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图像分割经典网络之Unet

Computer Technology

The School of Information Science and Technology

汇报人- *胡毕杰*

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图像分类

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输入 ⟶ 输出

(一张图片) (单个标签)

输入

输出

狗

?

输入 → 输出

狗

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CNN

输入 → 输出

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CNN

卷积神经网络

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图像分类

004

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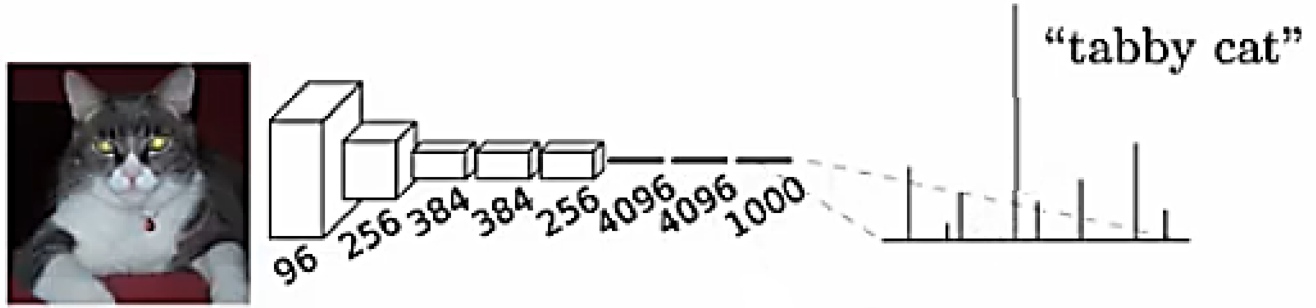
CNN
卷积神经网络



卷积层

全连接层

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图像分割

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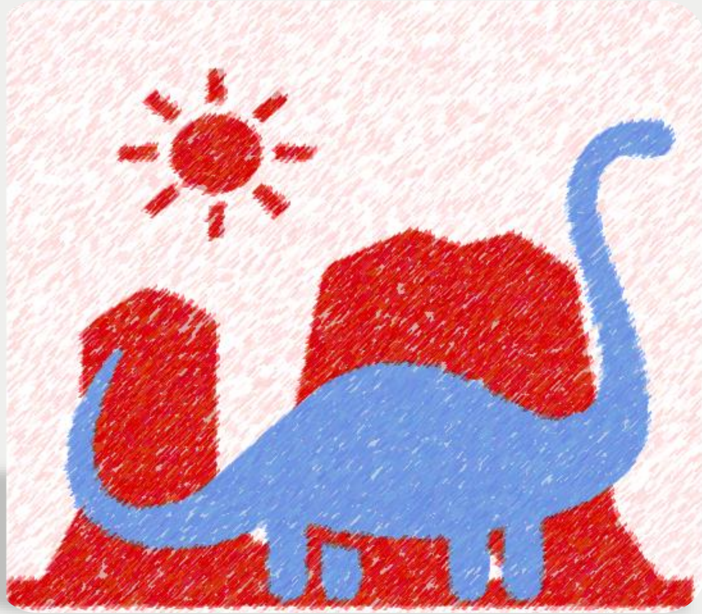
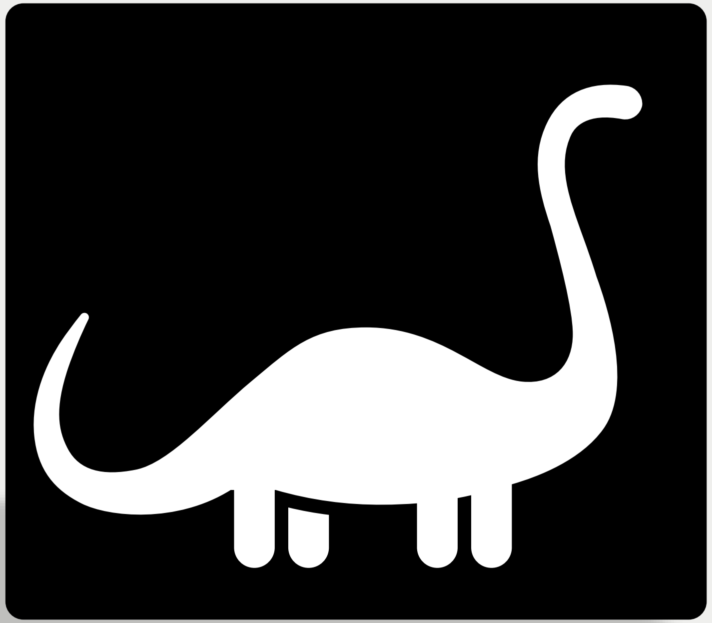
输入



