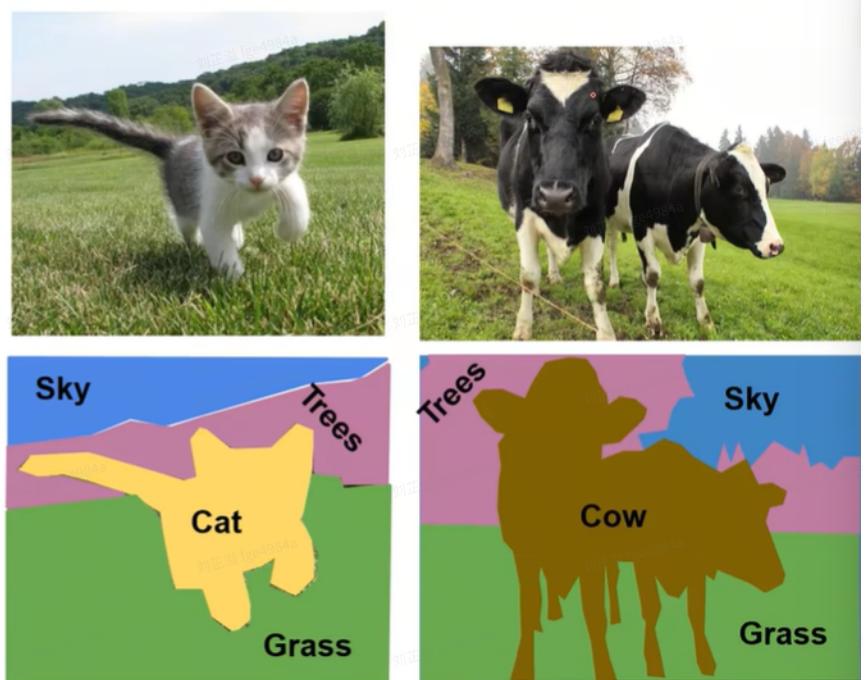


7. 图像分割



语义分割

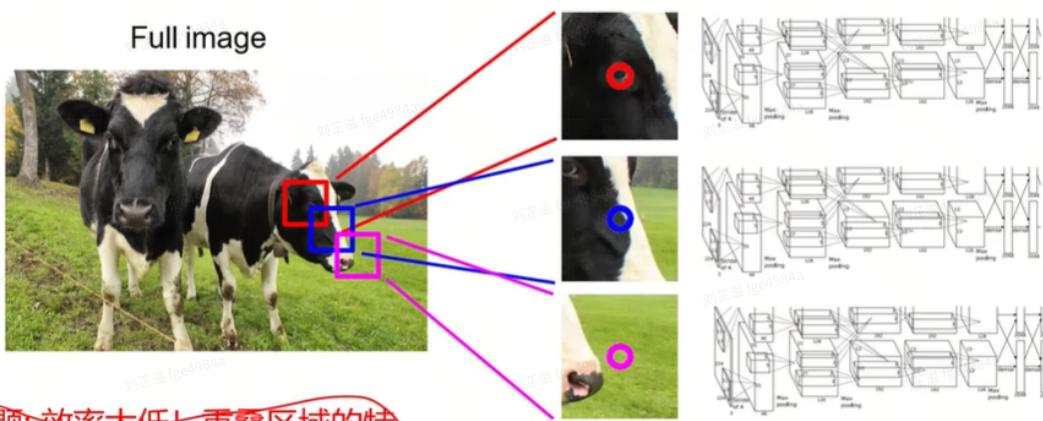
- 给每个像素分配类别标签；不区分实例，只考虑像素类别



语义分割思路：滑动窗口

提取区域 利用CNN对中心点像素分类

刘正强 fge4984a



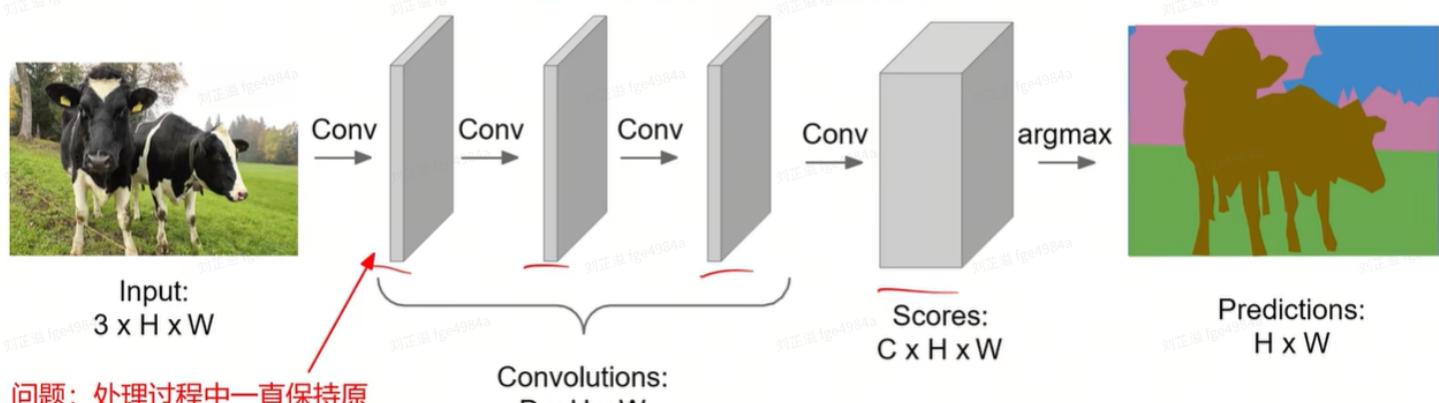
(问题: 效率太低! 重叠区域的特征反复被计算)

