



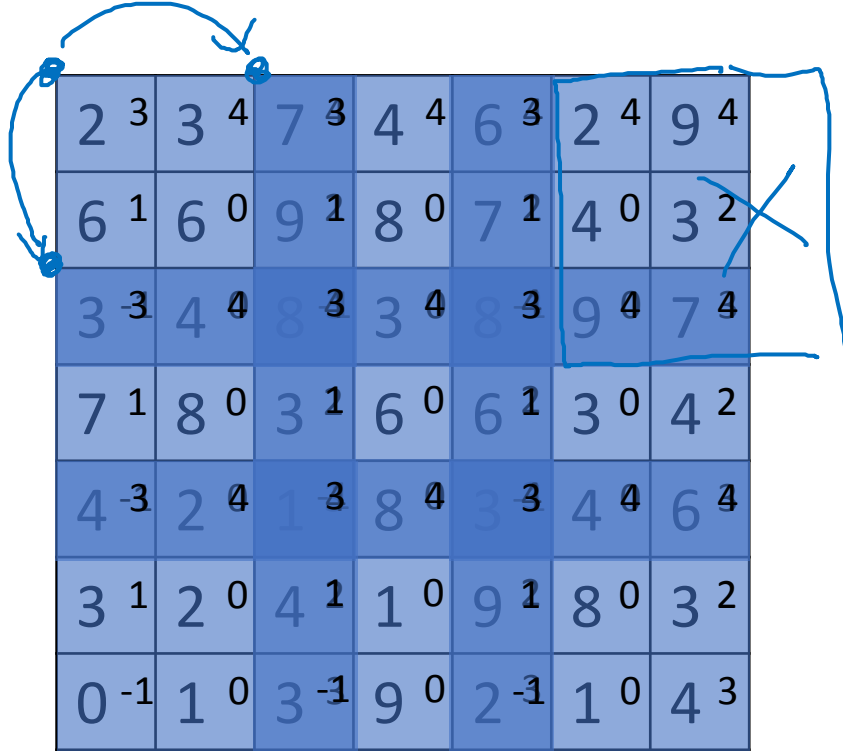
deeplearning.ai

# Convolutional Neural Networks

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Strided  
convolutions

# Strided convolution



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

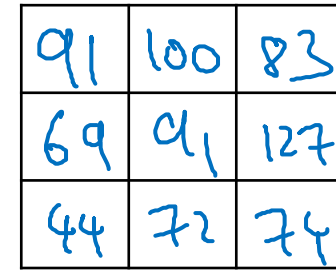
7x7

\*

3	4	4
1	0	2
-1	0	3

3x3

=



91	100	83
69	91	127
44	72	74

3x3

Stride = 2

$\lfloor z \rfloor = \text{floor}(z)$

$n \times n$  \*  $f \times f$   
 padding  $p$  stride  $s$   
 $s = 2$

$$\left\lfloor \frac{n + 2p - f}{s} + 1 \right\rfloor \times \left\lfloor \frac{n + 2p - f}{s} + 1 \right\rfloor$$

$$\frac{7 + 0 - 3}{2} + 1 = \frac{4}{2} + 1 = 3$$

# Summary of convolutions

$n \times n$  image       $f \times f$  filter

padding  $p$       stride  $s$

Output Size:

$$\left\lfloor \frac{n+2p-f}{s} + 1 \right\rfloor \times \left\lfloor \underbrace{\frac{n+2p-f}{s}} + 1 \right\rfloor$$

# Technical note on cross-correlation vs. convolution

Convolution in math textbook:

2 <sup>7</sup>	3 <sup>2</sup>	7 <sup>5</sup>	4	6	2
6 <sup>9</sup>	6 <sup>0</sup>	9 <sup>4</sup>	8	7	4
3 <sup>-1</sup>	4 <sup>1</sup>	8 <sup>3</sup>	3	8	9
7	8	3	6	6	3
4	2	1	8	3	4
3	2	4	1	9	8

3	4	5
1	0	2
-1	9	7

7	2	5
9	0	4
-1	1	3


$$(A * B) * C = A * (B * C)$$