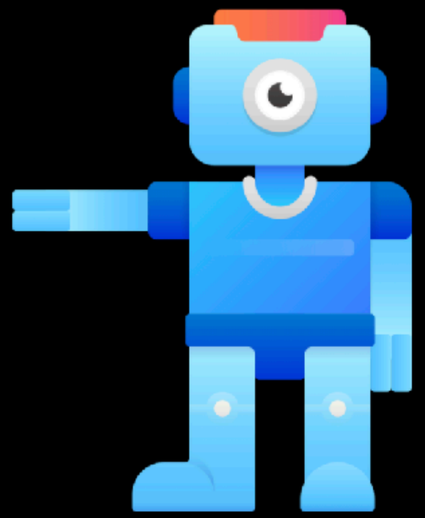


MODERN COMPUTER VISION

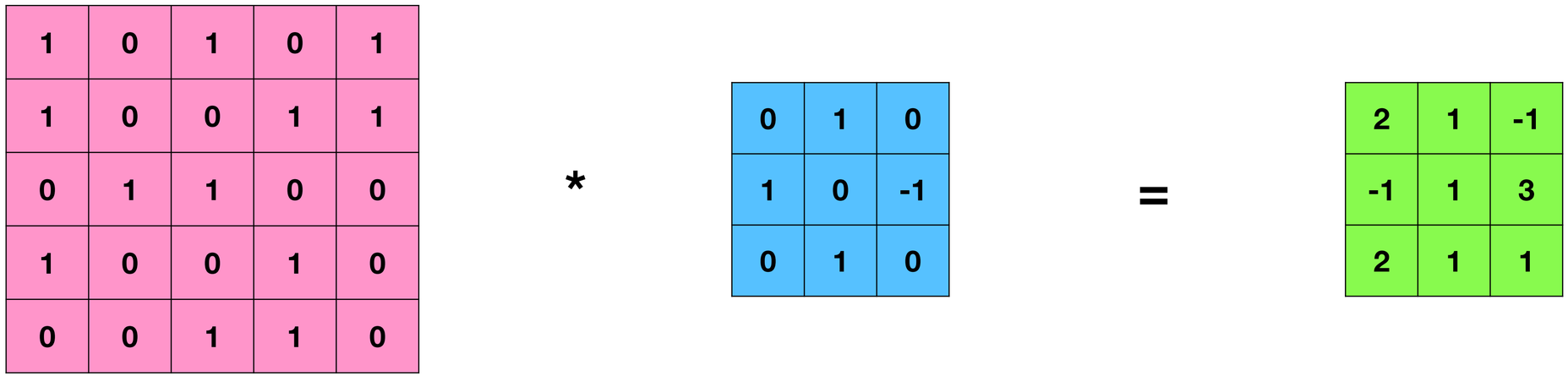
BY RAJEEV RATAN

Padding

Manipulating the input size

Padding

Notice How Conv Filters Produce an Output Smaller than the Input



5 x 5

$n \times n$

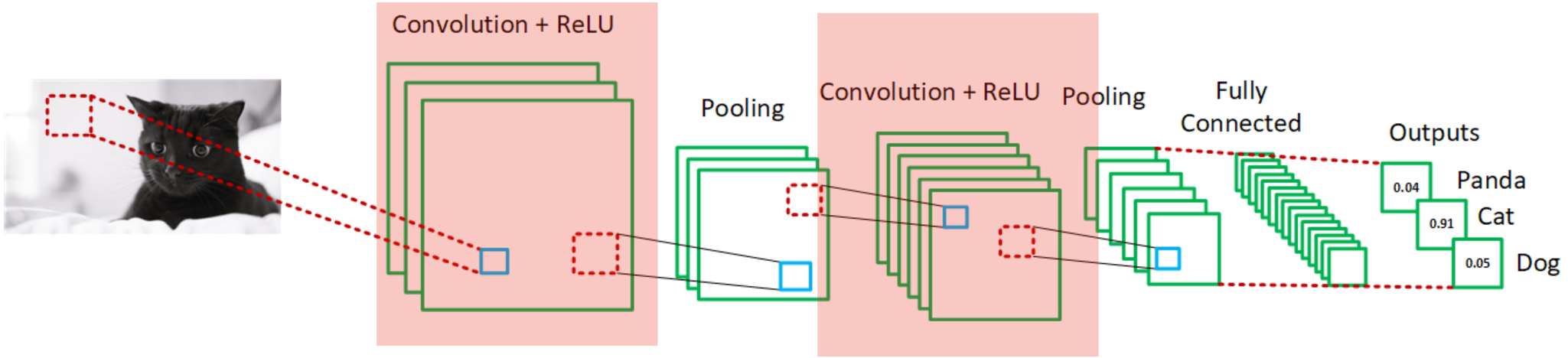
3 x 3

$f \times f$

3 x 3

$m \times m$

CNNs can have several sequences of Convolution layers



Consecutive Conv layers would keep shrinking the output

Can we preserve our image size?

We've added a 1 pixel pad of zeros (zero padding) around our input

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

*

0	1	0
1	0	-1
0	1	0

=

7 x 7

$n \times n$

3 x 3

$f \times f$

Padding

Let’s Perform our Convolution with the Padding

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

*

0	1	0
1	0	-1
0	1	0

=

7 x 7

$n \times n$

3 x 3

$f \times f$

Padding

Let’s Perform our Convolution with the Padding

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

*

0	1	0
1	0	-1
0	1	0

=

7 x 7

$n \times n$

3 x 3

$f \times f$

Padding

Let’s Perform our Convolution with the Padding

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

7 x 7

$n \times n$

*

0	1	0
1	0	-1
0	1	0

3 x 3

$f \times f$

=

Padding

Let’s Perform our Convolution with the Padding

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

7 x 7

$n \times n$

*

0	1	0
1	0	-1
0	1	0

3 x 3

$f \times f$

=

Padding

Let’s Perform our Convolution with the Padding

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

*

0	1	0
1	0	-1
0	1	0

=

7 x 7

$n \times n$

3 x 3

$f \times f$

Padding

Let’s Perform our Convolution with the Padding

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

7 x 7

$n \times n$

*

0	1	0
1	0	-1
0	1	0

3 x 3

$f \times f$

=

Padding

Let’s Perform our Convolution with the Padding

Feature Map Size = $n - f + 1 = m$

Feature Map Size = $7 - 3 + 1 = 5$

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

7 x 7

$n \times n$

*

0	1	0
1	0	-1
0	1	0

3 x 3

$f \times f$

=

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

5 x 5

$m \times m$

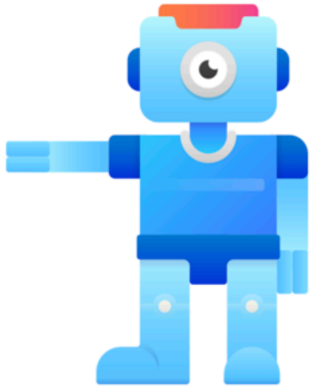
Why Use Padding?

- For very deep networks we don’t want to keep reducing the size
- Pixels at the edges contribute less to the output Feature Maps, thus we’re throwing away information from them

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

Without padding, our top left pixel is only touched by the Conv Filter once

Whereas, our centre pixel is passed over numerous times



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Next...

Stride