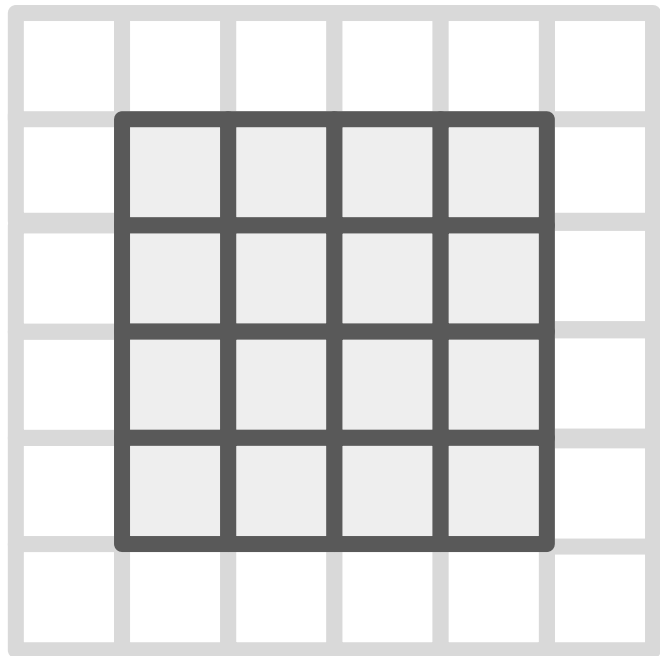


Transposed Convolutions

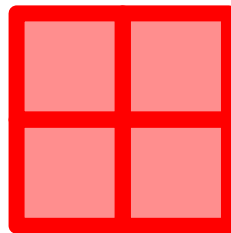
Dr. Chelsea Parlett-Pelleriti

Review: Convolutions (1 Channel)

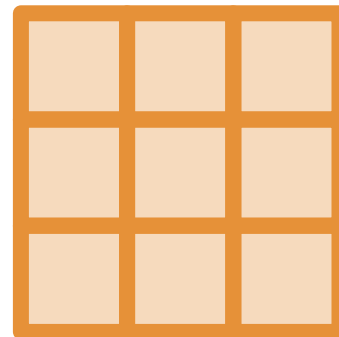
Input 4x4, 1 padding



Kernel 2x2,
stride 2

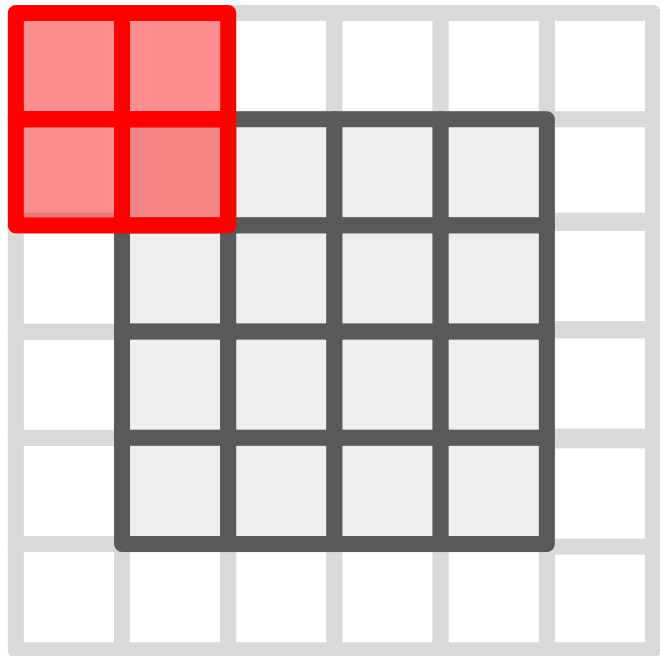


Output 3x3



Review: Convolutions (1 Channel)

Input 4x4, 1 padding



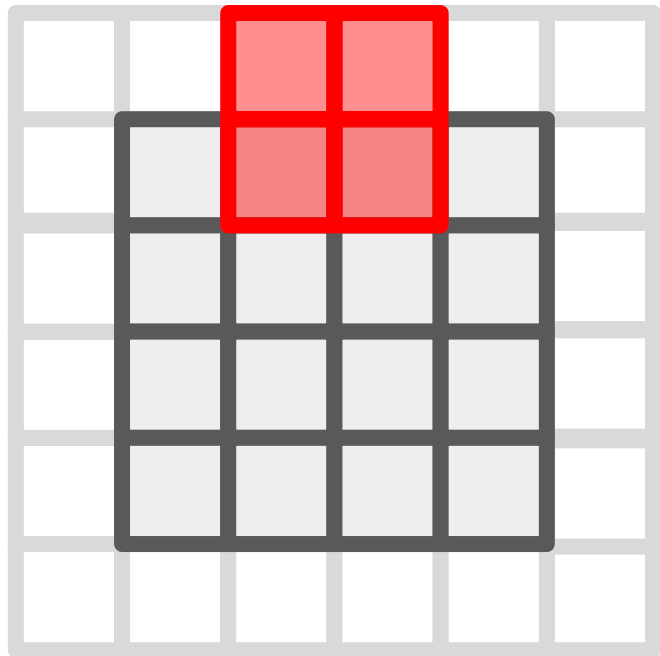
Kernel 2x2,
stride 2

Output 3x3



Review: Convolutions (1 Channel)

