



中南大學
CENTRAL SOUTH UNIVERSITY

软件学院
SCHOOL OF SOFTWARE

浅谈FCN

陈力

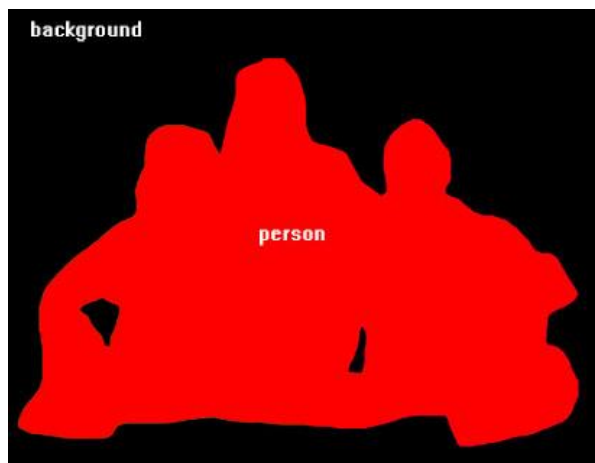
vchenli@csu.edu.cn

论文阅读：Fully Convolutional Networks for
Semantic Segmentation

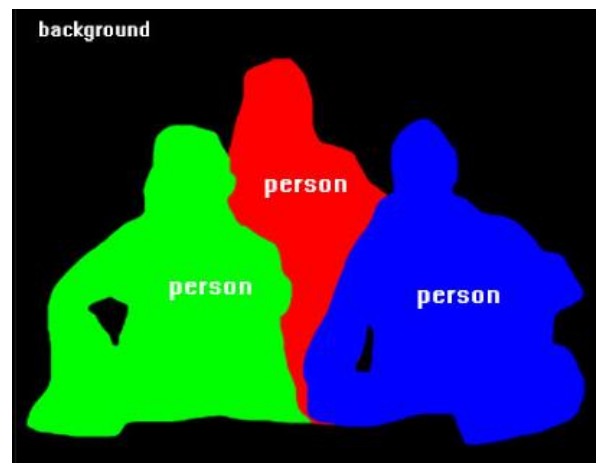
图像分割 (Segmentation)



