Introduction to Deep Learning (CS474)

Lecture 13

Rupam

Outline

- **Module 2**
  - Understanding Convolutions

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Introduction

- Let's get to the bottom of what convolutions are and how we can use them in our neural networks.

- If we want to recognize patterns corresponding to objects, like an airplane in the sky, we will likely need to look at how nearby pixels are arranged, and we will be less interested in how pixels that are far from each other appear in combination.

- Convolution is defined for a 2D image as the scalar product of a weight matrix, the kernel, with every neighborhood in the input.

Slide credit: E. STEVENS, L. ANTIGA, and T. VIEHMANN

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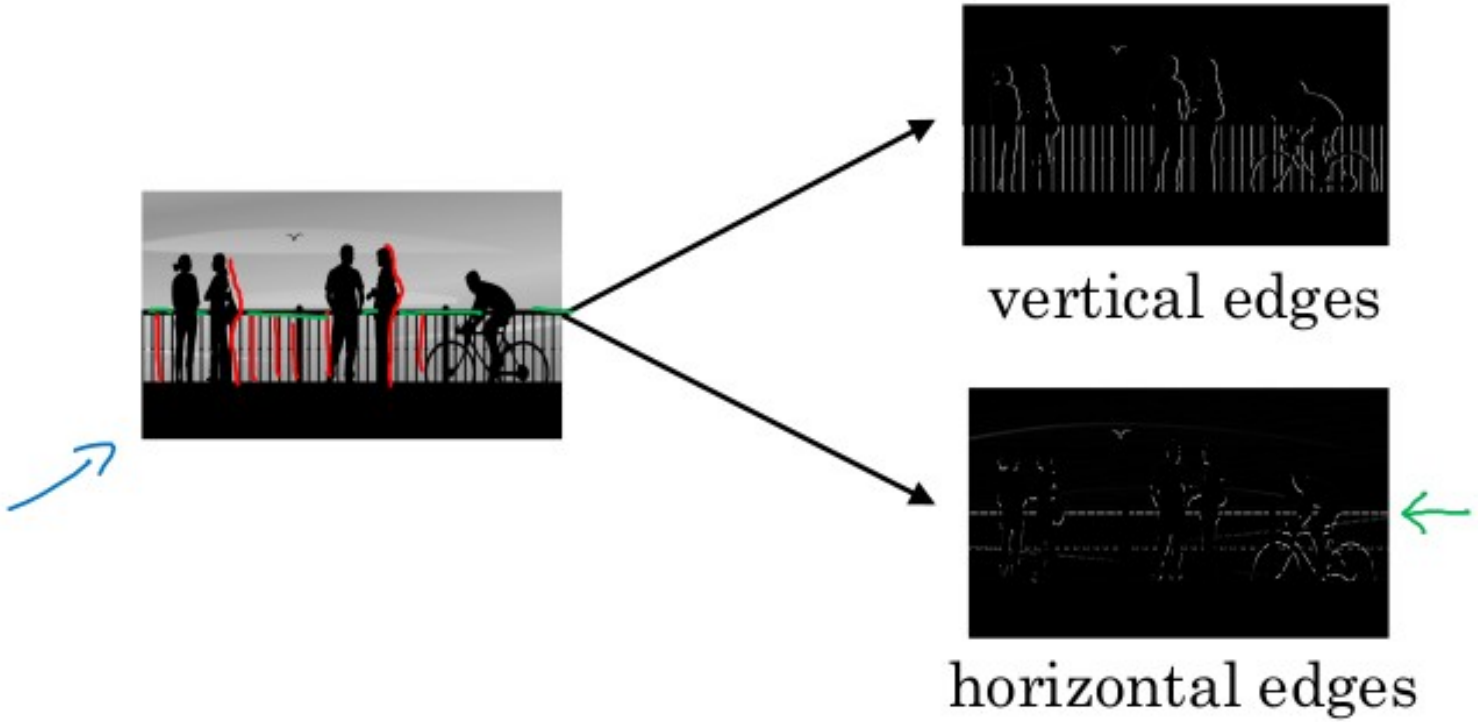
Example



