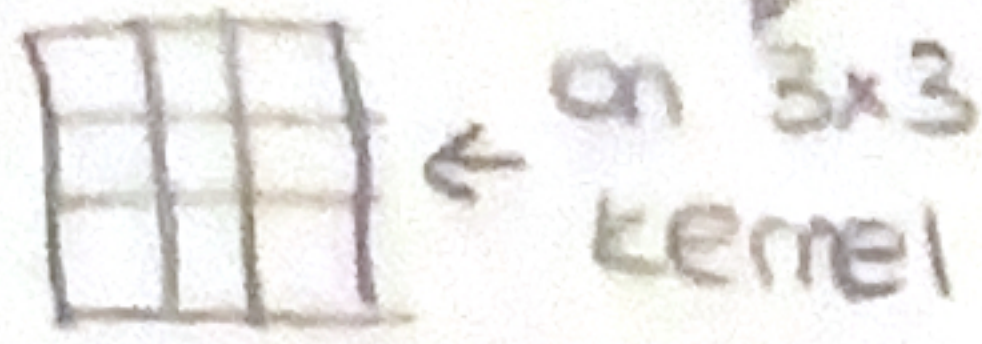


# Spatial Filtering

## Linear Spatial Filtering

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

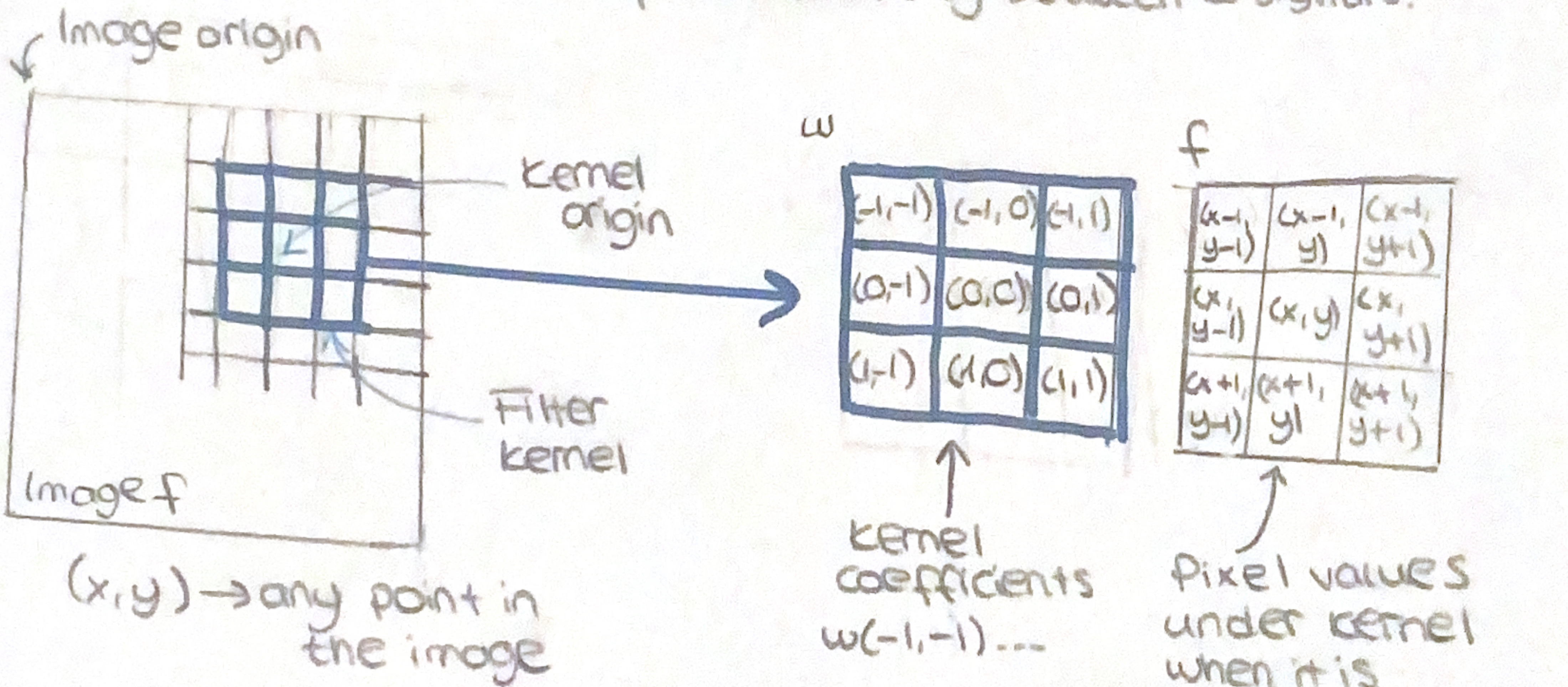
$$g(x, y) = w(-1, -1)f(x-1, y-1) + w(-1, 0)f(x-1, y) + \dots + w(0, 0)f(x, y) + \dots + w(1, 1)f(x+1, y+1)$$



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

## 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.



- **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.

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

|   |   |   |
|---|---|---|
| 1 | 2 | 3 |
| 4 | 5 | 6 |
| 7 | 8 | 9 |

Correlation

|   |   |   |
|---|---|---|
| 9 | 8 | 7 |
| 6 | 5 | 4 |
| 3 | 2 | 1 |

Convolution

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

- When kernel is symmetrical  
Correlation = convolution