Intelligence Artificielle (IA)
Deep Learning
CNN

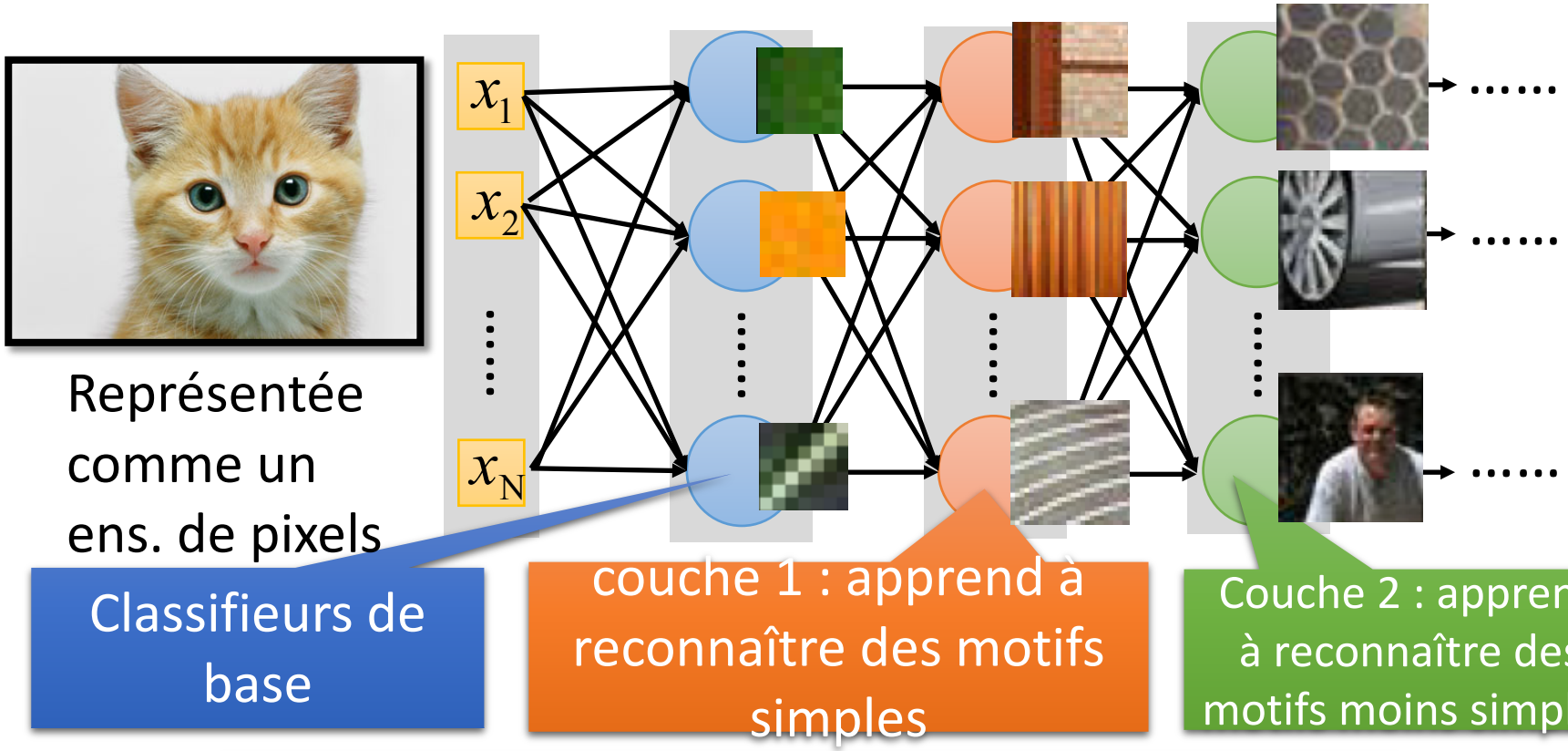
Akka Zemmari

LaBRI, Universite de Bordeaux - CNRS

2021-2022

CNN pour les images : Idées de base ?

[Zeiler, M. D., *ECCV 2014*]



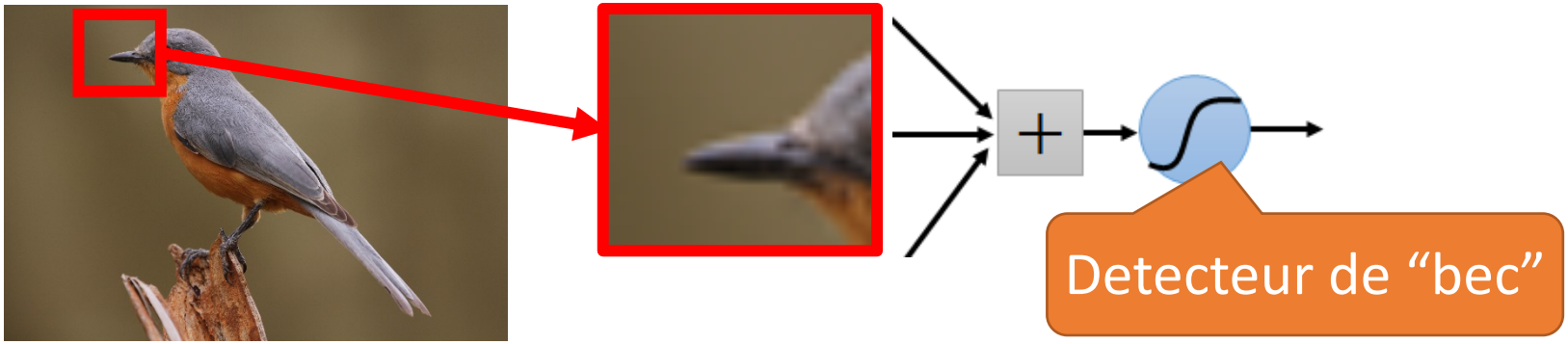
Peut-on exploiter les propriétés des images pour simplifier le réseau ?

CNN pour les images : Idées de base ?

- Des motifs sont plus petits que l'image entières

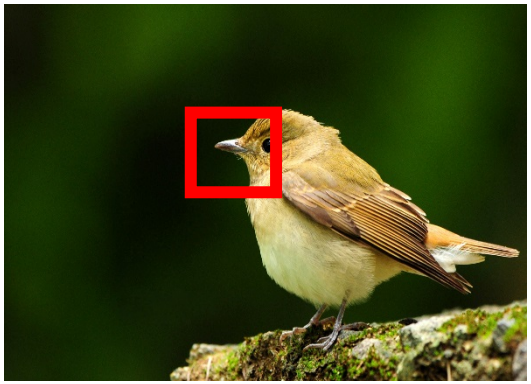
Un neurone n'a pas à voir toute l'image pour découvrir ces motifs.

