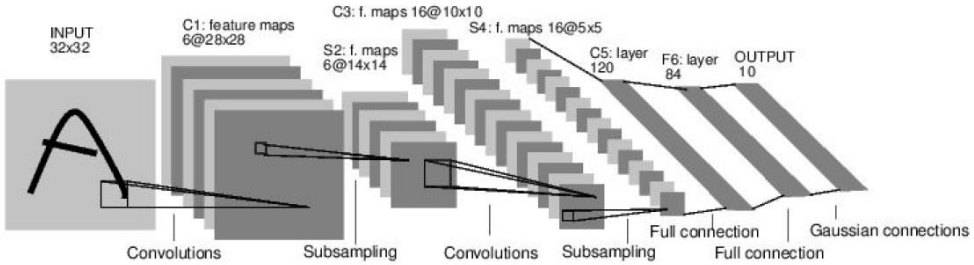
CENG 506 Deep Learning

Lecture 6 – Data Augmentation and Transfer Learning

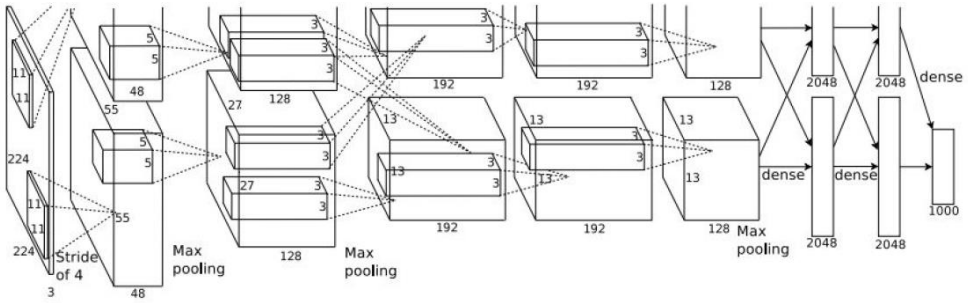
Slides were prepared using the course material of
Stanford's CNN Course (CS231n by Fei-Fei, Johnson, Yeung)

CNN refresher: Case Studies

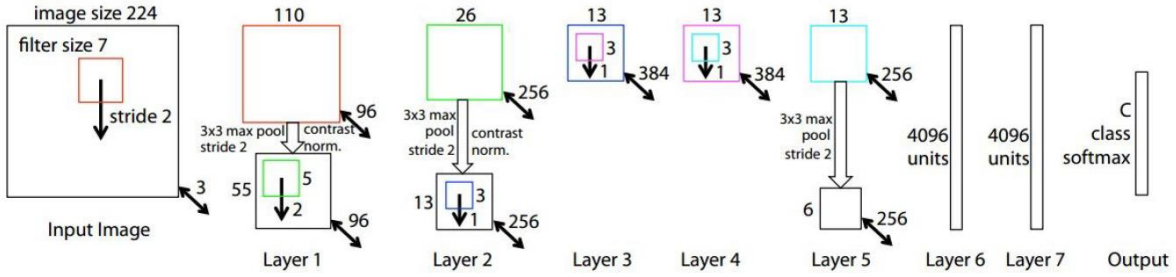
LeNet
(1998)



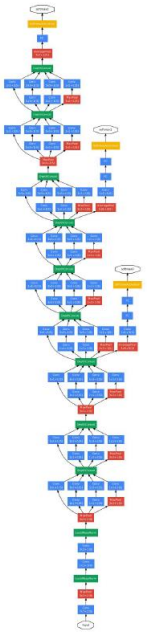
AlexNet
(2012)



ZFNet
(2013)

