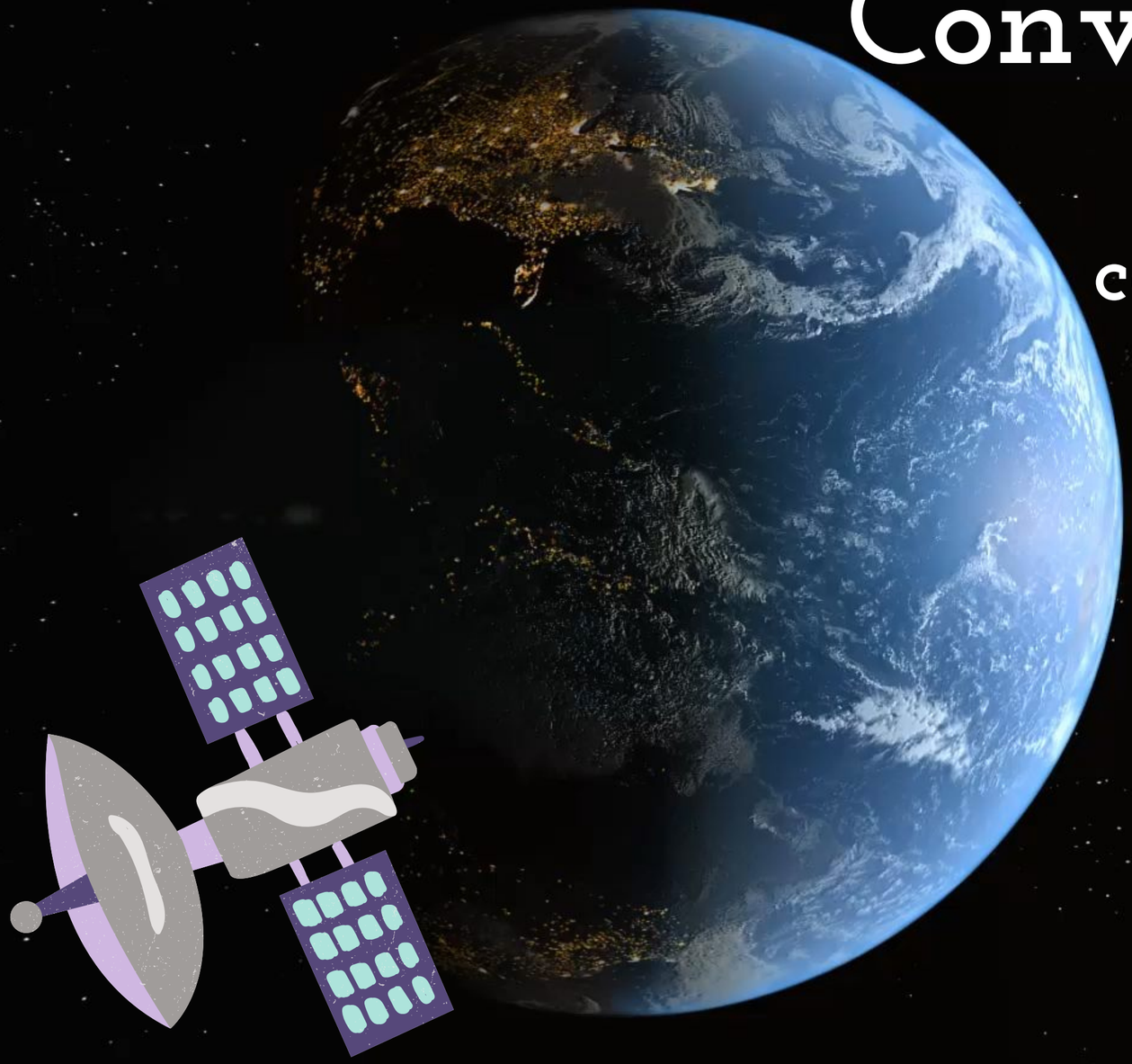
Convolutional neural network:
convolutional layer



