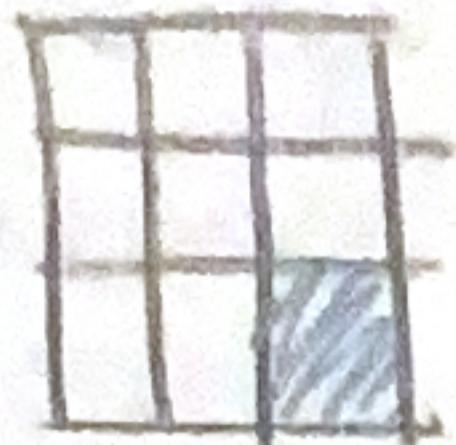


# Spatial Filtering

## Linear Spatial Filtering

Sum of products between image  $f$  & filter kernel  $w$ .

$$g(x,y) = w(-1,-1) f(x-1, y-1) + w(-1,0) f(x-1, y) + \dots \\ \quad + w(0,0) f(x,y) + \dots + w(1,1) f(x+1, y+1)$$



$$g(x,y) = \sum_{s=-a}^a \sum_{t=-b}^b w(s,t) f(x+s, y+t)$$

## Spatial Correlation & Convolution

Correlation: Moving center of a kernel over an image  $f$  computing sum of products at each location

Measurement between similarity of two signals

$(x,y) \rightarrow$  any point in the image

$w$

$(-1, -1)$	$(-1, 0)$	$(-1, 1)$
$(0, -1)$	$(0, 0)$	$(0, 1)$
$(1, -1)$	$(1, 0)$	$(1, 1)$

kernel  
coefficients

$(x-1, y-1)$	$(x-1, y)$	$(x-1, y+1)$
$(x, y-1)$	$(x, y)$	$(x, y+1)$
$(x+1, y-1)$	$(x+1, y)$	$(x+1, y+1)$

pixel  
values  
under kernel  
when it's centered  
on  $(x,y)$

$$\text{Correlation: } (w \cdot f)(x,y) = \sum_{s=-a}^a \sum_{t=-b}^b w(s,t) f(x+s, y+t)$$

Convolution: Measurement of effect of one signal on another

$$(w * f)(x,y) = \sum_{s=-a}^a \sum_{t=-b}^b w(s,t) f(x-s, y-t)$$

↑ flip the kernel on both sides

When kernel is symmetrical, correlation = convolution