Semantic Segmentation: Unet

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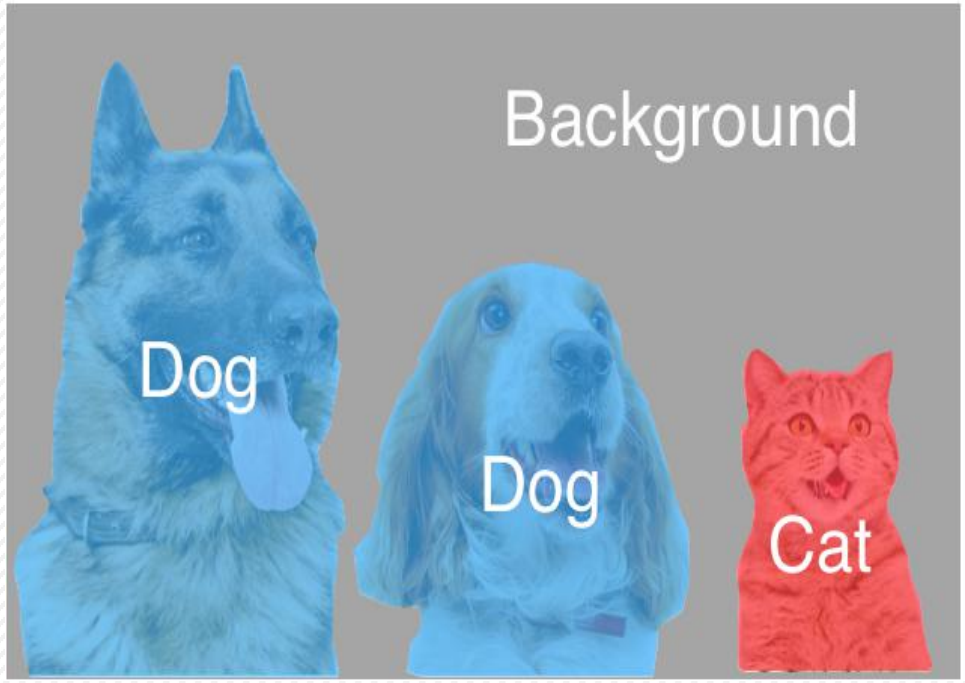
01

