Some Basic Deep Architectures

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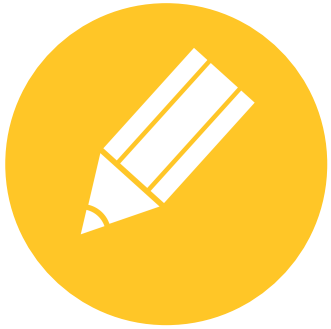
Objectives

Objective

Appraise the detailed architecture of a basic convolutional neural network



Objective

Explain the basic concepts and corresponding architecture for auto-encoders and recurrent neural networks

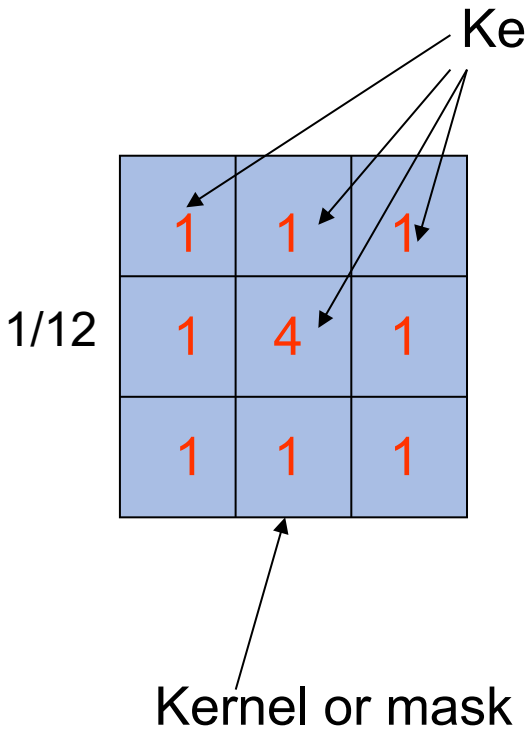
Overview

- Convolutional Neural Network (CNN)
  - will be given the most attention, for its wide range of application
- Auto-encoder
- Recurrent Neural Networks (RNN)

Convolutional Neural Network (CNN)

- Most useful for input data defined on grid-like structures, like images or audio
- Built upon concept of “convolution” for signal/image filtering
- Invokes other concepts like pooling, weight-sharing, and (visual) receptive field, etc.

Image Filtering via Convolution - 1 of 5



255	128	128	240	1	128	24	255
255	128	245	240	1	128	24	255
245	128	245	240	1	128	128	128
24	24	24	255	255	0	0	0
0	0	0	0	0	0	0	0
245	245	128	128	128	128	245	245
245	245	245	240	240	240	255	240
255	240	128	240	240	128	240	255

image

Image Filtering via Convolution - 2 of 5

New pixel value = (1*255+ 1*128+ 1*128+ 1*255+ 4*128+ 1*245+ 1*245+ 1*128+ 1*245)/12= 2141/12 =178

255 (1)	128 (1)	128 (1)	240	1	128	24	255
255 (1)	128 (4)	245 (1)	240	1	128	24	255
245 (1)	128 (1)	245 (1)	240	1	128	128	128
24	24	24	255	255	0	0	0
0	0	0	0	0	0	0	0
245	245	128	128	128	128	245	245
245	245	245	240	240	240	255	240
255	240	128	240	240	128	240	255

Image Filtering via Convolution - 3 of 5

255	128	128	240	1	128	24	255
255	178	245	240	1	128	24	255
245	128	245	240	1	128	128	128
24	24	24	255	255	0	0	0
0	0	0	0	0	0	0	0
245	245	128	128	128	128	245	245
245	245	245	240	240	240	255	240
255	240	128	240	240	128	240	255

Image Filtering via Convolution - 4 of 5

New pixel value = (1*128+ 1*128+ 1*240+ 1*178+ 4*245+ 1*240+ 1*128+ 1*245+ 1*240)/12= 2507/12 =209

255	128	128	240	1	128	24	255
255	178	245	240	1	128	24	255
245	128	245	240	1	128	128	128
24	24	24	255	255	0	0	0
0	0	0	0	0	0	0	0
245	245	128	128	128	128	245	245
245	245	245	240	240	240	255	240
255	240	128	240	240	128	240	255

Image Filtering via Convolution - 5 of 5

255	128	128	240	1	128	24	255
255	178	209	240	1	128	24	255
245	128	245	240	1	128	128	128
24	24	24	255	255	0	0	0
0	0	0	0	0	0	0	0
245	245	128	128	128	128	245	245
245	245	245	240	240	240	255	240
255	240	128	240	240	128	240	255

Image Filtering via Convolution: Kernels

Examples of Kernels:

