

EI320A(3) 深度學習使用 Python

Instructors

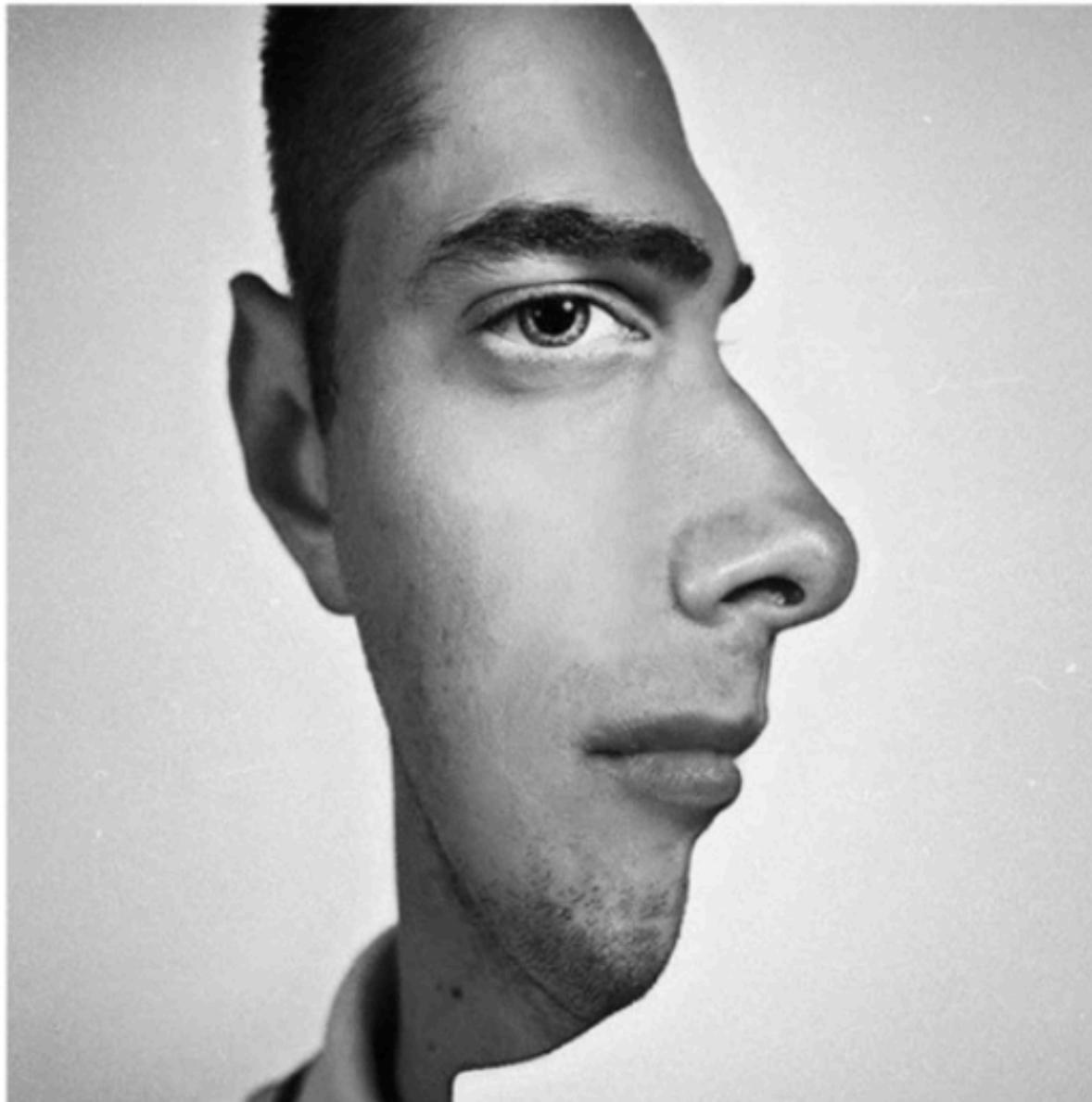
Tipajin Thaipisutikul (t.greentip@gmail.com)

