

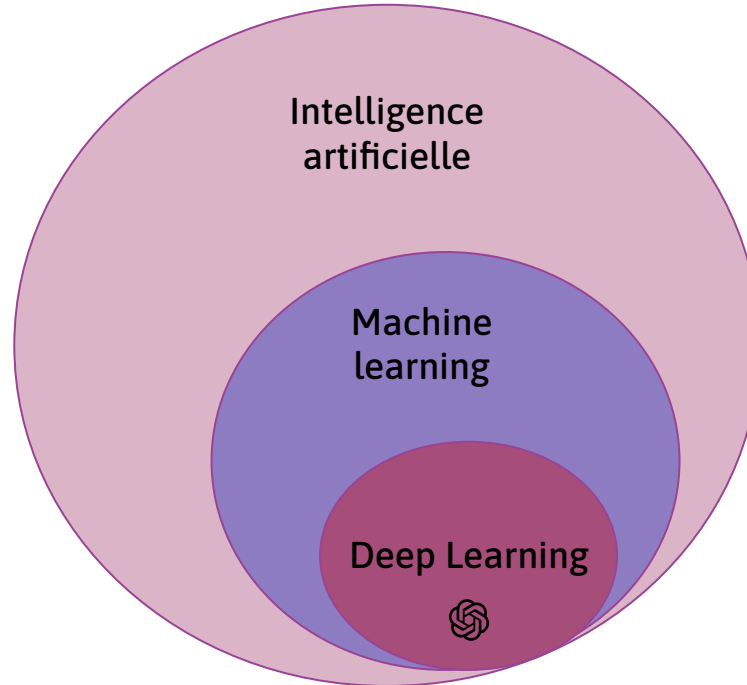
Deep learning

Application à la vision par ordinateur

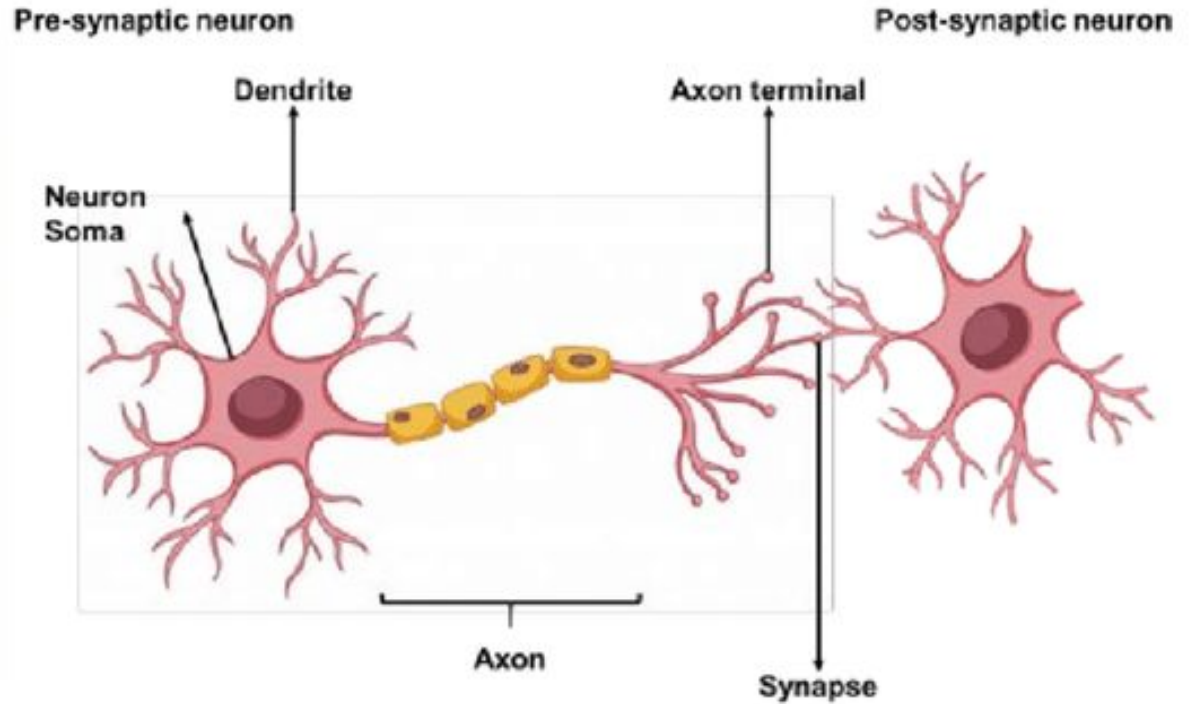
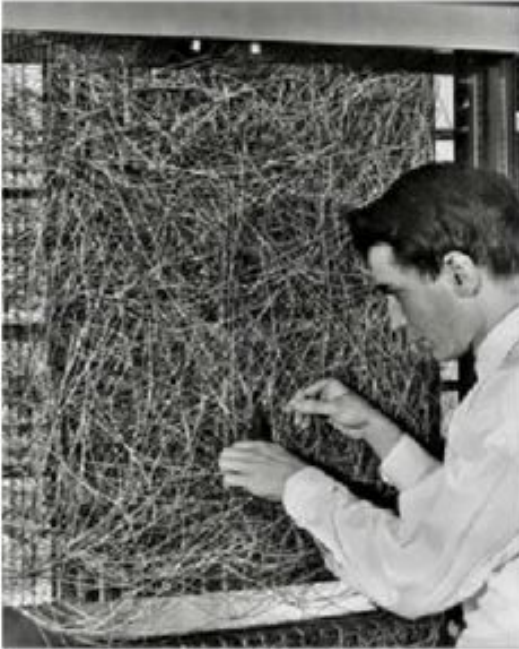
Au programme