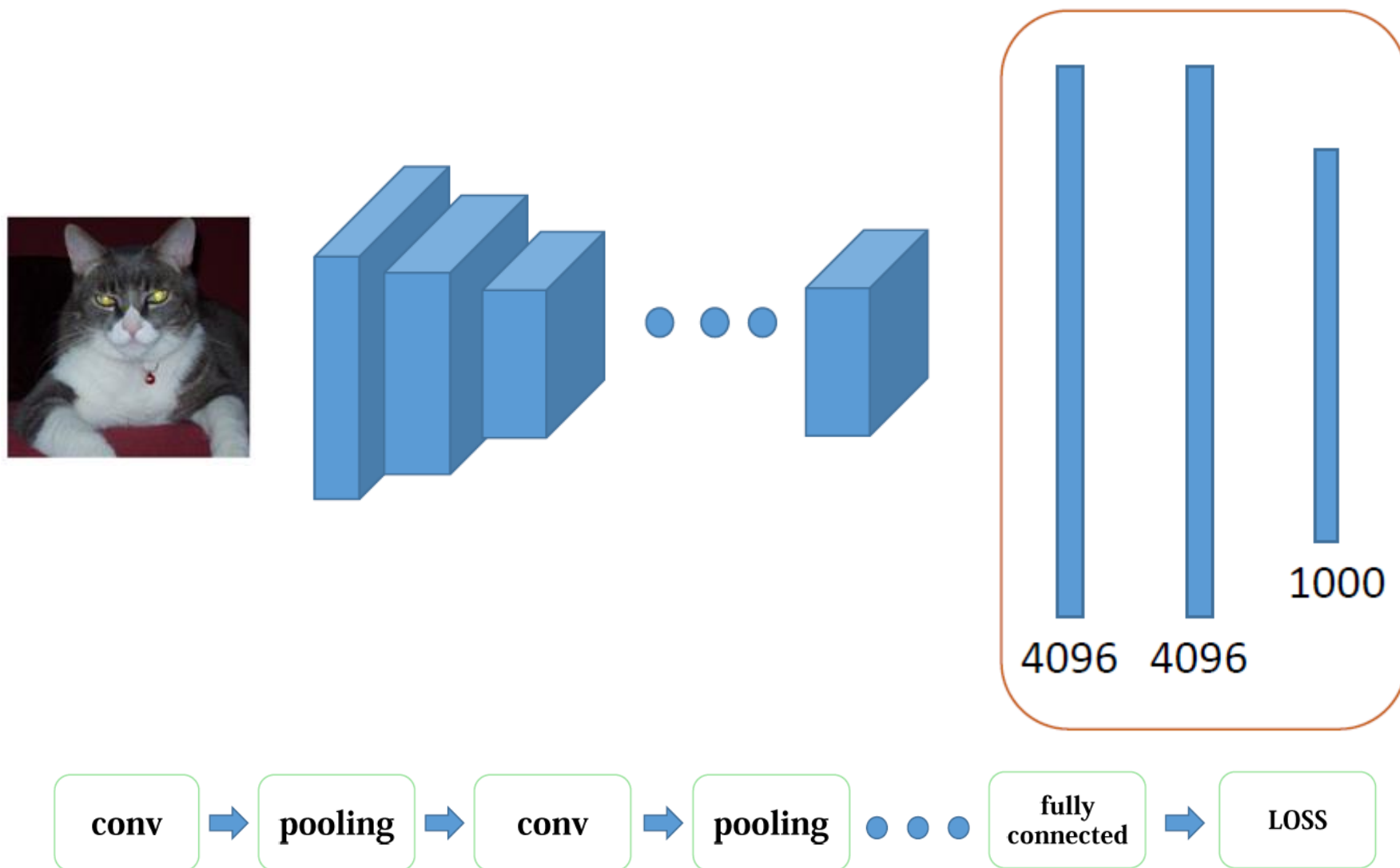
Semantic Segmentation



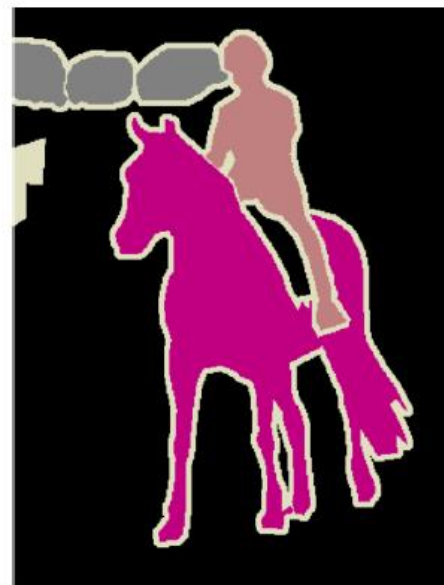
Instance Segmentation



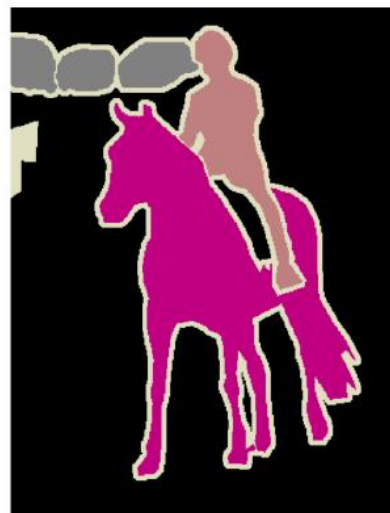
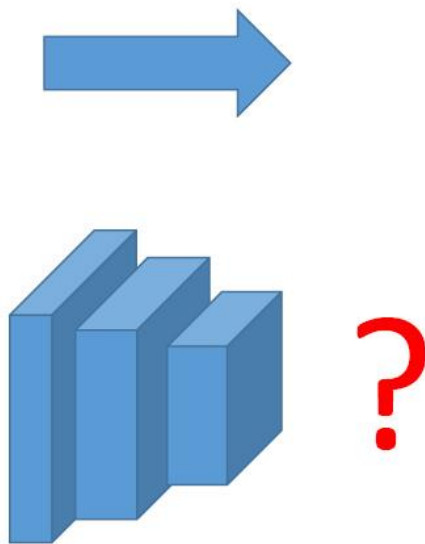
卷积神经网络 (CNN)



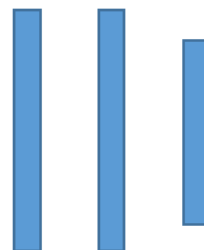
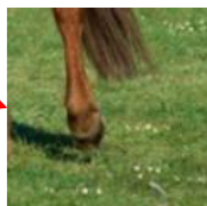
卷积神经网络 (CNN)



卷积神经网络 (CNN)



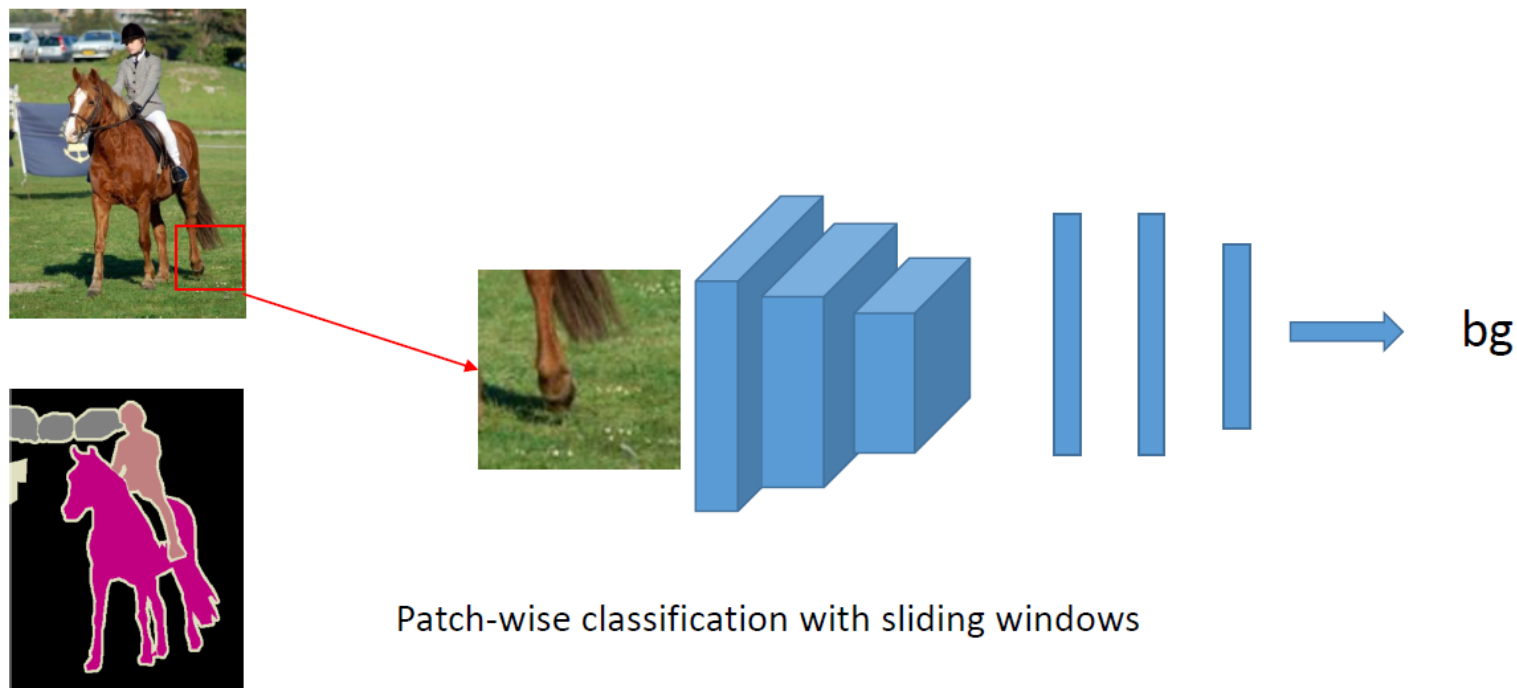
卷积神经网络 (CNN)



