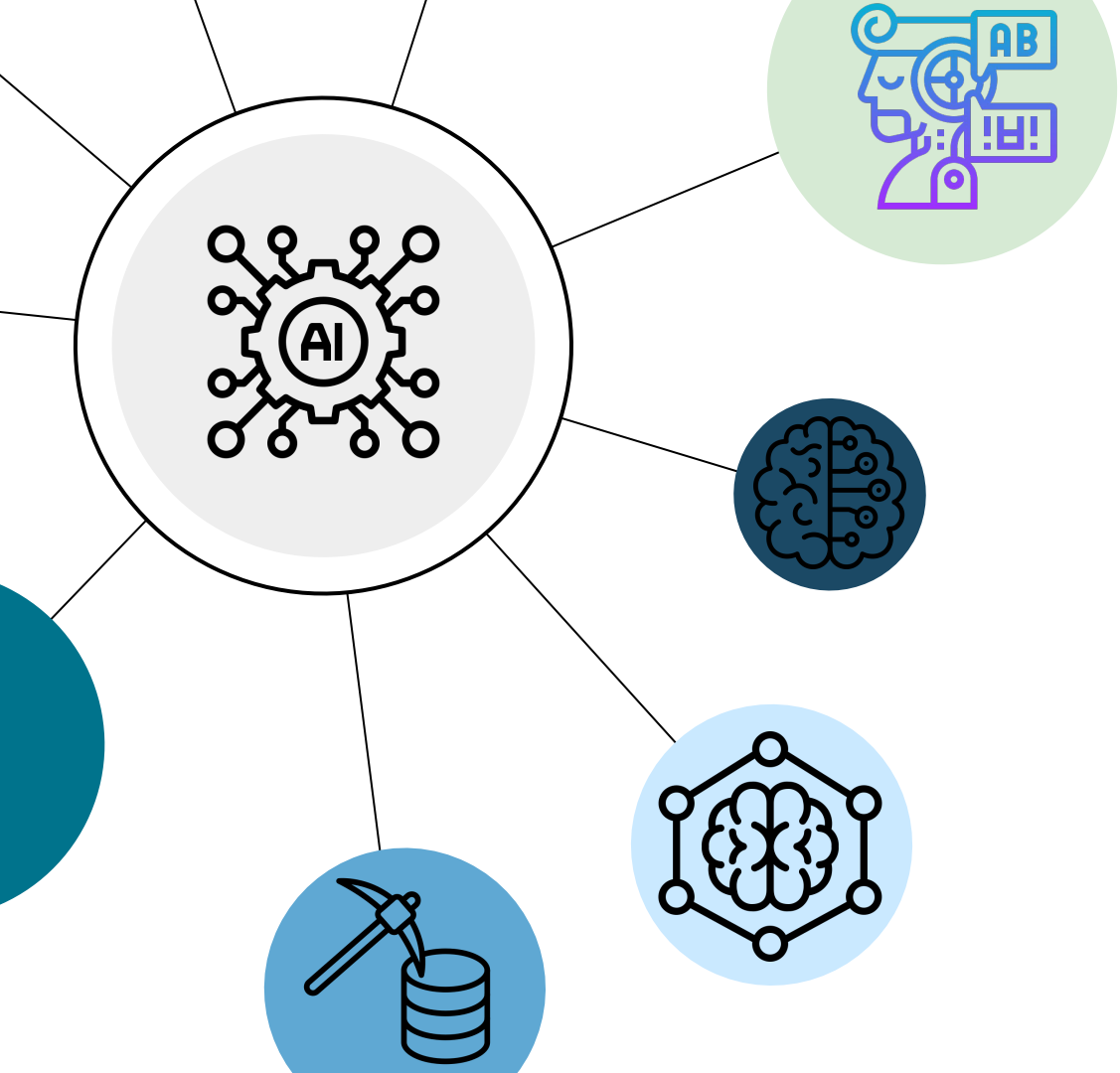


3iA Côte d'Azur
Institut interdisciplinaire d'intelligence artificielle

UNIVERSITÉ CÔTE D'AZUR

Introduction to Artificial Intelligence (AI)

Anaïs Ollagnier
Université Côte d'Azur, CNRS, Inria, I3S

General Information

- **3 sessions**

Lectures + Labs

- 1.A Definition & Demystification
- 1.B Machine Learning: Fundamentals

- 2.B Understanding Neural Networks
- 2.C Introduction to Deep Neural Networks

- 3.A What is Natural Language Processing?
- 3.B Basic Natural Language Processing (pre-processing, vectorization, embedding)
- 3.C Language Models and Transformers

General Information

- **Evaluation**
  - QCM (30 min, due for the 22nd February)
    - IA definition & Machine learning
  - QCM (30 min, due for the 25th March)
    - Data & Neuronal Networks

Course Overview and Objectives

- Modern AI :
  - refers to a field of computer science that focuses on developing algorithms and technologies that enable **machines to simulate human-like intelligence**, including learning, reasoning, problem-solving, and decision-making. It encompasses cutting-edge techniques such as deep learning, neural networks, and natural language processing to achieve advanced levels of automation and cognitive capabilities in machines.

- These advancements come with a range of scientific, societal, and environmental challenges :
  - **Equity:** data collection and quality, privacy, biases (sexist, racist)
  - **Responsibility:** European regulation (EU AI Act) and research and innovation practices
  - **Transparency:** model opacity and the need for interpretability, bias traceability, and consideration in final tools

- This course is here to :
  - Enable you to grasp these advancements in each of your disciplines and topics,
  - While also allowing you to understand the limitations and challenges of current techniques.

What this course is not

- This course will not provide you with disciplinary knowledge related to your master's field of expertise.
    - it equips you with the necessary knowledge to understand the new tools that are and will be introduced in your professions.
    - You can choose a project to further study an aspect of your discipline related to AI.
- This course does not teach you how to code.
    - However, you can delve into and modify the provided code and work on a project involving programming if you wish to do so.

Let’s start !

Down the rabbit hole and through the looking glass

IA in law

The application of Artificial Intelligence (AI) in law has led to several research axes, reflecting the intersection of technology and legal practices. Here are some main research areas in the field of AI in law:

1. **Legal Informatics and Technology:**
   - Exploring the development and impact of technology, including AI, on legal processes and information management.

2. **Natural Language Processing (NLP) for Legal Text:**
   - Researching the use of NLP techniques to analyze and understand legal texts, including statutes, case law, contracts, and legal opinions.

3. **Legal Knowledge Representation and Reasoning:**
   - Investigating methods to represent legal knowledge in a machine-readable format and developing reasoning algorithms for legal decision-making.

4. **Predictive Analytics in Legal Decision-Making:**
   - Examining the use of AI to predict legal outcomes, case law trends, and potential litigation risks based on historical data.

IA in law

5. **E-Discovery and Document Review:**
   - Researching AI applications for efficient and accurate document review in legal processes, including e-discovery and due diligence.

6. **Ethical and Regulatory Issues in AI and Law:**
   - Investigating the ethical implications and regulatory frameworks surrounding the use of AI in legal practice, including issues of bias, transparency, and accountability.

7. **Automated Legal Assistance and Chatbots:**
   - Exploring the development and effectiveness of AI-based tools providing legal assistance, answering queries, and facilitating access to legal information.

8. **Privacy and Security in Legal Tech:**
   - Examining the implications of AI technologies on privacy and security within legal systems, especially concerning data protection and confidentiality.

IA in law

9. **AI and Intellectual Property Law:**
   - Researching the legal implications of AI-generated content, including issues related to copyright, patentability, and ownership.

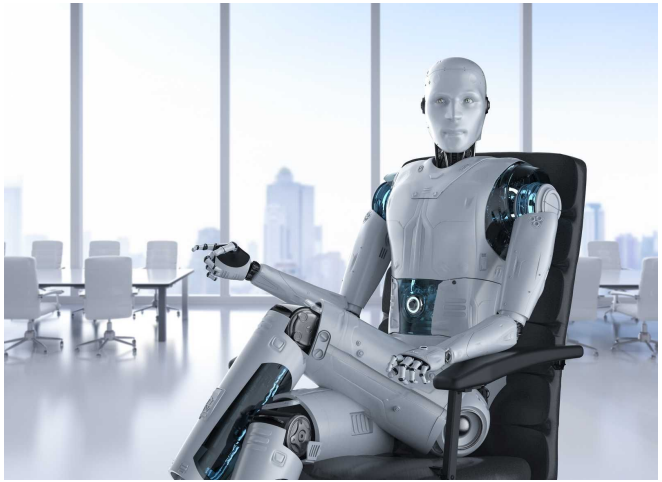
10. **Human-AI Collaboration in Legal Practice:**
    - Investigating the integration of AI tools into legal workflows and assessing how legal professionals collaborate with AI systems.

These research axes represent ongoing efforts to understand, improve, and responsibly deploy AI technologies in the legal domain. As the field evolves, new research areas may emerge to address emerging challenges and opportunities.

The use of AI is not anecdotal!

Source: Bloomberg Law Legal Technology Survey (2020), n = 331 in-house and law firm respondents

Artificial Intelligence: Definition and Demystification



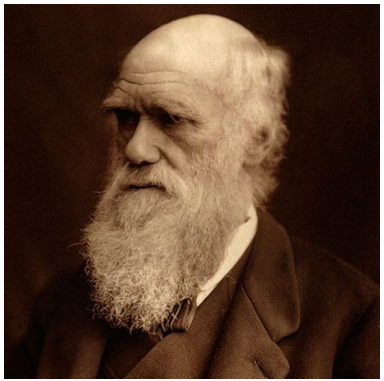
https://www.aimyths.org/

Sources for this lecture

- Andrew Ng, AI for Everyone, deeplearning.ai

- Frédéric Precioso, Tout ce que vous avez toujours voulu savoir sur l'intelligence artificielle, cours à Deep Law for Tech, 2021

What is Intelligence?



“"It is not the strongest species that survives, but the most adaptable."”

What is Intelligence?

The ability to perceive and deduce information, to derive knowledge from it that will be applied to adaptive **behavior** within an environment or context.

Intelligence encompasses a range of **cognitive abilities**: learn, deduce information, recognize repetitive patterns, solve problems, and make decisions.

- Linguistic Intelligence: an affinity for words, both written and spoken.
- Logical-Mathematical Intelligence: logical and mathematical aptitude.
- Spatial Intelligence: the ability to create a mental model of a space, navigate within it, and operate within it.
- Musical Intelligence: recognition of sounds and harmonies.
- Bodily-Kinesthetic Intelligence: the ability to use one's body in space, as seen in dancers or surgeons.
- Interpersonal Intelligence: the capacity for feeling, projection, and empathy.
- Intrapersonal Intelligence: the ability to create a self-understanding model.

What is Artificial Intelligence?