给每一个
像素进行分类

输出

Mask



输入

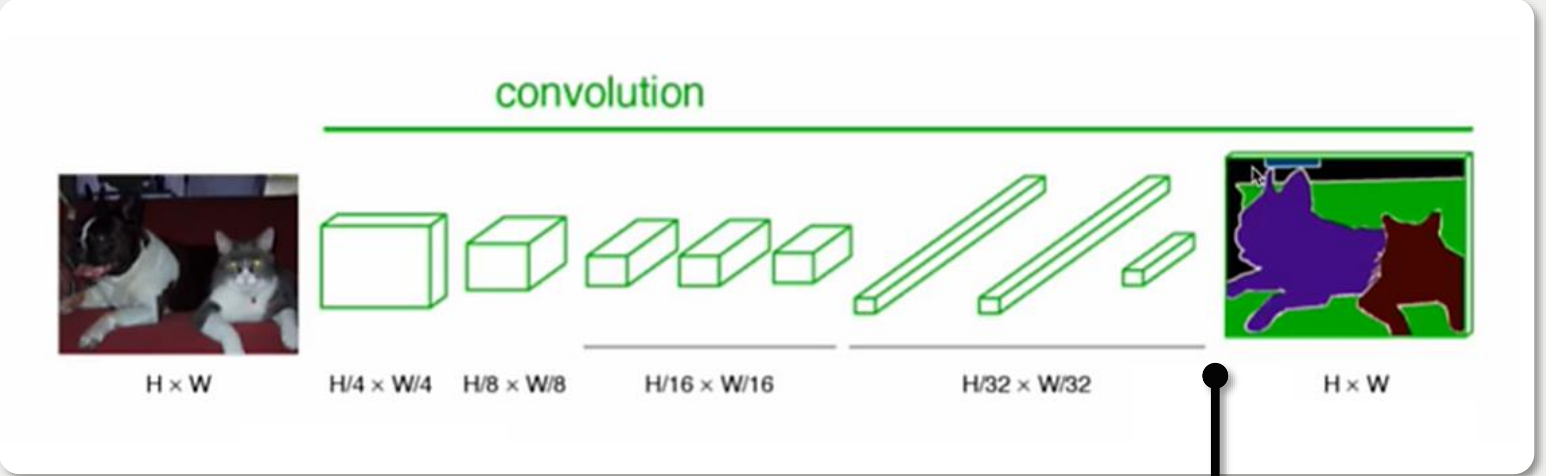
给每一个
像素进行分类

输出

Mask

FCN

FCN



上采样层

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上采样层

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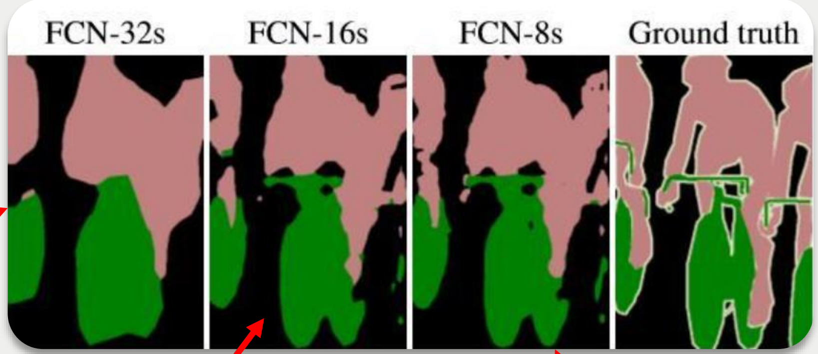