bg

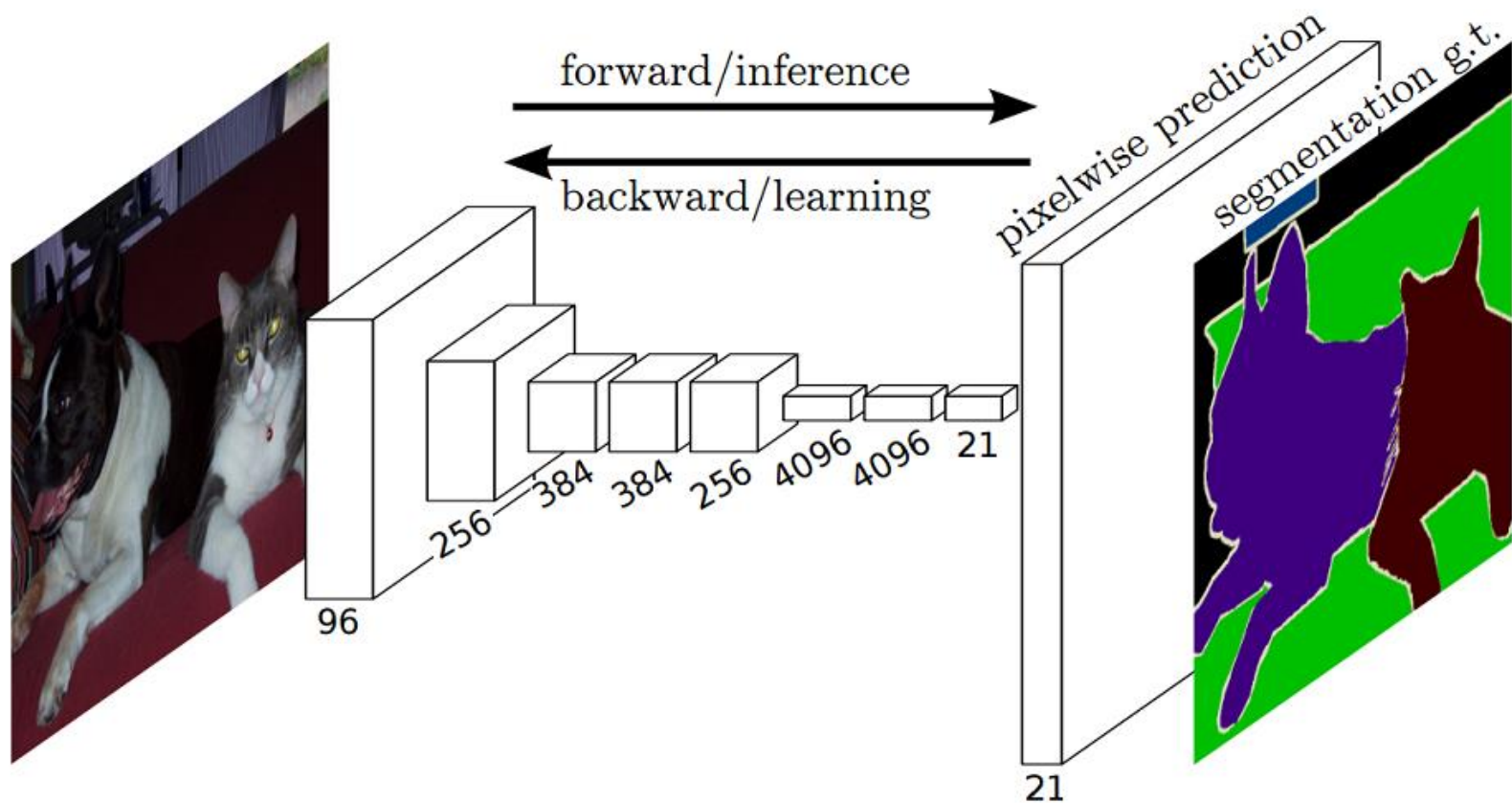
Patch-wise classification with sliding windows

卷积神经网络 (CNN)