- In 1956, the term artificial intelligence was defined as:

"*The construction of computer programs that engage in tasks that,* ***for the time being****, are performed* ***more satisfactorily*** *by human beings because they require* ***high-level*** *mental processes such as perceptual learning, memory organization, and critical reasoning.*". (Translation of the definition by Marvin Lee Minsky)

However, this concept has been present since antiquity (Automata and artificial creatures of Hephaestus, or the Golem in Jewish mythology, etc).

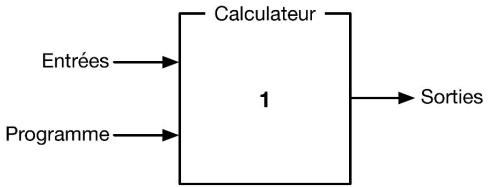
Artificial Intelligence

- In the first manifesto of Artificial Intelligence, **« Intelligent Machinery »**, in **1948**, **Alan Turing** distinguishes two different approaches to AI, which could be described as « **top-down** » or **knowledge-driven AI** and « **bottom-up** » ou **data-driven AI**

Artificial Intelligence, top-down

“**top-down**” or **knowledge-driven AI**

1. An operational hypothesis is made about how the world functions.
2. This hypothesis is translated into rules/equations.
3. Outputs are calculated based on inputs.

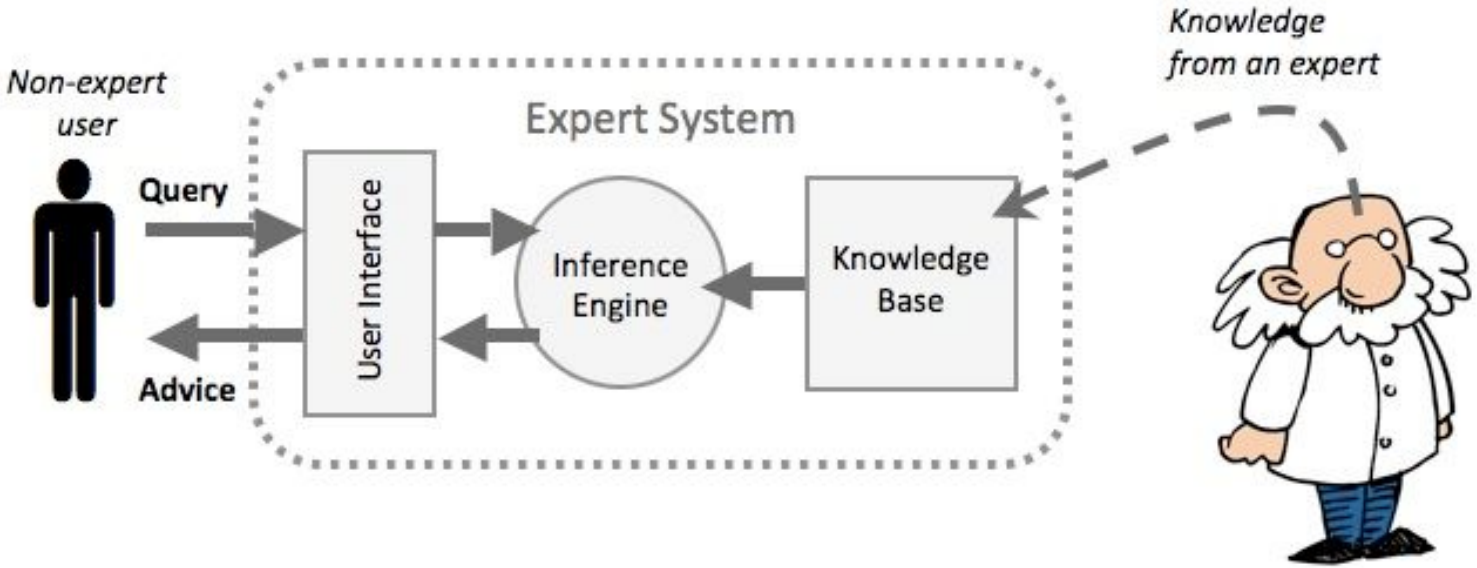


Hypothetico-deductive machines

(Figure: “La revanche des neurones”, D. Cardon, J.-P. Cointet, A. Mazières, Réseaux Volume 211, Issue 5, 2018, pages 173-220, https://hal.archives-ouvertes.fr/hal-01925644/file/RevancheNeurones_Reseaux.pdf)

Artificial Intelligence, top-down

Architecture of an expert system



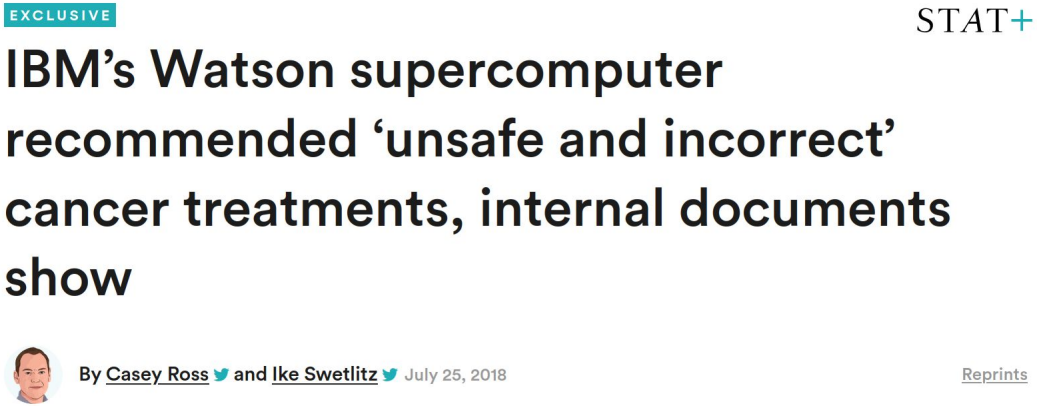
Expert Systems

- **Examples of applications:**

  - **Diagnosis:** In which one attempts to identify a human disease or the malfunction of a machine based on symptoms, meaning the observable manifestations of the disease or malfunction.
  - **Monitoring:** Whose objective is to keep a process under control by collecting information and making estimates about its progress.
  - **Planning:** In which the goal is to achieve a specific objective with the available resources.
  - **Interpretation of information and signals:** The purpose of which is to identify the emergence of particular situations of interest in the input data.

Artificial Intelligence, top-down

- Some recent failures:



EXCLUSIVE

STAT+

IBM's Watson supercomputer recommended 'unsafe and incorrect' cancer treatments, internal documents show

By Casey Ross and Ike Swetlitz July 25, 2018

Reprints

rbr ROBOTICS BUSINESS REVIEW

ANALYSIS / OPINION BUSINESS MARKETS / INDUSTRIES RESOURCES EVENTS RBR50

A Cyclist's Encounter with an Indecisive Google Self-Driving Car

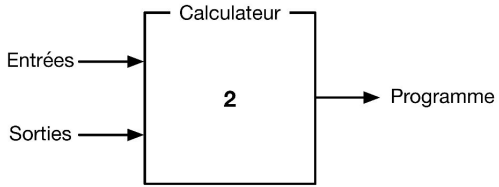
A bicyclist recently had a two-minute standoff with a Google self-driving car at a four-way stop in Austin, Texas. So what happened? We explain.

To watch:

https://www.primevideo.com/detail/Autopsie-d-une-Intelligence-artificielle/0OTSQABUG9B8OJO0P0A7AWMBV2

Artificial Intelligence, bottom-up

- “**bottom-up**” or **data-driven AI**
  - The equations/algorithms for making decisions are modified by other calculations to adapt to observed data.
    - Machine Learning (1983), Decision Trees (1983), Backpropagation (1984-1986), Random Forest (1995), Support Vector Machine (1995), Boosting (1995), Deep Learning (1998...2006)...



Inductive machines

(Figure: “La revanche des neurones”, D. Cardon, J.-P. Cointet, A. Mazières, Réseaux Volume 211, Issue 5, 2018, pages 173-220, https://hal.archives-ouvertes.fr/hal-01925644/file/RevancheNeurones_Reseaux.pdf)

What is Artificial Intelligence?

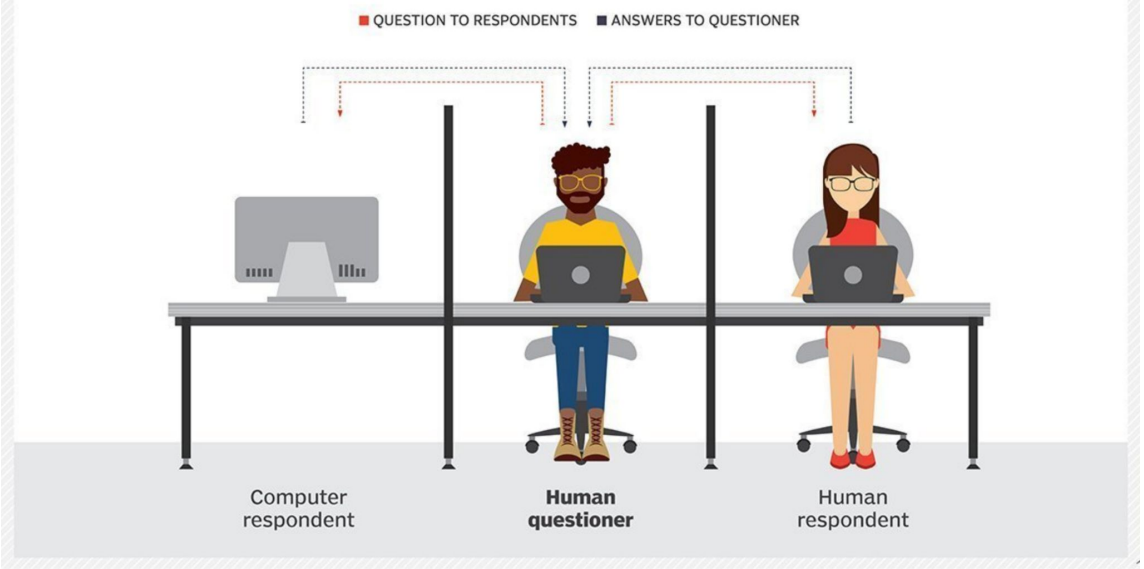
• A machine will be considered intelligent if it **replicates** the behavior of a human in a specific domain.

• A machine will be considered intelligent if it **models** the functioning of a human.

Turing test

• Created to provide a satisfactory operational definition of intelligence.

• A computer passes this test if a person, after asking written questions, cannot tell whether they are communicating with another human or a computer.



The Chinese room

John Searle (a philosophy professor at Berkeley) is confined in a room with no communication with the outside except through a window. Inside the room, there is a (very) large book containing a sequence of questions and relevant answers to these questions, written in Chinese.

• Searle specifies that he **knows nothing about Chinese**, and **English is his native language**.

• An experimenter transmits messages to him through the window, sometimes in English and sometimes in Chinese.

• Searle responds directly to messages written in English, but for those written in Chinese, he is forced to consult the book until he finds a matching question; he then copies the associated answer.

