

Intelligence Artificielle (IA)

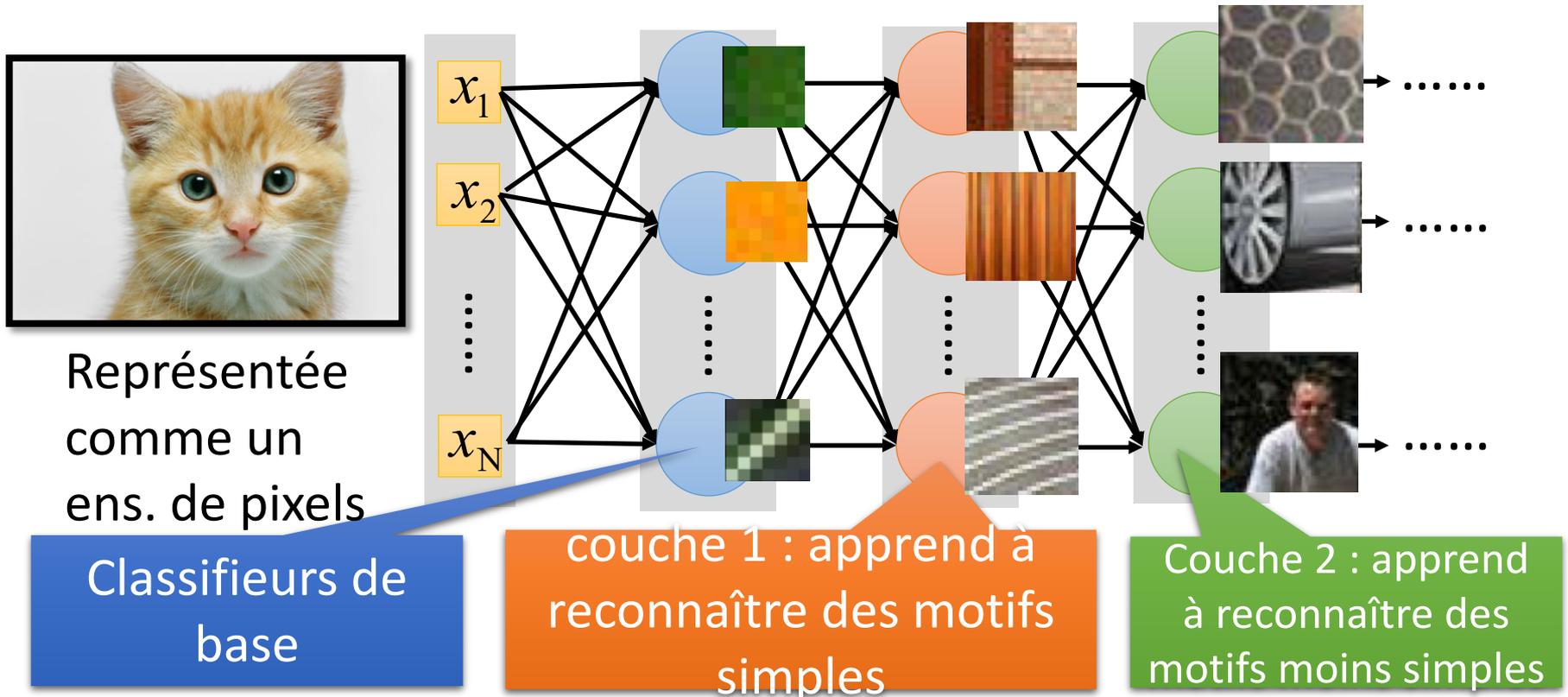
Deep Learning CNN

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CNN pour les images : Idées de base ?

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



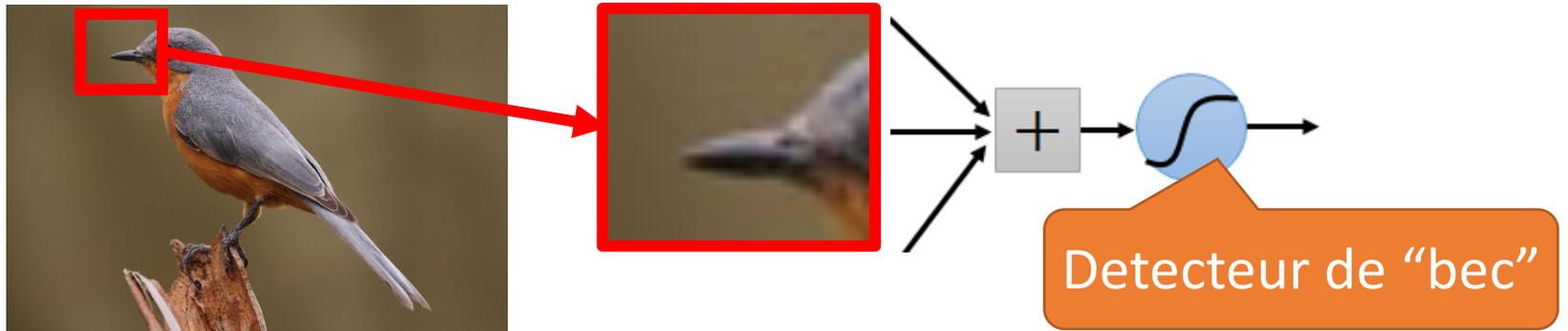
Peut-on exploiter les propriétés des images pour simplifier le réseau ?

CNN pour les images : Idées de base ?