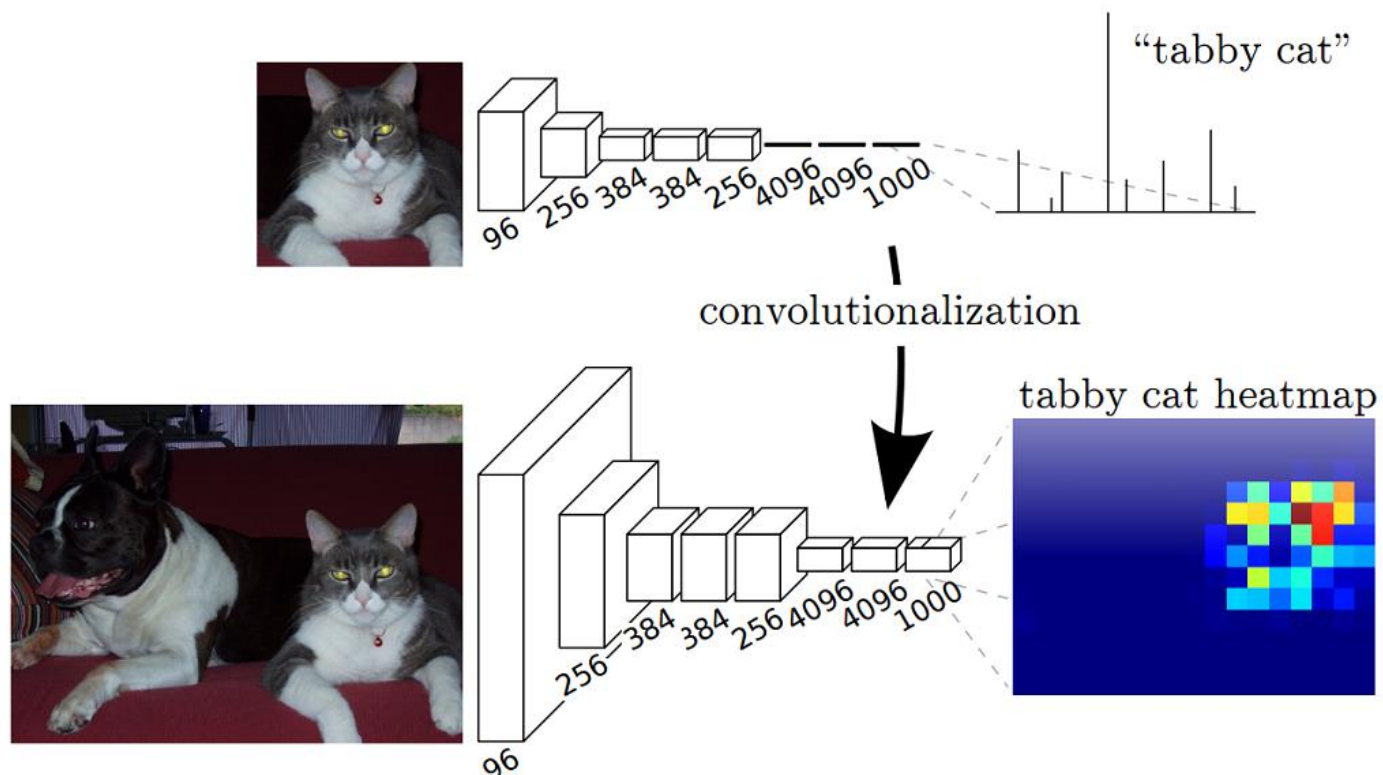


1. 存储开销很大。
2. 计算效率低下。
3. 像素块大小的限制了感知区域的大小。

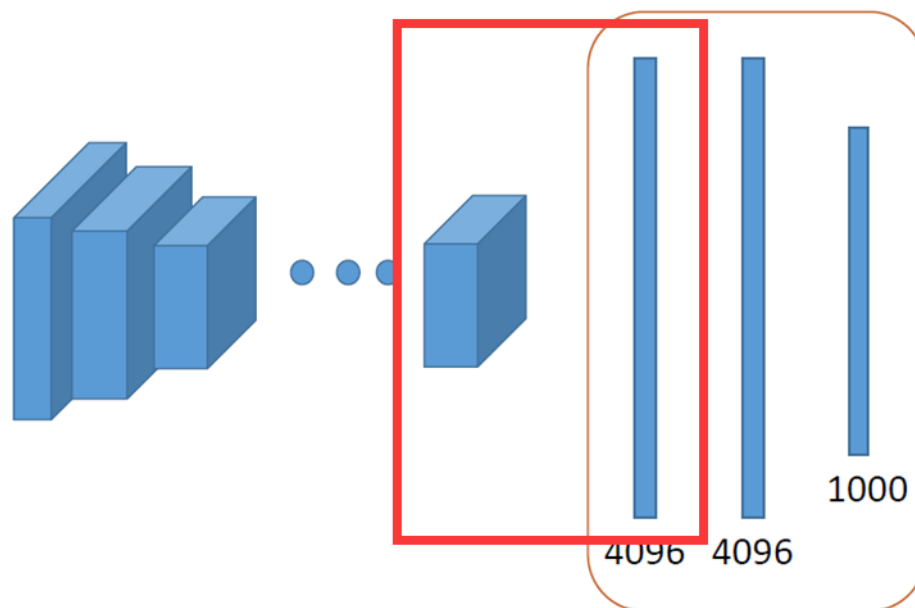
全卷积神经网络 (FCN)



全卷积神经网络 (FCN)



全卷积神经网络 (FCN)



Flatten层

```
keras.layers.core.Flatten()
```

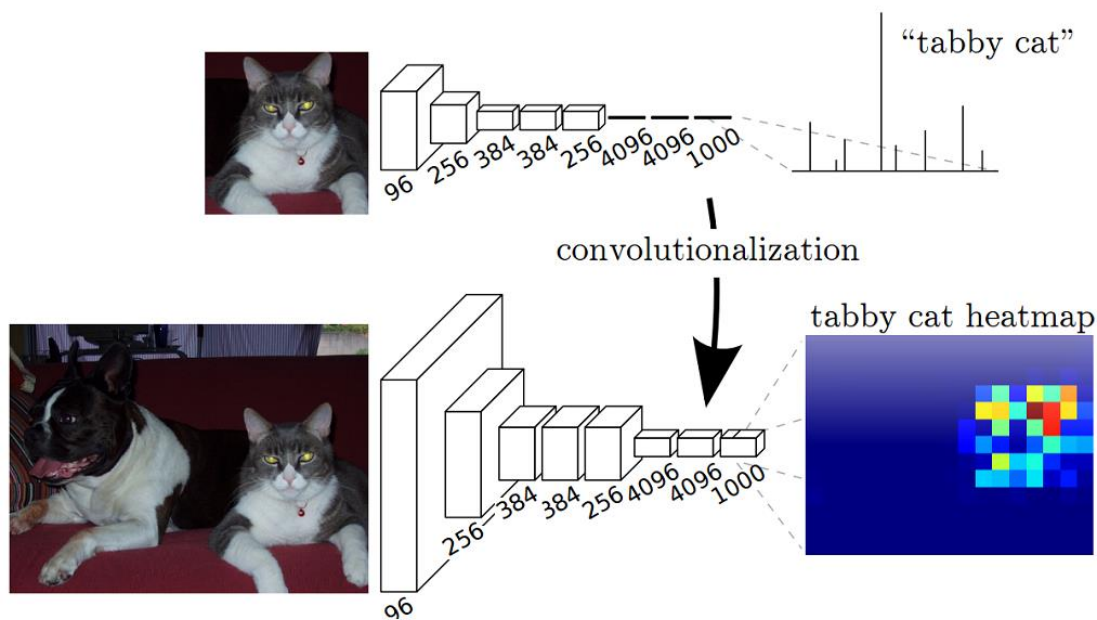
Flatten层用来将输入“压平”，即把多维的输入一维化，常用在从卷积层到全连接层的过渡。Flatten不影响batch的大小。

例子

```
model = Sequential()
model.add(Convolution2D(64, 3, 3,
                        border_mode='same',
                        input_shape=(3, 32, 32)))
# now: model.output_shape == (None, 64, 32, 32)

model.add(Flatten())
# now: model.output_shape == (None, 65536)
```

全卷积神经网络 (FCN)