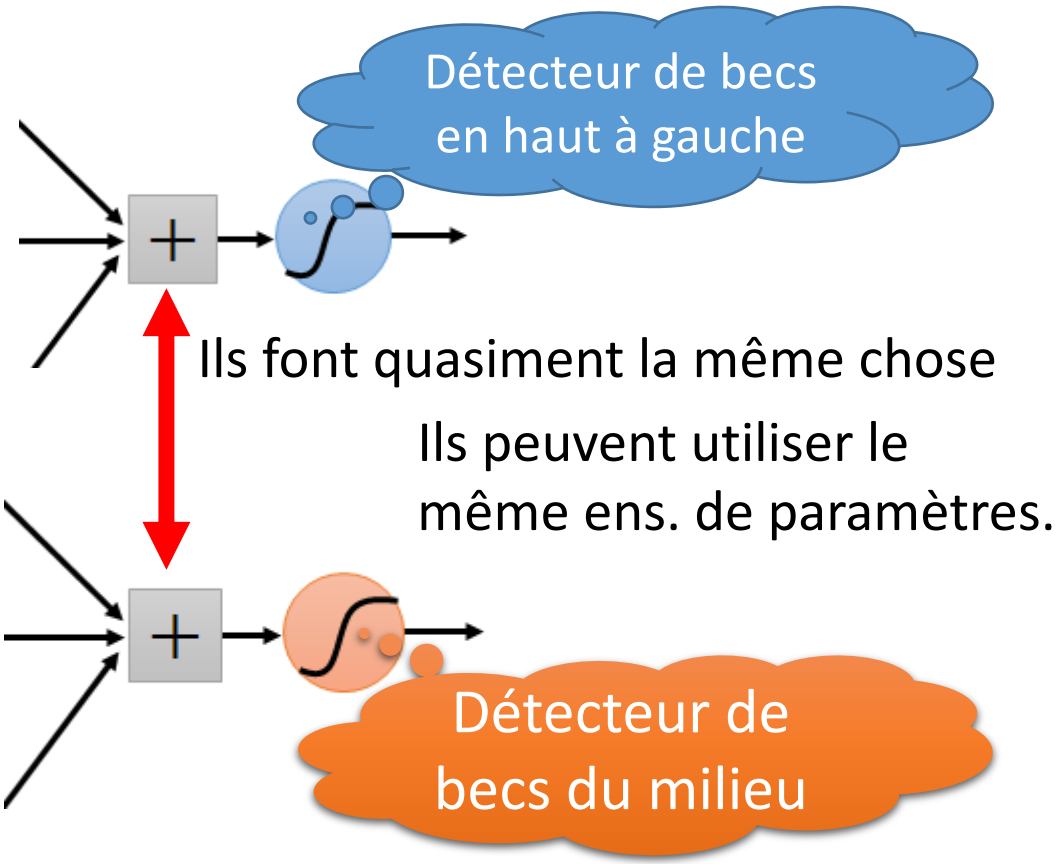
Connexion à de petites régions avec un nombre réduit de paramètres



CNN pour les images : Idées de base ?

- Les mêmes motifs peuvent apparaître dans des régions différentes





CNN pour les images : Idées de base ?

- Le sous-échantillonnage des pixels ne changera pas l'objet

Un oiseau

subsampling

Un oiseau

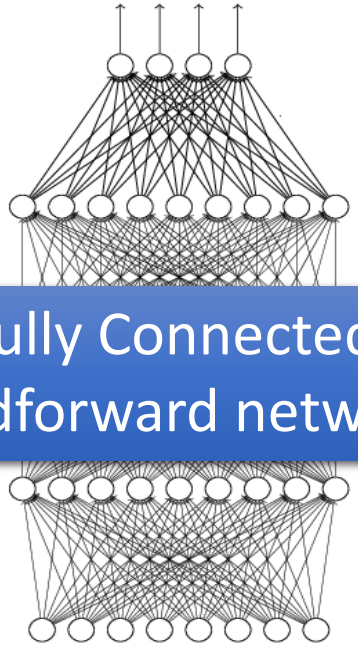
On peut sous-échantillonner les pixels pour réduire la taille de l'image

→ Moins de paramètres à apprendre

Retour au deep …

Réseau CNN

chat chien……



Fully Connected Feedforward network

Convolution

Max Pooling

Convolution

Max Pooling

Répéter plusieurs fois

Flatten

Réseau CNN

Property 1

- Some patterns are much smaller than the whole image

Property 2

- The same patterns appear in different regions.

Property 3

- Subsampling the pixels will not change the object

Convolution

Max Pooling

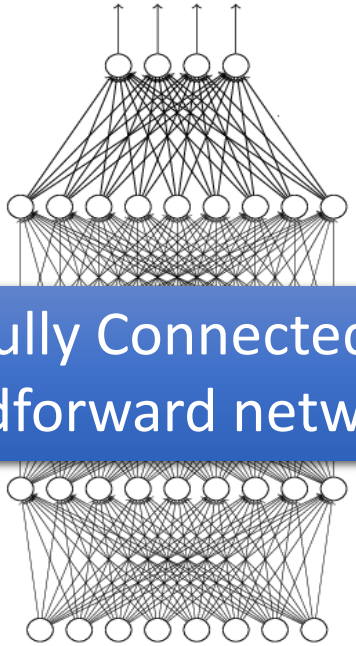
Convolution

Max Pooling

Répéter plusieurs fois

Flatten

Réseau CNN



cat dog ……

Fully Connected Feedforward network

Convolution

Max Pooling

Convolution

Max Pooling

Répéter plusieurs fois

Flatten

CNN – Convolution

Intuition

CNN – Convolution

Ce sont les paramètres qu'il faudra apprendre.

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

6 x 6 image

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

Matrix

-1	1	-1
-1	1	-1
-1	1	-1

Filter 2

Matrix

⋮

Property 1

Chaque filtre reconnaît un petit motif (3 x 3).

