Machine Learning

November 24, 2023

What is machine learning

Machine learning is the study of algorithms that automatically improve.
The **process** can be error proof or not error proof:

- The **error proof** learn and improve the results
- The **non error proof** leads to luck of improvement (process is just destroyed)

Machine learning is where computer discover how they can do tasks without being explicitly programmed to do so.

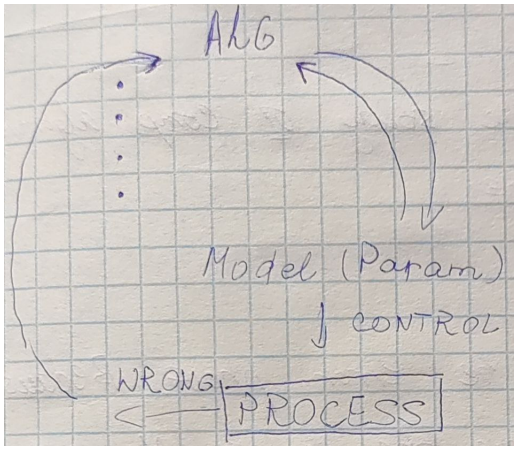

Figure 1: What is machine learning

Supervised algorithm

Algorithms build a mathematical model of data-set that contains both input and desired data.
Data, known as training data, consists of a set of training examples (supervised signal).

Learning without supervision

In this case, algorithms take a data-set that contains only inputs and find a structure from these (such as grouping data points).
Therefor, algorithm learns from test data (not tagged).

Partially supervised learning

Mix of the previous two.

Reinforcement learning

It is a type of machine learning that learns by interacting with an environment and receiving rewards or punishments for its actions.
The goal of reinforcement learning is to learn a policy that maximise the cumulative reward over time.
It is often used to solve problems that are difficult or impossible to solve with supervised or unsupervised learning, such as game playing, robotics, and control systems.

Self-learning

It is a more general term that refers to any type of learning that does not require explicit instruction.
Self-learning can occur through a variety of mechanisms, such as observation, exploration, and trial and error.

Learning functions

They are mathematical functions that describe how an agent learns.
Some common learning functions include linear regression, logistic regression, and neural networks.

Feature	Reinforcement learning	Self-learning	Learning functions
Learning goal	Maximize cumulative reward	Learn without explicit instruction	Model learning processes
Learning mechanism	Trial and error	Observation, exploration, trial and error	Mathematical functions
Applications	Game playing, robotics, control systems	Many areas of AI, human learning	Modeling reinforcement learning, self-learning, and other types of learning

Figure 2: Summary table

Inductive logic

Inductive reasoning is a method of reasoning in which premises are viewed as providing some evidence, but not as fully assuring the truth or conclusion.
We use it when we don't have full information.

Artificial neural network

The connections are called edges.
Neurons and edges usually have a weight that adjusts as learning progresses.
The weight increases or decreases the signal strength on the connection.
Neurons may have a threshold such that a signal is only sent when the aggregated signal exceeds this threshold.
Typically,neurons are aggregated into layers. Different layers can perform different transformations on their inputs. Signals pass from the first layer (input layer) to the last layer (output layer), possibly after passing through the layers multiple times.

From his speeches In an artificial neural network there are usually 3 layers.
Many times we can find in output with a combination of results BUT I want a concrete answer!!! (I might get otuput like "maybe the answers is 2 or maybe it's 3")

Learning neural network

Neural networks learn (or are trained) by processing examples, each of which contains known "inputs" and "output", creating probability-weighted associations between them that are stored in the data structure of the network itself.
The network then adjusts its weighted associations according to the learning rule and using this error value.
Further adjustments will cause the neural network to produce the output data that is closer and closer to the target data.
After enough of these adjustments,training can be completed based on certain criteria. This is called **supervised learning**.