227x227x3 \Rightarrow **7x7x512** \Rightarrow **4096** \Rightarrow

CNN输入图像尺寸固定

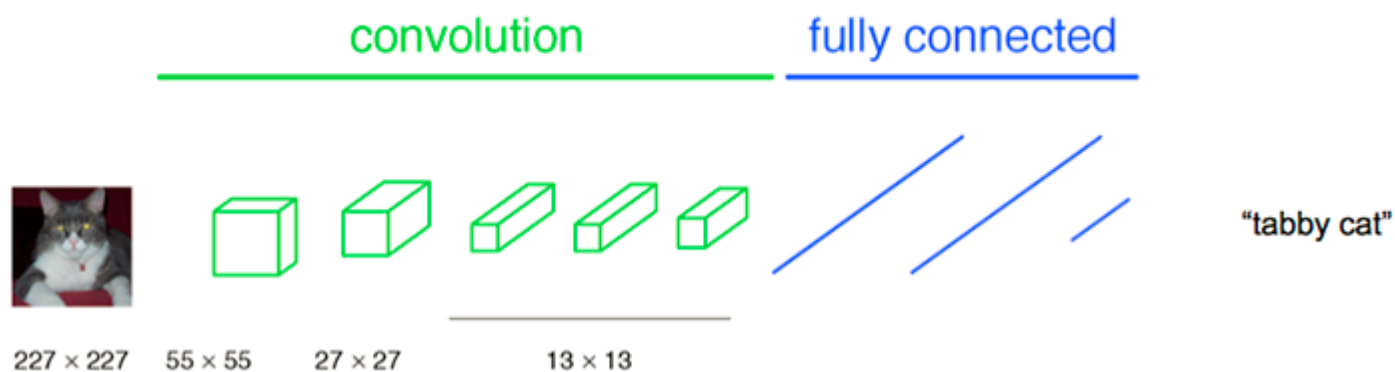
F=7,K=4096

227x227x3 \Rightarrow **7x7x512** \Rightarrow **1x1x4096** \Rightarrow

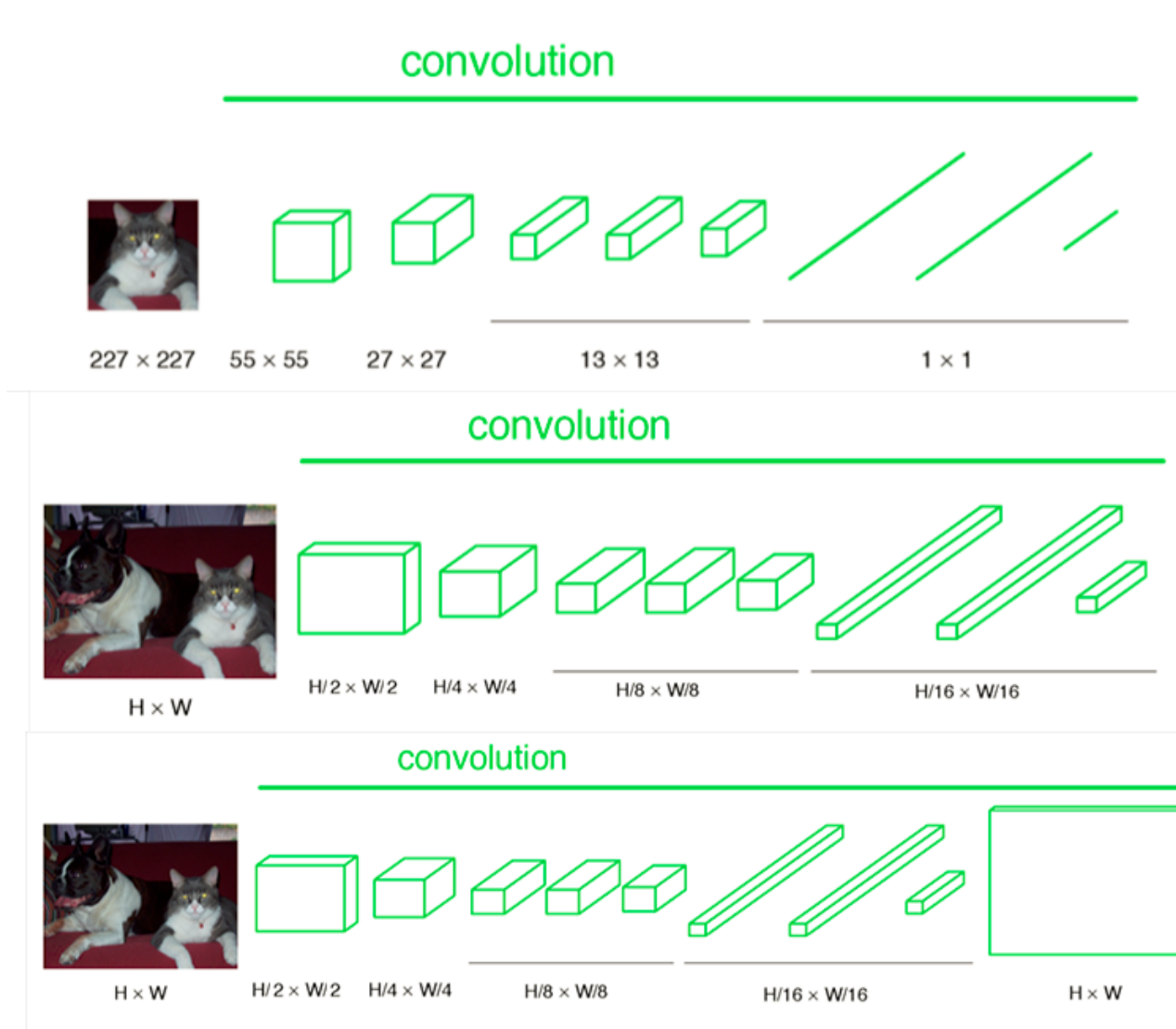
FCN输入图像尺寸不用固定

全卷积神经网络 (FCN)

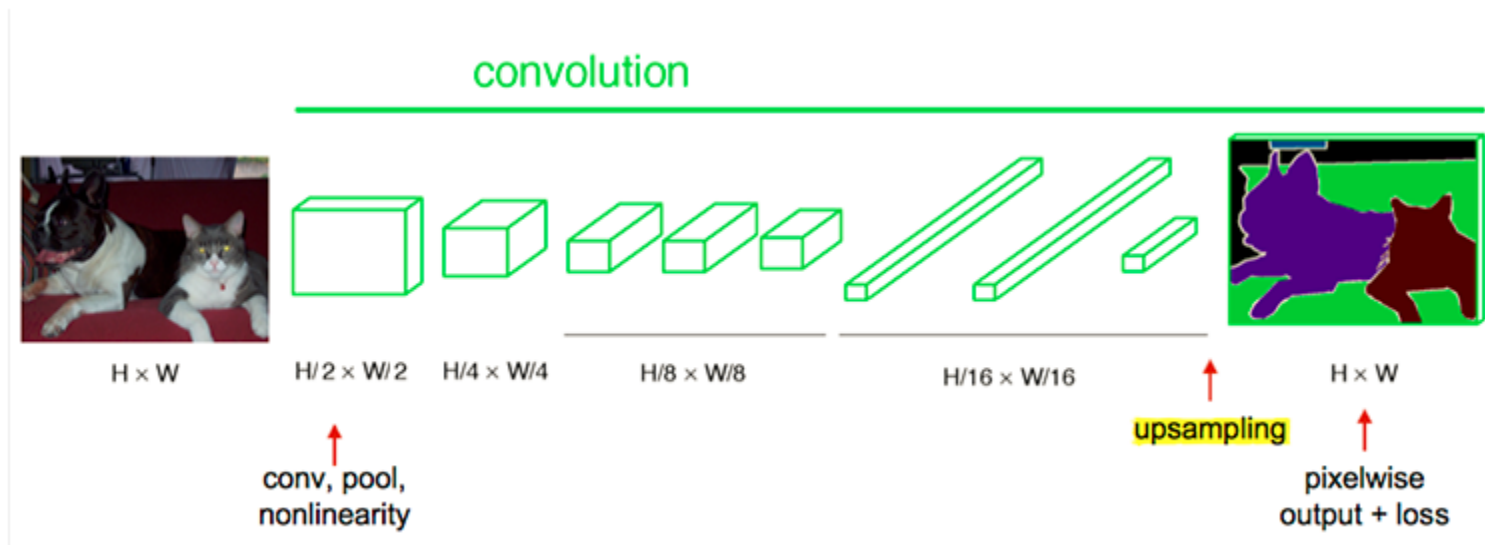
a classification network



全卷积神经网络 (FCN)



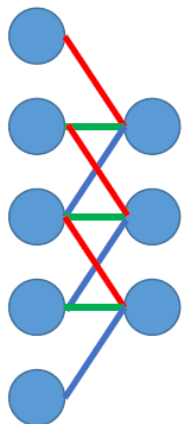
全卷积神经网络 (FCN)



Upsampling  反卷积(deconvolutional)  transposed convolution

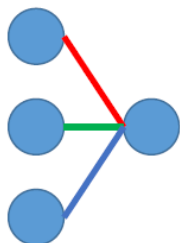
全卷积神经网络 (FCN)