- Fonctionnement d'un réseau de neurones
- Computer vision

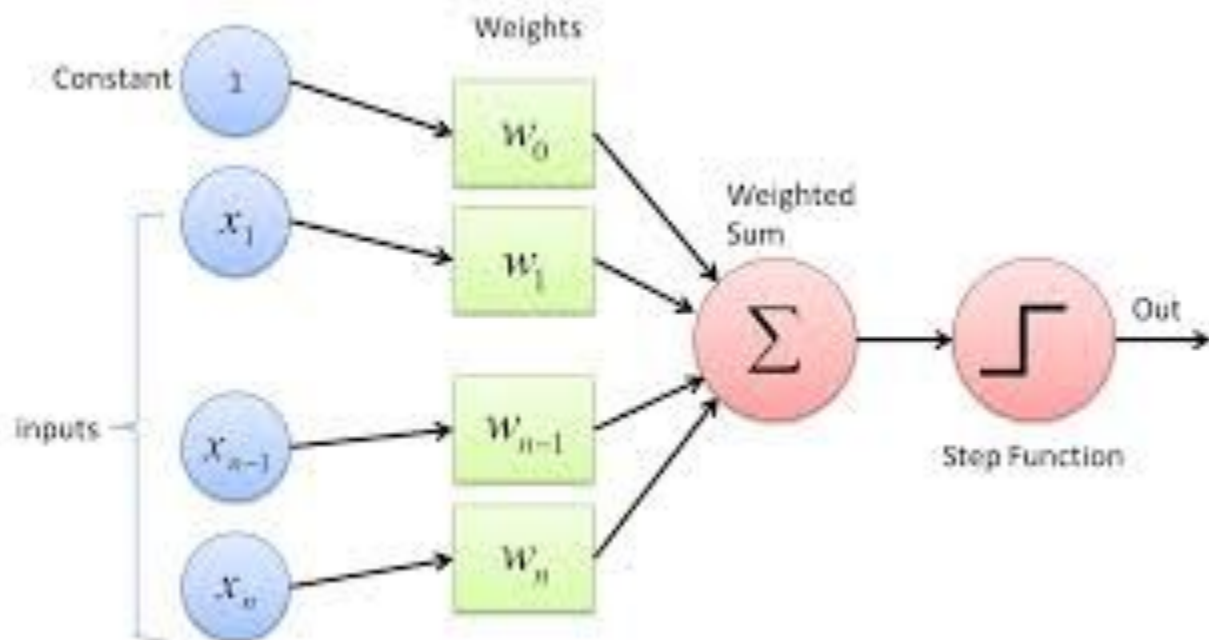
Le Deep Learning : une branche du Machine Learning