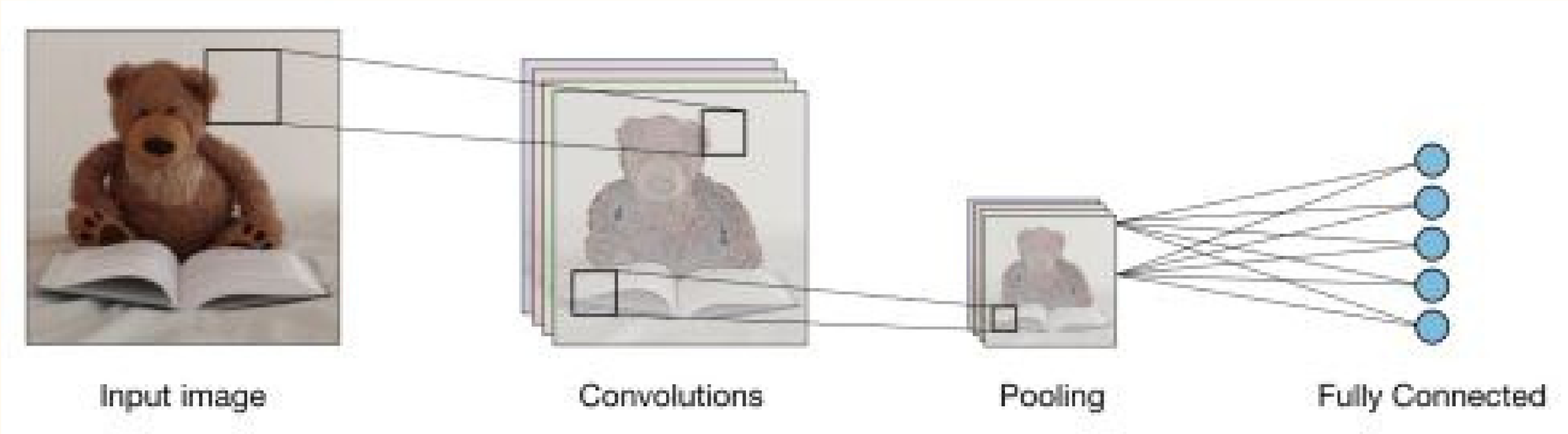
TUNSA

Tunisian Space Association

الجمعية التونسية للفضاء

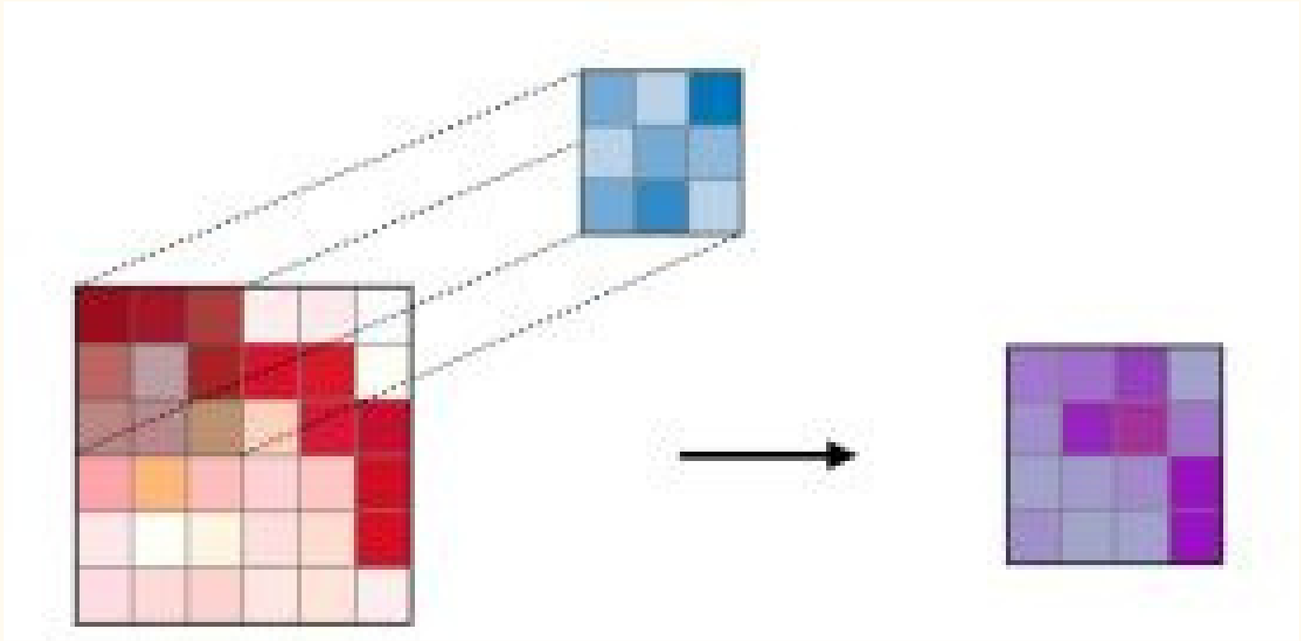
Architecture of CNN's

CONVOLUTIONAL NEURAL NETWORKS, ALSO KNOWN AS CNNS, ARE A SPECIFIC TYPE OF NEURAL NETWORKS THAT ARE GENERALLY COMPOSED OF THE FOLLOWING LAYERS:

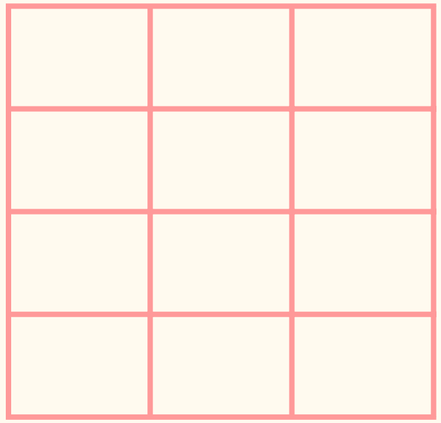


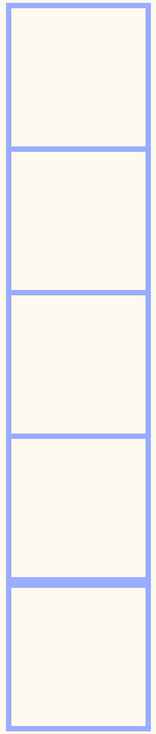
Convolutional layer (CONV)

THE CONVOLUTION LAYER (CONV) USES FILTERS THAT PERFORM CONVOLUTION OPERATIONS AS IT IS SCANNING THE INPUT I WITH RESPECT TO ITS DIMENSIONS. ITS HYPERPA RAMETERS INCLUDE THE FILTER SIZE F AND STRIDE S. THE RESULTING OUTPUT O IS CALLED FEATURE MAP OR ACTIVATION MAP.



