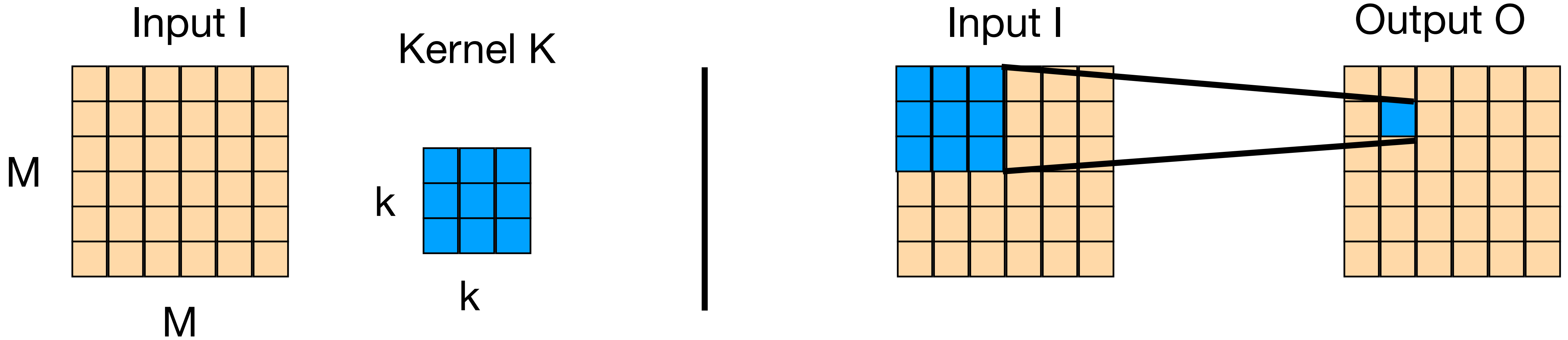


CNN recap

1 input channel 1 output channel



$$O_{i,j} = \sum_{n=0, m=0}^{k-1, k-1} K_{n,m} I_{i-k//2+n, j-k//2+m}$$