Franck Rosenblatt : l'inventeur du perceptron



Le perceptron



Les fonctions d'activation

Sigmoid

$$\sigma(x) = \frac{1}{1+e^{-x}}$$



tanh

$$\tanh(x)$$



ReLU

$$\max(0, x)$$



Leaky ReLU

$$\max(0.1x, x)$$



Maxout

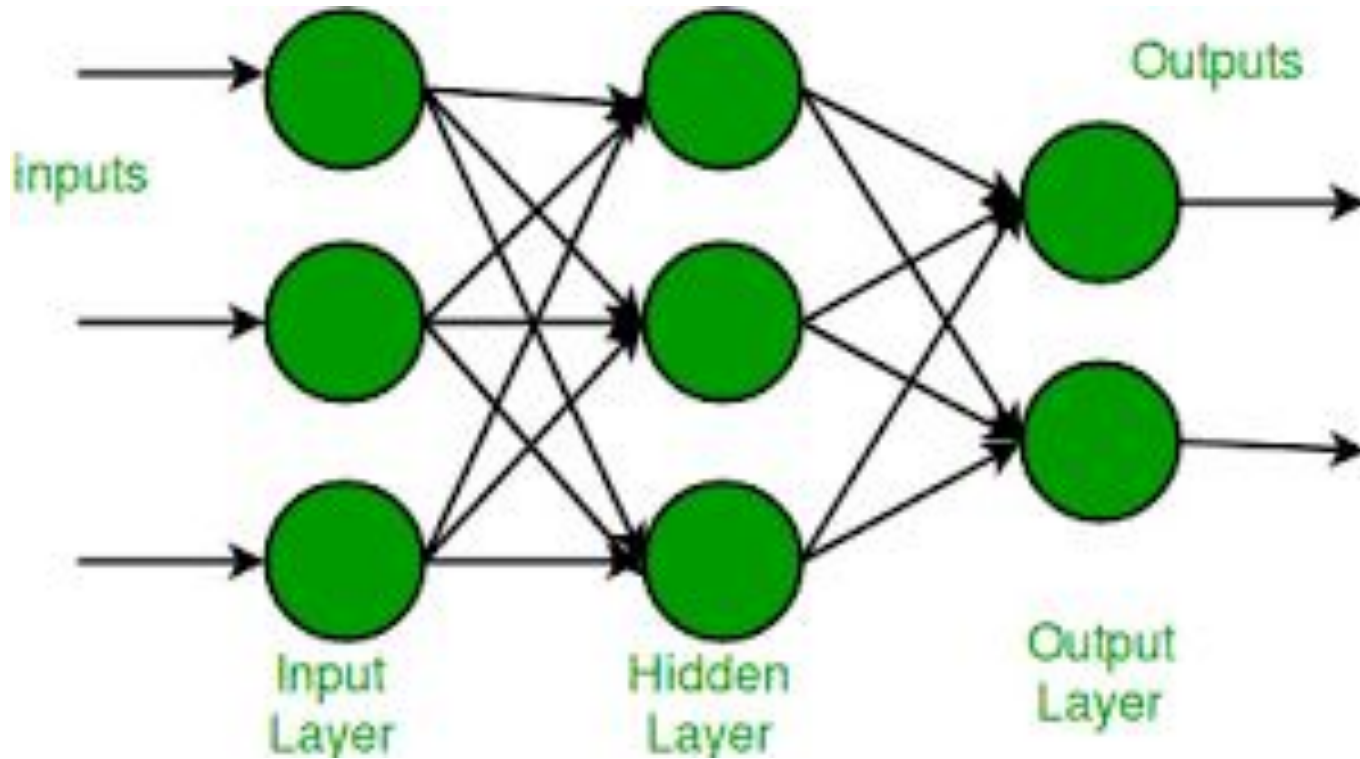
$$\max(w_1^T x + b_1, w_2^T x + b_2)$$

ELU

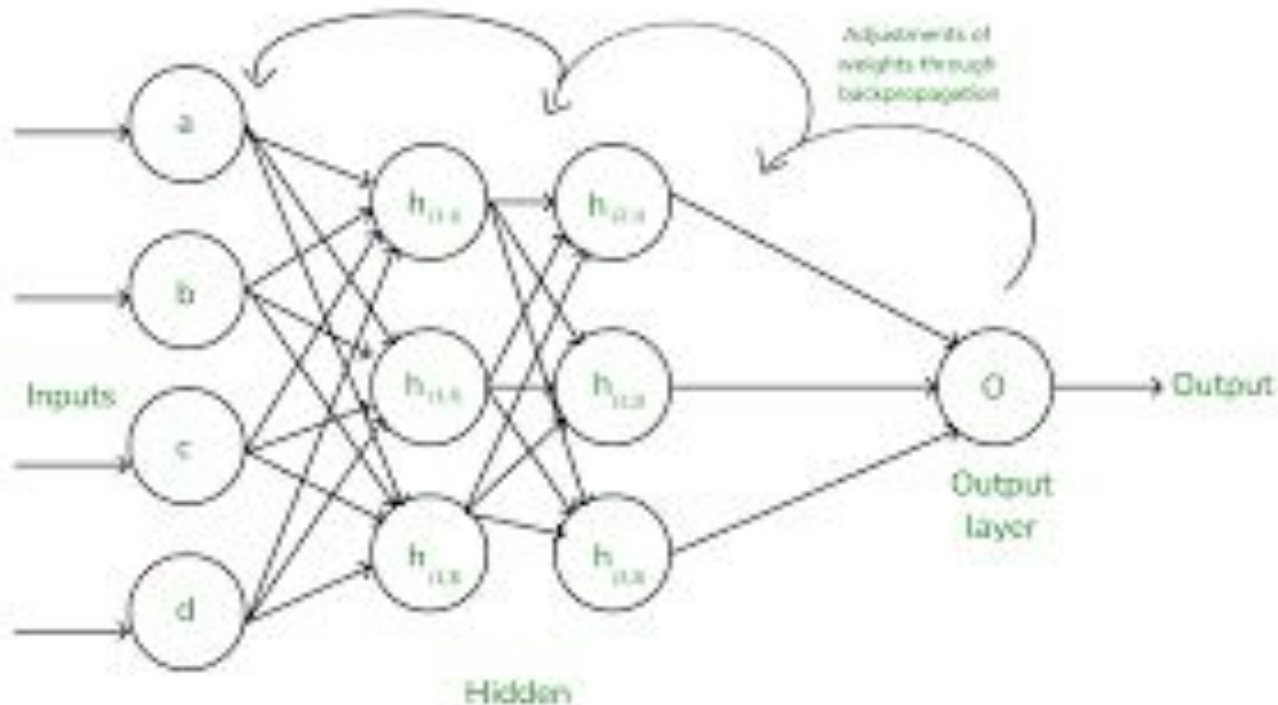
$$\begin{cases} x & x \geq 0 \\ \alpha(e^x - 1) & x < 0 \end{cases}$$