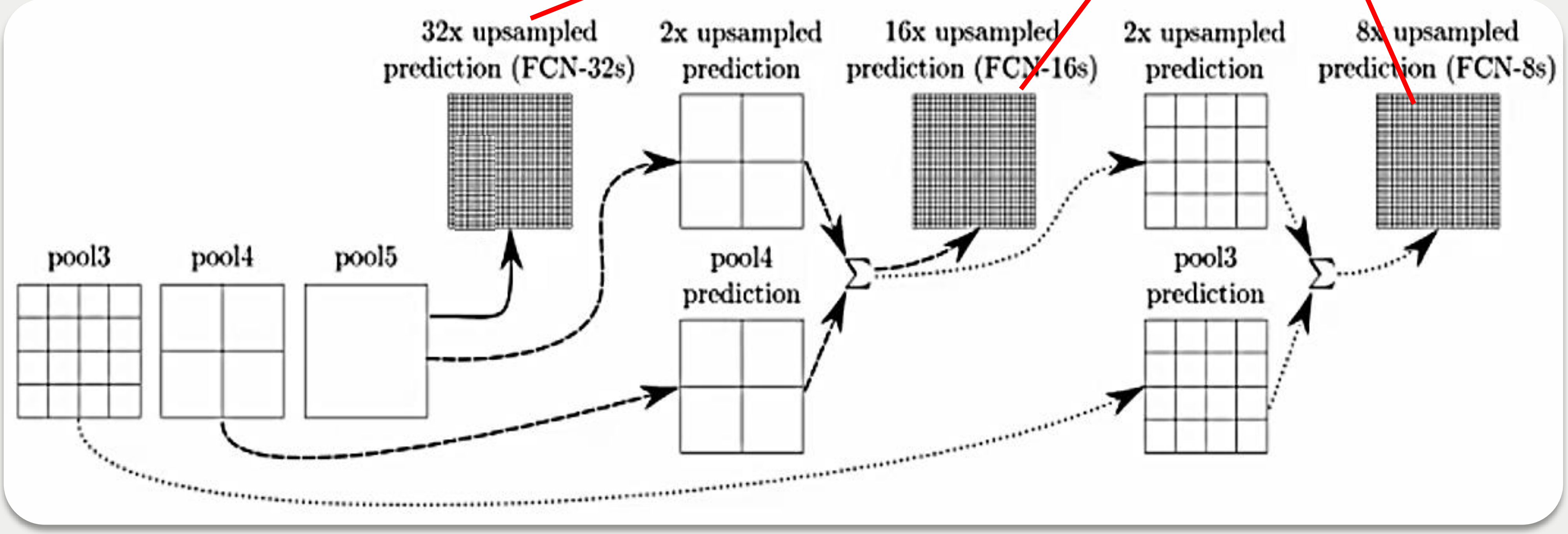

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FCN

UNet

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UNet

U-Net: Convolutional Networks for Biomedical Image Segmentation(cs.CV 2015.03.18)

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Network Architectur
e

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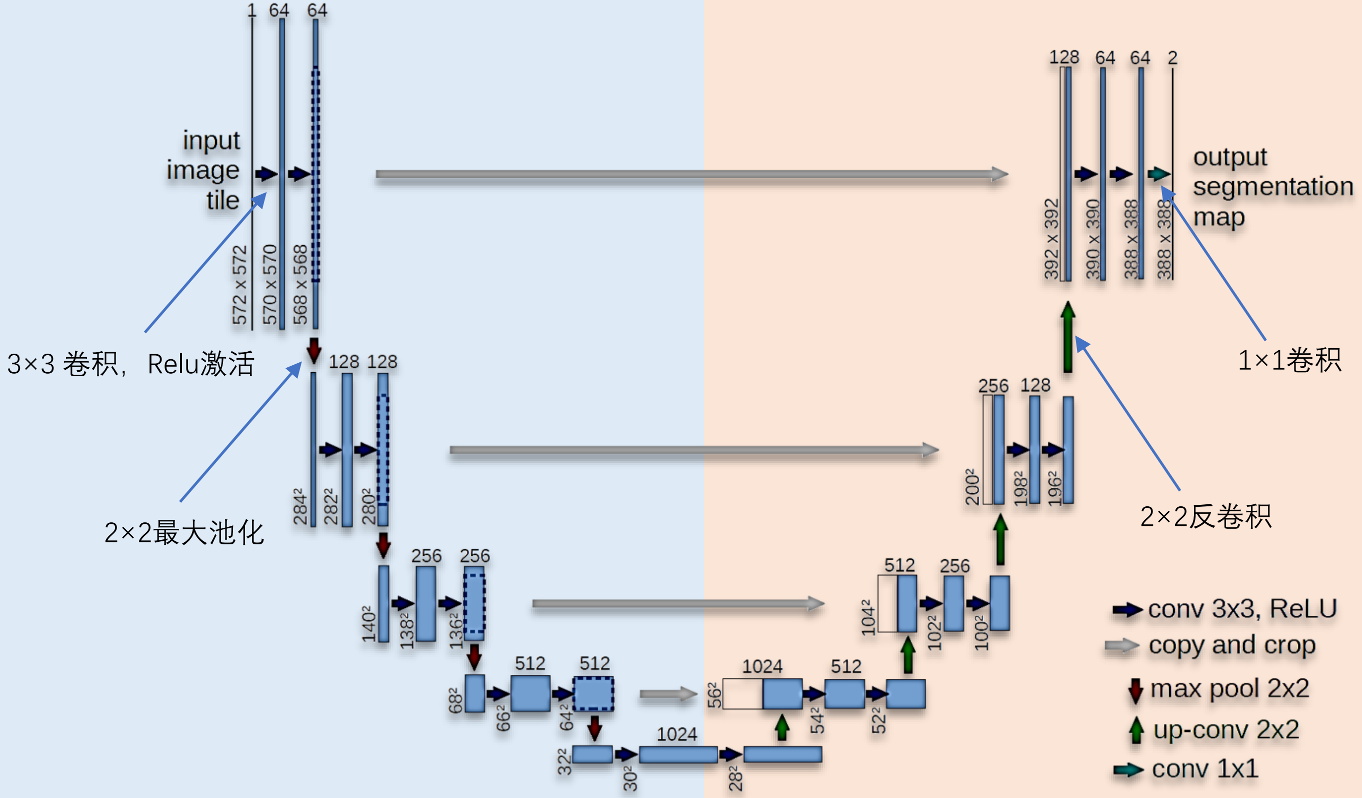
下采样