Background

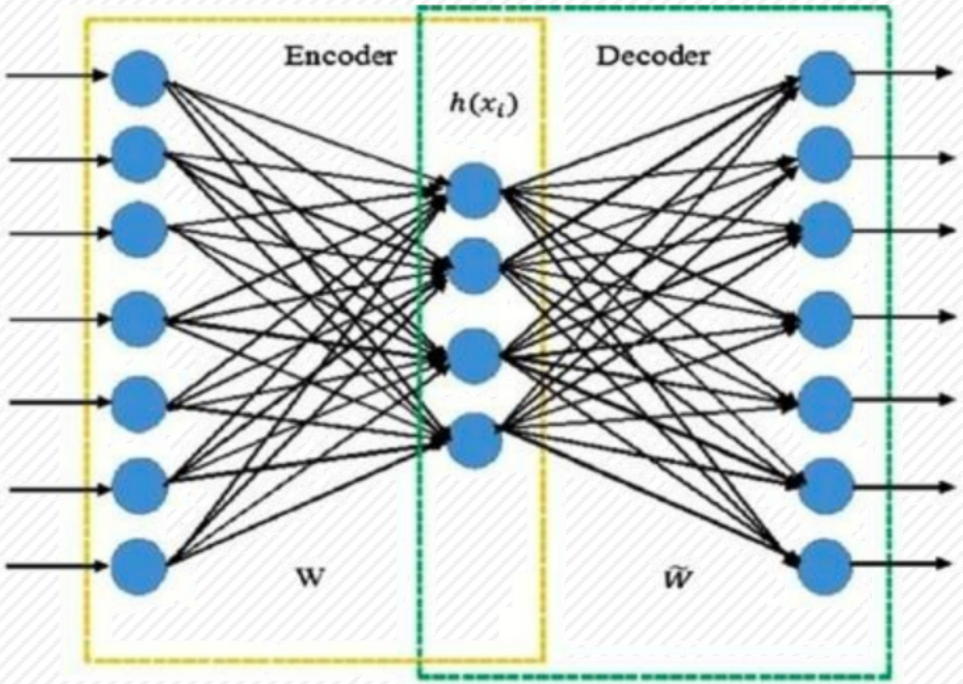
Semantic segmentation

Image Classification



Semantic Segmentation

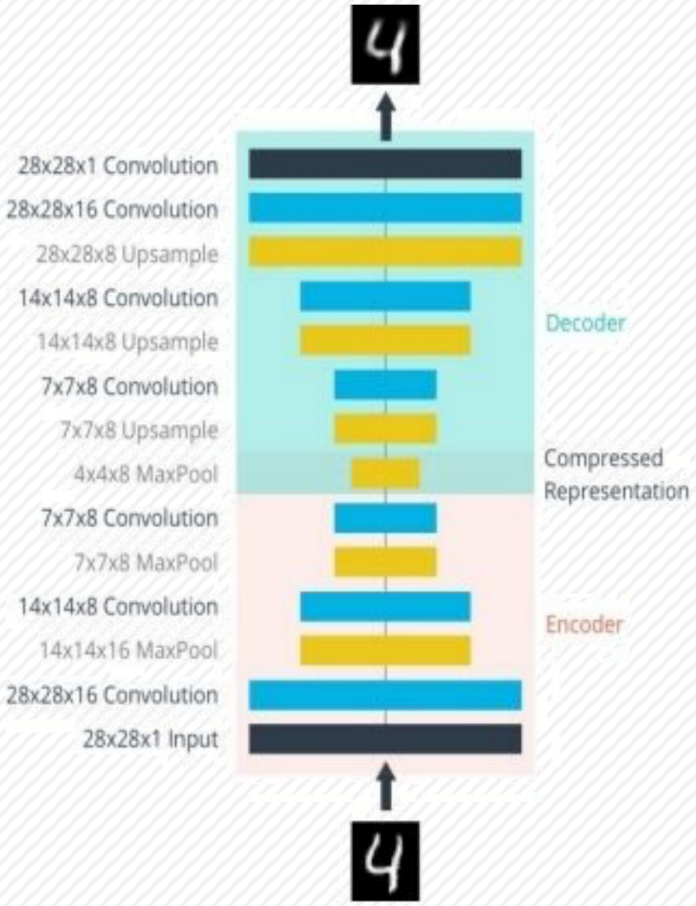
AutoEncoder



AutoEncoder idea is to map information from a feature space to a new feature space.

The input of the sample is also the ground true of the network.

AutoEncoder



The network between encoder and decoder can be diverse.