CNN – Convolution

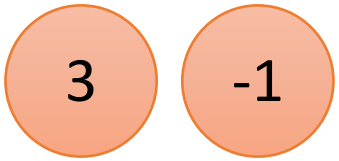
1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

stride=1

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

6 x 6 image



CNN – Convolution

1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

If stride=2

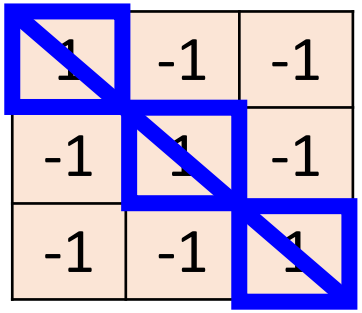
1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

6 x 6 image

3 -3

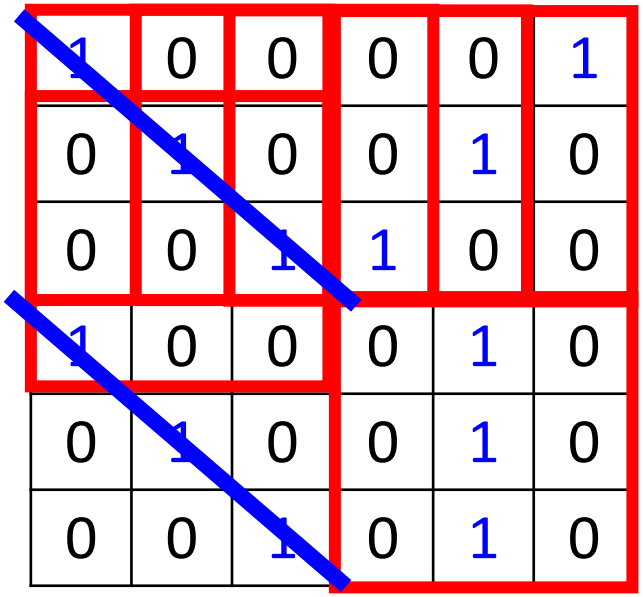
On choisit stride=1

CNN – Convolution

