

DEEP LEARNING

Final chapter

S.Djellouli

LETS TALK CNN

WHAT IS CNN ?

S.Djellouli



What is CNN ?

A convolutional neural network (CNN) is a type of deep learning model that is widely used for image recognition and computer vision tasks. It is particularly effective at analyzing visual data due to its ability to automatically learn and extract meaningful features from images.

What is CNN ?

The key building blocks of a CNN are convolutional layers, pooling layers, and fully connected layers. Here's a brief overview of each component:

Step 1 - Convolution

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau) g(t - \tau) d\tau$$

Step 1 - Convolution

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

Input Image

0	0	1
1	0	0
0	1	1

Feature
Detector

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

Feature
Detector



0				

Feature Map

Step 1 - Convolution

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

Input Image



0	0	1
1	0	0
0	1	1

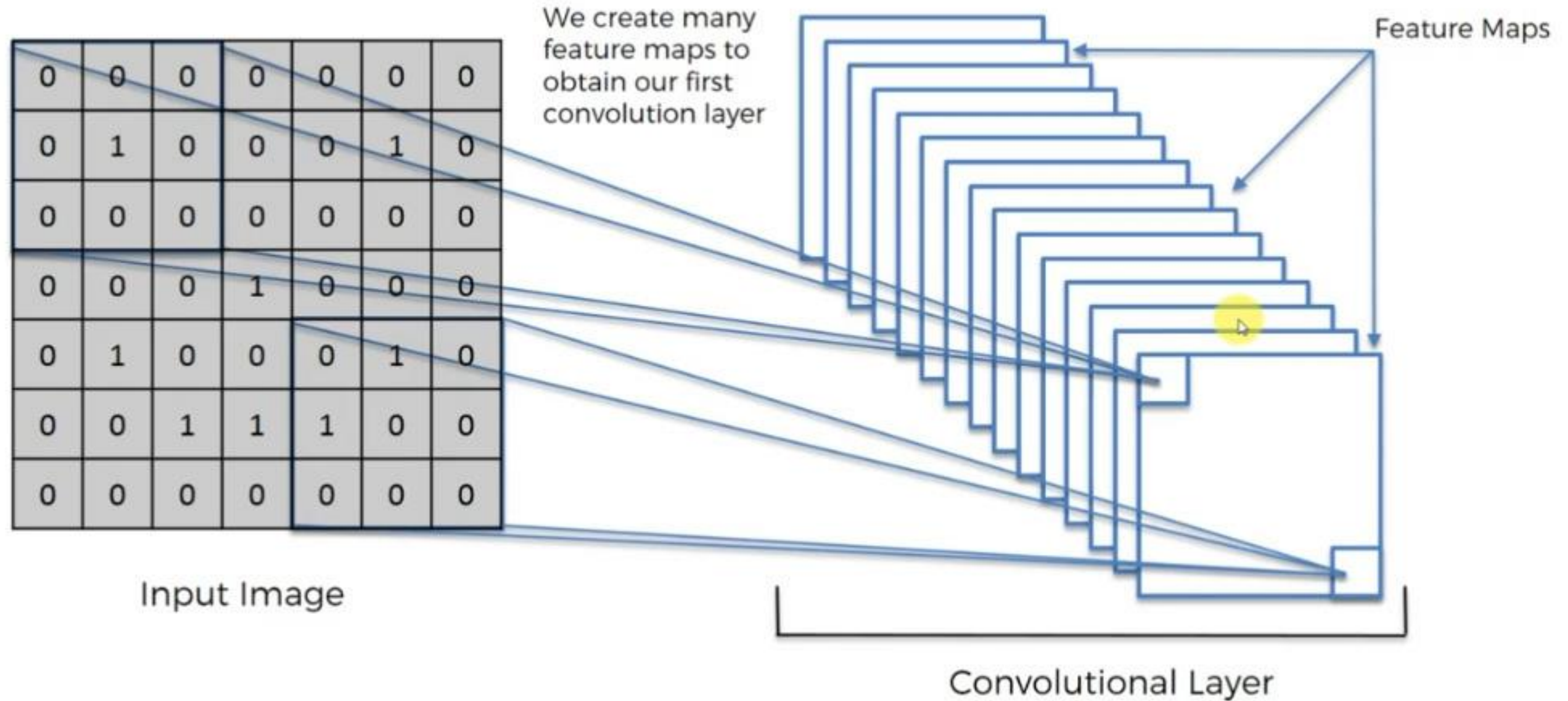
Feature
Detector



0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0
0	0	1	2	1

Feature Map

Step 1 - Convolution



Step 1 - Convolution

Blur:

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



Step 1 - Convolution

Sharpen:

0	0	0	0	0
0	0	-1	0	0
0	-1	5	-1	0
0	0	-1	0	0
0	0	0	0	0



Step 1 - Convolution

Edge Enhance:

	0	0	0	
	-1	1	0	
	0	0	0	



Step 1 - Convolution

Edge Detect:

	0	1	0	
	1	-4	1	
	0	1	0	

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Step 1 - Convolution

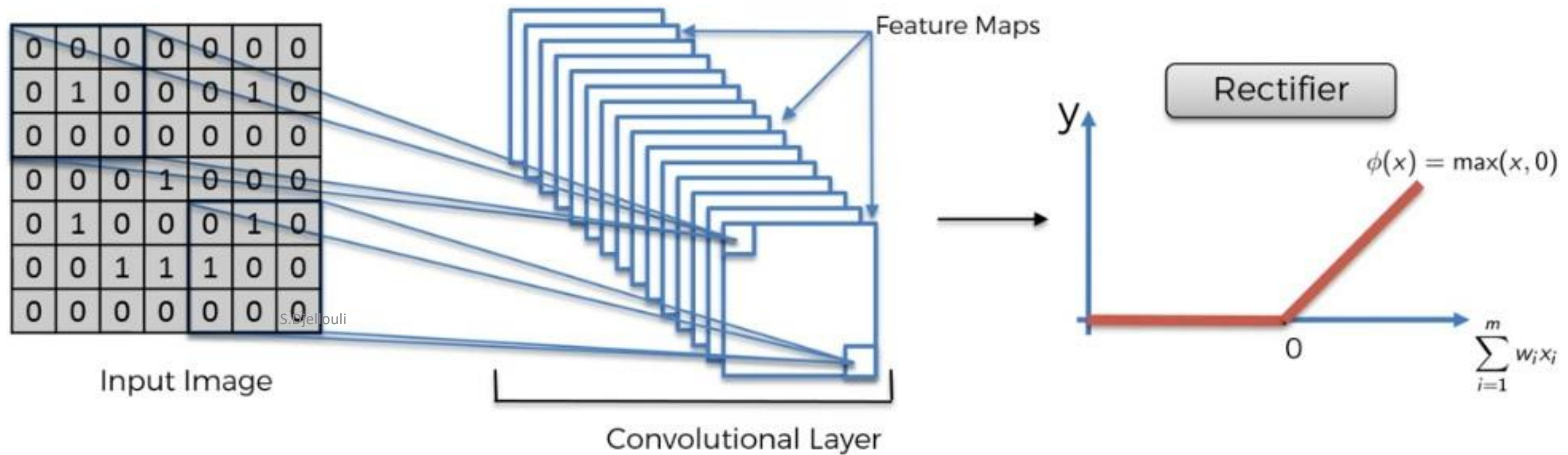
Emboss:

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

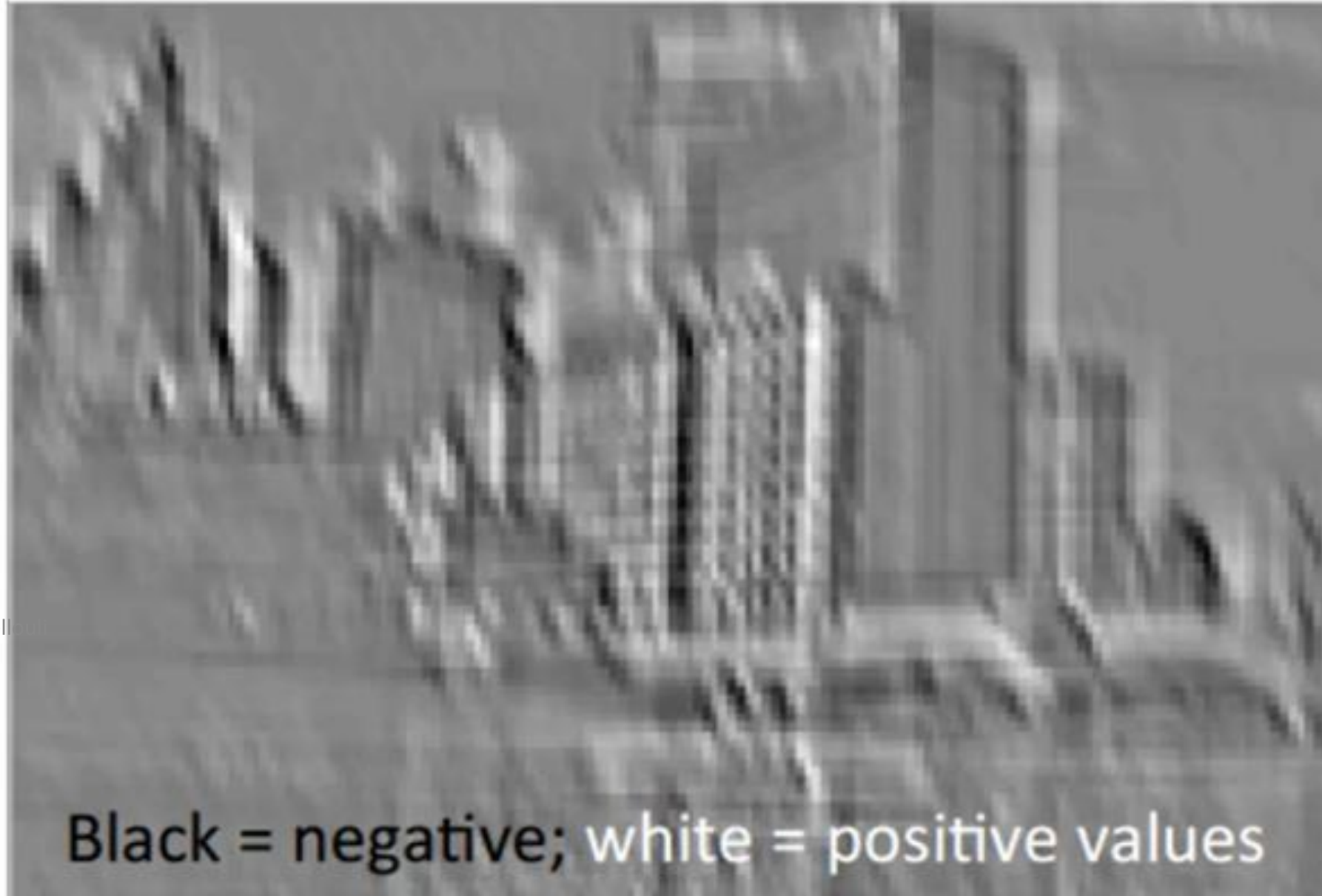
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Step 1 (B) – ReLU Layer



