Cours Deep Learning

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Chapitre 2 : Convolutional Neural Network (CNN)

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Application :

- ➢Application Vision
- ➢Image processing

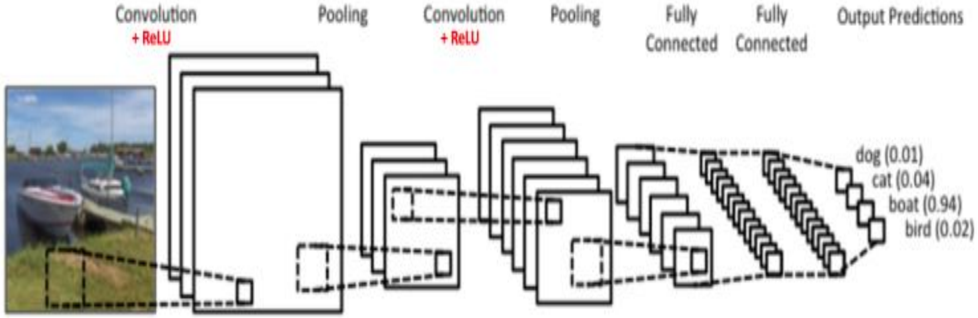
Les étapes :

1) Convolutional Layers

2) Pooling layers

3)Flatten

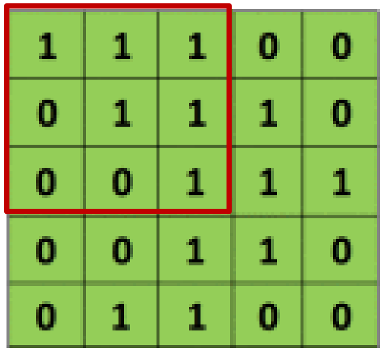
4) Fully connected layers



Chapitre 2 : Convolutional Neural Network (CNN)

Convolutional Layers

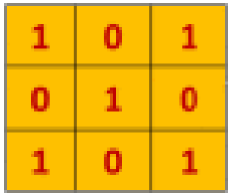
Extraction des caractéristiques de l’image d’entrée



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

Input Image

*



1	0	1
0	1	0
1	0	1

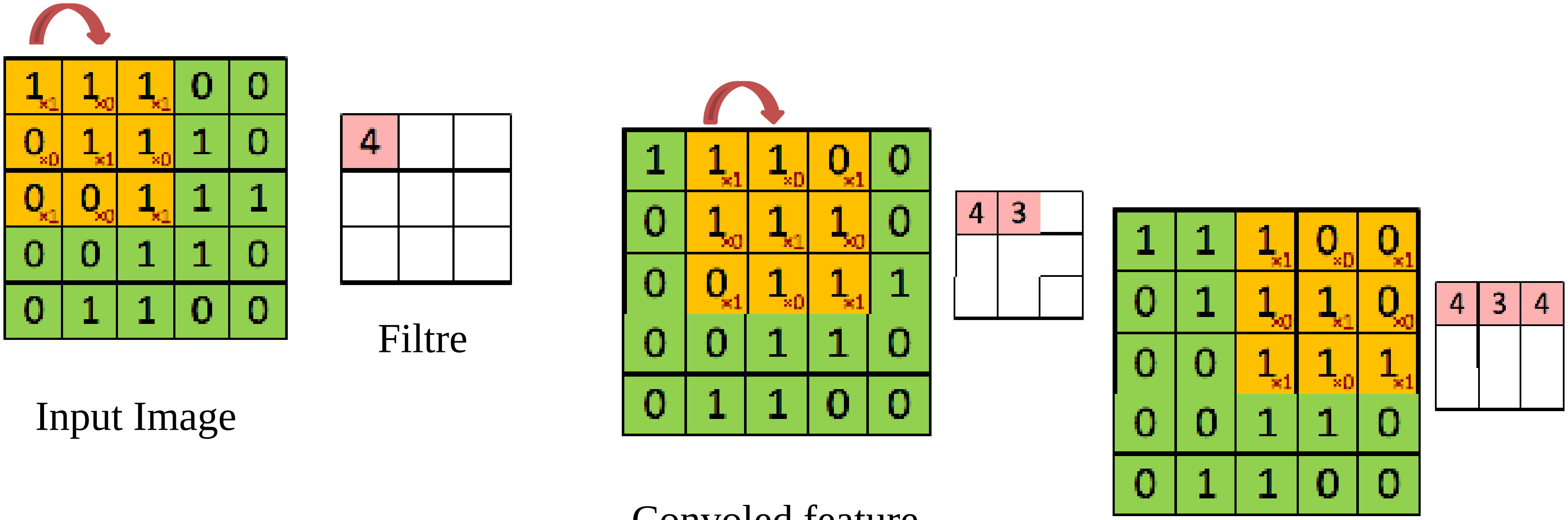
Filtre/ Kernel/
Feature detector
(3*3)
1*1+1*0+
1*1+0*0+1*1+1*0+0*1+0*0+1
*1