2D convolution

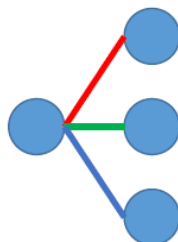


Convolution:
Stride = 1
Kernel=3

Convolution kernel



Deconvolution kernel



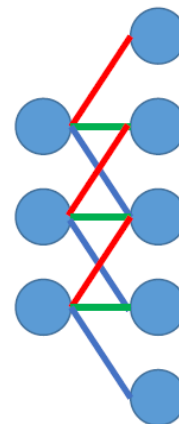
Error flow



Data flow

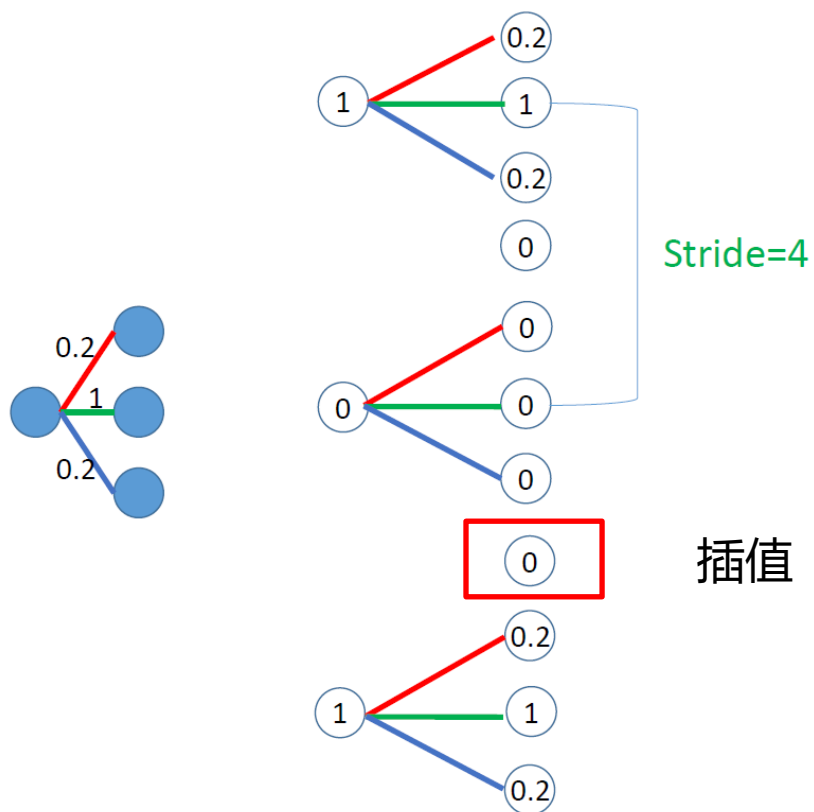


Deconvolution



Donvolution:
Stride = 1
Kernel=3

全卷积神经网络 (FCN)



$$h_o = \frac{h_i + 2 * pad - kernel_h}{stride_h} + 1$$

stride: 4

kernel_size: 3

全卷积神经网络 (FCN)