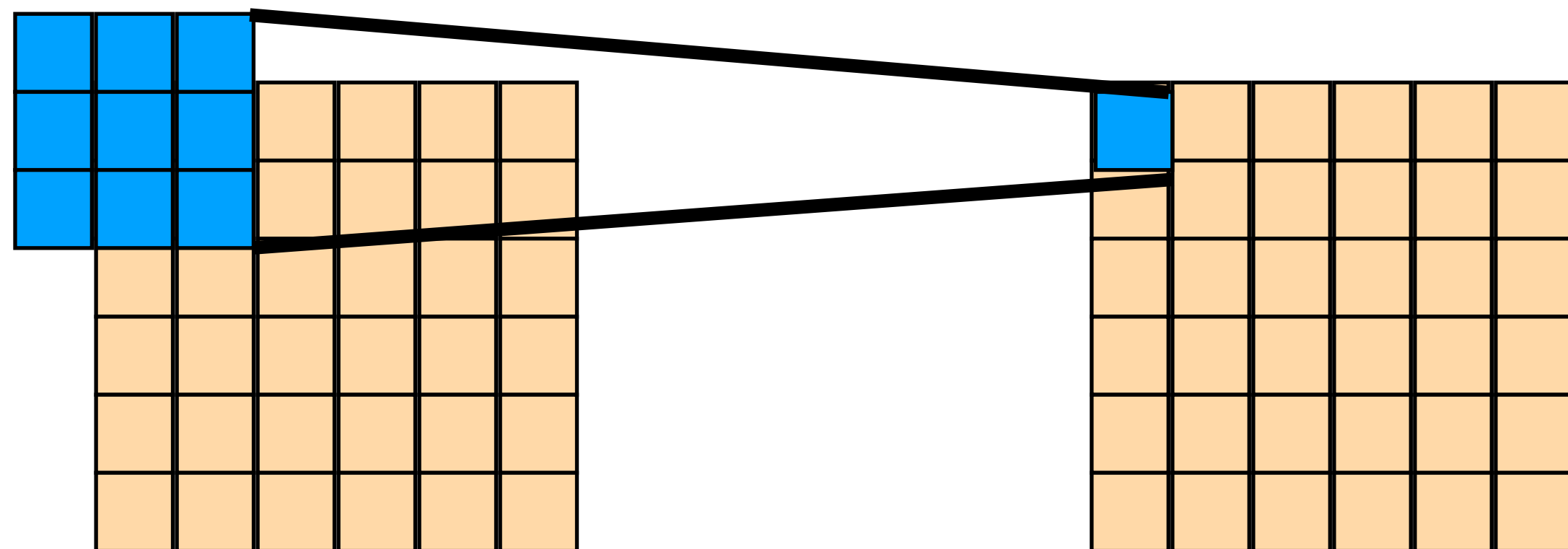
CNN recap

Different paddings

Zero padding

Input I

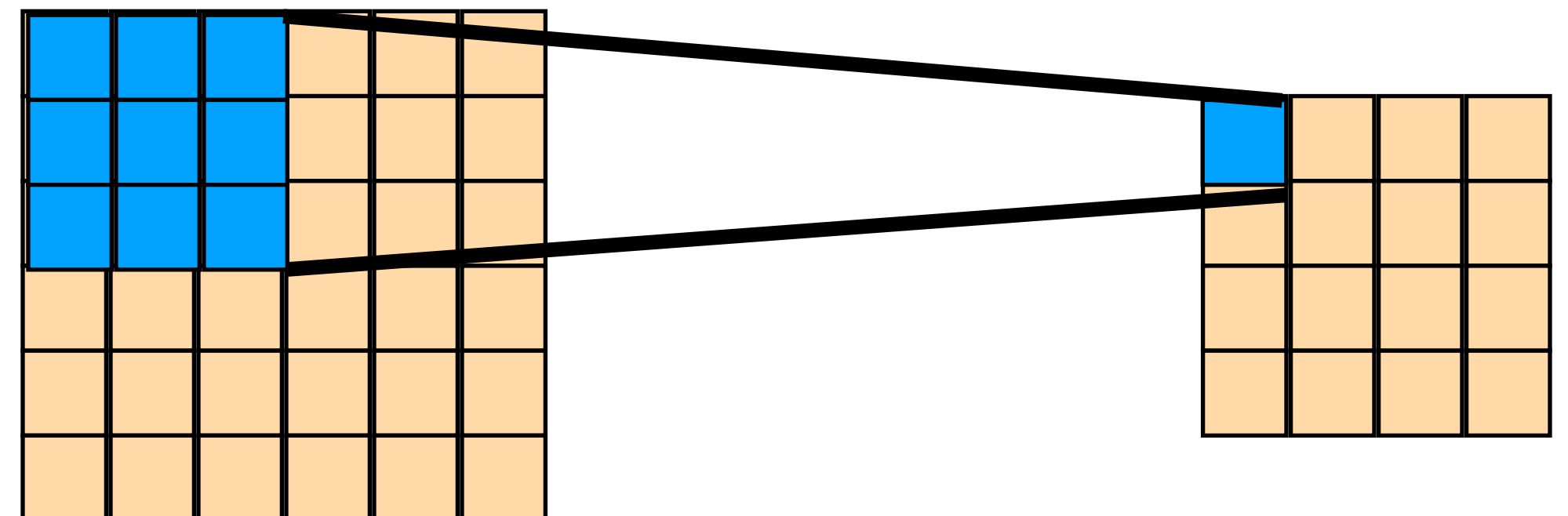