Farabet et al, "Learning Hierarchical Features for Scene Labeling," TPAMI 2013

Pinheiro and Collobert, "Recurrent Convolutional Neural Networks for Scene Labeling", ICML 2014

语义分割思路：全卷积

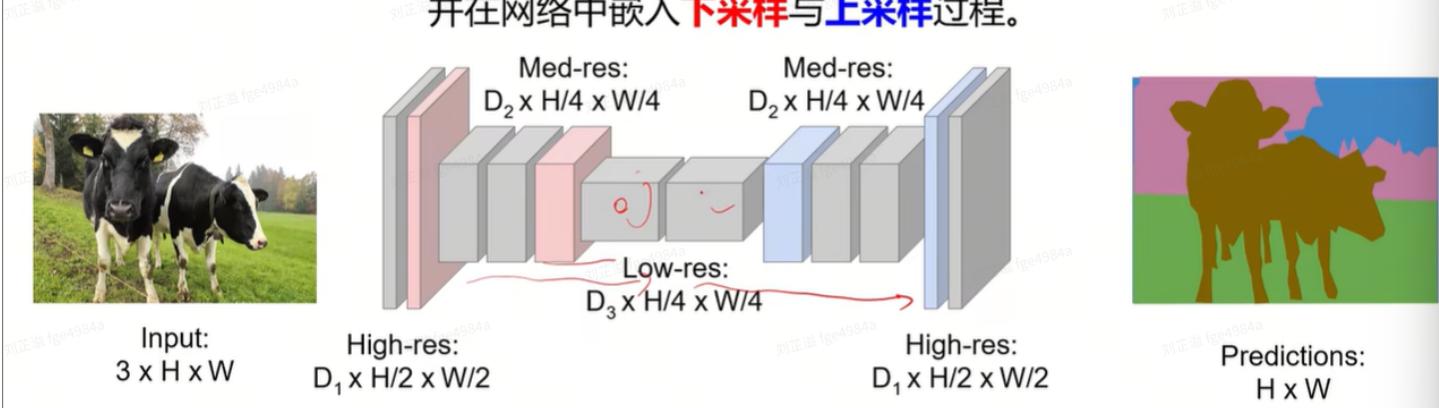
解决方案：让整个网络只包含卷积层，
一次性输出所有像素的类别预测。



问题：处理过程中一直保持原始分辨率，对于显存的需求会非常庞大...

