Artificial Intelligence in Telecommunications Networks

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Summary

The goal of IT is to automate tasks, store and manage information, and facilitate communication.

$\Rightarrow$ scientific methods for processing information using computers.

- Machine learning algorithms (deep learning)
  $\Rightarrow$ represent and analyze complex situations.

- Efficiency
  $\Rightarrow$ function of the quantity given

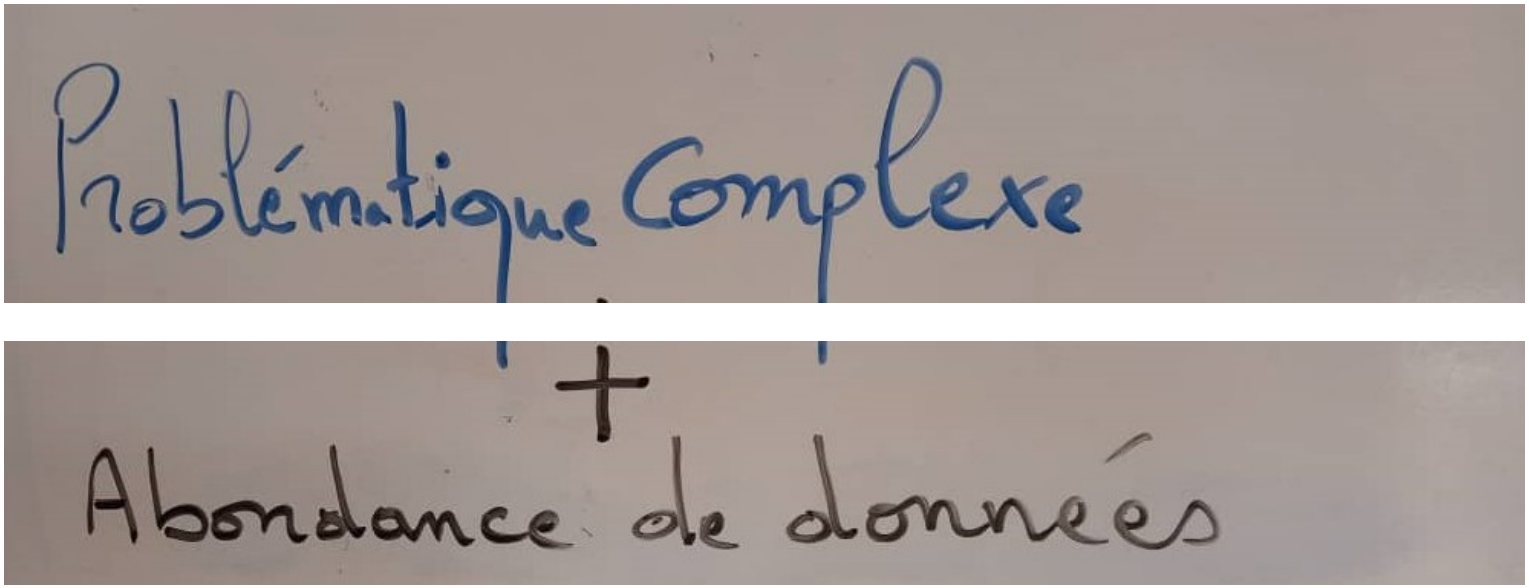
Telecommunications networks :
$\Rightarrow$ complex objects with many components
$\Rightarrow$ with many parameters

- Complexity of issues
  $\Rightarrow$ Telecommunications networks are becoming increasingly complex and sophisticated.

- Abundance of data
  $\Rightarrow$ Telecommunications networks generate a very large amount of data on their operation
  - telemetry data,
  - quality of service indicators,
  - Availability rate
  - ...

  allowing their operators to have an accurate picture of their performance.