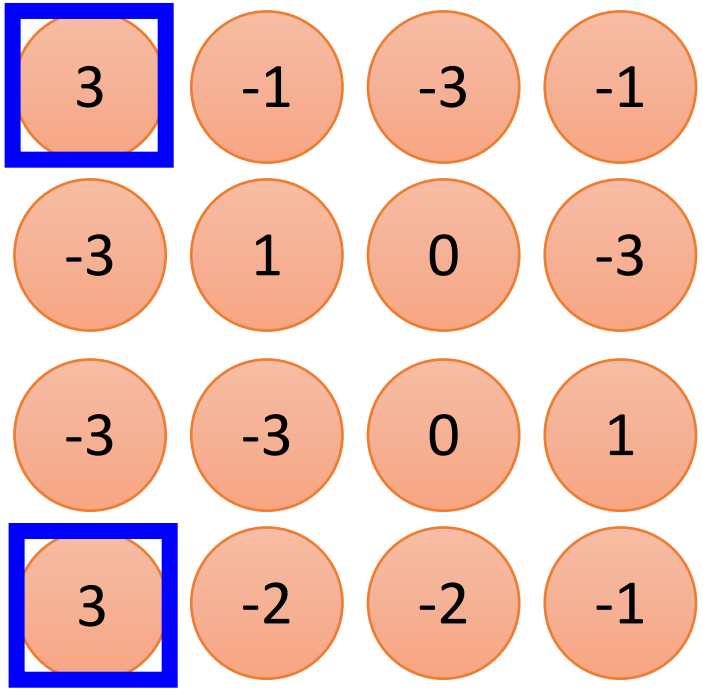


Filter 1

stride=1



6 x 6 image



Property 2

CNN – Convolution

-1	1	-1
-1	1	-1
-1	1	-1

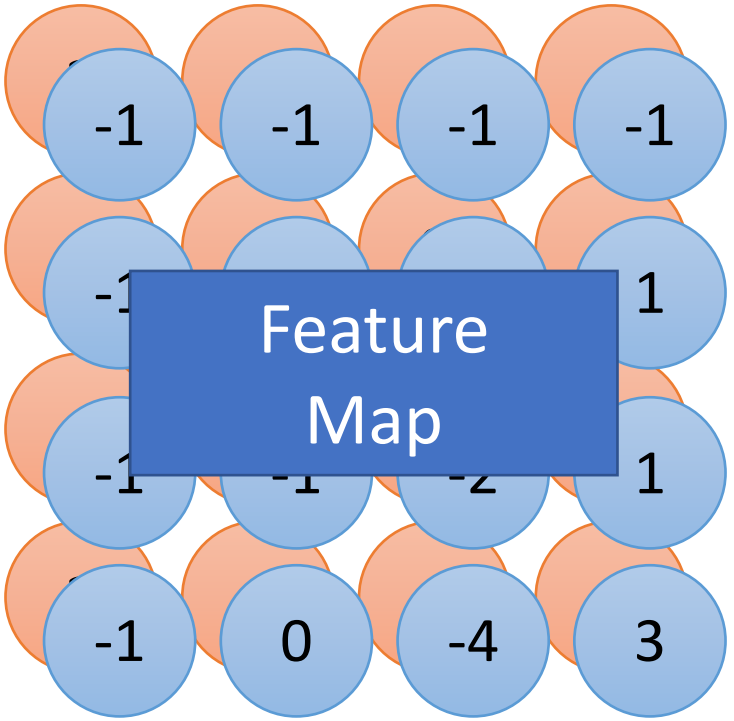
Filter 2

stride=1

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

6 x 6 image

Faire la même chose
avec chaque filtre

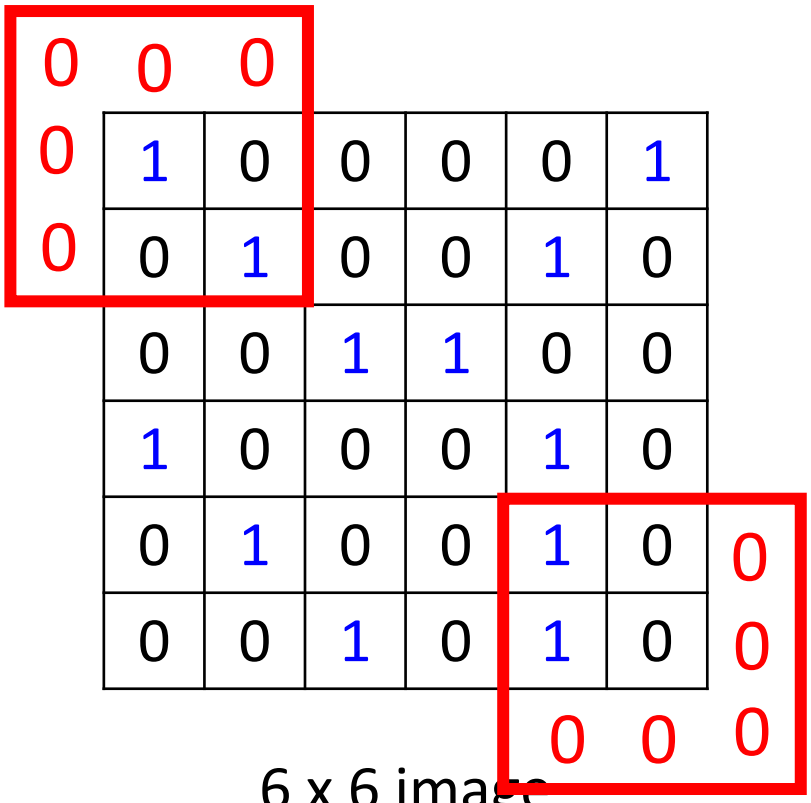


4 x 4 image

CNN – Zero Padding

1	-1	-1
-1	1	-1
-1	-1	1

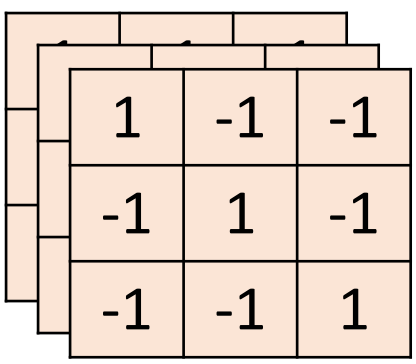
Filter 1



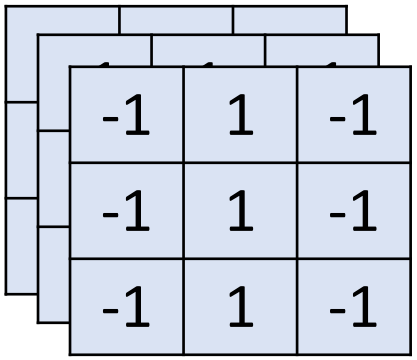
