Dilation and Upconvolution

Receptive Field – Striding

Conv 3, Stride 2

Receptive Field: 3

Conv 3, Stride 2

Receptive Field: 7

Conv 3, Stride 2
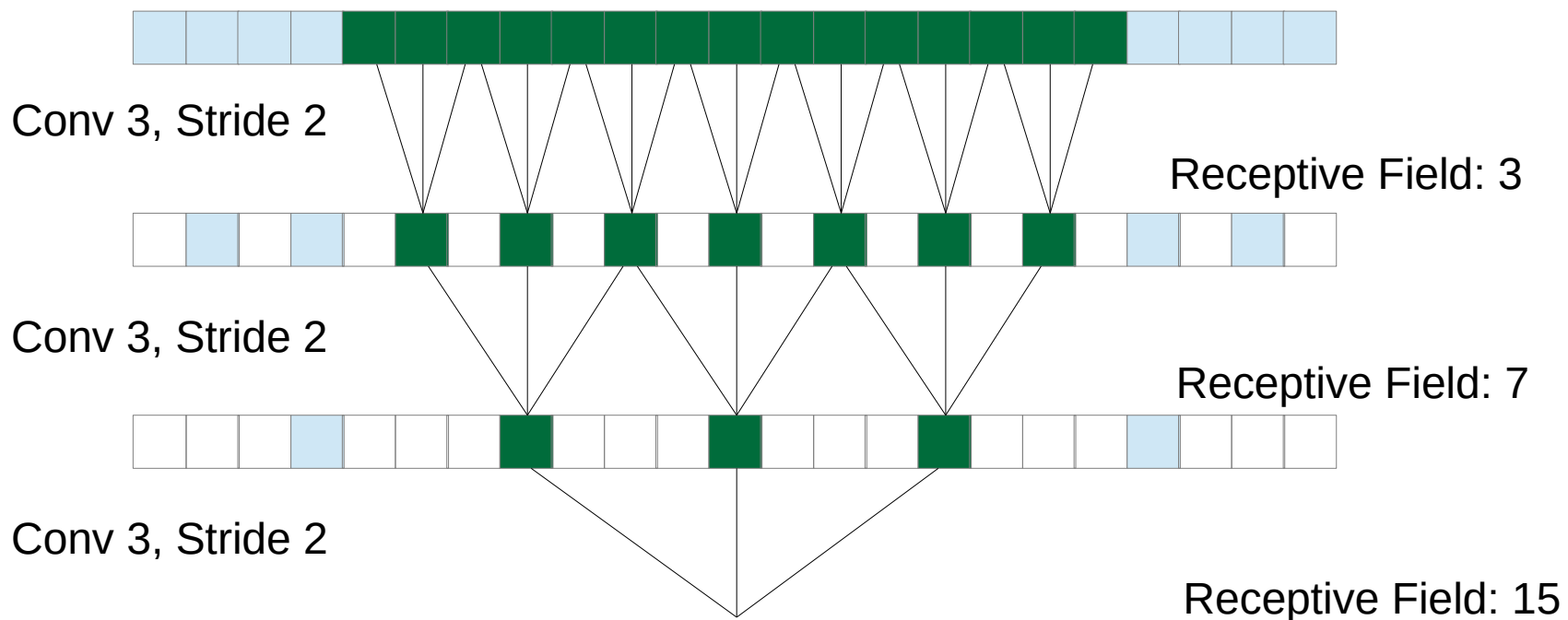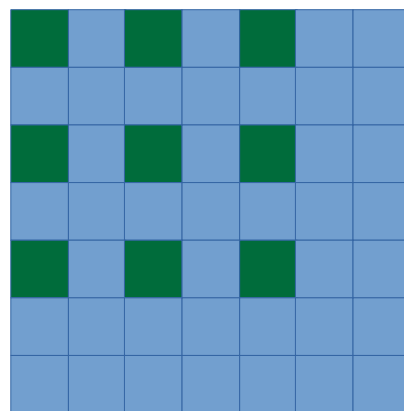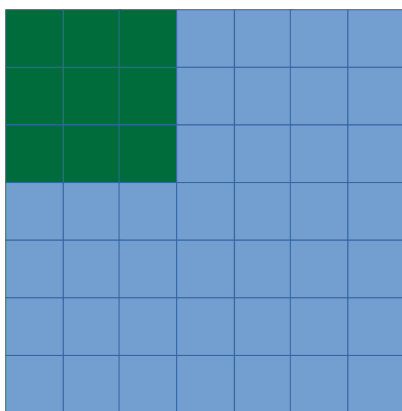
Receptive Field: 15