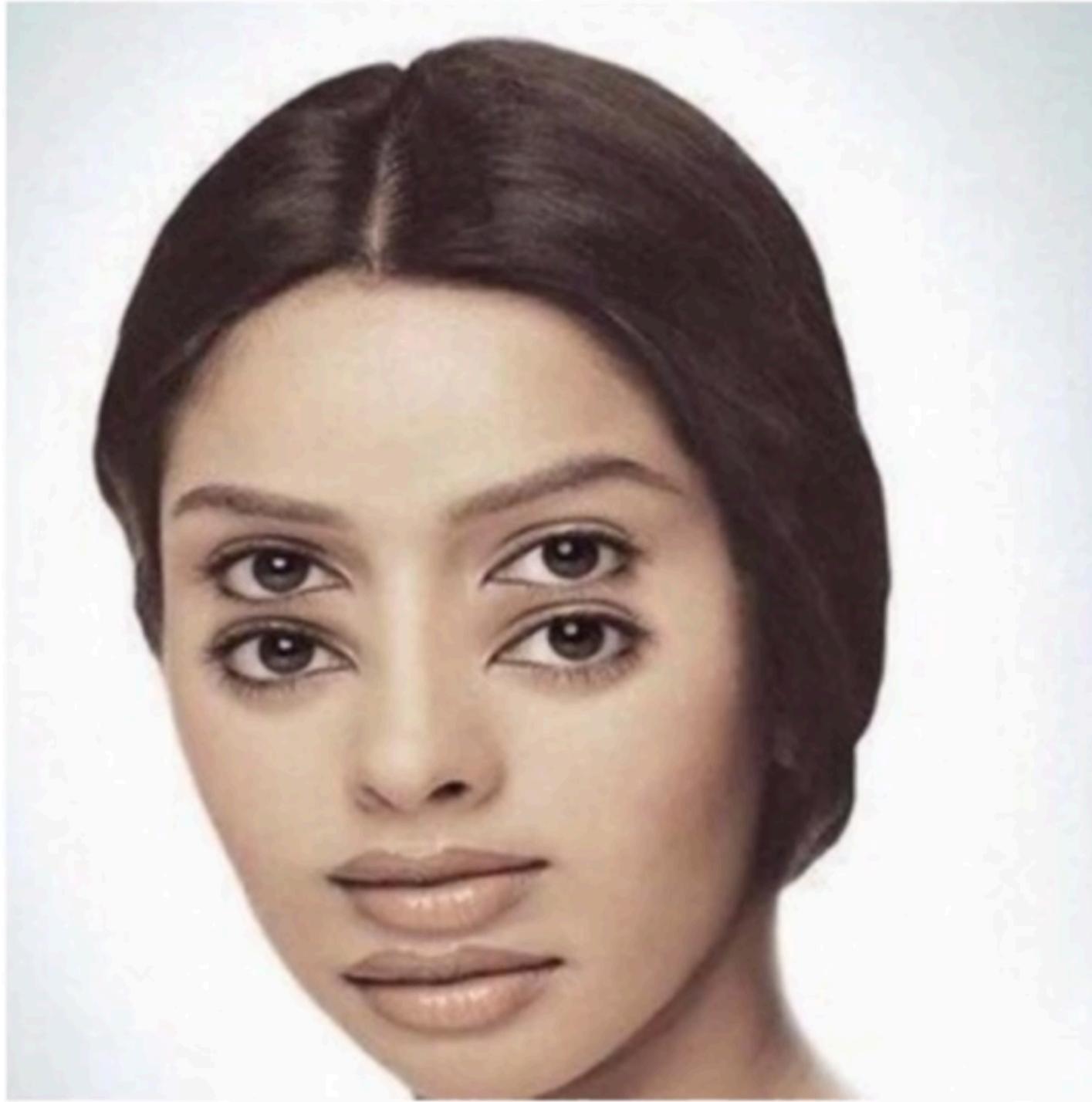
Prof. Huang-Chia Shih (hcshih@Saturn.yzu.edu.tw)

CNN Outline

- What are Convolutional Neural Networks?
- Step 1 - Convolutional Operation
- Step 1(b) – ReLu Layer
- Step 2 – Pooling
- Step 3 - Flattening
- Step 4 – Full Connection
- Summary

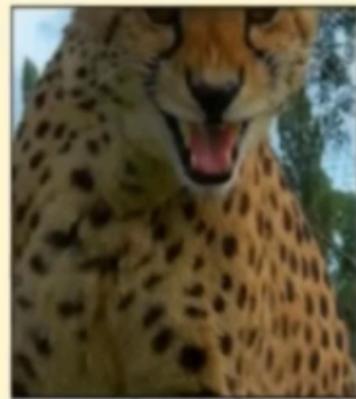
Convolutional Neural Networks





Convolutional Neural Networks

Examples from the test set
(with the network's guesses)



cheetah

cheetah

leopard

snow leopard

Egyptian cat



bullet train

bullet train

passenger car

subway train

electric locomotive



hand glass

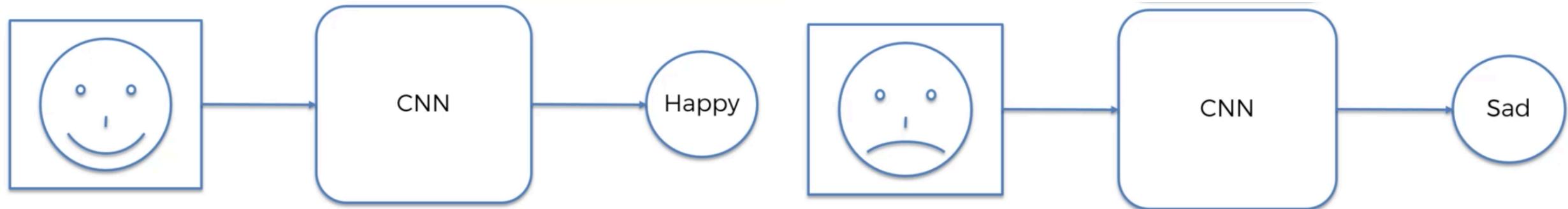
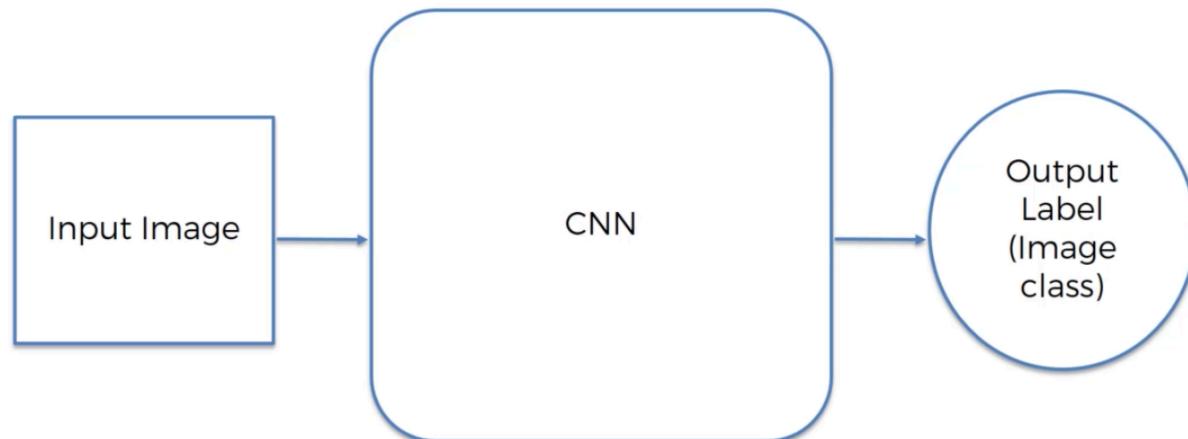
scissors