Slide credit: Prof. Andrew Ng

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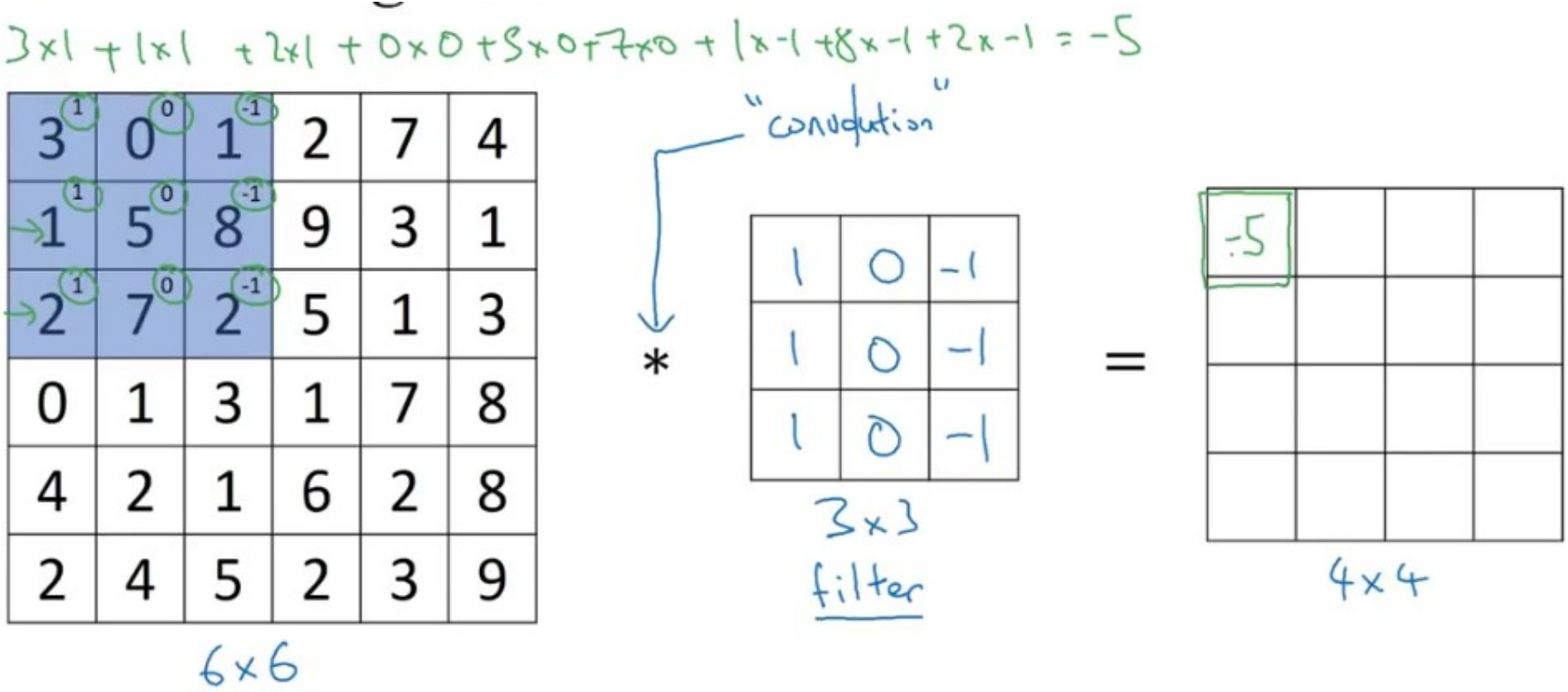
Example: Vertical Edge Detection