Searle's remarks

- Searle then points out that for the external experimenter, the messages transmitted in Chinese will appear as relevant as those transmitted in English.
- However, **Searle knows English while he knows nothing about Chinese**.
- Similarly, **one cannot infer from the fact that a program successfully passes the Turing test that it understands what is being discussed**.

Intelligent machines or processes

- First attempts:
  - Calculating machine (Pascal)
  - Cybernetics (Wiener)
  - Thinking machine (Babbage & Turing)

- Intelligent behaviors:
  - Solving problems
  - Understanding natural language texts
  - Perceiving an environment and interacting with it

Example: Chess

- In the first case, the primary goal will be to obtain an efficient program. It doesn't matter if the machine performs calculations that are beyond human reach, such as **exploring hundreds of millions (or billions) of positions per second.**
- In the second case, the initial focus will be on **understanding how humans play chess**. To achieve this, masters will be interviewed, an effort will be made to uncover the rules more or less consciously followed by the players: attempting to control the center, to dominate a color of squares, etc. The implemented program will validate this.

ELIZA

The ELIZA system (by Joseph Weizenbaum at MIT), by identifying key expressions in sentences and reconstructing pre-made sentences from them, was capable, as early as 1965, of engaging in natural language dialogue, momentarily deceiving individuals who believed they were interacting with a human psychologist!

However, **ELIZA had no real understanding of the sentences it processed**.

It was probably Terry Winograd's SHRDLU system in 1970 that was **the first to "understand" something about natural language** and to use this understanding in dialogues that revolved around a simplified world of blocks.

Areas of research in AI

Virtual Reality

This field offers new forms of interaction between humans and machines. The advent of more powerful computers with impressive three-dimensional graphics capabilities, coupled with visualization and interaction peripherals (headsets, gloves, etc.), allows the provision of sensory information needed to convince users that they are immersed.

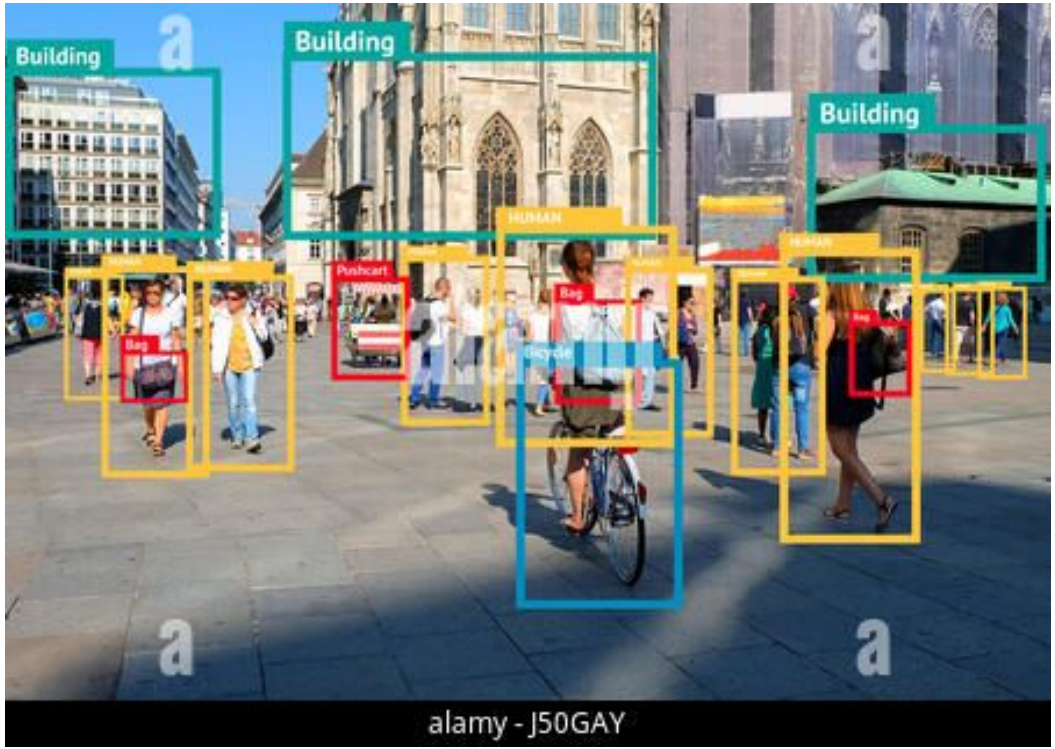
Larry Hedges of the Georgia Institute of Technology has long been using virtual reality to treat certain phobias, such as fear of elevators or spiders.

Areas of research in AI

Pattern Recognition

Research in this field aims to automate the recognition of typical situations in terms of perception. Its methods have numerous applications. These include vision, speech recognition, optical character recognition, and image synthesis.

Advancements in video image recognition already allow the police to spot a target in a crowd.



Areas of research in AI

Artificial Life

This field focuses on the study of ecosystems and the replication, using artificial systems, of characteristics inherent to living systems (ranging from cellular mechanisms to population dynamics, including models of individual development).

Areas of research in AI

Robotics

Important AI subfield, robotics can be seen as the intelligent interconnection of perception, action, and the operation of robots.

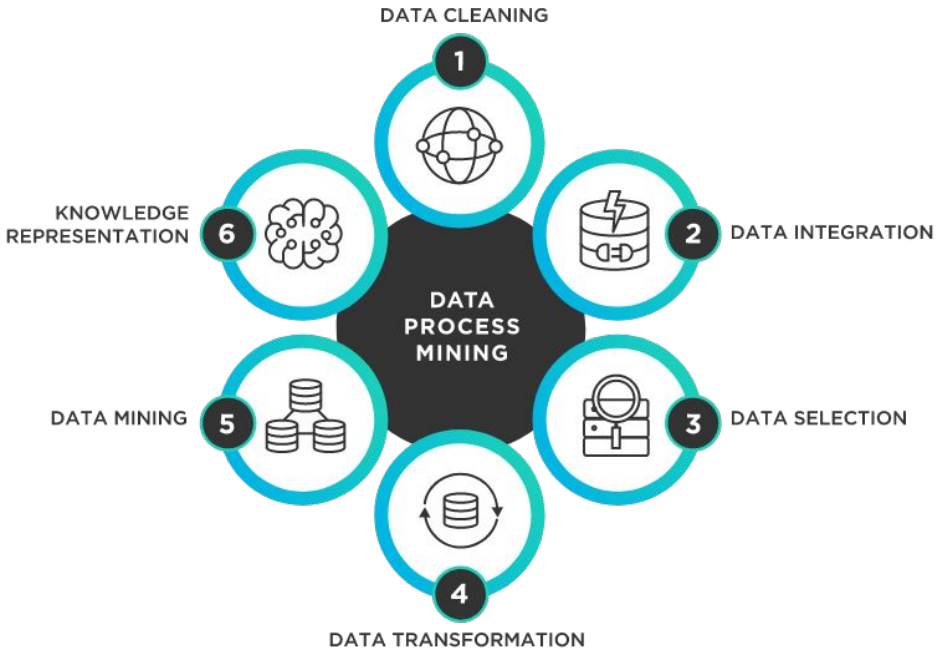
Used to maintain dynamic representations of their environment, it allows robots to have the ability to sense, move, reason, and possibly communicate in natural language.

Areas of research in AI

Multimedia Indexing

The multimedia resources found on the web today are numerous, voluminous, and sometimes irrelevant.

AI offers tools for "**data mining**" to extract synthetic knowledge from them or discover hidden information, diagnose situations, or assist in supervising system operations.



The AIs around us!

The AIs around us!

At home...

Voice Assistants: Voice-controlled AI systems like Amazon's Alexa, Apple's Siri, and Google Assistant can answer questions, control smart home devices, and provide information and entertainment.

Kitchen Appliances: Smart kitchen appliances can use AI to help with cooking and meal planning.

Robotic Vacuum Cleaners: These devices use AI for navigation and to adapt to your home's layout.

At work...

Collaboration and Communication: AI is integrated into collaboration tools to automate tasks, schedule meetings, and improve communication within teams.

Email Management: AI tools can prioritize and categorize emails, detect spam, and suggest replies, making email communication more efficient.

Cybersecurity: AI is used for threat detection and prevention to protect organizations from cyberattacks.

The AIs around us!

In cities…

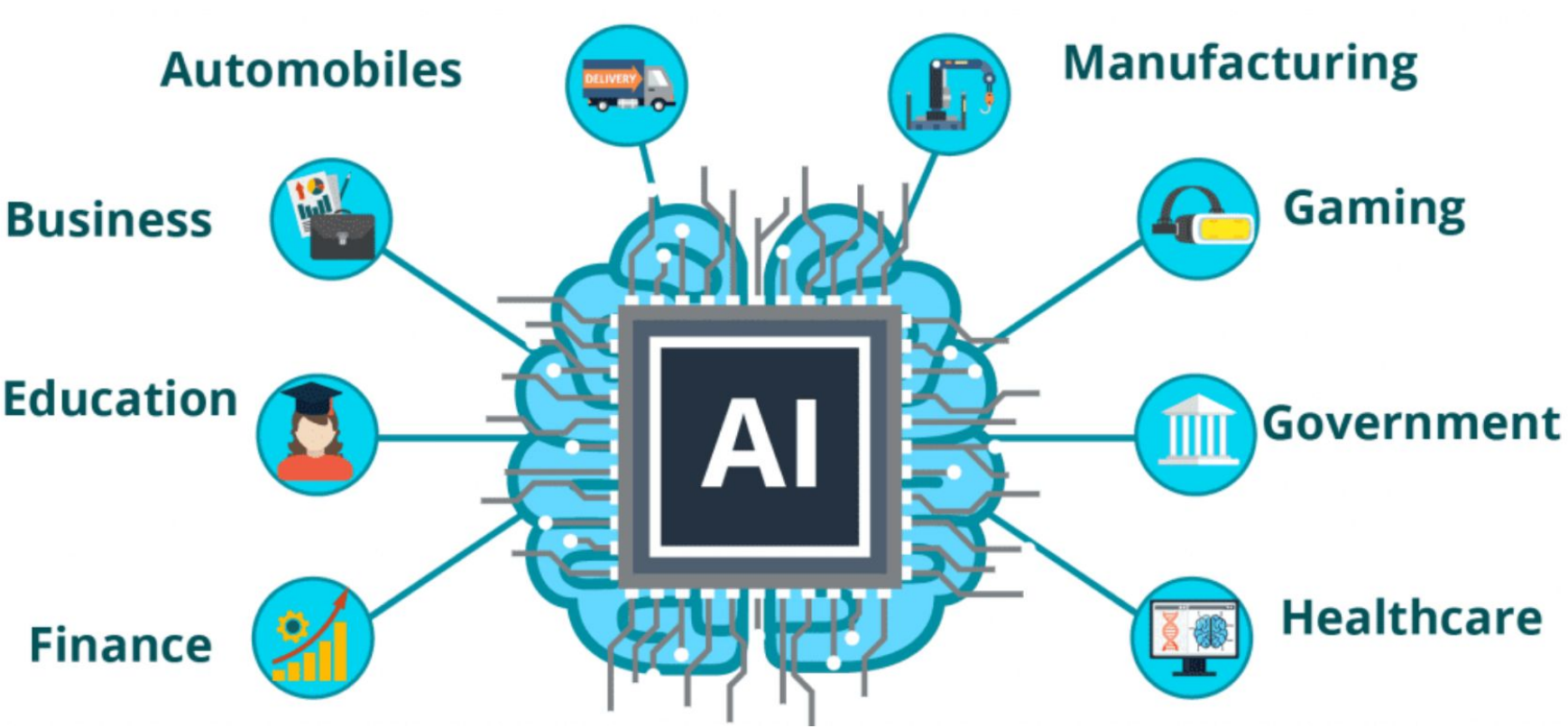
Traffic Management: AI-driven traffic management systems use real-time data from cameras, sensors, and GPS devices to optimize traffic flow, reduce congestion, and improve transportation systems.

