

Smoothing Filters

Blurring

Smoothing

- Smoothing filter will blur the image.
- Each pixel in the image is mixed in with its surrounding pixel intensities. This mixture of pixels in a neighborhood becomes our blurred pixel.
- This effect is quite helpful while performing image processing tasks.

Types of Smoothing Filters

1. Averaging
2. Median
3. Gaussian
4. Bilateral

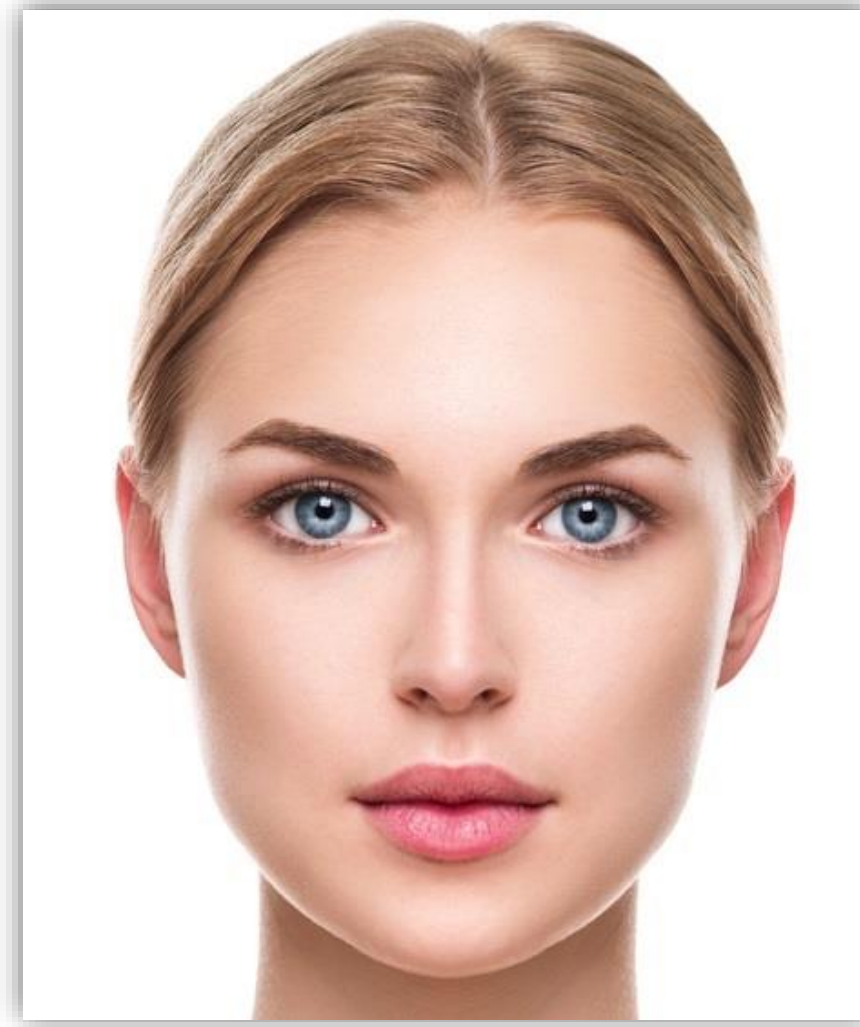
Averaging

Smoothing Filter

Averaging Blur

- Step-1: Define $k \times k$ sliding window on top of the image.
 - k is always odd number
- Step-2: Slide the window from left to right and top to bottom
- Step-3: For each stride (usually stride =1), pixel at the center of the matrix is **average** of pixels surrounding it.

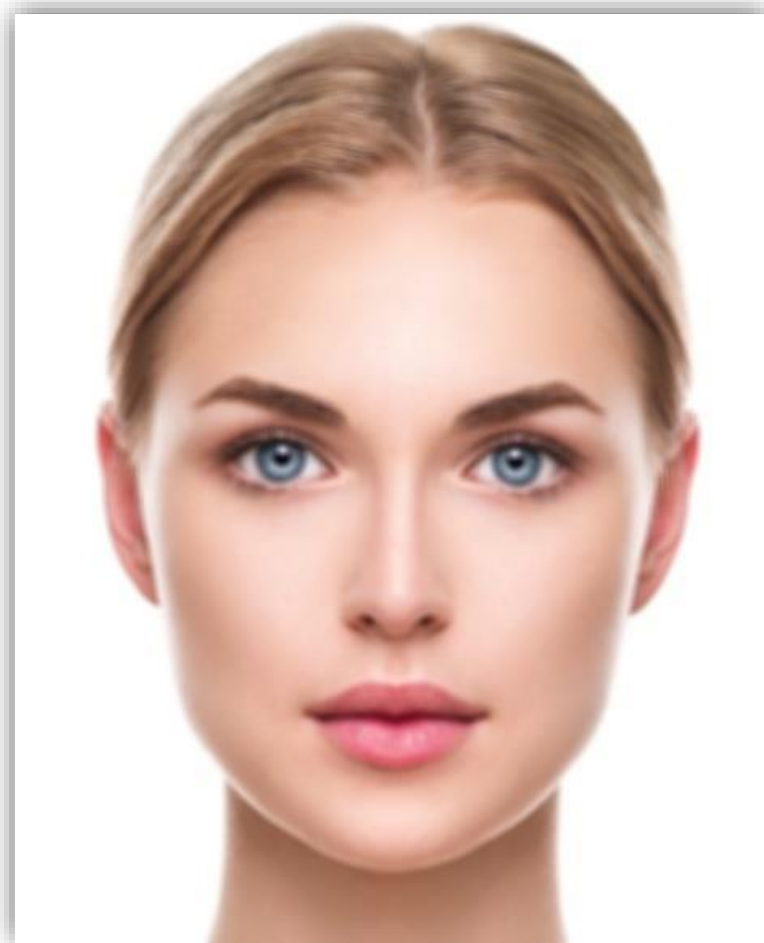
If size of sliding window increases blur effect increases



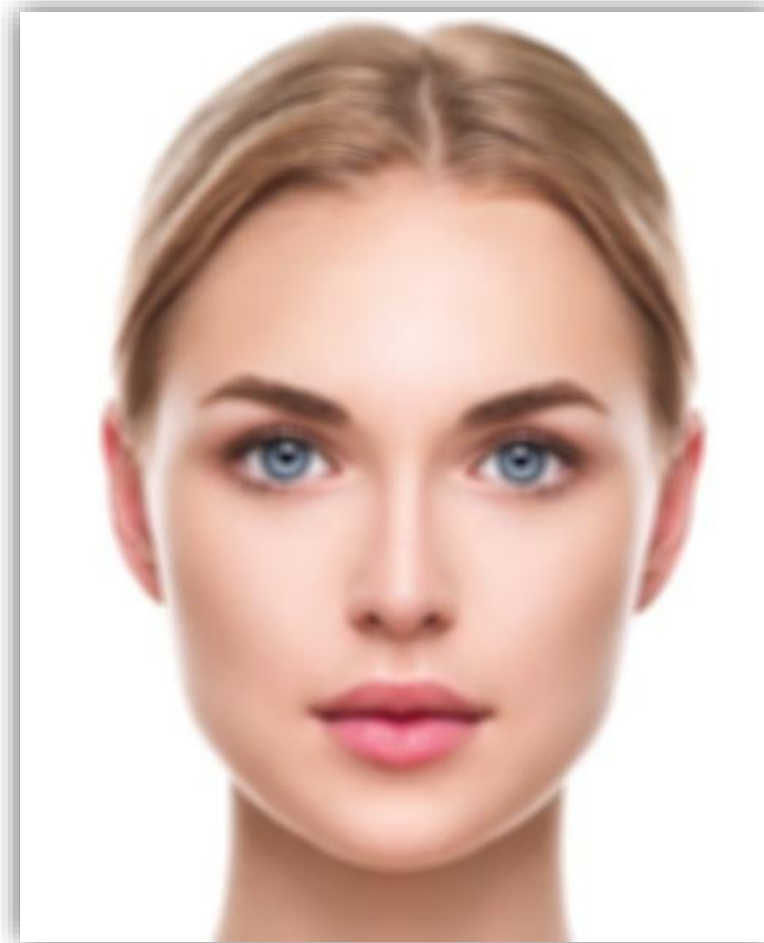
(3 x 3)