- 让整个网络只包含卷积层；并在网络中嵌入下采样与上采样过程

解决方案：让整个网络只包含卷积层，
并在网络中嵌入下采样与上采样过程。



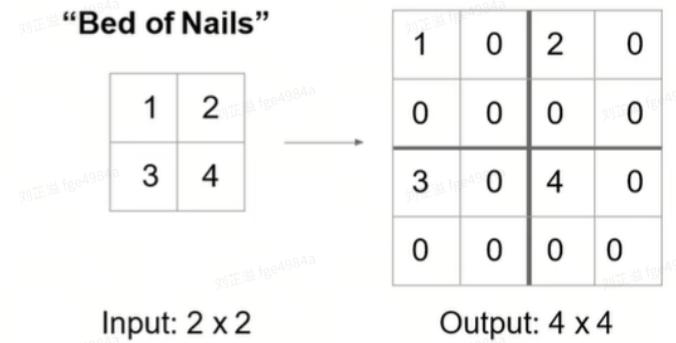
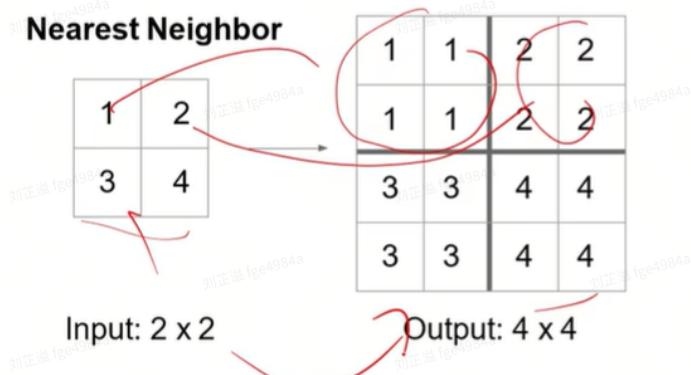
Long, Shelhamer, and Darrell, "Fully Convolutional Networks for Semantic Segmentation", CVPR 2015
Noh et al, "Learning Deconvolution Network for Semantic Segmentation", ICCV 2015

下采样

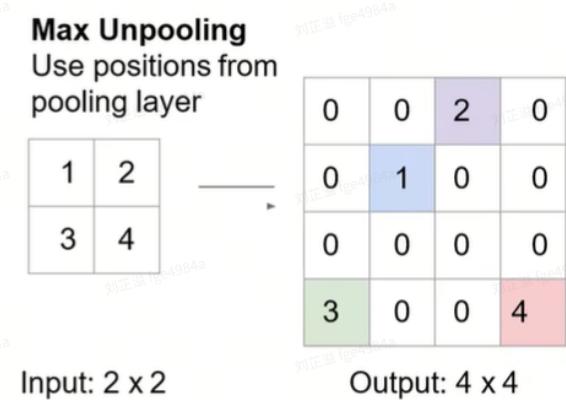
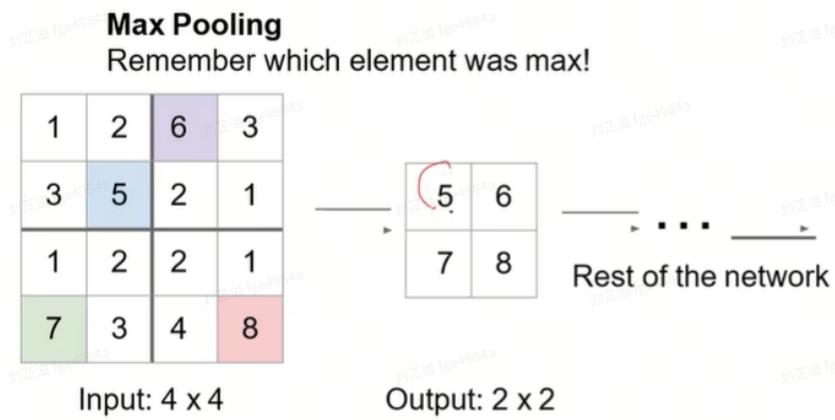
- Pooling, strided convolution

上采样

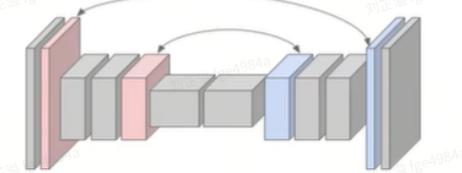
反池化操作: "Unpooling"



反池化操作: "Max Unpooling"