Output O



No padding

Input I

Output O



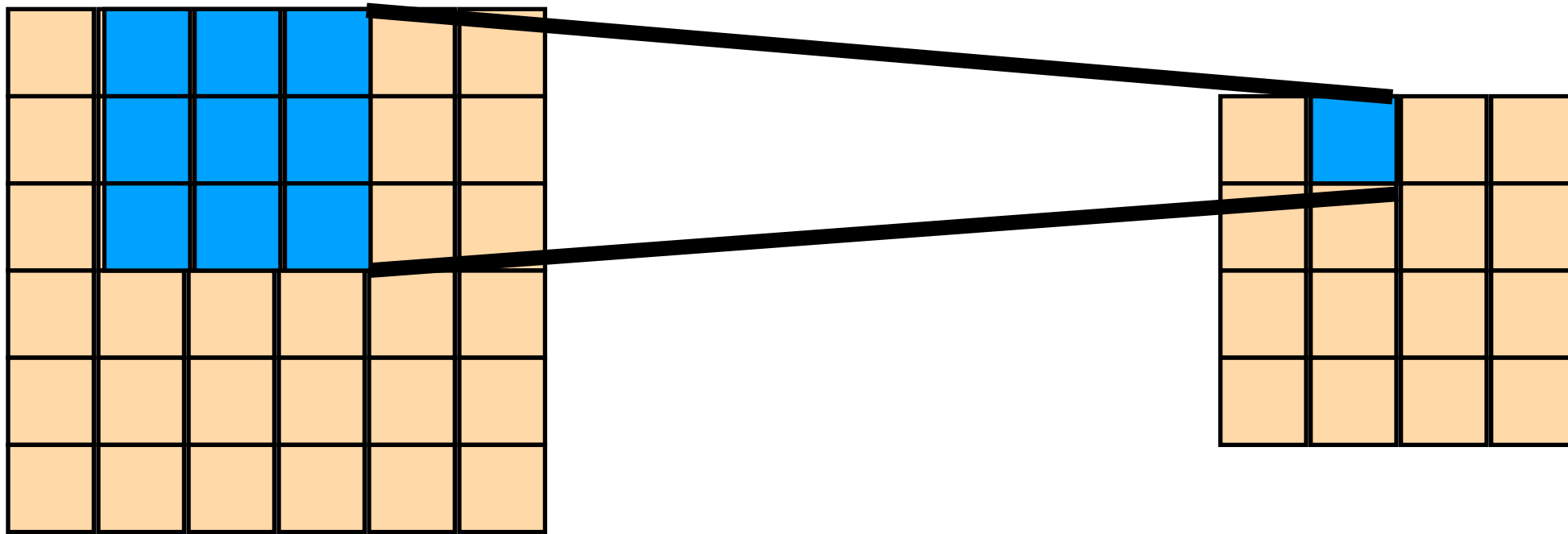
CNN recap

No padding

Different strides

Input I