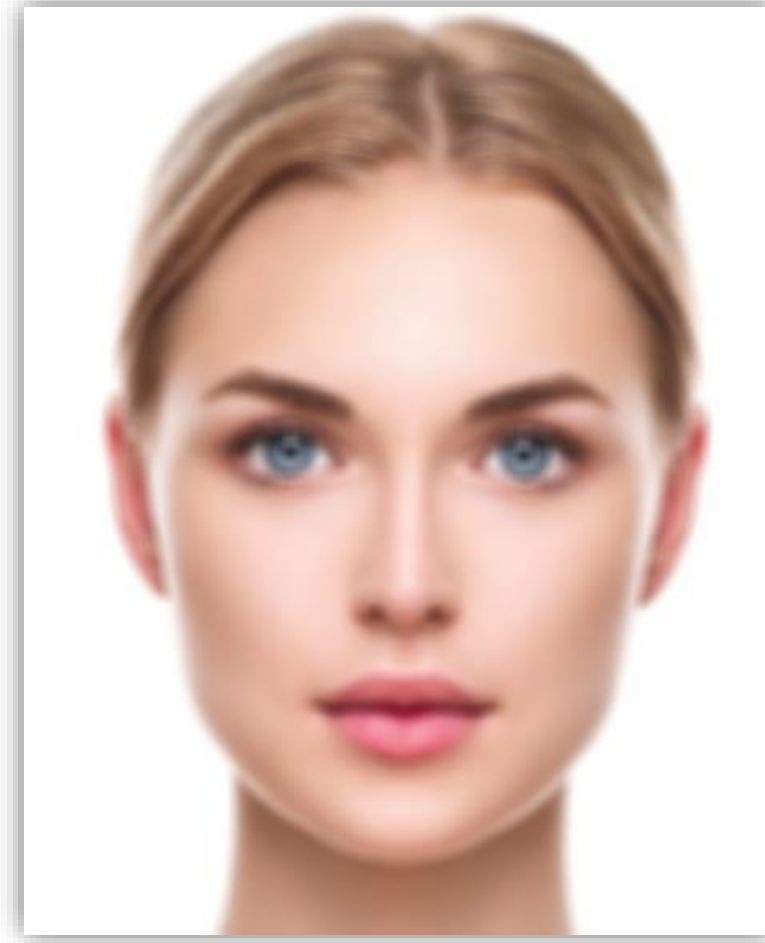
(5 x 5)



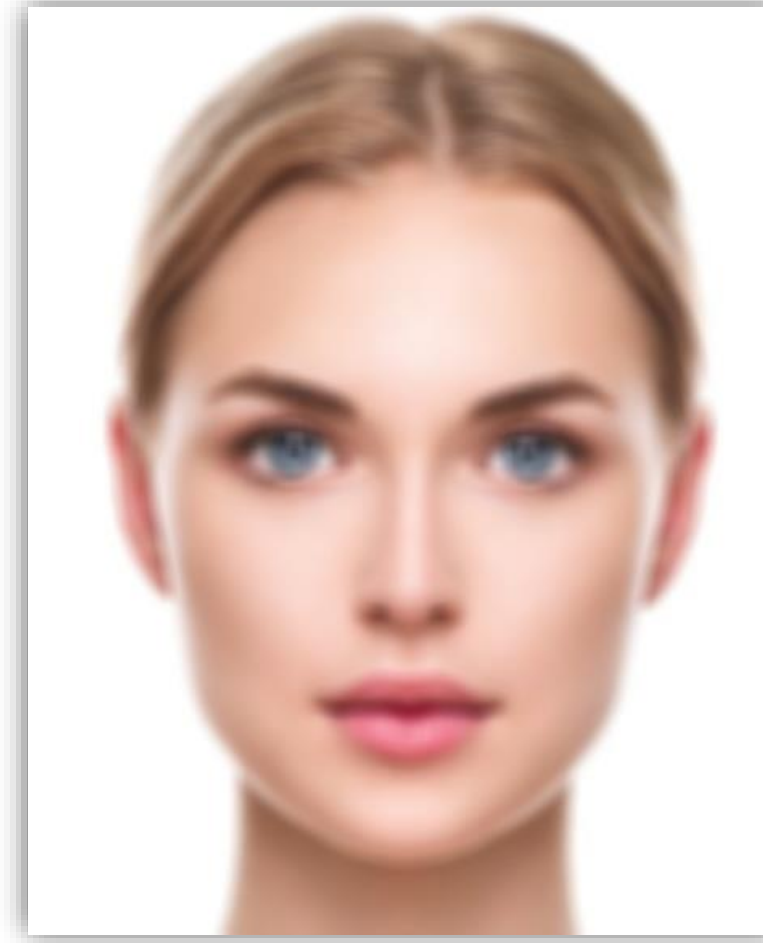
(7 x 7)