Input 4x4, 1 padding



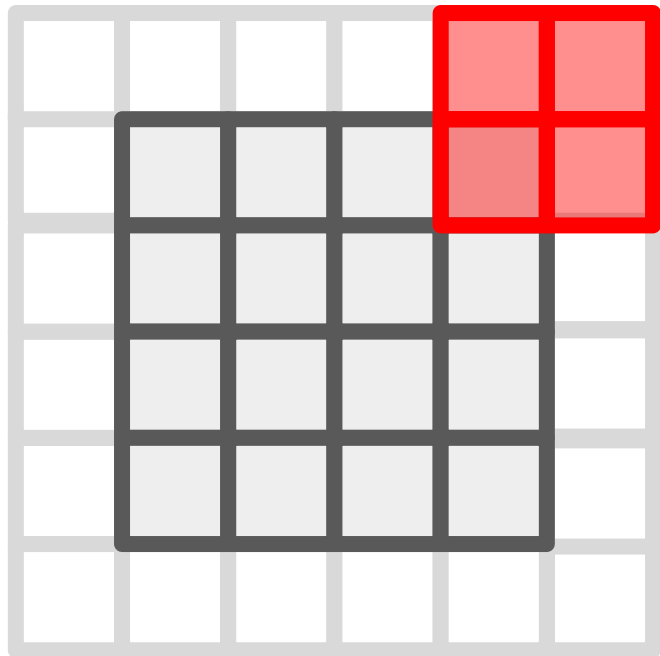
Kernel 2x2,
stride 2

Output 3x3



Review: Convolutions (1 Channel)

Input 4x4, 1 padding



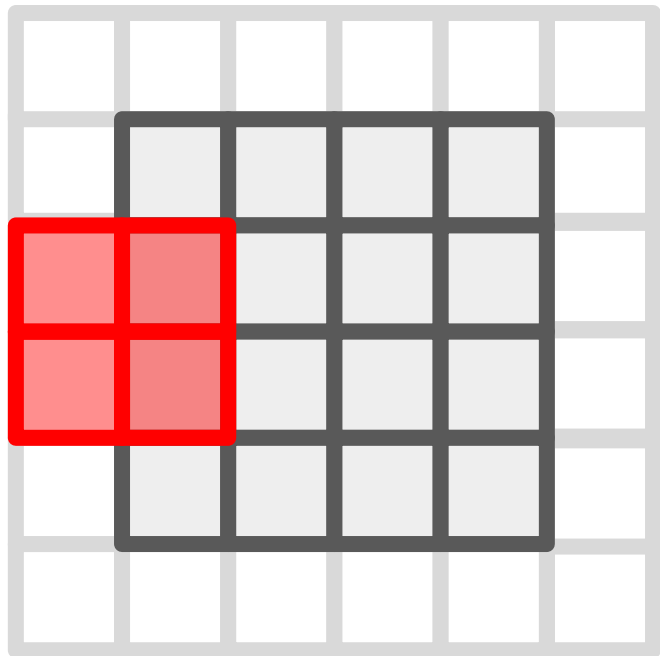
Kernel 2x2,
stride 2

Output 3x3



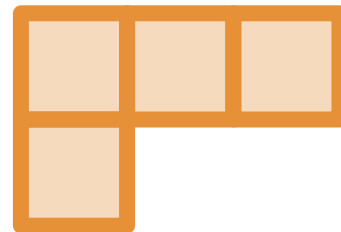
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



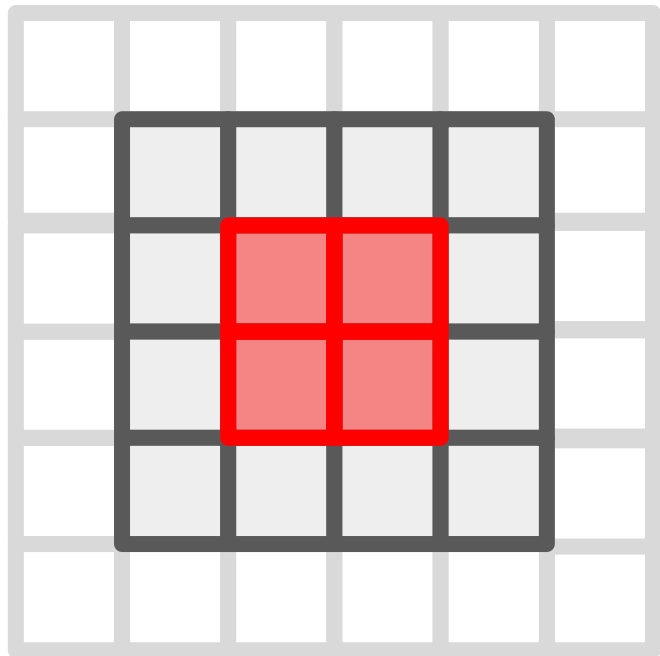
Kernel 2x2,
stride 2

Output 3x3



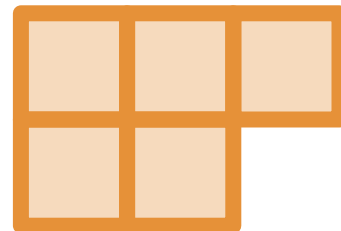
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