hand glass

frying pan

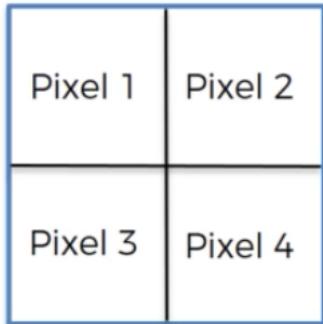
stethoscope

Convolutional Neural Networks

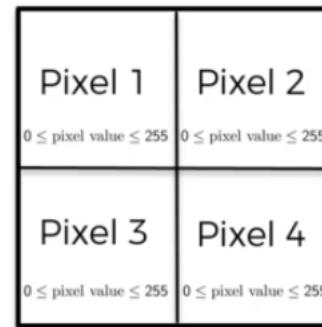


Convolutional Neural Networks

B / W Image 2x2px

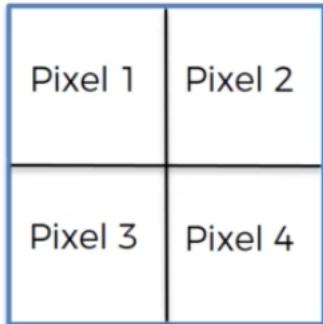


2d array

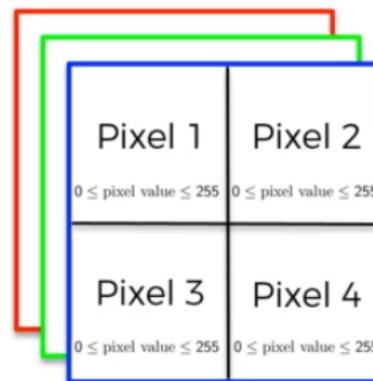


0: black
255:white

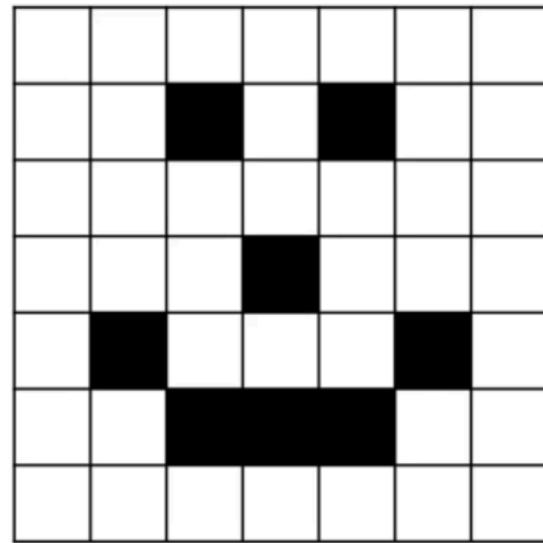
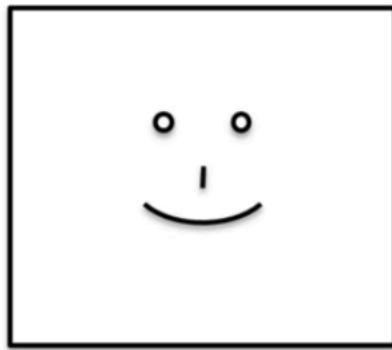
Colored Image 2x2px



3d array



Convolutional Neural Networks



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

STEP 1: Convolution



STEP 2: Max Pooling



STEP 3: Flattening



STEP 4: Full Connection

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Step 1 - Convolutional Operation