Problématique Complexe


Problématique Complexe
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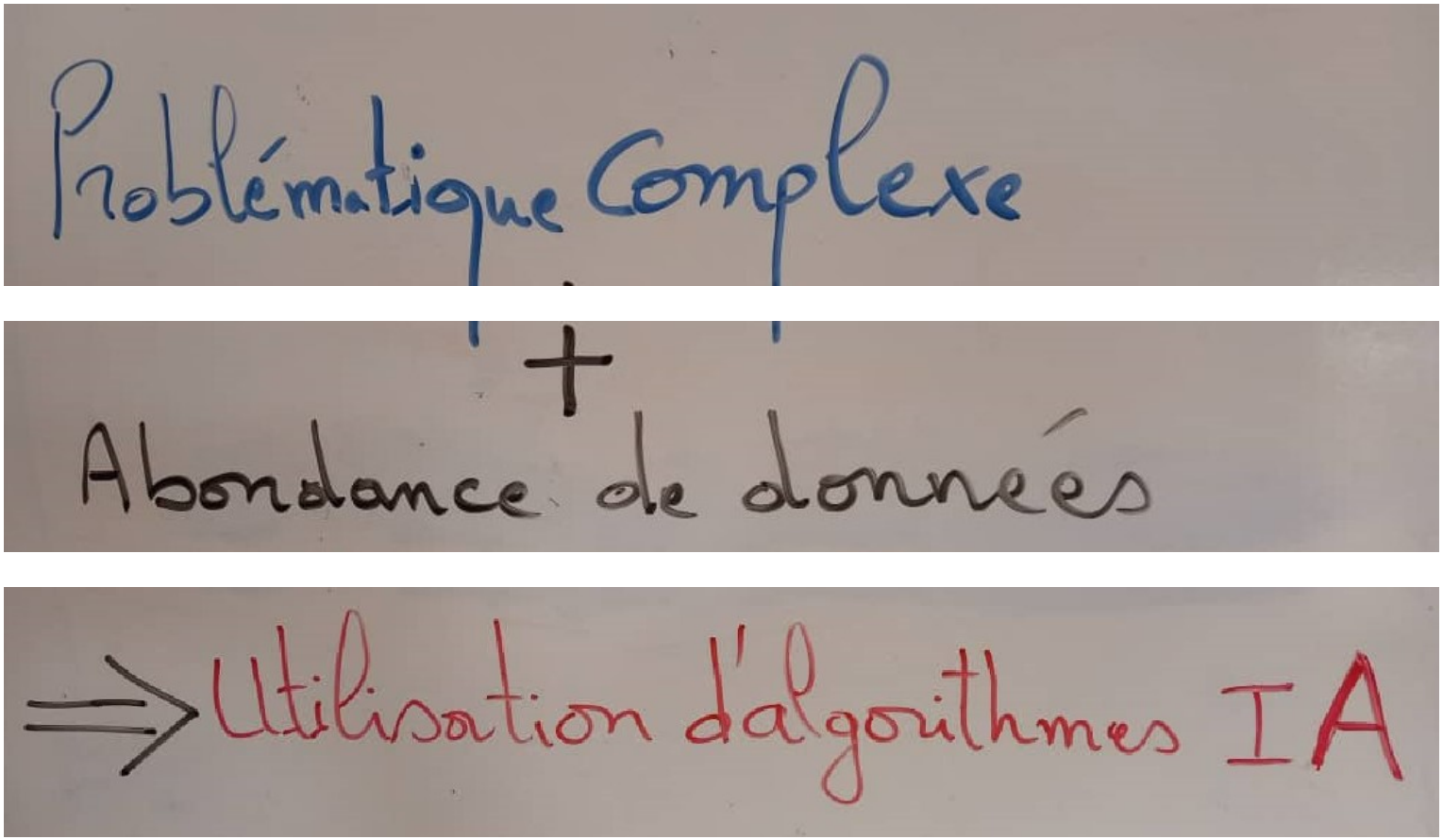
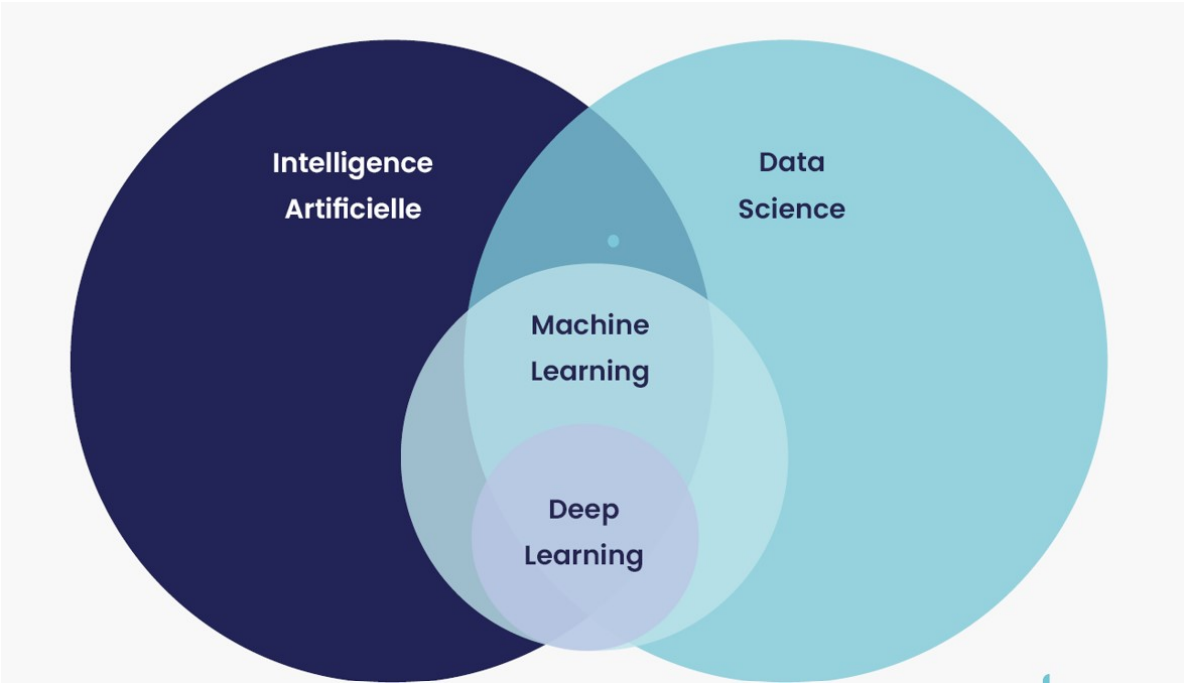
Abondance de données