1/12

1	1	1
1	4	1
1	1	1

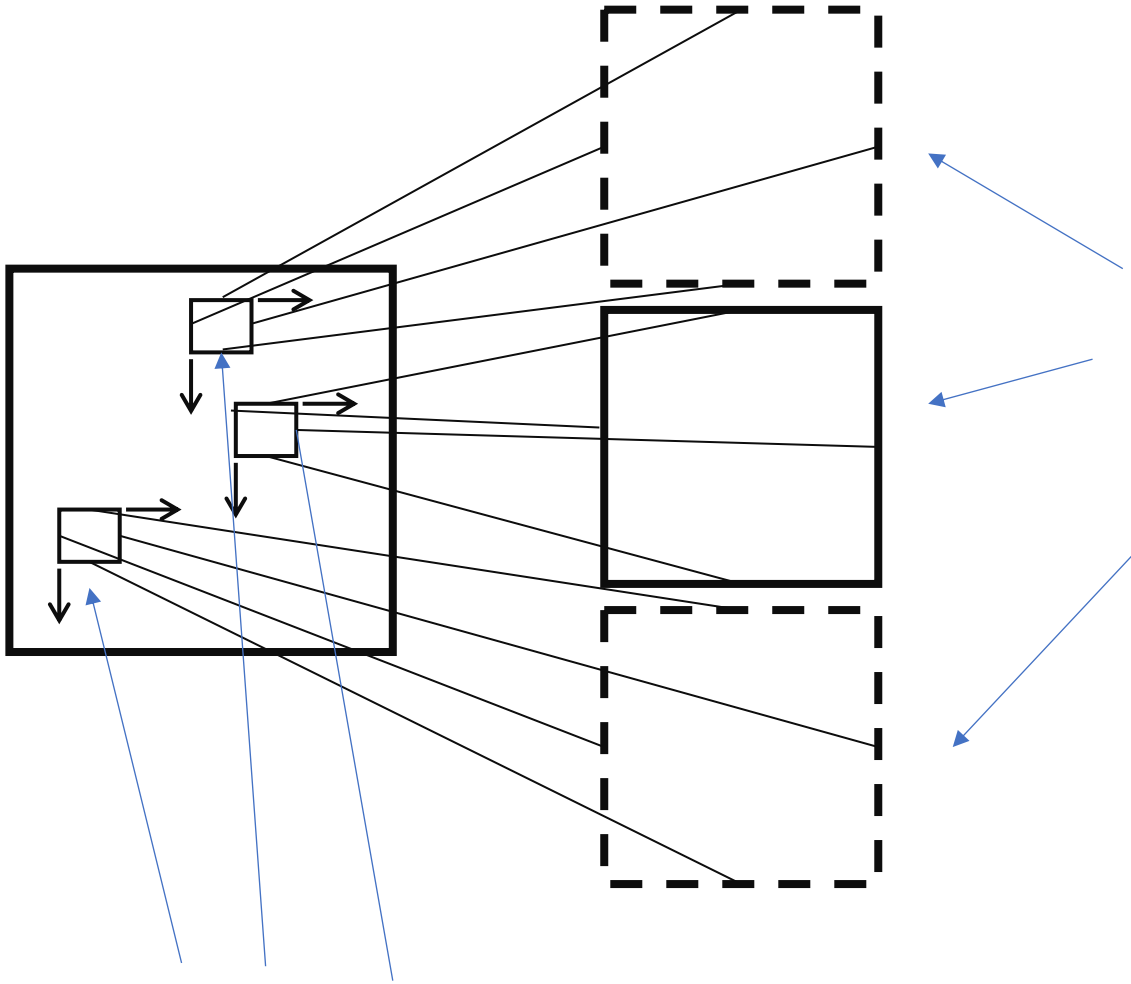
Smoothing/Noise-reduction

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

(Vertical) Edge detection

- By varying coefficients of the kernel, we can achieve different goals
  - Smoothing, sharpening, detecting edges, etc.
- Better yet: can we learn proper kernels?  Part of CNN objective