常规的两次3*3卷积、RELU激活层、2*2的maxpooling

上采样

2*2的反卷积，融合、常规的两次3*3卷积、RELU激活层



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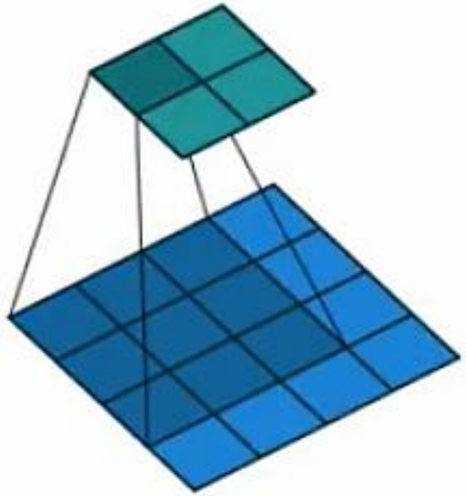
反卷积
(Transposed convolution)

$$W = \begin{pmatrix} w_{0,0} & w_{0,1} & w_{0,2} & 0 & w_{1,0} & w_{1,1} & w_{1,2} & 0 & w_{2,0} & w_{2,1} & w_{2,2} & 0 & 0 & 0 & 0 & 0 \\ 0 & w_{0,0} & w_{0,1} & w_{0,2} & 0 & w_{1,0} & w_{1,1} & w_{1,2} & 0 & w_{2,0} & w_{2,1} & w_{2,2} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & w_{0,0} & w_{0,1} & w_{0,2} & 0 & w_{1,0} & w_{1,1} & w_{1,2} & 0 & w_{2,0} & w_{2,1} & w_{2,2} & 0 \\ 0 & 0 & 0 & 0 & 0 & w_{0,0} & w_{0,1} & w_{0,2} & 0 & w_{1,0} & w_{1,1} & w_{1,2} & 0 & w_{2,0} & w_{2,1} & w_{2,2} \end{pmatrix}$$

