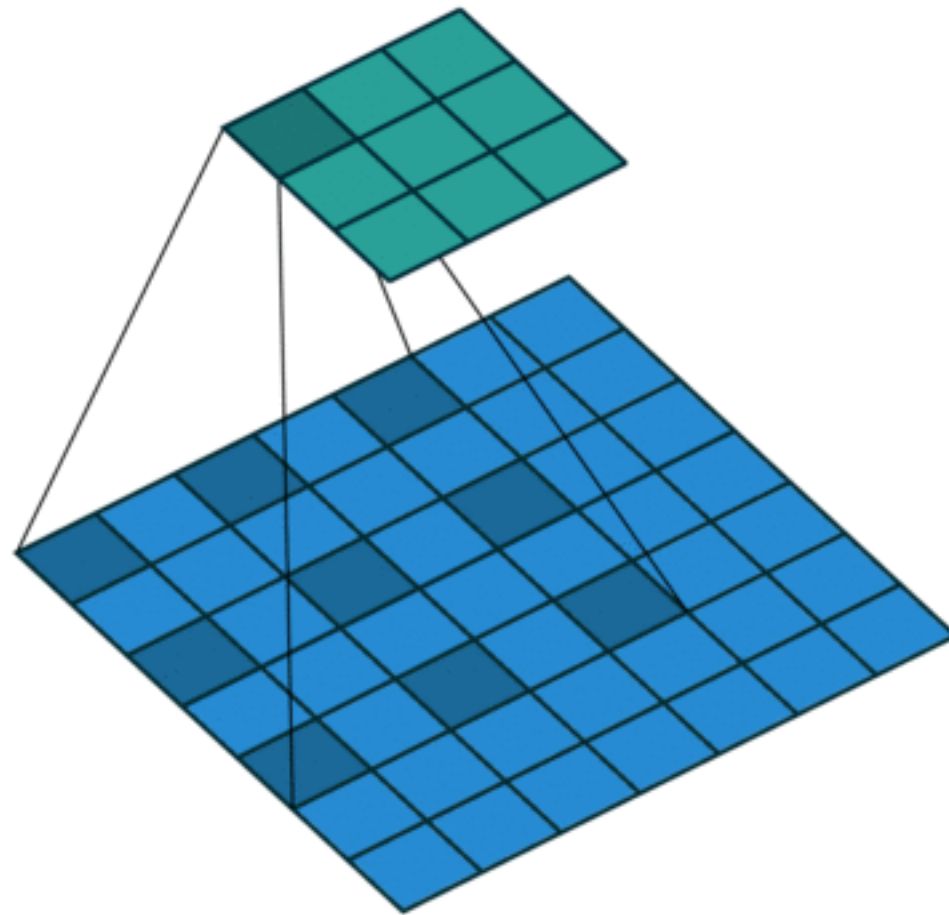


# Types of Convolutions in Deep Learning

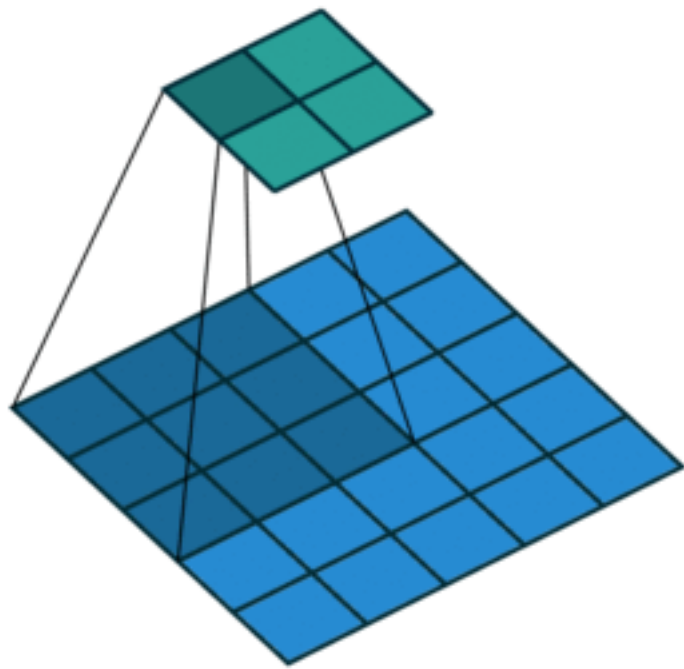