Such systems learn to perform tasks by considering examples, generally without programming task-specific rules.
For example,in image recognition, they can learn to recognise images that contain cats by looking at sample images that have been manually tagged as "cat" or "no cat" and using the results to identify cats in other images.
They do this without any prior knowledge of cats, for example that they have fur, tails, whiskers, and cat faces. Instead, they automatically generate identifying characteristics from processed examples.

From his speeches
I receive combinations of inputs -¿ this combination of inputs must give me a very clear output.
So I train a model that works just like this (first)
In this case training and working are two separate phases.
First I train and then I work - after the training (working) the model will not know if the result is correct or not, it will just give the answer.

Example on the blackboard
What the function does is analyse the pixels - the function will find differences between the two figures, because the second A is smaller.
If I trained the model for example to recognise a # - it could exchange the small A for a #.
What you can do is make the model look for control points!!!

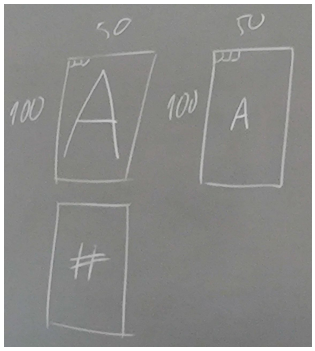

Figure 3: Example with the A

Oral example
In the case of faces, I look for the nose, eyes, mouth and then check the PROPORTIONS.

Network model

The neural network was created as an attempt to use the architecture of the human brain to perform tasks that conventional algorithms could not cope with. Researchers soon switched to improving empirical outcomes, mostly abandoning attempts to remain faithful to their biological precursors.
Neurons are linked together in different ways so that the output of some neurons becomes the input of others.
The web creates a directed weighted graph.
An artificial neural network consists of a set of simulated neurons.
Each neuron is a node that is connected to the other nodes through links that correspond to biological axon-synapsedendrite connections.

Each link has a weight that determines the strength of the influence of one node on another.

Neurons

ANNs are made up of artificial neurons that are conceptually derived from biological neurons.
Each artificial neuron has an input and produces one output that can be sent to many other neurons.
The input data can be values for the characteristics of an external data sample, such as images or documents, or it can be outputs from other neurons.
The outputs of the terminal neural output neurons perform a task such as recognising an object in an image.

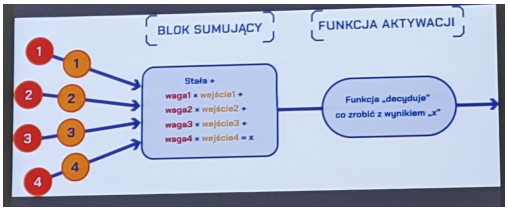

Figure 4: Artificial neuron

Input (orange) can be 0 or 1.
Vates can be 0.3, 0.7, 0.9, etc (input intensity) -¿ they are used for the activation of the neurons.
The function works based on the result of the sum (usually very simple).

if x > value
the neuron is active
else
I don't activate it

Elements of the neuron

- Connections and weights: the network consists of connections, each of which provides the output of one neuron as input to another neuron. Each connection is assigned a weight that represents its relative importance. A given neuron can have many input and output connections.
- Propagation function: the propagation function calculates the inputs for a neuron based on the outputs of its predecessors' neurons and their connections as a weighted sum. You can add a deviation term to the propagation result.

Example on the blackboard

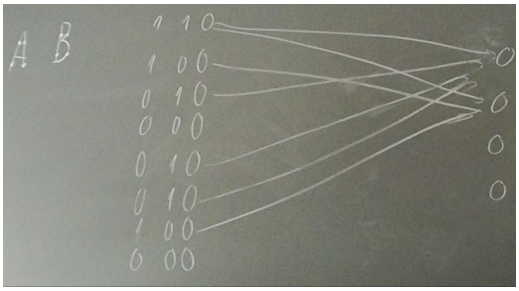

Figure 5: Example A-B

Some cases, some patterns activate both in A and B BUT they will have less power thanks to the vates.
If they do not have enough power the neuron will not be activated.