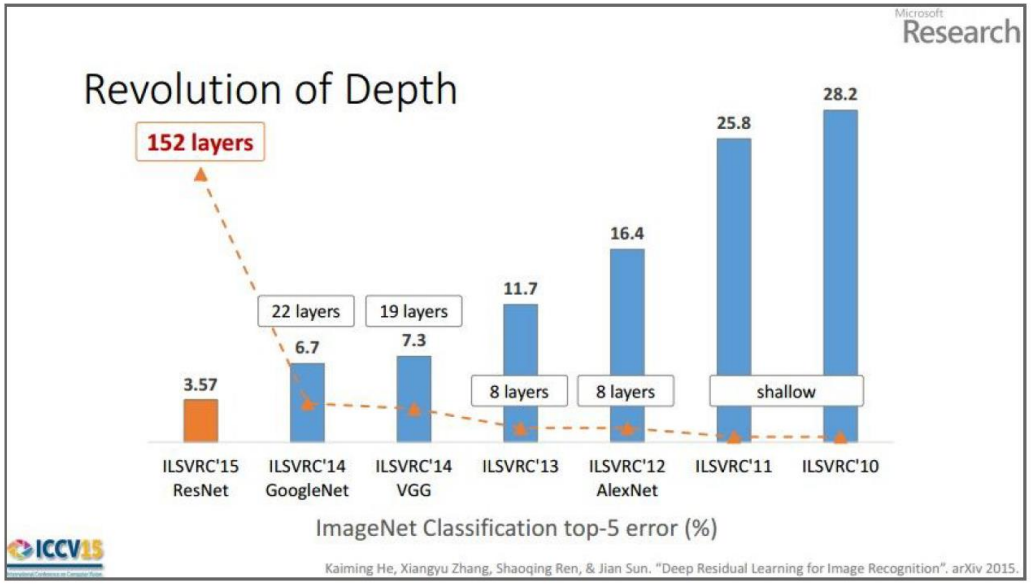


CNN refresher: Case Studies



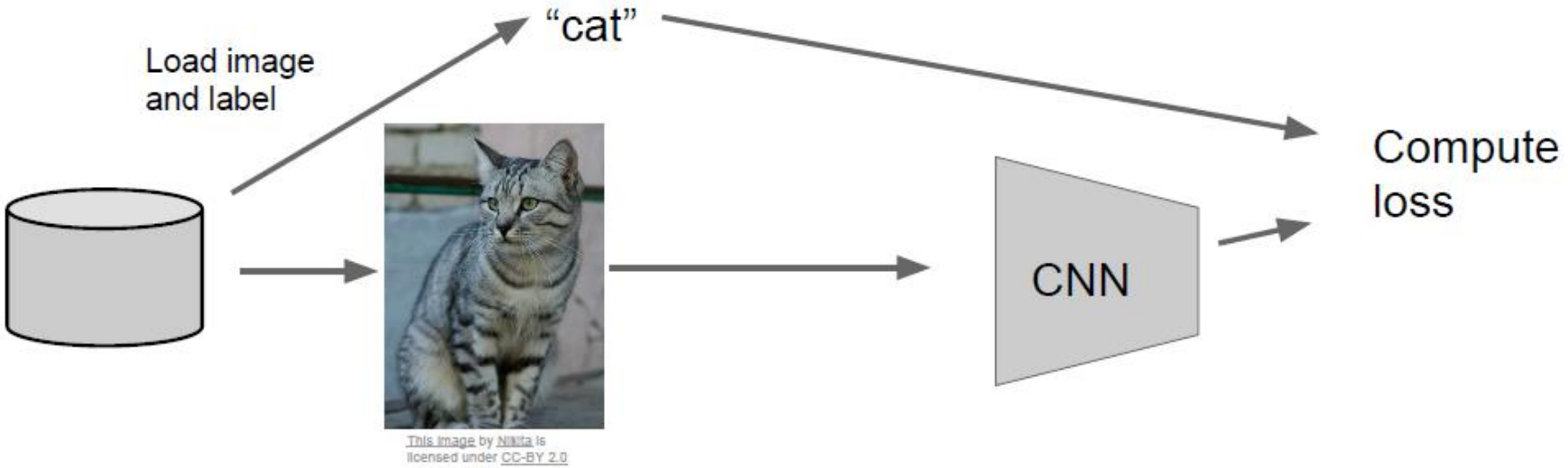
GoogLeNet
(2014)

ResNet
(2015)



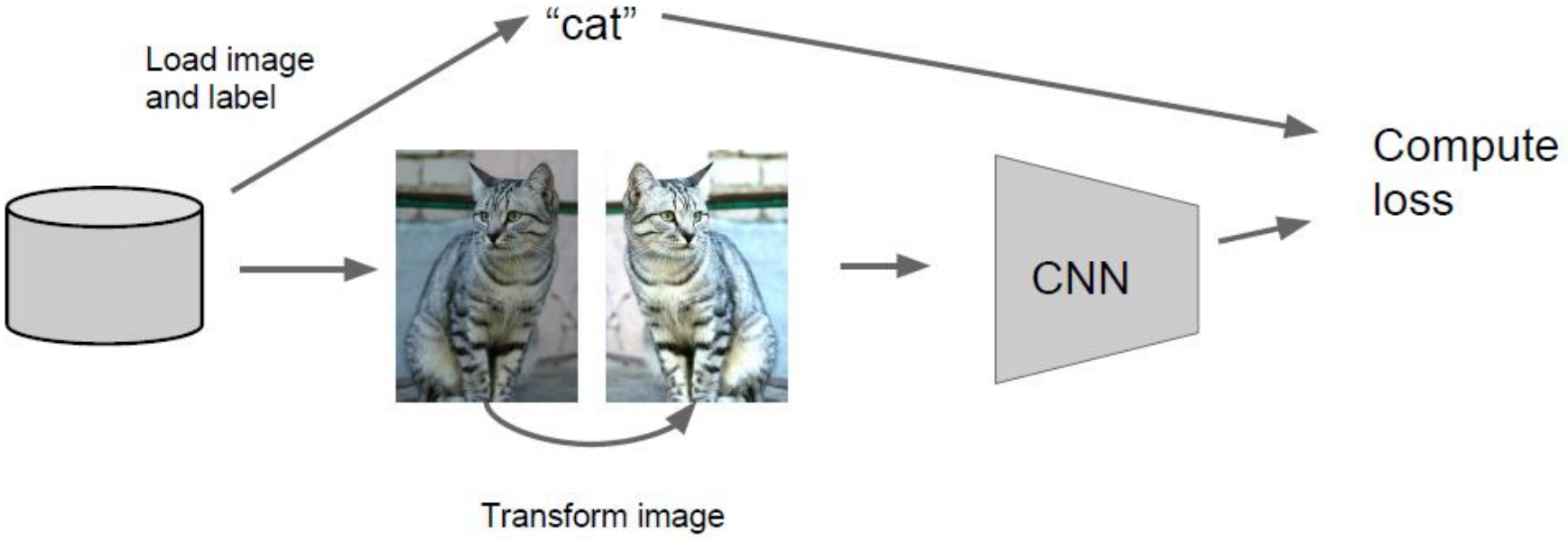
Data Augmentation

Improves generalization by introducing a larger variety in input data.