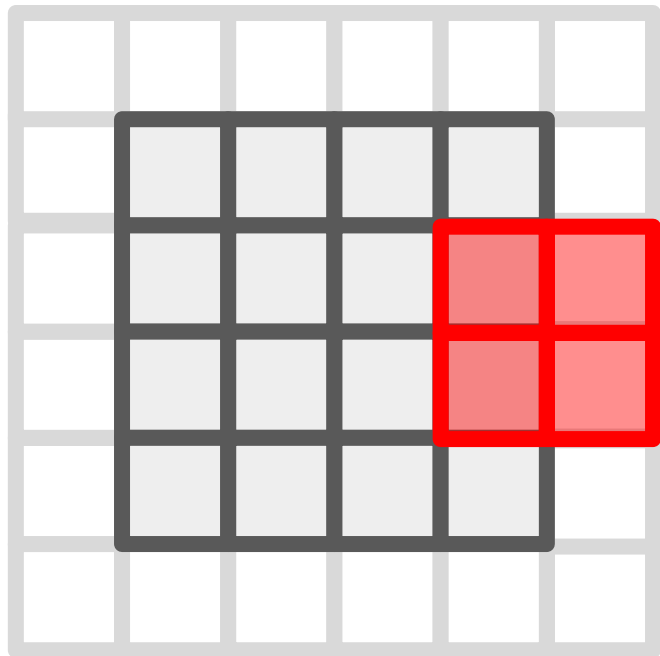
Kernel 2x2,
stride 2

Output 3x3



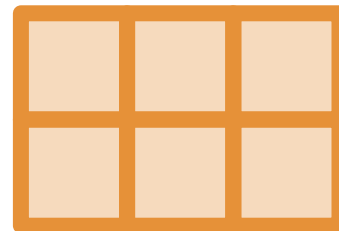
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



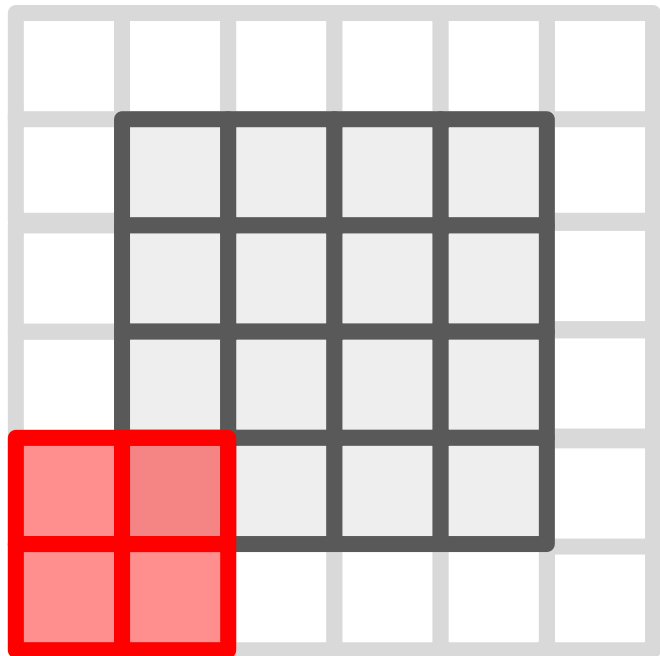
Kernel 2x2,
stride 2

Output 3x3



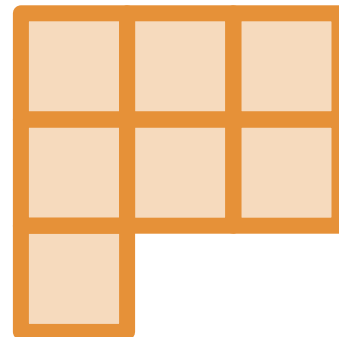
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



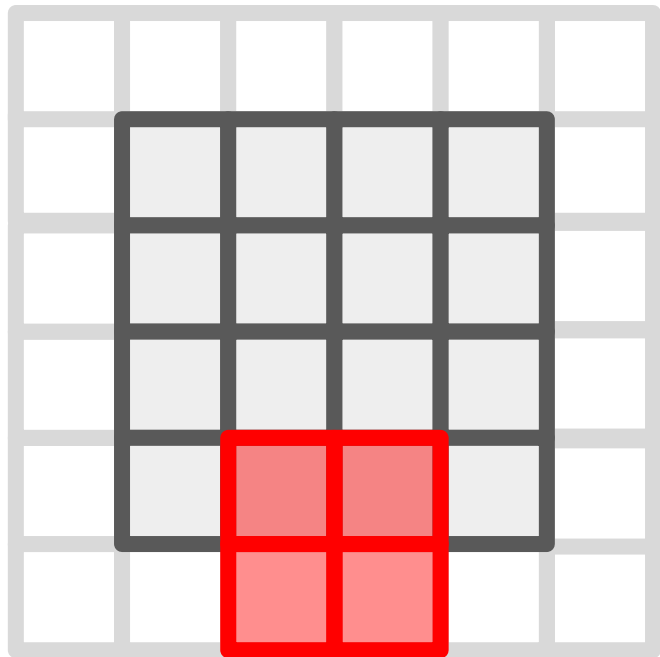
Kernel 2x2,
stride 2

Output 3x3



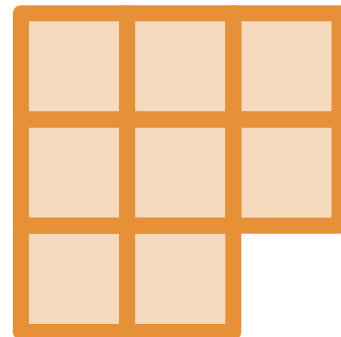
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



