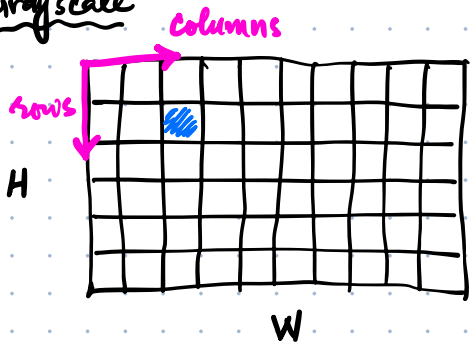
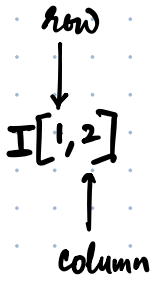
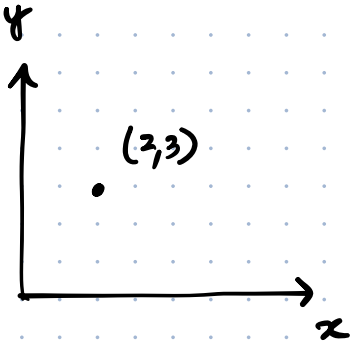
Image Representation

Grayscale

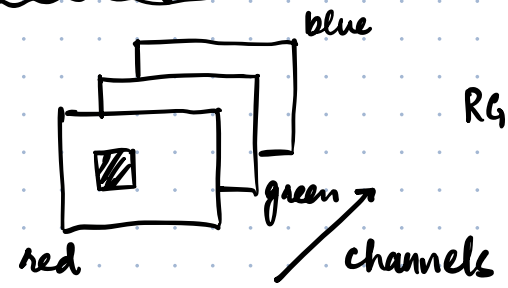






0-255 ⟶ 0.0 - 1.0

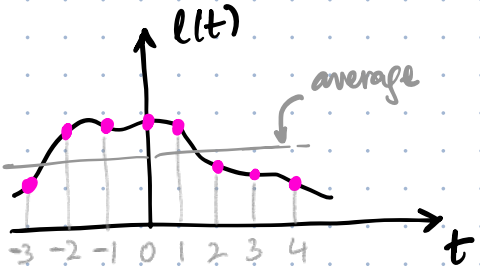
Color images.



RGB

= (, ,)

Linear Filtering



(i) DC (average)

$$\mu = \frac{1}{N}\sum_{n=0}^{N-1} x[n]$$

(ii) Comparing two signals.

$$D^2 = \frac{1}{N}\sum_{n=0}^{N-1} |x_1[n] - x_2[n]|^2$$

(iii) Power

$$P_x = \frac{1}{N}\sum_{n=0}^{N-1} |x[n]|^2$$

Linear System

* satisfy the principle of superposition

(i) $f(x_1+x_2) = f(x_1)+f(x_2)$ Additivity

(ii) $f(ax) = af(x)$ Homogeneity (scaling) for any scalar a.

Linear Translation Invariant Systems (LTIs)

- when the input is translated, the output is also translated.

$$g[n-n_0] = f(x[n-n_0])$$

↓

Convolution:

$$x[n] * h[n] = \sum_{k=-\infty}^{\infty} x[k]\,h[n-k]$$

↑ captures the system

x: 0 1 0 3 4 9 8 1 ← signal

h: -1 0 2 0 1 ← filter / kernel

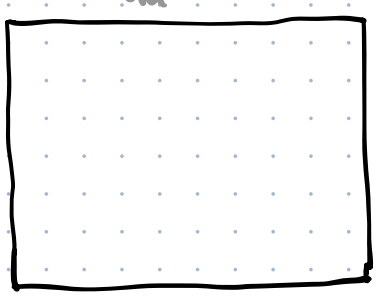
x x 0 1 0 3 4 9 8 1

1 0 2 0 -1 ← flip for convolution

↓ ↓ ↓ ↓

0 -1 -4 -2

old



* F

F

→

Resulting image

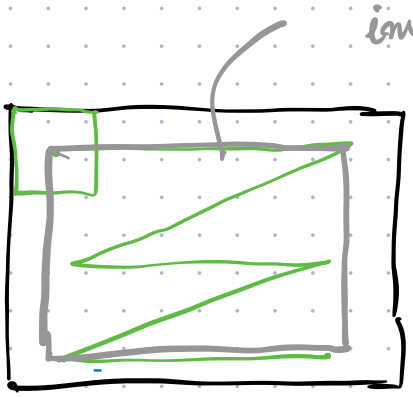
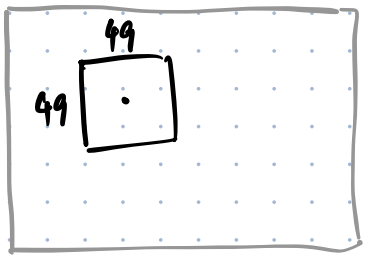


Image: 1000×1000

Filter: 49×49

How many x and + : ignore boundaries



49^2 (x), $49^2 - 1$ (+1)

1000×1000