Problématique Complexe
+
Abondance de données
⇒ Utilisation d'algorithmes IA

Summary

model type

- Learning algorithms rely on models that may be of a different nature.
- Each learning algorithm has its own specificities and is more or less effective depending on the nature of the tasks it must perform.
- Deep learning is based on a model of neural networks, has enabled many advances in the field of machine learning.



learning mode

Machine learning $\Rightarrow$ Learn and improve from experience without being explicitly programmed.
Beyond the types of models used, there are various learning modes :

- supervised learning
- Unsupervised learning
- Reinforcement learning

supervised learning

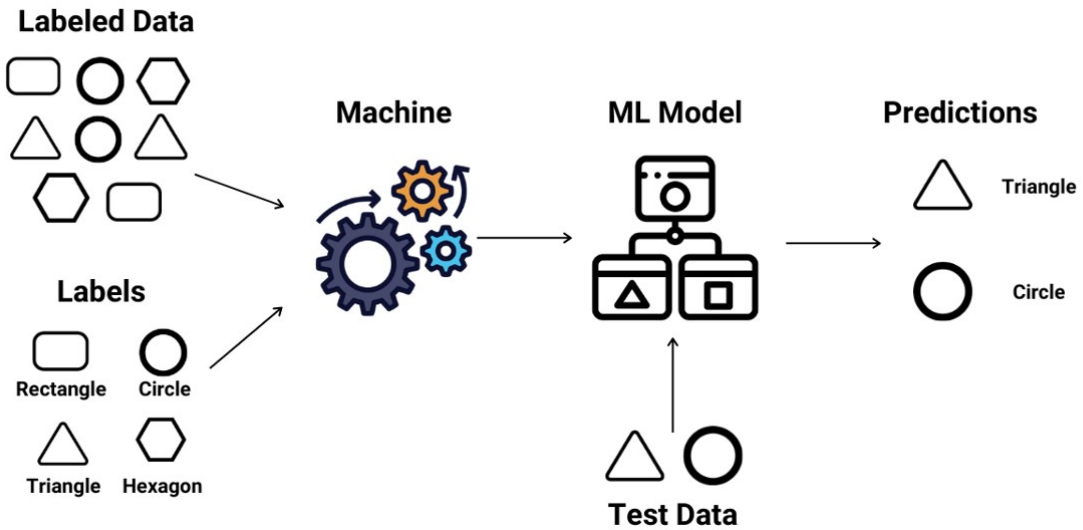
Definition

Supervised learning is a learning method in which a model is trained on a set of labeled data. Labels allow the model to understand what they need to learn .

Sample applications

This technique can be applied to classify customers into different user groups based on their data consumption habits.

$\Rightarrow$ Indicate for classification and regression problems.