## Dilated Convolutions



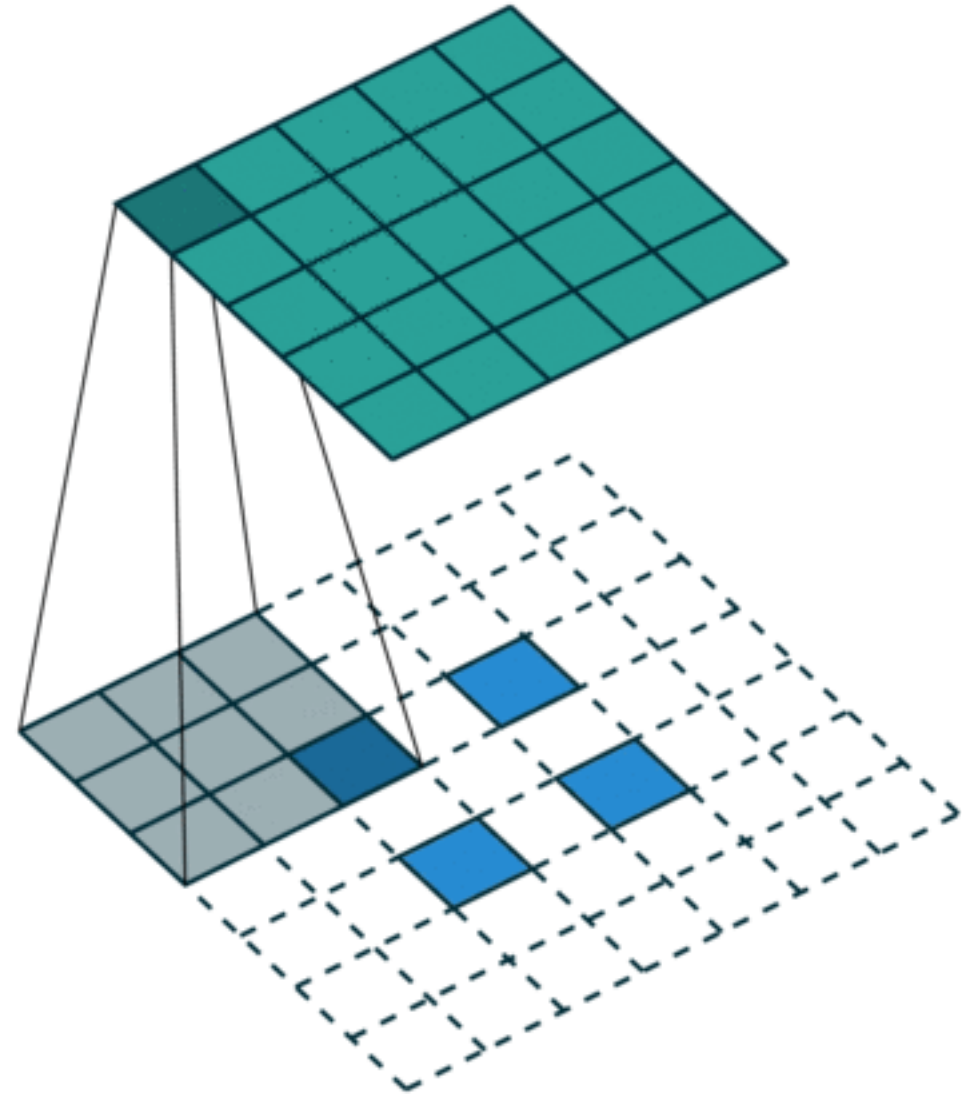
Extra parameter: dilation rate (defines spacing)