1030*1372

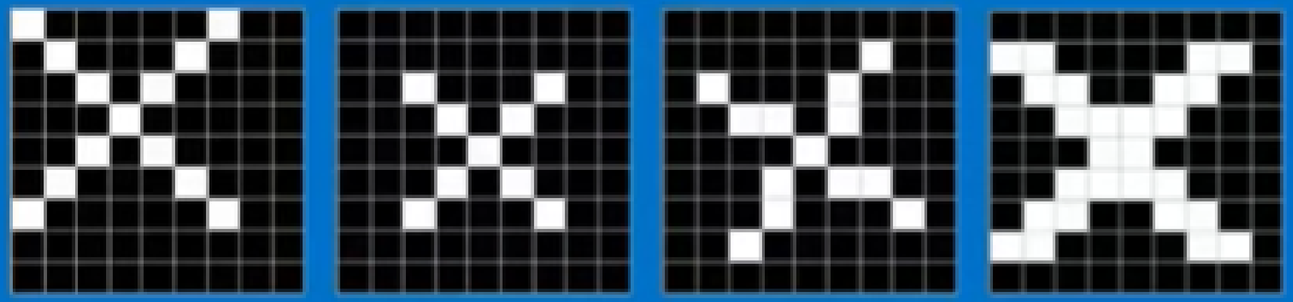




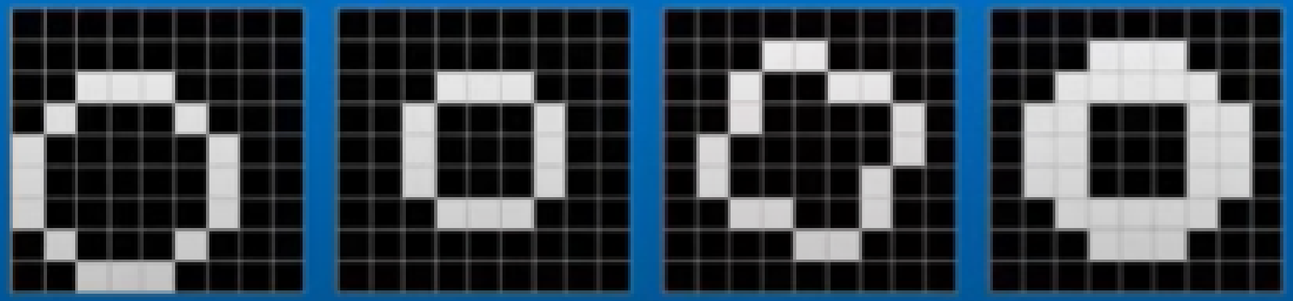
$z=w*x+b$

$a=g(z)$

Trickier cases



translation scaling rotation weight