Segmentation

Instead of classifying the whole image, classify each pixel

Not Cat

Cat

Cat

We need to keep all of the spatial resolution

Dilation

Increase the receptive field without increasing kernel size or losing resolution

Holes
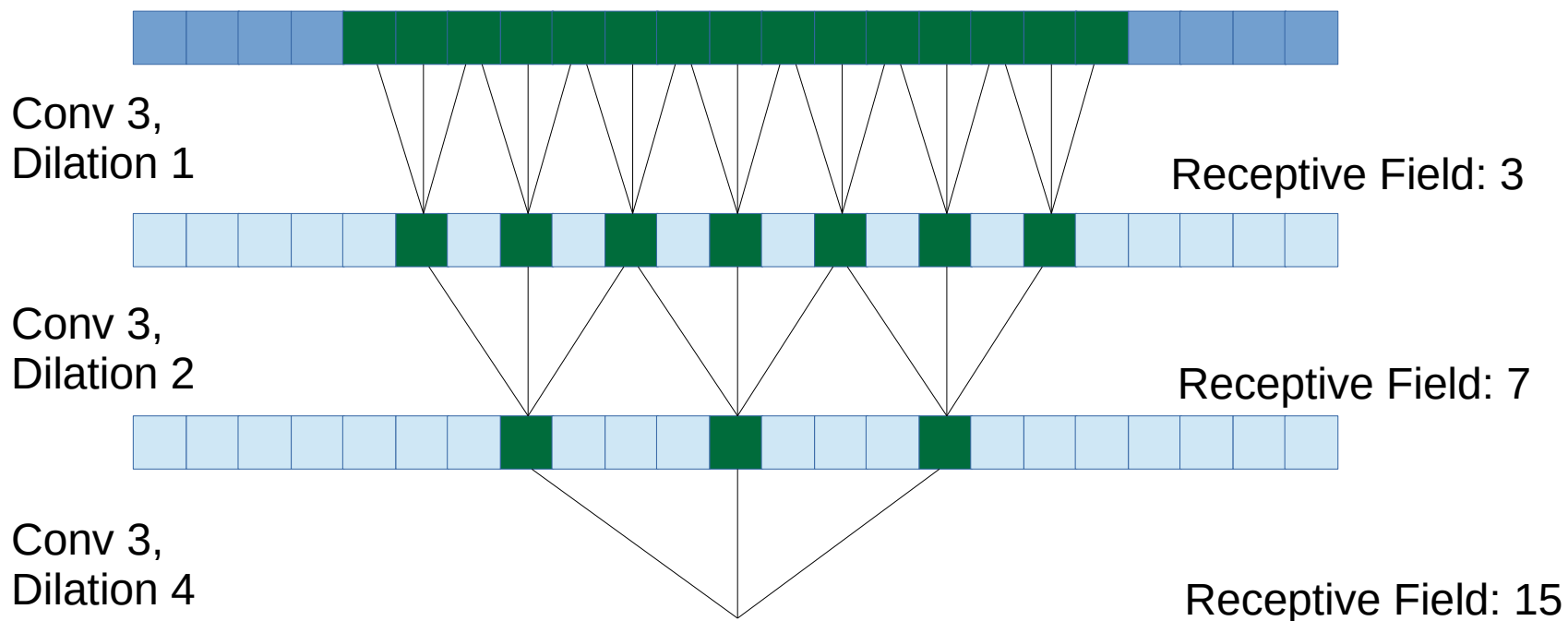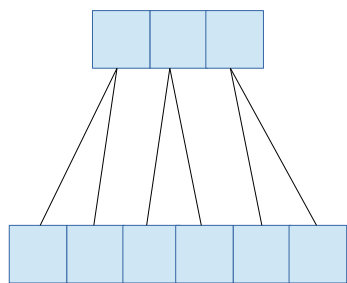
A trous