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

Input Image

1	0	1
0	1	0
1	0	1

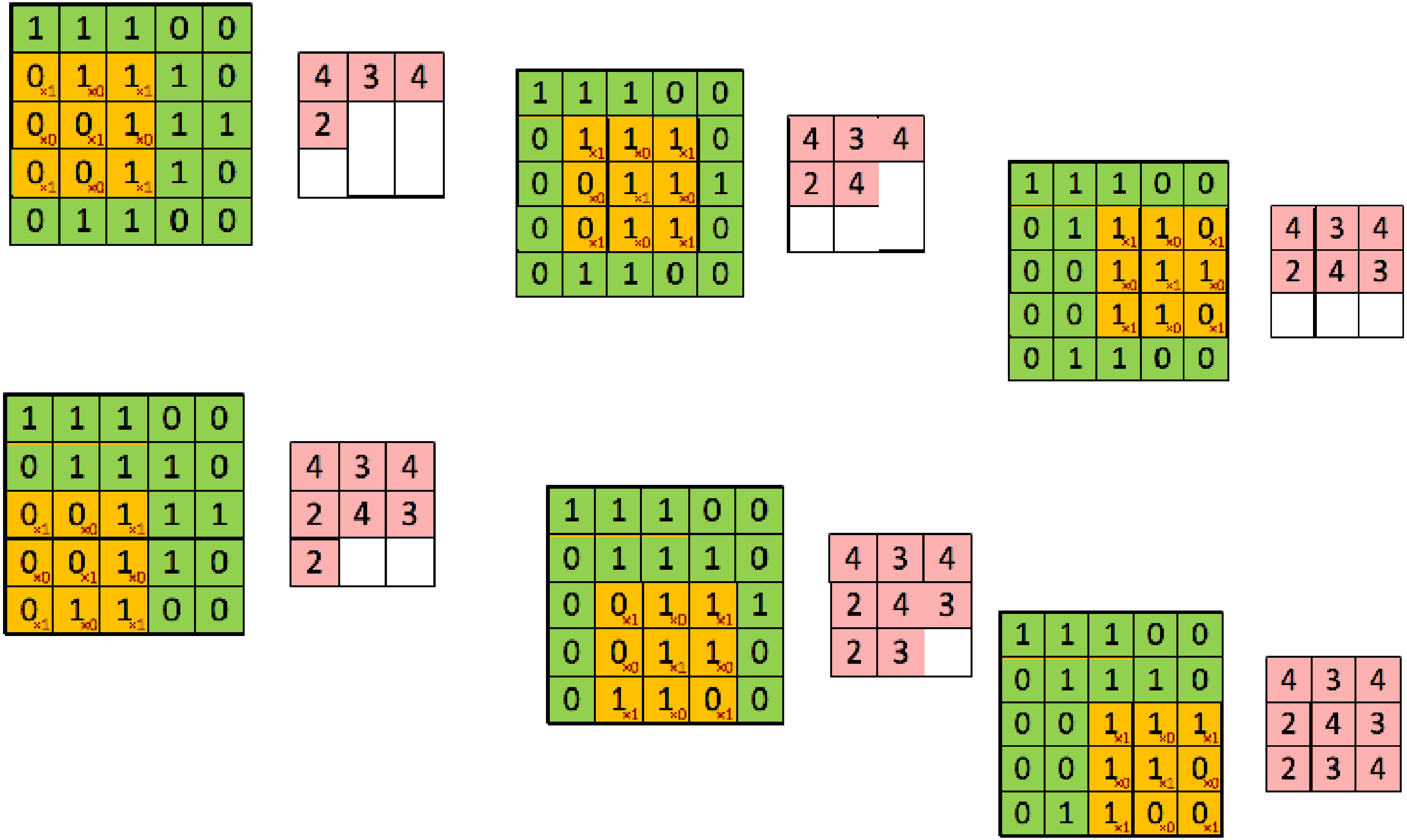
Filtre



Input Image

Filtre

Convoled feature
Activation Map
Feature Map



1	1	1	0	0
$0_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	1	0
$0_{\times 0}$	$0_{\times 1}$	$1_{\times 0}$	1	1
$0_{\times 1}$	$0_{\times 0}$	$1_{\times 1}$	1	0
0	1	1	0	0