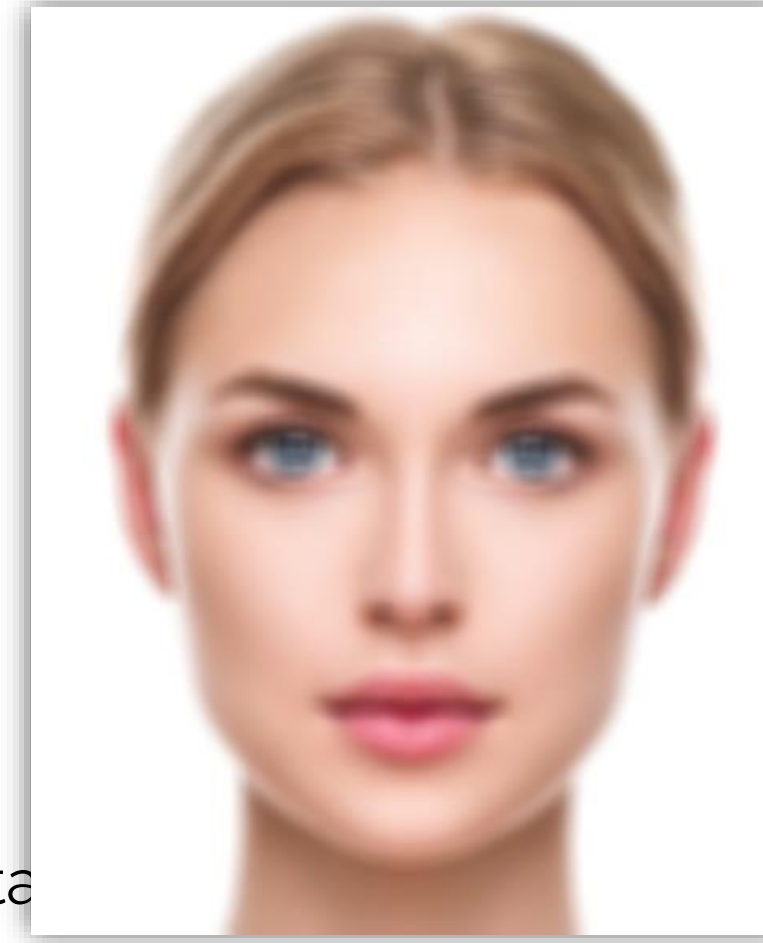
(9 x 9)



(11 x 11)



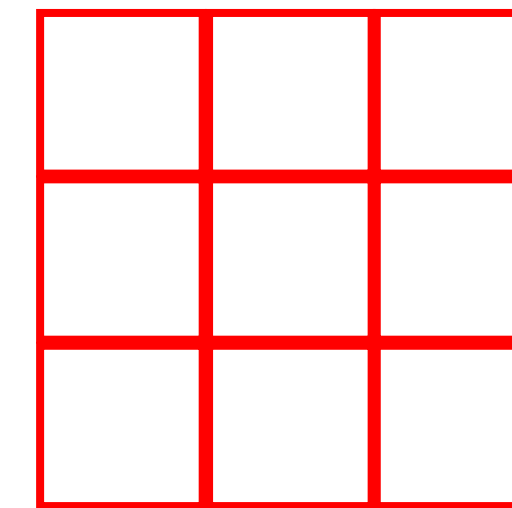
(13 x 13)



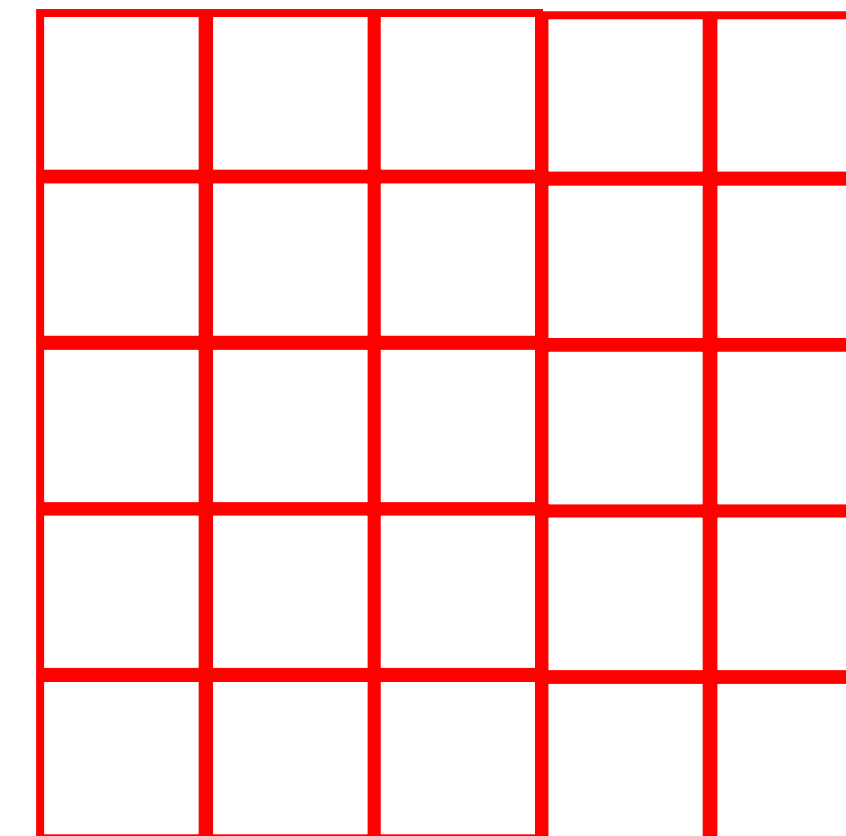
ata

Convolve Process

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



3×3



5×5

Convolve Process

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31

Convolve Process

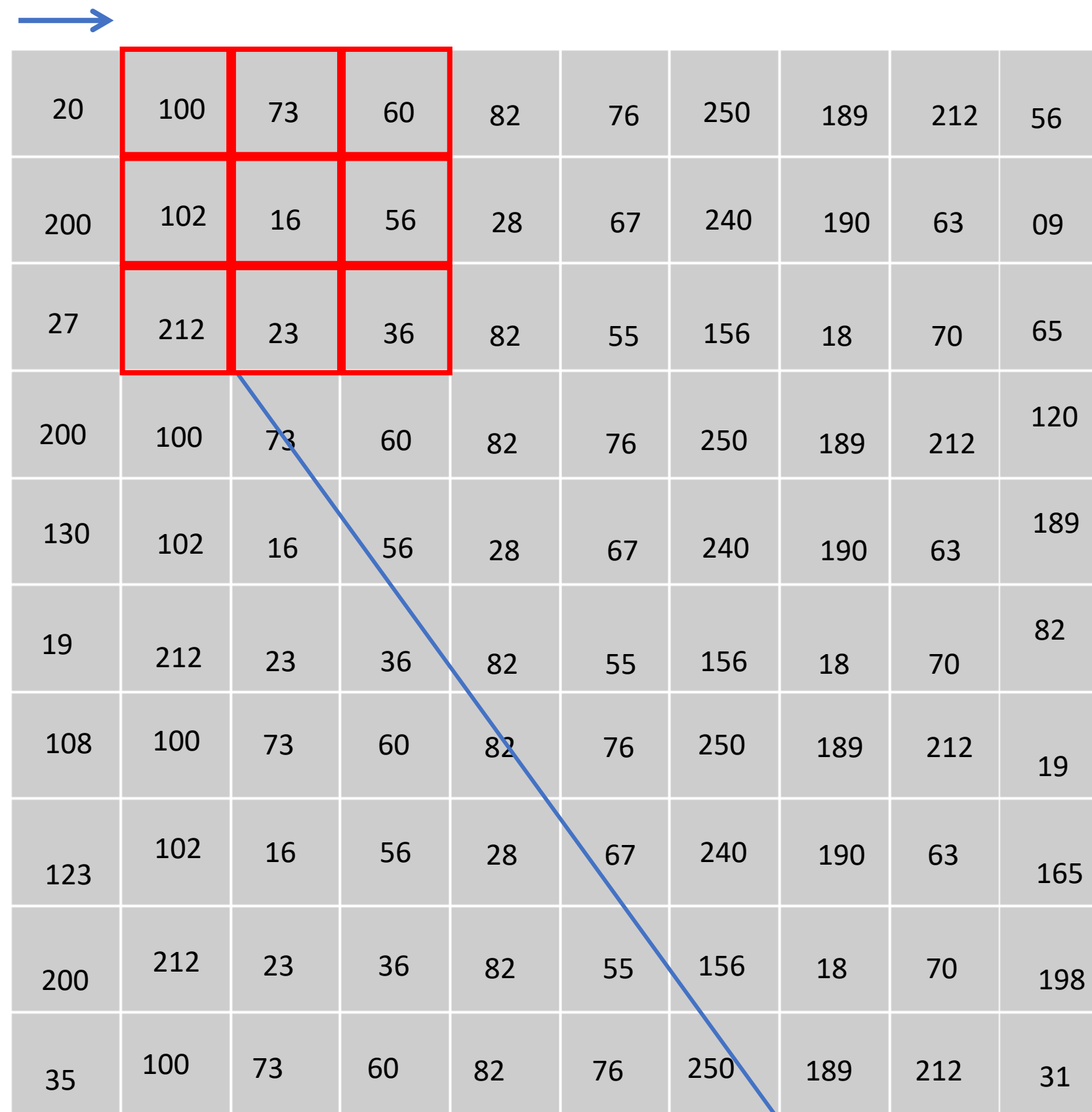
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31