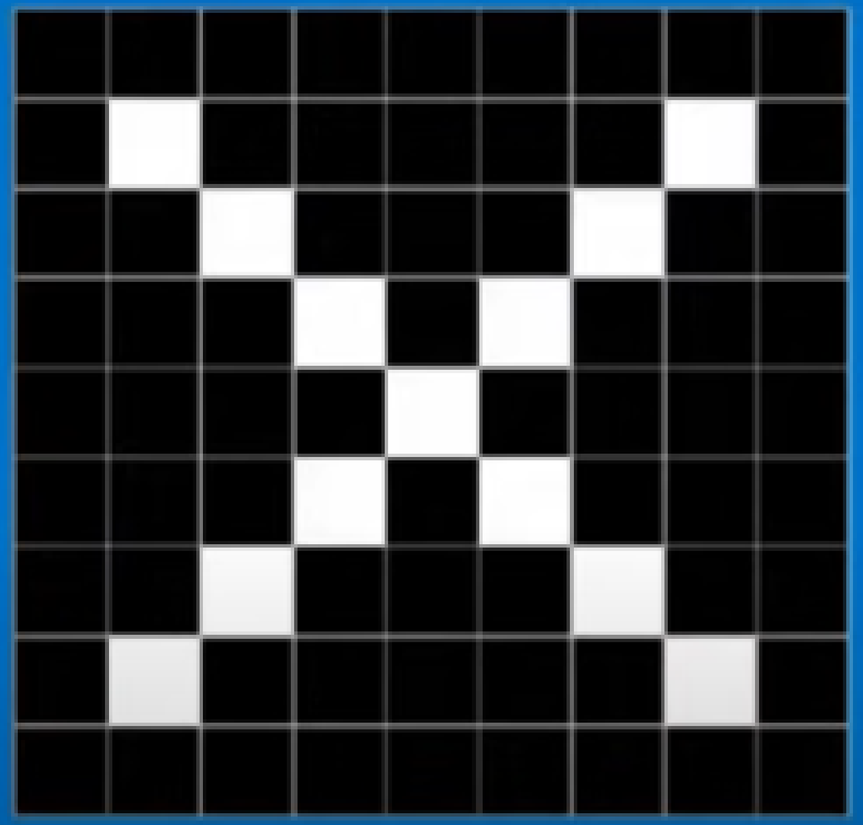
CNN

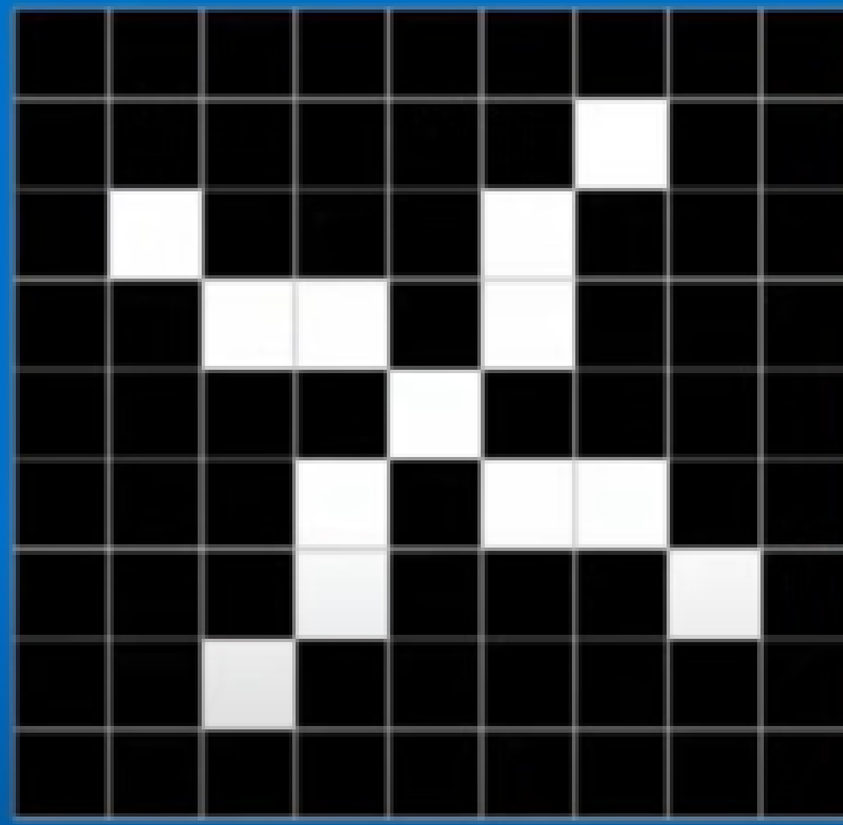
X

CNN

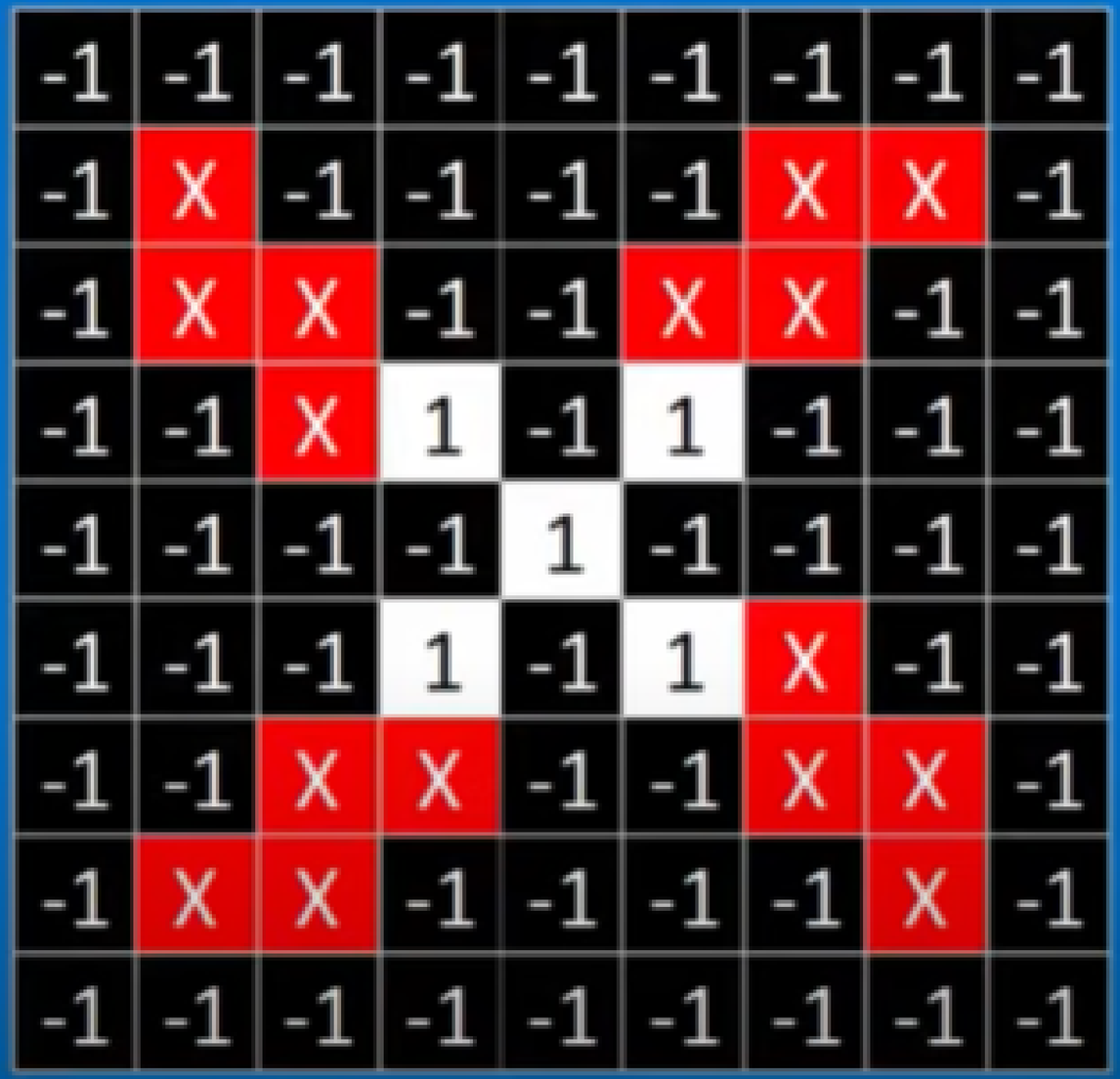
O

Deciding is hard





What computers see