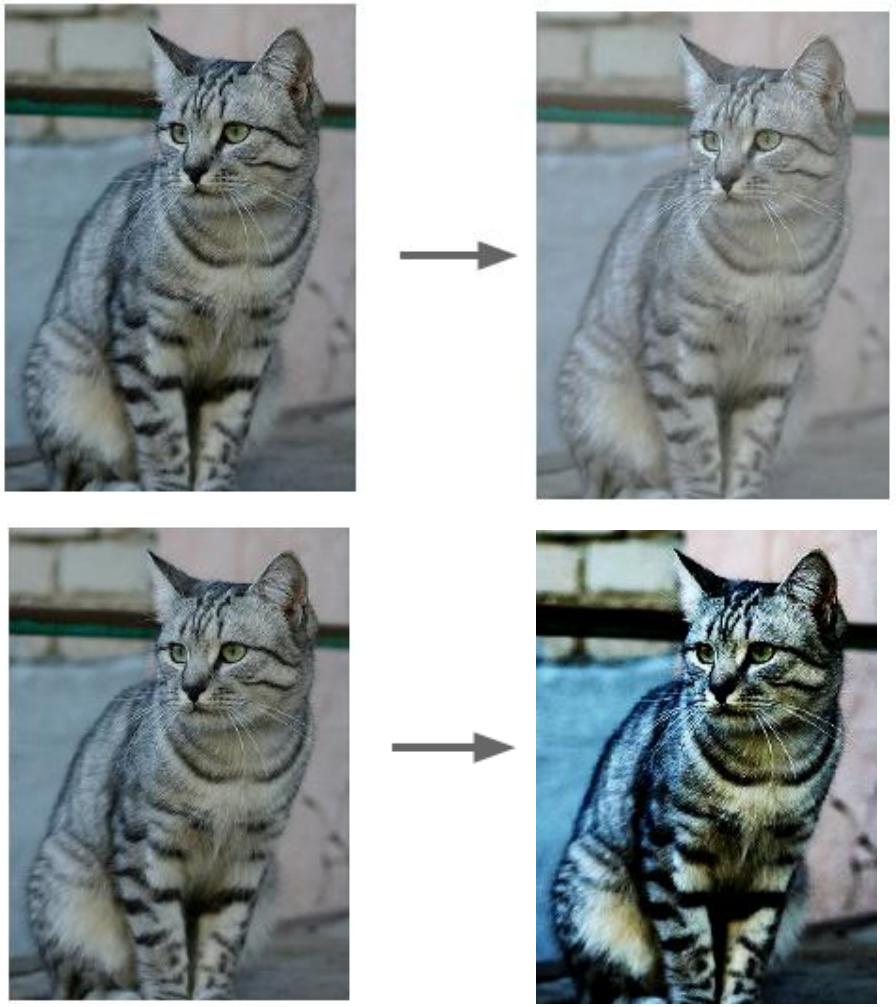
Data Augmentation

Uses different random transformations (color, intensity, size, aspect ratio, flips etc.) of the input image.