$$h_o = \frac{h_i + 2 * pad - kernel_h}{stride_h} + 1$$

16x16



transposed convolution

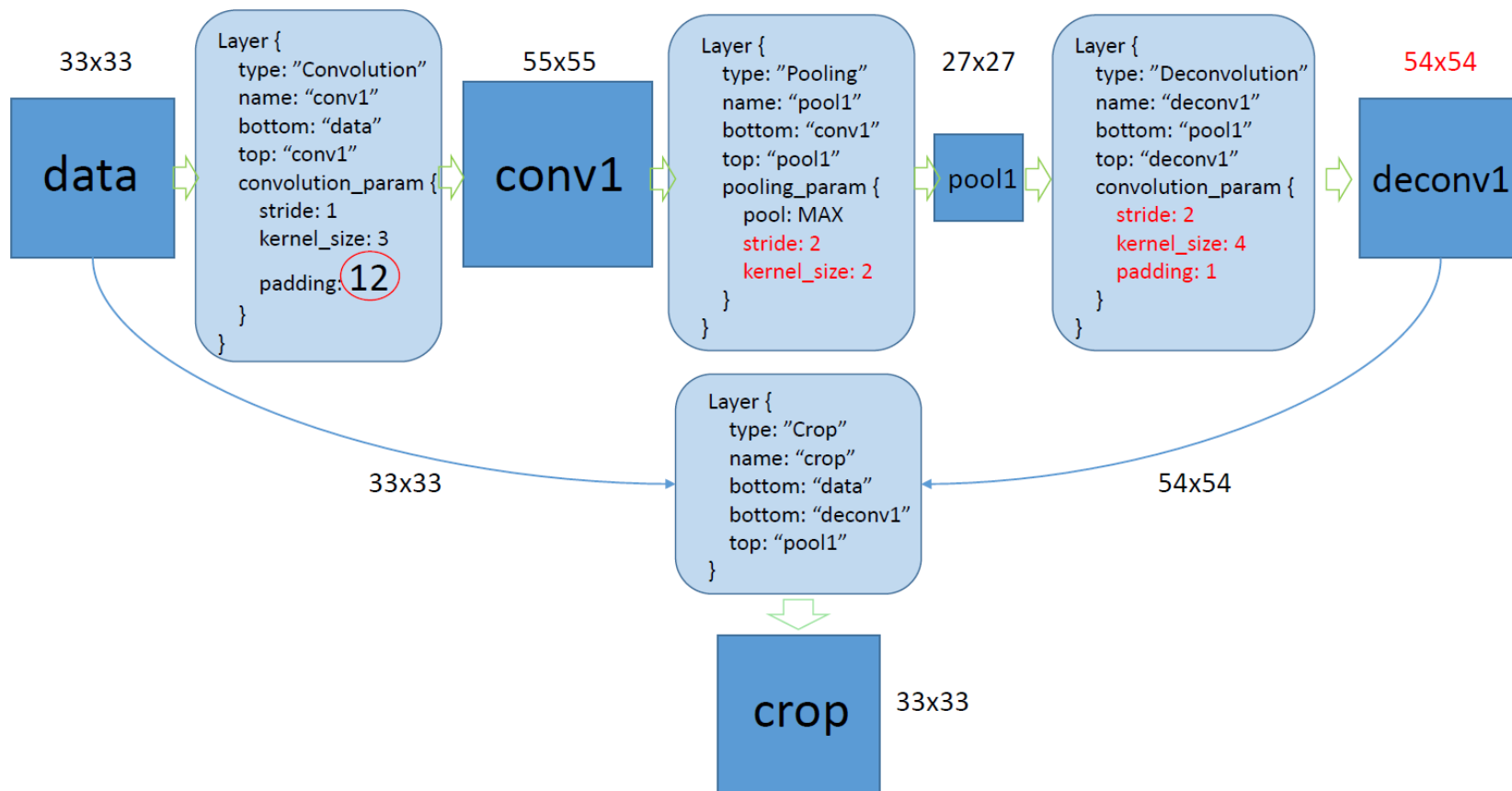
stride: 2
kernel_size: 4
padding: 1

32x32

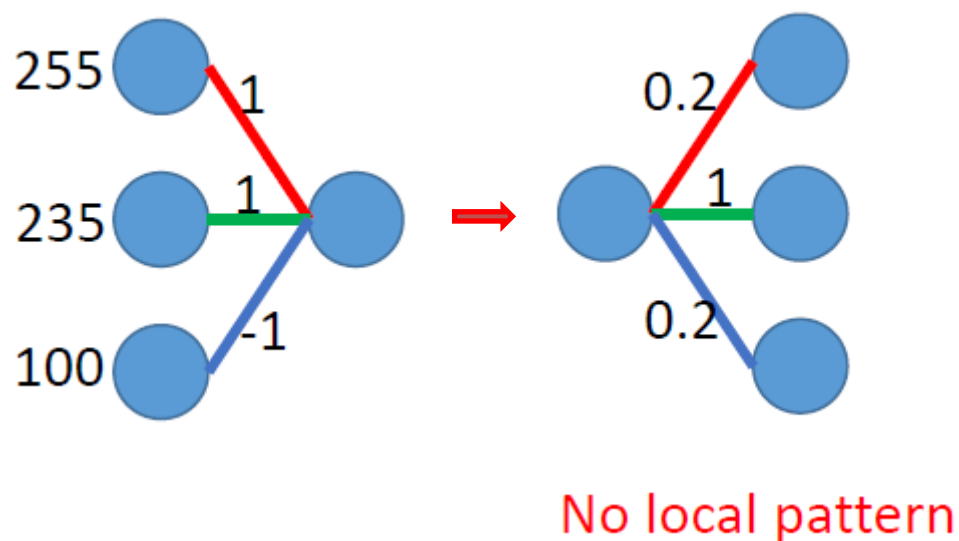


全卷积神经网络 (FCN)

$$h_o = \frac{h_i + 2 * pad - kernel_h}{stride_h} + 1$$

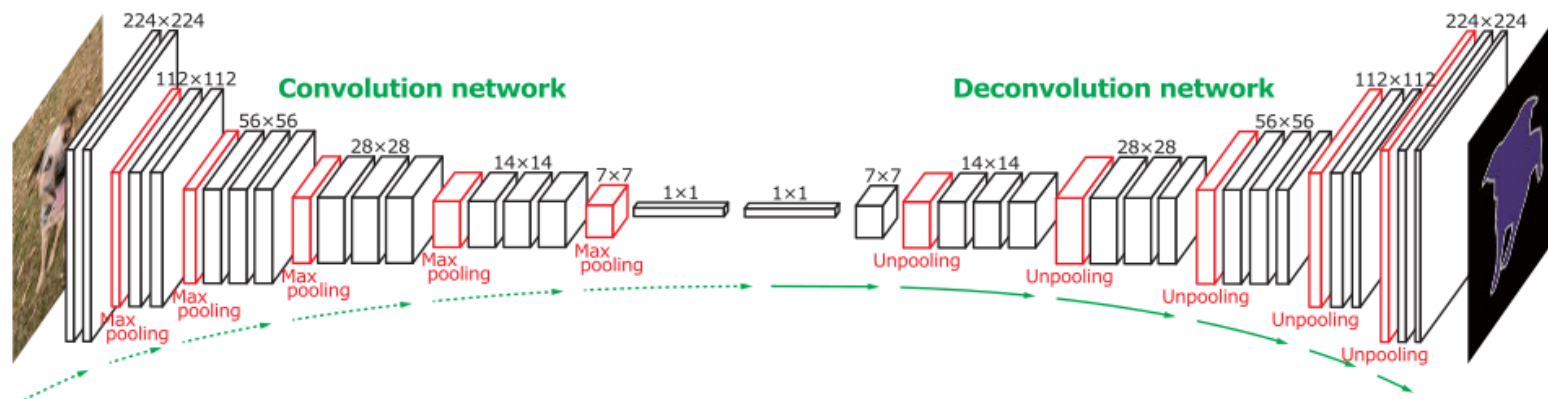


全卷积神经网络 (FCN)

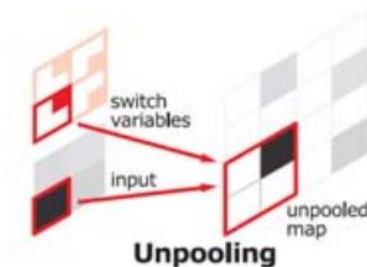
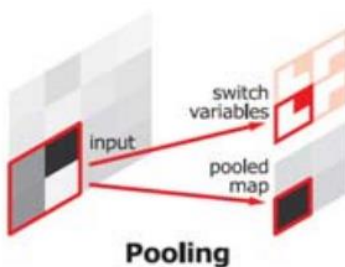
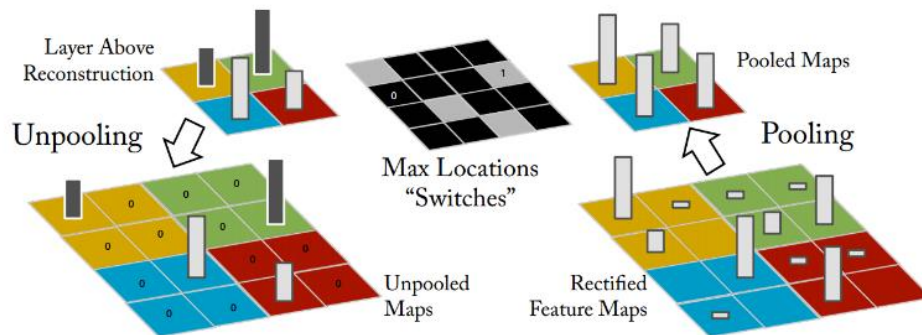


所以反卷积一般学习率设置为0，即卷积核不变
(有论文开放学习率发现效果也不明显)