$X = (x_1, x_2, \ldots, x_{16})^T$ $Y = (y_1, y_2, y_3, y_4)^T$



卷积： $W \cdot X$

4x16, 16x1
4x1

反卷积： $W^T \cdot Y$

16x4, 4x1
16x1

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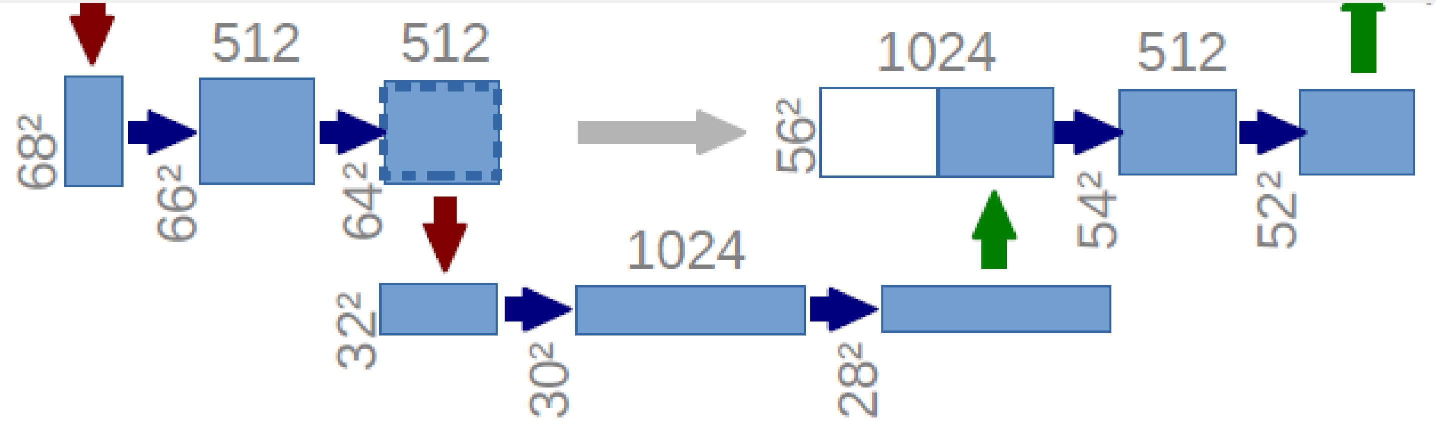

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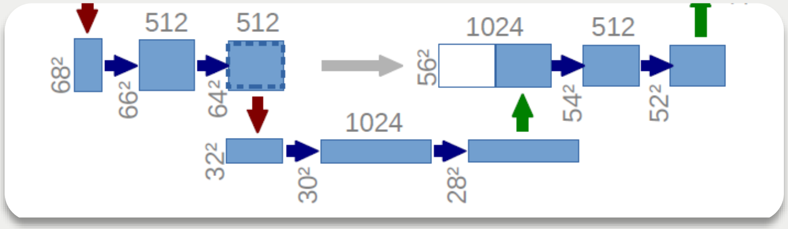
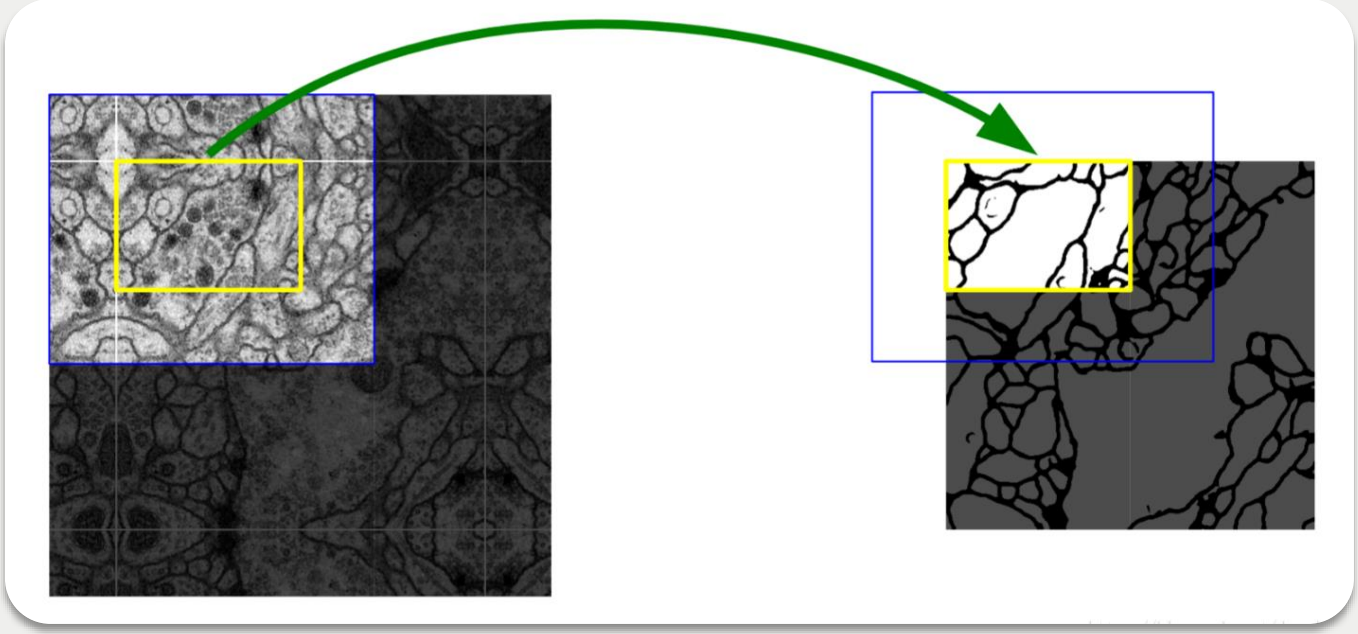


