# CSC420: Tutorial 2

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# Overview

P0: Convolution Output Dimensions

- as a warm-up, we look at some output dimensions

P1: 2D Convolution from Scratch

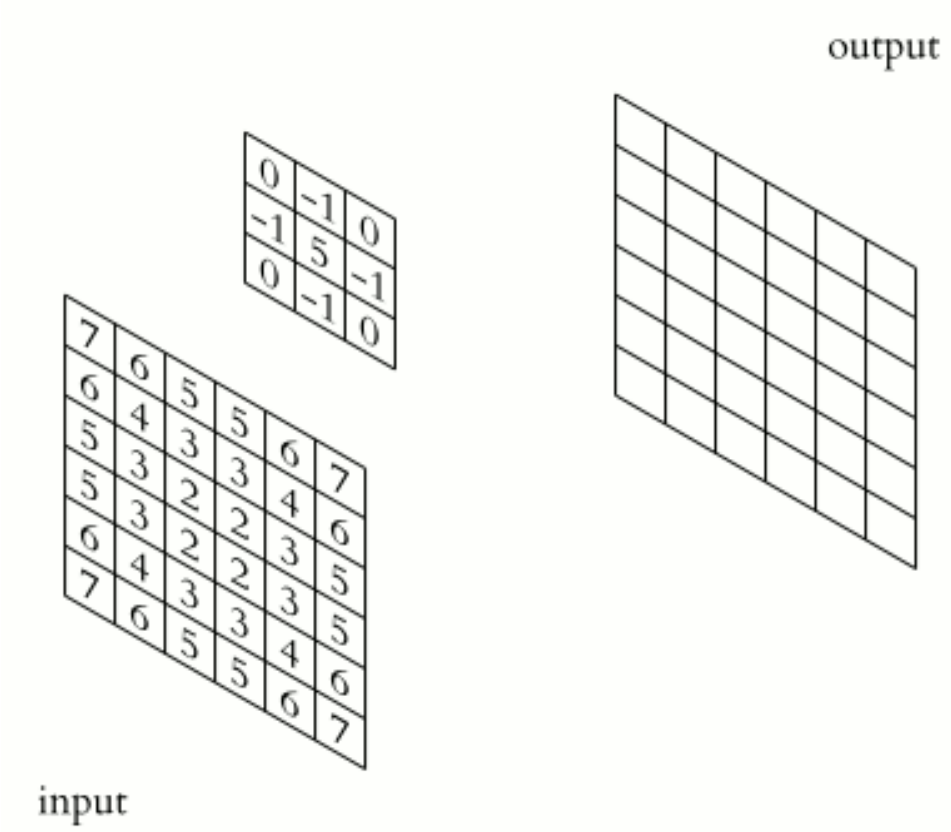
- in the first half, we go down one abstraction layer implementing 2D convolution from scratch in numpy

P2: Fine-tune a Convolutional Backbone

- in the second half, we go up one abstraction layer and modify already trained convolutional networks to classification and segmentation

# P0: Convolution Output Dimensions

- sliding an inner product with a learnable kernel over the image
- design choices:
  - filter size *f*
  - number of filters $c_{out}$
  - padding *p*
  - stride *s*




Source: https://commons.wikimedia.org/wiki/File:2D_Convolution_Animation.gif

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- input tensor dimension: (b, $c_{in}$, h, w)

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- keep batch dimension, generate $c_{out}$ feature maps: (b, $c_{out}$, …)
- assume quadratic kernel and uniform padding and stride

- output overall: (b, $c_{out}$, $\frac{(\text{h} - \text{f} + (2 \times \text{p}))}{s} + 1$, $\frac{(\text{w} - \text{f} + (2 \times \text{p}))}{s} + 1$)