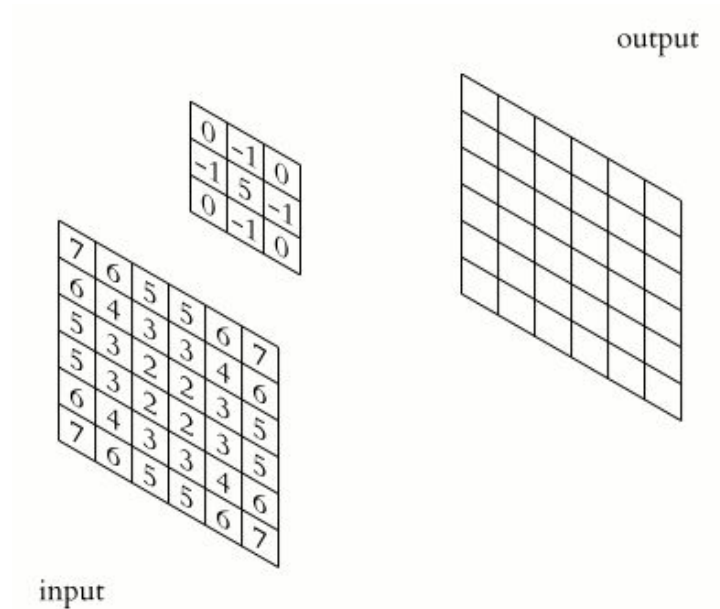


Convolutional Neural Networks Basic

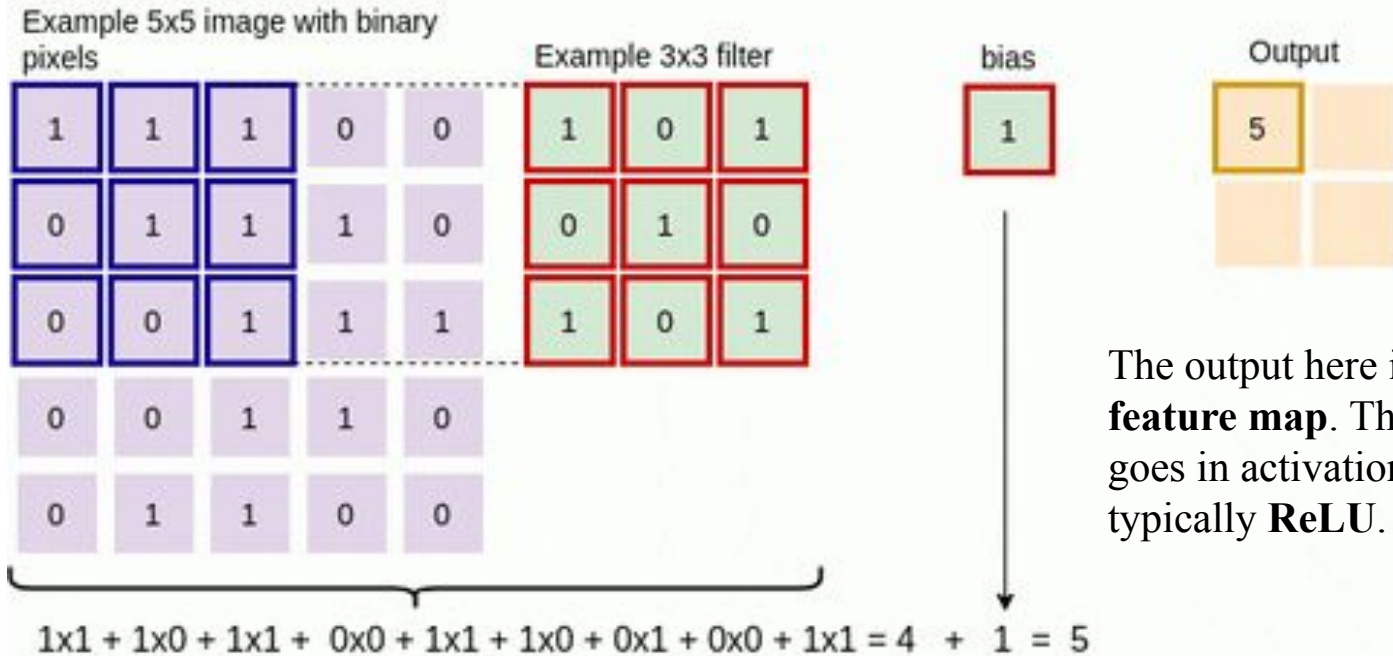
Maleeha Hassan
Helmholtz AI

What is Convolution?

A convolution operation, by definition, is an element-wise multiplication of two matrices, followed by a sum.