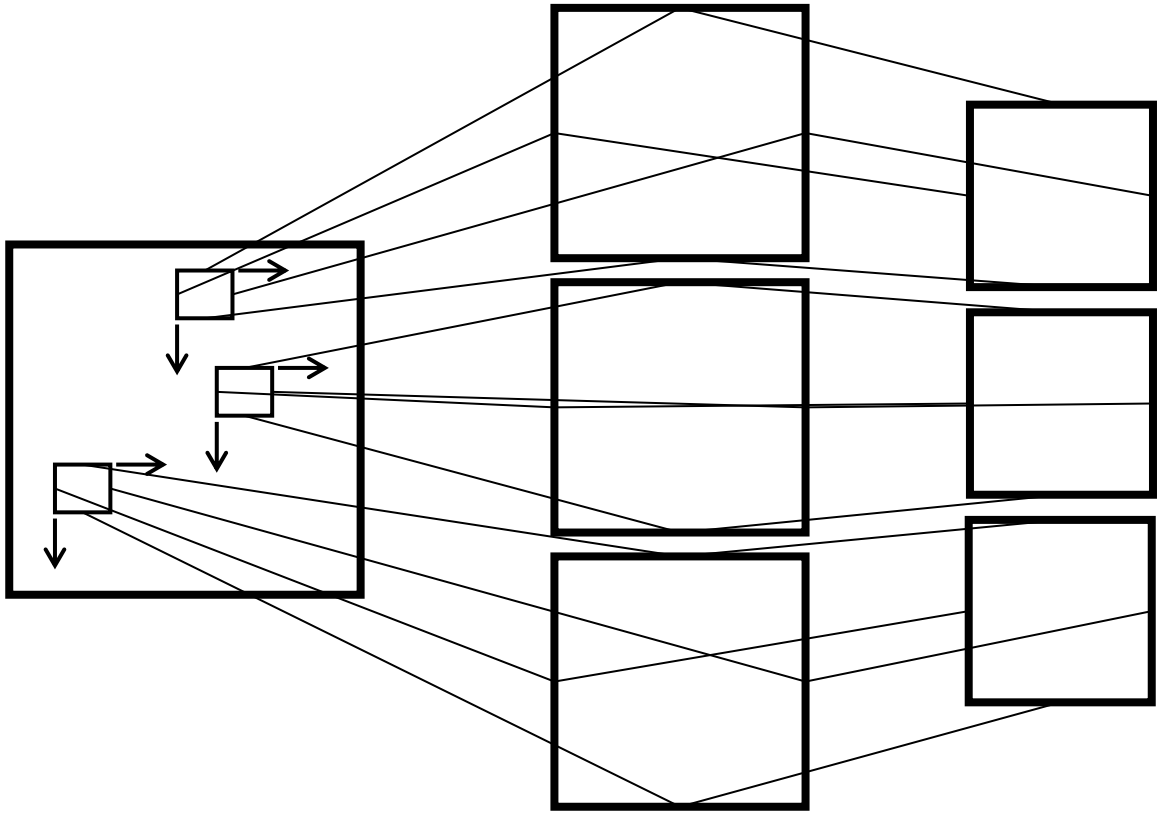
2D Convolutional Neuron



The number of kernels defines the number of *features maps* (*channels*).

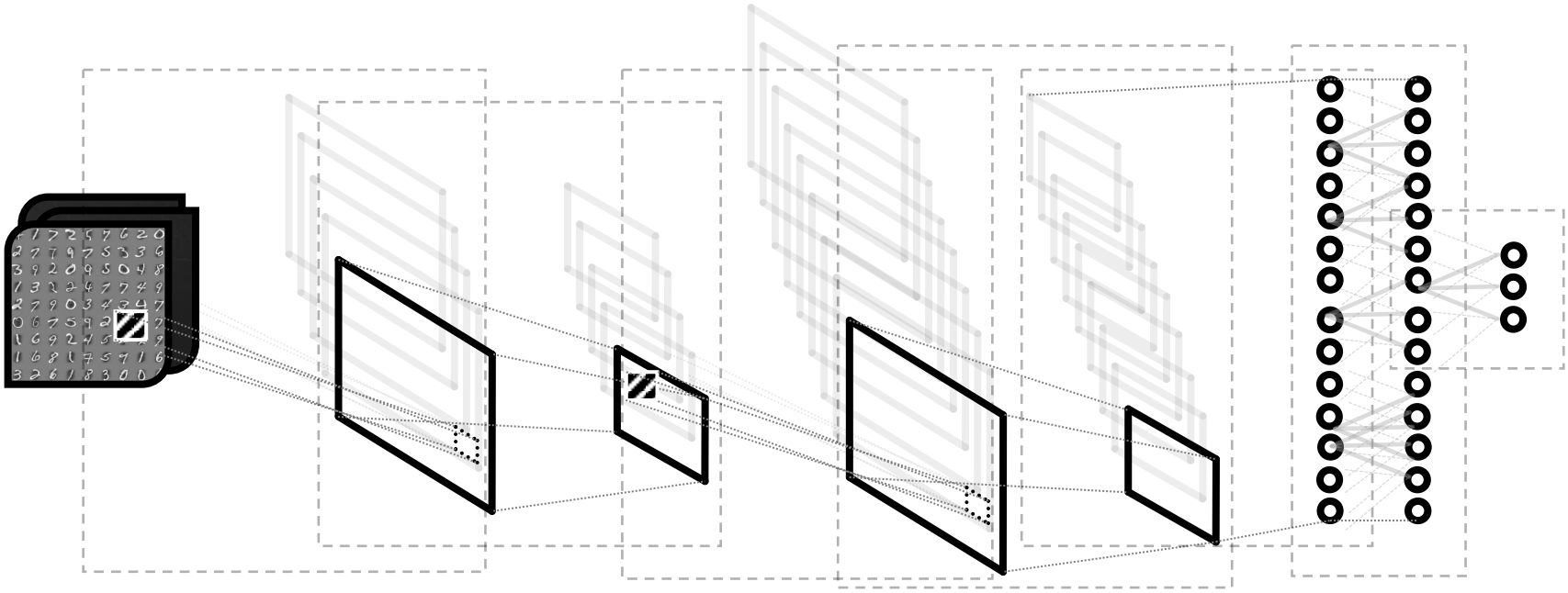
The sizes of the kernels define the *receptive fields*.

Convpool Layer



Convolution, pooling, and going through some activations

Illustrating A Simple CNN



Some convpool layers plus some fully-connected layers