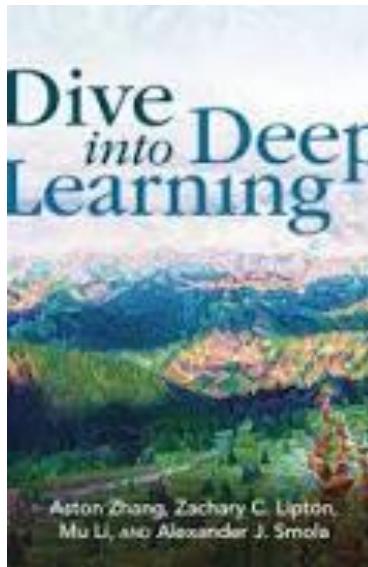


Bibliography / Sources

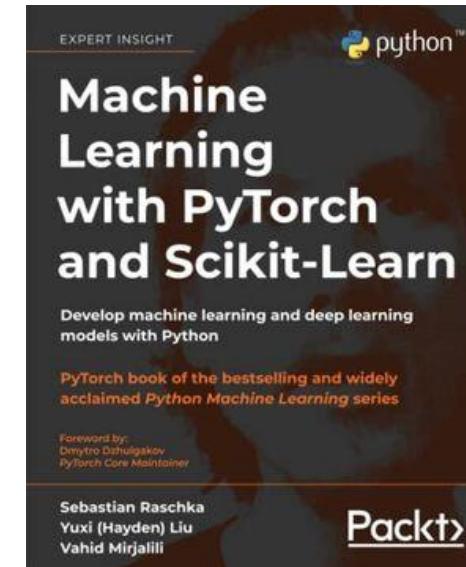
"Deep Learning"



Dive into Deep Learning



Machine Learning with Pytorch and Scikit-Learn



Resources



coursera



HUGGING FACE



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<https://distill.pub/>

<https://d2l.ai/index.html>

<https://neptune.ai/blog>

<https://medium.com/>

Thank you all!