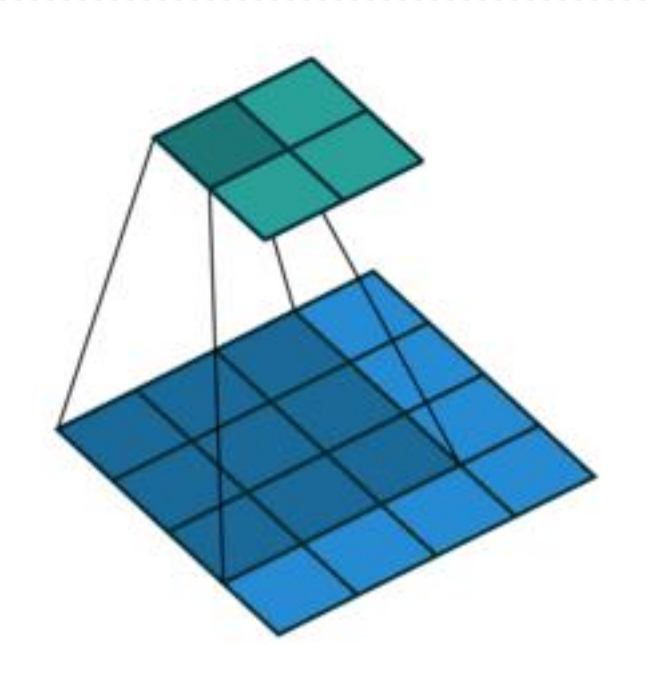
1.2 Upsampling

Dog

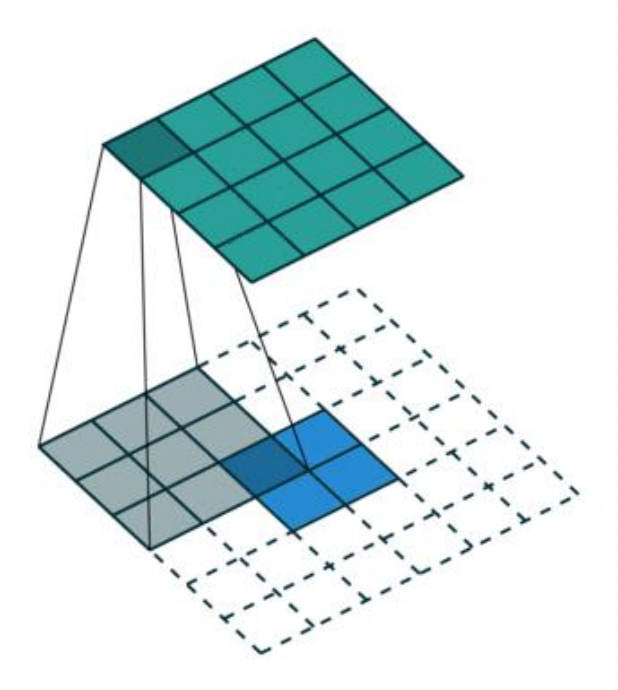
Dog

Reshape

Deconvolution

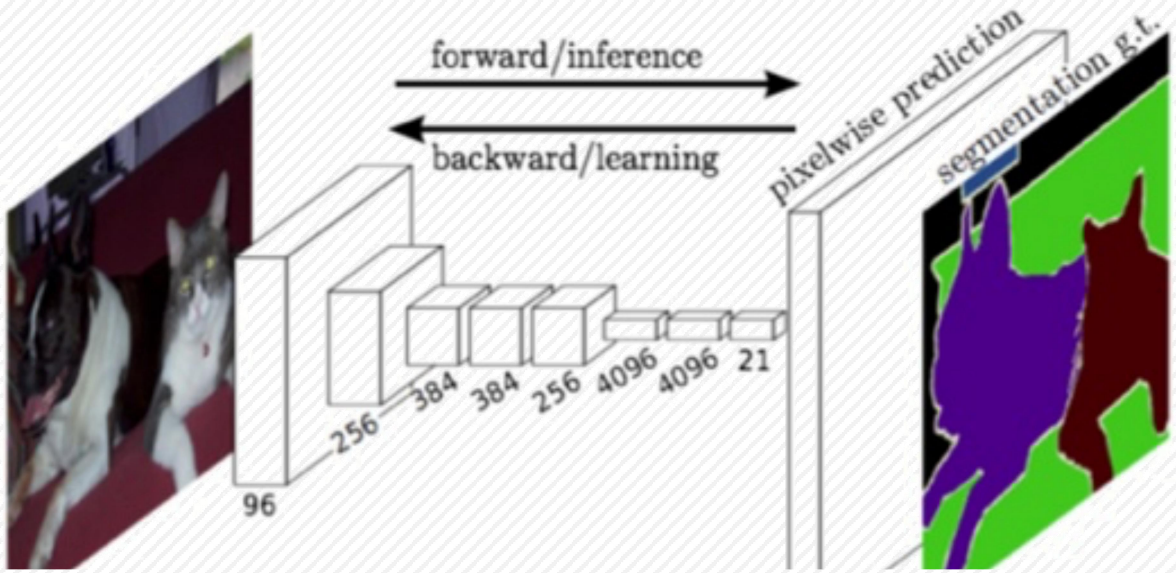


Convolution



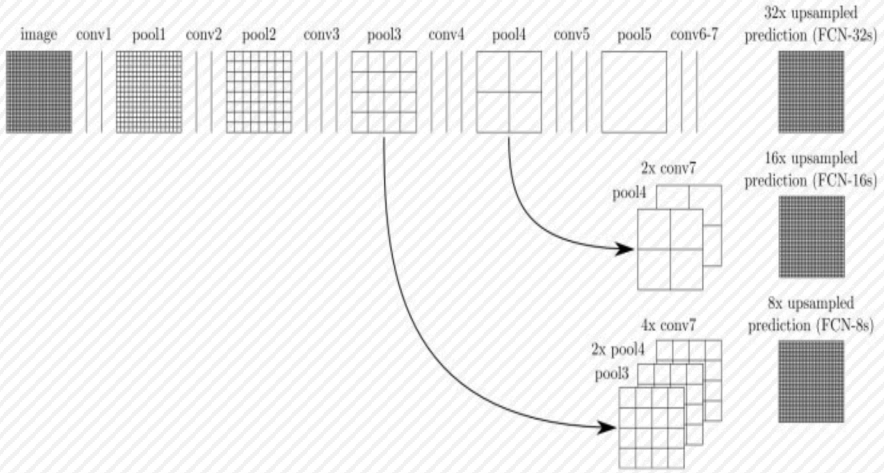
Deconvolution

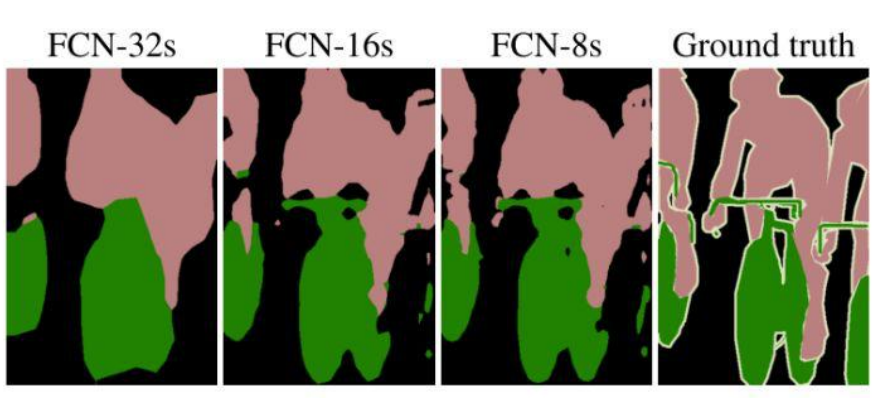