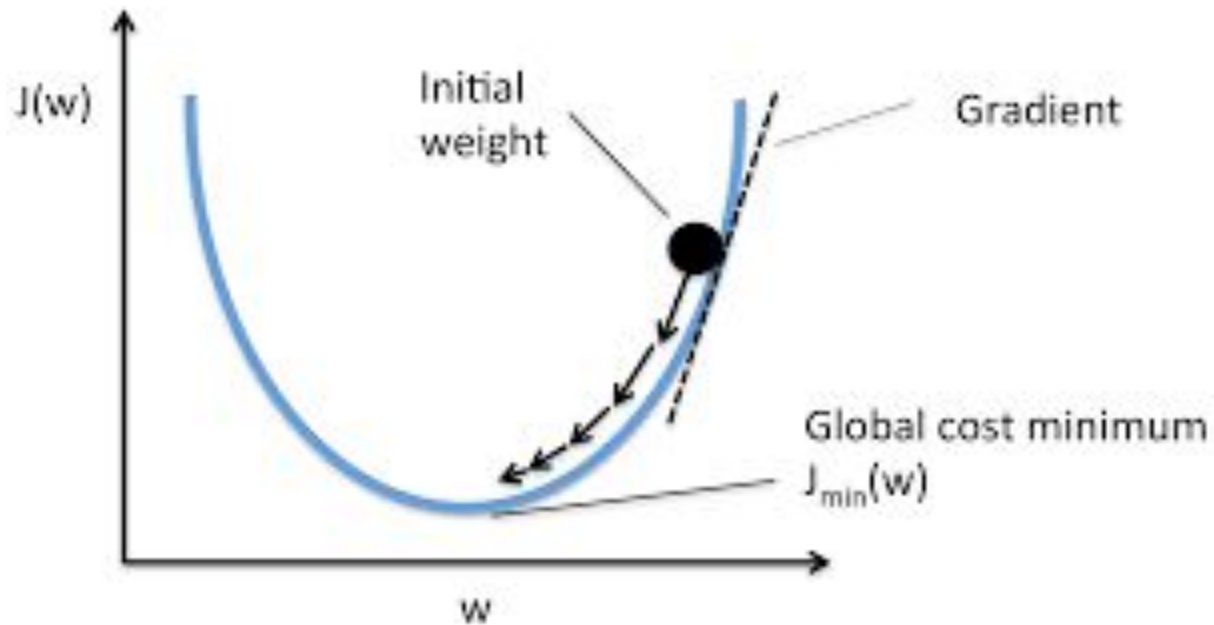
Le perceptron multi-couche



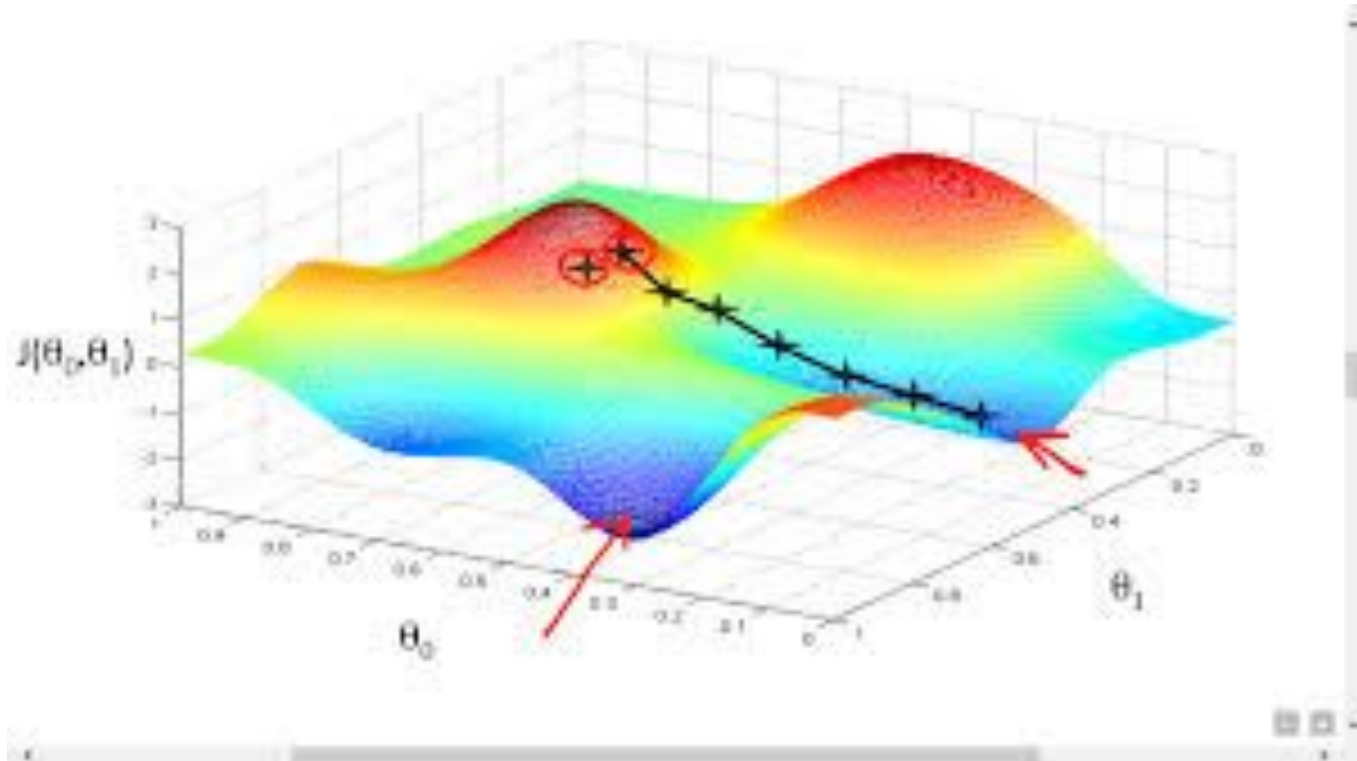
Comment entraîner ces modèles : la backpropagation