# Types of Convolutions in Deep Learning

## Transposed Convolutions



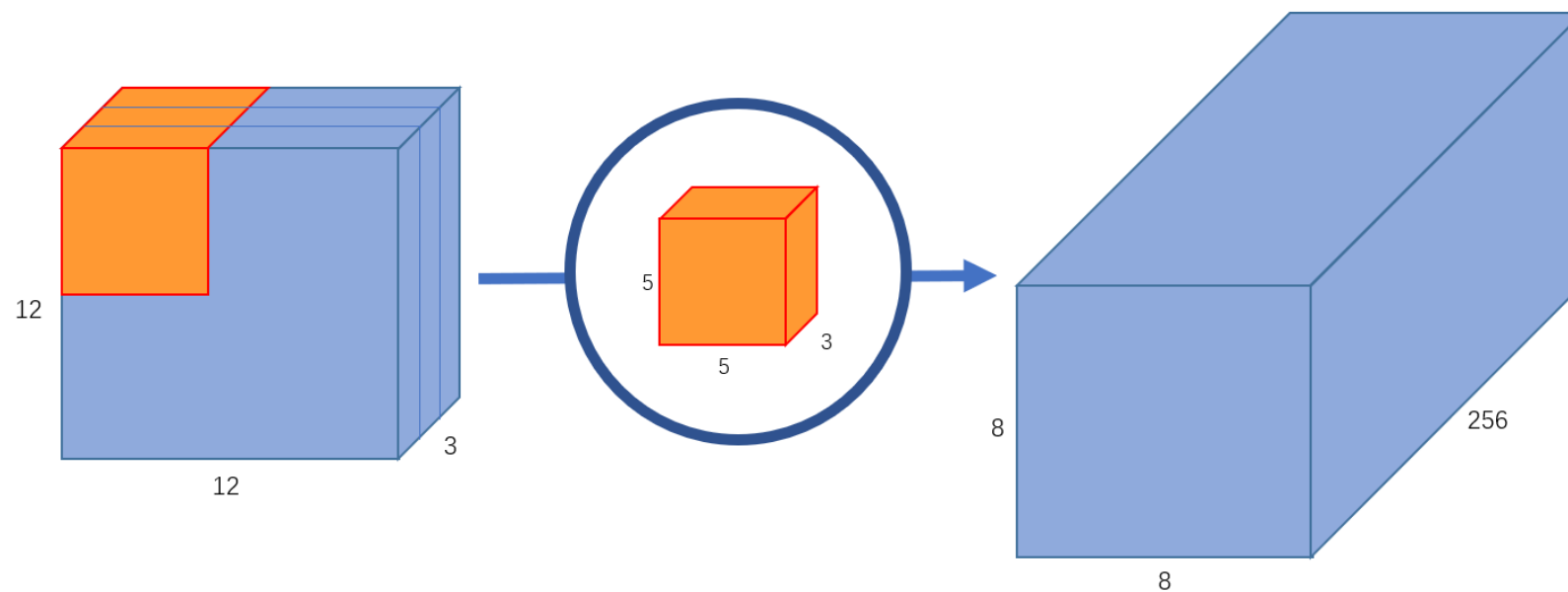
Standard Conv2d  
Padding: valid  
Stride: 2