- Des motifs sont plus petits que l'image entières

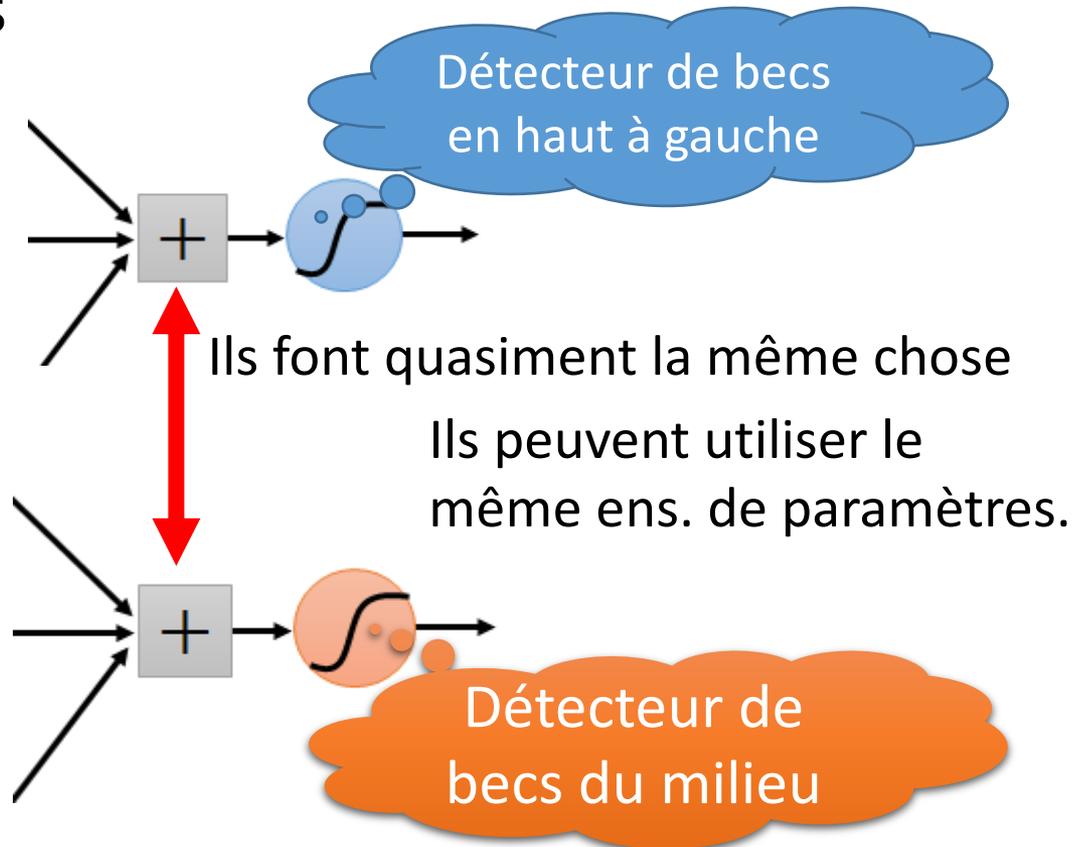
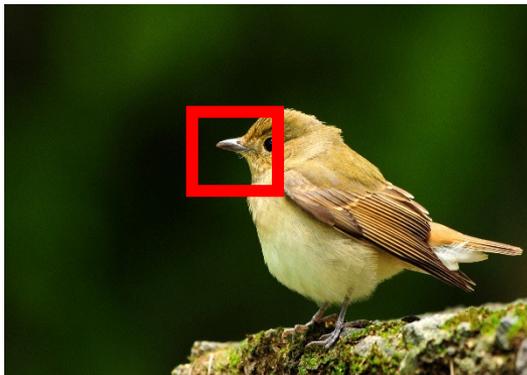
Un neurone n'a pas à voir toute l'image pour découvrir ces motifs.

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

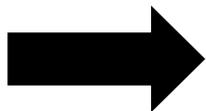


subsampling

Un oiseau



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

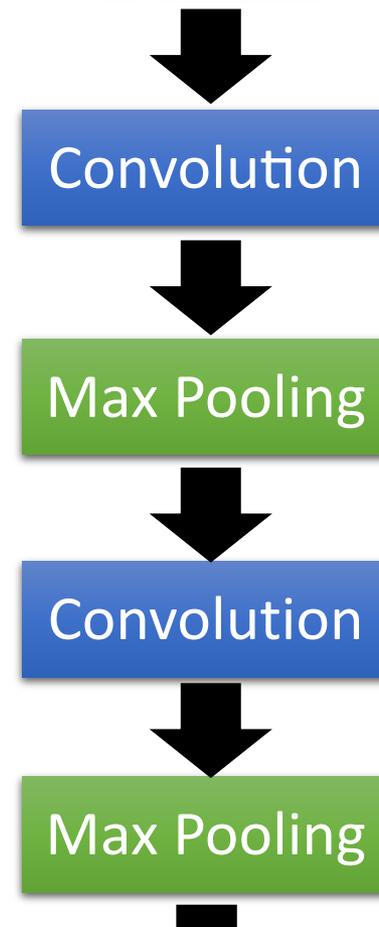
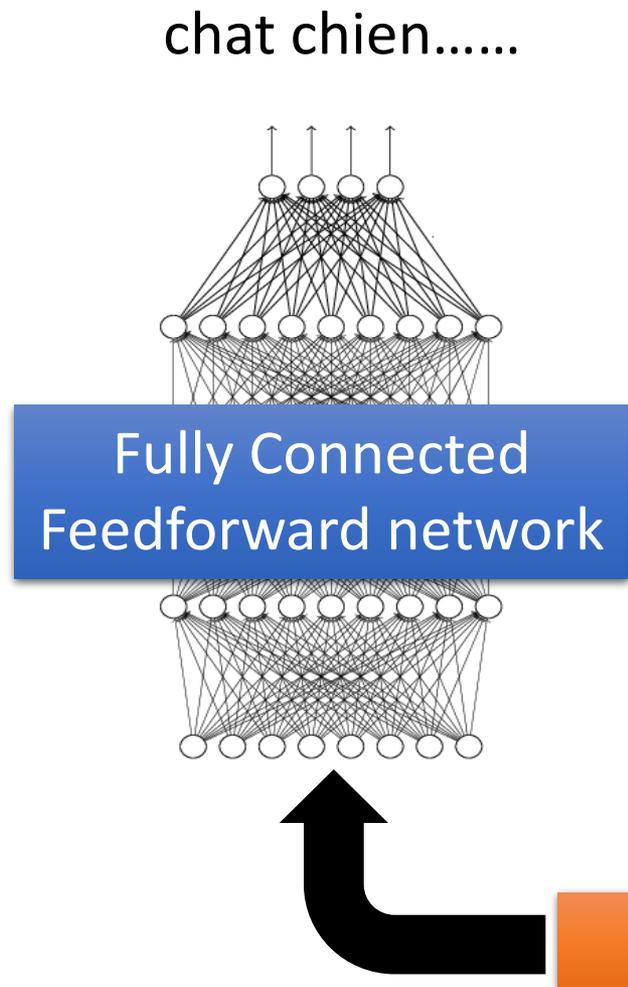


Moins de paramètres à apprendre

Retour au deep ...