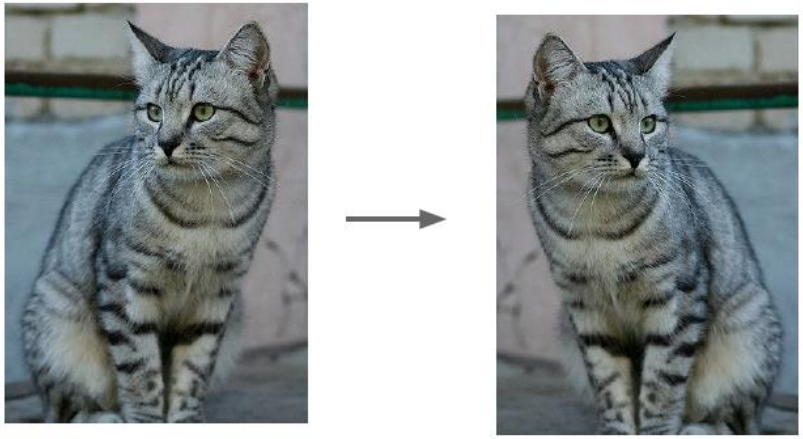
Data Augmentation

Color jitter:
Randomize contrast and brightness

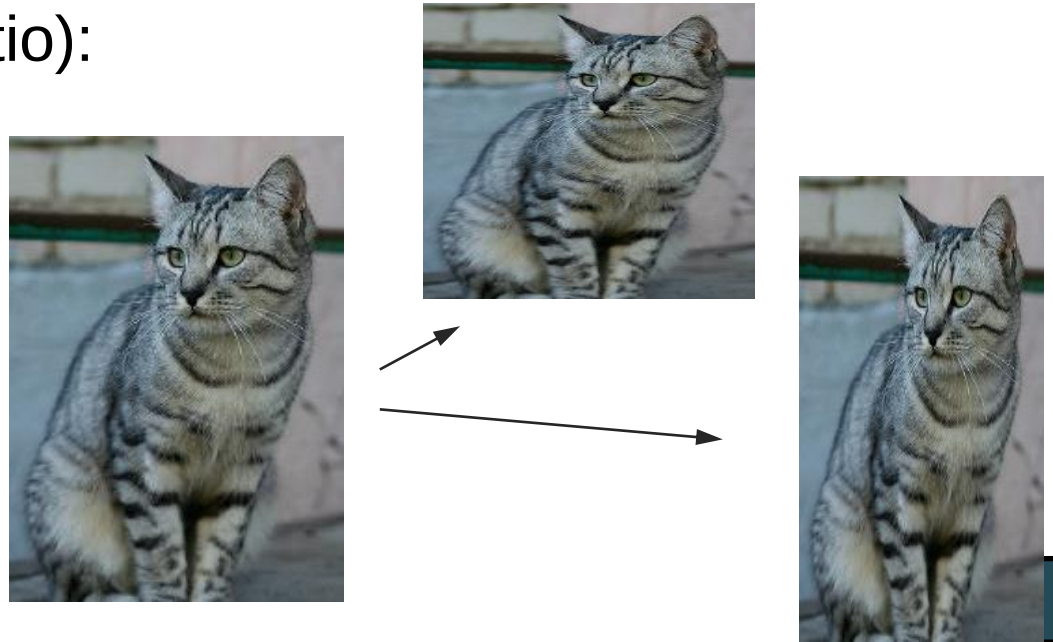


Data Augmentation

Horizontal flips:

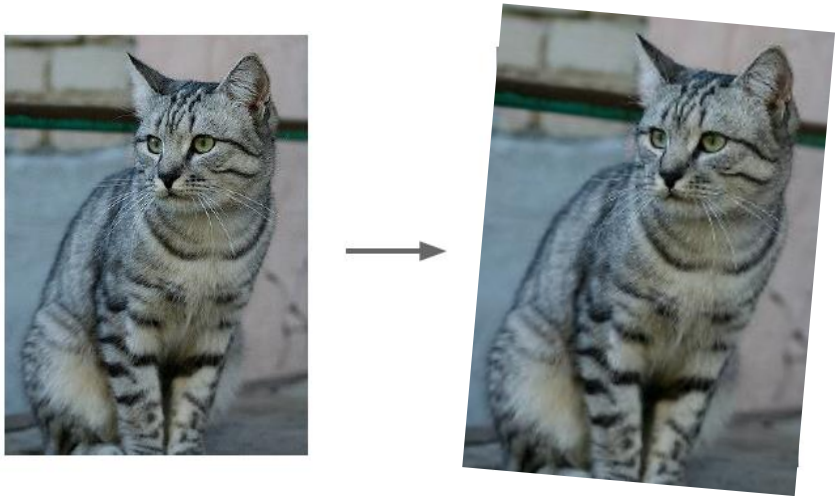


Stretching (aspect ratio):

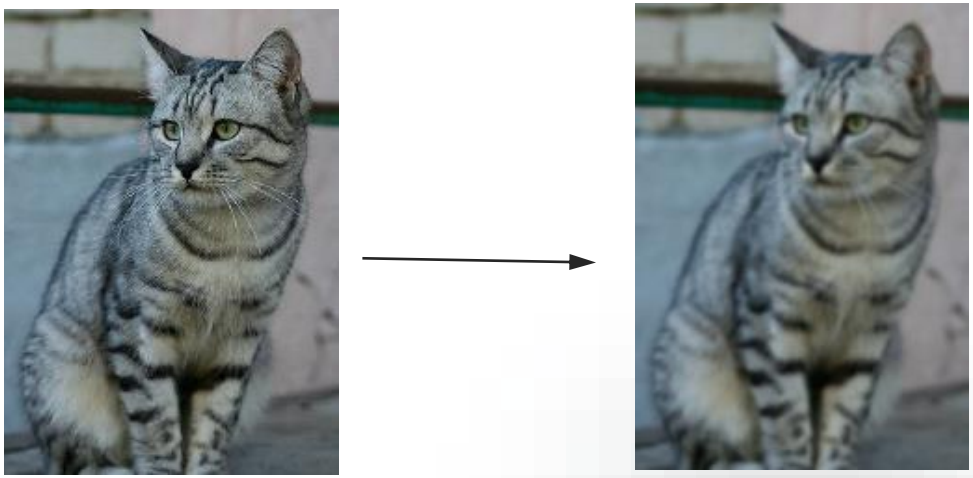


Data Augmentation

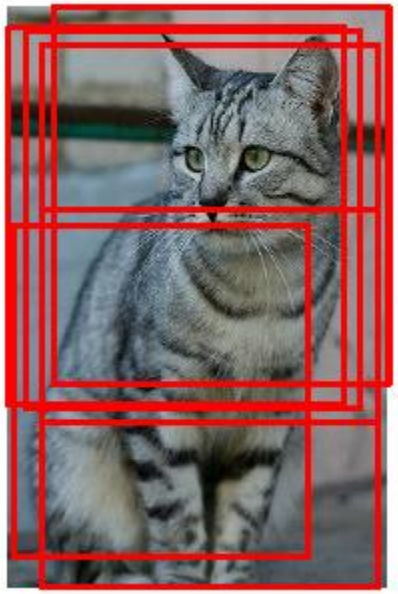
Rotation:



Blur:



Data Augmentation



Training: Sample random crops / scales

E.g. ResNet:

Sample random 224x224 patches
(part of a cat is still a cat)

Testing: Look for a fixed set of crops

E.g. ResNet:

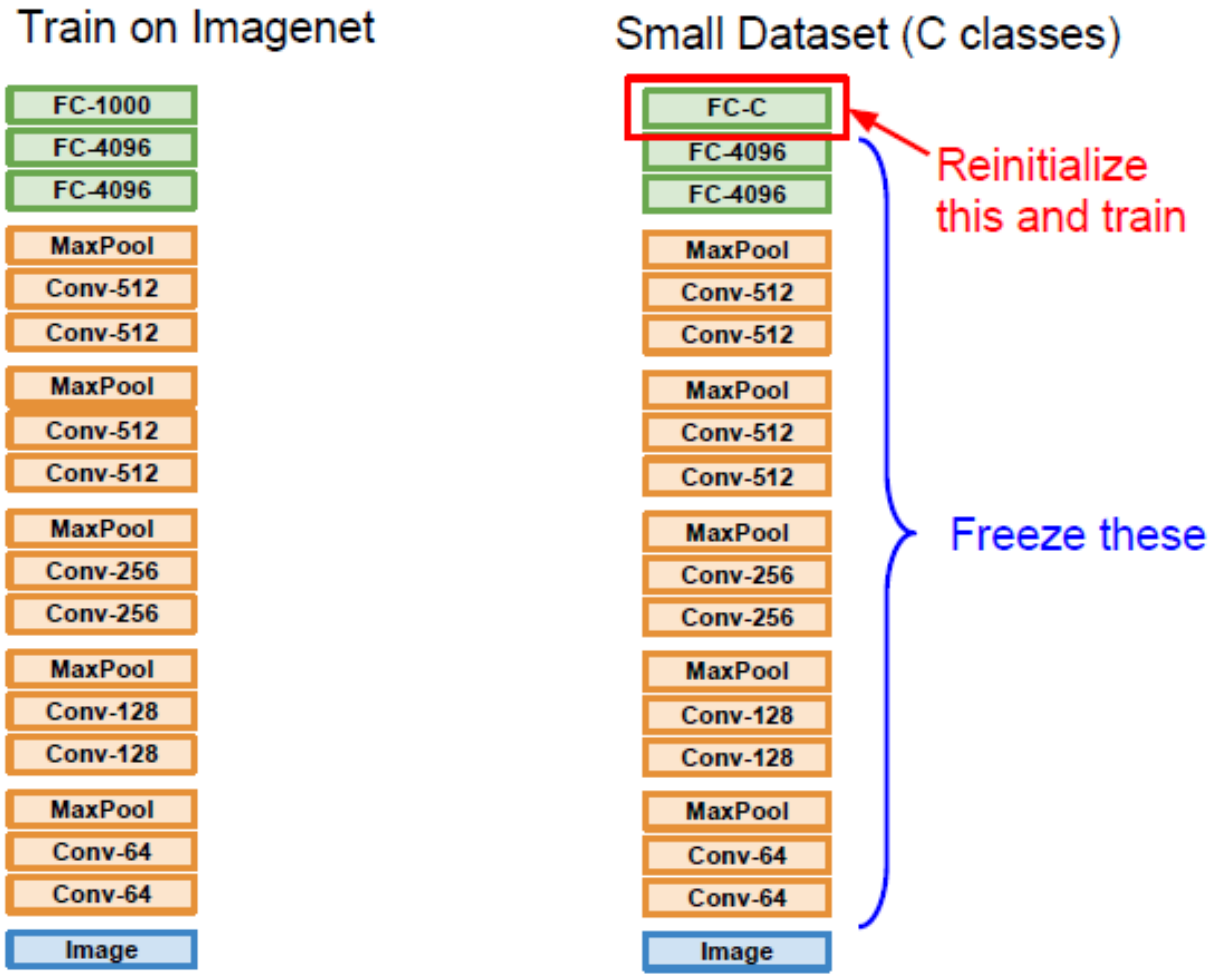
- Resize image at different scales
- At each scale use several 224x224 crops (corners and center)

Transfer Learning

“You need a lot of data if you want to train/use CNNs”