Step 1 (B) – ReLU Layer



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Step 1 (B) – ReLU Layer



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Step 2 - Max Pooling



Step 2 - Max Pooling

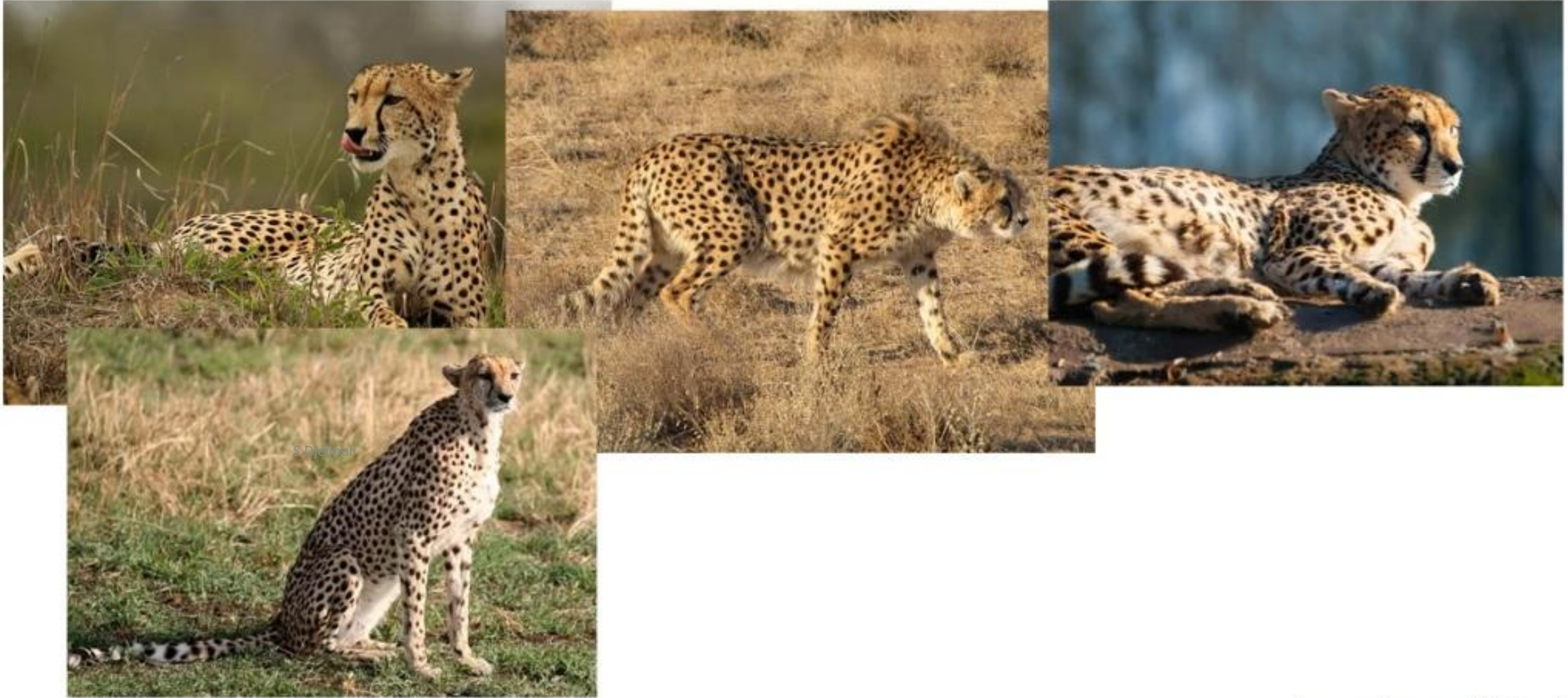


Image Source: Wikipedia

Step 2 - Max Pooling

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0
0	0	1	2	1

Feature Map

Max Pooling



1		

Pooled Feature Map

Step 2 - Max Pooling

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0
0	0	1	2	1

Feature Map