Average
=

$$\frac{20+100+73+200+102+16+27+212+23}{9} = 85$$

Convolve Process

Stride = 1



A 10x10 grid of numbers. A 3x3 subgrid is highlighted with a red border, representing the kernel. The values in the kernel are 100, 73, 60, 102, 16, 56, 212, 23, 36. A blue arrow points from the bottom-right corner of the kernel to a blue circle containing the text 'Average ='. Another blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A third blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A fourth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A fifth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A sixth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A seventh blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. An eighth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A ninth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A tenth blue arrow points from the bottom-right corner of the grid to a blue circle containing the text 'Average ='. A blue arrow points from the top-left corner of the grid to the right.

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31

Average
=

$$\frac{100+73+60+102+16+56+212+23+36}{9} = 75$$

Convolve Process

Stride = 1
→

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Average
=

Convolve Process

Stride = 1
→

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

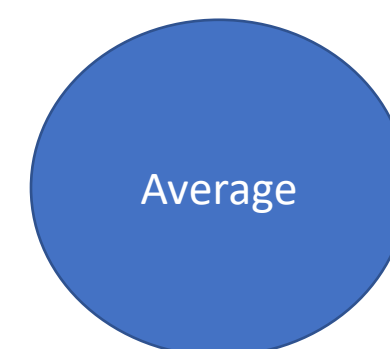
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

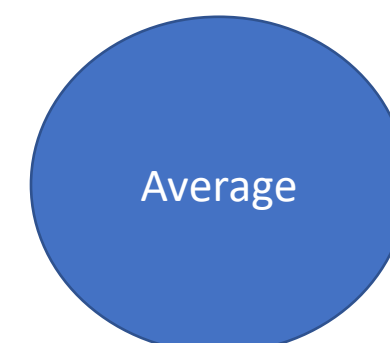
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

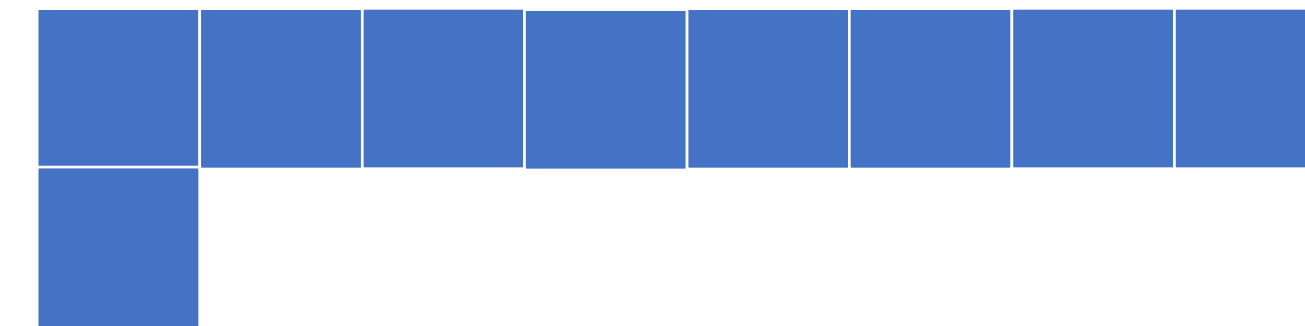
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1 ↓

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31

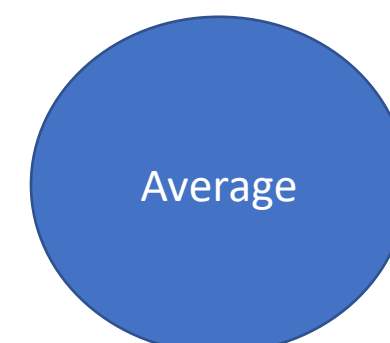
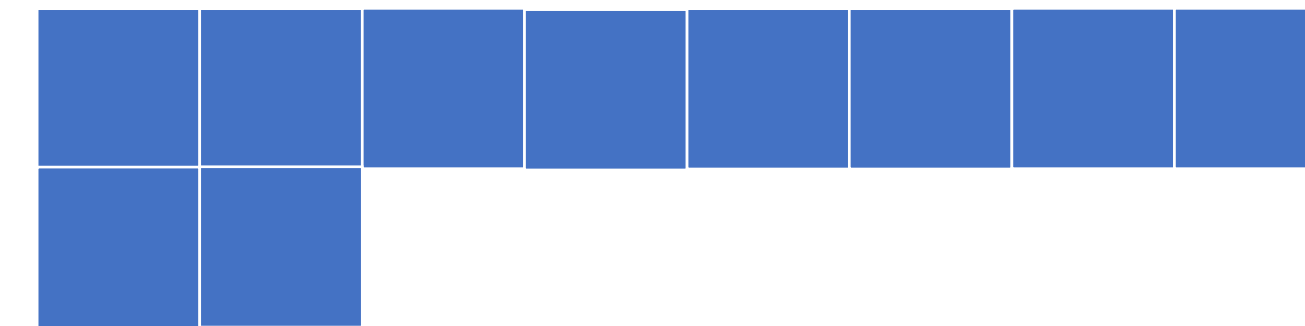


