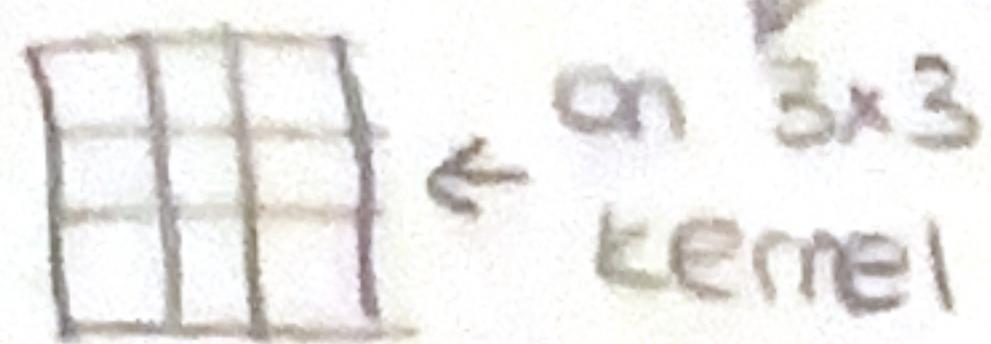


Spatial Filtering

Linear Spatial Filtering

Sum of products between image f & filter kernel w

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



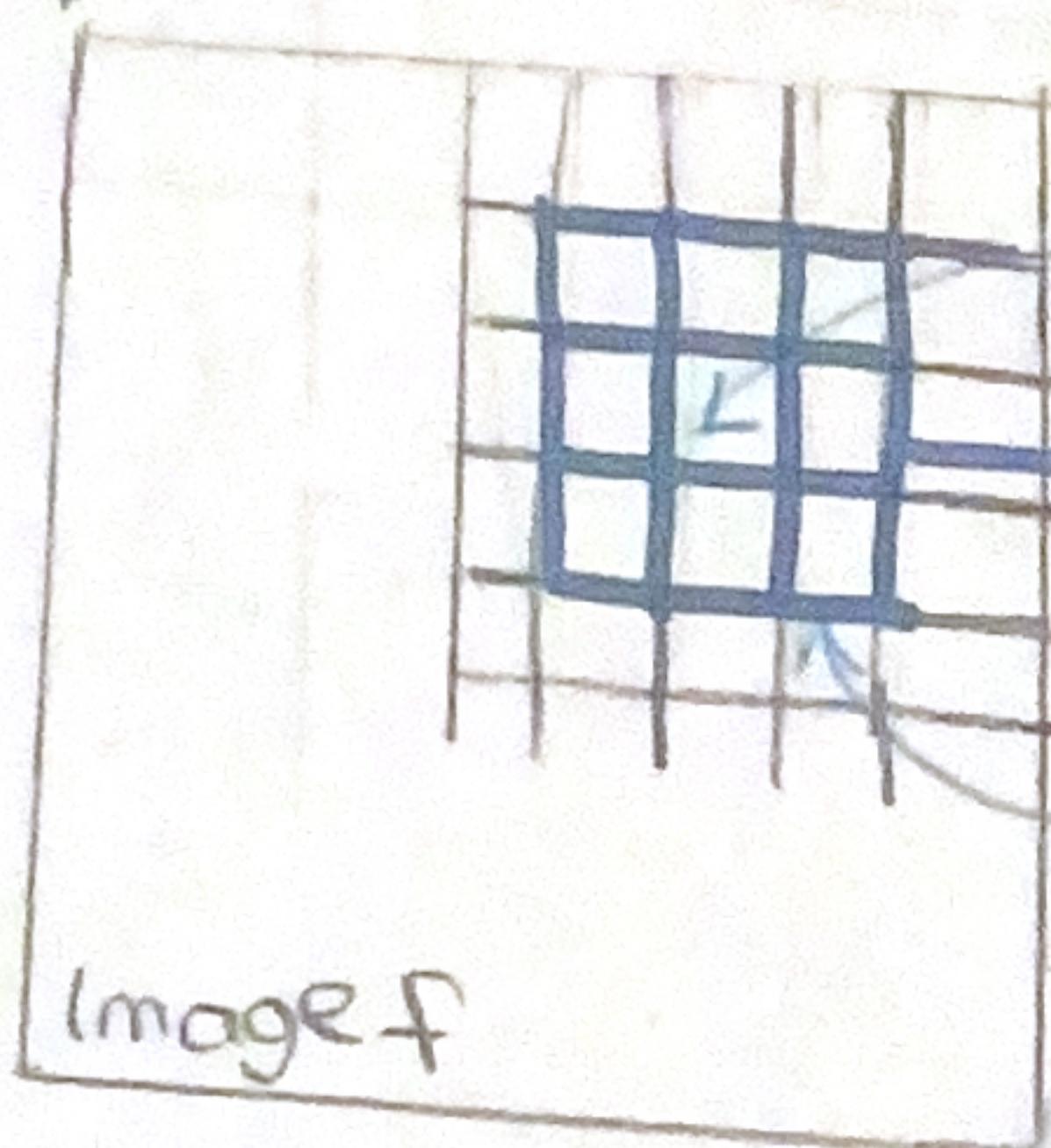
$$* g(x,y) = \sum_{s=-a}^a \sum_{t=-b}^b w(s,t) \cdot f(x+s, y+t)$$

Spatial Correlation & Convolution

- Correlation: Moving center of a kernel over an image and computing sum of products at each location.