Max Pooling



1	1	

Pooled Feature Map

Step 2 - Max Pooling

0	1	0	0	0
0	1	1	1	0
1	0	1	2	1
1	4	2	1	0
0	0	1	2	1

Feature Map

Max Pooling



1	1	0
4	2	1
0	2	1

Pooled Feature Map

Step 3 – Flattening

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Step 3 - Flattening

1	1	0
4	2	1
0	2	1

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Pooled Feature Map

Step 3 - Flattening

1	1	0
4	2	1
0	2	1

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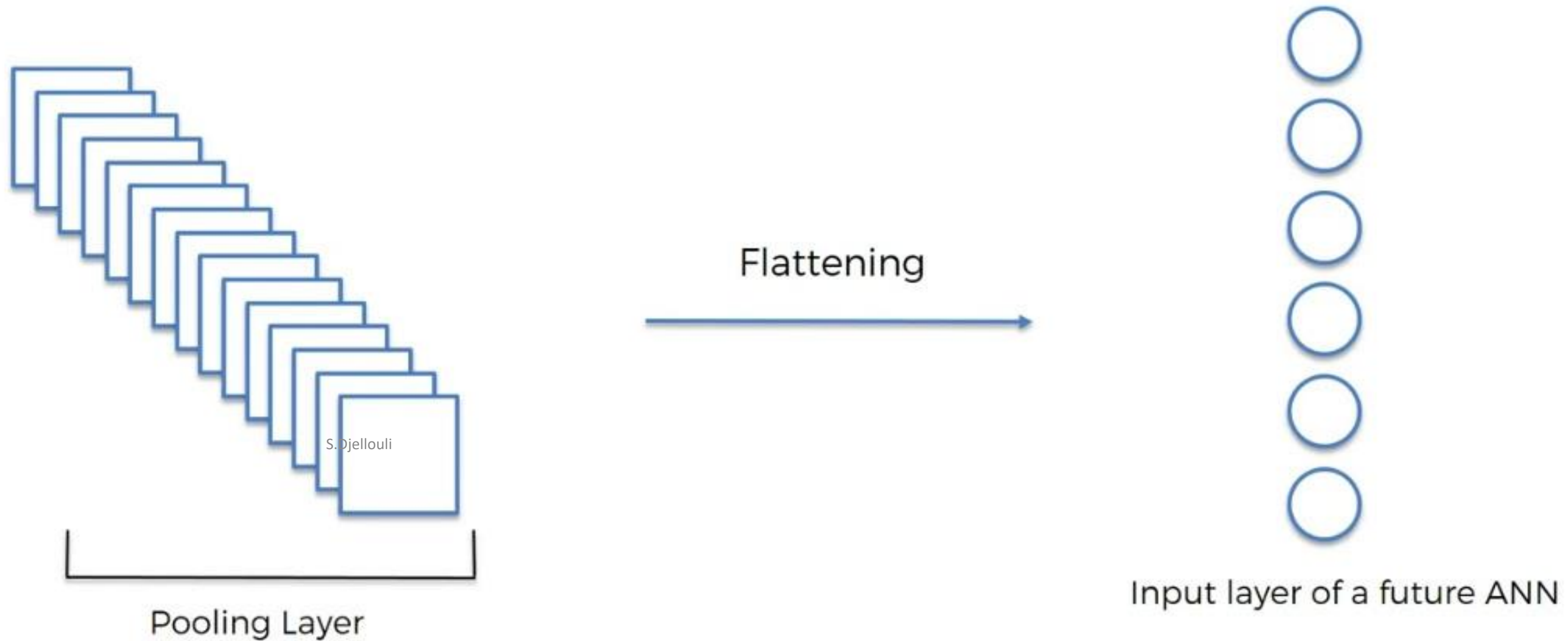
Pooled Feature Map