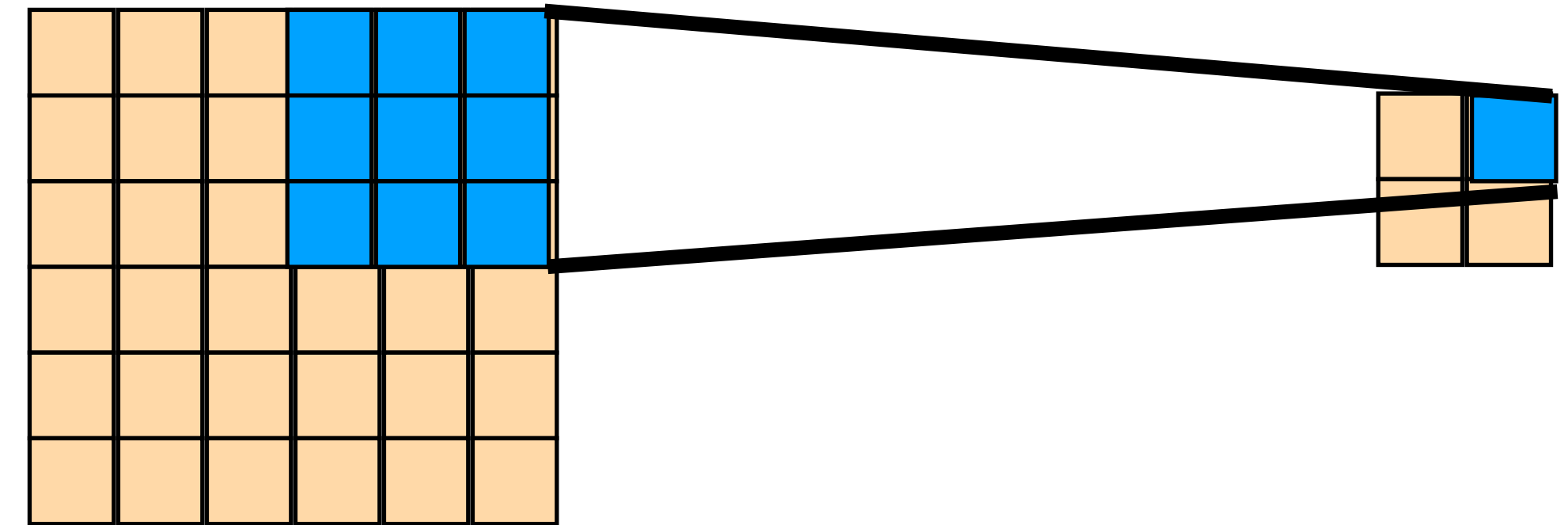
Output O



Stride = 1

Input I

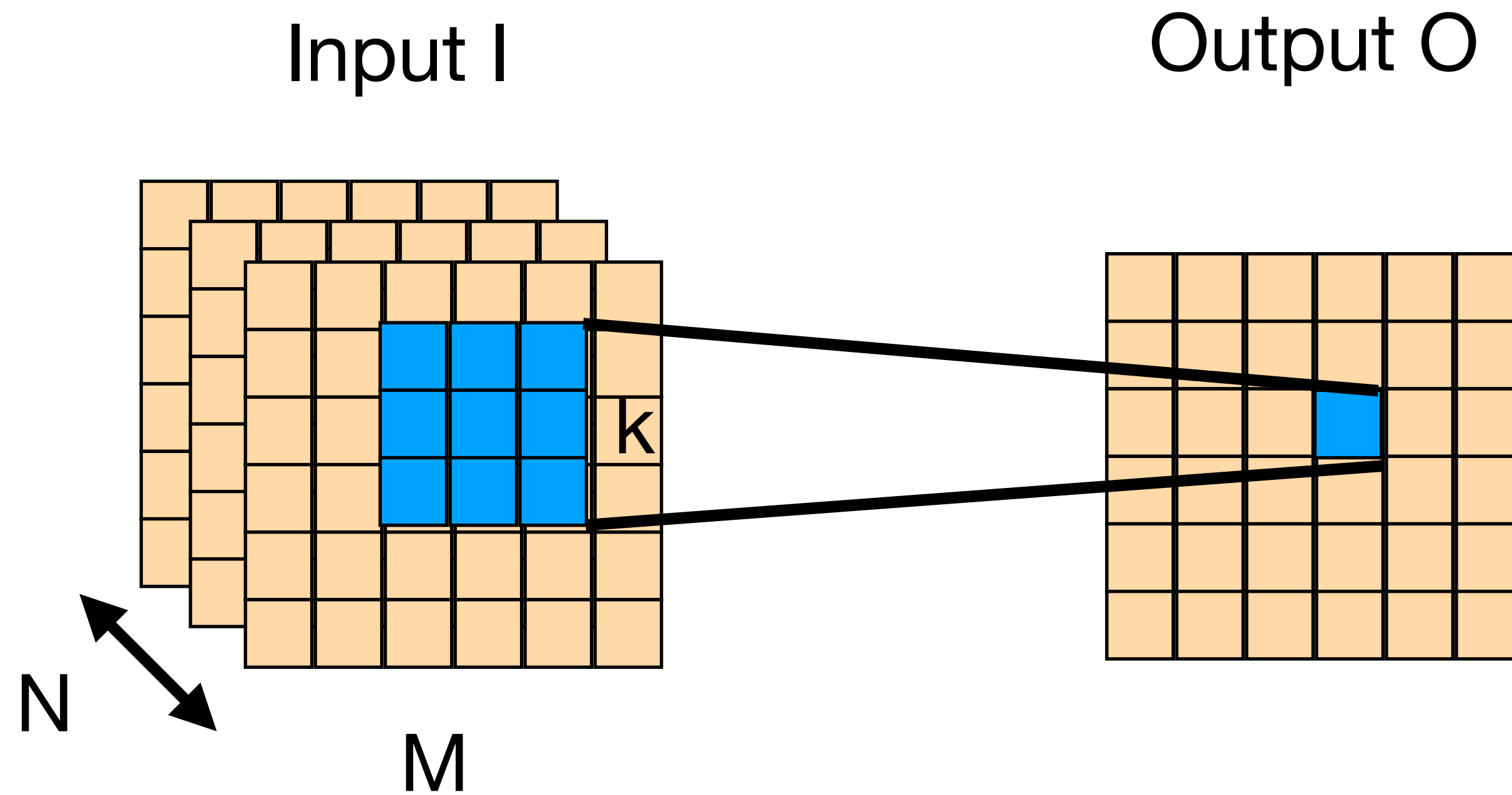
Output O



Stride = 3

CNN recap