It's a measurement of the similarity between 2 signals.

Image origin



Kernel origin

Filter kernel

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

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

kernel coefficients
 $w(-1,-1), \dots$

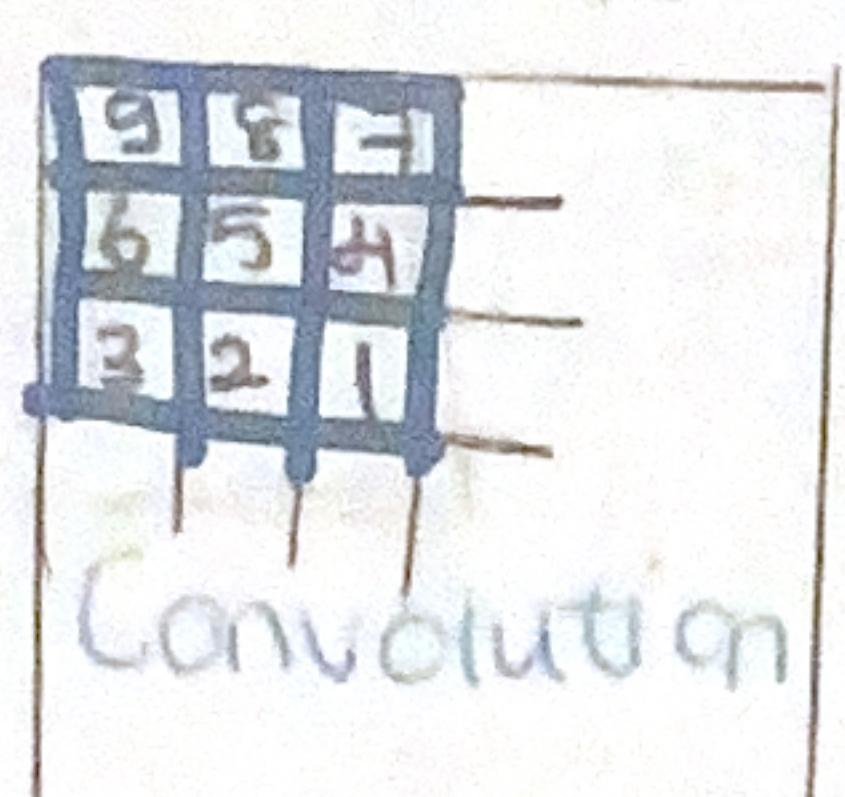
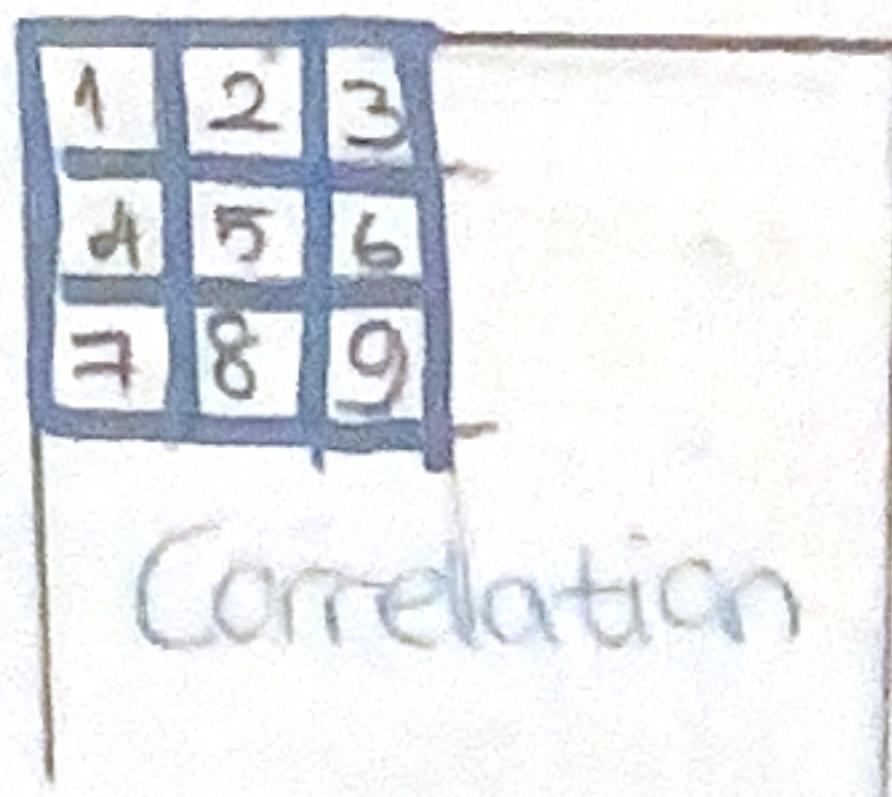
(x-1, y-1)	(x-1, y)	(x-1, y+1)
(x, y-1)	(x, y)	(x, y+1)
(x+1, y-1)	(x+1, y)	(x+1, y+1)

pixel values under kernel when it is centered on (x,y)

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

- Convolution: Measurement of effect of one signal on the other signal.

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



$$\text{Kernel } w: \begin{matrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{matrix}$$

- When kernel is symmetrical
Correlation = convolution