On obtient ainsi une autre image 6 x 6

Zero padding

CNN – image en couleurs

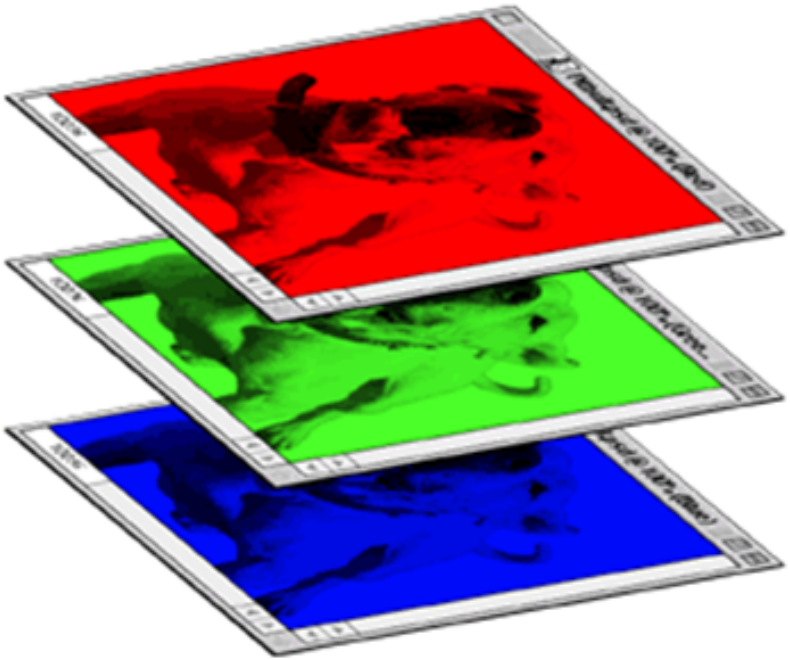


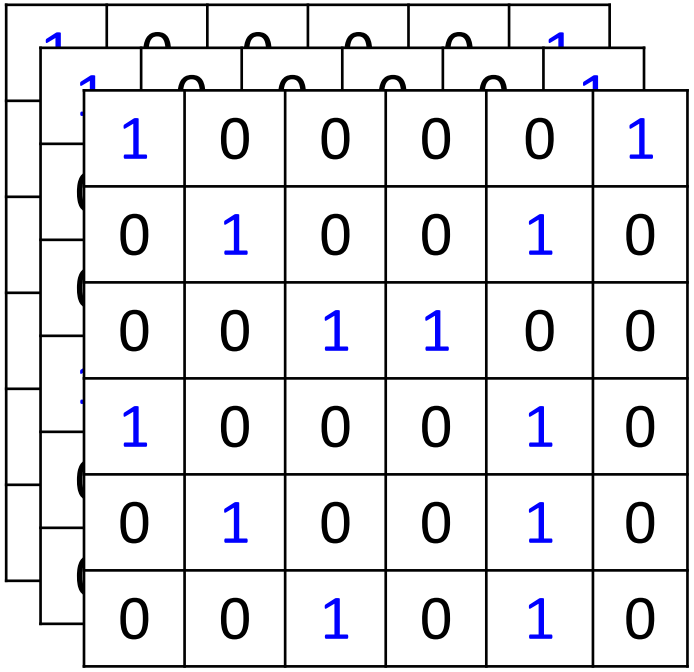
Filter 1



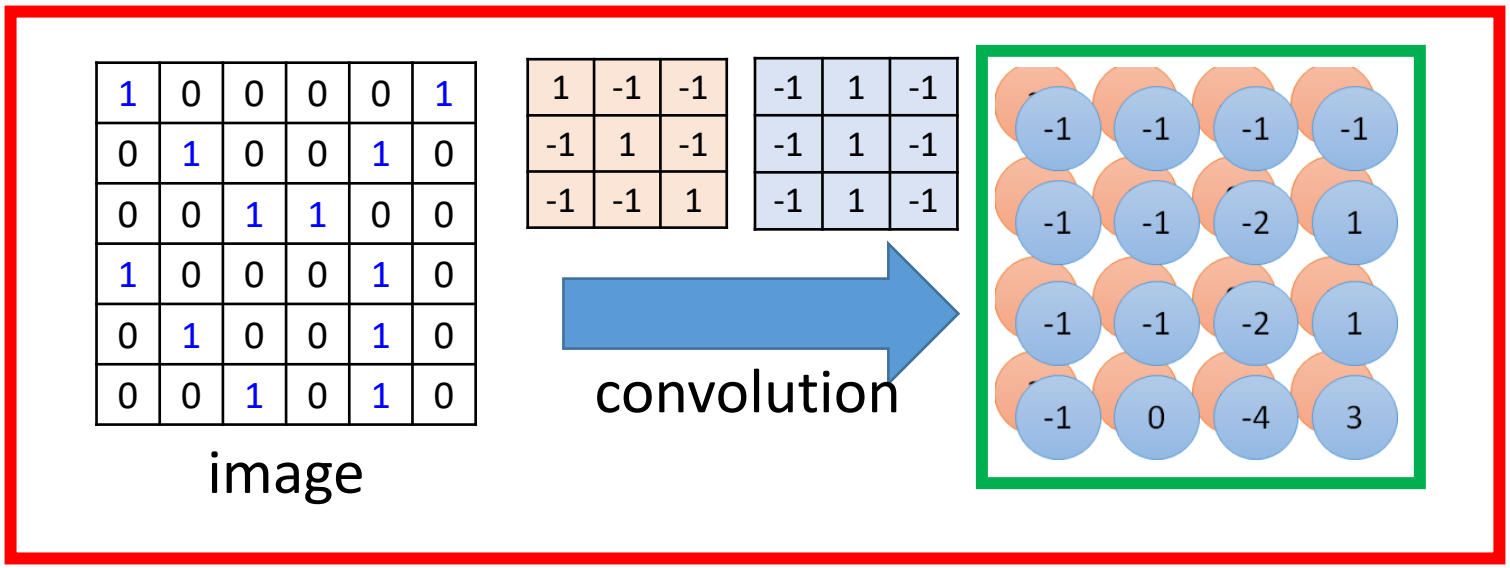
Filter 2

Colorful image



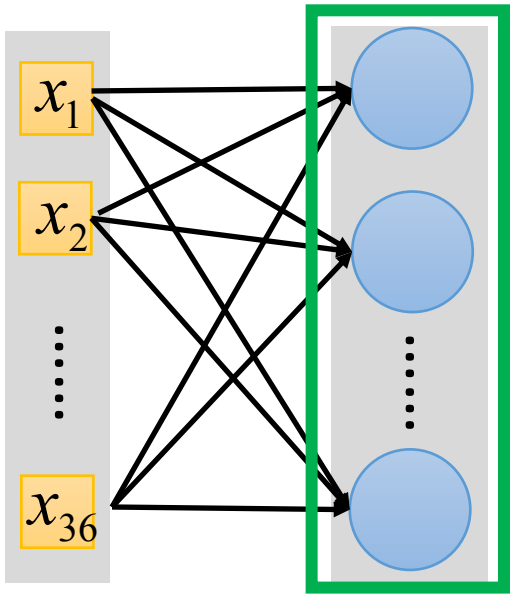


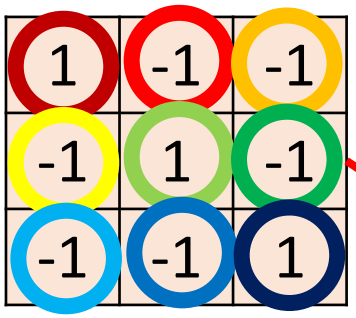
Convolution v.s. Fully Connected



Fully-connected

1	0	0	0	0	1
0	1	0	0	1	0
0	0	1	1	0	0
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0





