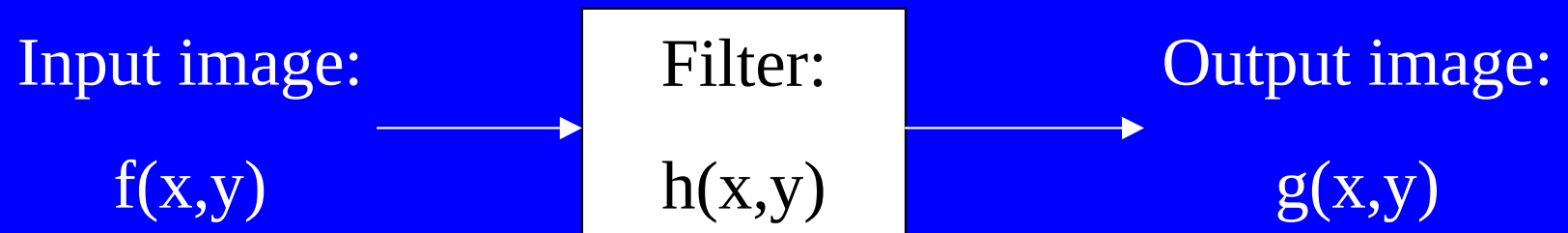


CONVOLUTION



Convolution: Continuous form

- We define the convolution of $f(x, y)$ by $h(x, y)$ as the integral:

$$g(x, y) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f(a, b) \, h(x - a, y - b) \, da \, db$$

Convolution: Discrete form

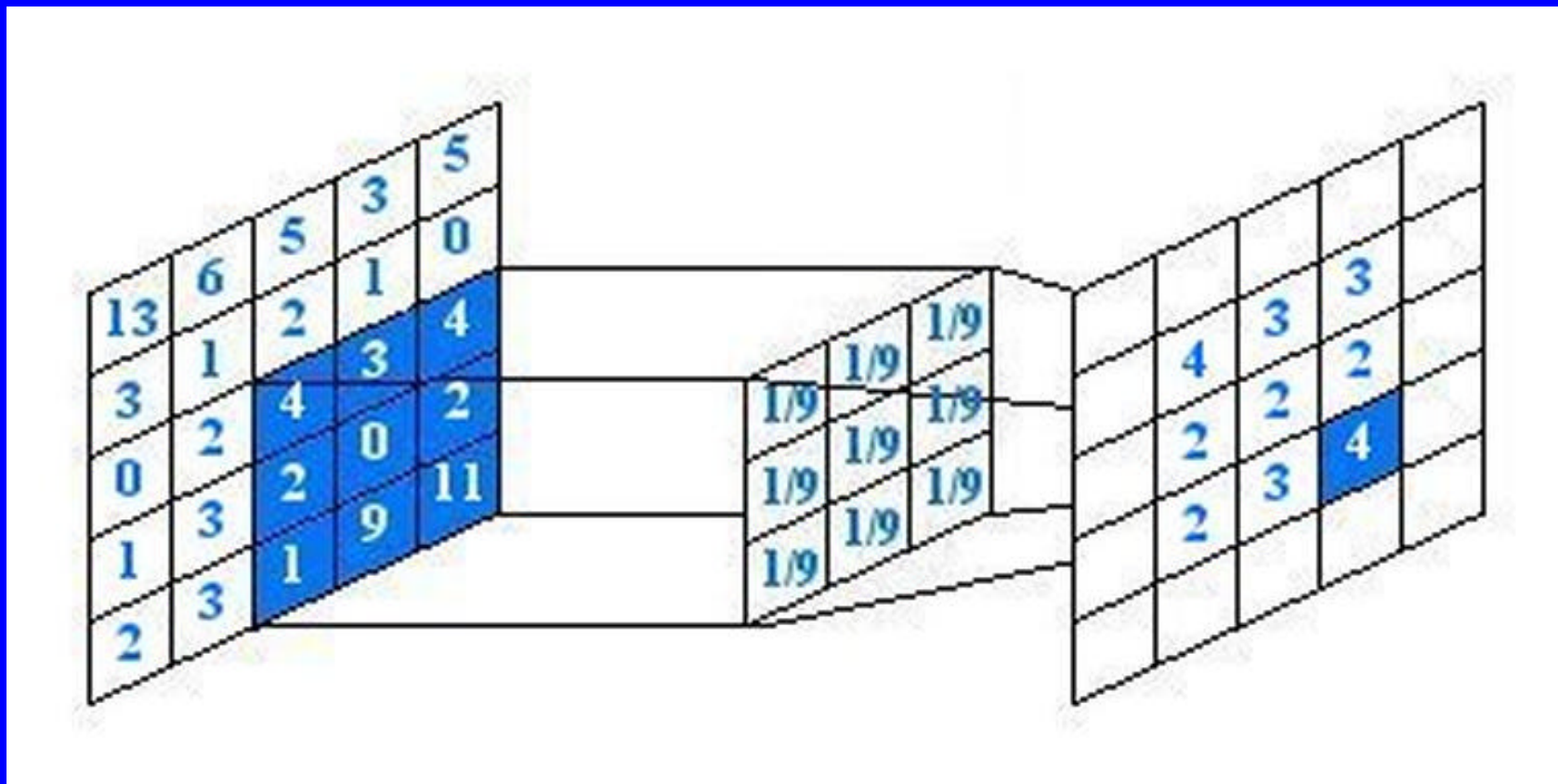
- In the discrete form:

$$g(x, y) = \sum_{-\infty}^{\infty} \sum_{-\infty}^{\infty} f(a, b) \quad h(x - a, y - b)$$

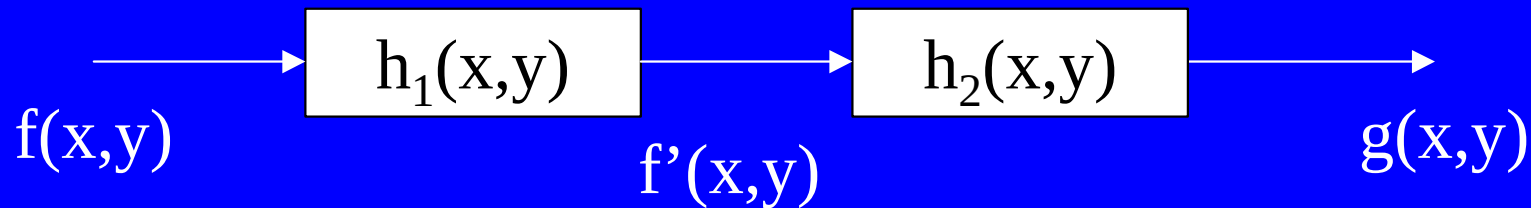
- We denote convolution as

$$g(x, y) = f(x, y) * h(x, y)$$

Convolution: Example



Convolution: Multiple filters



$$f'(x, y) = f(x, y) * h_1(x, y)$$

$$g(x, y) = f'(x, y) * h_2(x, y)$$

$$= \{f(x, y) * h_1(x, y)\} * h_2(x, y)$$

$$= f(x, y) * \{h_1(x, y) * h_2(x, y)\}$$

Convolution: Equivalents

- Impuls respons
- Convolution kernel
- Mask
- Operator
- Filter