4	3	4
2		

1	1	1	0	0
0	$1_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	0
0	$0_{\times 0}$	$1_{\times 1}$	$1_{\times 0}$	1
0	$0_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	0
0	1	1	0	0

4	3	4
2	4	

1	1	1	0	0
0	1	$1_{\times 1}$	$1_{\times 0}$	$0_{\times 1}$
0	0	$1_{\times 0}$	$1_{\times 1}$	$1_{\times 0}$
0	0	$1_{\times 1}$	$1_{\times 0}$	$0_{\times 1}$
0	1	1	0	0

4	3	4
2	4	3

1	1	1	0	0
0	1	1	1	0
$0_{\times 1}$	$0_{\times 0}$	$1_{\times 1}$	1	1
$0_{\times 0}$	$0_{\times 1}$	$1_{\times 0}$	1	0
$0_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	0	0

4	3	4
2	4	3
2		

1	1	1	0	0
0	1	1	1	0
0	$0_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$	1
0	$0_{\times 0}$	$1_{\times 1}$	$1_{\times 0}$	0
0	$1_{\times 1}$	$1_{\times 0}$	$0_{\times 1}$	0

4	3	4
2	4	3
2	3	

1	1	1	0	0
0	1	1	1	0
0	0	$1_{\times 1}$	$1_{\times 0}$	$1_{\times 1}$
0	0	$1_{\times 0}$	$1_{\times 1}$	$0_{\times 0}$
0	1	$1_{\times 1}$	$0_{\times 0}$	$0_{\times 1}$

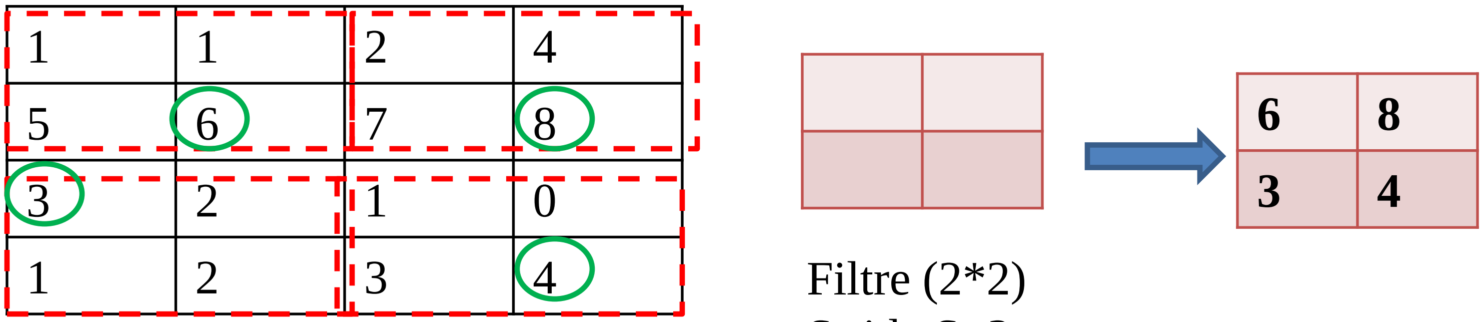
4	3	4
2	4	3
2	3	4

Chapitre 2: Convolutional Neural Network (CNN)