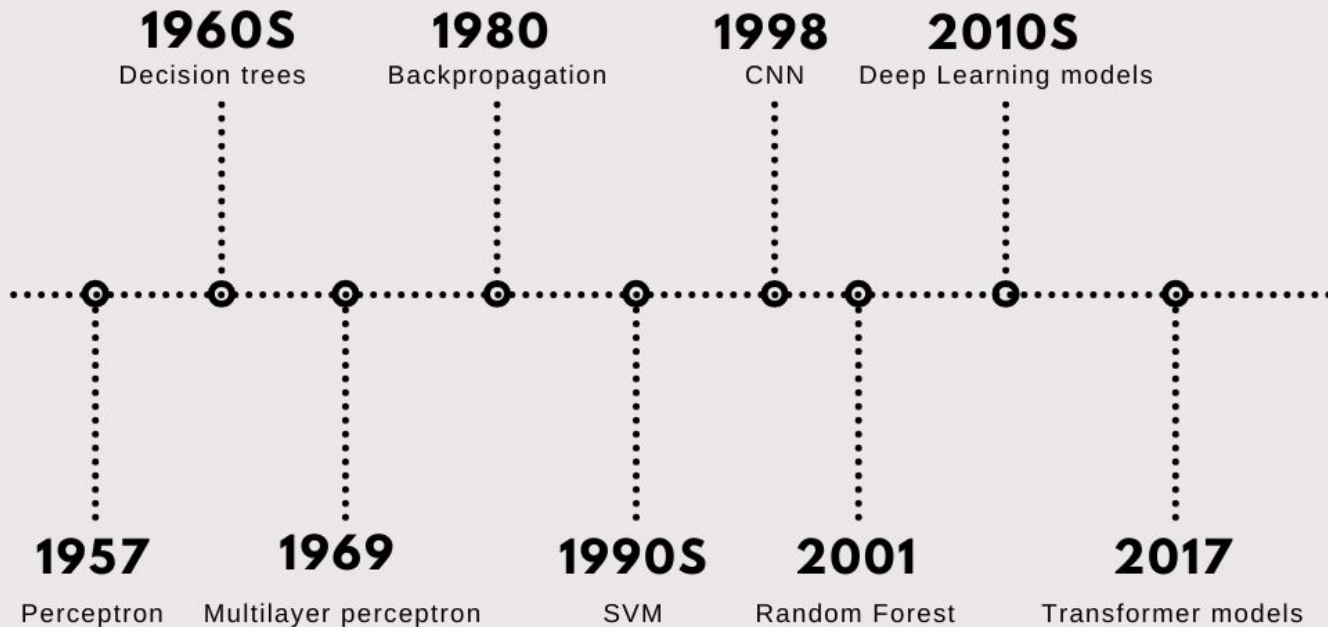
La descente de gradient



Le risque : les minima locaux



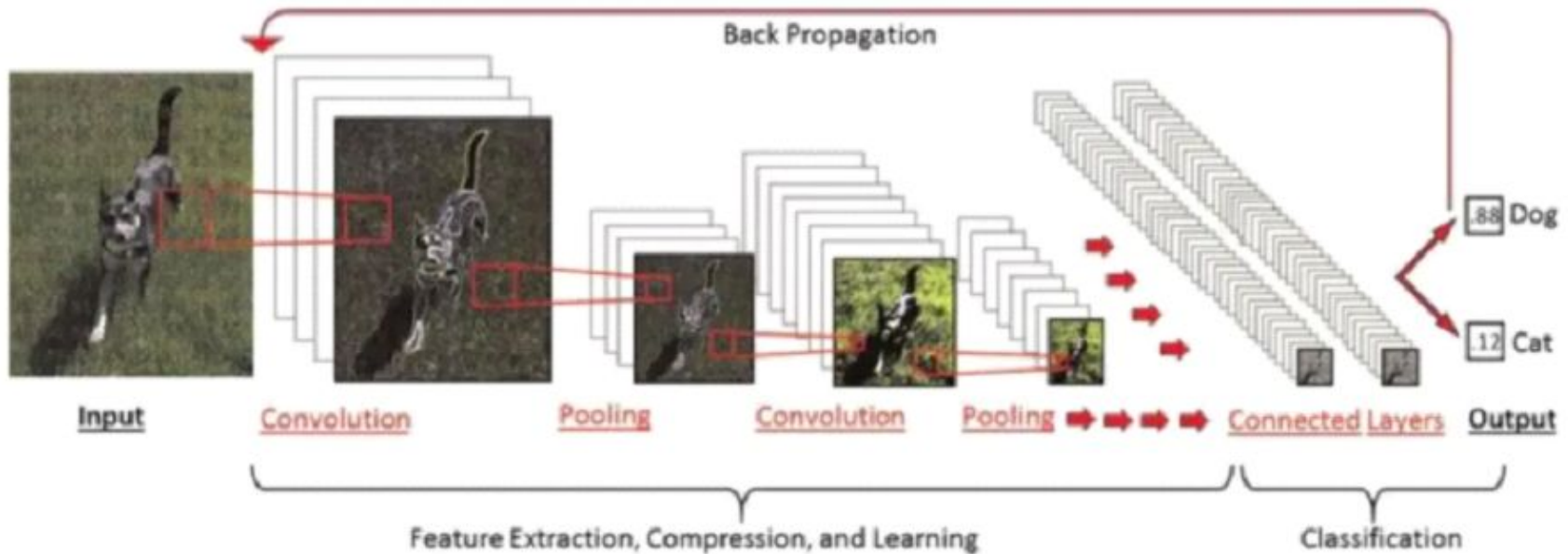
Important ML milestones



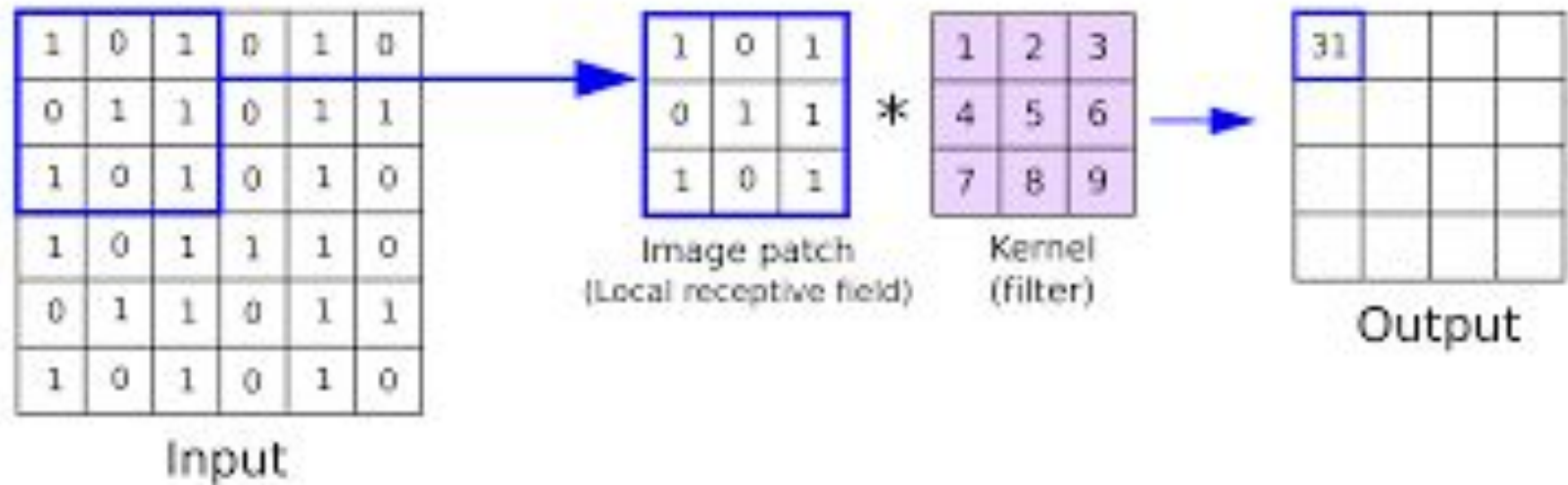
Au programme