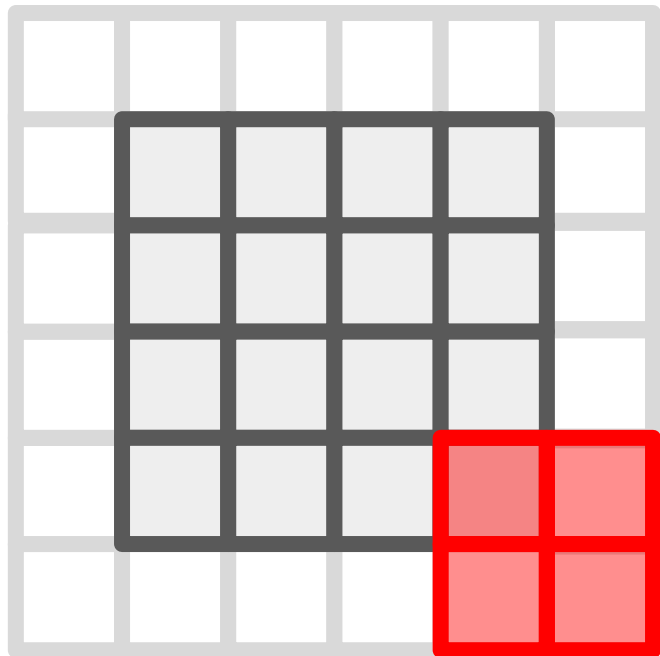
Kernel 2x2,
stride 2

Output 3x3



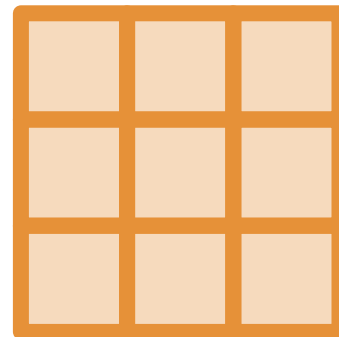
Review: Convolutions (1 Channel)

Input 4x4, 1 padding



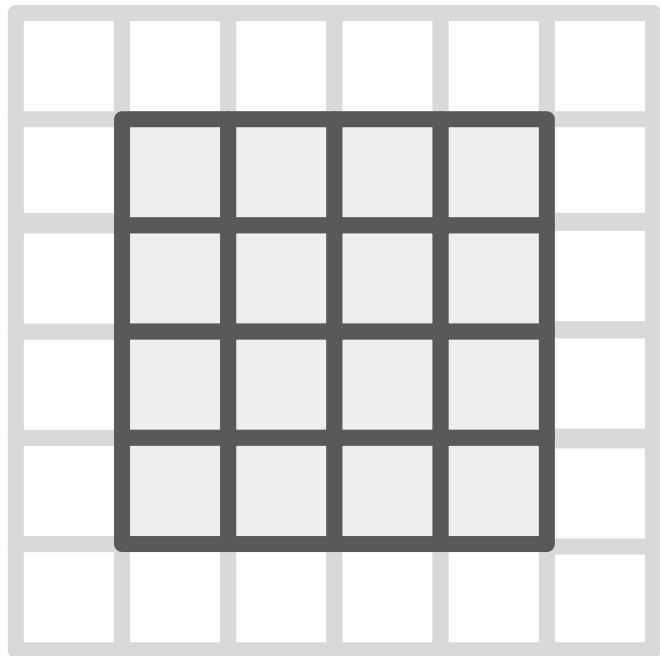
Kernel 2x2,
stride 2

Output 3x3

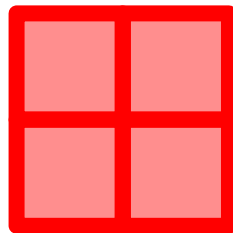


Review: Convolutions (1 Channel)