Pooling Layers

- Max Pooling
- Average Pooling
- Sum Pooling

1/ Max Pooling



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

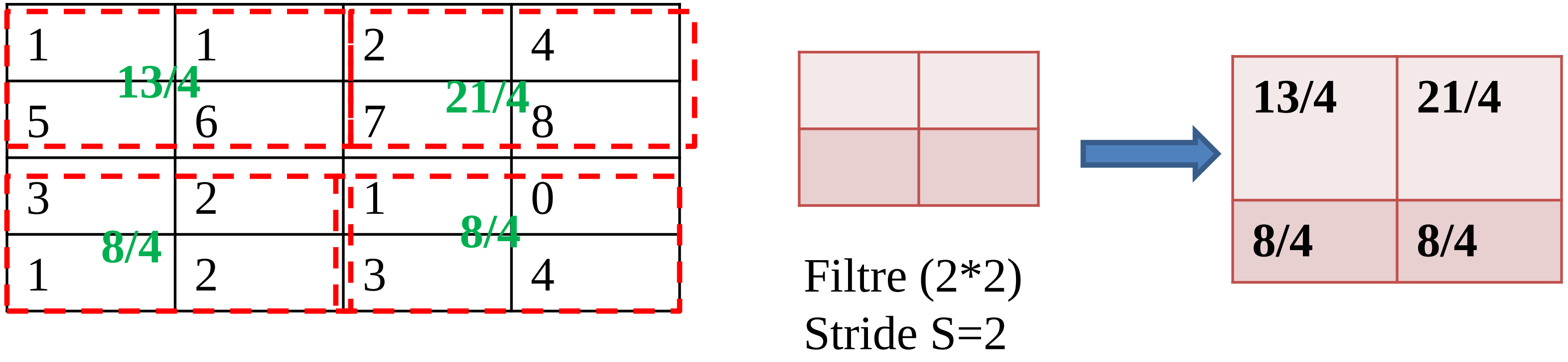
6	8
3	4

Filtre (2*2)
Stride S=2

Chapitre 2 : Convolutional Neural Network (CNN)

Pooling Layers

2/ Aveage Pooling



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

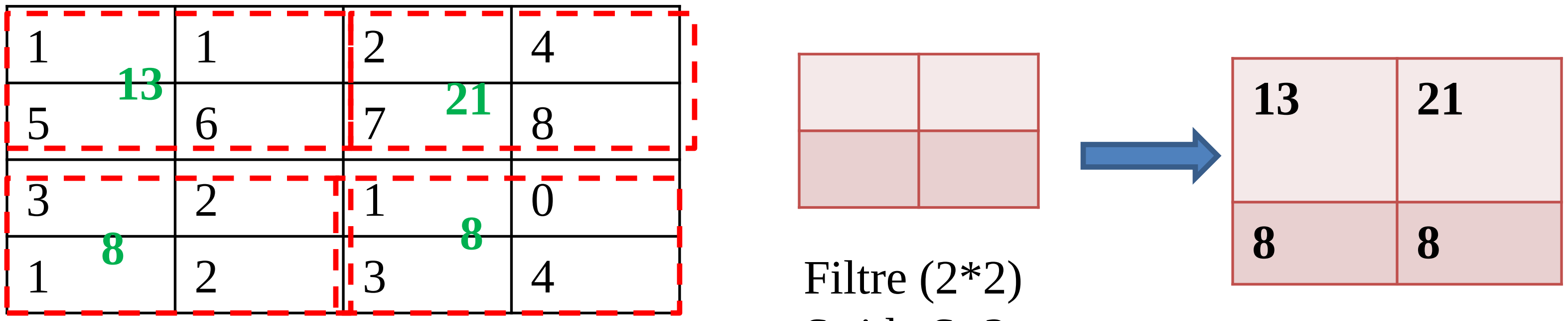
Filtre (2*2)
Stride S=2

13/4	21/4
8/4	8/4

Chapitre 2: Convolutional Neural Network (CNN)