Réseau CNN



Répéter plusieurs fois



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

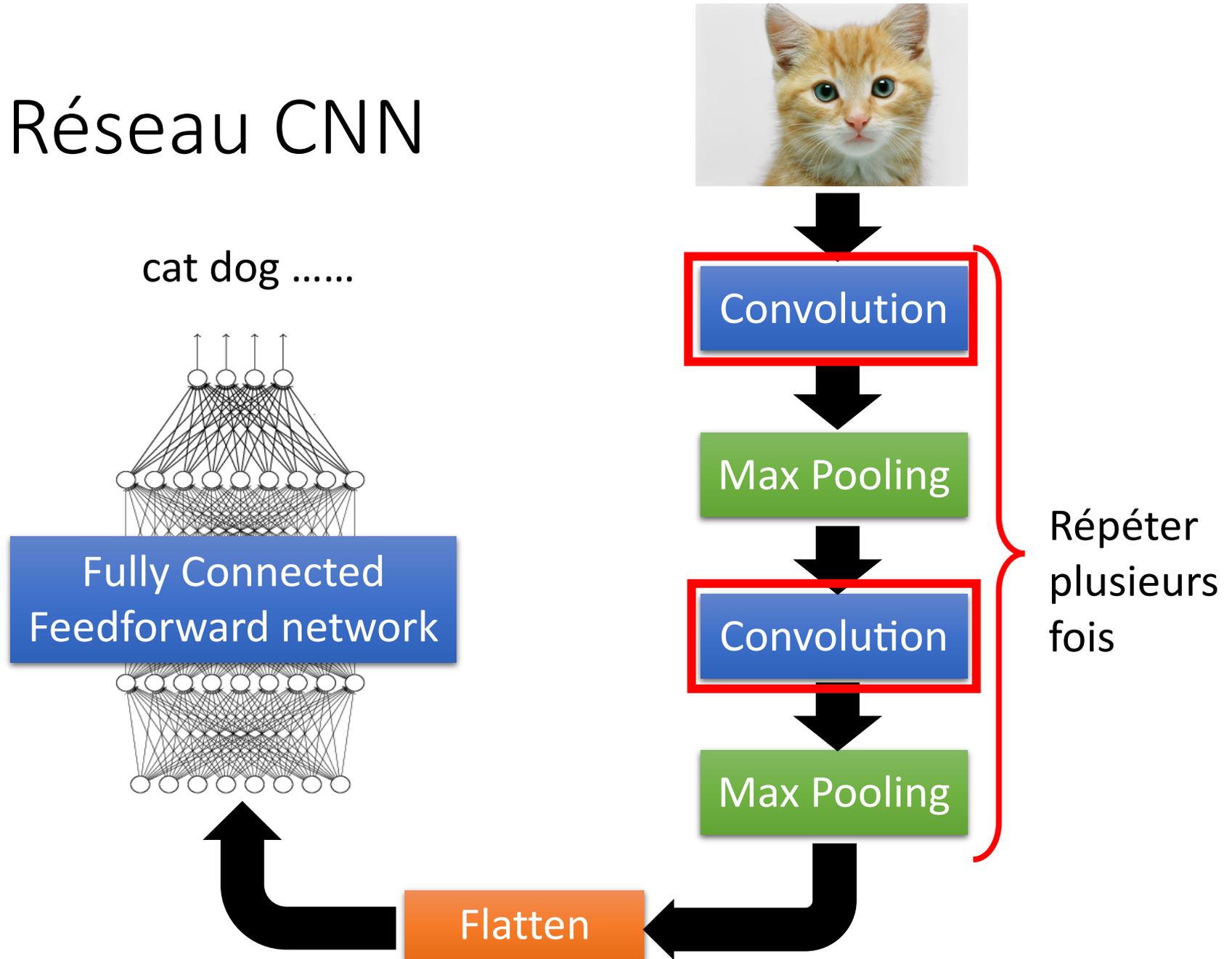
Max Pooling

Flatten

Répéter plusieurs fois



Réseau CNN



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

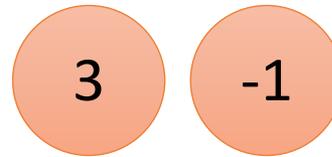
1	-1	-1
-1	1	-1
-1	-1	1

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

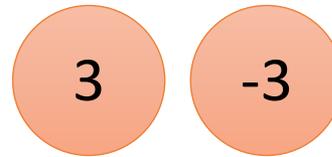
1	-1	-1
-1	1	-1
-1	-1	1

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



On choisit stride=1

CNN – Convolution