Fully Convolution Network



One-step deconvolution

Fully Convolution Network





Feature fusion

1.4 Fully Convolution Network

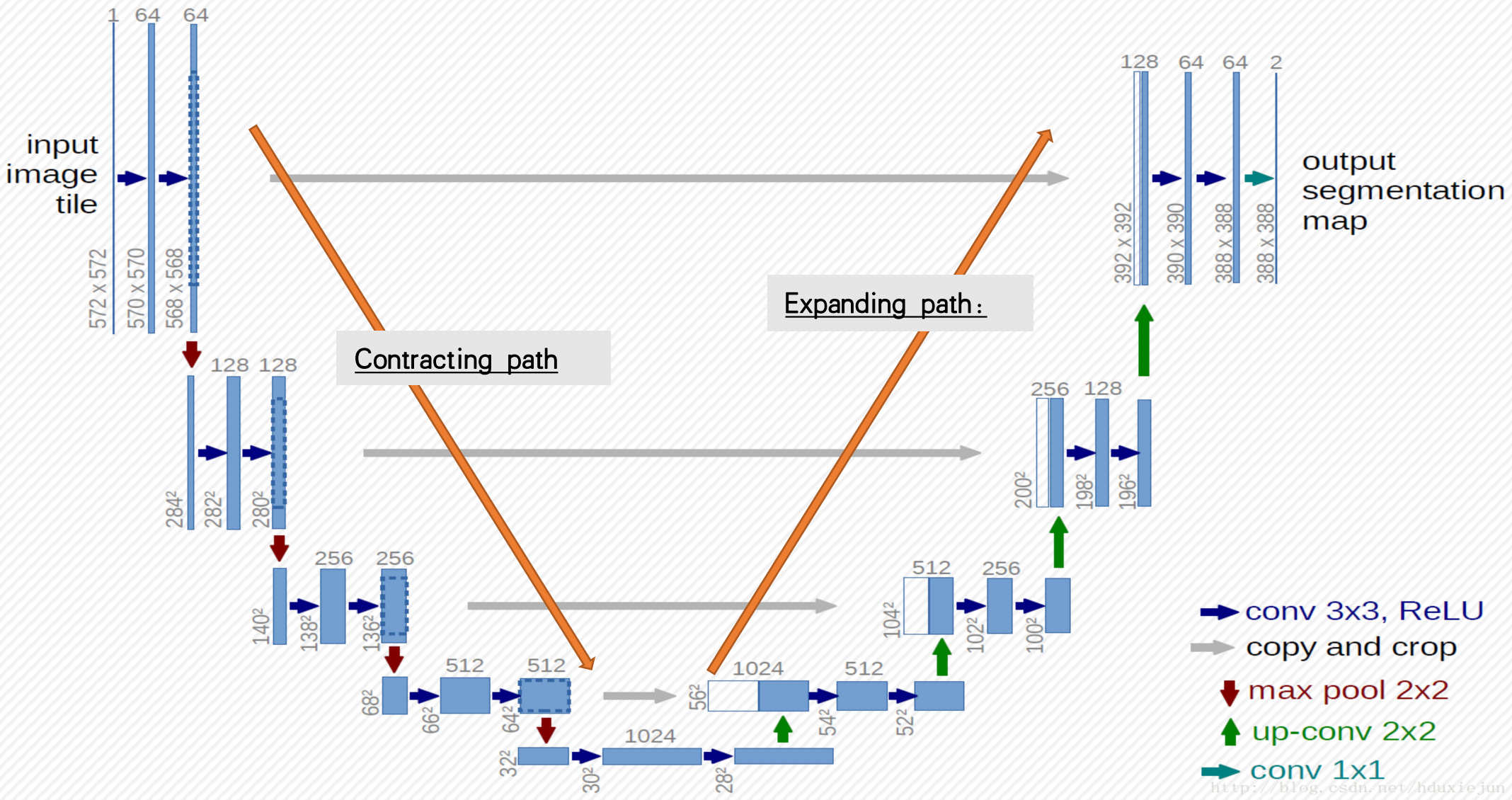
Advantage: There are not fully connected layer, can accept input images of any size.

Disadvantage: The results are still not fine enough.