a	b	c
d	e	f
g	h	i

a		b		c
d		e		f
g		h		i

Receptive Field – Dilation

Conv 3,
Dilation 1

Receptive Field: 3

Conv 3,
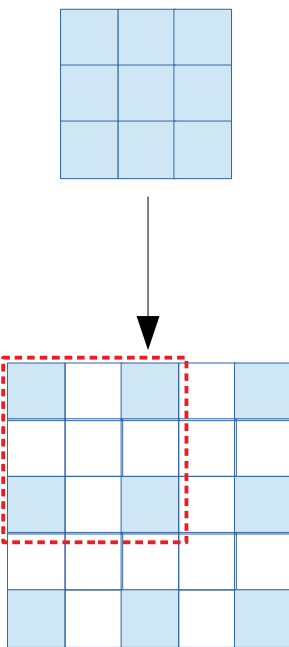Dilation 2

Receptive Field: 7

Conv 3,
Dilation 4

Receptive Field: 15

Upconvolution

Dilate the input

Transpose convolution

"Deconvolution"

Fractionally strided convolution

Upconvolution

Conv

Conv

Conv

} Spatial resolution decreasing,
Channels increasing

Up Conv

Up Conv

Up Conv

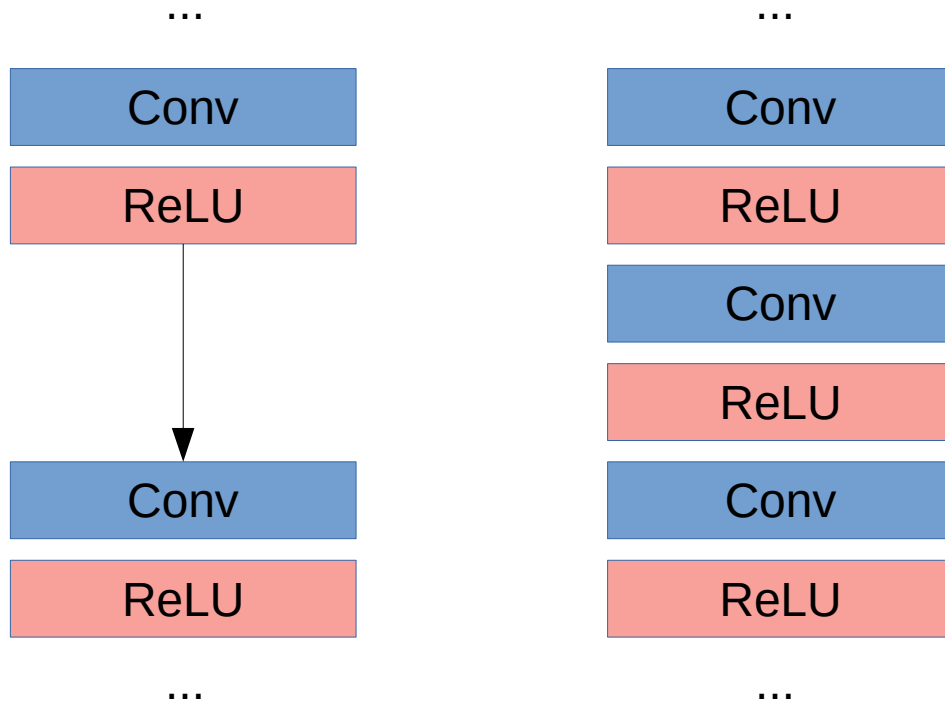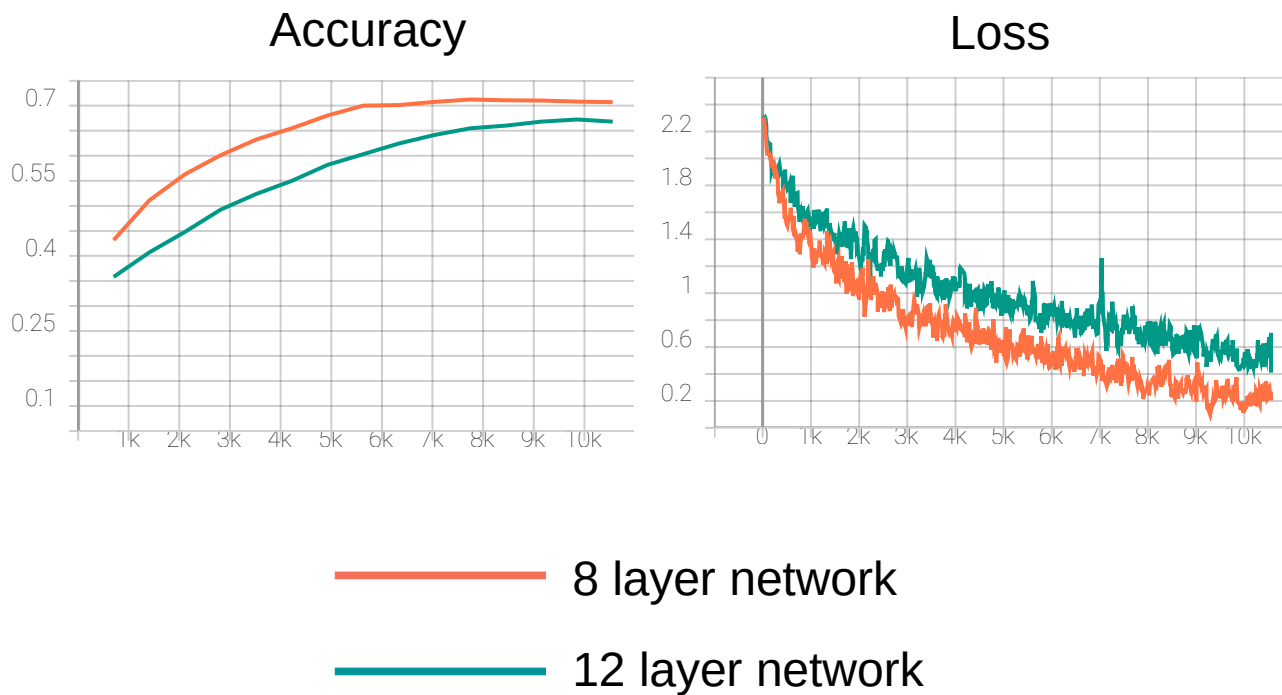} Spatial resolution increasing,
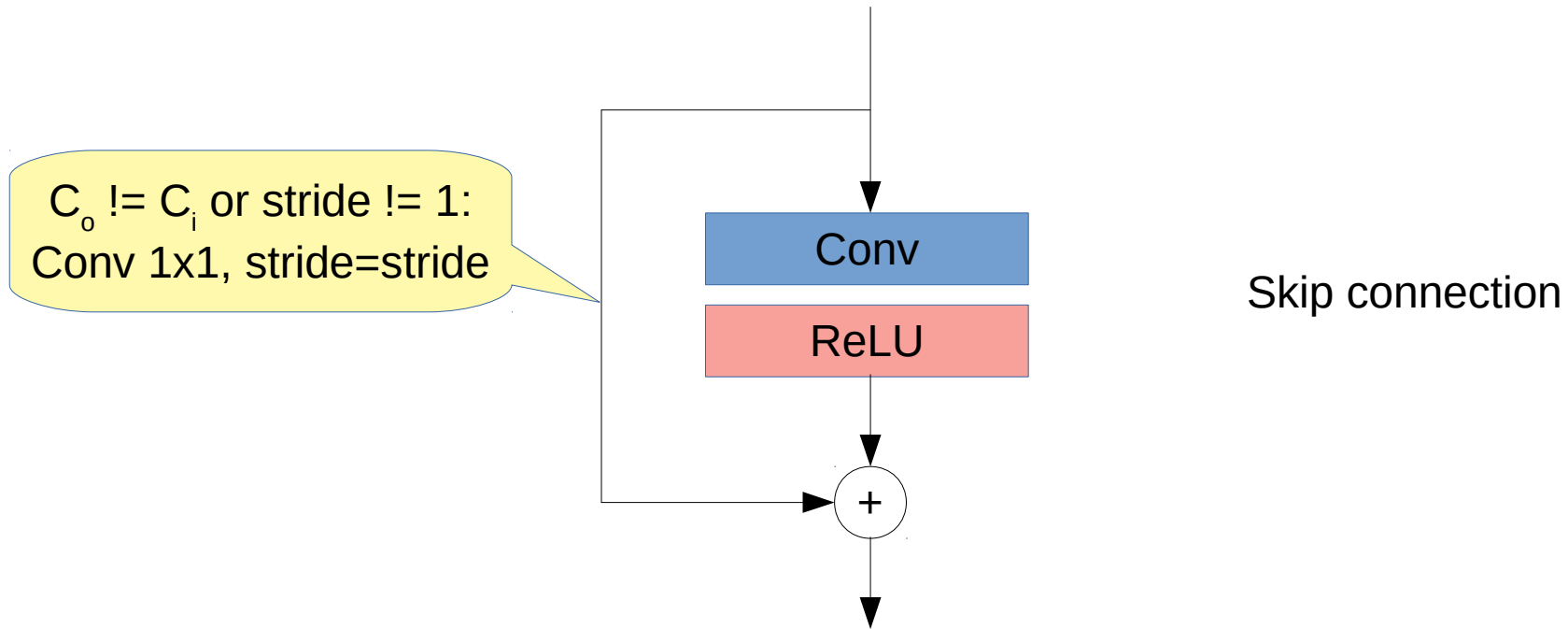Channels decreasing
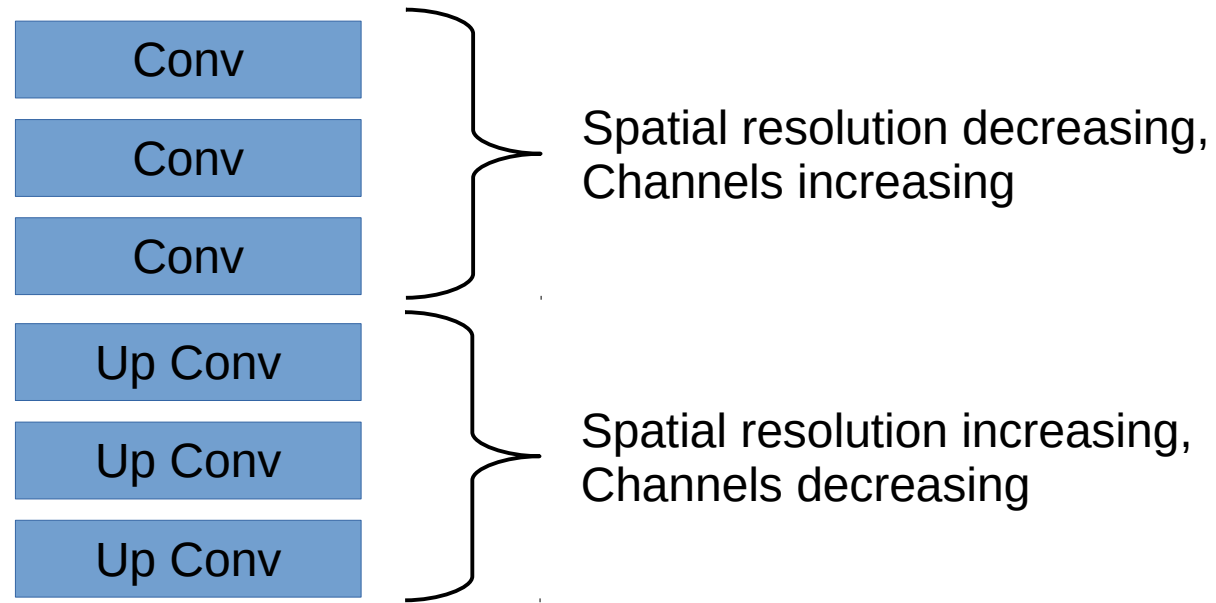
Residual Connections