Multiple channels: N input channels 1 output channel



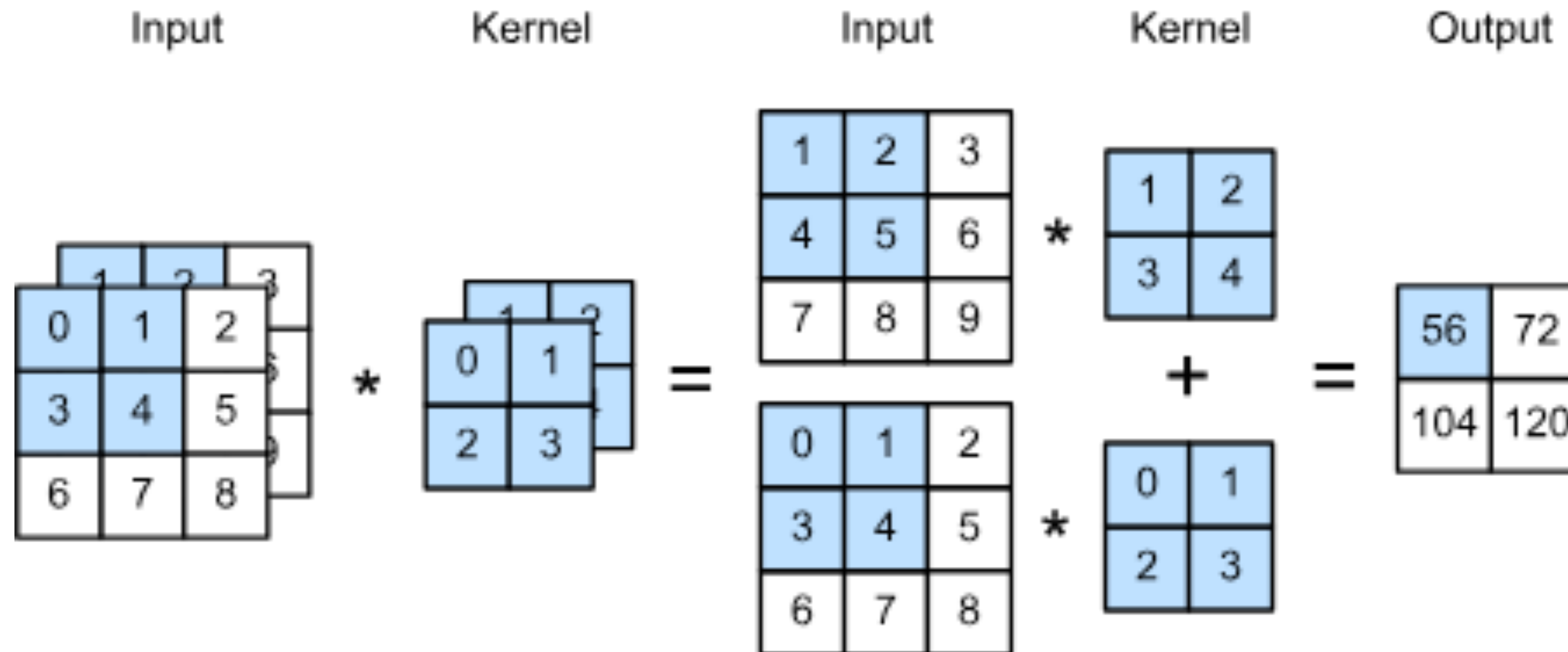
I_{abc} is pixel value of channel a at position (b,c)