stride=1

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

Filter 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

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

Property 2

CNN – Convolution

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

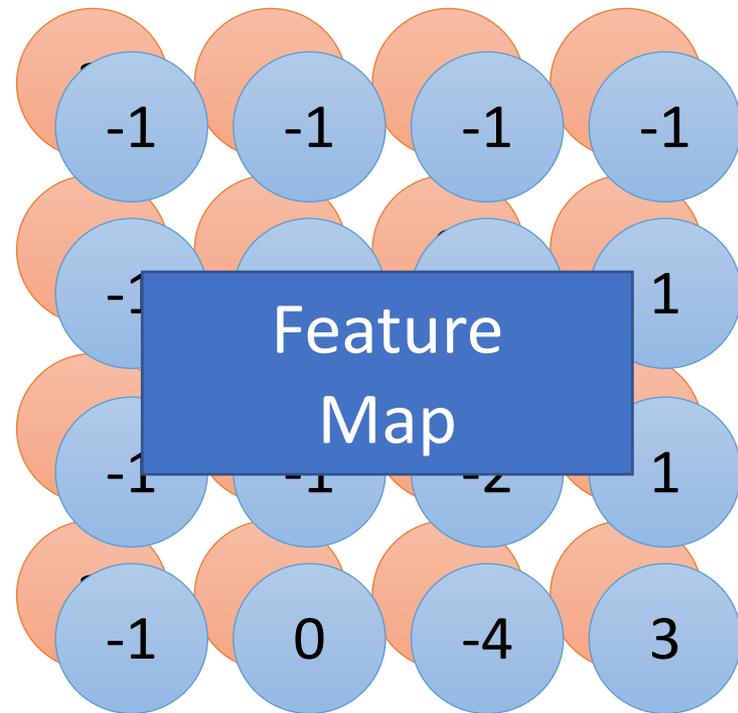
Filter 2

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

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

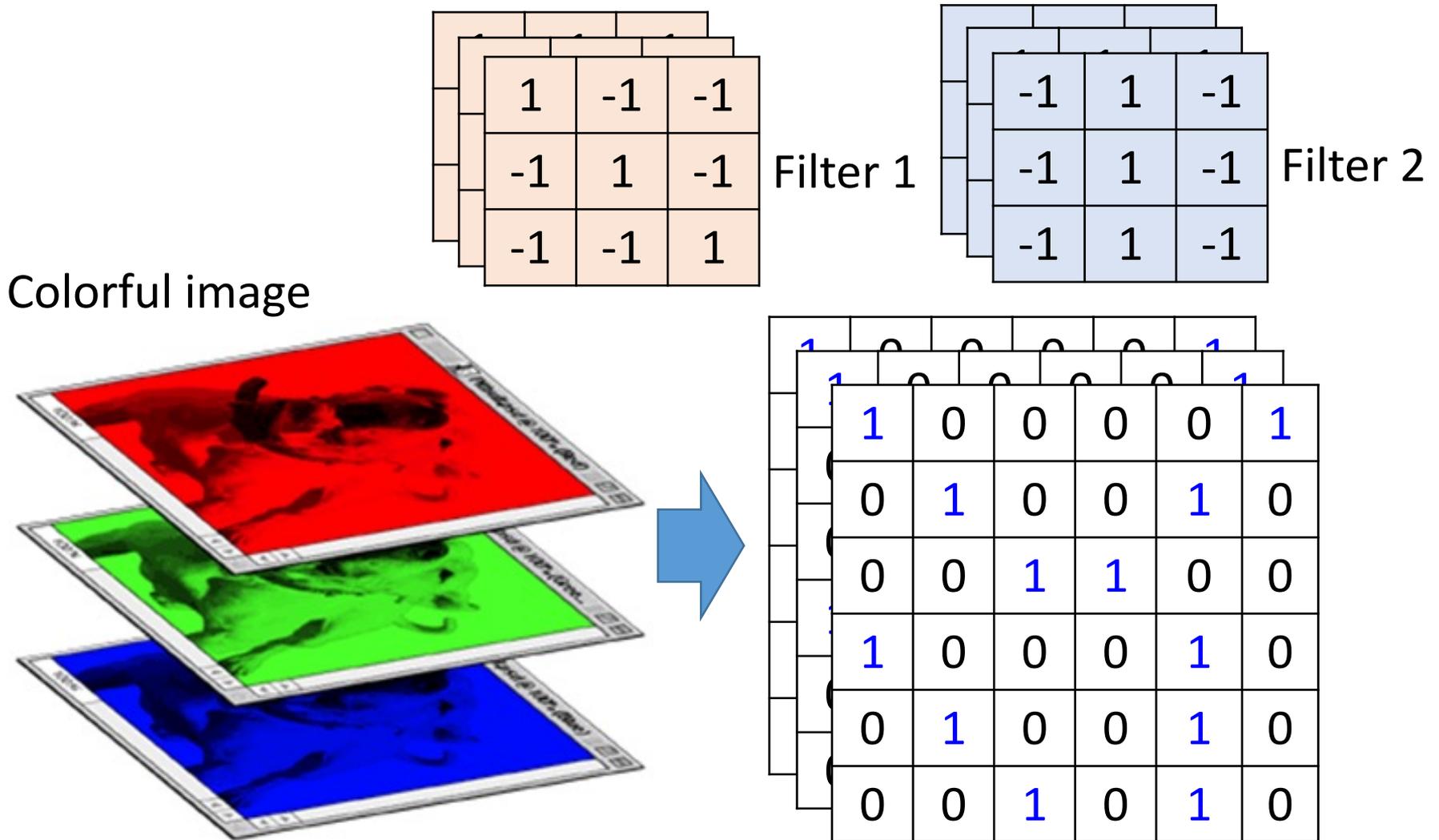
6 x 6 image

On obtient ainsi une autre image 6 x 6