Public Safety: AI is employed for predictive policing, emergency response optimization, and surveillance to enhance public safety and reduce crime rates.

Environmental Monitoring: AI-driven sensors collect data on air quality, water quality, noise levels, and other environmental factors to ensure a healthier urban environment.

Agriculture: In urban farming initiatives, AI helps manage crops, optimize resource usage, and promote sustainable agriculture.

AI Applications



IA in Healthcare

Medical Imaging: AI is used to analyze medical images such as X-rays, MRIs, and CT scans. AI algorithms can assist radiologists in detecting abnormalities, including tumors, fractures, and other medical conditions. This helps in early diagnosis and treatment.

Disease Diagnosis: AI systems are capable of diagnosing diseases based on symptoms and patient data. For instance, AI can be used in diagnosing diabetic retinopathy, skin cancer, and other conditions.

Personalized Medicine: AI helps in tailoring treatments and medications to individual patients. By analyzing a patient's genetic data and medical history, AI can suggest the most effective and least risky treatments.

Drug Discovery: AI accelerates drug discovery by analyzing vast datasets to identify potential drug candidates. This reduces the time and cost required to develop new medications.

Predictive Analytics: AI is used for predicting disease outbreaks, patient readmissions, and other health-related events. It allows healthcare providers to allocate resources more efficiently and improve patient care.

IA in Finance

Algorithmic Trading: AI-driven algorithms are used for high-frequency trading. These algorithms analyze market data and execute trades at high speeds to take advantage of price differentials.

Risk Assessment: AI models are employed for risk assessment and management. They can predict market trends, assess credit risk, and identify potential fraud by analyzing vast datasets in real time.

Customer Service: Chatbots and virtual assistants are used for customer support, offering quick responses to customer inquiries and managing routine tasks such as balance inquiries and account transfers.

Fraud Detection: AI systems use machine learning to detect unusual patterns and behaviors associated with fraud. They can identify fraudulent transactions and activities in real time, reducing financial losses.

Personal Finance and Robo-Advisors: AI-driven robo-advisors provide personalized investment advice based on individual financial goals, risk tolerance, and market conditions. They manage investment portfolios and allocate assets efficiently.

IA in Gaming

Non-Player Characters (NPCs): AI-driven NPCs have become more intelligent and responsive. They can adapt to players' strategies, offer realistic interactions, and provide a challenging gaming experience.

Procedural Content Generation: AI algorithms are used to generate in-game content, such as levels, maps, and landscapes. This ensures that games remain engaging and offer a unique experience with each playthrough.

Character Behavior and Animation: AI is employed to create realistic character animations and behaviors. Characters can navigate complex terrains, display emotions, and respond to in-game events.

Voice and Speech Recognition: Games often use speech recognition to enable players to interact with NPCs or issue voice commands. This technology enhances the immersion and interactivity of the gaming experience.

FUTUREPEDIA Submit a Tool Discover a Tool Login

FUTUREPEDIA

THE LARGEST DIRECTORY OF AI TOOLS, UPDATED DAILY.

Try searching for a category

Tattoos AI

Create the perfect tattoo design with your personal AI-powered tattoo artist If you have an idea for a tattoo...

#misc #image

Stock AI

Get the perfect image. Everytime. Find exactly the image you need. And if it doesn't exist, we'll create it for...

#image

Excel Formula Bot

Transform your text instructions into Excel formulas in seconds with the help of AI. Stop wasting hours...

#misc #assistant

To sum up

The goal of Artificial Intelligence (AI) is to design **systems capable of replicating human behavior in its reasoning activities**.

AI aims to **model intelligence as a phenomenon** (similar to how physics, chemistry, or biology aim to model other phenomena).

We are still far from the hopes and fears predicted by science fiction authors in movies such as 2001: A Space Odyssey, Artificial Intelligence, The Matrix, and Terminator.

The ultimate goal of artificial intelligence is not to replace humans but to assist them, allowing them to focus on increasingly creative or enjoyable tasks.

What is knowledge representation?

Humans are best at understanding, reasoning, and interpreting knowledge. ***But how machines do all these things comes under knowledge representation and reasoning****.*

Knowledge Representation

Knowledge representation is a branch of artificial intelligence that focuses on **modeling and formalizing information or knowledge** for the purpose of processing it automatically (encoding, structuring, transforming, storing, formulating hypotheses, reasoning/making inferences, etc.).

What to Represent:

- **Objects**: all the facts about objects in our world domain.
- **Events:** events are the actions which occur in our world.
- **Performance:** it describe behavior which involves knowledge about how to do things.
- **Meta-knowledge:** it is knowledge about what we know.
- **Facts:** facts are the truths about the real world and what we represent.
- **Knowledge-Base:** a structured repository or database that stores information and knowledge in a specific domain or area of interest. It typically includes various types of data and knowledge such as the previous ones.

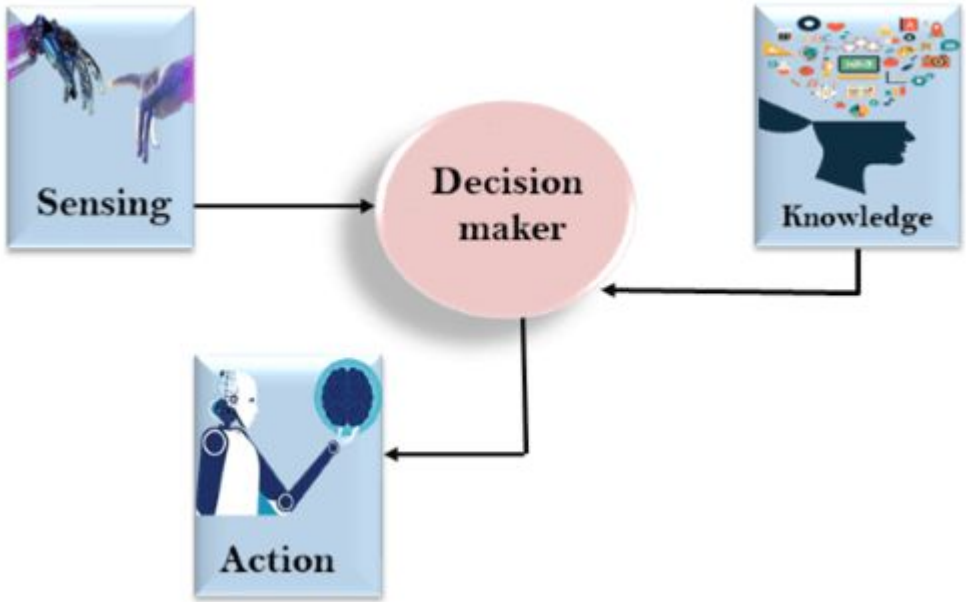
Types of knowledge

Knowledge: Knowledge is awareness or familiarity gained by experiences of facts, data, and situations.

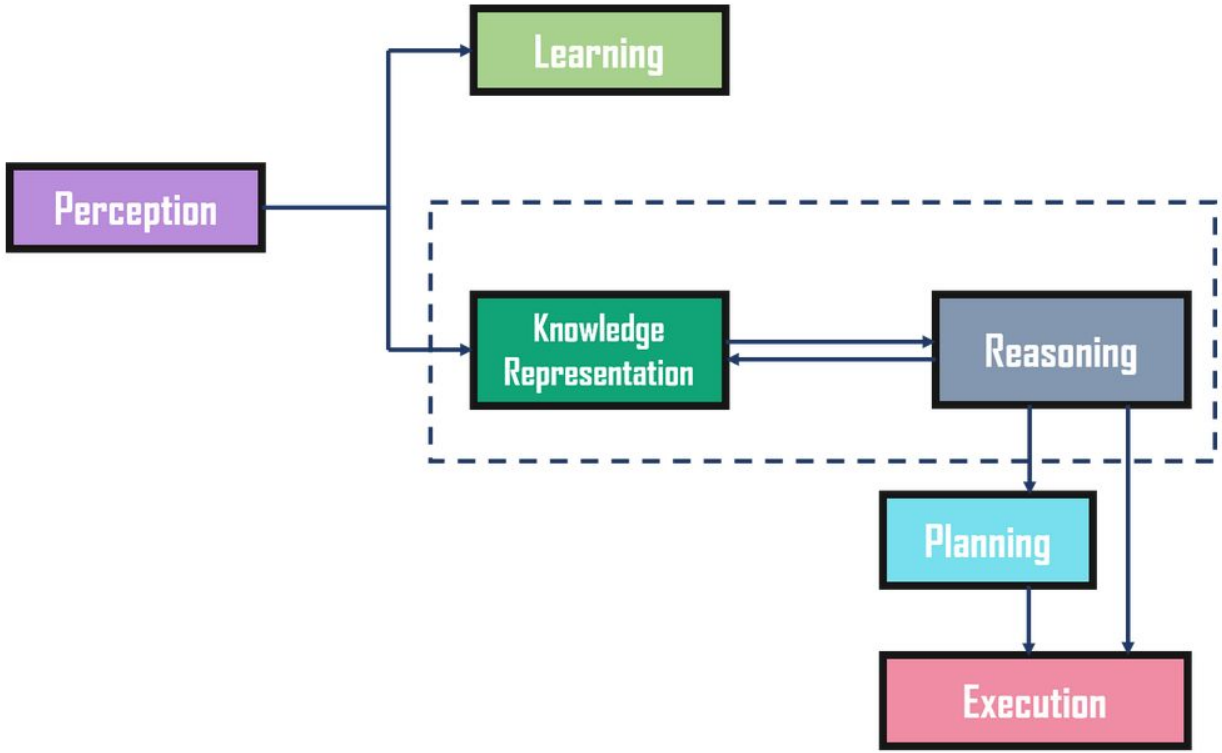
- **Declarative**: knowing facts and concepts
- **Procedural**: knowing how to do things
- **Meta-Knowledge**: knowledge about other knowledge types
- **Heuristic**: expert-based rules of thumb
- **Structural** : knowledge of relationships between concepts