$$O_{i,j} = \sum_{c=0}^{N-1} \sum_{n=0, m=0}^{k-1, k-1} K_{c,n,m} I_{c,i-k//2+n, j-k//2+m}$$

CNN recap

Multiple channels: N input channels 1 output channel

Example with two channels



CNN recap

Multiple channels: N input channels L output channel

Just take L independent kernels (indexed by l)

$$O_{l,i,j} = \sum_{c=0}^{N-1} \sum_{n=0, m=0}^{k-1, k-1} K_{l,c,n,m} I_{c,i-k//2+n, j-k//2+m}$$

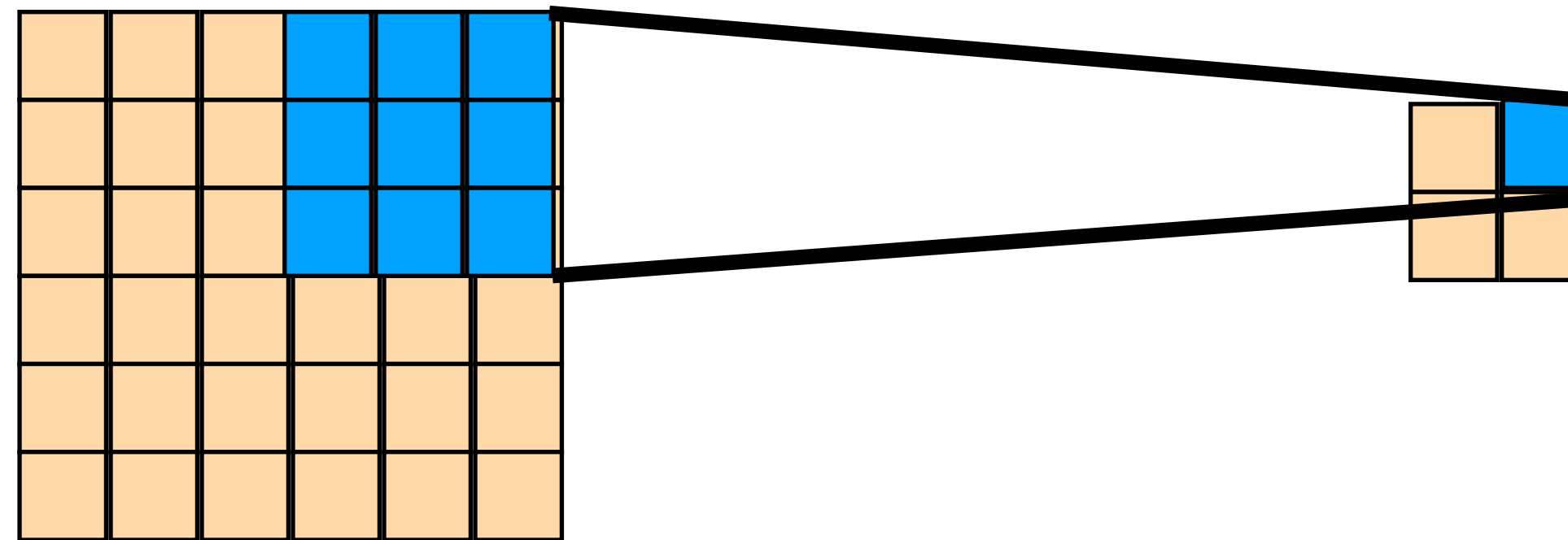
CNN recap

Downsampling

Operation e.g. max or average

Input I

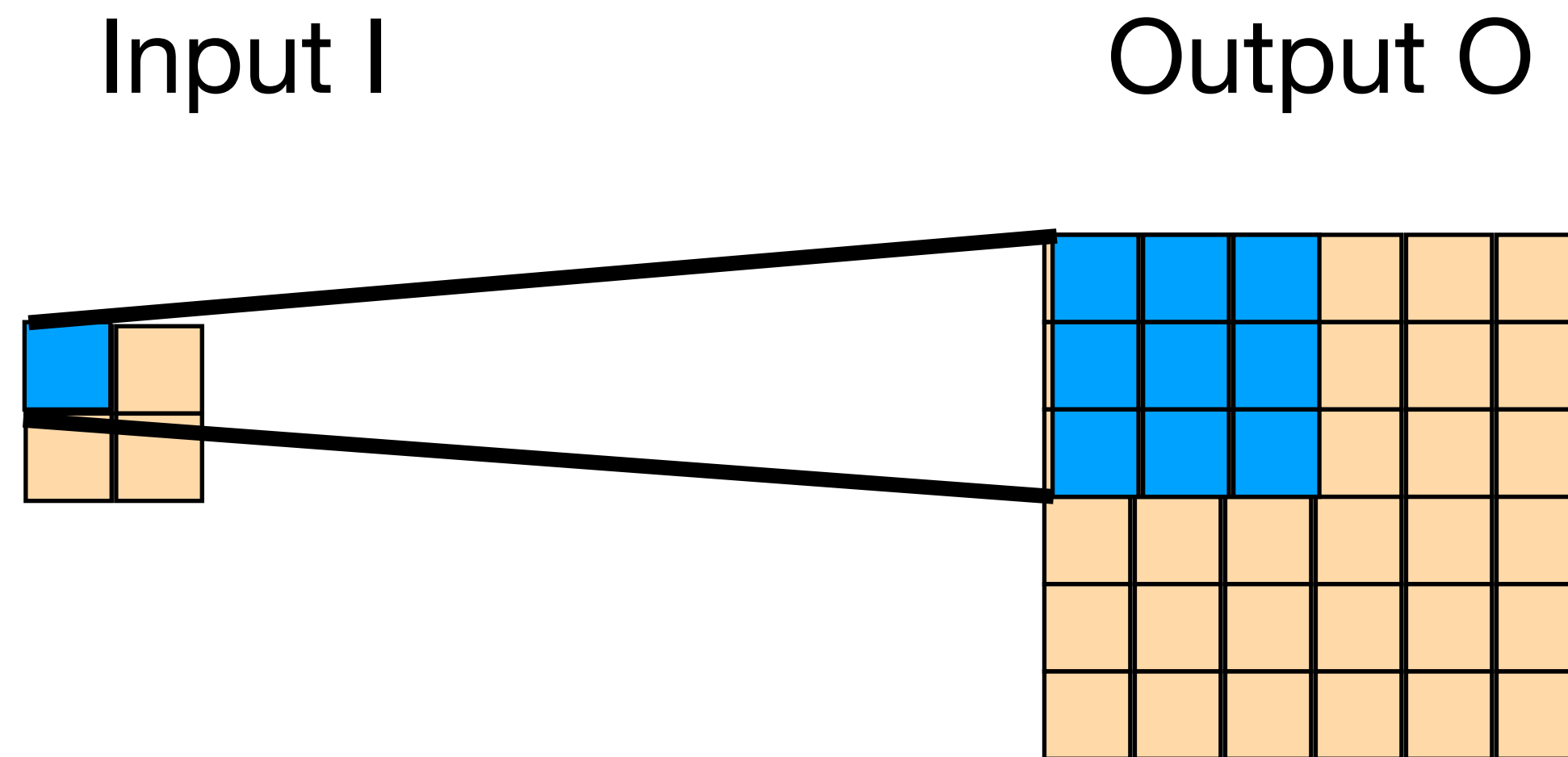
Output O



Stride = 3

CNN recap

Upsampling



E.g. All values equal or transposed convolution

Categorical cross-entropy

$$C = - \sum_j y_j^{\text{target}} \ln y_j^{\text{out}}$$

j goes over all possible labels