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

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

Element-Wise



0	0	1
1	0	0
0	1	1

=

0			

Input Image

Feature
Detector
Filter/ Kernel

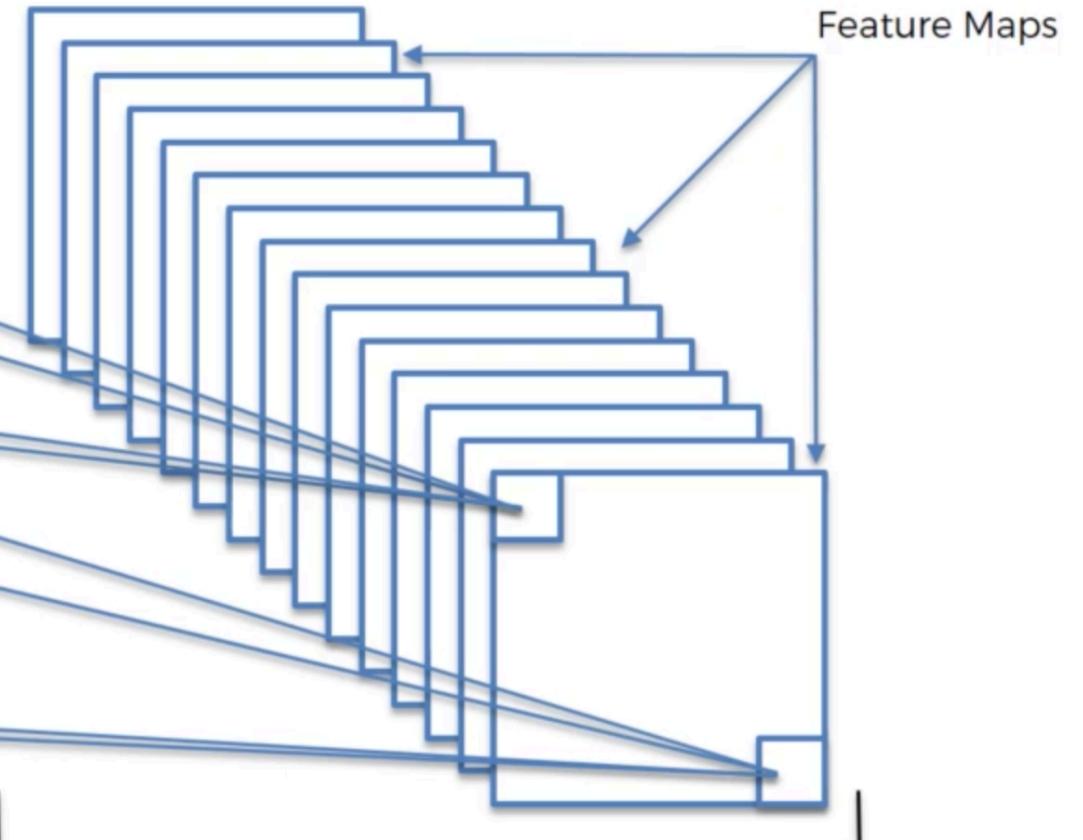
Feature Map
Activation Map

Is smaller than an original image

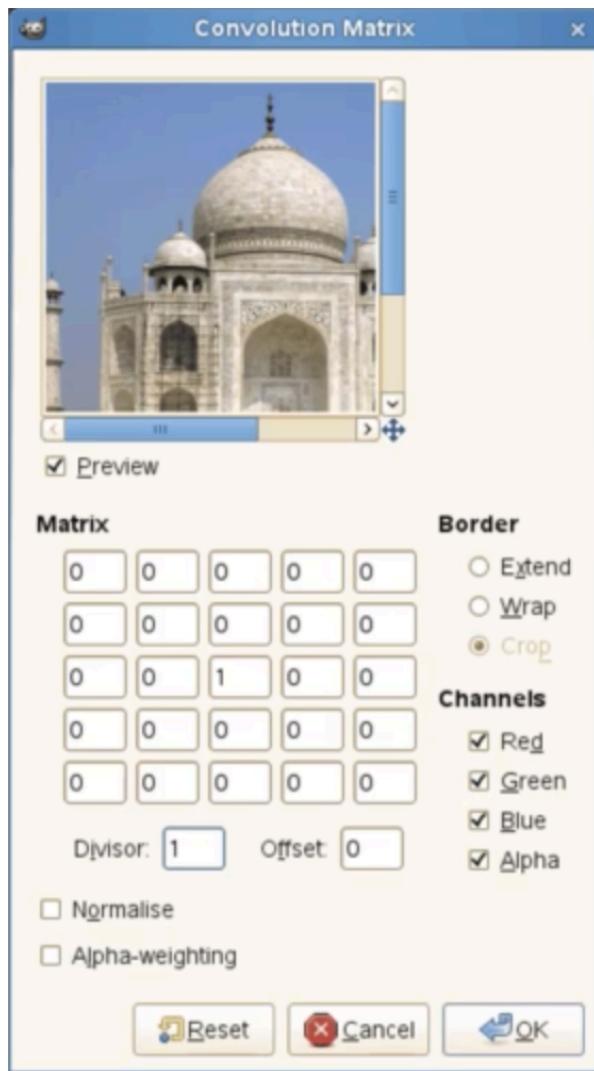
Step 1 - Convolutional Operation

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

We create many feature maps to obtain our first convolution layer



Step 1 - Convolutional Operation



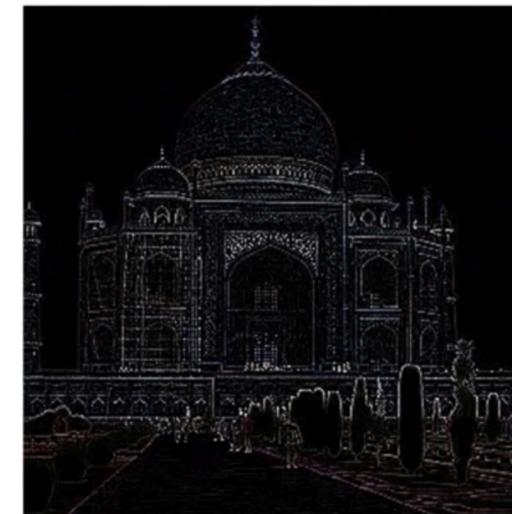
Blur:

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



Edge Detect:

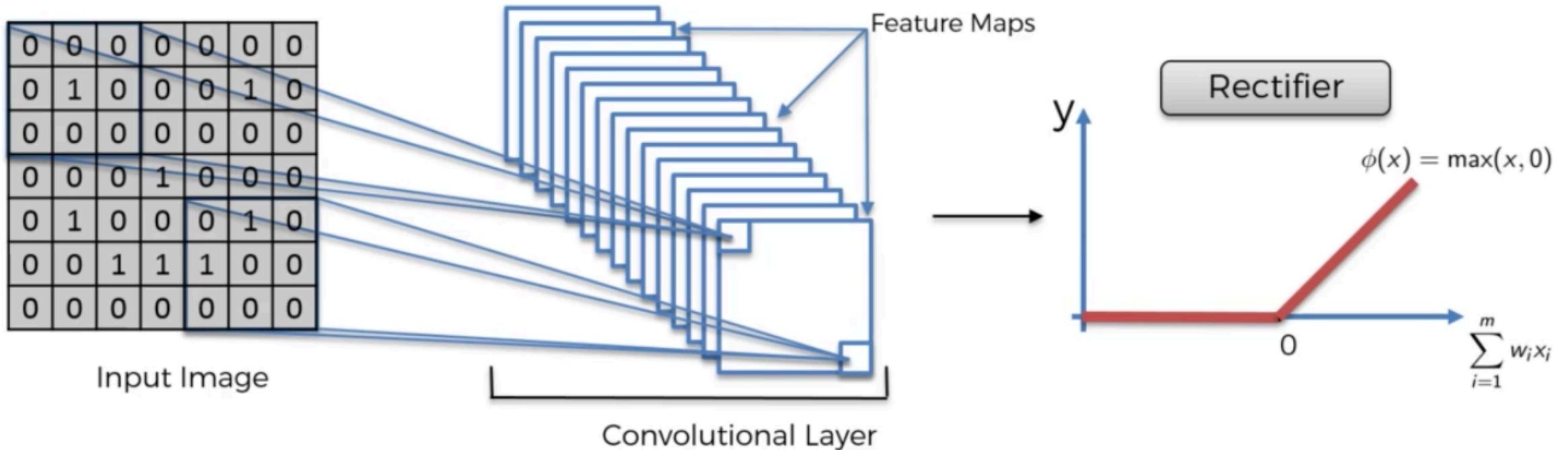
0	1	0
1	-4	1
0	1	0



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Step 1(b) – ReLu Layer



Step 1(b) – ReLu Layer



Without ReLU
With ReLU



Black = negative; white = positive values



Only non-negative values

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Step 2 – Pooling



Step 2 – 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

Stride =2

Max Pooling



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		

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