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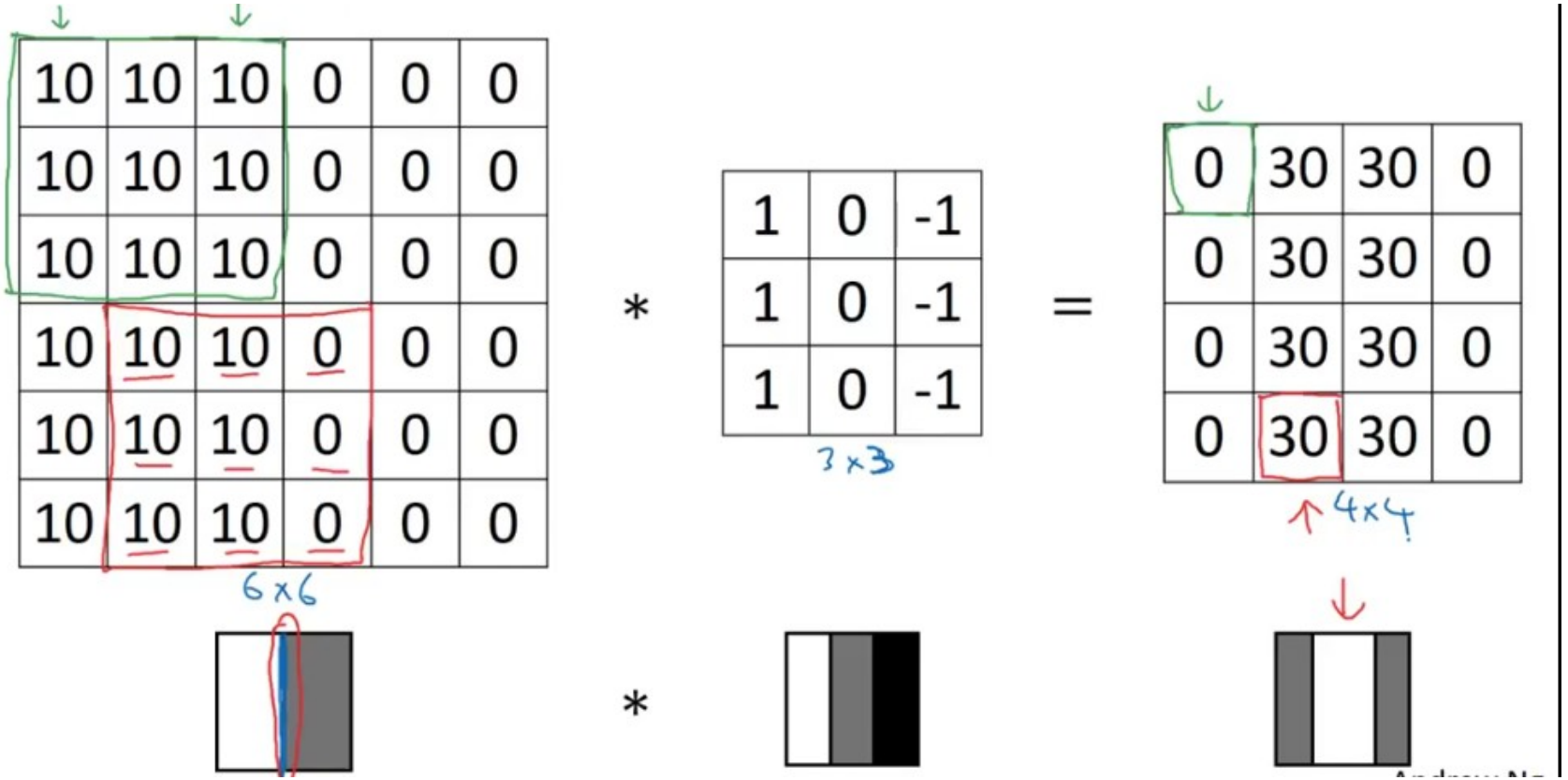
Example: Vertical Edge Detection



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Example: Vertical and Horizontal Edge Detection