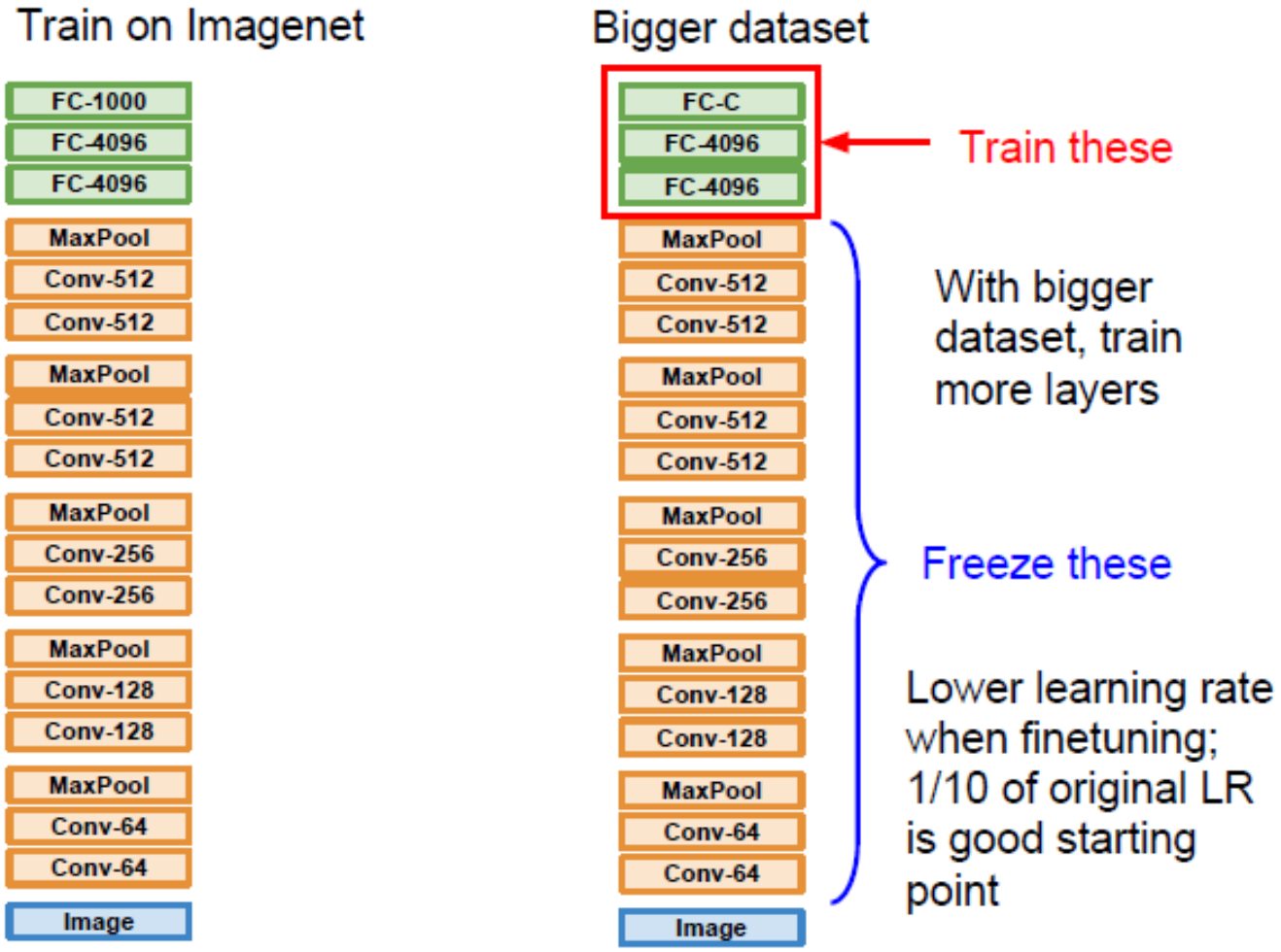
Wrong!

Transfer Learning with CNNs



Donahue et al, “DeCAF: A Deep Convolutional Activation Feature for Generic Visual Recognition”, ICML 2014
Razavian et al, “CNN Features Off-the-Shelf: An Astounding Baseline for Recognition”, CVPR Works.2014

Transfer Learning with CNNs



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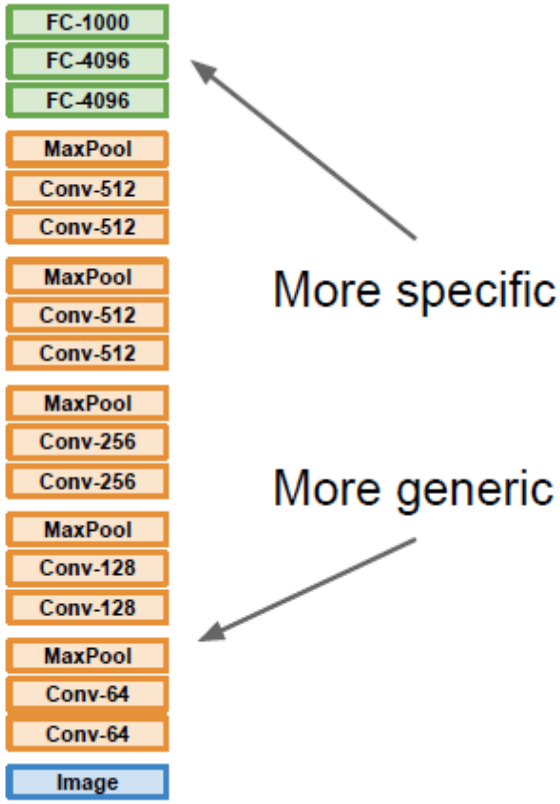
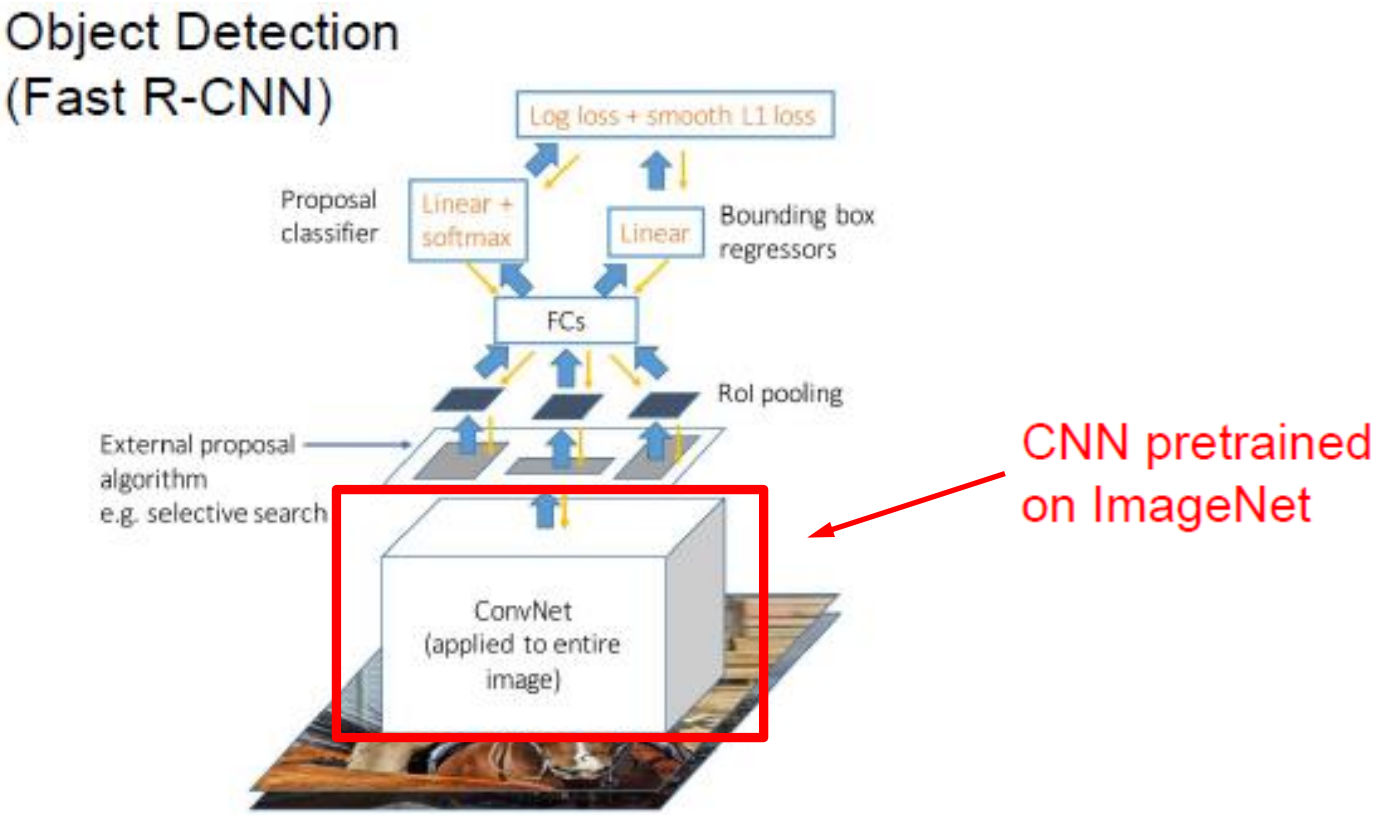
Transfer Learning with CNNs