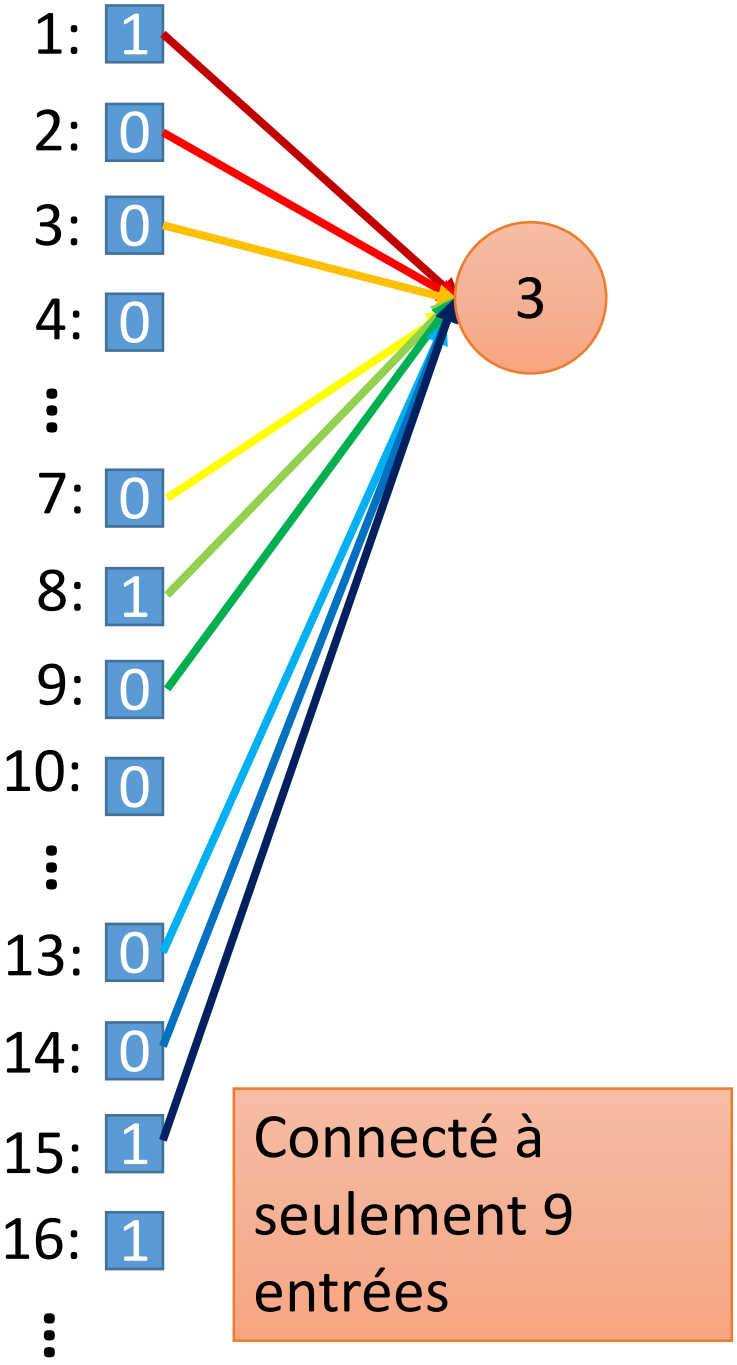
Filter 1

1	0	0	0	0	
0	1	0	0	1	
0	0	1	1	0	
1	0	0	0	1	0
0	1	0	0	1	0
0	0	1	0	1	0

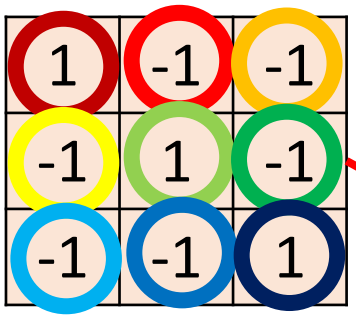
3	-1	-3	-1
-3	1	0	-3
-3	-3	0	1
3	-2	-2	-1

6 x 6 image

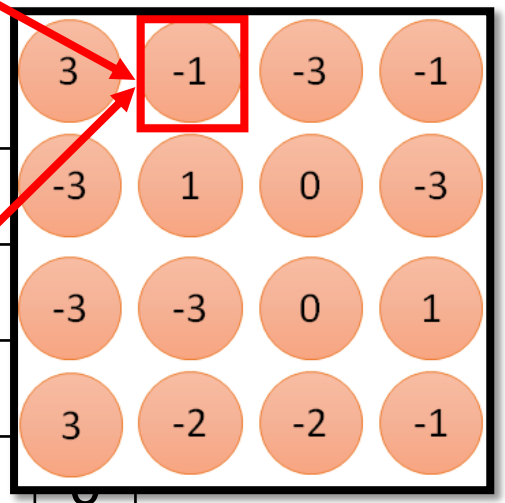
Moins de paramètres !



Connecté à seulement 9 entrées



Filter 1

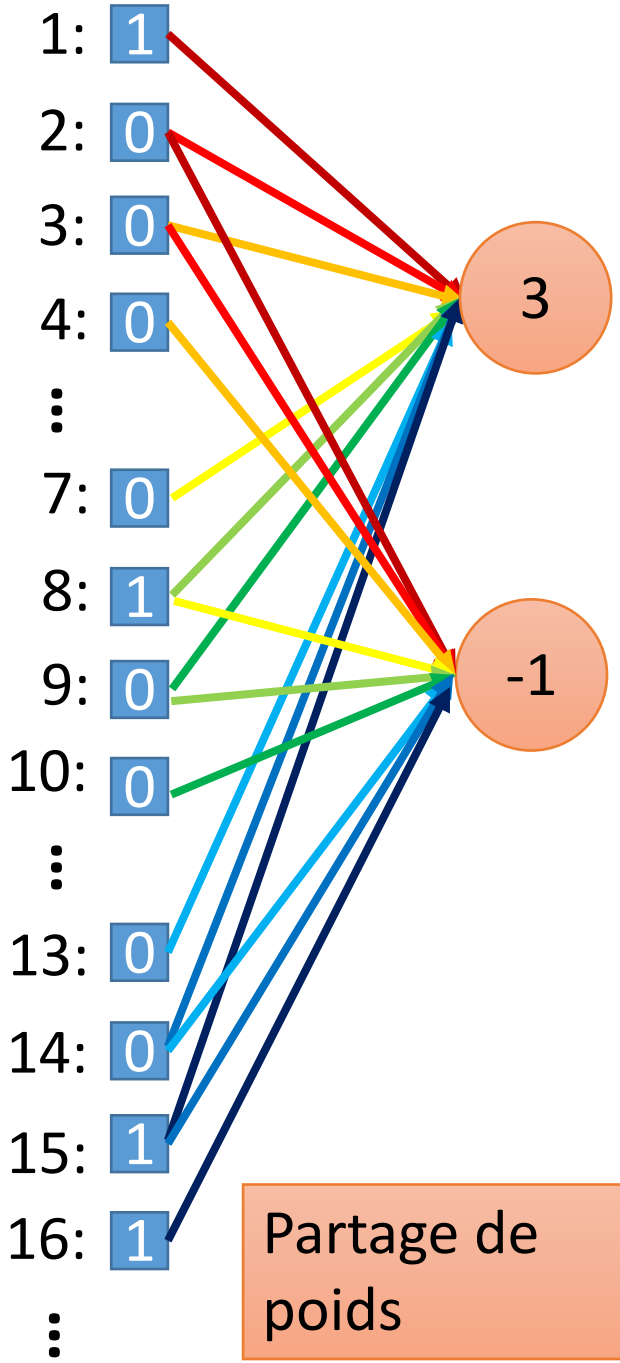


1	0	0	0	0	
0	1	0	0	1	
0	0	1	1	0	
1	0	0	0	1	
0	1	0	0	1	0
0	0	1	0	1	0

6 x 6 image

Moins de paramètres !

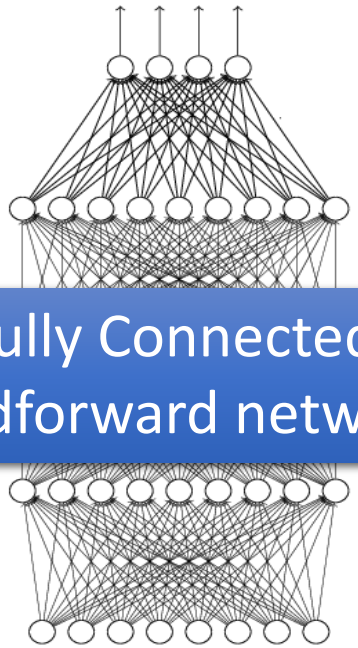
Encore moins de paramètres !