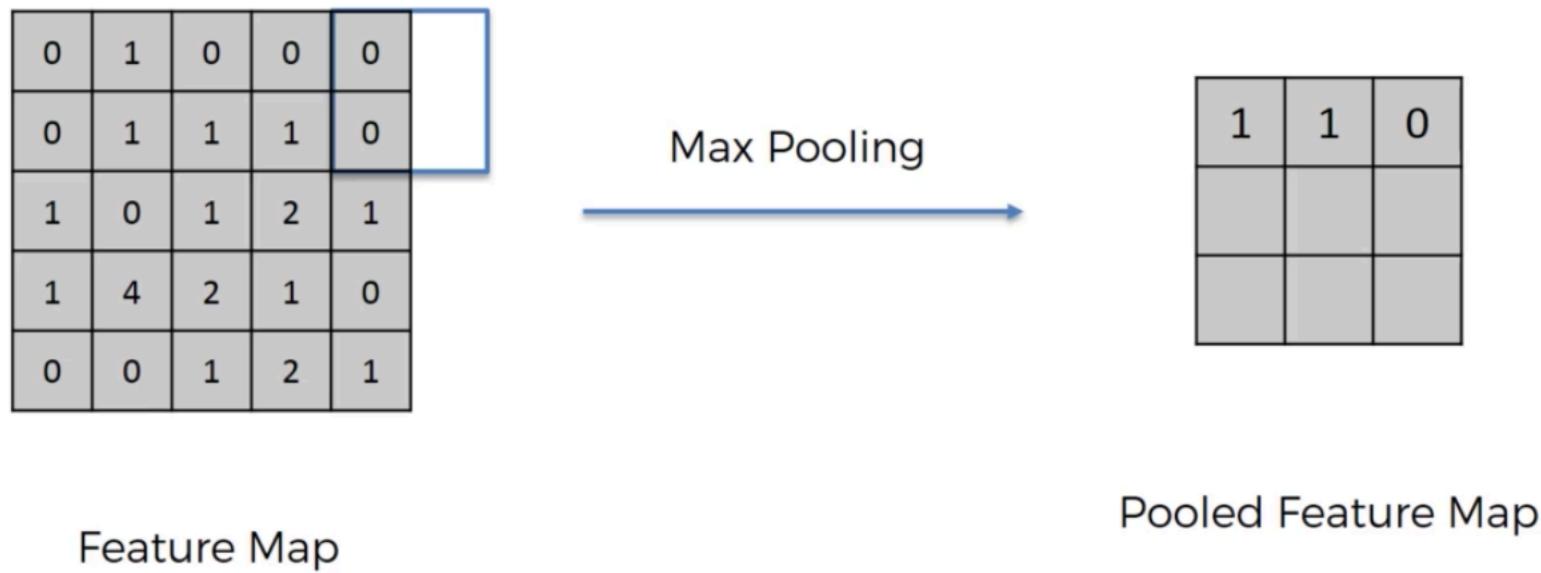
Max Pooling



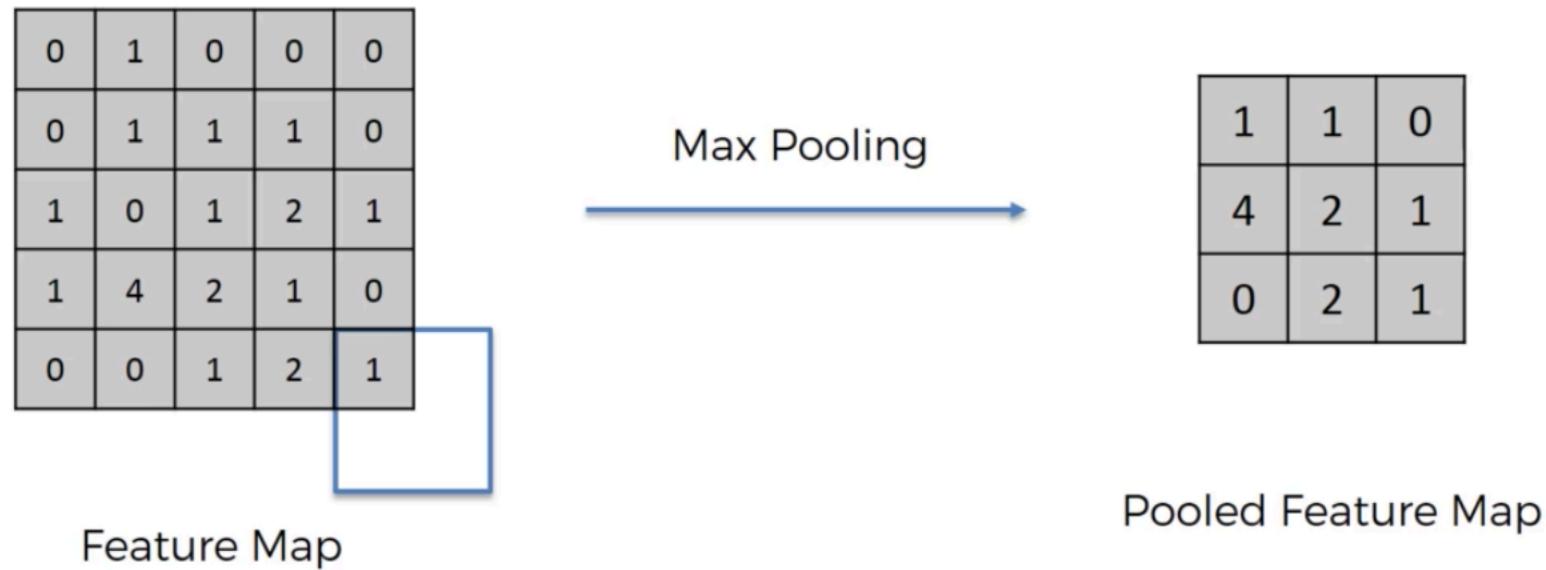
1	1	

Pooled Feature Map

Step 2 – Max Pooling



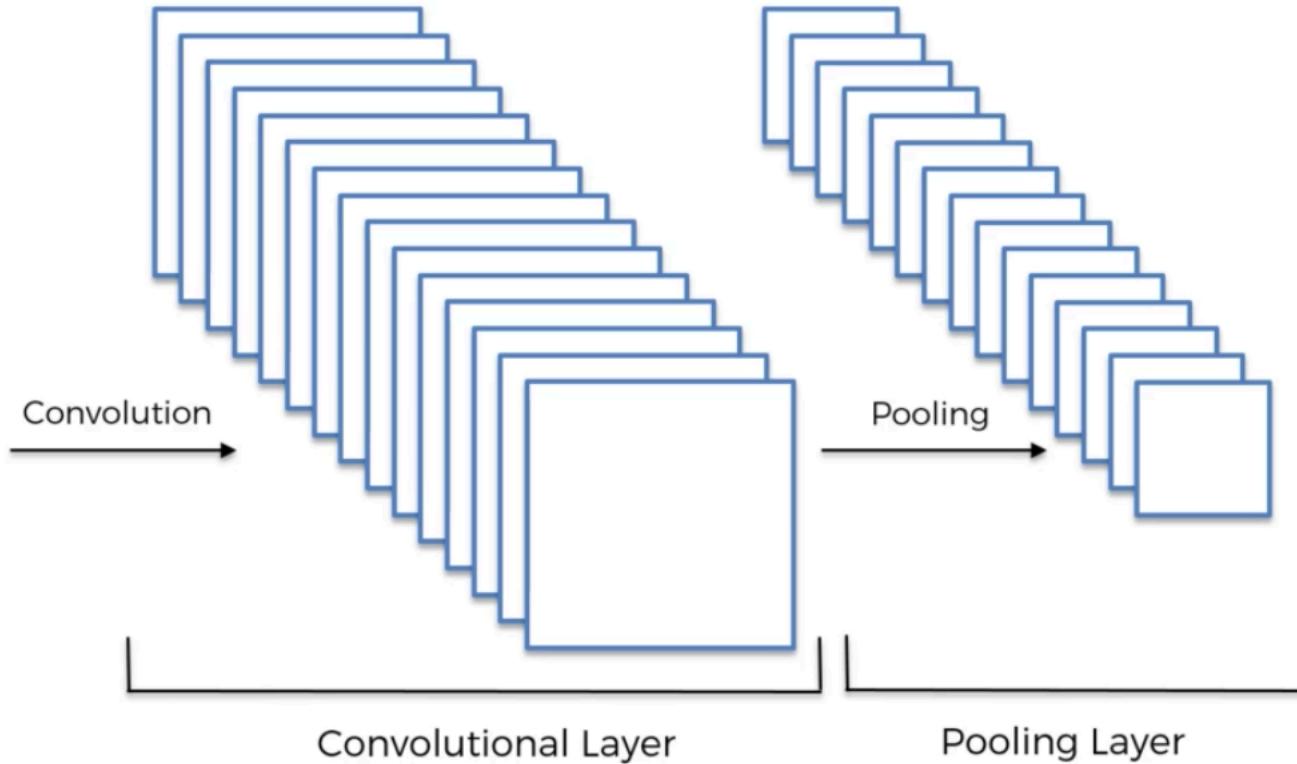
Step 2 – Max Pooling



Step 2 – Max Pooling

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

Input Image



Step 2 – Max Pooling

<https://www.cs.ryerson.ca/~aharley/vis/conv/flat.html>



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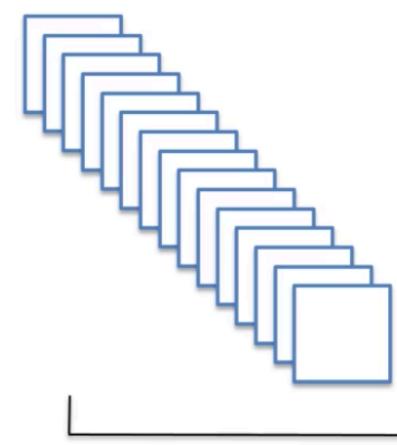
Step 3 - Flattening