The relation between knowledge and intelligence

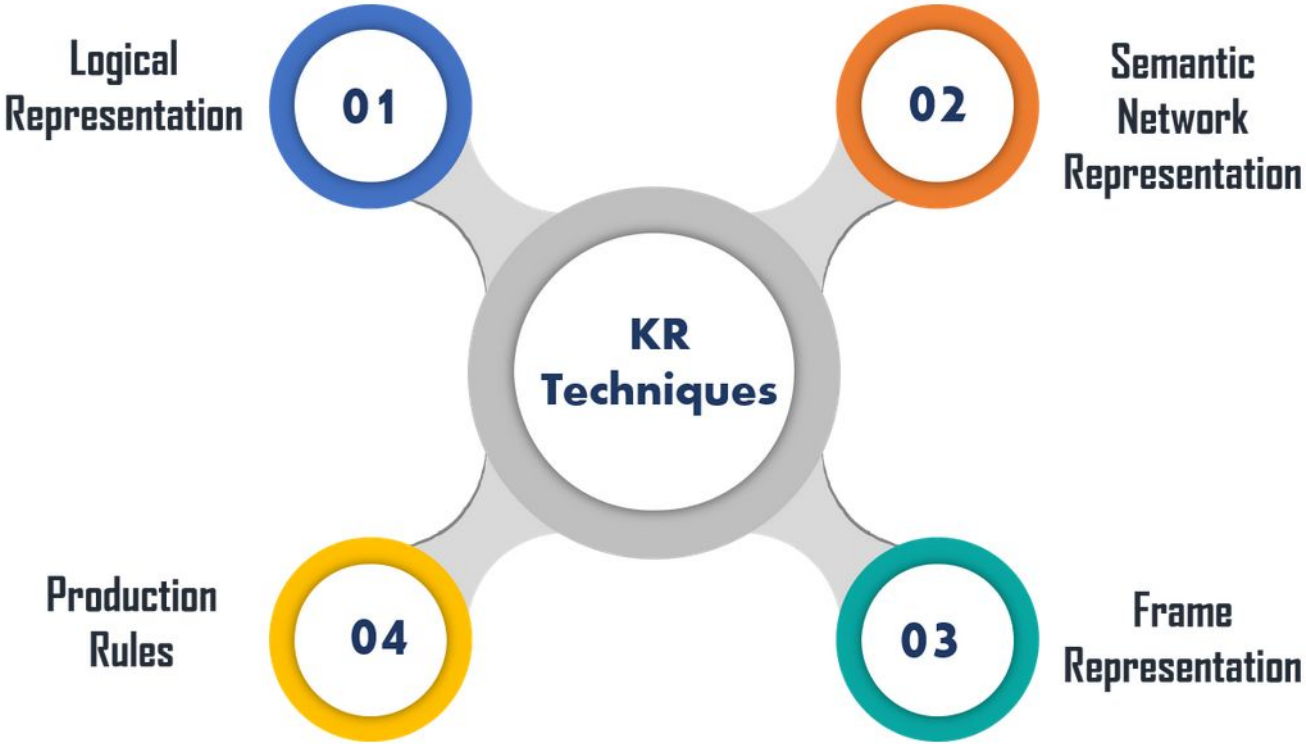
The relationship between knowledge and intelligence is that knowledge is a component of intelligence. Knowledge refers to the information, facts, and skills that an individual has acquired through learning and experience. Intelligence, on the other hand, is a broader cognitive ability that encompasses problem-solving, reasoning, learning, and adaptability.



AI knowledge cycle



Techniques of knowledge representation



Logical Representation

Logical representation is a structured language characterized by clear rules, specifically designed for handling propositions without ambiguity. It serves the purpose of **drawing conclusions from different conditions and establishes crucial communication guidelines**. This form of representation is built upon well-defined syntax and semantics, ensuring reliable and accurate inference. It enables the translation of sentences into logical forms through the consistent application of syntax and semantics.

Propositional logic

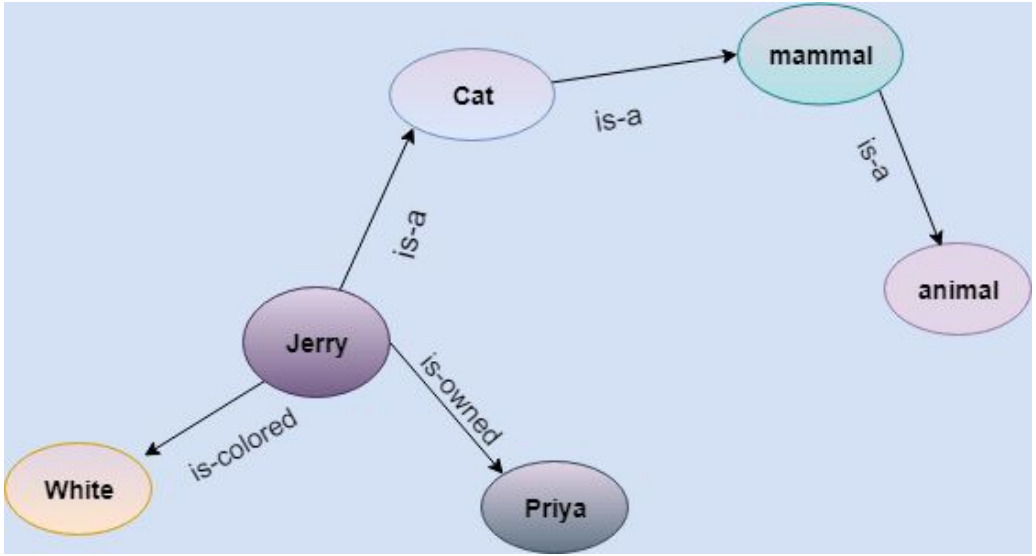
Deals with propositions (statements) and their logical relationships, using variables and operators (e.g., AND, OR, NOT) to represent truth values.

Predicate logic

Extends propositional logic by introducing quantifiers (e.g., for all, there exists) and variables to represent complex statements about objects and relationships.

Semantic Network Representation

Semantic networks provide an alternative to predicate logic for representing knowledge. Within semantic networks, **knowledge can be visually organized using graphical structures**. These structures comprise nodes, representing objects, and connecting arcs that signify relationships between these objects. Semantic networks facilitate the categorization and linkage of objects in various ways and offer the advantage of being straightforward to comprehend and readily expand upon.



Frame Representation

A frame serves as a structured record, encompassing a set of attributes and their corresponding values, enabling the depiction of real-world entities. In the realm of artificial intelligence, frames act as **data structures that organize knowledge** by delineating typical scenarios. They comprise slots, each with distinct names and values, which are referred to as facets, and these slots can accommodate various types and sizes of information.

CLASS FRAME

Frame Name	Bird	
Properties	Color	unknown
	Eats	Worms
	#wings	2
	Flies	true
	Hungry	unknown
	Activity	unknown

INSTANCE FRAME

Frame Name	Tweety	
Properties	Color	yellow
	Eats	worms
	#wings	1
	Flies	False
	Hungry	unknown
	Activity	unknown

Production Rules

A production rule system is structured around pairs of conditions and actions, denoted as "If condition then action." It comprises three primary components:

1. **The Set of Production Rules**: This is a collection of rules that define conditions and corresponding actions.
2. **Working Memory**: The working memory stores information about the current problem-solving state. Production rules can both read from and write to this memory.
3. **The Recognize-Act Cycle**: In this cycle, the agent checks conditions to determine if they are met. When a condition is satisfied, the associated action is executed. This entire process constitutes a single recognize-act cycle

Example:

- **IF (at bus stop AND bus arrives) THEN action (get into the bus)**
- **IF (on the bus AND paid AND empty seat) THEN action (sit down).**
- **IF (on bus AND unpaid) THEN action (pay charges).**
- **IF (bus arrives at destination) THEN action (get down from the bus).**

What is knowledge reasoning?

Humans are best at understanding, reasoning, and interpreting knowledge. ***But how machines do all these things comes under knowledge representation and reasoning****.*

Reasoning & Inference

Reasoning and inference are essential cognitive processes that enable AI systems to draw conclusions, make decisions, and generate new knowledge based on the information and data available to them.

Reasoning: The ability of an AI system to use logic, rules, and knowledge to reach conclusions or make inferences about a given situation or problem. It involves processing existing information to derive new information or to answer questions logically.

Inference: The process of deriving new information, conclusions, or solutions from the available data and knowledge. It is a broader concept that encompasses various types of reasoning, including deductive, inductive, and abductive reasoning.

Symbolic Reasoning

Symbolic AI uses **symbols and rules to represent knowledge and perform deductive reasoning**. It's based on formal logic and includes expert systems and knowledge-based systems.

```
% Define some facts about family relationships
parent(john, lisa).
parent(john, kate).
parent(mary, lisa).
parent(mary, kate).

% Define rules to deduce sibling relationships
sibling(X, Y) :- parent(Z, X), parent(Z, Y), X \= Y.

% Define a rule to deduce if one person is a mother
mother(X, Y) :- parent(X, Y), female(X).

% Define a rule to deduce if one person is a father
father(X, Y) :- parent(X, Y), male(X).

% Define genders for individuals
male(john).
male(lisa).
female(mary).
female(kate).
```

Logic-Based Reasoning

This approach uses formal logic, including propositional and first-order logic, to make inferences. Rule-based systems and theorem proving fall under this category.

Premises:

1. If it's raining (R), the ground will be wet (W).
2. It's raining (R).

Conclusion: 3. Therefore, the ground is wet (W).

- Statement 1 is represented as: $R \rightarrow W$ (if R, then W).
- Statement 2 is simply: R.

Statistical Inference

Statistical inference is a process of drawing conclusions from data using statistical methods. It's widely used in various fields, including science, economics, and social sciences. Here's an example to illustrate statistical inference:

Example: Clinical Drug Trial

1. **Data Collection:** The company records the change in blood pressure for each participant before and after the trial.
2. **Hypothesis Testing:** The company has a hypothesis: "The new drug will significantly lower blood pressure compared to the placebo."
3. **Data Analysis:** They use statistical methods to analyze the data. One common analysis method is a t-test to compare the means of the two groups.
4. **Inference:** After analyzing the data, they find that the treatment group had a statistically significant reduction in blood pressure compared to the control group. This suggests that the new drug is effective.
5. **Conclusion:** Based on the statistical inference, the company concludes that the new drug is effective in lowering blood pressure.

Machine Learning

Machine learning models, including supervised and unsupervised learning, can infer patterns, relationships, and make predictions based on data. Deep learning, a subset of machine learning, uses neural networks for complex reasoning tasks.