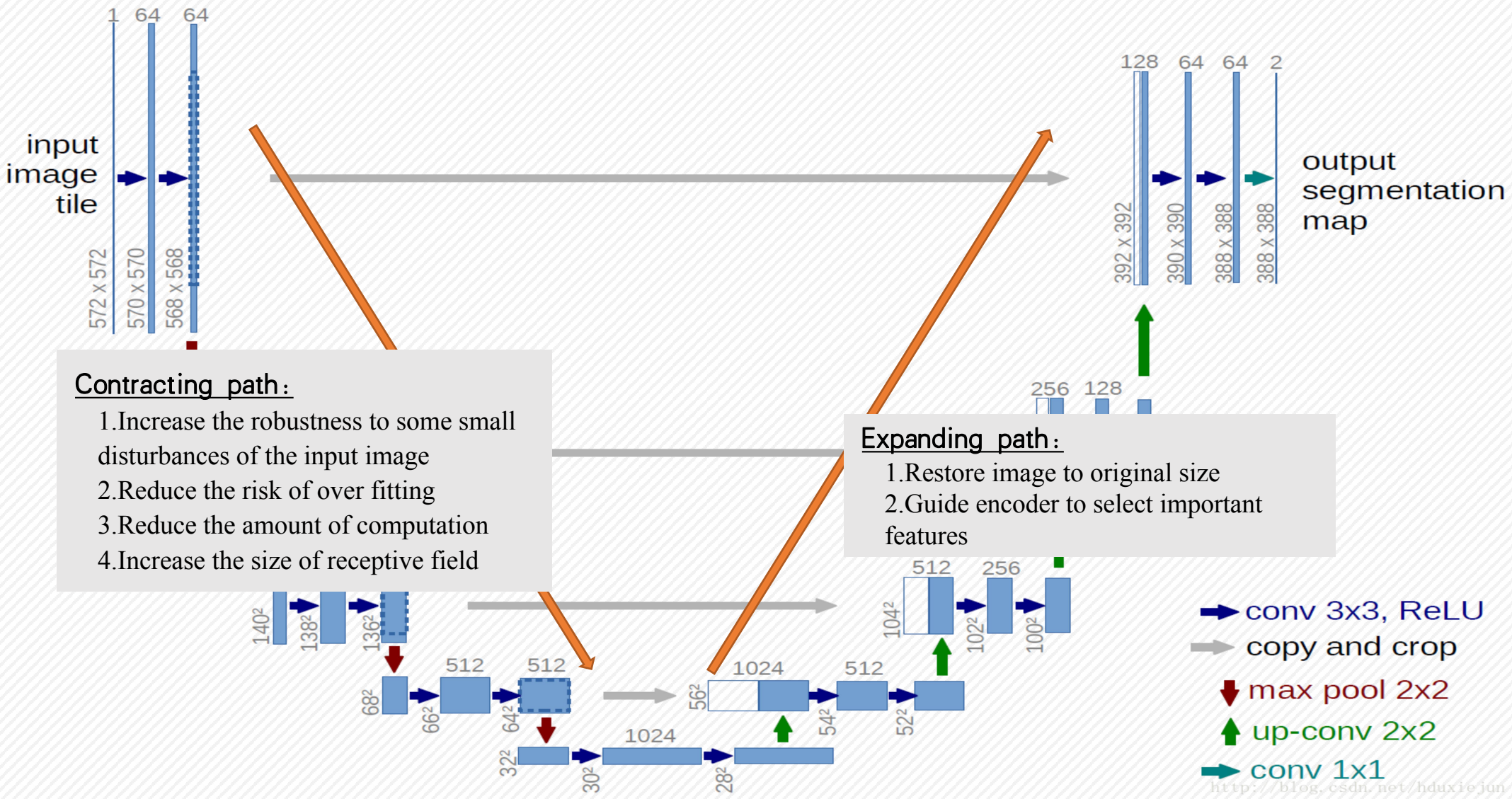
02

Architecture

U net


input image tile
1 64 64
572 x 572
570 x 570
568 x 568
128 128
284²
282²
280²
256 256
140²
138²
136²
512 512
68²
66²
64²
1024
32²
30²
28²
1024 512
56²
54²
52²
512 256
104²
102²
100²
256 128
200²
198²
196²
128 64 64 2
392 x 392
390 x 390
388 x 388
388 x 388
output segmentation map
Contracting path
Expanding path：
conv 3x3, ReLU
copy and crop
max pool 2x2
up-conv 2x2
conv 1x1
http://blog.csdn.net/hduxiejun