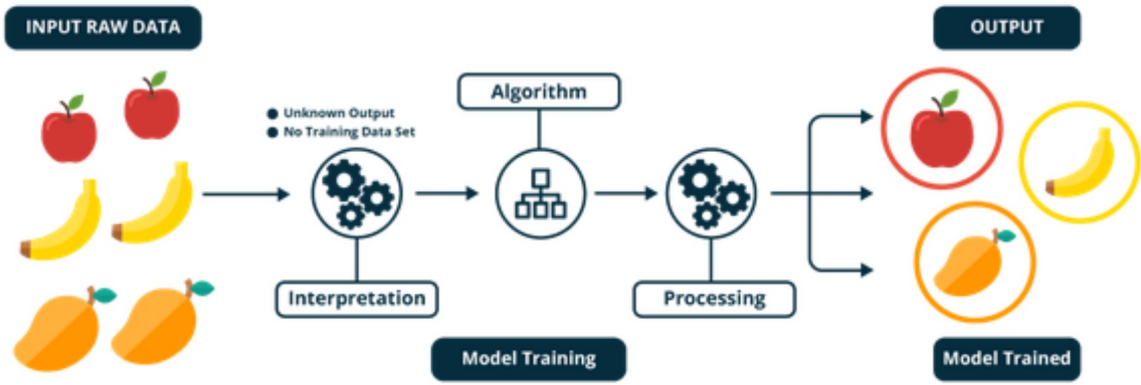
Unsupervised learning

Définition

Unsupervised learning is a type of learning in which an algorithm looks for patterns in data without being guided by labels.

Sample applications

For example, from images of faces of different people, the algorithm will build a model to classify faces in different groups according to criteria that it has established itself.
⇒ Specify for association, clustering, and downsizing rule issues.



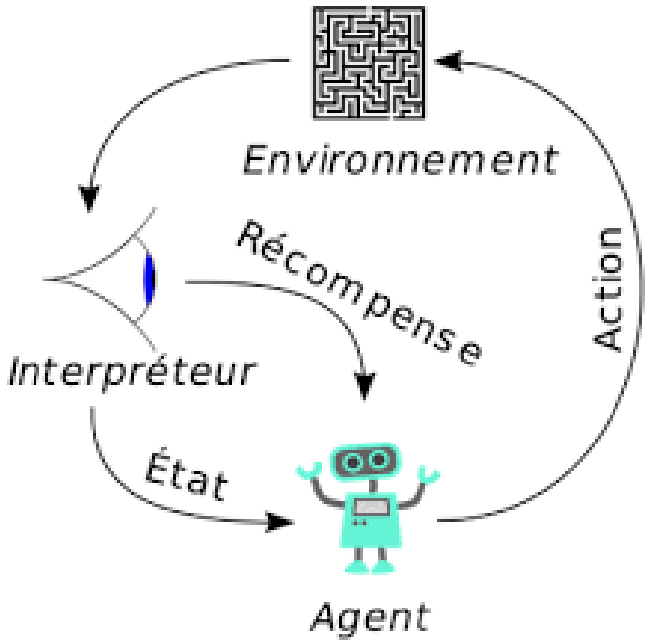
Reinforcement learning

Définition

Reinforcement learning is a learning method that involves a learning system through interaction with its environment. The system is rewarded or penalized depending on the action it takes.

Sample applications

This method can be used to optimize resource management in a telecommunications network by learning how to dynamically allocate resources based on demand.



Summary

Service optimization

- Artificial intelligence makes it possible to learn from past experiences that have been observed.
- In the case of telecommunications networks, these past experiences may concern :
  - breakdowns
  - malfunctions observed
  - the solutions used to solve them.

Predictive maintenance

- based on datasets describing previous malfunctions
- and knowing the user experience,

$\Rightarrow$ Supervised learning can identify a state of dysfunction by taking into consideration all the parameters to characterize it.

Incident response

Once an incident is detected or anticipated, an AI approach can

- quickly consider all possible solutions,
- simulate their deployment and
- Measuring its potential effects
- Propose these resolution approaches to a human operator who will then be able to make a choice among the proposed solutions.

Real-time equipment and network optimization

Artificial intelligence can consider :

- all the changes it can make to the network configuration, and
- Simulate the deployment of these changes

$\Rightarrow$ assess the effects of these changes

Real-time equipment and network optimization

In particular, artificial intelligence can be used to
$\Rightarrow$ Optimize network energy consumption

- by putting to sleep equipment (antennas, servers, fibers ...) that are unlikely to be used or on the contrary in
- dynamically allocating more resources to them

$\Rightarrow$ Machine learning can also be combined with Software Defined Network (SDN) to configure the network globally and consistently .

Optimization of the quality of service

Radio planning

- Beamforming
- Optimized cell deployment
- Location of terminals
- Antenna tilt