	very similar dataset	very different dataset
very little data	Use Linear Classifier on top layer	You're in trouble…
quite a lot of data	Finetune a few layers	Finetune a larger number of layers

Transfer Learning with CNNs (it's the norm, not an exception)



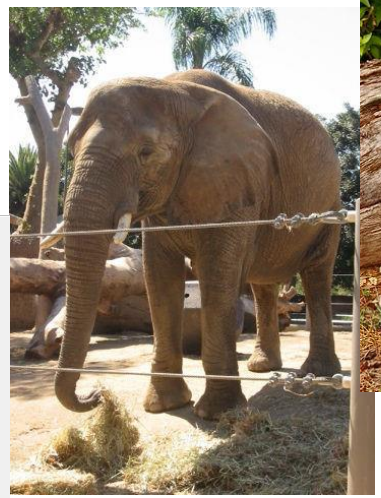
Girshick, "Fast R-CNN", ICCV 2015
Figure copyright Ross Girshick, 2015. Reproduced with permission.

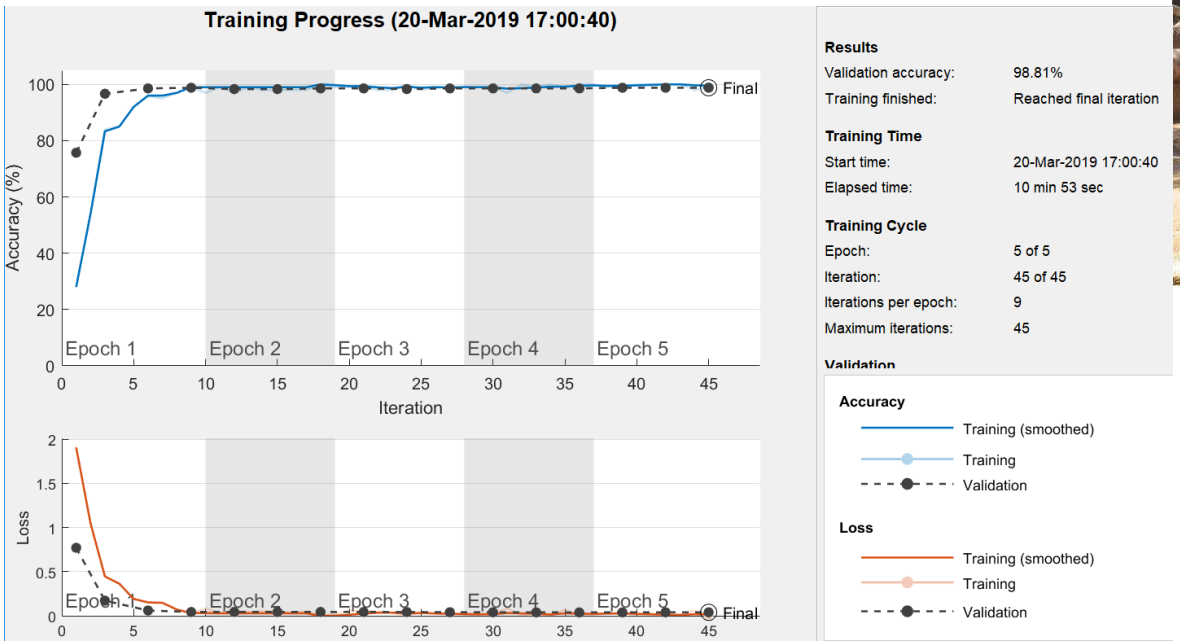
A classification example

Classification of animals
(4 classes, 350 samples per class)