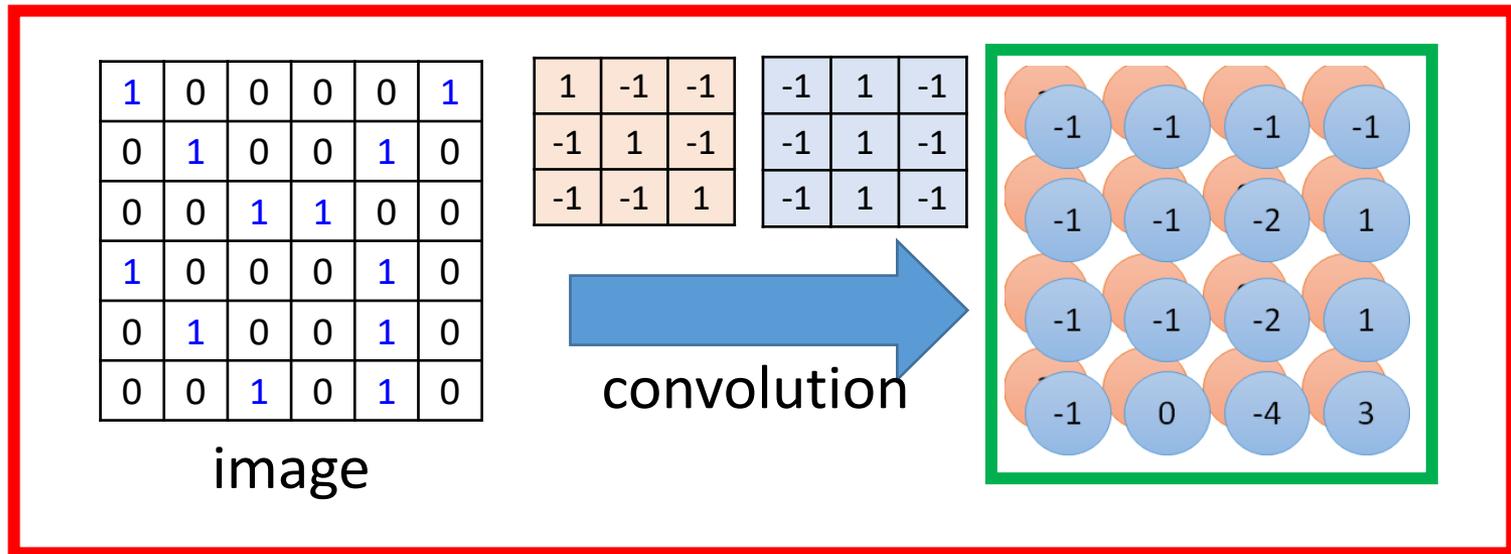


Zero padding

CNN – image en couleurs

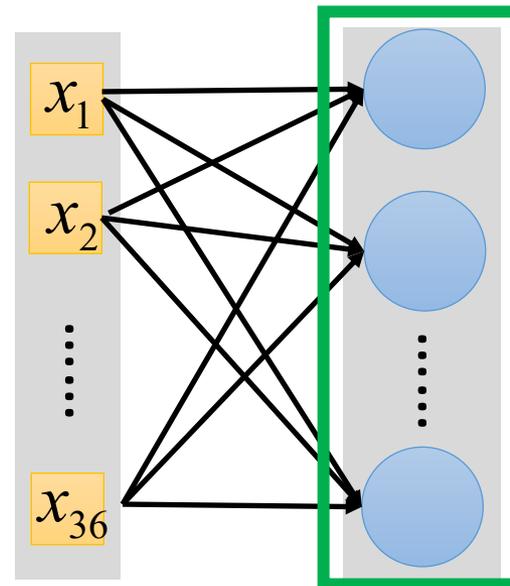


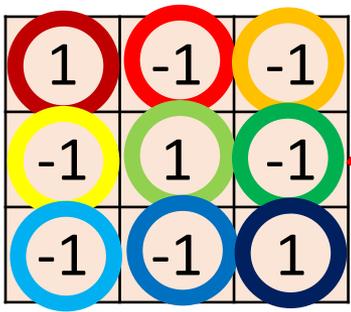
Convolution v.s. Fully Connected



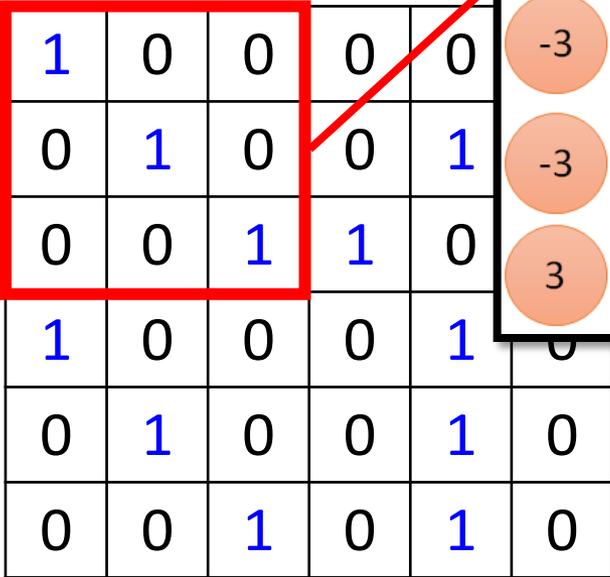
Fully-
connected

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

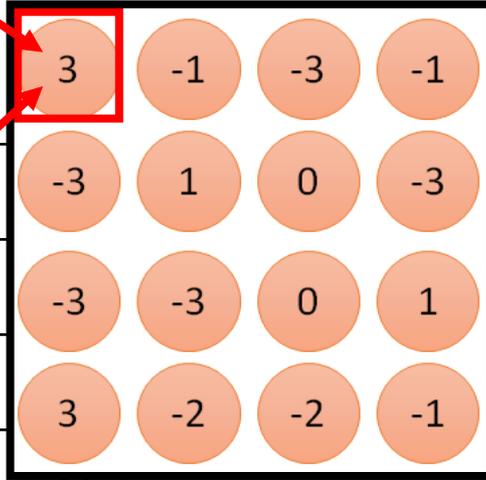




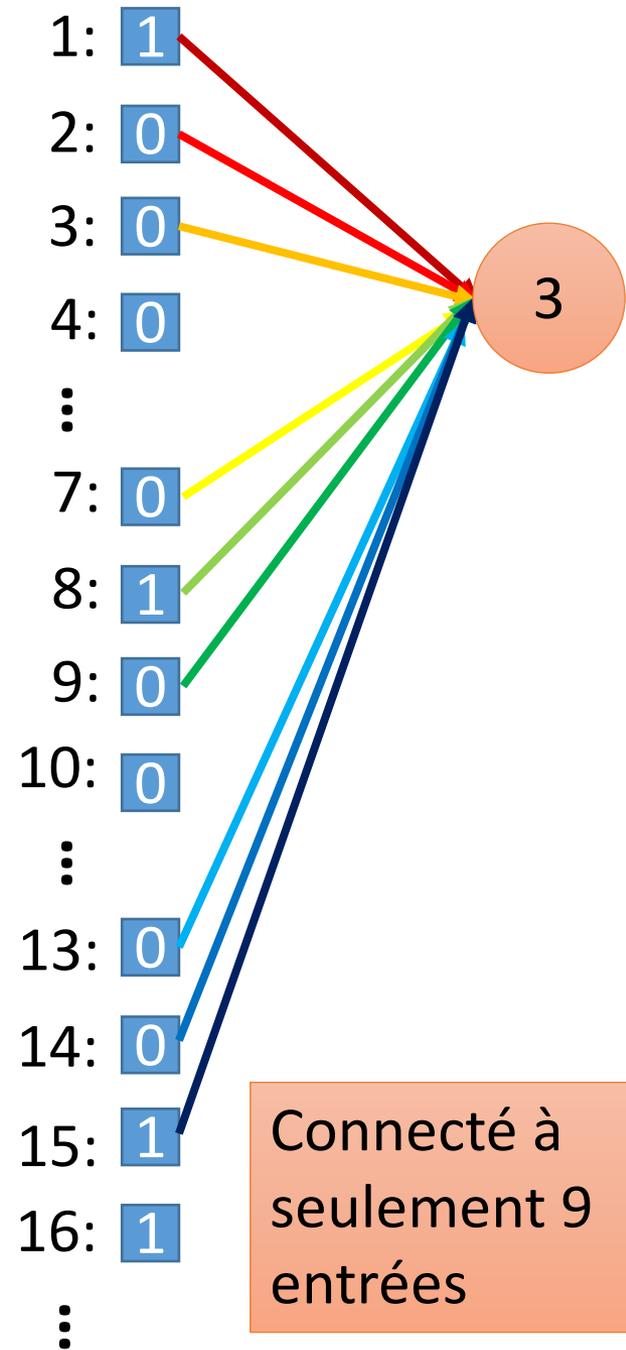
Filter 1



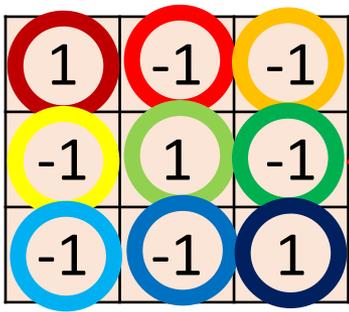
6 x 6 image



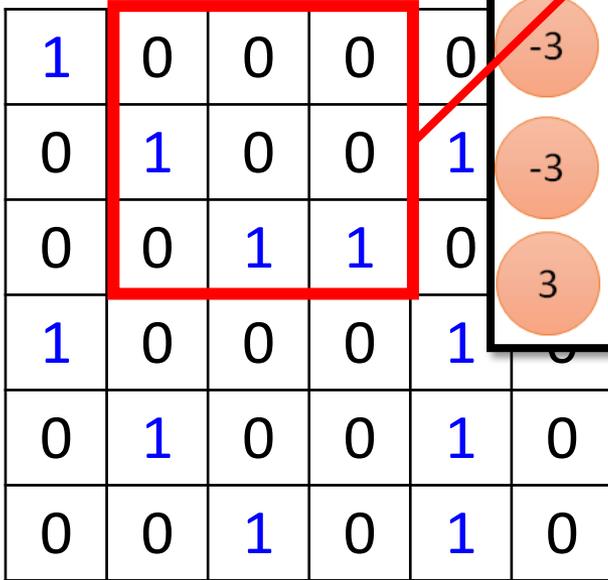
Moins de paramètres !