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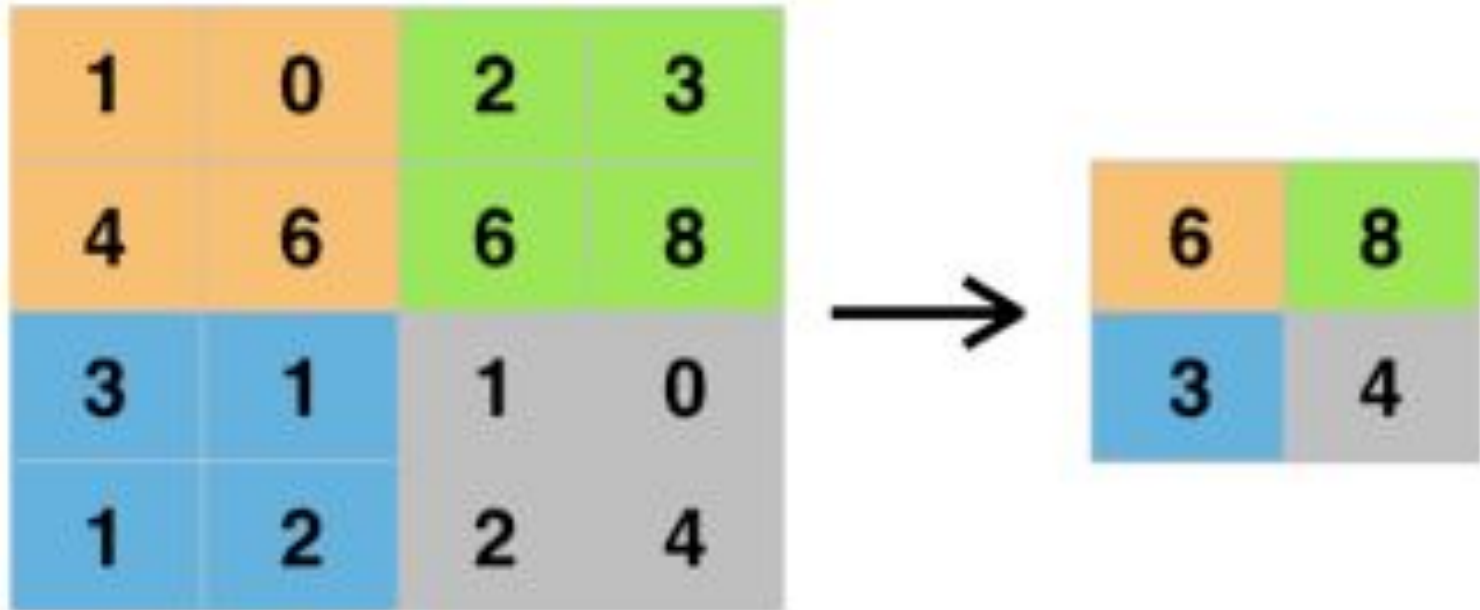
Les réseaux convolutionnels (CNN)



Les couches de convolution

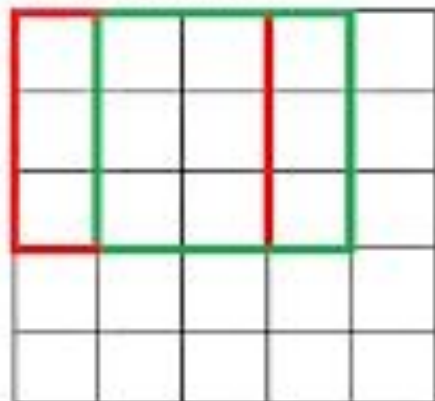


Les couches de “Max pooling”