A dataset collected from Internet

Transfer learning (AlexNet-ImageNet)





Results

Validation accuracy:	98.81%
Training finished:	Reached final iteration

Training Time

Start time:	20-Mar-2019 17:00:40
Elapsed time:	10 min 53 sec

Training Cycle

Epoch:	5 of 5
Iteration:	45 of 45
Iterations per epoch:	9
Maximum iterations:	45

Validation

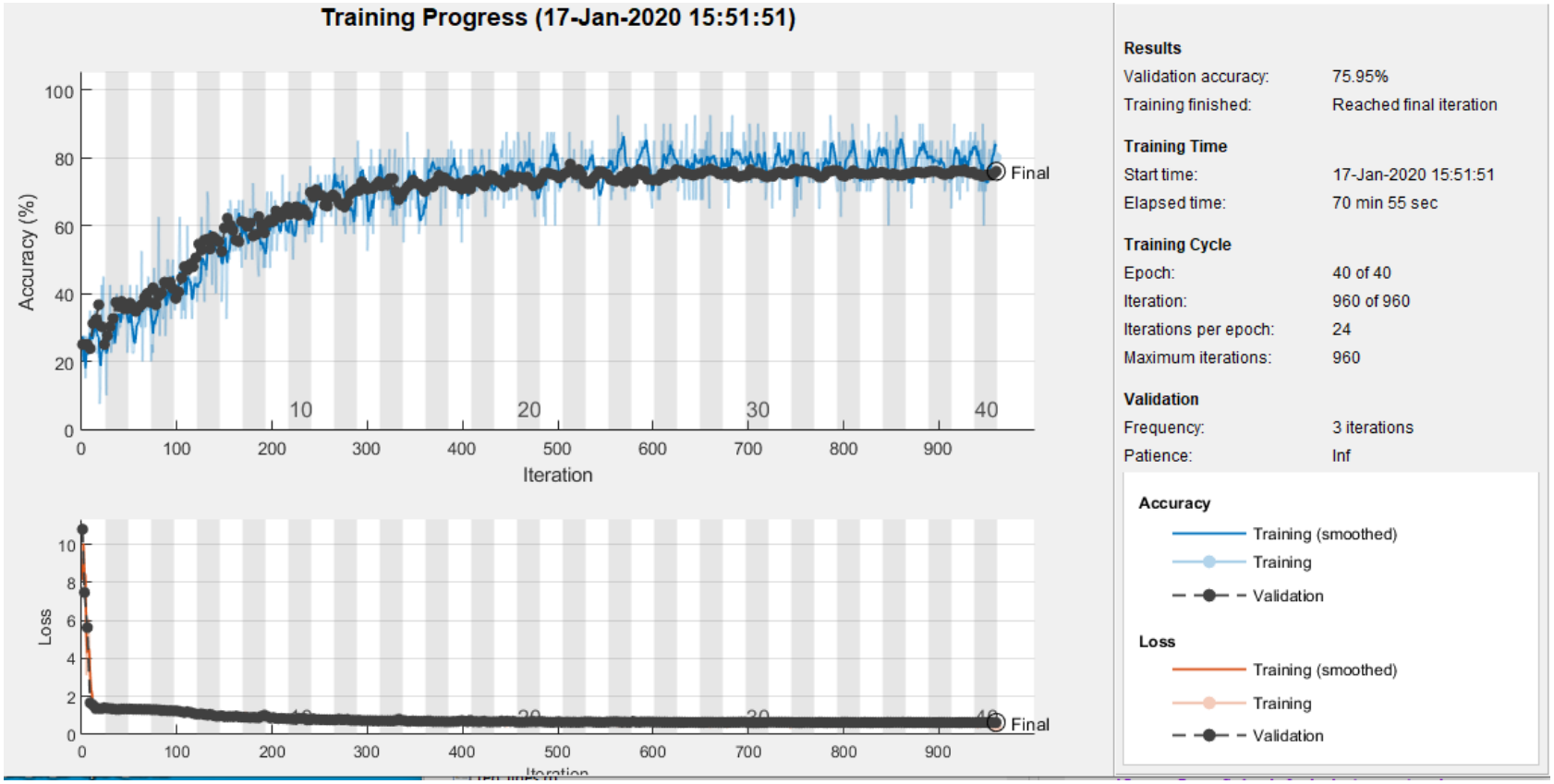
Accuracy

Training (smoothed)
Training
Validation

Loss

Training (smoothed)
Training
Validation

Without Transfer Learning?



We could reach only 76% accuracy even after 40 epochs (and with optimized hyperparameters).

40epochs
Initial LR: 0.001
with learning rate decay
(half at each 10 epoch)
Reg.strength=0.2
MiniBatchSize: 40