Deep Networks are Hard to Train

- We can train maybe 10-15 layers with the techniques we have seen so far.

- 20-30 with some other techniques we will see next week.

...

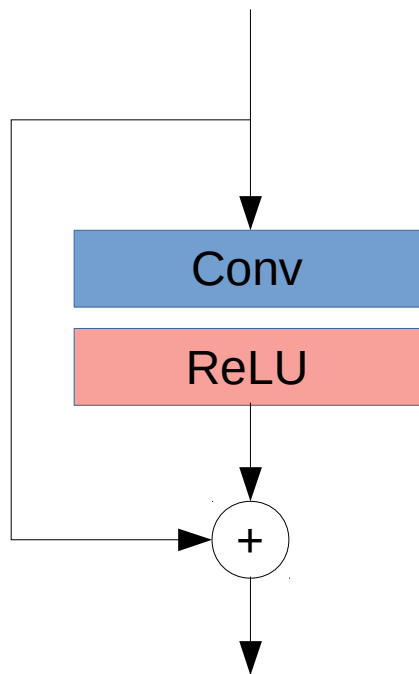| Conv |
|------|
| ReLU |

Conv
ReLU

...

...

Conv
ReLU

Conv
ReLU

Conv
ReLU

...

Deep Networks are Hard to Train

Accuracy · Loss · 8 layer network · 12 layer network

Residual Connections

Residual Connections – Gradient

Forward Pass

Backward Pass

Conv

ReLU

+

Conv'

ReLU'

+
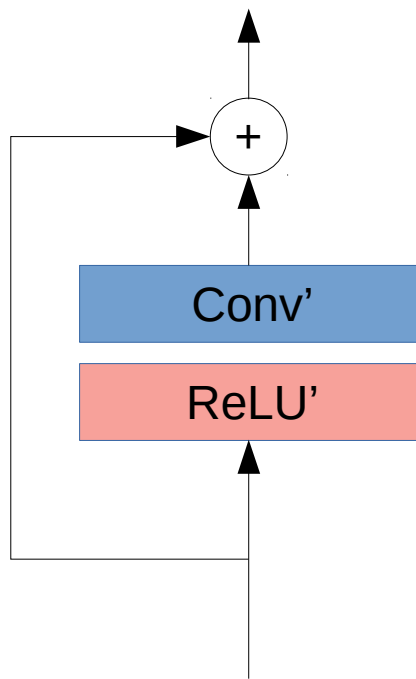
Training networks with up to 1000 layers

Upconvolution – Residual Connections

Conv

Conv

Conv

Up Conv

Up Conv

Up Conv

Spatial resolution decreasing, Channels increasing

Spatial resolution increasing, Channels decreasing