Convolve Process

Stride = 1



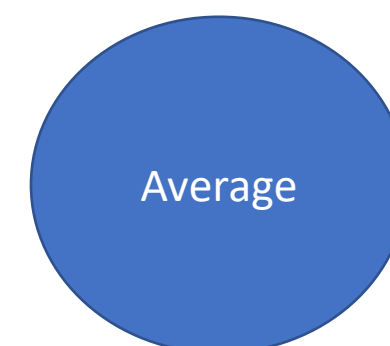
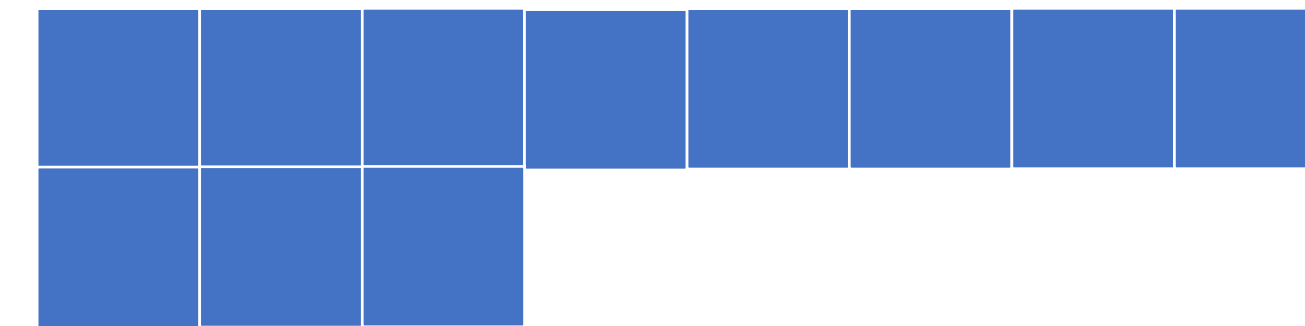
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

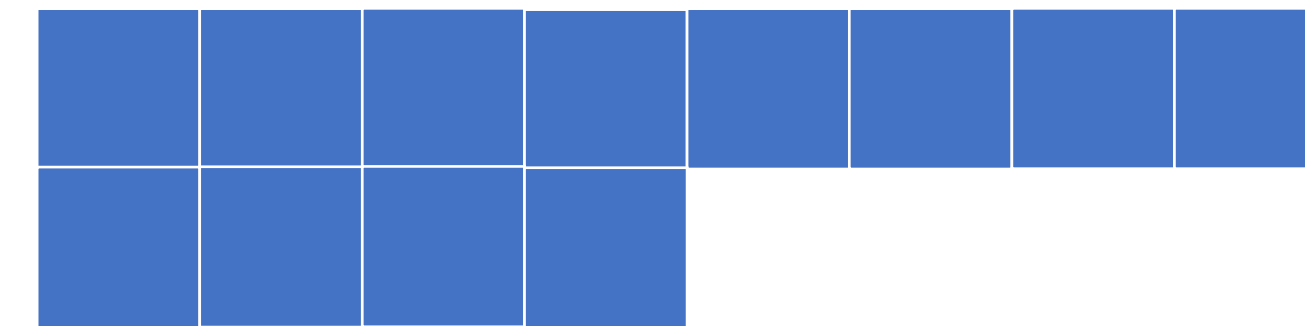
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

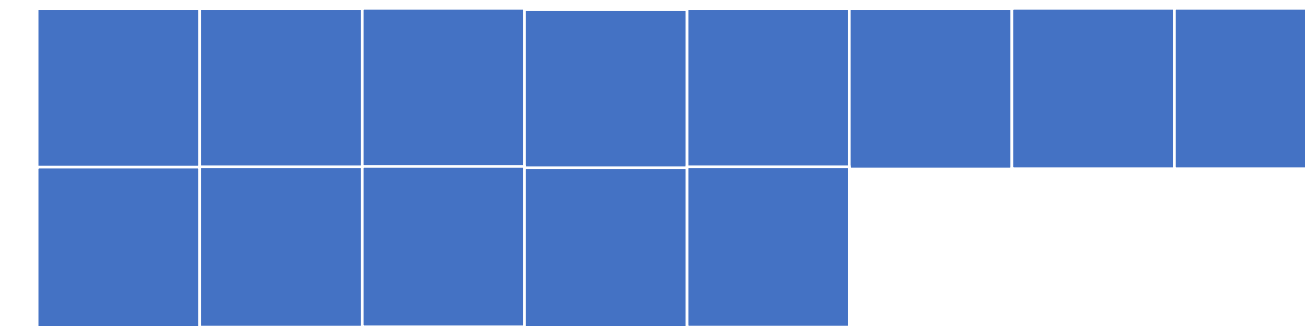
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

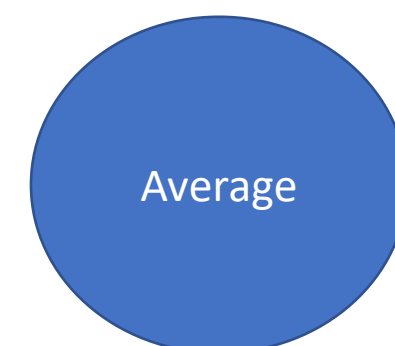
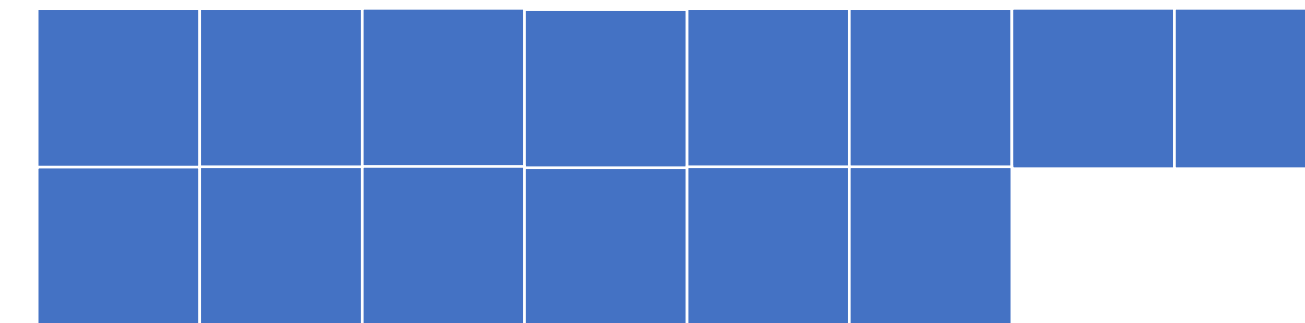
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

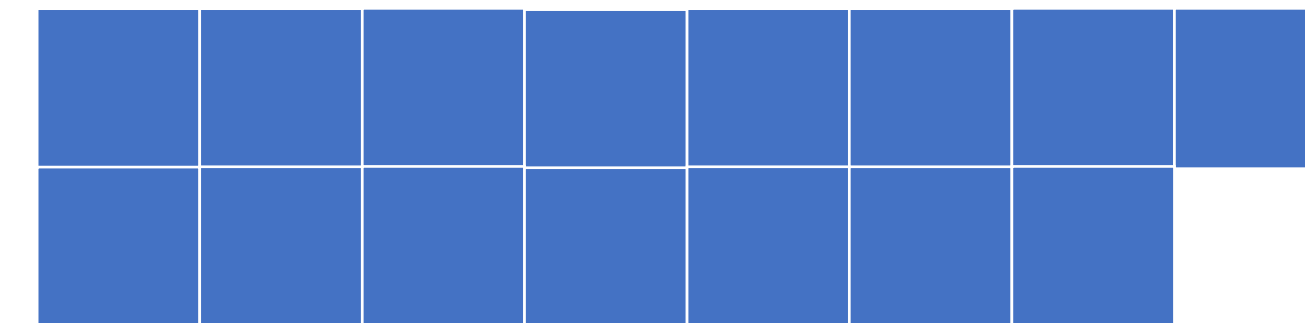
20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