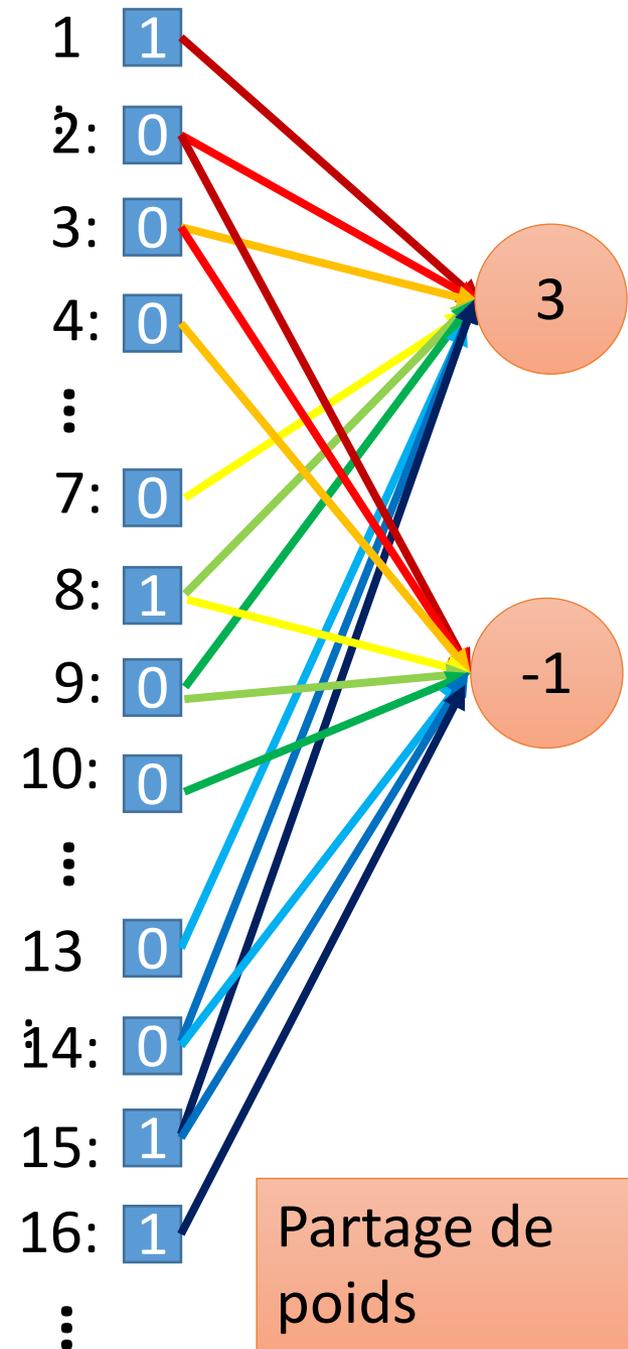
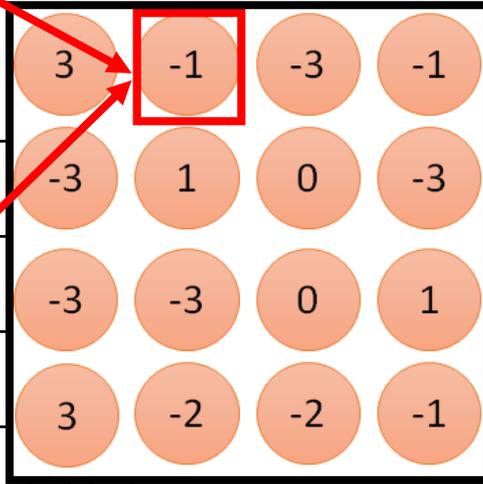
Connecté à seulement 9 entrées



Filter 1



6 x 6 image



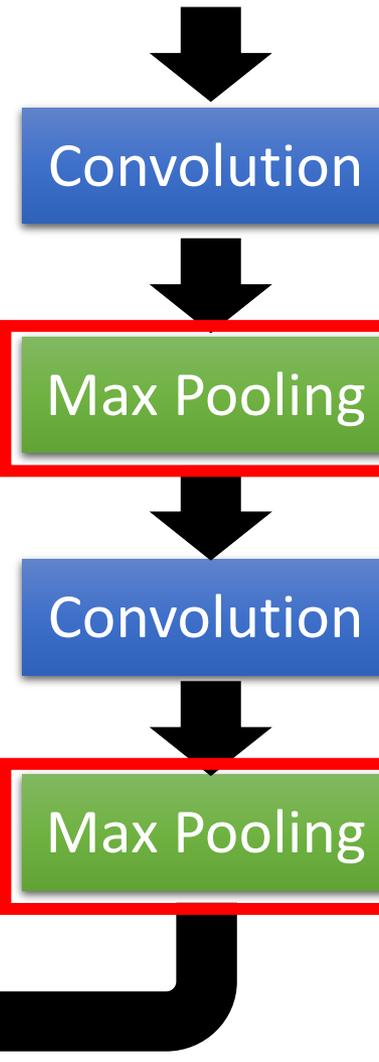
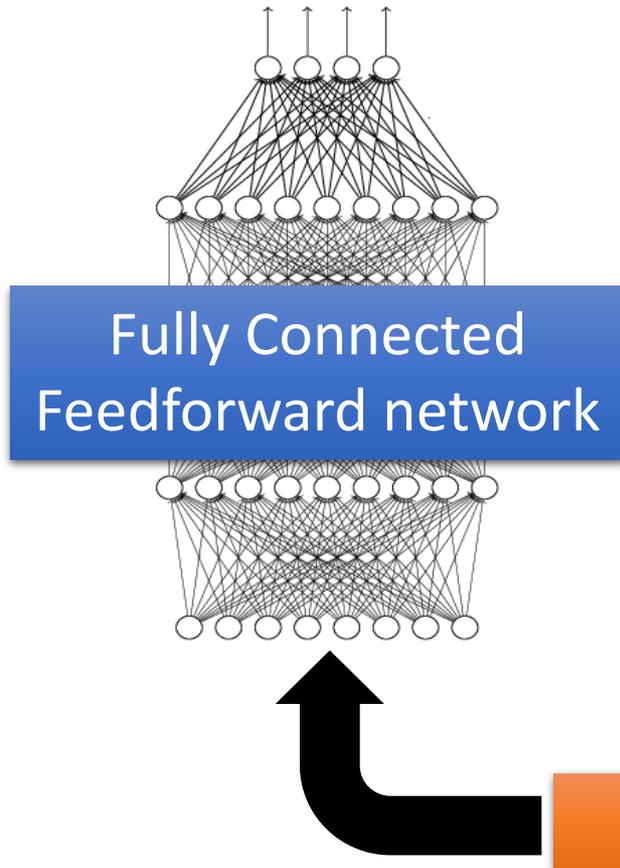
Partage de poids

Moins de paramètres !