1	1	0
4	2	1
0	2	1

Pooled Feature Map

Flattening

1
1
0
4
2
1
0
2
1

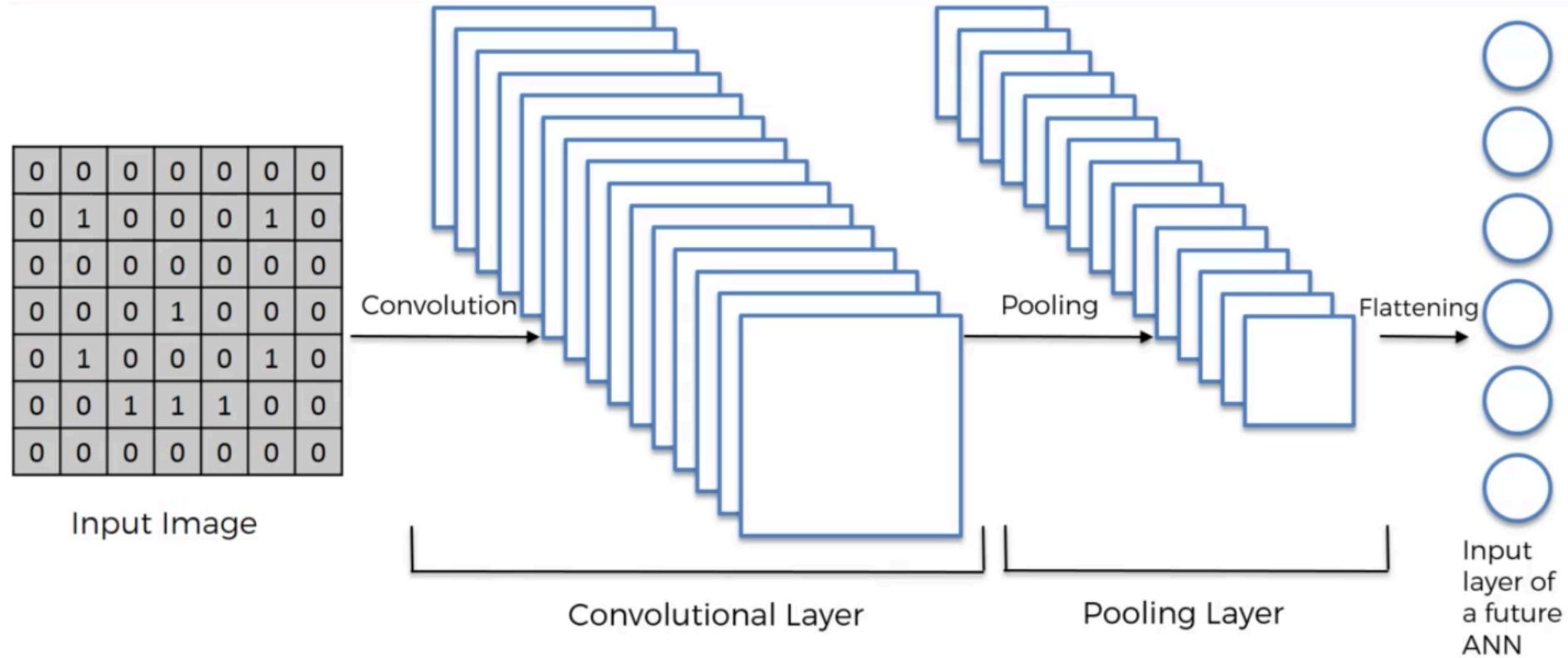


Flattening



Input layer of a future ANN

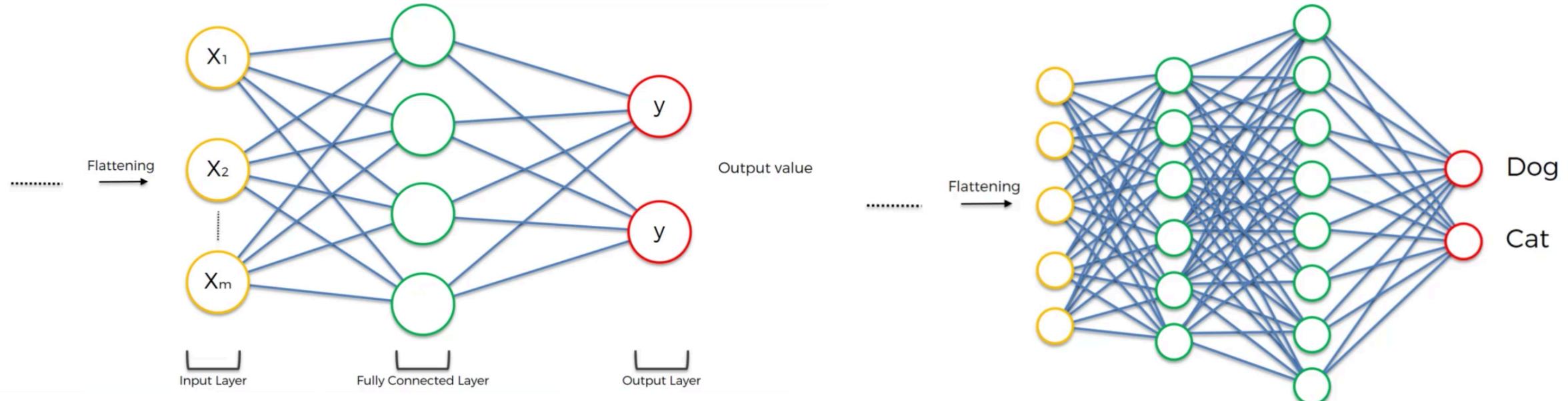
Step 3 - Flattening