Pooling Layers

3/ Sum Pooling



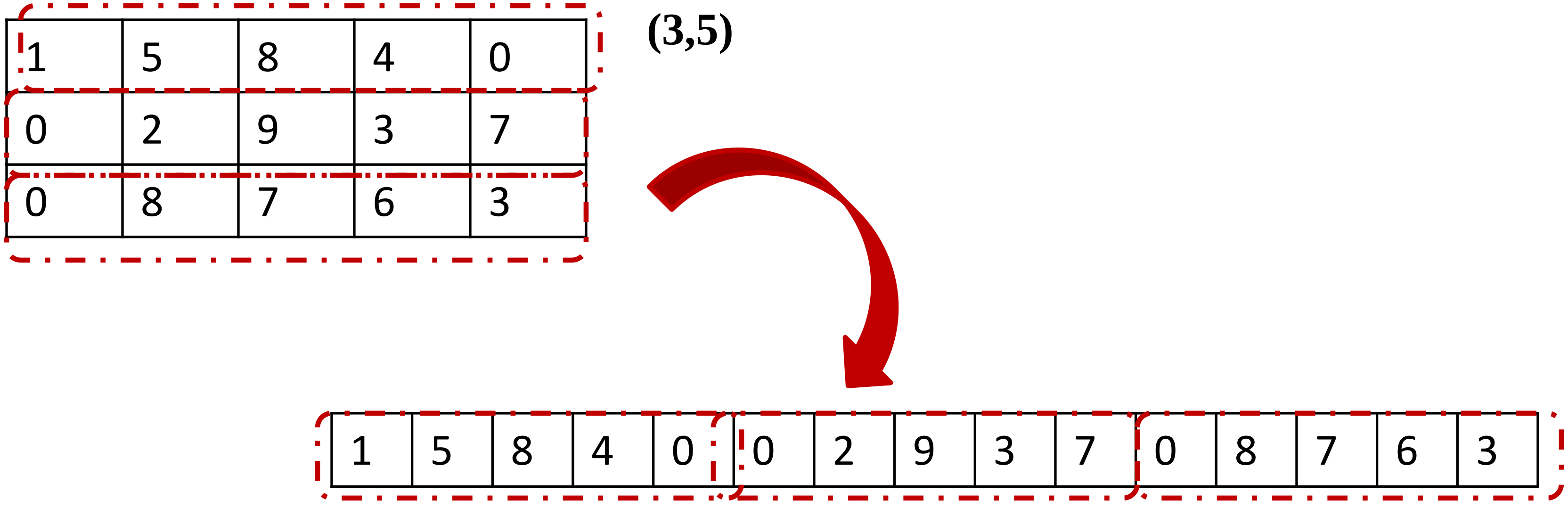
1	1	2	4
5	6	7	8
3	2	1	0
1	2	3	4

Filtre (2*2)
Stride S=2

13	21
8	8

Chapitre 2 : Convolutional Neural Network (CNN)

Flatten



1	5	8	4	0
0	2	9	3	7
0	8	7	6	3

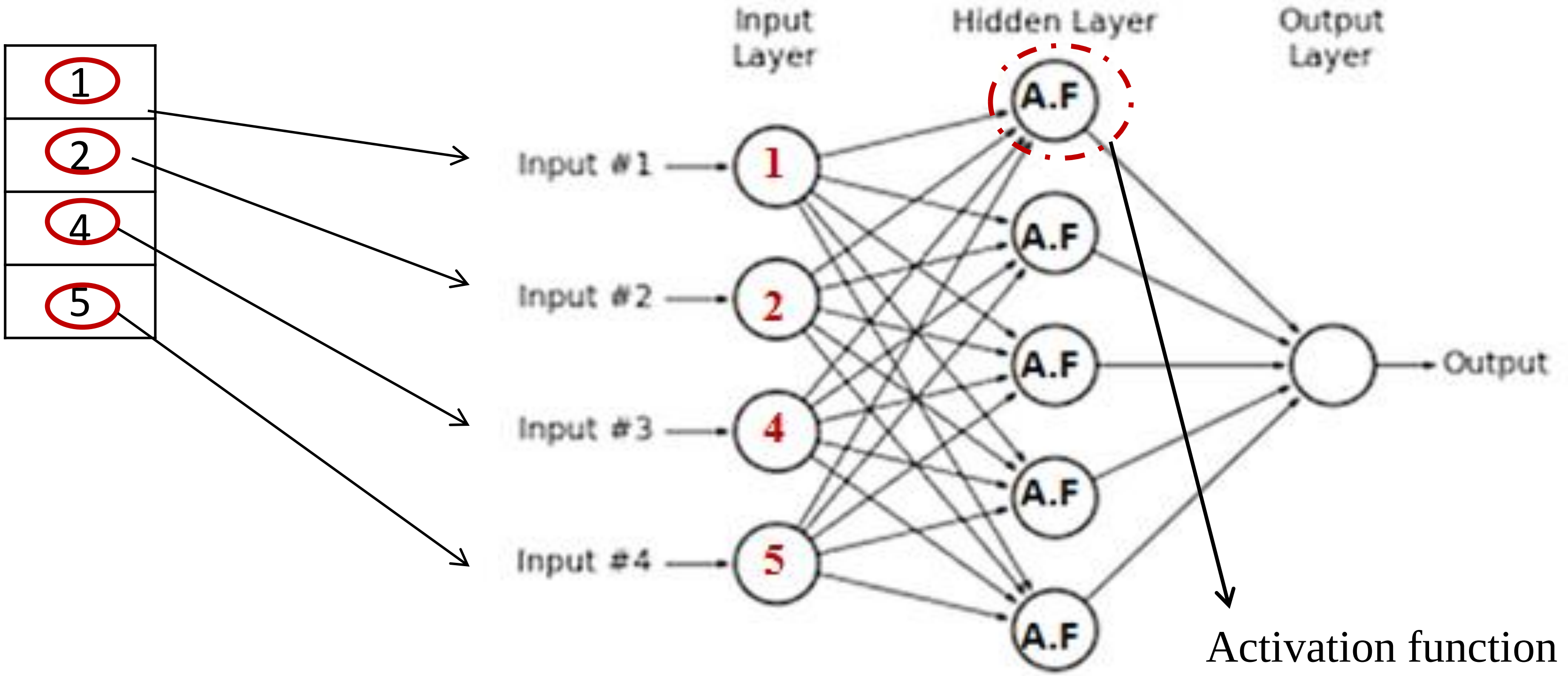
(3,5)