Encore moins de paramètres !

Réseau CNN

chat chien



Répéter plusieurs fois

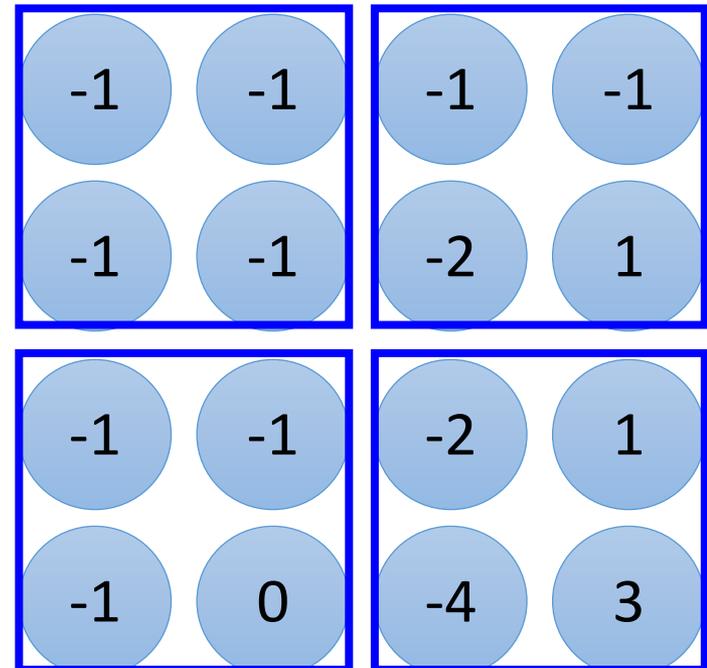
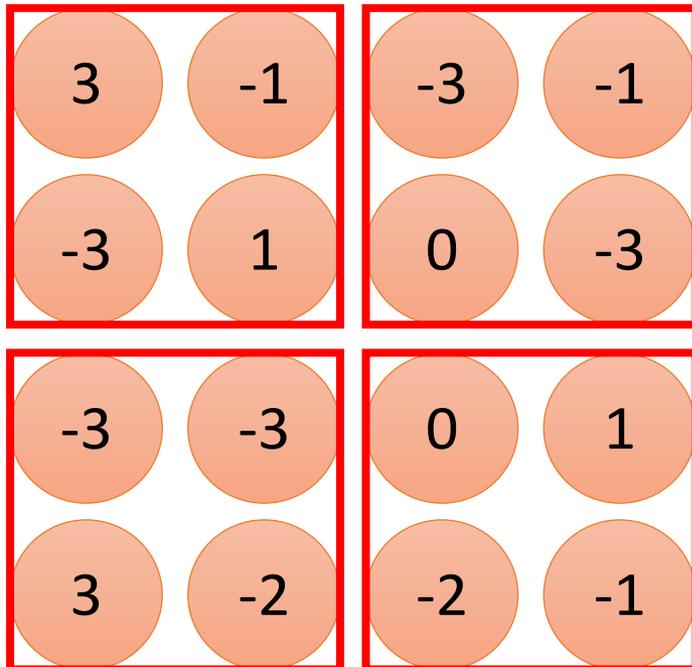
CNN – Max Pooling

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

Filter 1

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

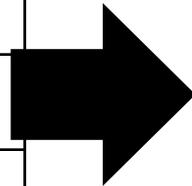
Filter 2



CNN – Max Pooling

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

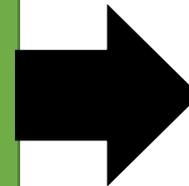
6 x 6 image



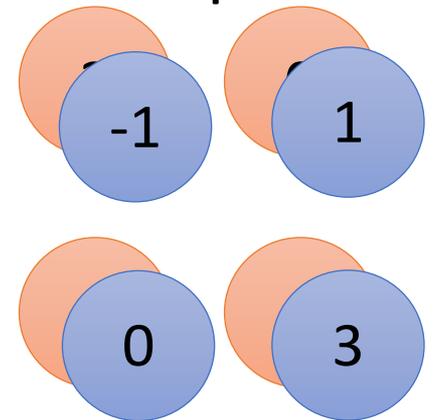
Conv



Max
Pooling



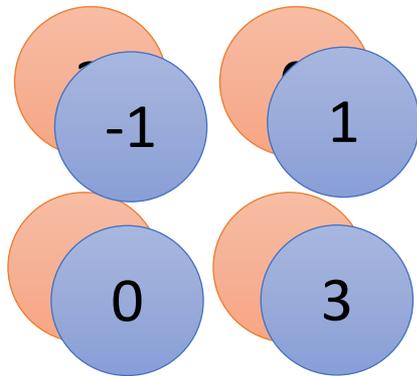
Nouvelle
image
Plus petite



2 x 2 image

Chaque filtre
est un canal

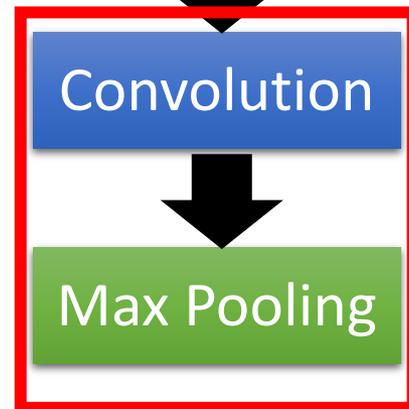
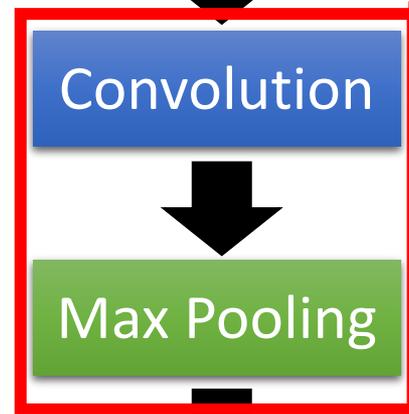
Réseau CNN