Example: Email Spam Filter

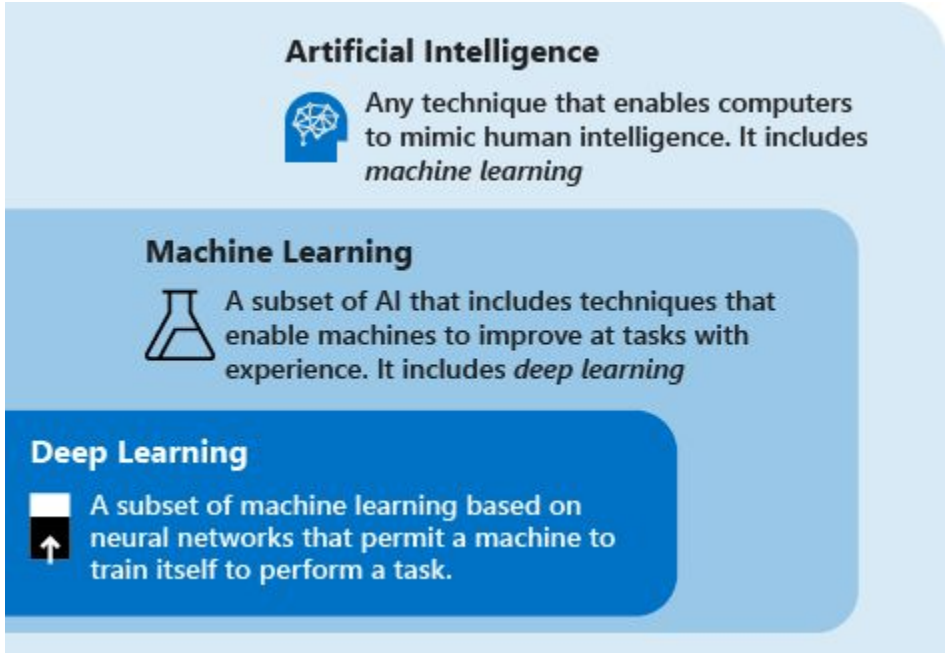
Imagine you're developing an email spam filter using machine learning. The goal is to automatically classify incoming emails as either "spam" or "not spam" (ham).

Machine Learning Steps:

1. **Data Collection:** Gather a dataset of emails that are already labeled as either spam or not spam. This dataset includes features like email content, sender information, subject, and more.
2. **Algorithm Selection:** Choose a machine learning algorithm suitable for the task. Common choices include Naive Bayes, Support Vector Machines, or deep learning models.
3. **Training:** Train the selected algorithm on the training data, which consists of examples of both spam and non-spam emails. The algorithm learns patterns and characteristics of spam emails during this phase.
4. **Evaluation:** Evaluate the trained model's performance on a separate testing dataset. Metrics like accuracy, precision, recall, and F1-score are calculated to assess how well the model can distinguish spam from non-spam emails.

Introduction to Machine Learning

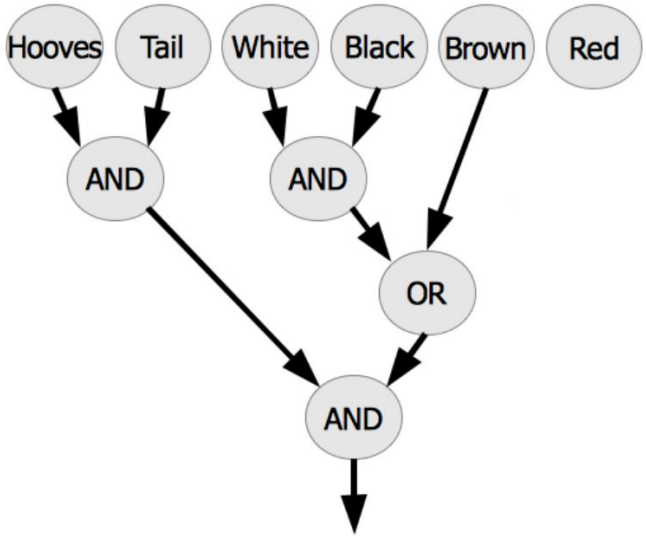
IA VS Machine Learning VS Deep Learning



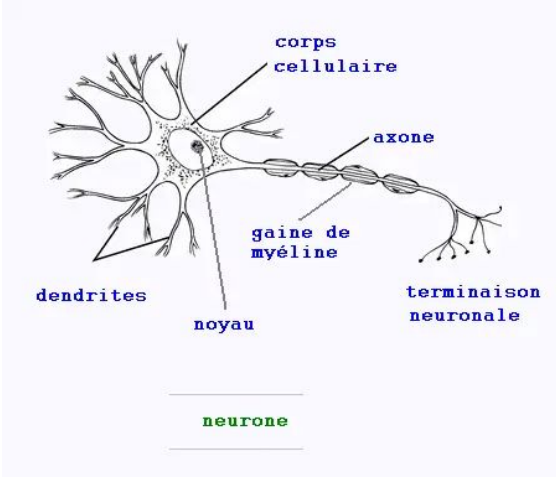
Symbolic or Cognitive Approaches

Based on the modeling of logical reasoning, on the representation and manipulation of knowledge through formal symbols.

- The early theorists of this approach are John McCarthy and Marvin Minsky.
- Several types of symbolic AI programs:
  - Expert systems
  - Constraint programming
  - Case-based reasoning

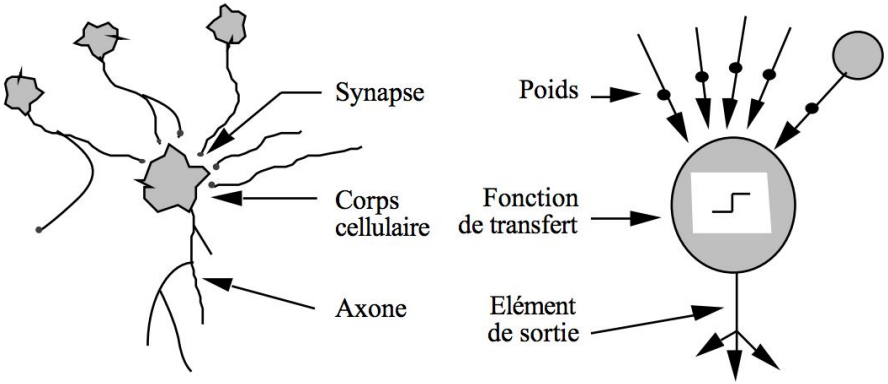


Connectionist Approach



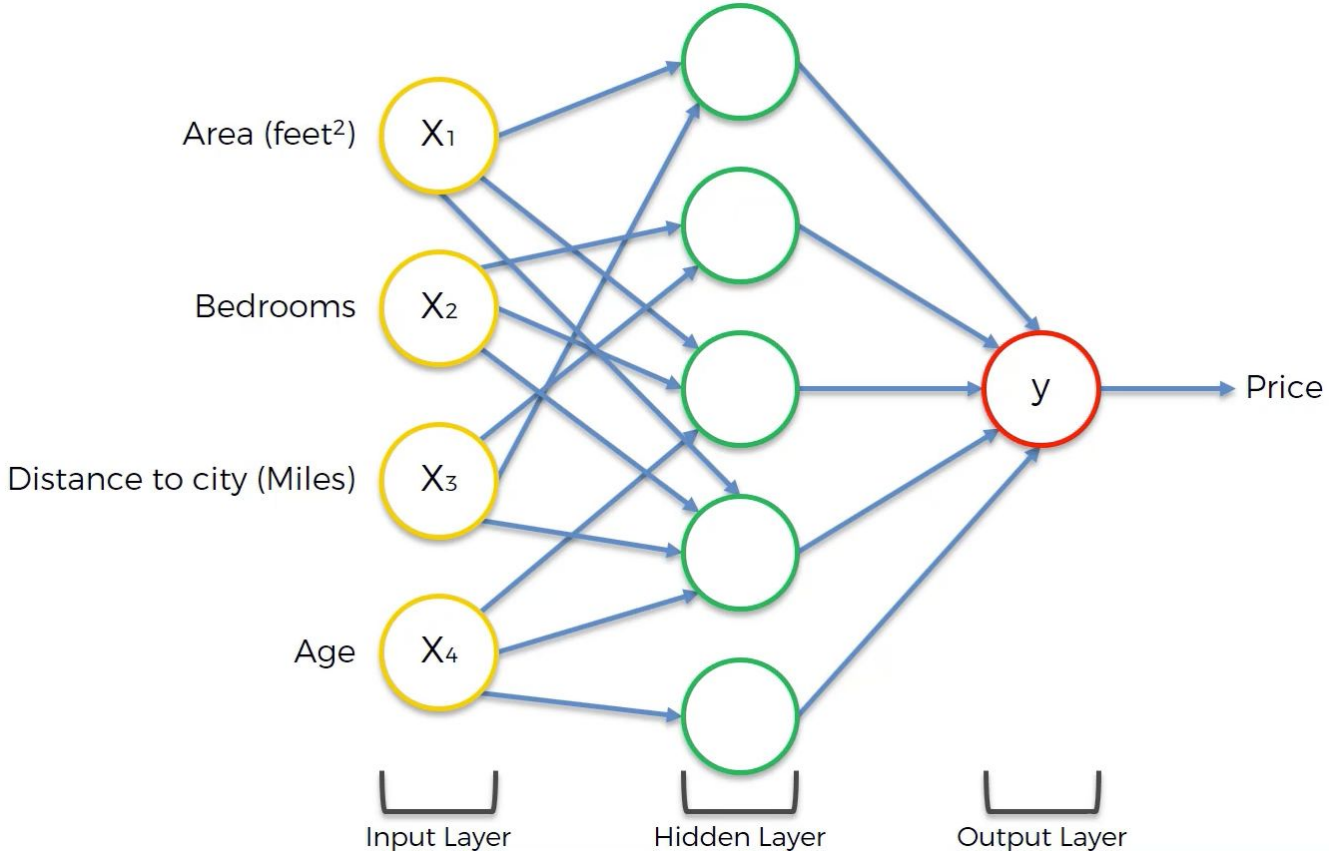
- A natural neuron
  (approximately 100 billion in the brain)

  - A formal (artificial) neuron:

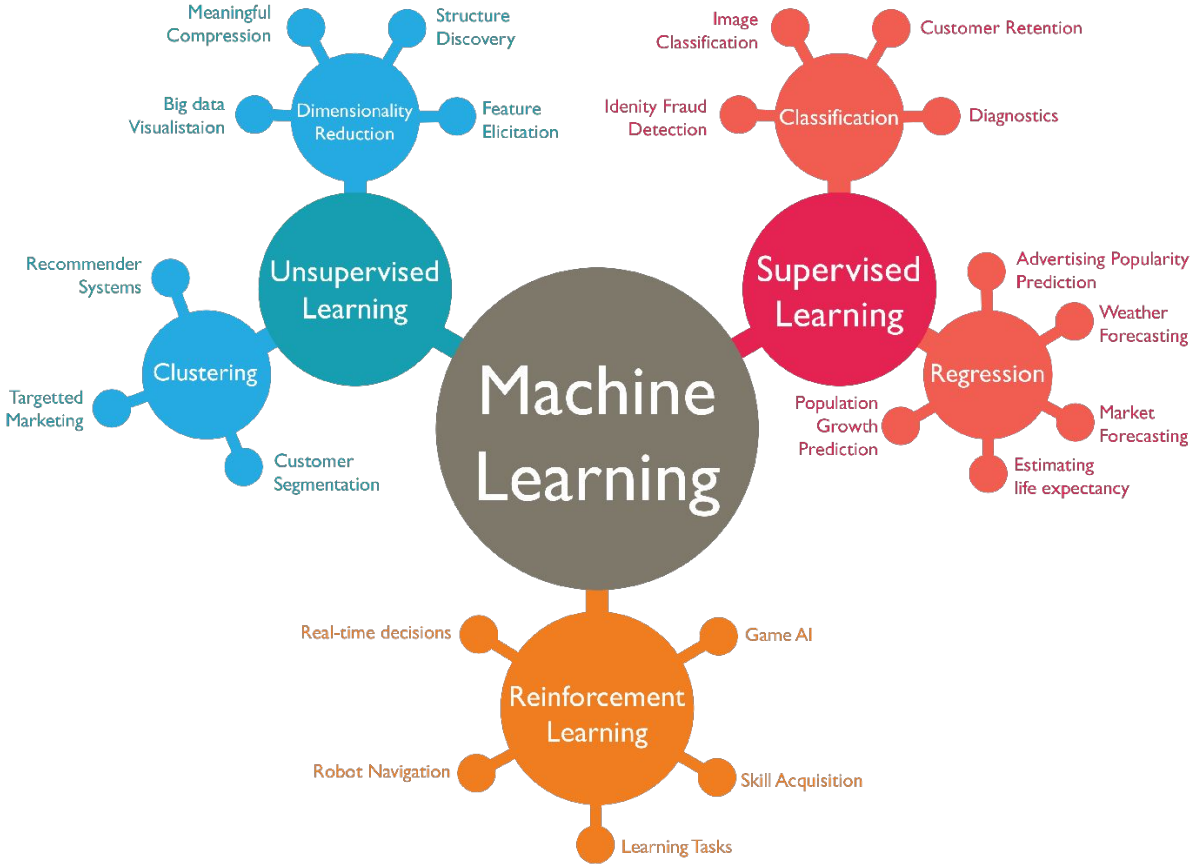


Natural neuron	**Artificial neuron**
Cell body	neuron
Dendrites	inputs
Axon	output
Synapses	weights

Neuronal networks



Machine Learning



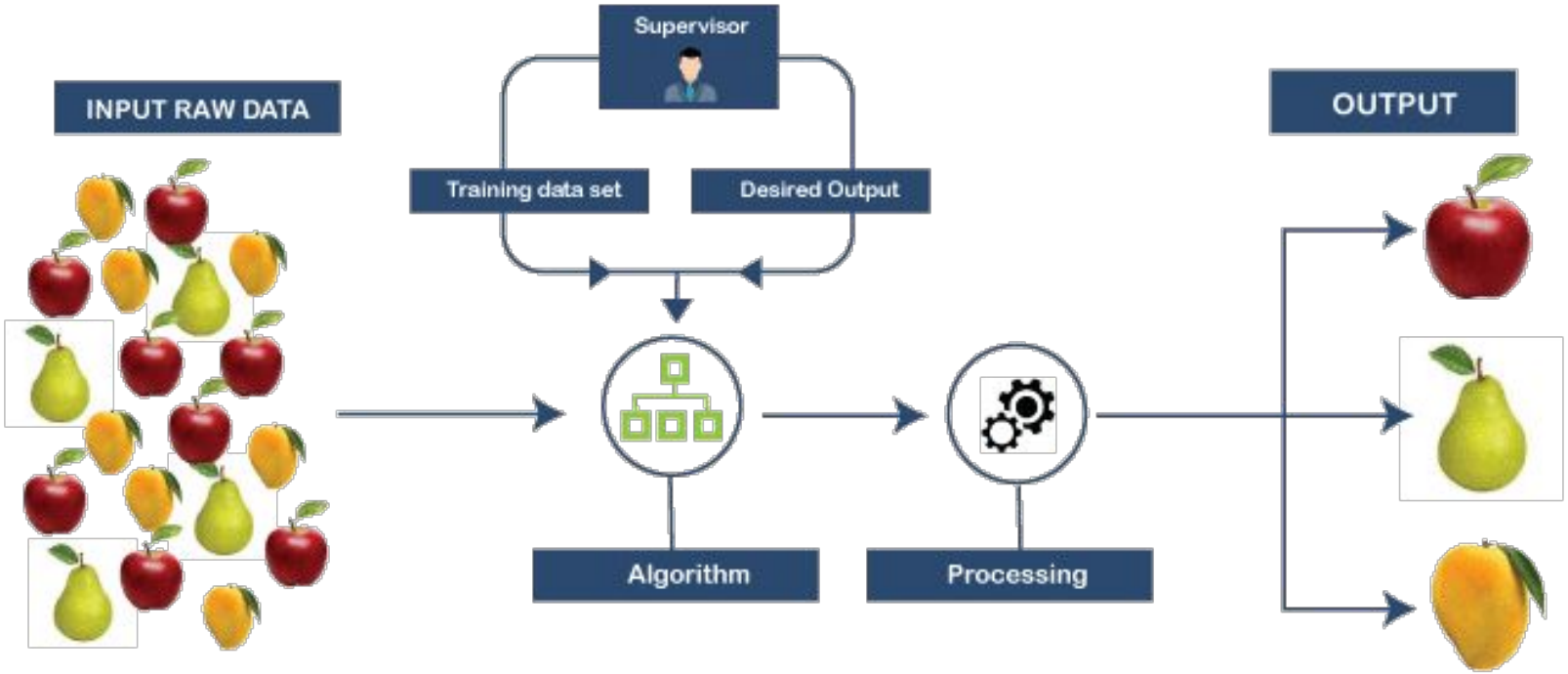
Machine Learning

"Machine learning" (automatic learning) is an algorithm that **gradually learns a concept**: an object, a face, a language, a behavior, a sentiment…

When applied to neural networks, it's the operation of **adjusting all the network's parameters** so that it closely approximates the functional relationship between inputs and targets.

The simplest algorithm is **linear regression**, which allows you to separate groups of data points.

Supervised Learning

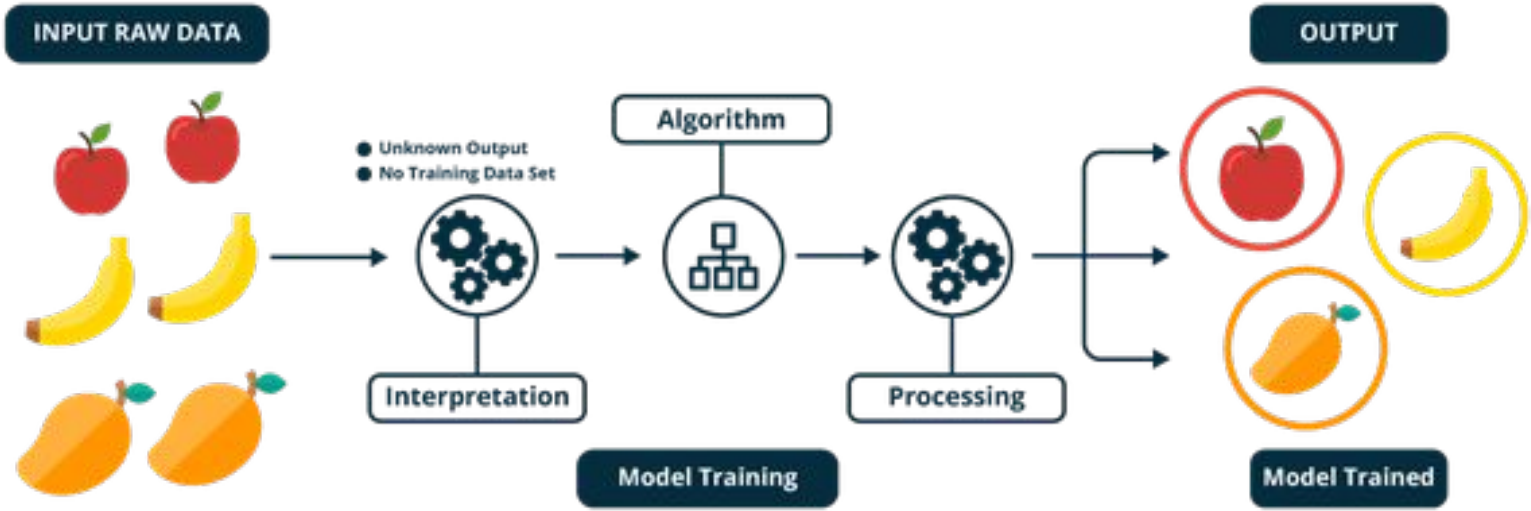


Supervised Learning

Some examples :

Input A	→	Output B	Application
email	→	spam? (0/1)	Spam filtering
audio	→	text transcript	Speech recognition
English	→	Chinese	Machine translation
ad, user info	→	Click? (0/1)	Online advertising
image, radar info	→	positions of other cars	Self-driving car
human face	→	name	Face recognition

Unsupervised Learning

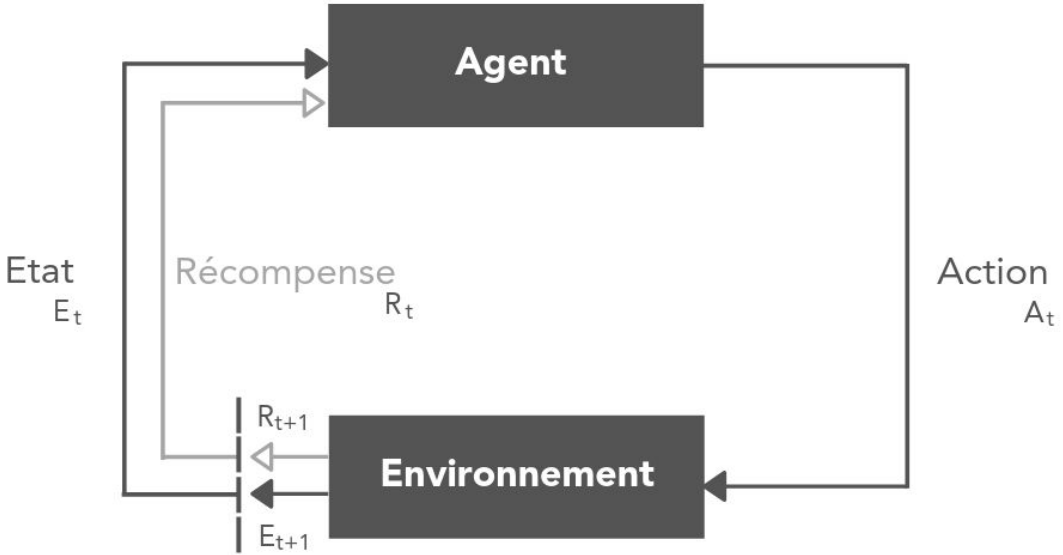


Unsupervised Learning

Some examples :

- data exploration,
- customer segmentation,
- recommender systems,
- target marketing campaigns, and
- data preparation and visualization, etc.