U net



Contracting path：

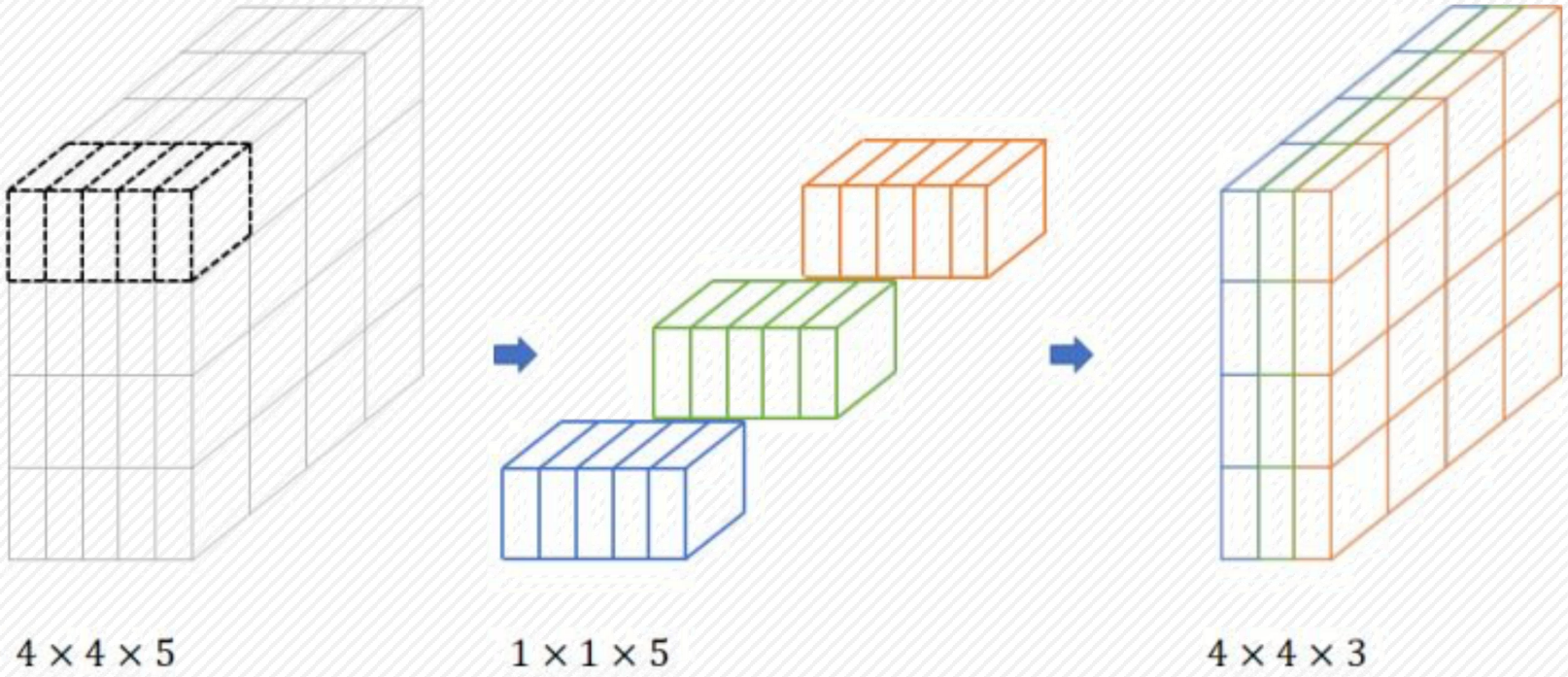
1.Increase the robustness to some small disturbances of the input image
2.Reduce the risk of over fitting
3.Reduce the amount of computation
4.Increase the size of receptive field

Expanding path：

1.Restore image to original size
2.Guide encoder to select important features

http://blog.csdn.net/hduxiejun

1x1 convolution layer



1x1 convolutiona layer:

1. Control dimension change
2. Reduce the amount of calculation and the consumption of storage

Unet Loss function

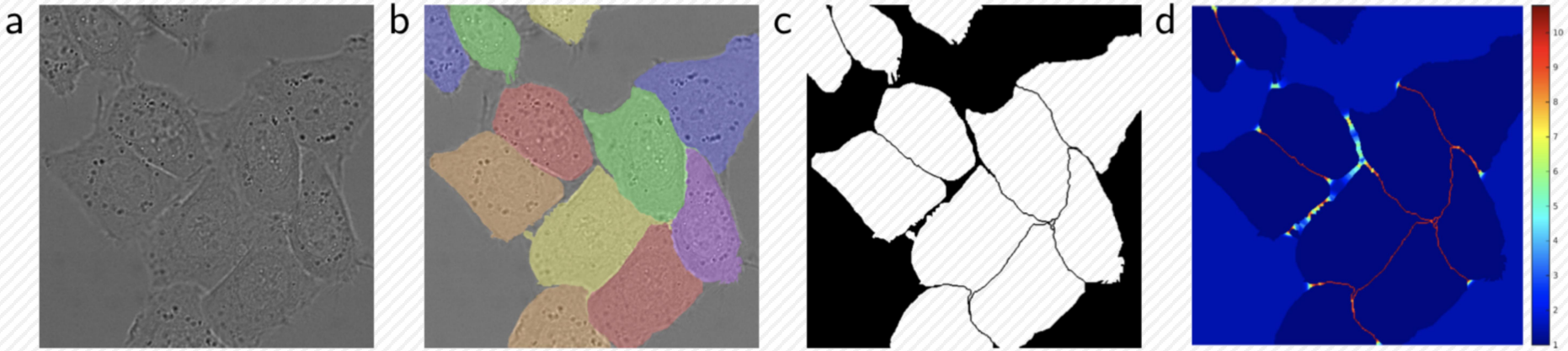
$$E = \sum_{\mathbf{x} \in \Omega} w(\mathbf{x}) \log(p_{\ell(\mathbf{x})}(\mathbf{x}))$$

$$w(\mathbf{x}) = w_c(\mathbf{x}) + w_0 \cdot \exp\left(-\frac{(d_1(\mathbf{x}) + d_2(\mathbf{x}))^2}{2\sigma^2}\right)$$

pre-compute the weight map for each ground truth segmentation to com- pensate the different frequency of pixels from a certain class in the training data set