Une nouvelle image

Plus petite que l'image d'origine

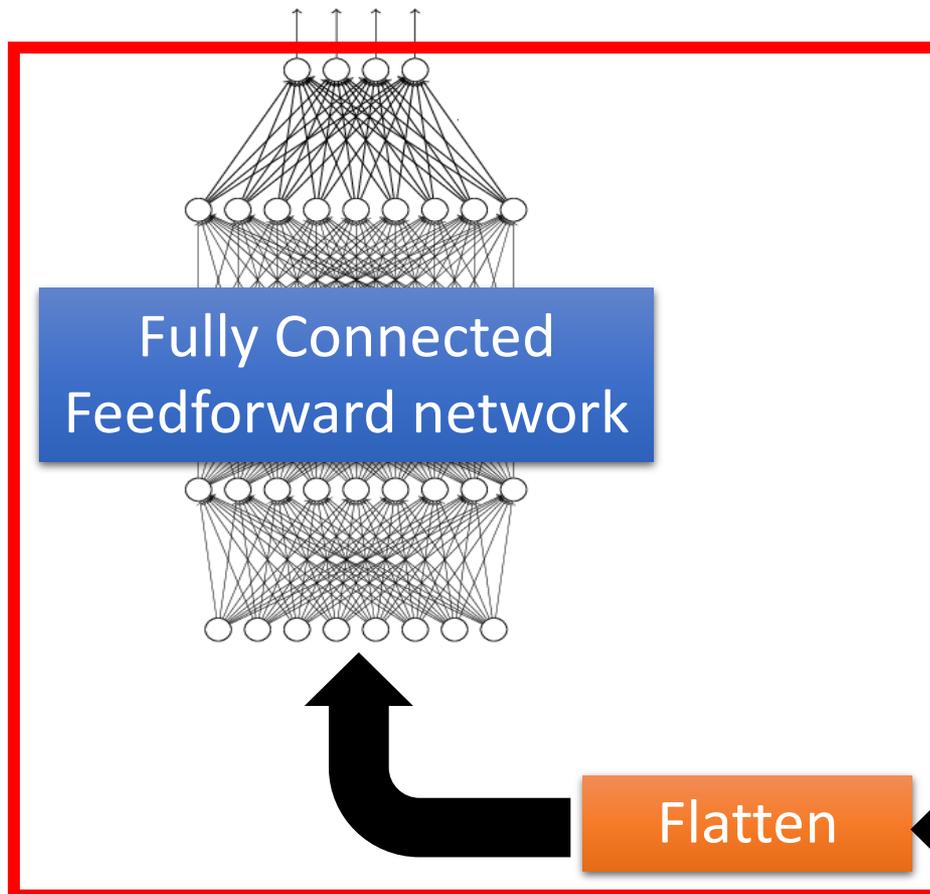
Le nombre de canaux est le nombre de filtres



Répéter plusieurs fois

Réseau CNN

chat chien



Convolution

Max Pooling

Une nouvelle image

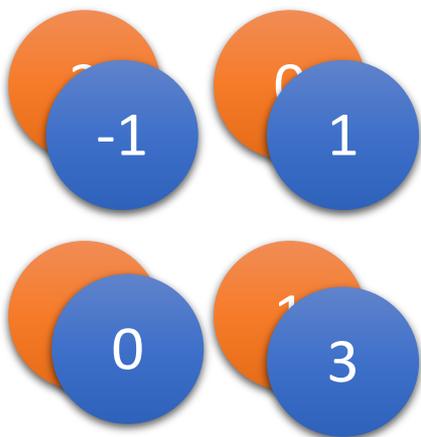
Convolution

Max Pooling

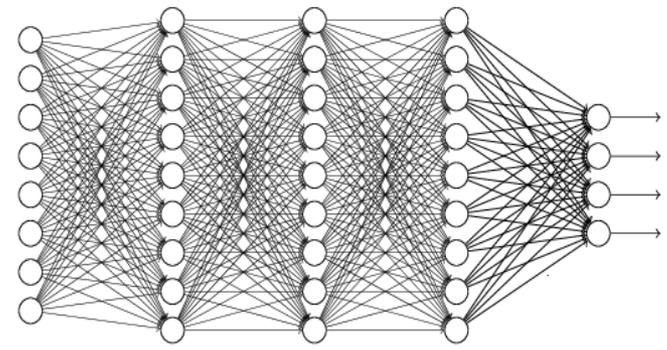
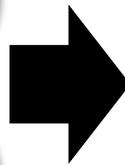
Une nouvelle image

Flatten

Flatten

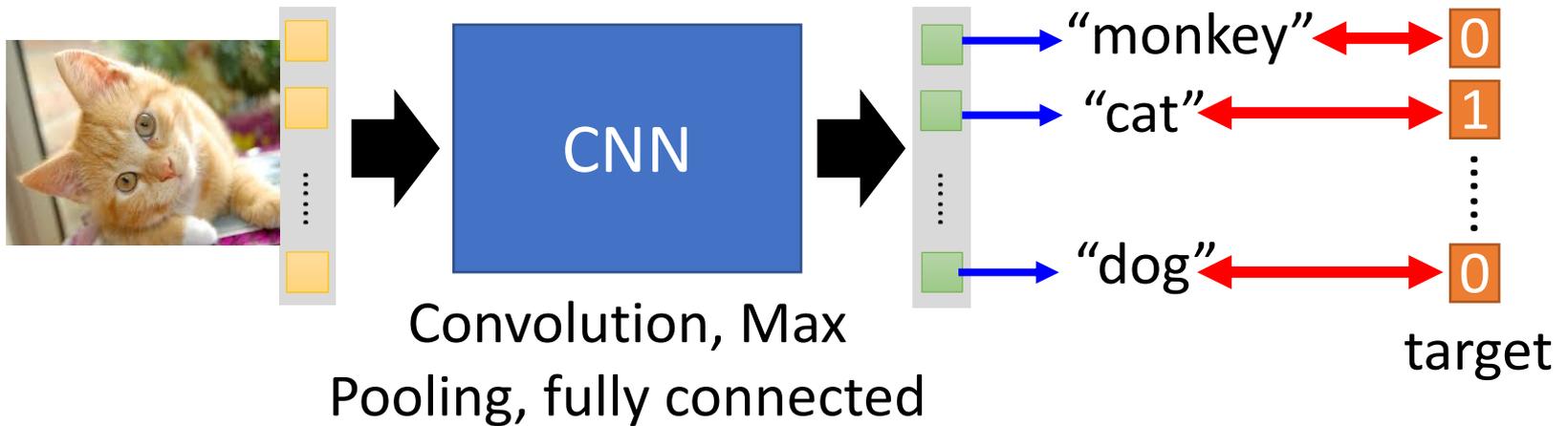


Flatten



Fully Connected Feedforward network

Convolutional Neural Network



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