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

Vertical

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

Horizontal

10	10	10	0	0	0
10	10	10	0	0	0
10	10	10	0	0	0
0	0	0	10	10	10
0	0	0	10	10	10
0	0	0	10	10	10

*

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

=

0	0	0	0
30	10	-10	-30
30	10	-10	-30
0	0	0	0

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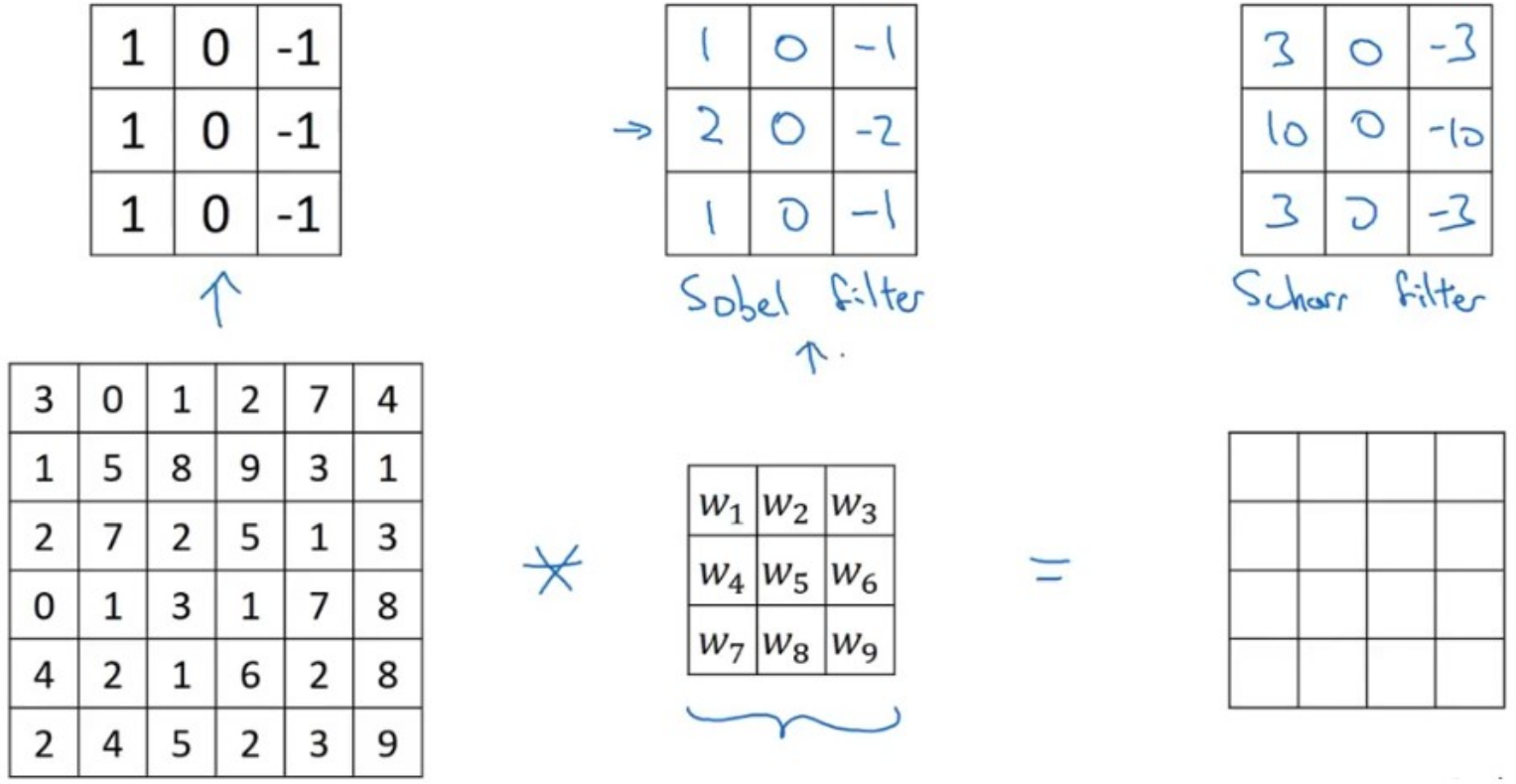
Example:



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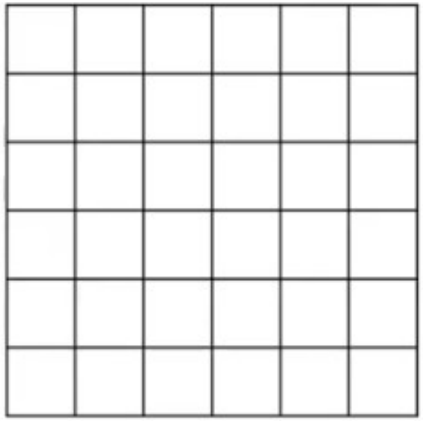
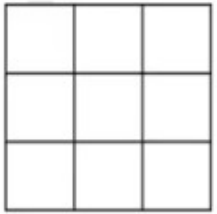
Problem with Earlier Set-Up



*



3×3
f×f

=

6×6
n×n

n-f+1 × n-f+1
6-3+1=4

→ 4×4

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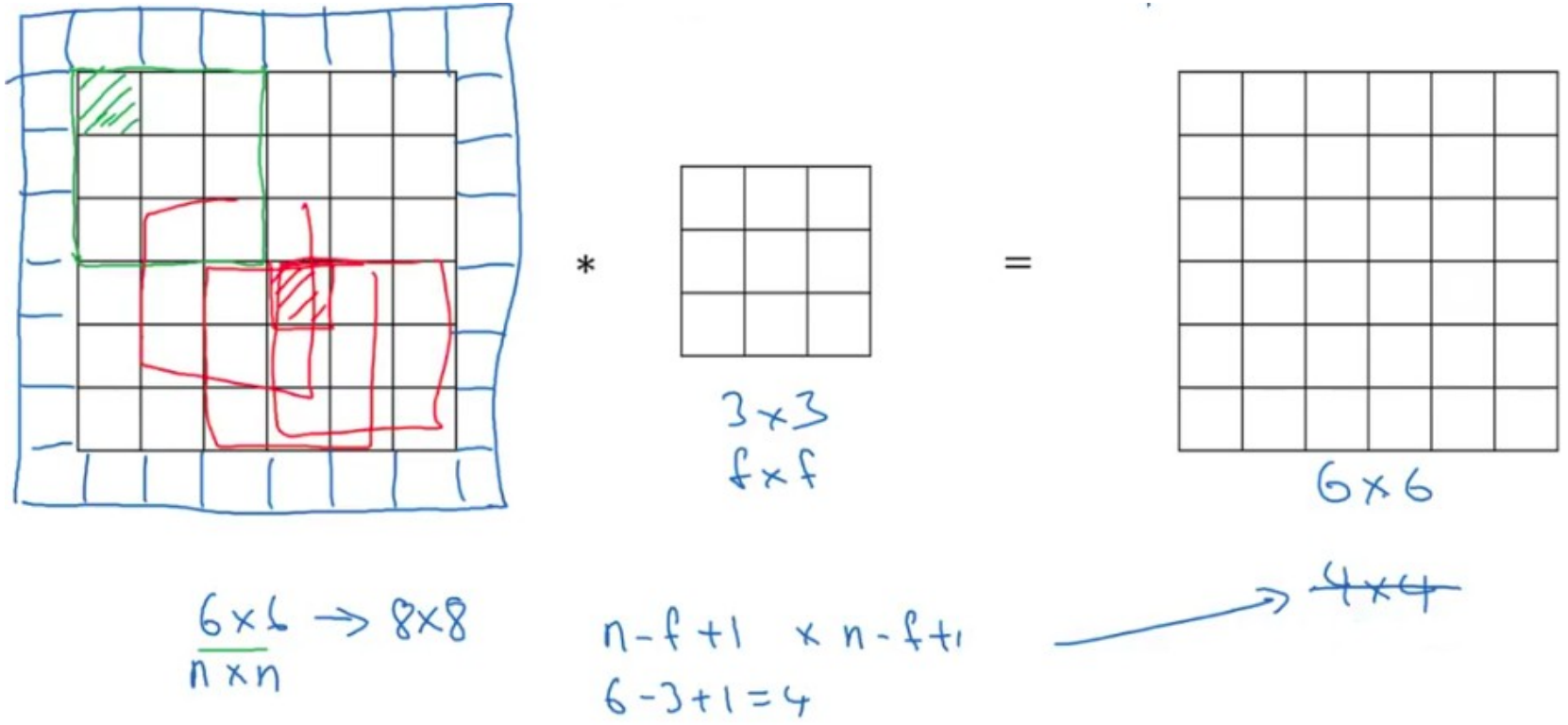
Padding



