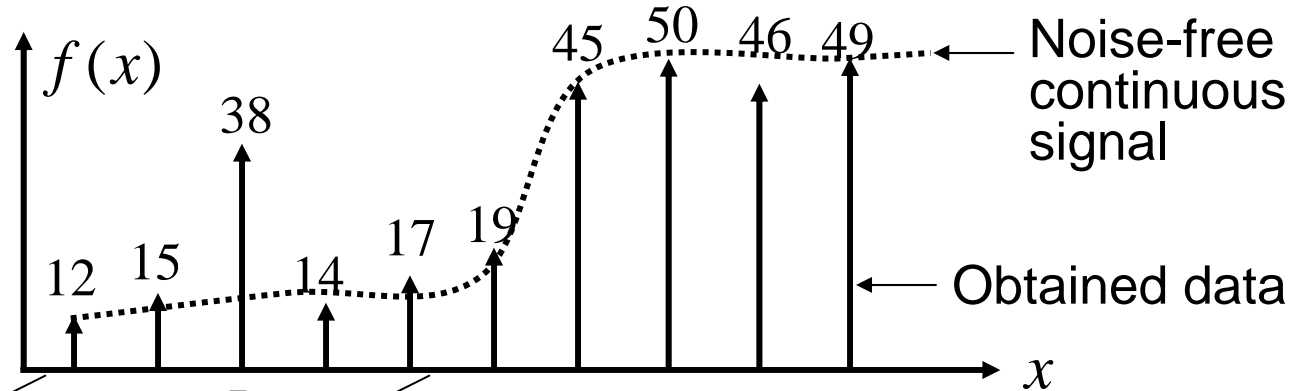


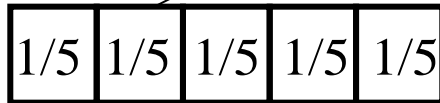
Noise reduction (1) averaging -1D-

Case of averaging five points

Before



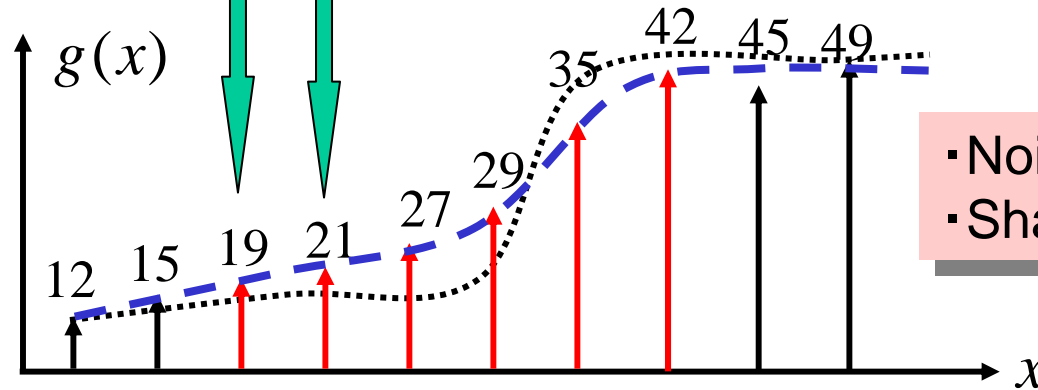
Kernel



Each original data is replaced by the averaged value.

...