Overlap-tile 策略



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数据增强

数据增强

色彩抖动	尺度变换	翻转变换
平移变换	噪声扰动	随机弹性变形

数据增强

色彩抖动	尺度变换	翻转变换
平移变换	噪声扰动	**随机弹性变形**

损失函数

$$p_k(\mathbf{x}) = \exp(a_k(\mathbf{x}))/\left(\sum_{k'=1}^{K}\exp(a_{k'}(\mathbf{x}))\right)$$

像素点形式的softmax，
$a_k(x)$表示像素x在特征图中的第k层的激活值，
k表示是第几个特征通道，
x表示像素点，
K表示类别的个数。

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

$\ell : \Omega \to \{1,\dots,K\}$ 每个像素的真实标签

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

表示训练构成中像素点的重要性
w_c表示平衡类别频率的权重图
d_1表示此像素点到离它最近cell边界的距离，
d_2表示此像素点到离他第二近cell边界的距离。

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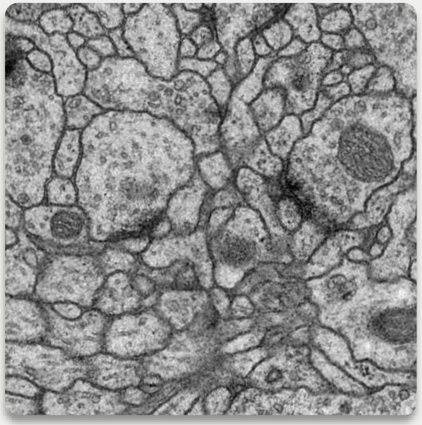
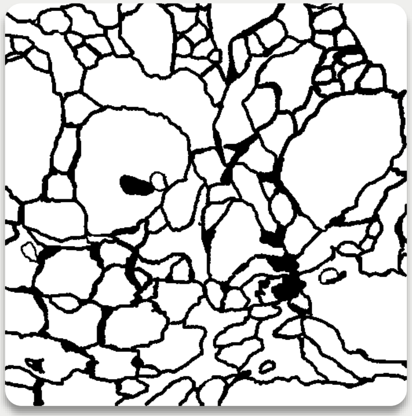
实验

- 框架：keras
- 训练集：30张细胞图
- 测试集：30张细胞图



原图



结果

论文连接：https://arxiv.org/pdf/1505.04597.pdf
源码连接：https://github.com/FENGShuanglang/unet

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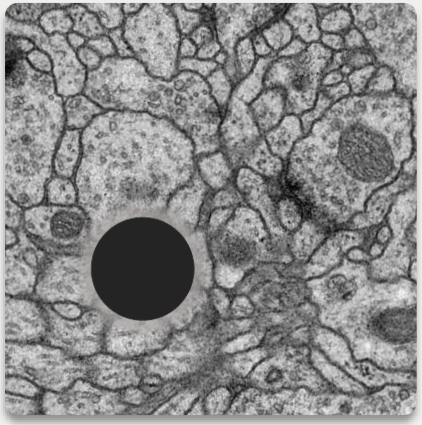
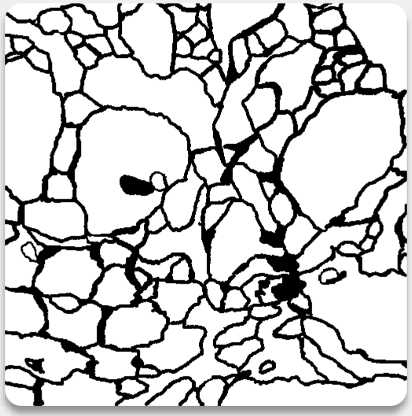


原图



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THANK FOR YOUR ATTENTION

BY Hu.

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