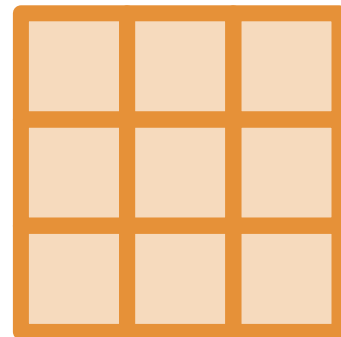
Input 4x4, 1 padding



Kernel 2x2,
stride 2

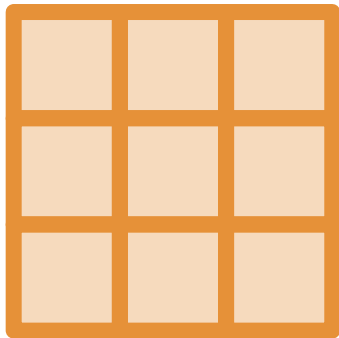


Output 3x3

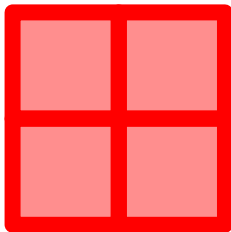


Transposed Convolutions

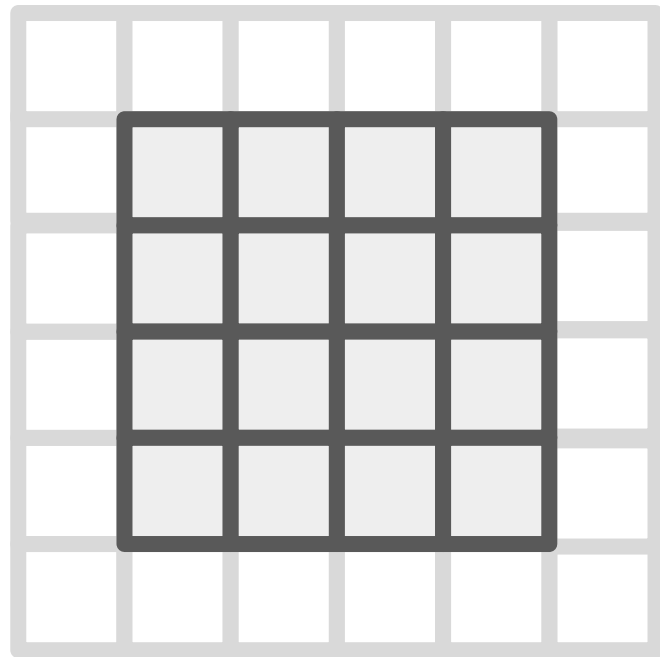
Input 3x3, 1 padding



Kernel 2x2,
stride 2

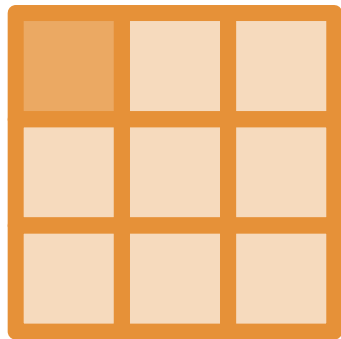


Output 4x4



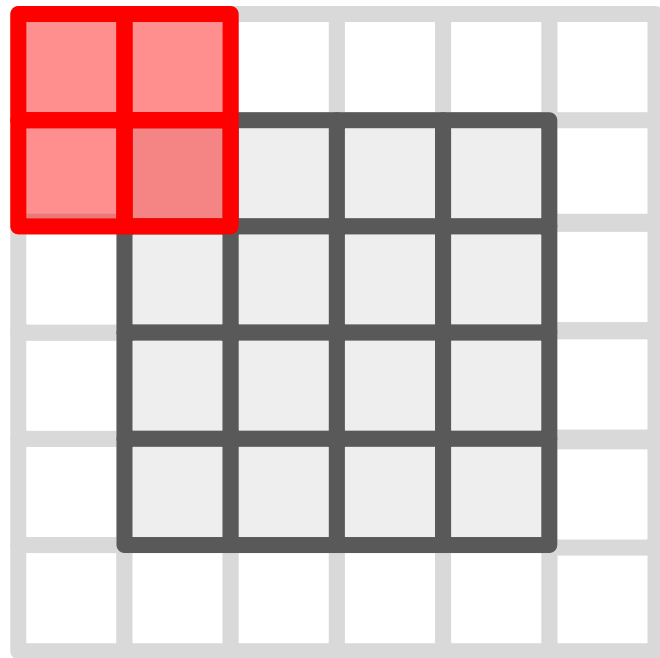
Transposed Convolutions

Input 3x3, 1 padding



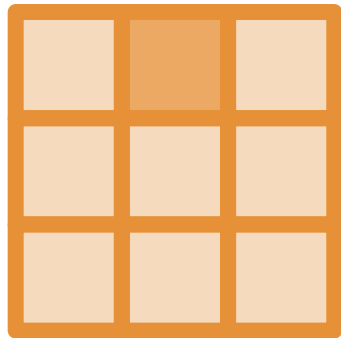
Kernel 2x2,
stride 2

Output 4x4



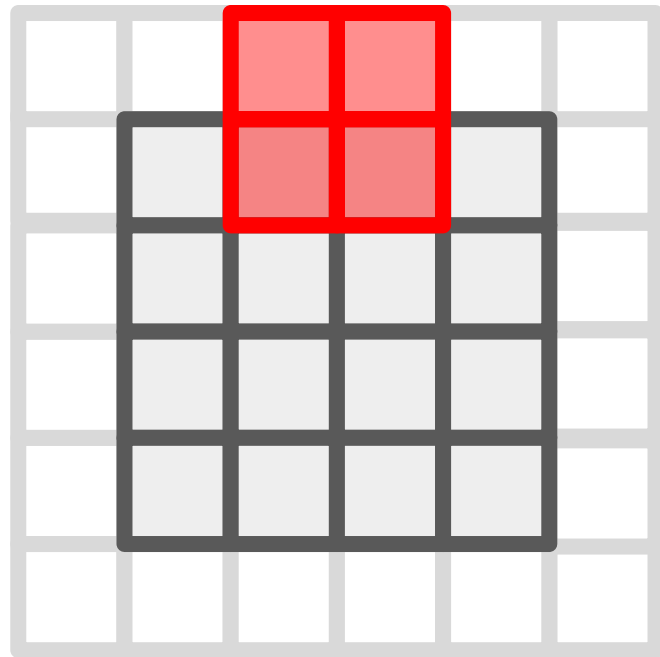
Transposed Convolutions

Input 3x3, 1 padding



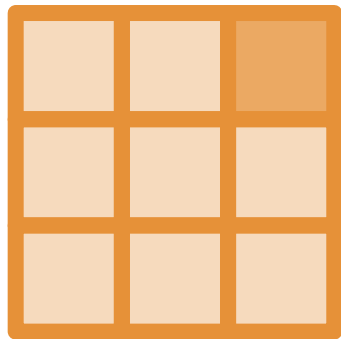
Kernel 2x2,
stride 2

Output 4x4



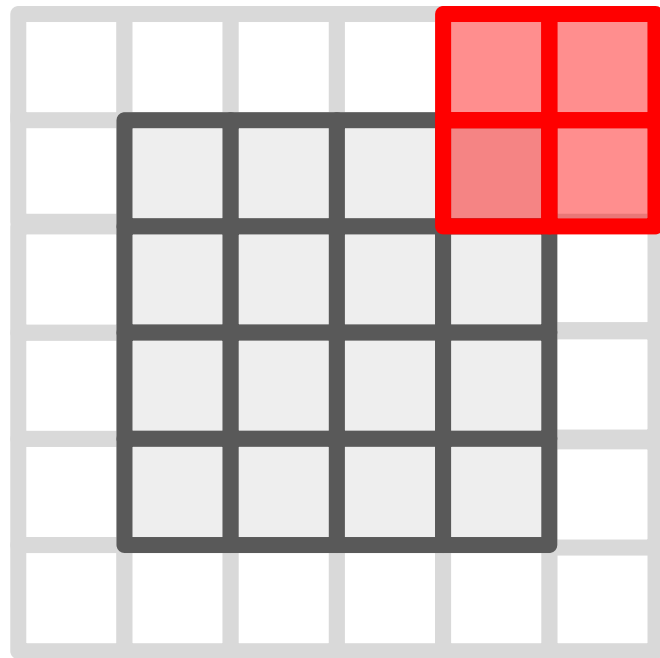
Transposed Convolutions

Input 3x3, 1 padding



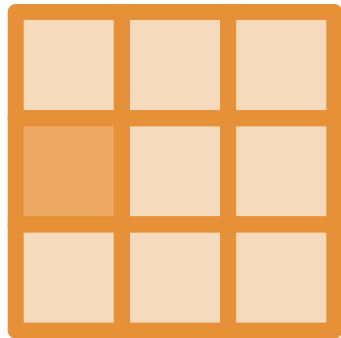