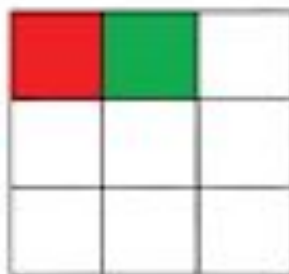


Le stride

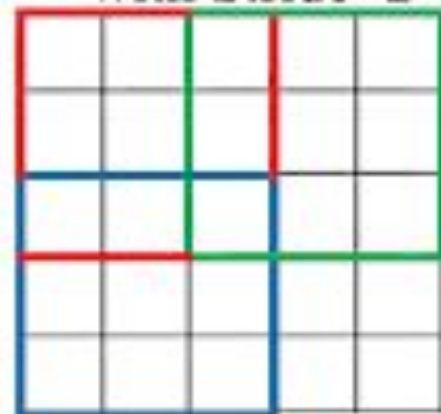
Convolution
with Stride=1



Output



Convolution
with Stride=2



Output



Le padding

Input

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

Kernel

0	1
2	3

*

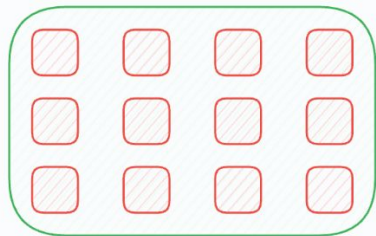
=

Output

0	3	8	4
9	19	25	10
21	37	43	16
6	7	8	0

Entraînement par batch

whole dataset

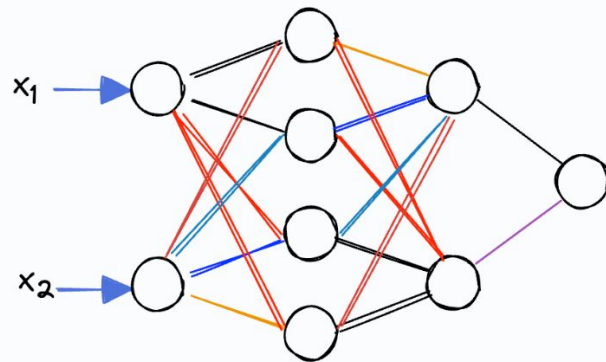


select
mini-batch

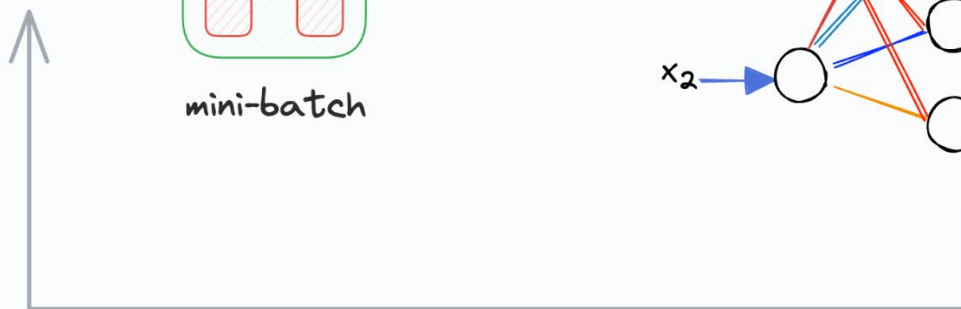


mini-batch

train
model



repeat for all
mini-batches



Batch normalization

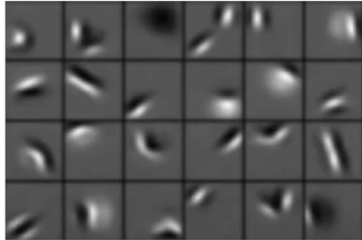