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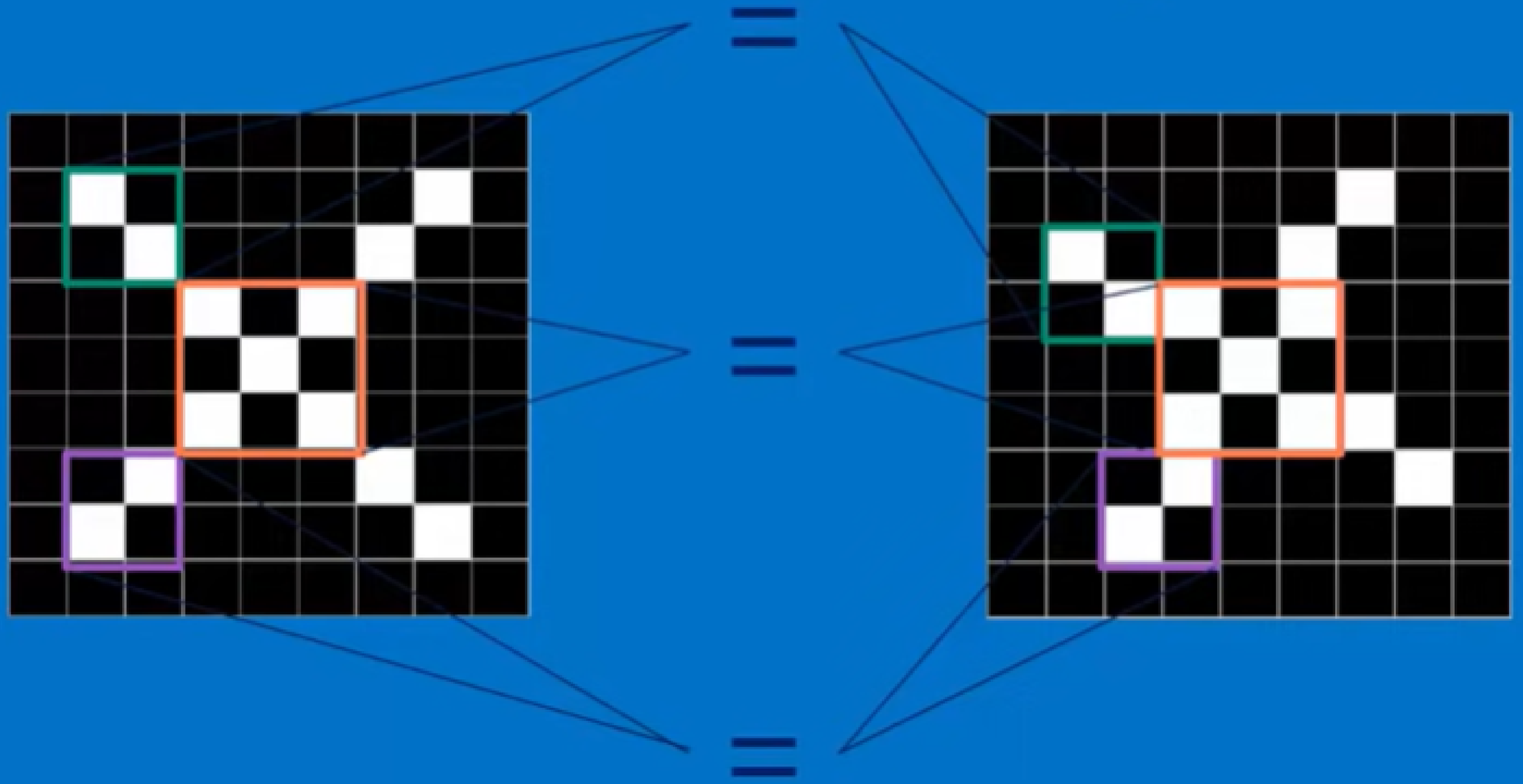
Based on the original graphic novel "Meitantei Conan" by Gosho Aoyama published by Shogakukan Inc.