Kernel 2x2,
stride 2

Output 4x4



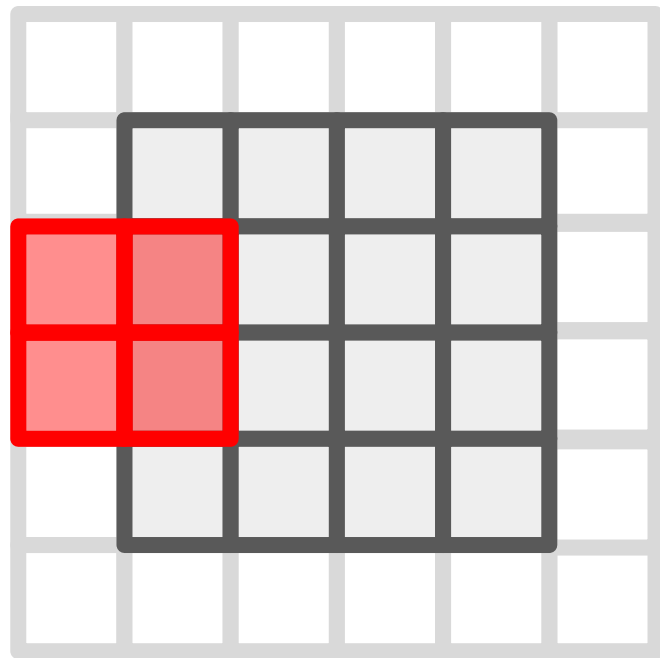
Transposed Convolutions

Input 3x3, 1 padding



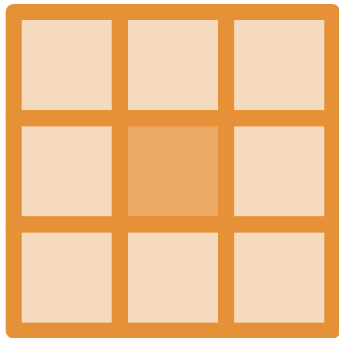
Kernel 2x2,
stride 2

Output 4x4



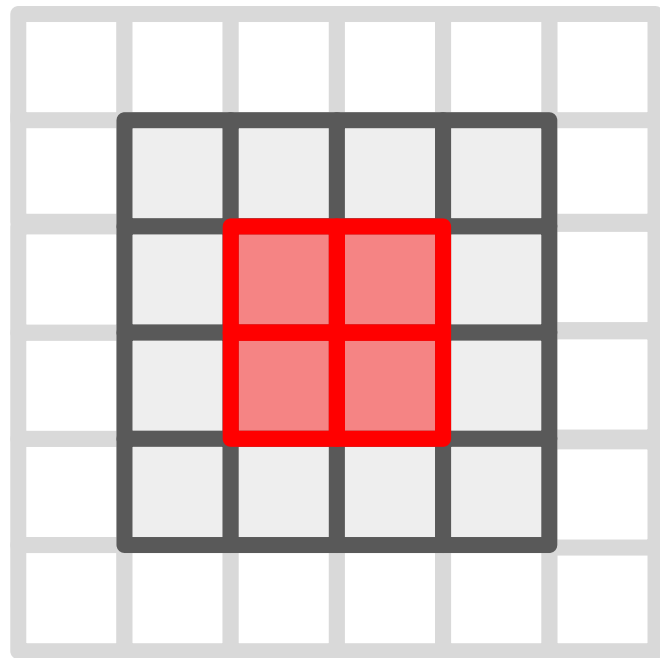
Transposed Convolutions

Input 3x3, 1 padding



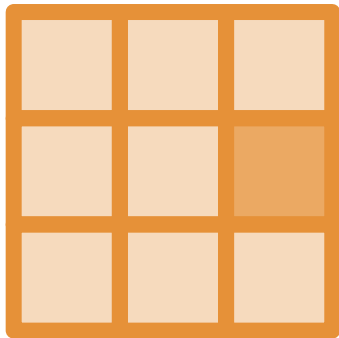
Kernel 2x2,
stride 2

Output 4x4



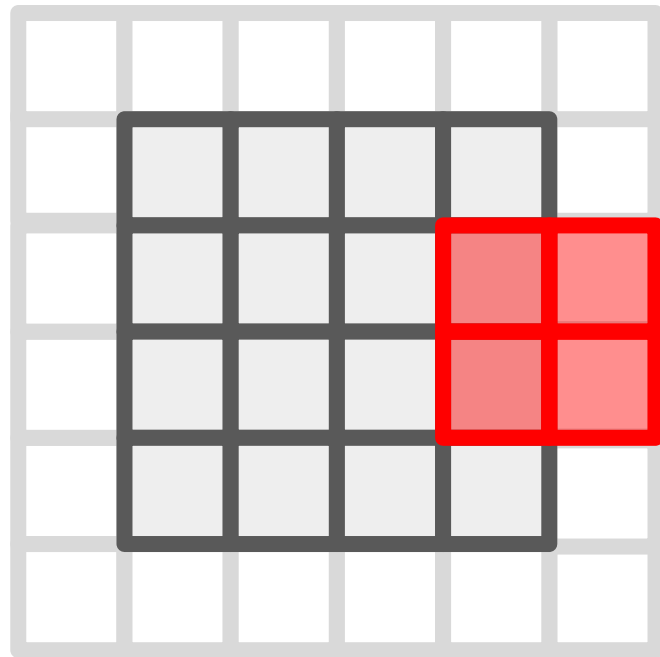
Transposed Convolutions

Input 3x3, 1 padding



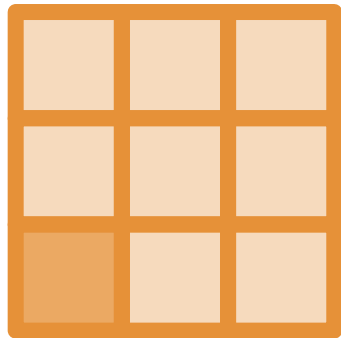
Kernel 2x2,
stride 2

Output 4x4



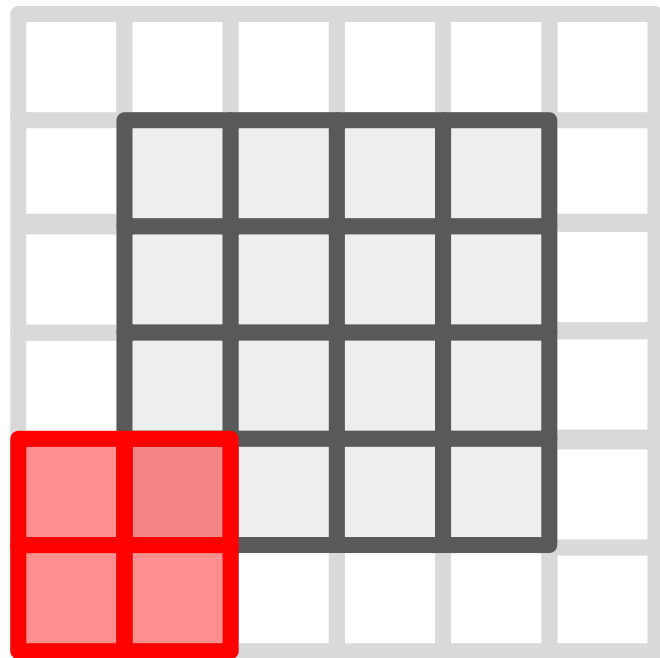
Transposed Convolutions

Input 3x3, 1 padding



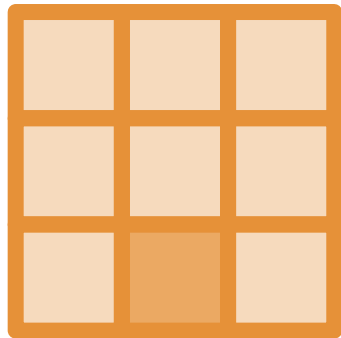
Kernel 2x2,
stride 2

Output 4x4



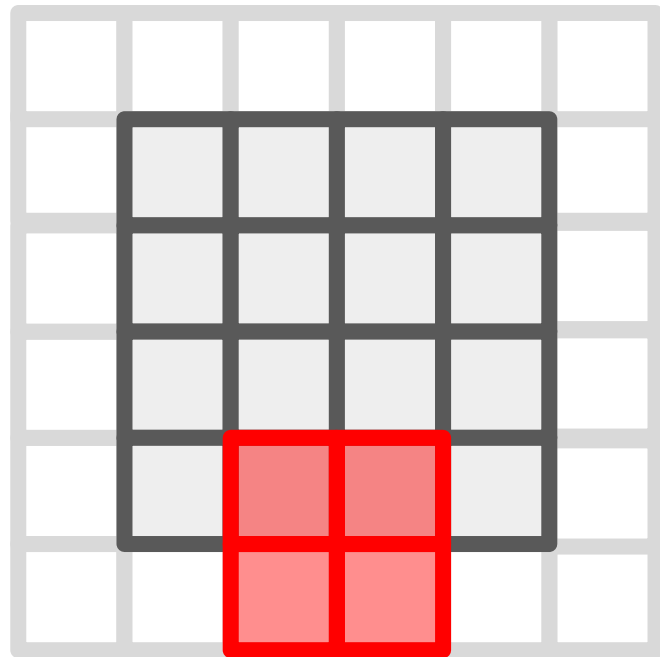
Transposed Convolutions

Input 3x3, 1 padding



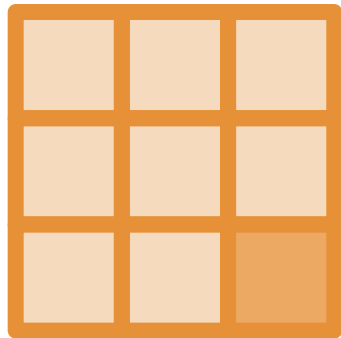