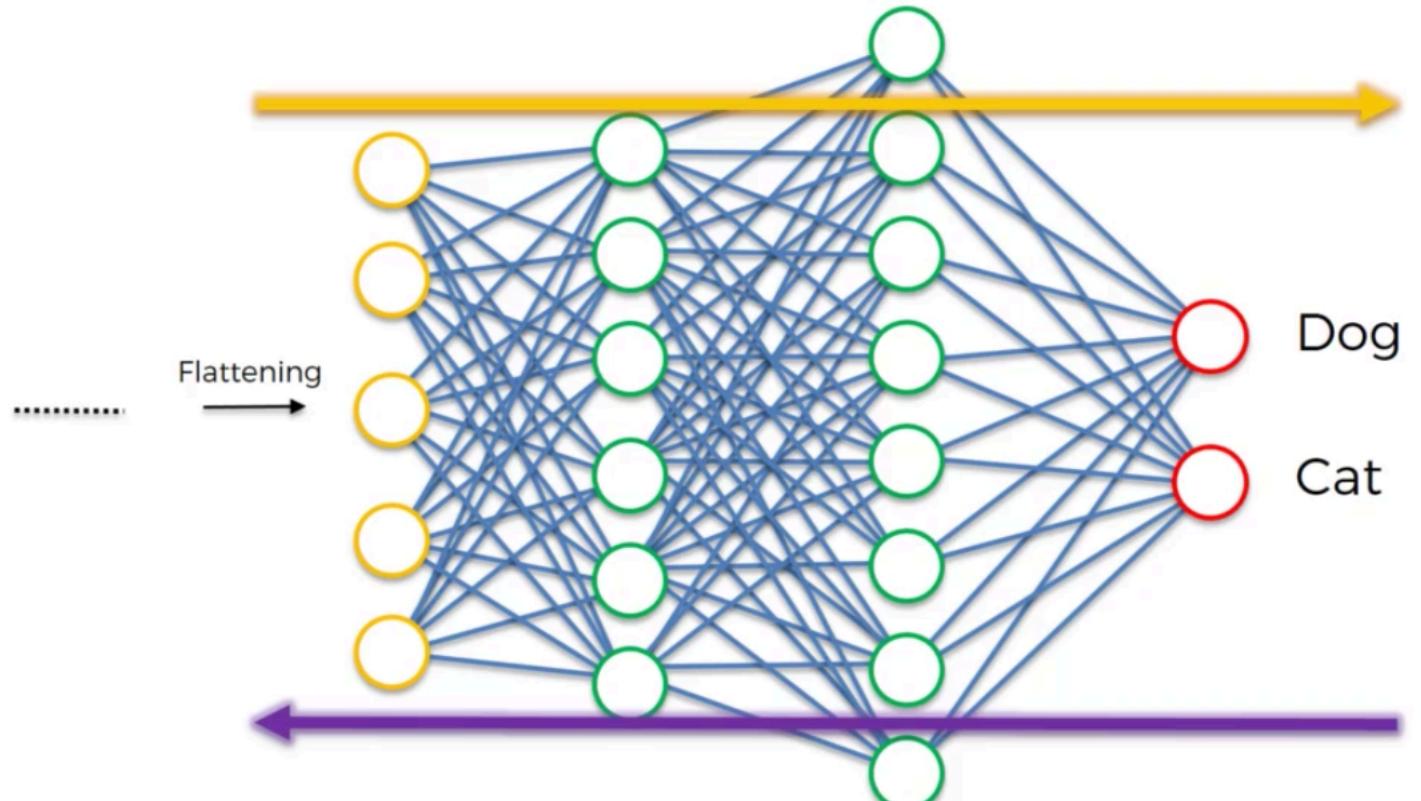
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Step 4 – Full Connection



Step 4 – Full Connection



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Summary

