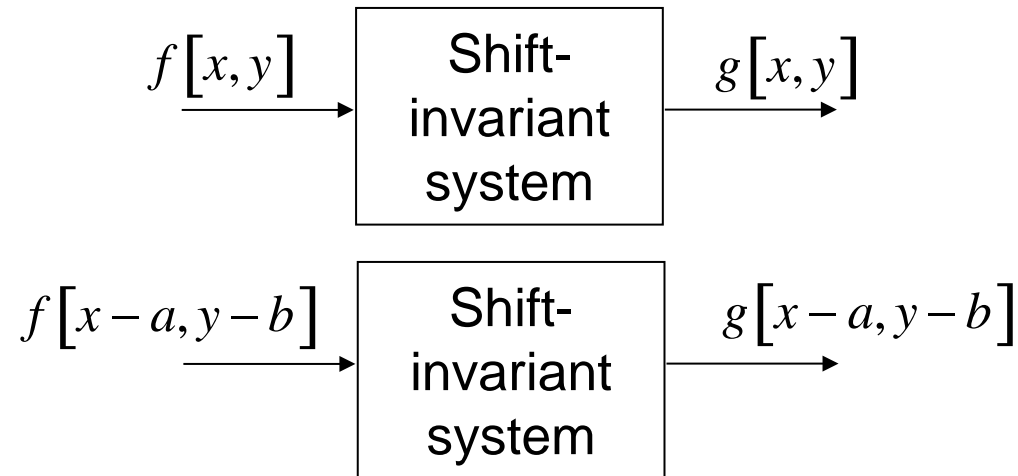# Binary image processing

- Binary images are common
  - Intermediate abstraction in a gray-scale/color image analysis system
    - Thresholding/segmentation
    - Presence/absence of some image property
  - Text and line graphics, document image processing
- Representation of individual pixels as 0 or 1, convention:
  - foreground, object = 1 (white)
  - background = 0 (black)
- Processing by logical functions is fast and simple
- Shift-invariant logical operations on binary images: "*morphological" image processing*
- Morphological image processing has been generalized to gray-level images via level sets

Shift-invariance

- Assume that digital images $f[x,y]$ and $g[x,y]$ have infinite support

$$[x,y] \in \{\cdots,-2,-1,0,1,2,\cdots\} \times \{\cdots,-2,-1,0,1,2,\cdots\}$$

. . . then, for all integers a and b

$f[x,y]$ → Shift-invariant system → $g[x,y]$

$f[x-a,y-b]$ → Shift-invariant system → $g[x-a,y-b]$

- Shift-invariance does **<u>not</u>** imply linearity (or vice versa).

Structuring element

- Neighborhood "window" operator

$$W\left\{f\left[x,y\right]\right\} = \left\{f\left[x-x',y-y'\right] : \left[x',y'\right] \in \Pi_{xy}\right\}$$

"structuring element"

- Example structuring elements Π_{xy} :

5x5 square

cross