Partage de poids

Réseau CNN

chat chien ……



Fully Connected Feedforward network

Convolution

Max Pooling

Convolution

Max Pooling

Répéter plusieurs fois

Flatten

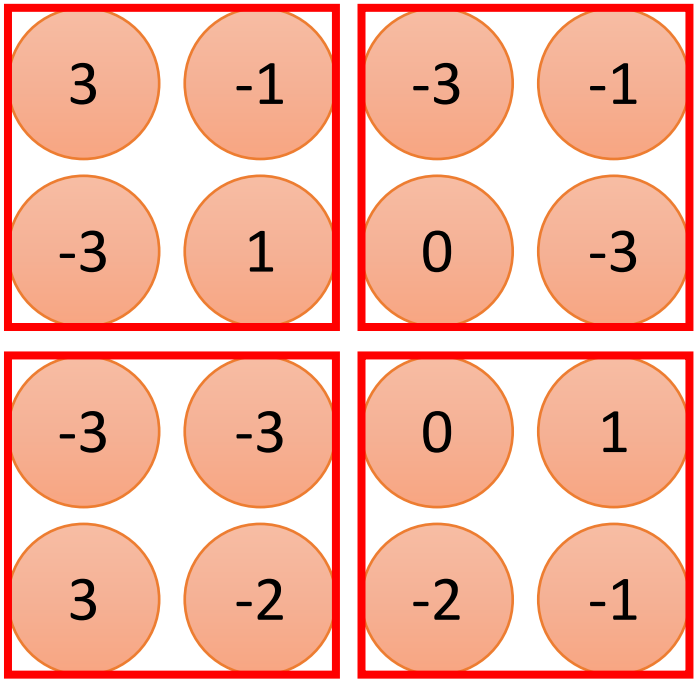
CNN – Max Pooling

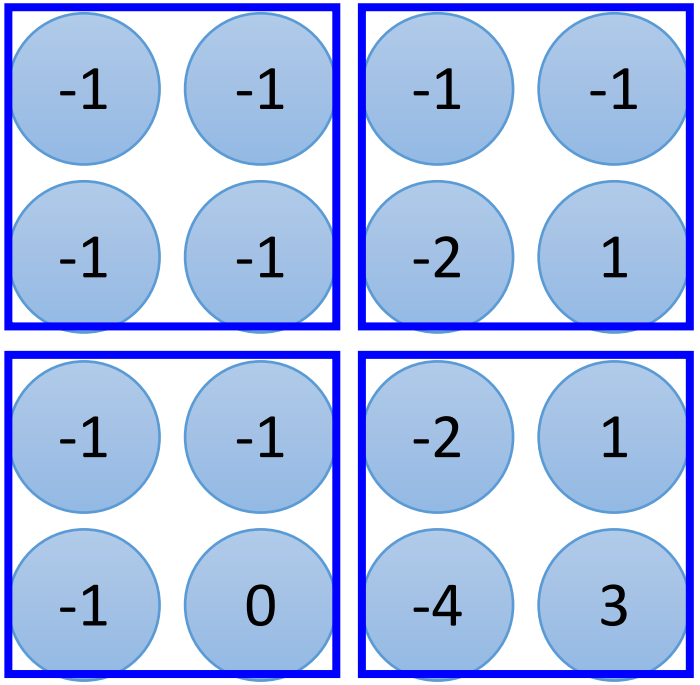
1	-1	-1
-1	1	-1
-1	-1	1

Filter 1

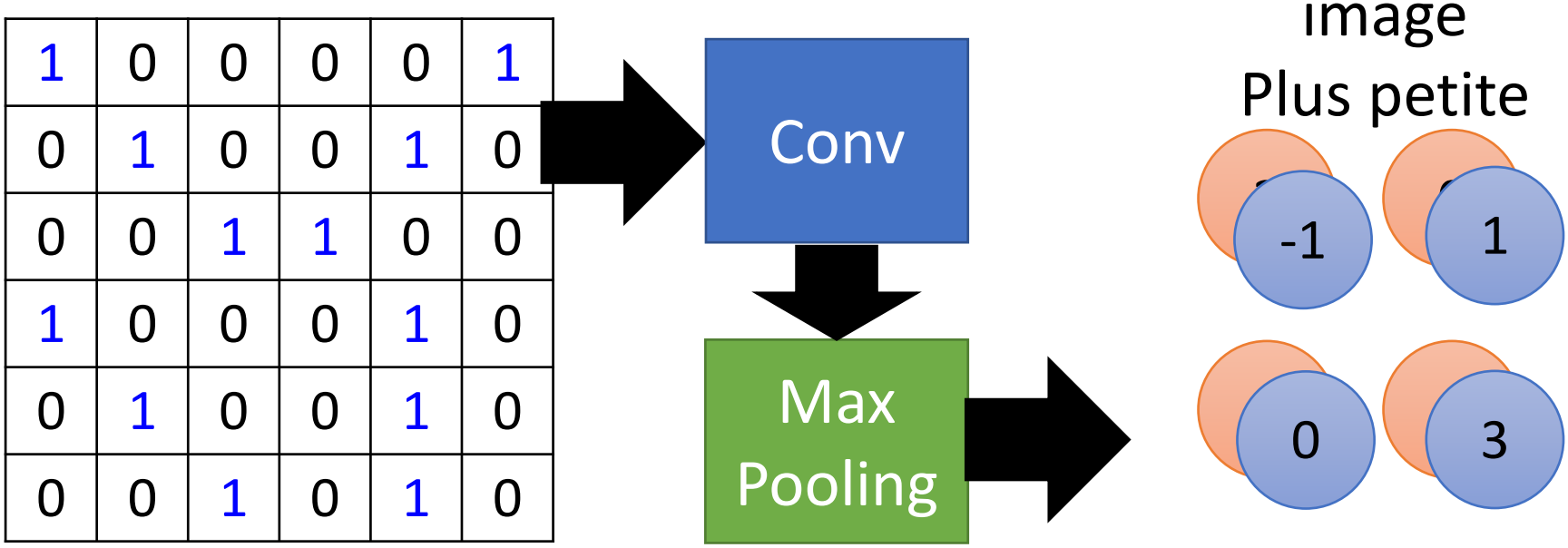
-1	1	-1
-1	1	-1
-1	1	-1

Filter 2

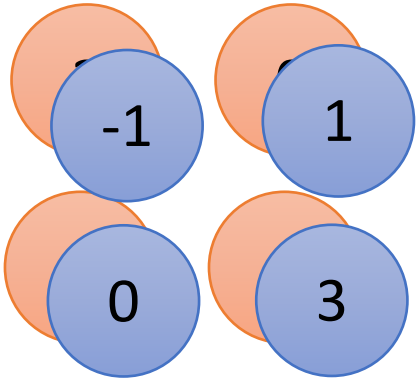




CNN – Max Pooling



Réseau CNN



Une nouvelle image

Convolution

Max Pooling

Convolution

Max Pooling

Répéter plusieurs fois

Plus petite que l'image d'origine