After

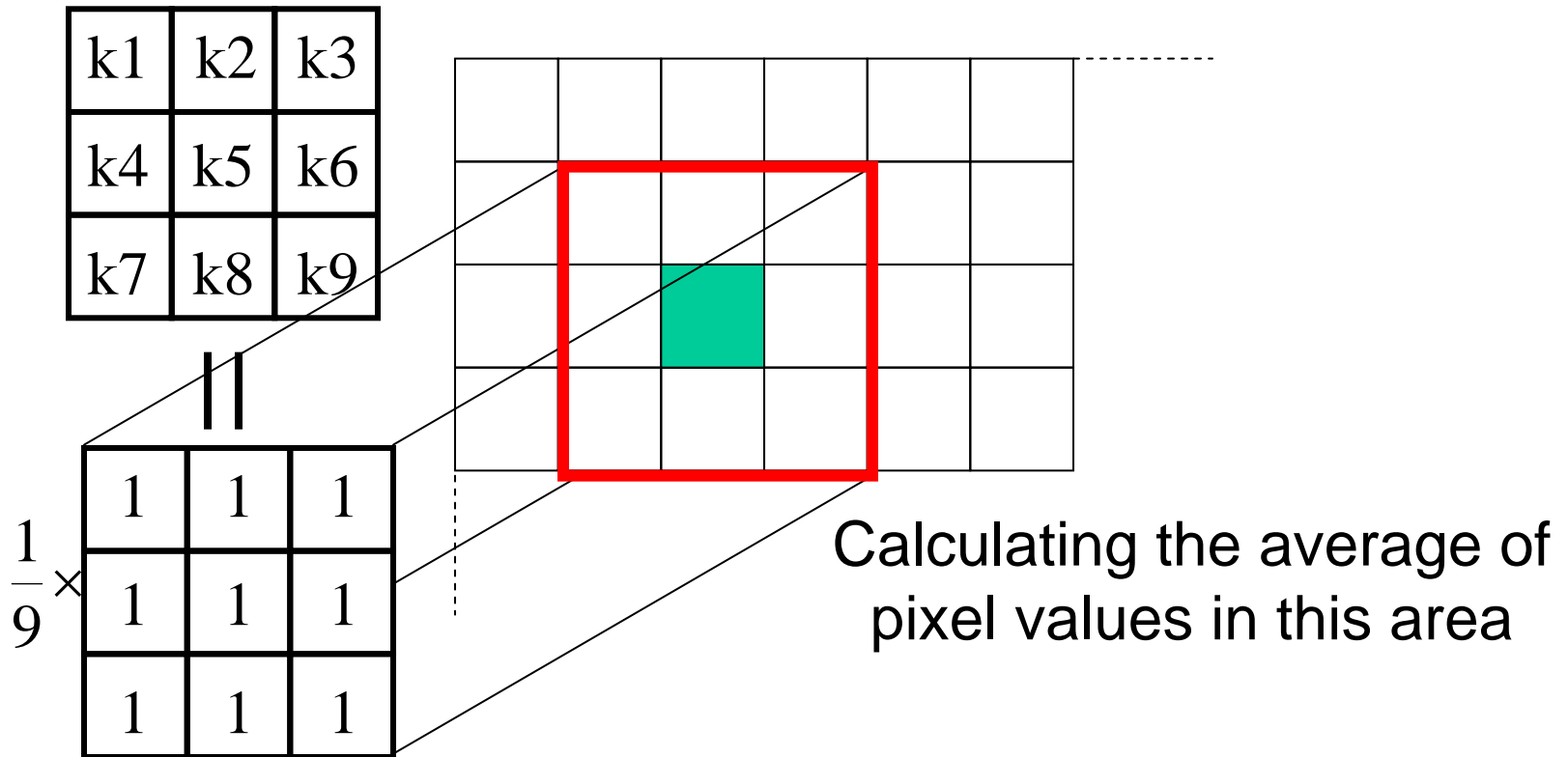


- Noise is reduced
- Shape gets blunt

Noise reduction (1) averaging -2D-

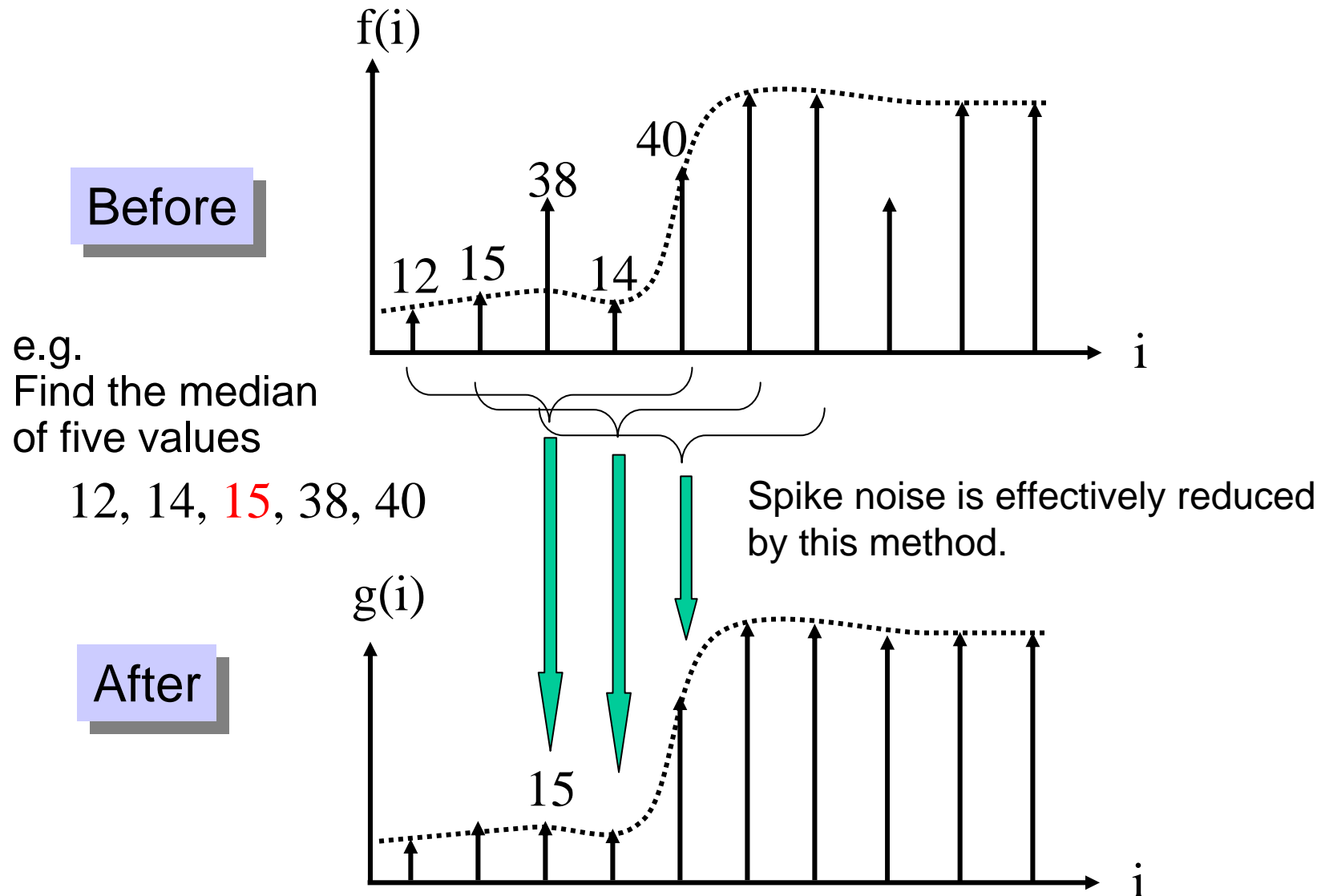
Case of averaging 3 x 3 pixels

Convolution kernel



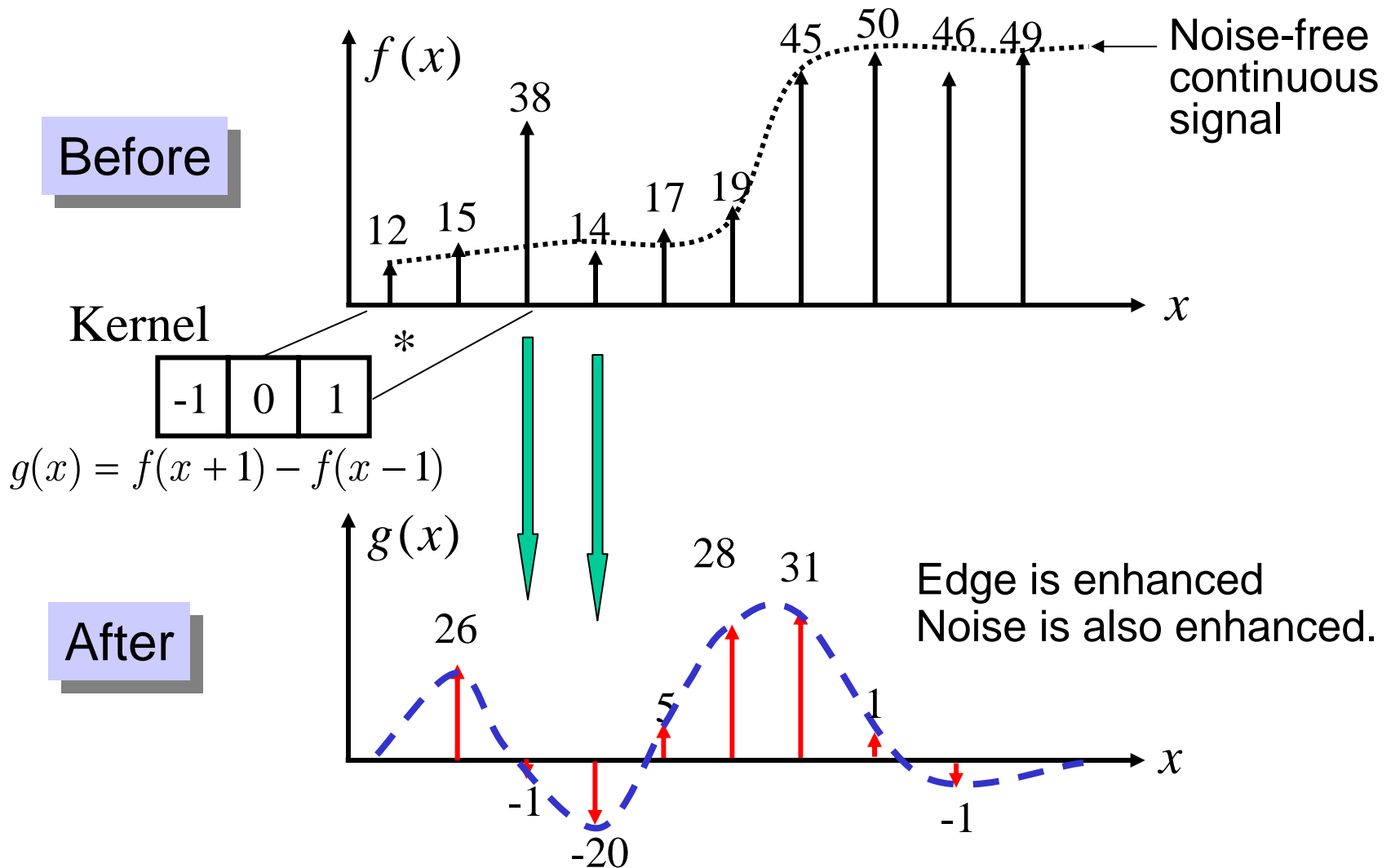
Noise reduction (2) Median filter -1D-

Each original data is replaced by the median of neighboring region.



Edge enhancement -1D-

Differential filter: original data is replaced by the difference between neighboring pixel values.



Edge enhancement -2D-

Laplacian filter

	x		
	0	-1	0
	-1	4	-1
	0	-1	0
y			

Sobel filter

	x		
	-1	0	1
	-2	0	2
	-1	0	1
y			

Difference between center and four-neighbors

f1	f2	f3
f4	f5	f6
f7	f8	f9

Difference in x-direction
Averaging in y-direction

Second-order difference in y-direction $(f_8 - f_5) - (f_5 - f_2)$

Second-order difference in x-direction $(f_6 - f_5) - (f_5 - f_4)$