ConvNets match pieces of the image

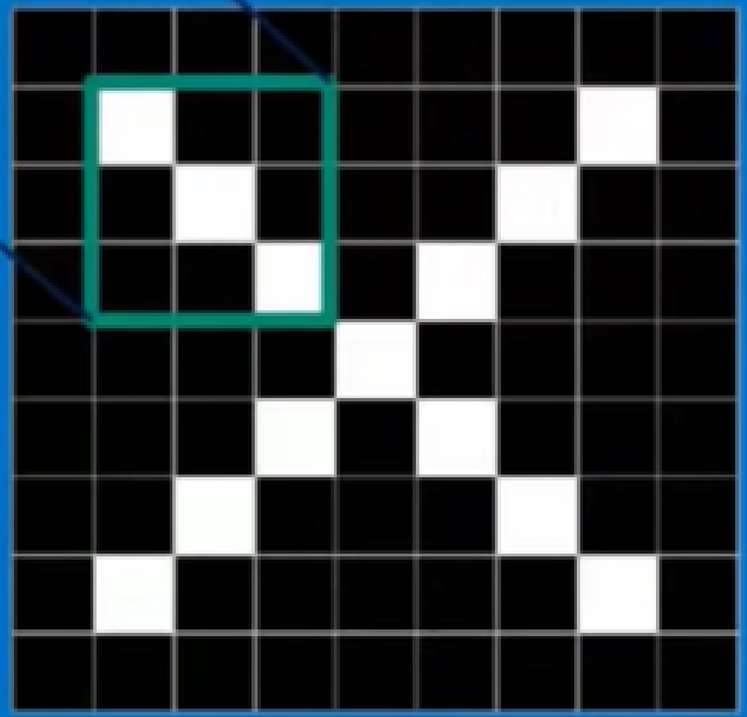


features

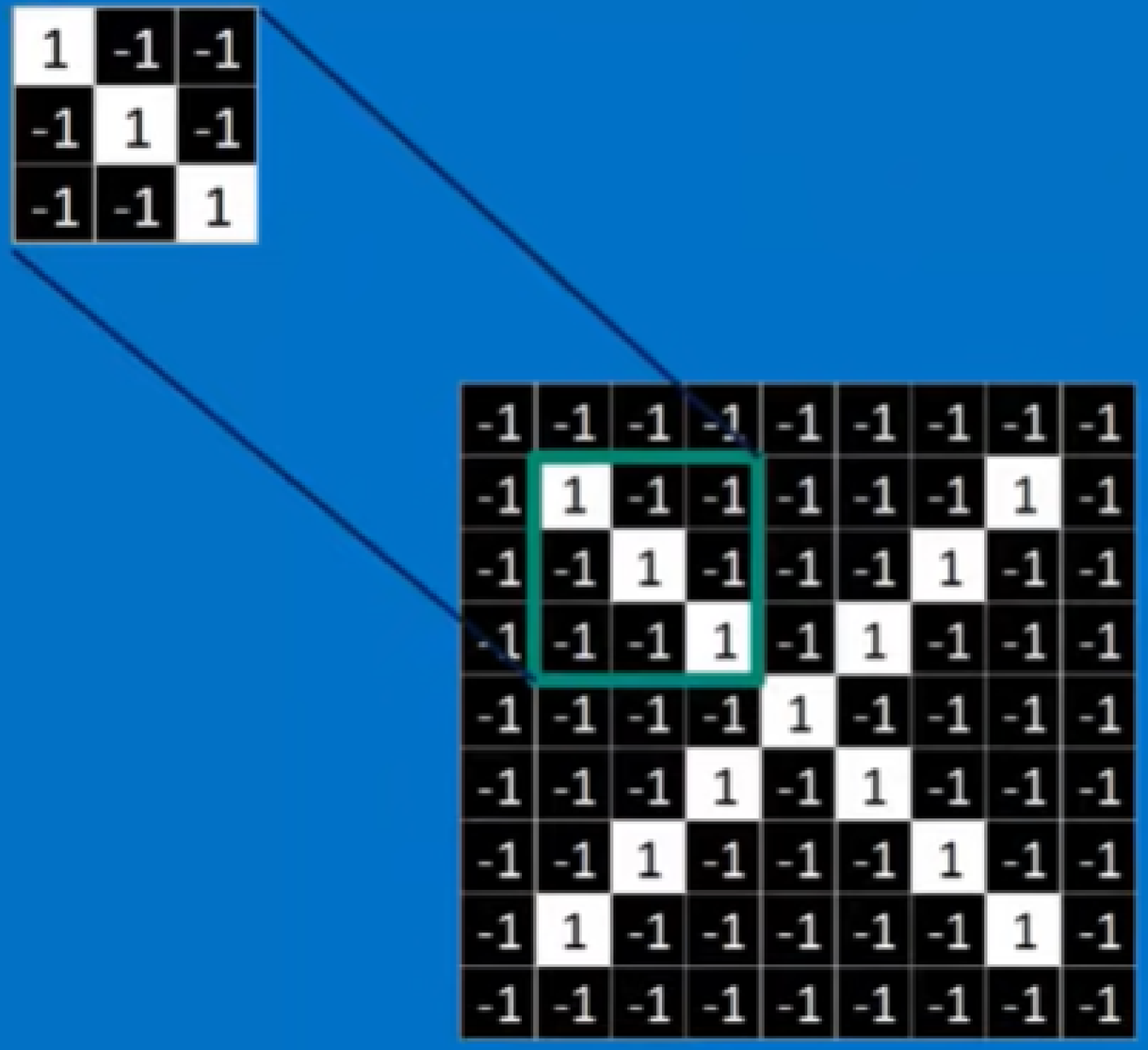
1	-1	-1
-1	1	-1
-1	-1	1

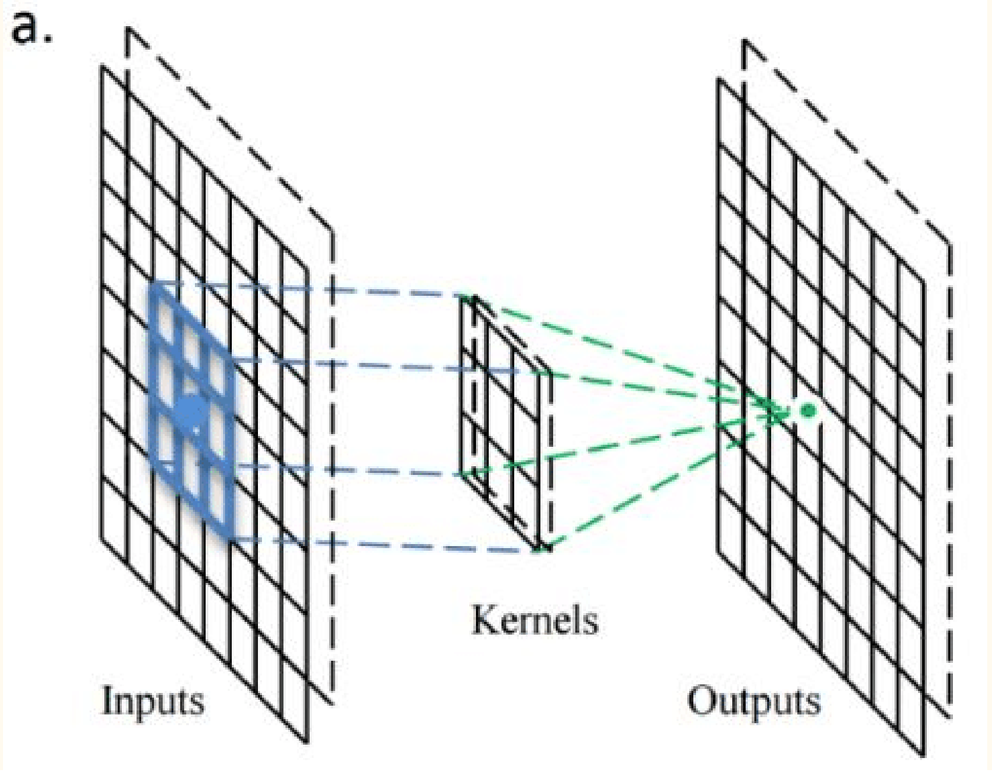
1	-1	1
-1	1	-1
1	-1	1

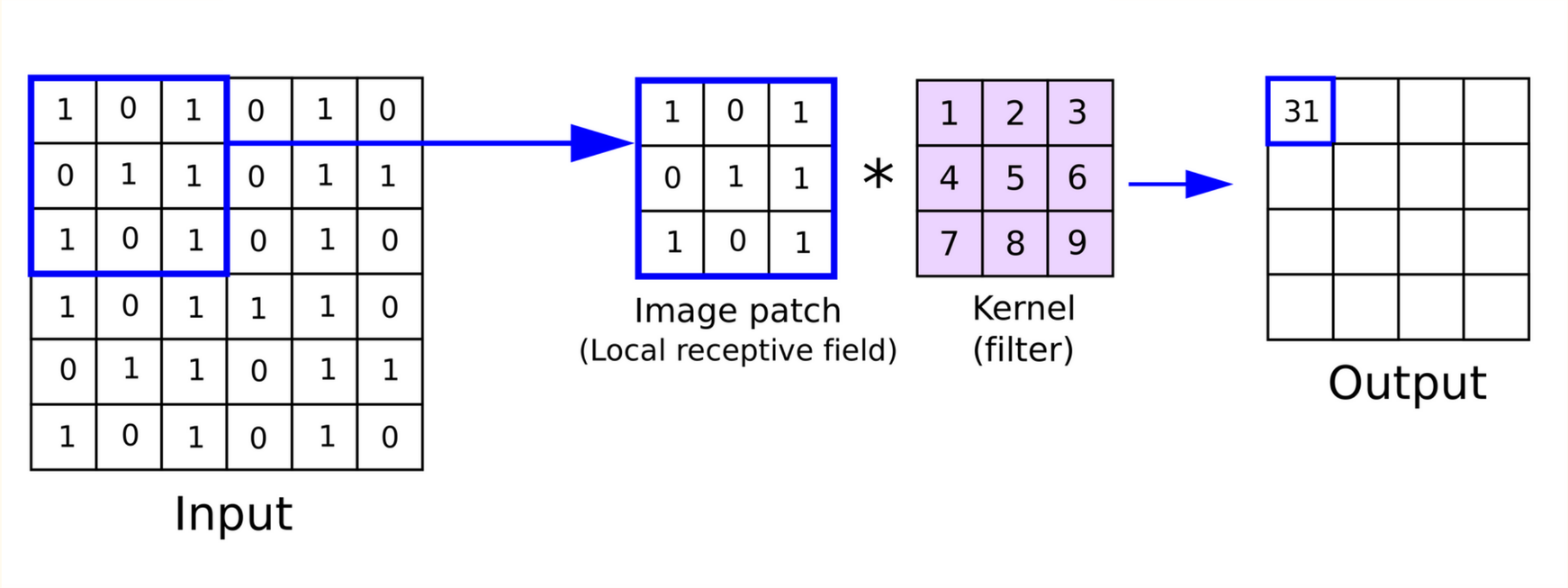
-1	-1	1
-1	1	-1
1	-1	-1



Filtering: The math behind the match




a.
Inputs
Kernels
Outputs


1 0 1 0 1 0
0 1 1 0 1 1
1 0 1 0 1 0
1 0 1 1 1 0
0 1 1 0 1 1
1 0 1 0 1 0
Input
1 0 1
0 1 1
1 0 1
Image patch
(Local receptive field)
*
1 2 3
4 5 6
7 8 9
Kernel
(filter)
31
Output