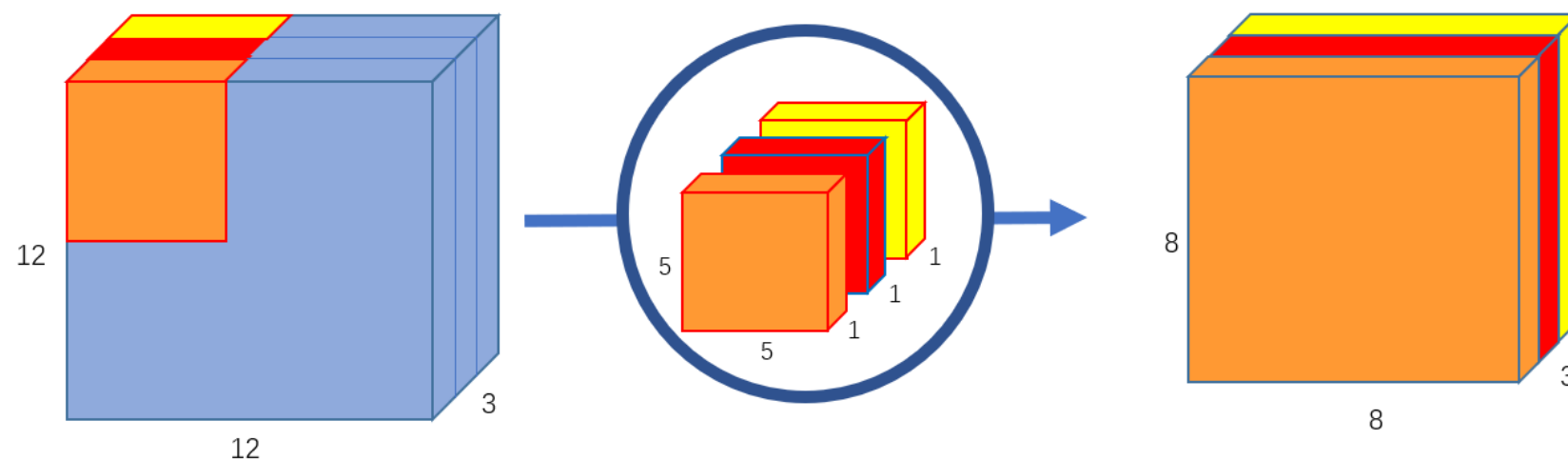
Transposed convolution  
Used in encoder-decoder architectures

# Types of Convolutions in Deep Learning

## Depthwise separable convolutions



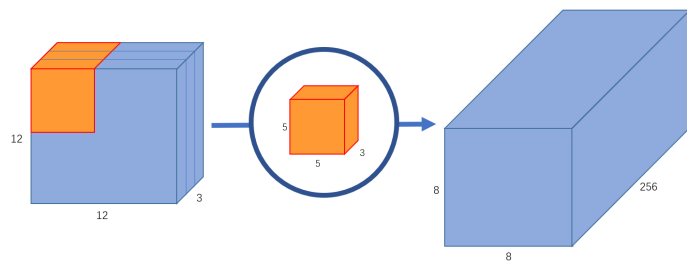
Standard Conv2D  
kernel  
 $5 \times 5 \times 3 \times 256$



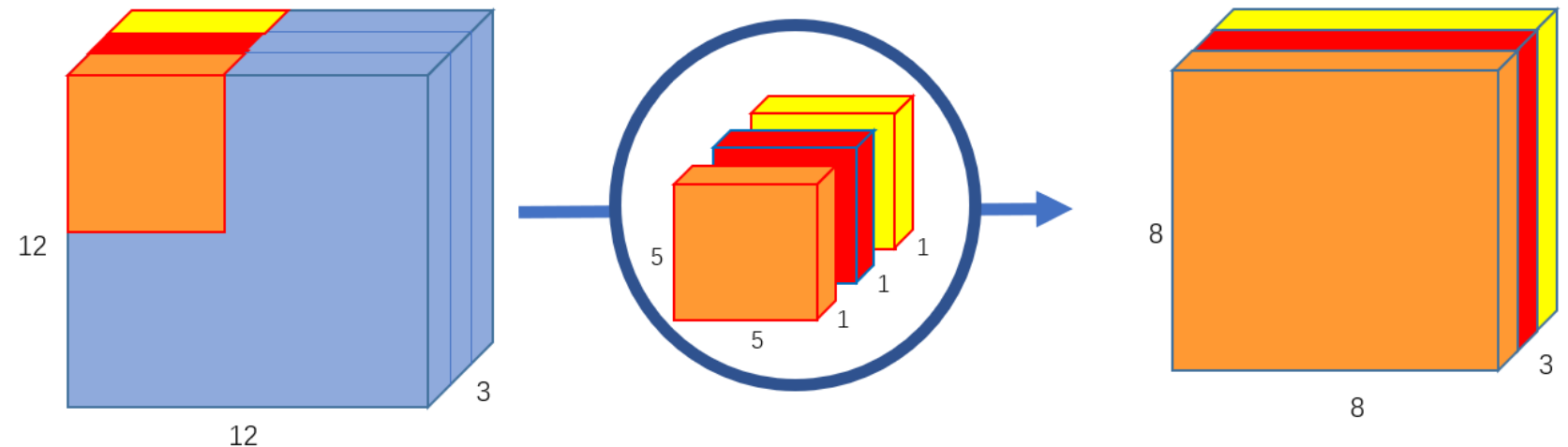
Depthwise  
separable Conv  
Step 1 kernel:  
 $5 \times 5 \times 3$