Le nombre de canaux est le nombre de filtres

Réseau CNN

chat chien ……

Convolution

Max Pooling

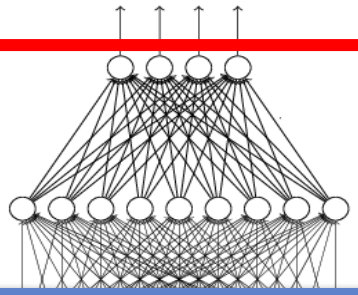
Une nouvelle image

Convolution

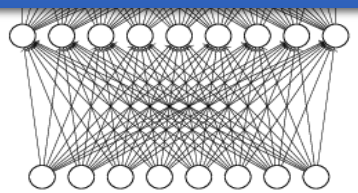
Max Pooling

Une nouvelle image

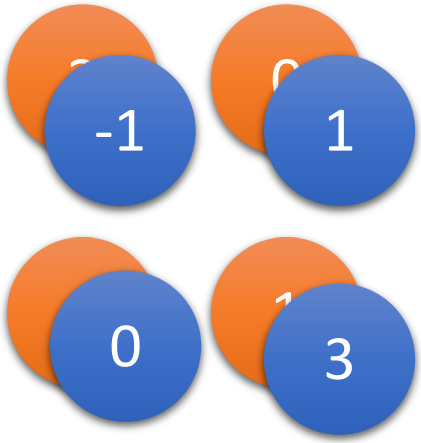
Flatten



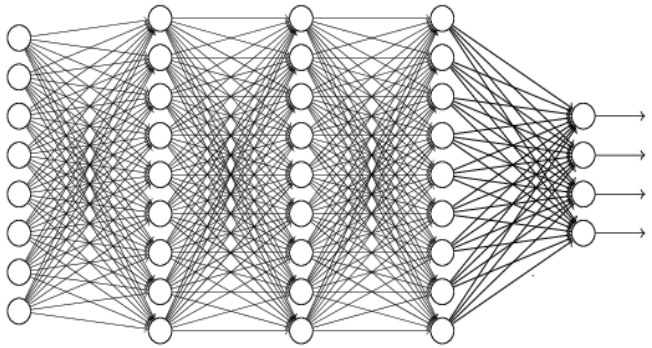
Fully Connected Feedforward network



Flatten

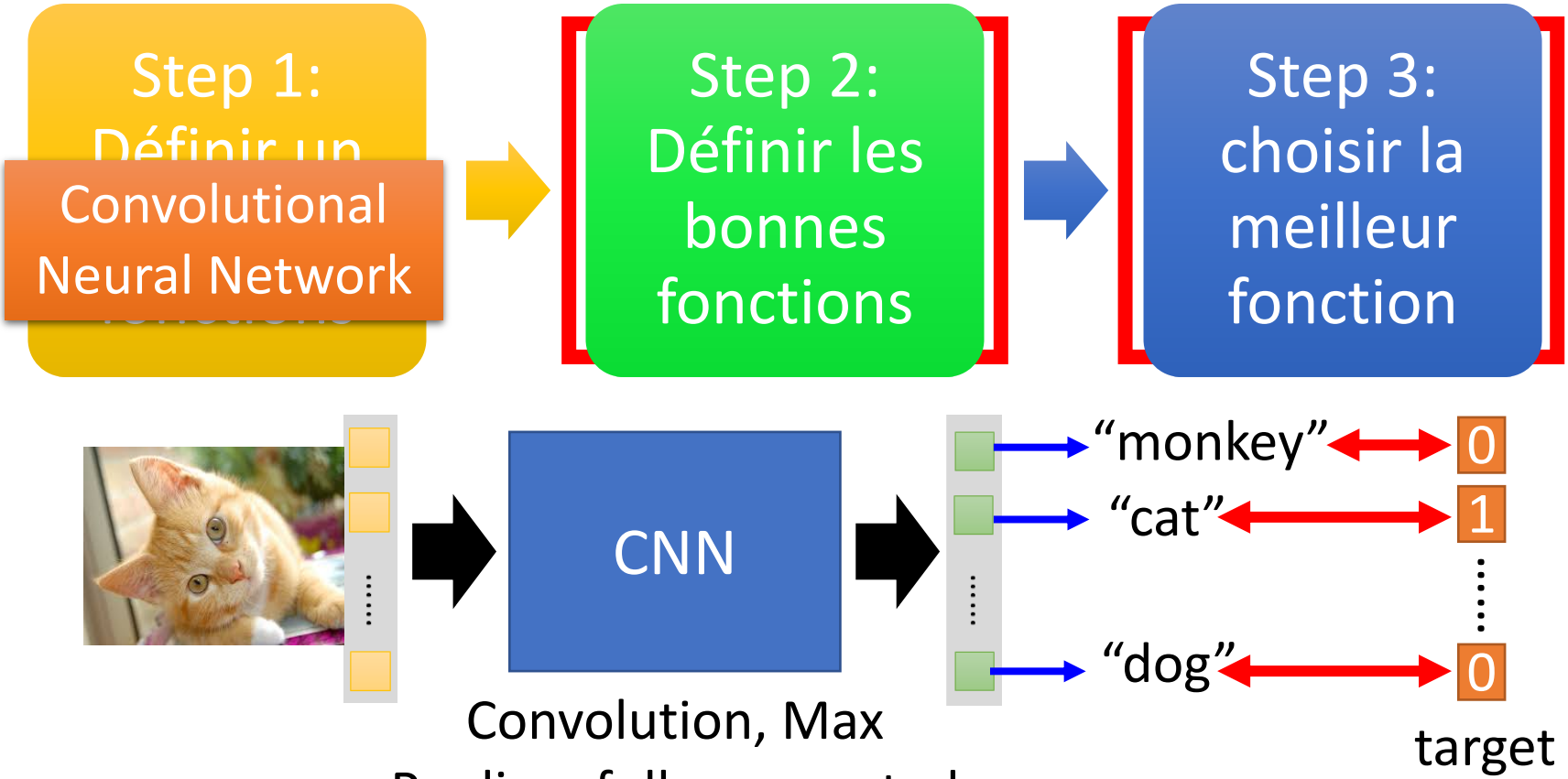


Flatten



Fully Connected Feedforward network

Convolutional Neural Network



Apprentissage: Rien de nouveau, juste la descente du gradient (et ses variantes) ……