Kernel 2x2,
stride 2

Output 4x4



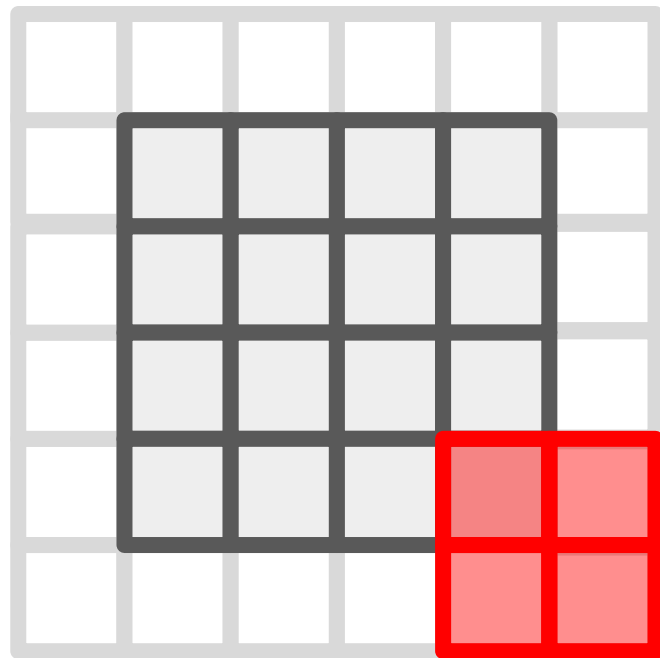
Transposed Convolutions

Input 3x3, 1 padding



Kernel 2x2,
stride 2

Output 4x4

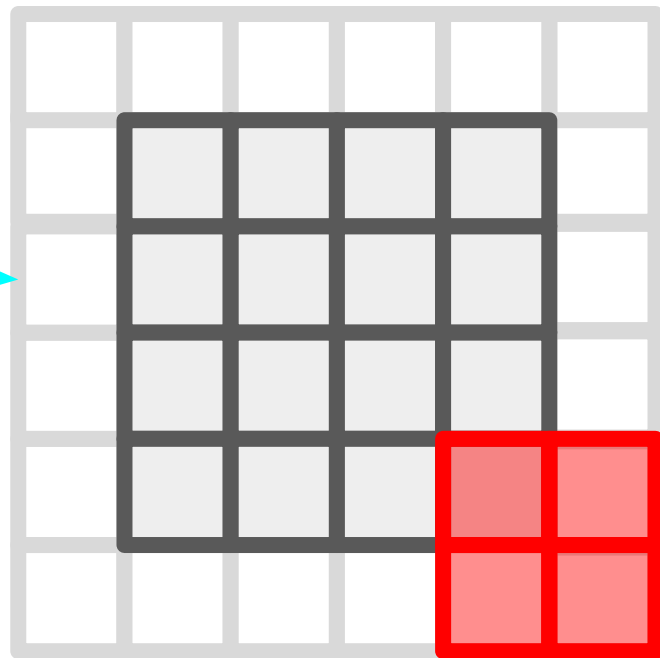


Transposed Convolutions

Note: When padding = 1, we drop the outer layer of the output

Kernel 2x2,

Output 4x4



stride = 1
padding = 0

1	2
3	4

Input

1	1	1
1	1	1
1	1	1

Kernel

1	1	1	
1	1	1	
1	1	1	

Step 1

1	1+2	1+2	2
1	1+2	1+2	2
1	1+2	1+2	2

Step 2

1	1+2	1+2	2
1+3	1+2+3	1+2+3	2
1+3	1+2+3	1+2+3	2
3	3	3	

Step 3

1	1+2	1+2	2
1+3	1+2+3+ 4	1+2+3+4	2+4
1+3	1+2+3+ 4	1+2+3+4	2+4
3	3+4	3+4	4

Step 4

1	3	3	2
4	10	10	6
4	10	10	6
3	7	7	4

Output

stride = 2
padding = 0

1	2
3	4

Input

1	1	1
1	1	1
1	1	1

Kernel

1	1	1		
1	1	1		
1	1	1		

Step 1

1	1	1+2	2	2
1	1	1+2	2	2
1	1	1+2	2	2

Step 2