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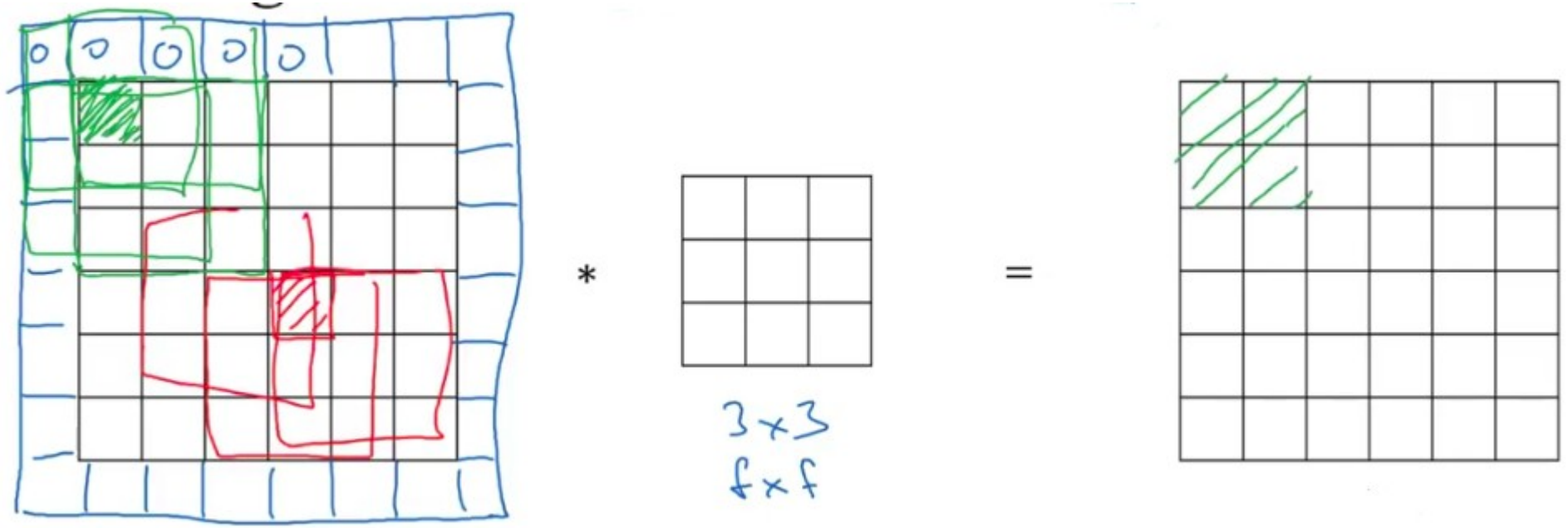
Padding



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Padding

↳ no padding

"Valid": $n \times n * f \times f \rightarrow n-f+1 \times n-f+1$

$6 \times 6 * 3 \times 3 \rightarrow 4 \times 4$

"Same": Pad so that output size is the same as the input size. [n+2p-f+1=n]

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References

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