Flattening

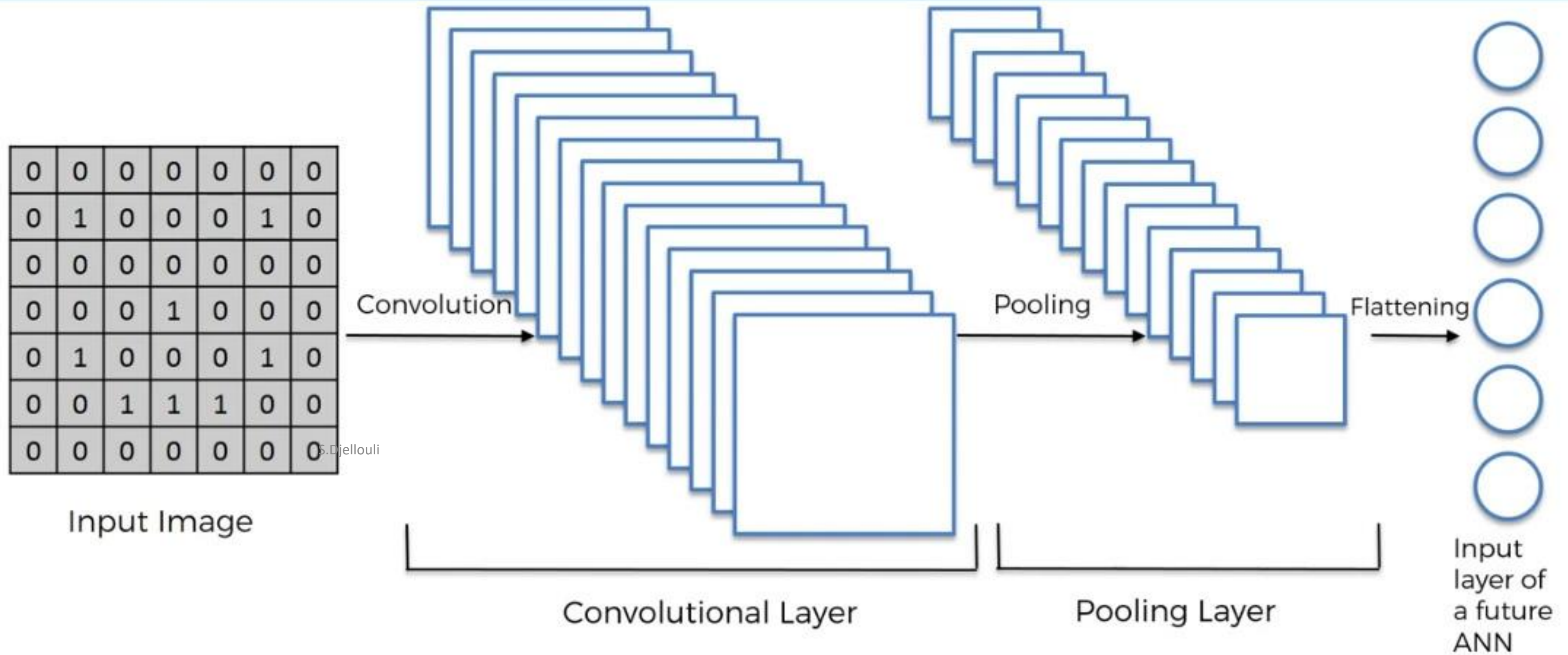


1
1
0
4
2
1
0
2
1

Step 3 - Flattening



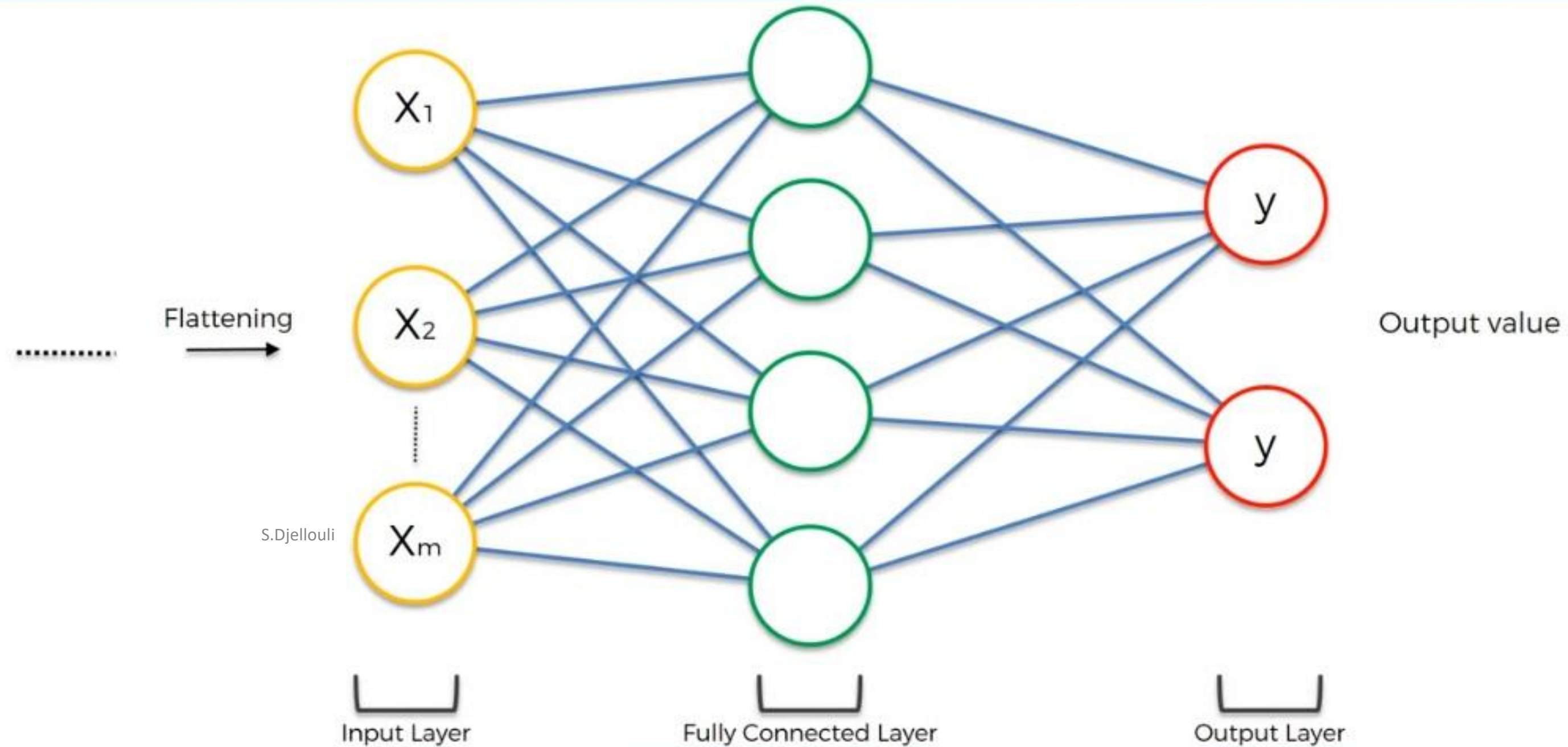
Step 3 - Flattening



Step 4 – Full Connection

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Step 4 - Full Connection



Softmax & Cross-Entropy

NN1

Row	Dog^	Cat^	Dog	Cat
#1	0.9	0.1	1	0
#2	0.1	0.9	0	1
#3	0.4	0.6	1	0

Classification Error

$$1/3 = 0.33$$

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Mean Squared Error

0.25

Cross-Entropy

0.38

NN2

Row	Dog^	Cat^	Dog	Cat
#1	0.6	0.4	1	0
#2	0.3	0.7	0	1
#3	0.1	0.9	1	0

$$1/3 = 0.33$$

0.71

1.06