1	1	1+2	2	2
1	1	1+2	2	2
1+3	1+3	1+2+3	2	2
3	3	3		
3	3	3		

Step 3

1	1	1+2	2	2
1	1	1+2	2	2
1+3	1+3	1+2+3 +4	2+4	2+4
3	3	3+4	4	4
3	3	3+4	4	4

Step 4

1	1	3	2	2
1	1	3	2	2
4	4	10	6	6
3	3	7	4	4
3	3	7	4	4

Output

stride = 2
padding = 1

1	2
3	4

Input

1	1	1
1	1	1
1	1	1

Kernel

1	1	1		
1	1	1		
1	1	1		

Step 1

1	1	1+2	2	2
1	1	1+2	2	2
1	1	1+2	2	2

Step 2

1	1	1+2	2	2
1	1	1+2	2	2
1+3	1+3	1+2+3	2	2
3	3	3		
3	3	3		

Step 3

1	1	1+2	2	2
1	1	1+2	2	2
1+3	1+3	1+2+3 +4	2+4	2+4
3	3	3+4	4	4
3	3	3+4	4	4

Step 4

1	3	2
4	10	6
3	7	4

Output

stride = 2
padding = 1

1	2
3	4

Input

1	1	1
1	1	1
1	1	1

Kernel

1	1	1		
1	1	1		
1	1	1		

Step 1

1	1	1+2	2	2
1	1	1+2	2	2
1	1	1+2	2	2

Step 2

1	1	1+2	2	2
1	1	1+2	2	2
1+3	1+3	1+2+3	2	2
3	3	3		
3	3	3		

Step 3

	1	1+2	2	
	1+3	1+2+3 +4	2+4	
	3	3+4	4	

Step 4

1	3	2
4	10	6
3	7	4

Output