1 Batch with 3 samples mean std_dev

Features ↑	x_1	1	3	8	4	2.94	→
	x_2	3	4	3	3.33	0.471	→
	x_3	5	6	2	4.33	1.69	→
	x_4	7	2	1	3.33	2.62	→

Normalization across mini-batch,
independently for each feature

Chaque couche génère des “features” de plus en plus haut niveau

Low-level features



Edges, dark spots

Mid-level features



Eyes, ears, nose

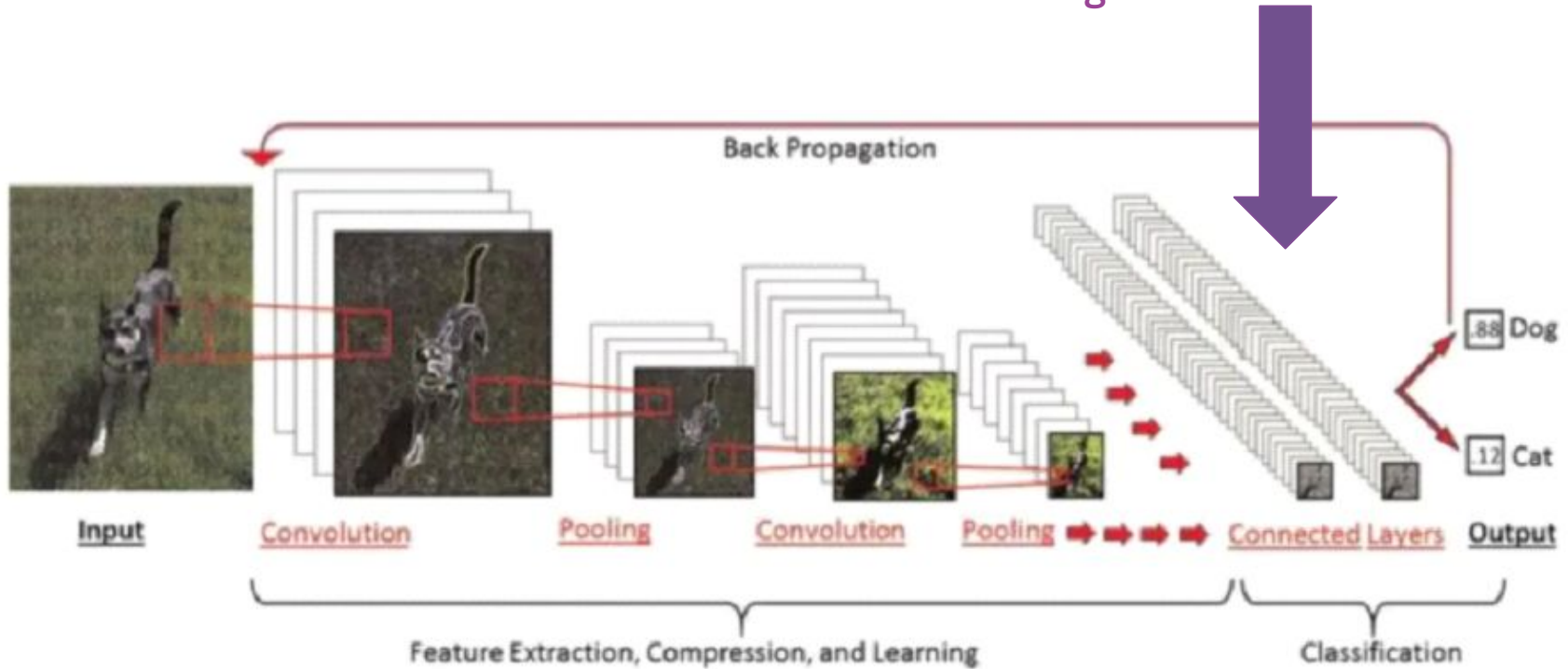
High-level features



Facial structure

Profondeur dans le réseau

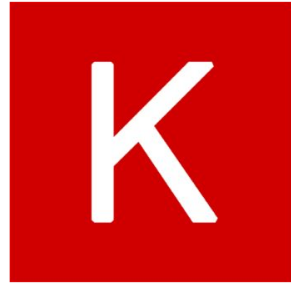
Extraction de features de l'image



Les outils les plus connus



TensorFlow



Keras



PyTorch



Avez-vous des
questions ?