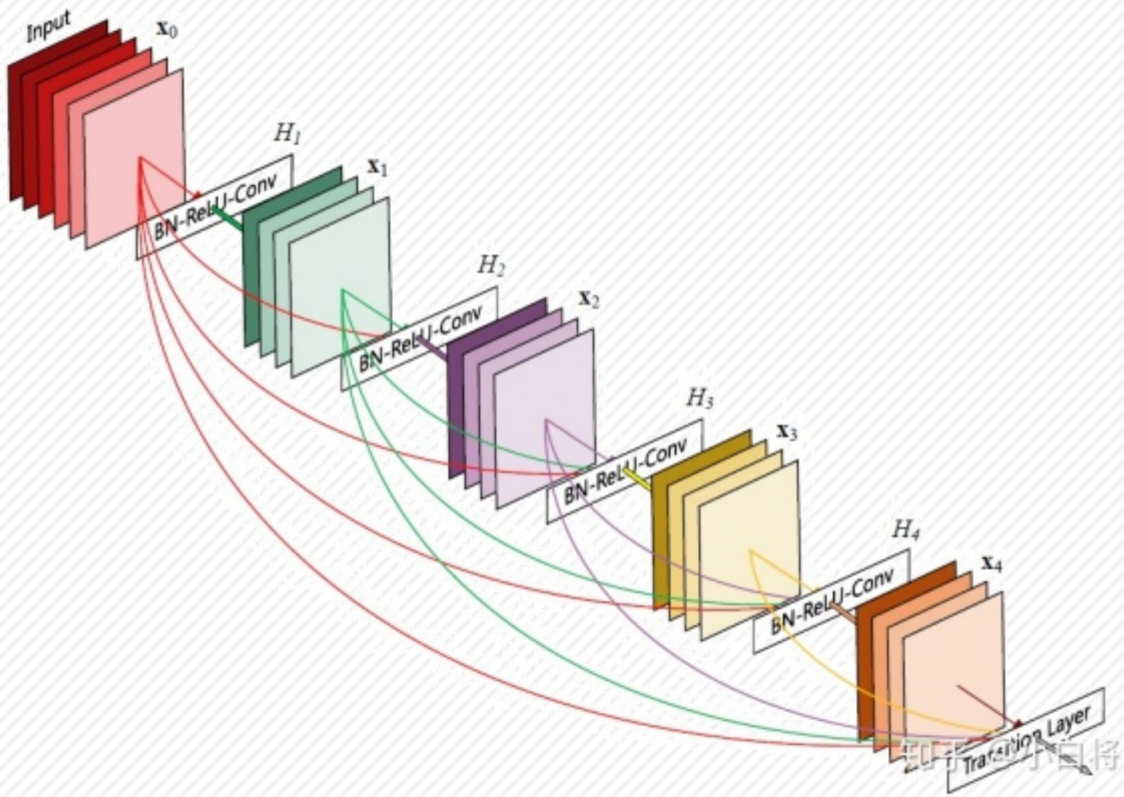
2.3 Unet Loss function

5



03 Development

What is the DenseNet ?