Stride = 1
→

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Convolve Process

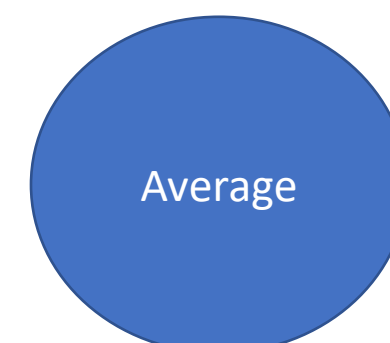
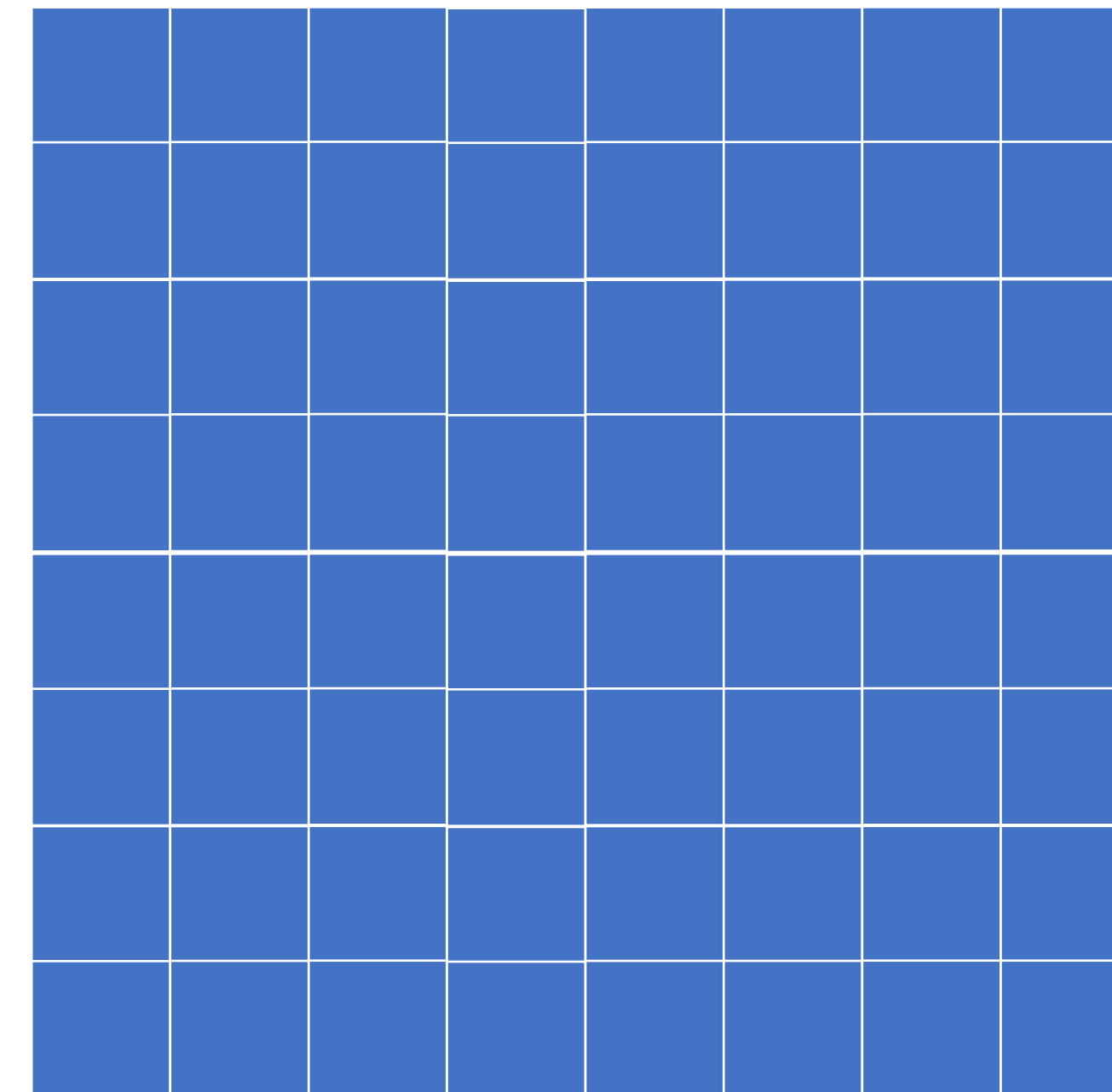
Stride = 1
→