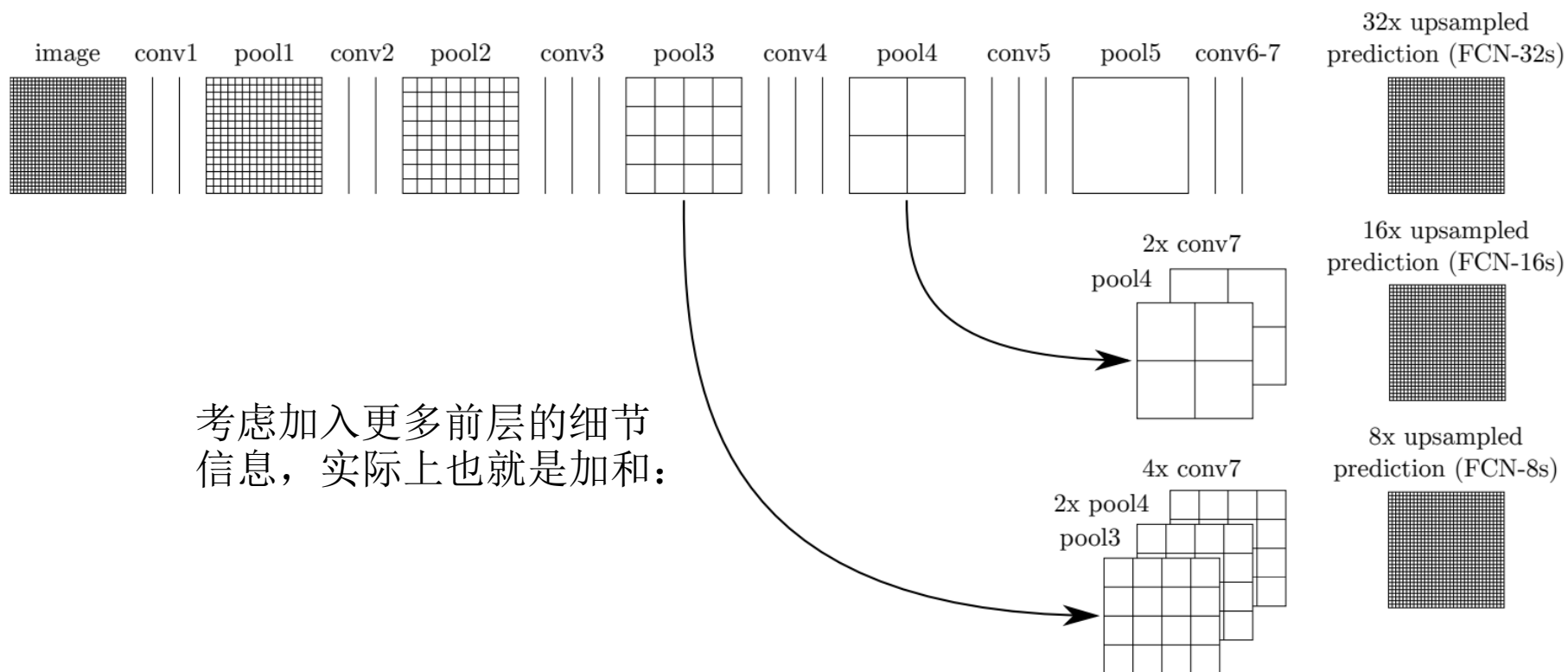
全卷积神经网络 (FCN)



Unpooling?

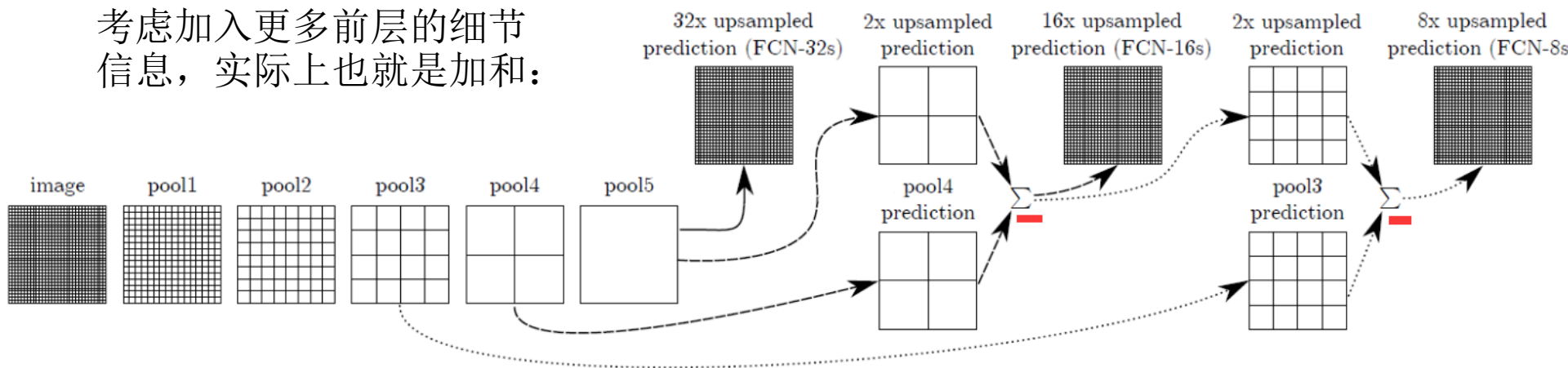


全卷积神经网络 (FCN)



全卷积神经网络 (FCN)

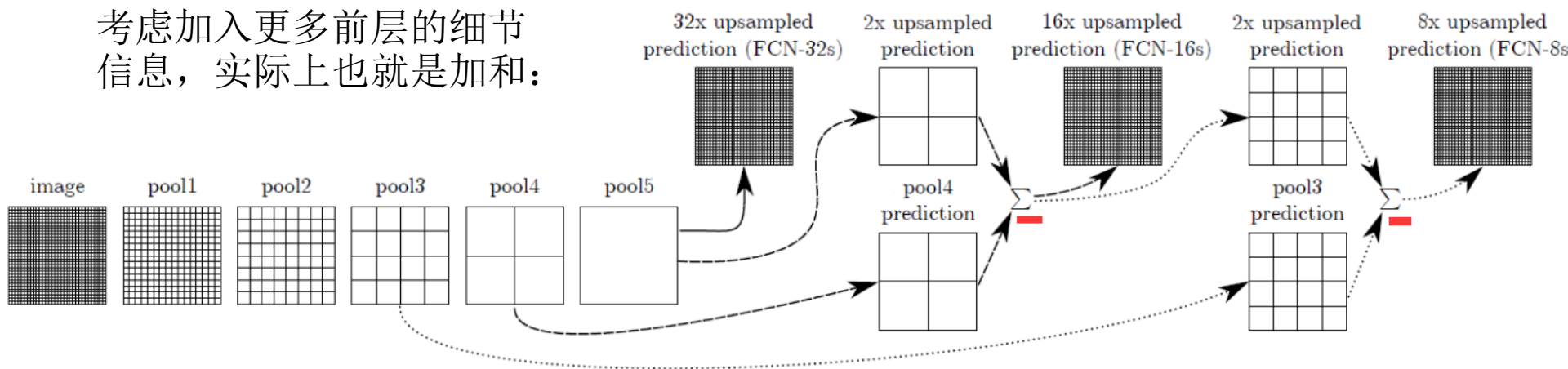
考虑加入更多前层的细节信息，实际上也就是加和：



	pixel acc.	mean acc.	mean IU	f.w. IU
FCN-32s-fixed	83.0	59.7	45.4	72.0
FCN-32s	89.1	73.3	59.4	81.4
FCN-16s	90.0	75.7	62.4	83.0
FCN-8s	90.3	75.9	62.7	83.2

全卷积神经网络 (FCN)

考虑加入更多前层的细节
信息，实际上也就是加和：



Thanks