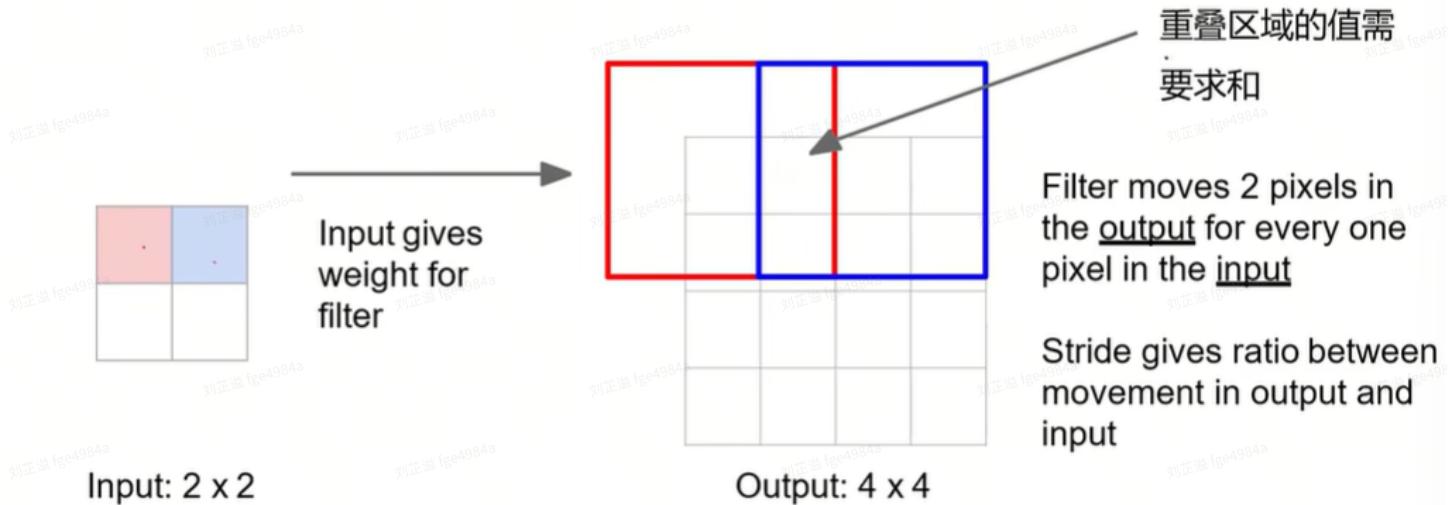


Corresponding pairs of
downsampling and
upsampling layers



可学习的上采样: 转置卷积(Transpose Convolution)

3 x 3 转置卷积 (transpose convolution) , stride 2 pad 1



卷积与矩阵相乘

- 转置卷积的参数都是神经网络自己学习的

卷积与矩阵相乘 (一维例子)

将卷积写为矩阵乘法

$$\vec{x} * \vec{a} = X \vec{a}$$

$$\begin{bmatrix} x & y & x & 0 & 0 & 0 \\ 0 & x & y & x & 0 & 0 \\ 0 & 0 & x & y & x & 0 \\ 0 & 0 & 0 & x & y & x \end{bmatrix} \begin{bmatrix} 0 \\ a \\ b \\ c \\ d \\ 0 \end{bmatrix} = \begin{bmatrix} ay + bz \\ ax + by + cz \\ bx + cy + dz \\ cx + dy \end{bmatrix}$$

例子: 1D 卷积, 卷积核尺寸

尺寸=3, 步长=1, 零填充=1

Convolution transpose multiplies by the transpose of the same matrix:

$$\vec{x} *^T \vec{a} = X^T \vec{a}$$

$$\begin{bmatrix} x & 0 & 0 & 0 \\ y & x & 0 & 0 \\ z & y & x & 0 \\ 0 & z & y & x \\ 0 & 0 & z & y \\ 0 & 0 & 0 & z \end{bmatrix} \begin{bmatrix} a \\ b \\ c \\ d \end{bmatrix} = \begin{bmatrix} ax \\ ay + bx \\ az + by + cx \\ bz + cy + dx \\ cz + dy \\ dz \end{bmatrix}$$

6

将卷积写为矩阵乘法

$$\vec{x} * \vec{a} = X \vec{a}$$

$$\begin{bmatrix} x & y & x & 0 & 0 & 0 \\ 0 & 0 & x & y & x & 0 \end{bmatrix} \begin{bmatrix} 0 \\ a \\ b \\ c \\ d \\ 0 \end{bmatrix} = \begin{bmatrix} ay + bz \\ bx + cy + dz \end{bmatrix}$$

例子: 1D 卷积, 卷积核尺寸=3, 步长=2, 零填充=1

Convolution transpose multiplies by the transpose of the same matrix:

$$\vec{x} *^T \vec{a} = X^T \vec{a}$$

$$\begin{bmatrix} x & 0 \\ y & 0 \\ z & x \\ 0 & y \\ 0 & z \\ 0 & 0 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} ax \\ ay \\ az + bx \\ by \\ bz \\ 0 \end{bmatrix}$$