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



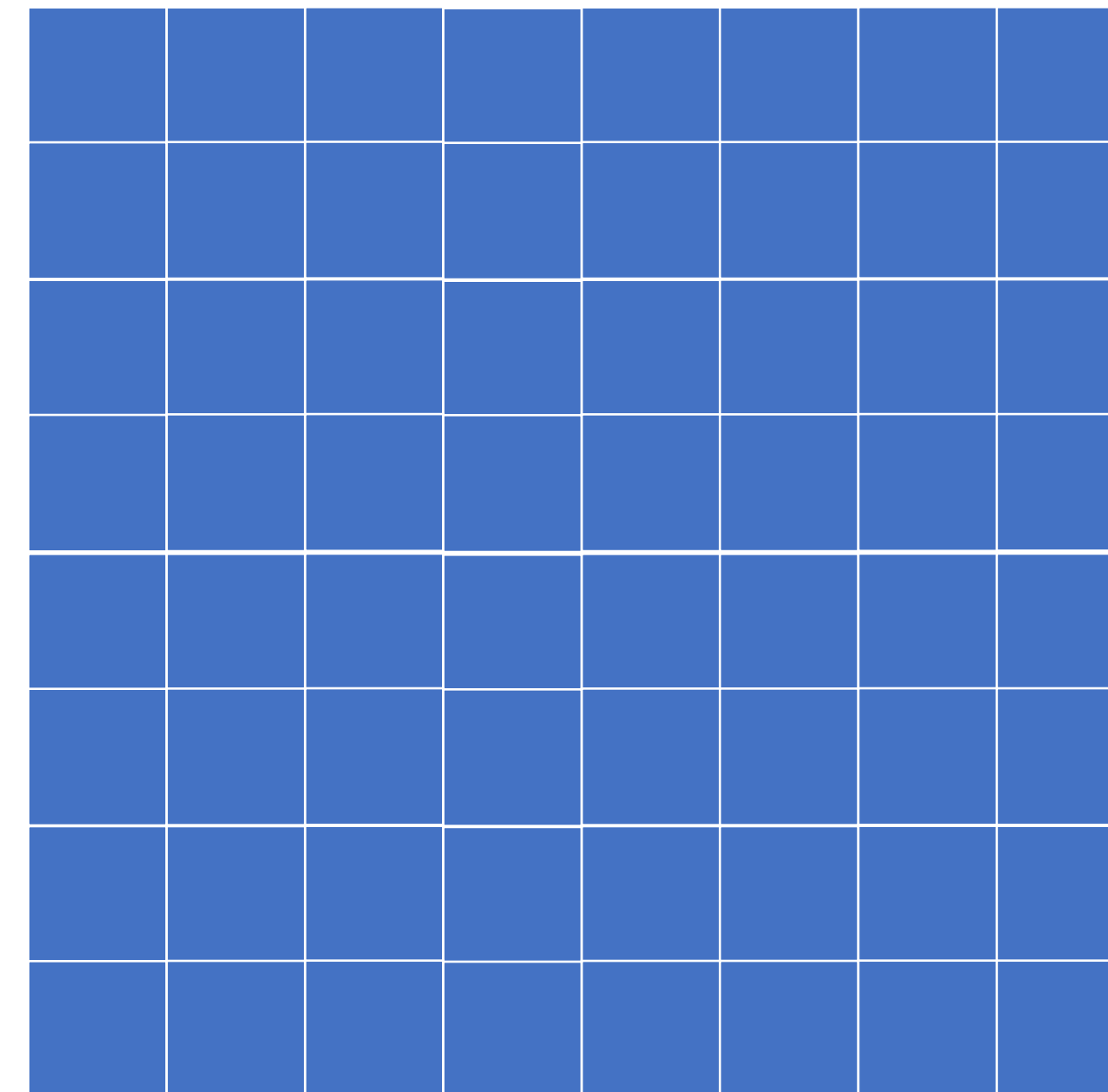
Convolve Process

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31

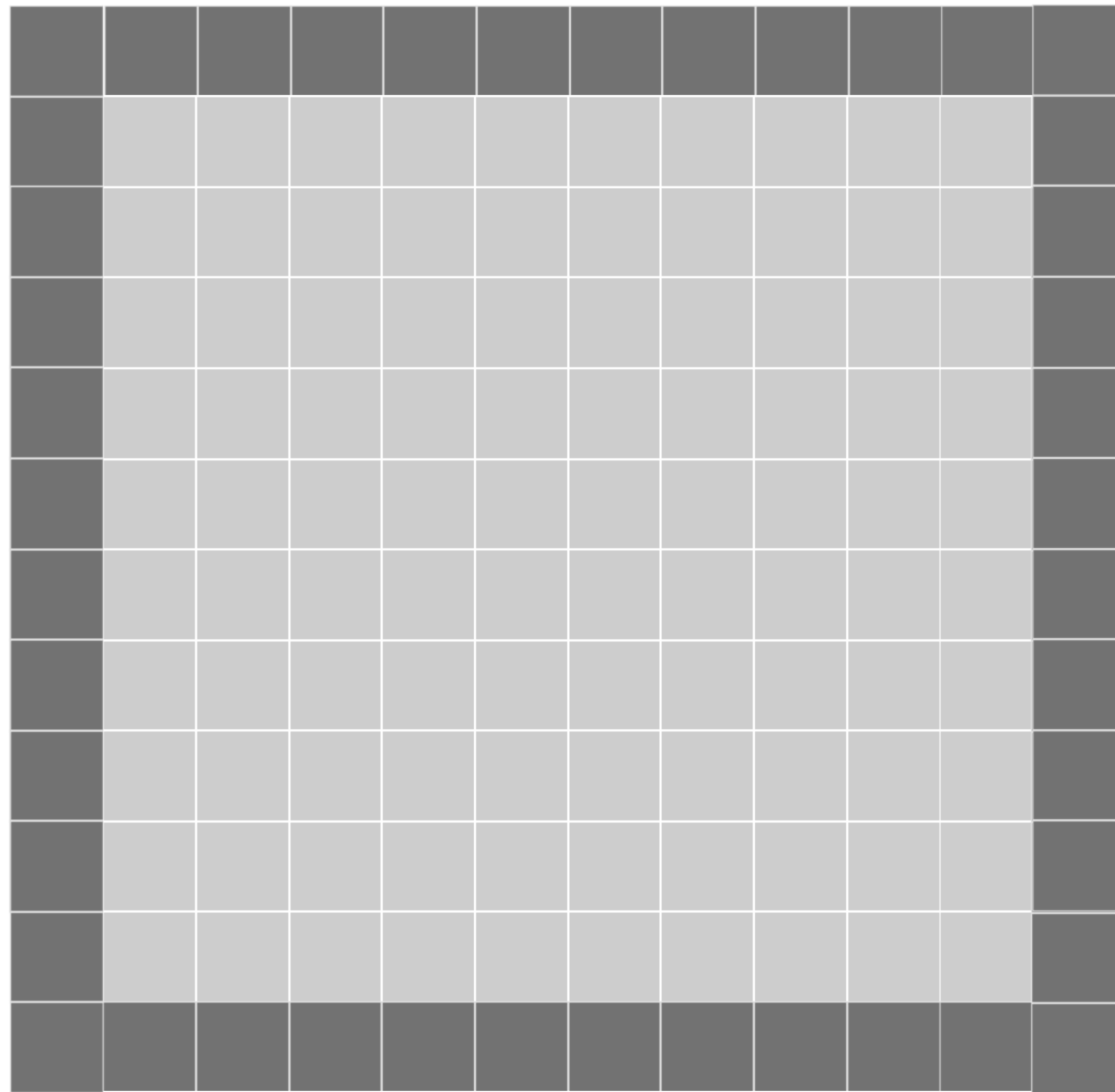


Convolve Process

20	100	73	60	82	76	250	189	212	56
200	102	16	56	28	67	240	190	63	09
27	212	23	36	82	55	156	18	70	65
200	100	73	60	82	76	250	189	212	120
130	102	16	56	28	67	240	190	63	189
19	212	23	36	82	55	156	18	70	82
108	100	73	60	82	76	250	189	212	19
123	102	16	56	28	67	240	190	63	165
200	212	23	36	82	55	156	18	70	198
35	100	73	60	82	76	250	189	212	31