DenseNet: better CNN model than ResNet

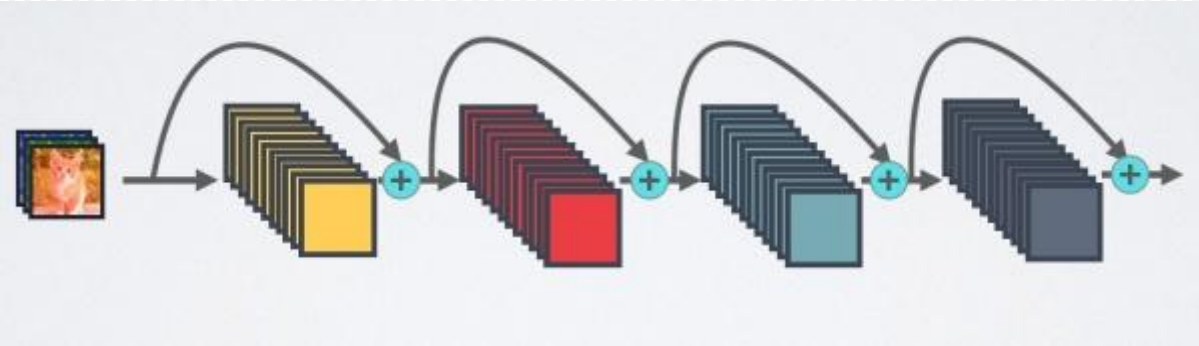


Figure 1 short circuit connection mechanism of ResNet network

The difference between ResNet and DenseNet

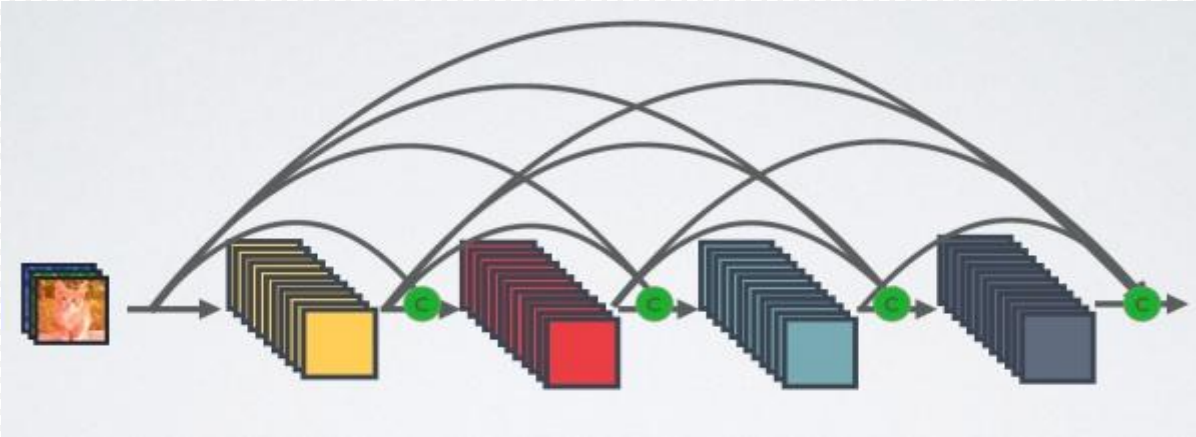
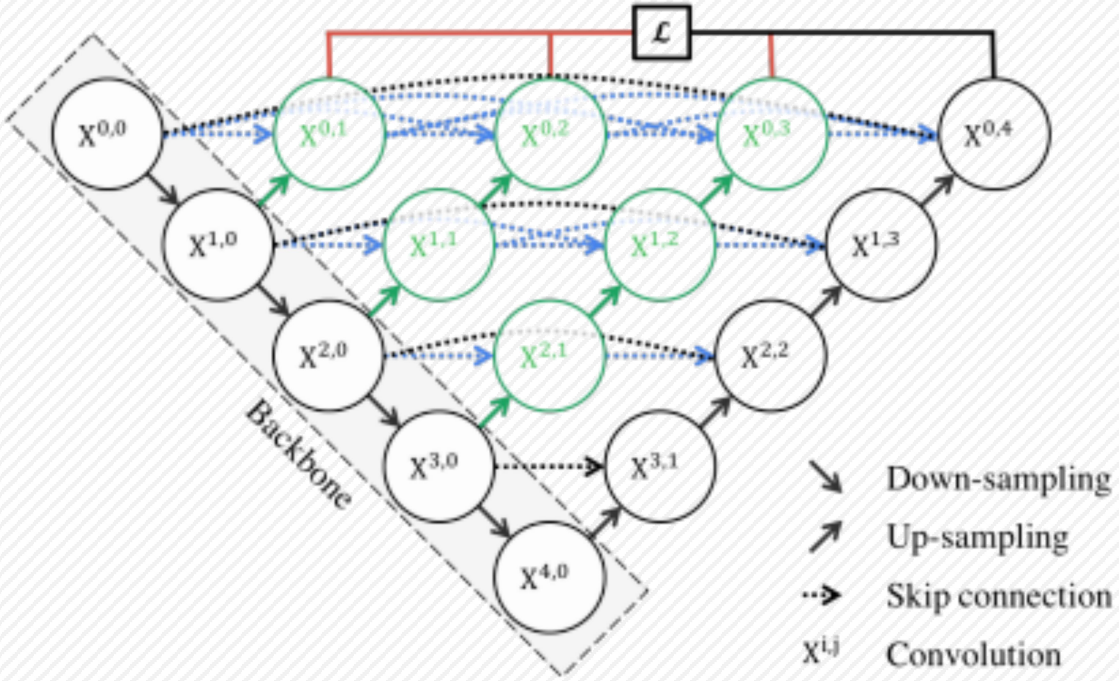


Figure 2 DenseNet network's dense connection mechanism

3.3 The advantage of DenseNet

Unet++

Unet forms UNet++ based on the idea of DenseNet



(a)

Full—Resolution Residual Networks for Semantic Image Segmentation Street Scenes

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Thanks for all