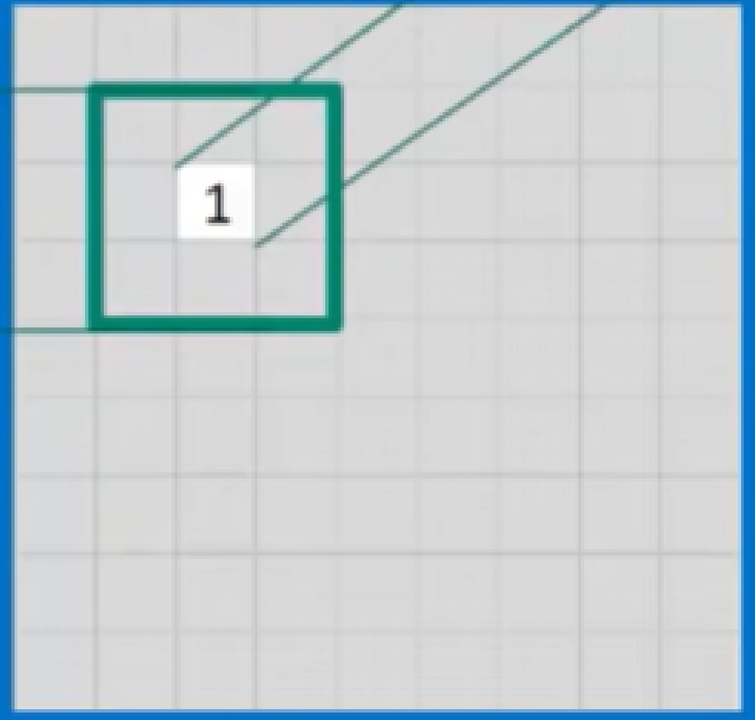
Filtering: The math behind the match

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

1	1	1
1	1	1
1	1	1

$$\frac{1+1+1+1+1+1+1+1+1}{9} = 1$$

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



Convolution: Trying every possible match

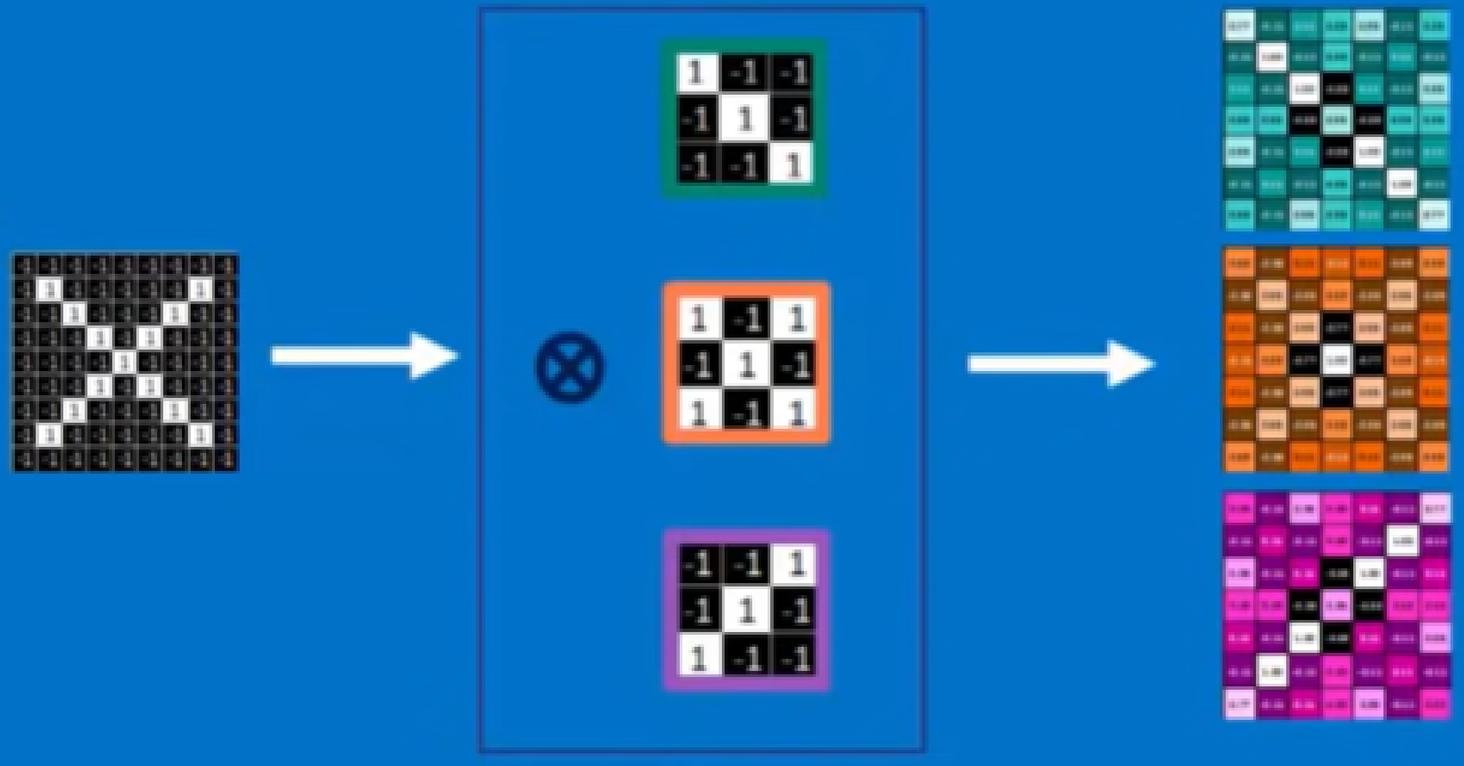
1	-1	-1
-1	1	-1
-1	-1	1

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

0.77	-0.11	0.11	0.33	0.55	-0.11	0.33
-0.11	1.00	-0.11	0.33	-0.11	0.11	-0.11
0.11	-0.11	1.00	-0.33	0.11	-0.11	0.55
0.33	0.33	-0.33	0.55	-0.33	0.33	0.33
0.55	-0.11	0.11	-0.33	1.00	-0.11	0.11
-0.11	0.11	-0.11	0.33	-0.11	1.00	-0.11
0.33	-0.11	0.55	0.33	0.11	-0.11	0.77

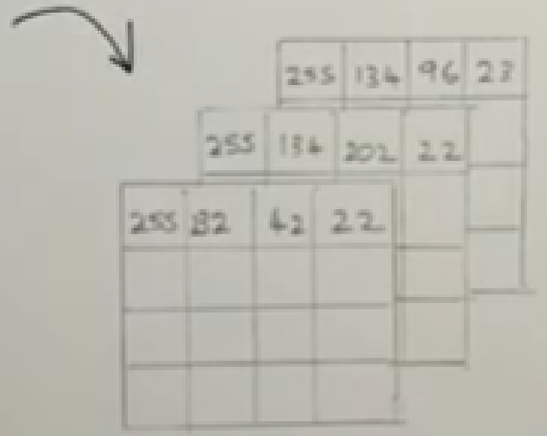
Convolution layer

One image becomes a stack of filtered images



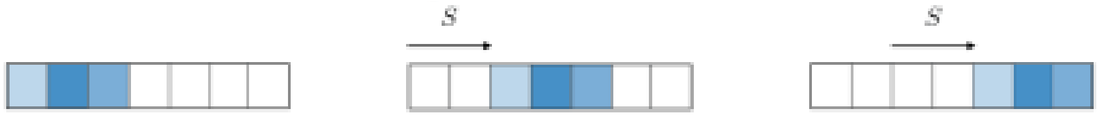
Neural Network Basics

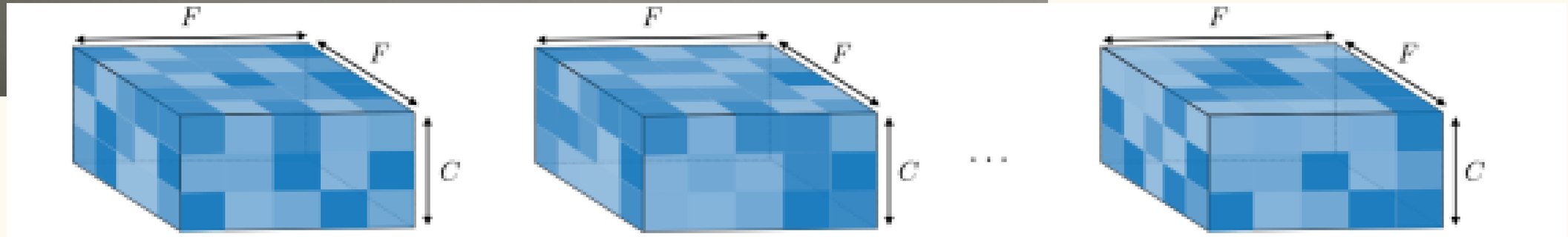
36×36×3



36×36×3 = 3888

❒ **Stride** – For a convolutional or a pooling operation, the stride S denotes the number of pixels by which the window moves after each operation.





شكرا على حسن المتابعة والاهتمام