Convolutional Layer



Max Pooling

Take the **highest** value from the area covered by the kernel

Example: Kernel of size 2 x 2; stride=(2,2)

3	2	0	0
0	7	1	3
5	2	3	0
0	9	2	3

Convolved Feature (4 x 4)

Output

7	

Max values

Average Pooling

Calculate the **average** value from the area covered by the kernel

3	2	0	0
0	7	1	3
5	2	3	0
0	9	2	3

Convolved Feature (4 x 4)

Output

3	

Average values

0	0	0	0	0	0	...
0	156	155	156	158	158	...
0	153	154	157	159	159	...
0	149	151	155	158	159	...
0	146	146	149	153	158	...
0	145	143	143	148	158	...
...

Input Channel #1 (Red)

0	0	0	0	0	0	...
0	167	166	167	169	169	...
0	164	165	168	170	170	...
0	160	162	166	169	170	...
0	156	156	159	163	168	...
0	155	153	153	158	168	...
...

Input Channel #2 (Green)

0	0	0	0	0	0	...
0	163	162	163	165	165	...
0	160	161	164	166	166	...
0	156	158	162	165	166	...
0	155	155	158	162	167	...
0	154	152	152	157	167	...
...

Input Channel #3 (Blue)

-1	-1	1
0	1	-1
0	1	1

Kernel Channel #1



308

1	0	0
1	-1	-1
1	0	-1

Kernel Channel #2



-498

0	1	1
0	1	0
1	-1	1

Kernel Channel #3



164

+

+

+ 1 = -25



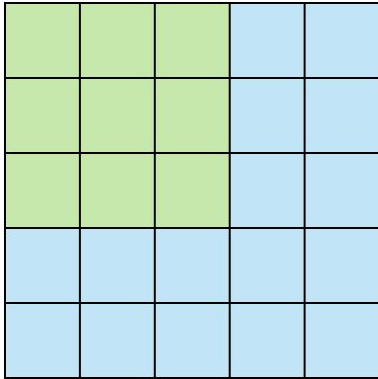
Bias = 1

Output

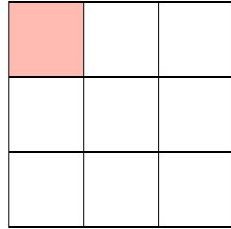
-25				...
				...
				...
				...
				...
...

What is Stride?

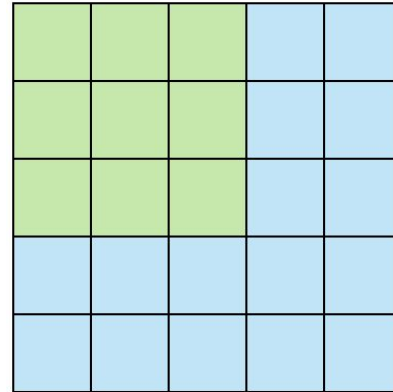
The amount of pixels by which the kernel moves over top of the input matrix is called stride.



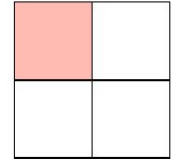
Stride 1



Feature Map

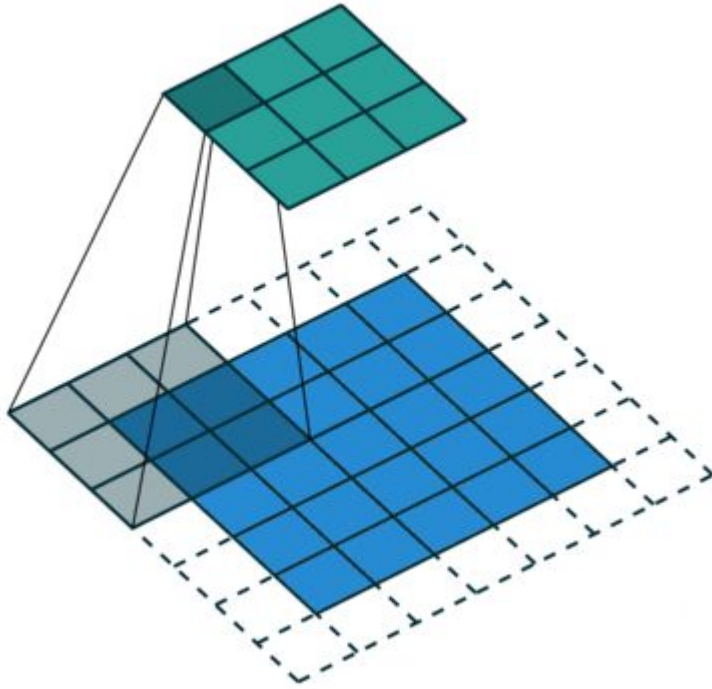


Stride 2



Feature Map

What is Padding?



Input

0 ₂	0 ₀	0 ₁	0	0	0	0
0 ₁	2 ₀	2 ₀	3	3	3	0
0 ₀	0 ₁	1 ₁	3	0	3	0
0	2	3	0	1	3	0
0	3	3	2	1	2	0
0	3	3	0	2	3	0
0	0	0	0	0	0	0

Output

1	6	5
7	10	9
7	10	8