Reinforcement Learning



Reinforcement Learning

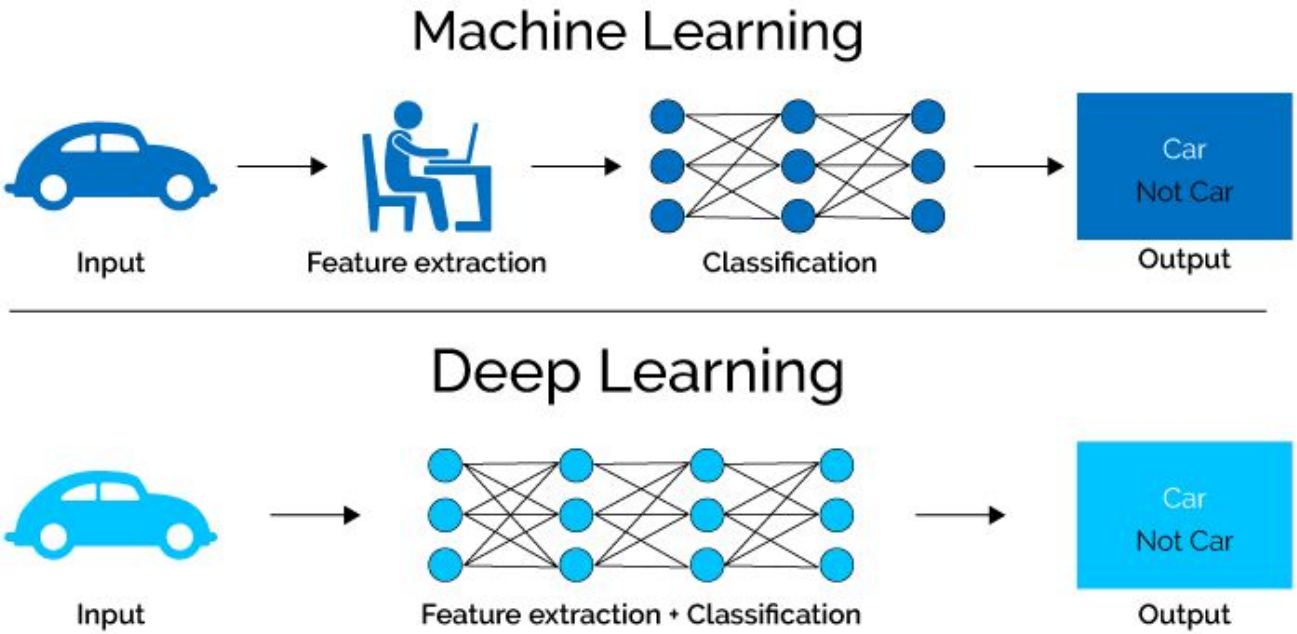
Some examples :

- Autonomous vehicles

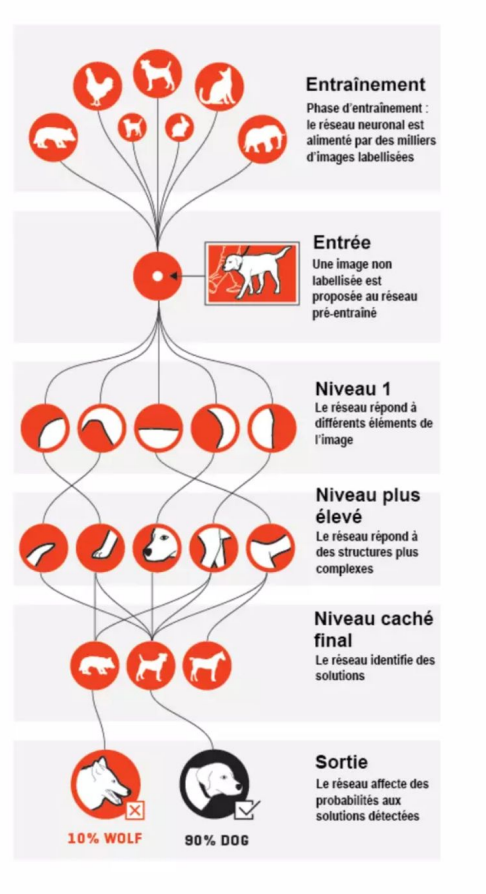
AWS DeepRacer is an autonomous racing car designed to test reinforcement learning on a physical track. It uses cameras to visualize the track and a reinforcement learning model to control speed and direction.

But not limited: https://neptune.ai/blog/reinforcement-learning-applications

“Deep Learning”



“Deep Learning”



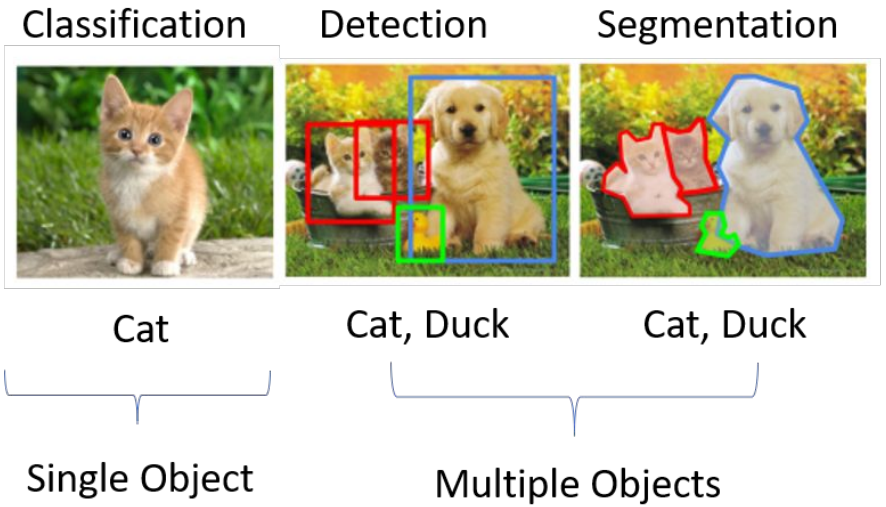
- “deep learning” is a set of methods that leverages the advancements in neural networks to recognize objects, images, images within images, donations, phrases in a phone call, and more.

- It always involves two phases: a training or education phase, which is carried out on labeled data, and a discovery phase, which uses unlabeled data.

Key ML Applications Today

Computer Vision

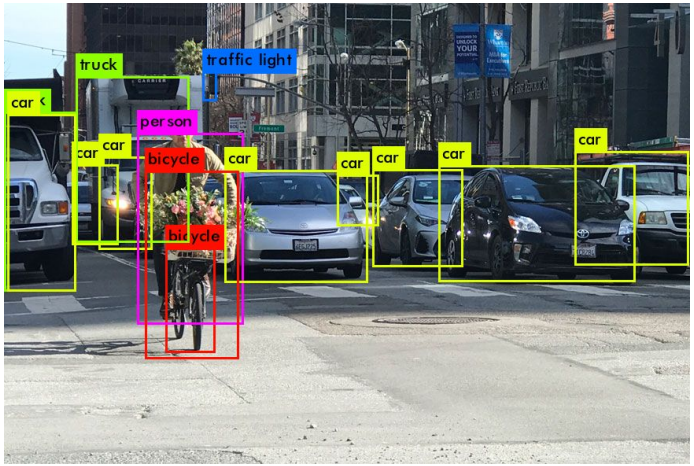
- Image Classification, Object Recognition
  - Face Detection



- Object detection

- Image segmentation

- Tracking



Natural Language Processing

- Text classification
  - Sentiment Analysis
- Information retrieval
  - E.g. Web search
- Named Entity Recognition
- Translation

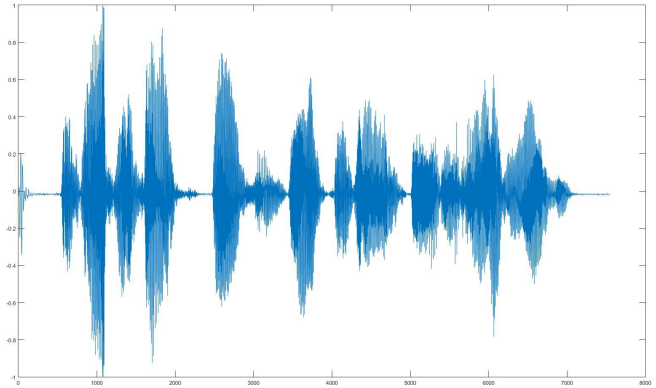
"Queen Elizabeth II knighted Sir Paul McCartney for his services to music at the Buckingham Palace"

AIは、新たな電気だ
AI is the new electricity

Signal Processing

- Speech Recognition (speech-to-text)
- Trigger word/wakeword detection
- Speaker ID
- Speech synthesis (text-to-speech)

  The quick brown fox jumps over the lazy dog.



Data in ML

- Unstructured data (images, audio, text)

 image  audio AIは、新たな電気だ AI is the new electricity text

- Structured data

House size (square feet)	# of bedrooms	Price (1000$)
523	1	100
645	1	150
708	2	200

Clay batch #	Supplier	Mixing time (minutes)
001	ClayCo	35
034	GooClay	22
109	BrownStuff	28

What is “data” ?

Dataset

size of house (square feet)	# of bedrooms	price (1000$)
523	1	115
645	1	150
708	2	210
1034	3	280
2290	4	355
2545	4	440

image	label
	cat
	not cat
	cat
	not cat

Data Acquisition

- Manual labeling


cat


not cat


cat


not cat

- From observing behaviors

user ID	time	price ($)	purchased
4783	Jan 21 08:15.20	7.95	yes
3893	March 3 11:30.15	10.00	yes
8384	June 11 14:15.05	9.50	no
0931	Aug 2 20:30.55	12.90	yes

machine	temperature (◦C)	pressure (psi)	machine fault
17987	60	7.65	N
34672	100	25.50	N
08542	140	75.50	Y
98536	165	125.00	Y

- Download from websites/partnerships
  - Our case (Amazon reviews, IMDB reviews, Celeb dataset, google-speech-dataset)

Your turn !

In order to understand how this data is encoded and manipulated before working with it and performing some ML tasks (sentiment analysis, part 2).

https://colab.research.google.com/drive/1IaRN7kn6IRtSZUvhM9gkW_4xjbSDJ8CC?usp=sharing