1	5	8	4	0	0	2	9	3	7	0	8	7	6	3

(3*5) : (1,15

Chapitre 2 : Convolutional Neural Network (CNN)

Fully connected layers : Classification



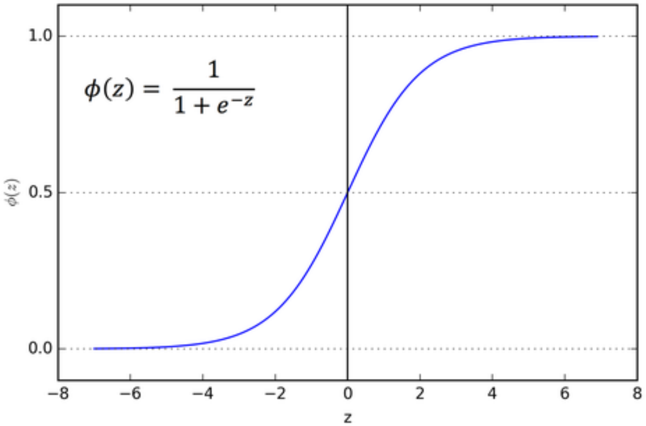
Chapitre 2: Convolutional Neural Network (CNN)

Fully connected layers : Classification

Activation function

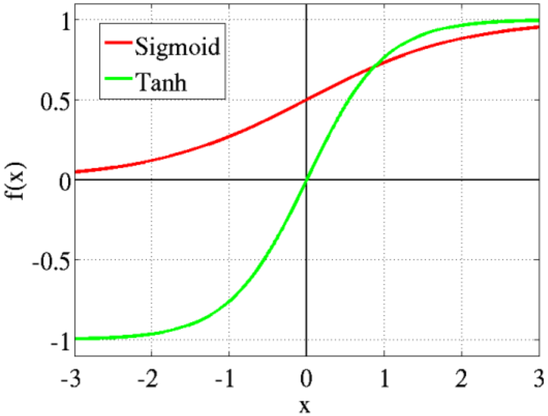
- **Sigmoid :** probabilité entre 0 et 1
  Classification binaire

$$f(x) = \frac{1}{1+\exp(-z)}$$



- **Tanh** : hyperbolic tangent Activation Function
  Mieux que Sigmoid
  Probabilité entre -1 et 1
  Classification binaire

$$\mathrm{f(x)} = \frac{1-\exp(x)}{1+\exp(x)}$$



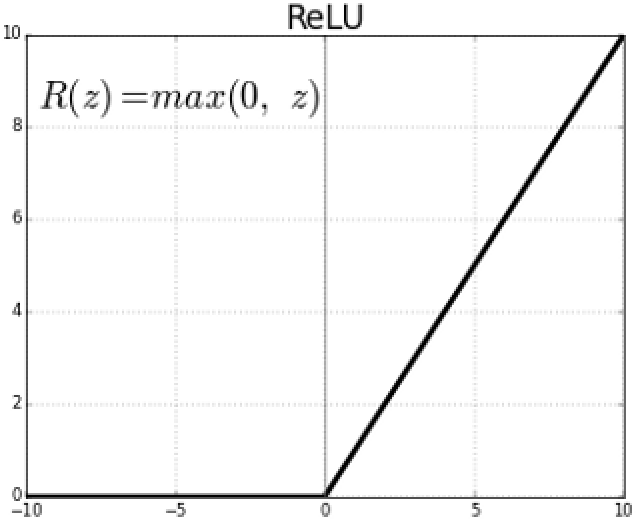
Chapitre 2 : Convolutional Neural Network (CNN)

Fully connected layers : Classification

Activation function

- **Relu : Rectified Linear Unit**

$$f(x) = \max(0, x)$$



- **Softmax :** Classification multiclass

$$\mathrm{f(x)} = \frac{\exp(x)}{\sum_{i=1}^{k} \exp(x)}$$