Padding to Retain the W & H



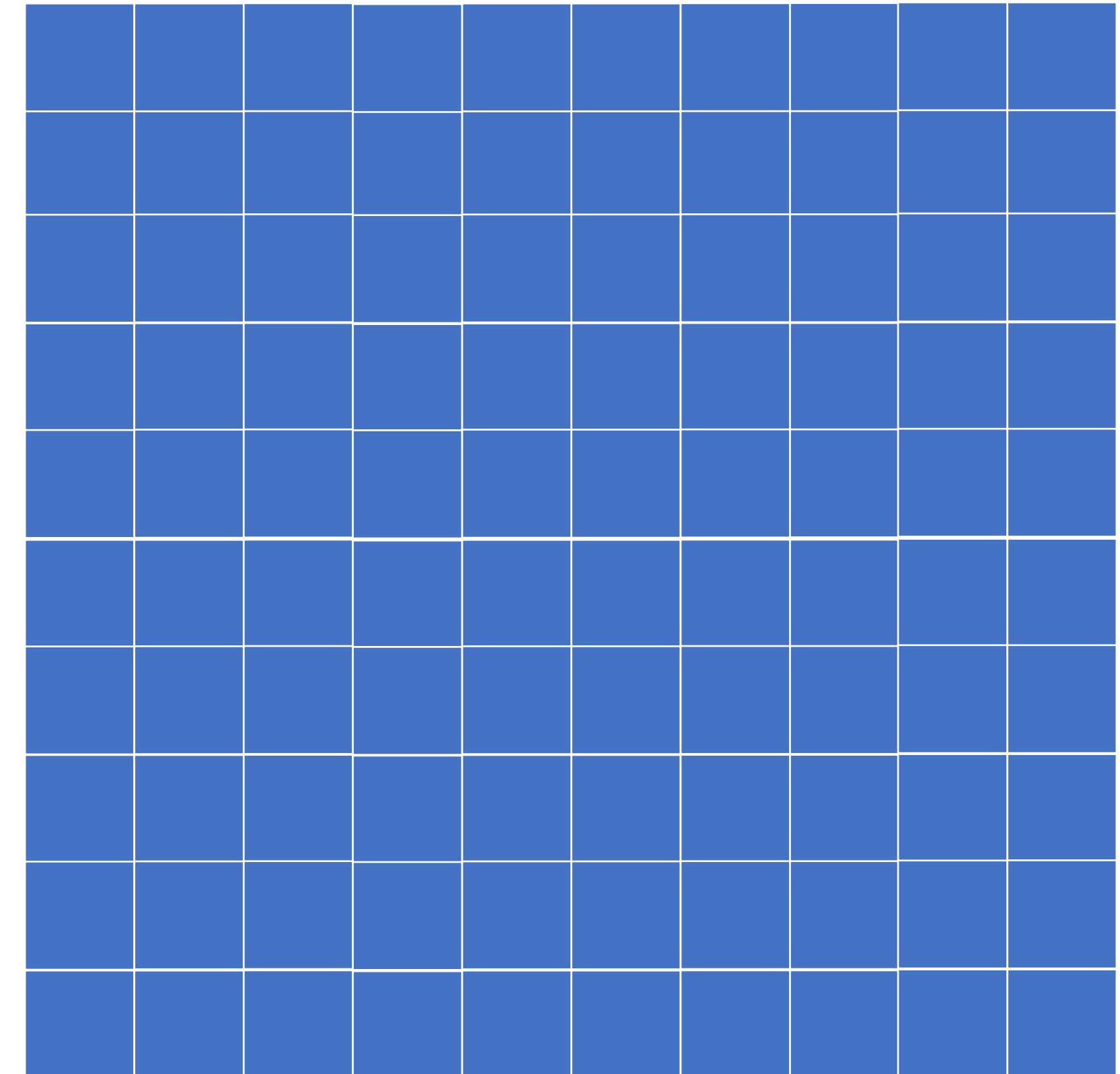
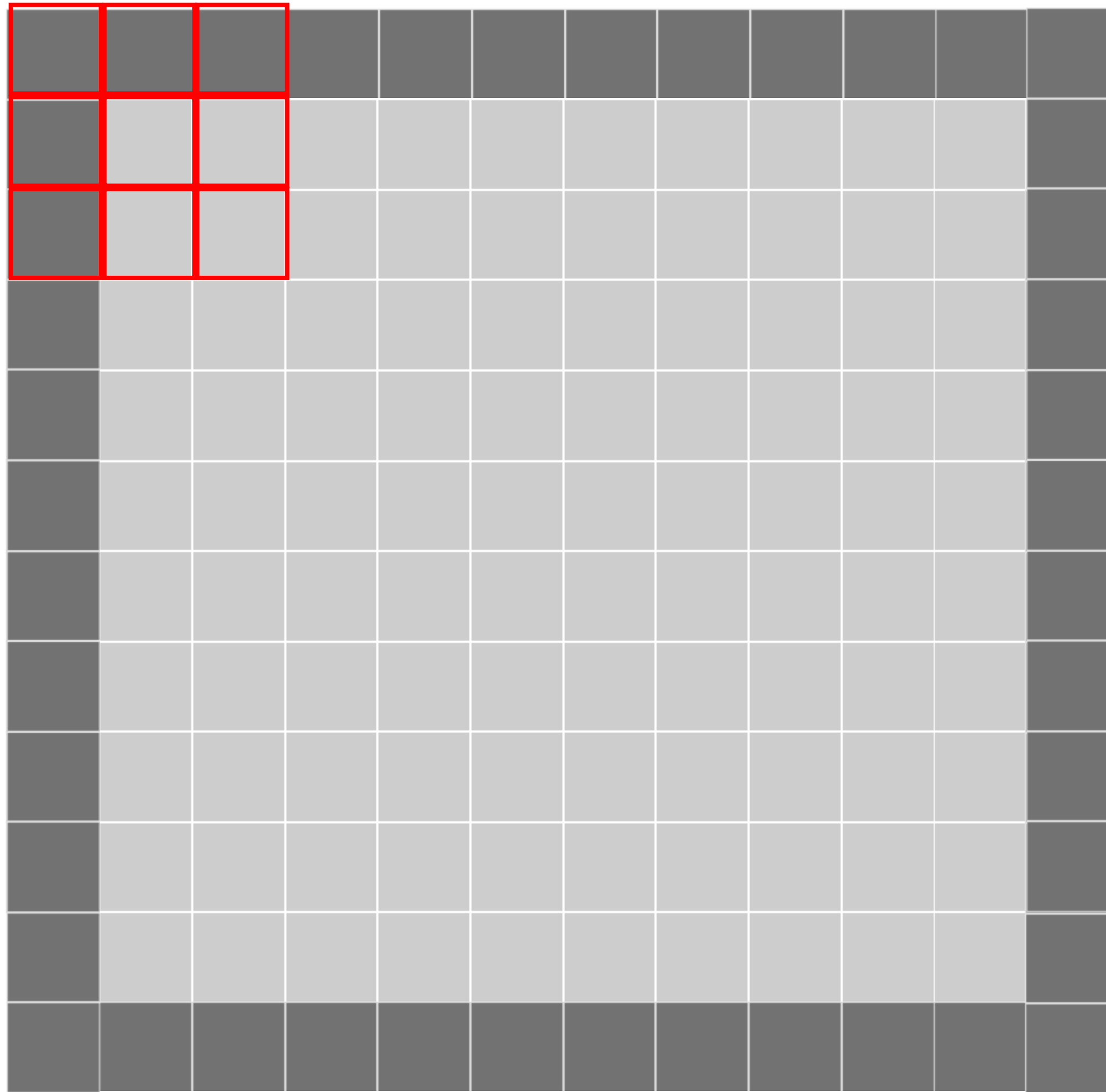
Same Padding

	20	100	73	60	82	76	250	189	212	56	
	200									09	
	27									65	
	200									120	
	130									189	
	19									82	
	108									19	
	123									165	
	200									198	
	35	100	73	60	82	76	250	189	212	31	

Same Padding or Zero Padding

0	0	0	0	0	0	0	0	0	0	0	0
0	20	100	73	60	82	76	250	189	212	56	0
0	200									09	0
0	27									65	0
0	200									120	0
0	130									189	0
0	19									82	0
0	108									19	0
0	123									165	0
0	200									198	0
0	35	100	73	60	82	76	250	189	212	31	0
0	0	0	0	0	0	0	0	0	0	0	0

Apply Convolve



Average Blur in OpenCV

```
cv2.blur(src, ksize)
```

Next

Average Blur OpenCV Python