# Types of Convolutions in Deep Learning

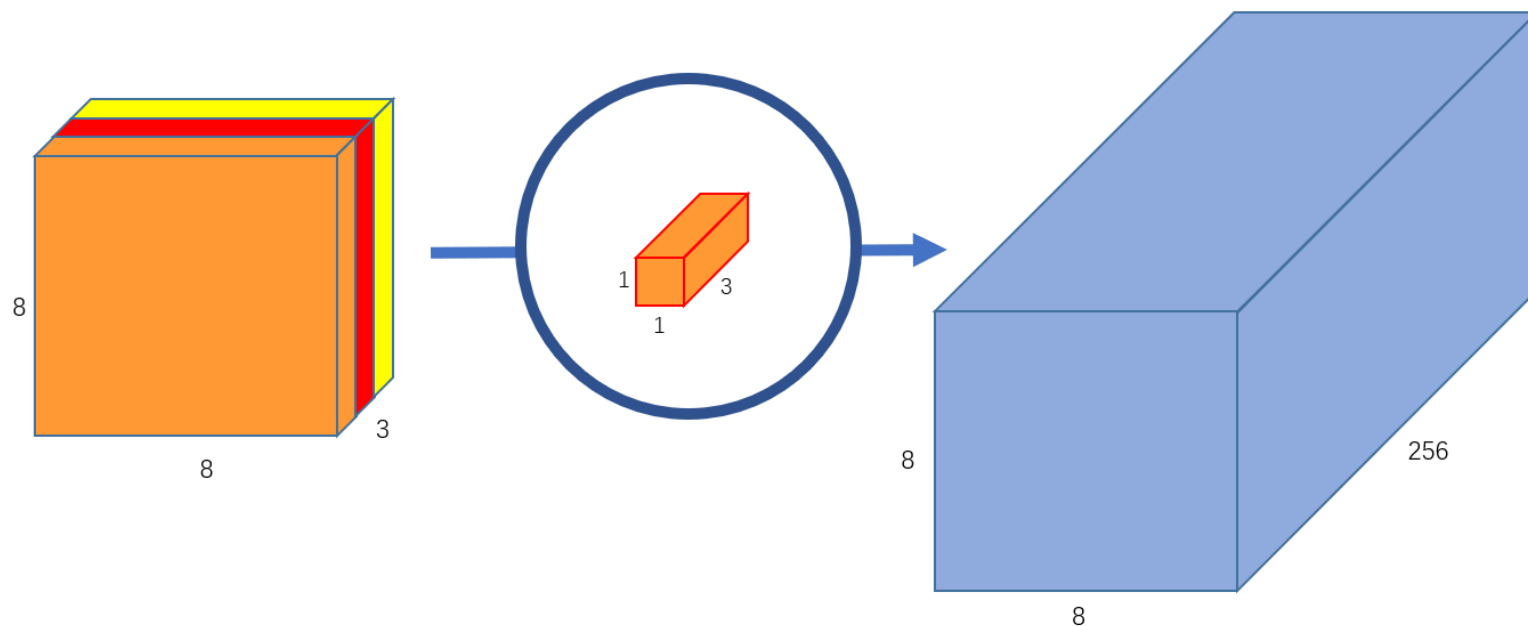
## Depthwise separable convolutions



Standard Conv2D  
kernel  
 $5 \times 5 \times 3 \times 256$



Step 1 kernel:  $5 \times 5 \times 3$



Step 2 kernel:  
 $1 \times 1 \times 3 \times 256$

Compare:

$1228800$  multiplications vs.  $3 \times 5 \times 5 \times 8 \times 8 + 256 \times 1 \times 1 \times 3 \times 8 \times 8 = 53952$