Binárne obrazy
Matematická mofológia

Original (f)

Darken $(f - 128)$

Lighten $(f + 128)$

Invert $(255 - f)$

Original (f)

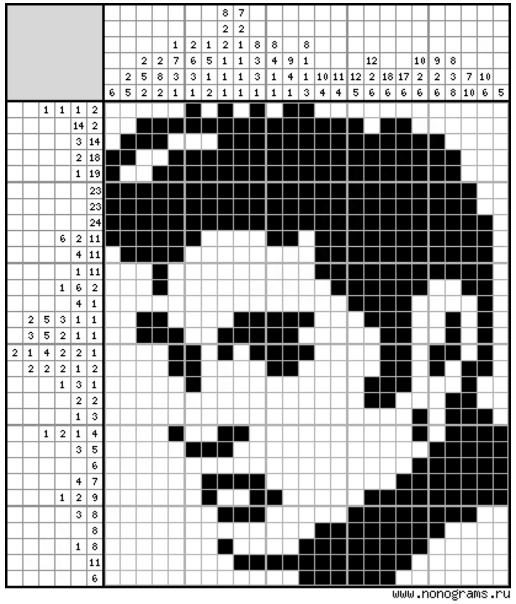
Low Contrast $(f/2)$

High Contrast $(f * 2)$

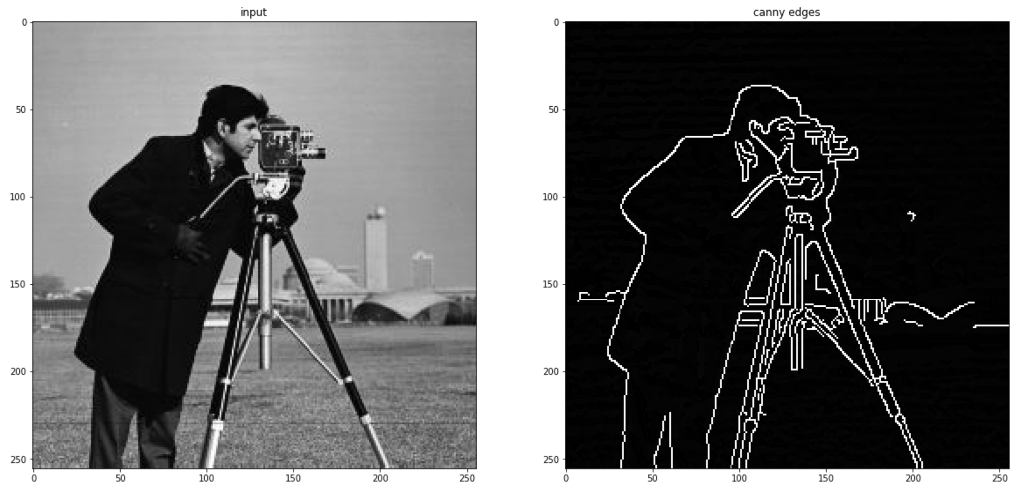
Gray $(0.3f_R + 0.6f_G + 0.1f_B)$

Binárny obraz

- 1-bitová hodnota jasu pre každý pixel
- Malá veľkosť súboru (+ run-length encoding)
- Výstup operácii - napr. detekcie hrán

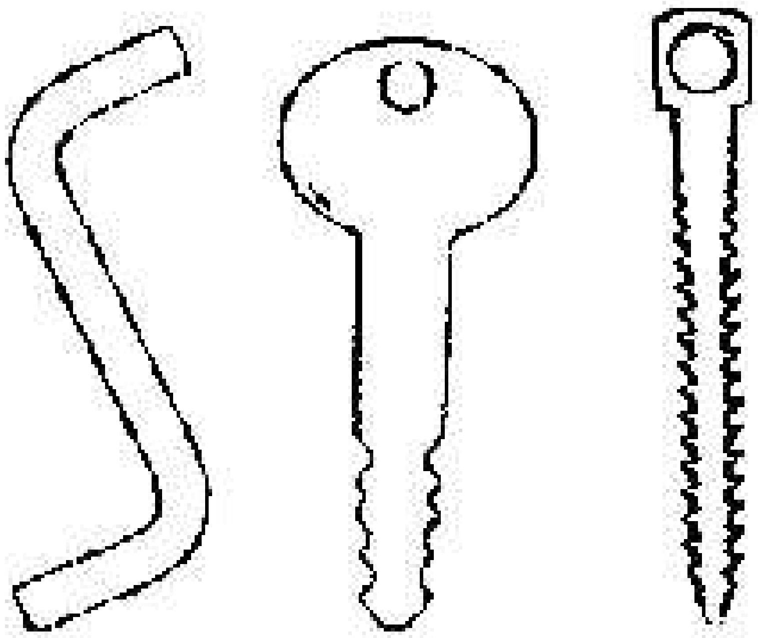


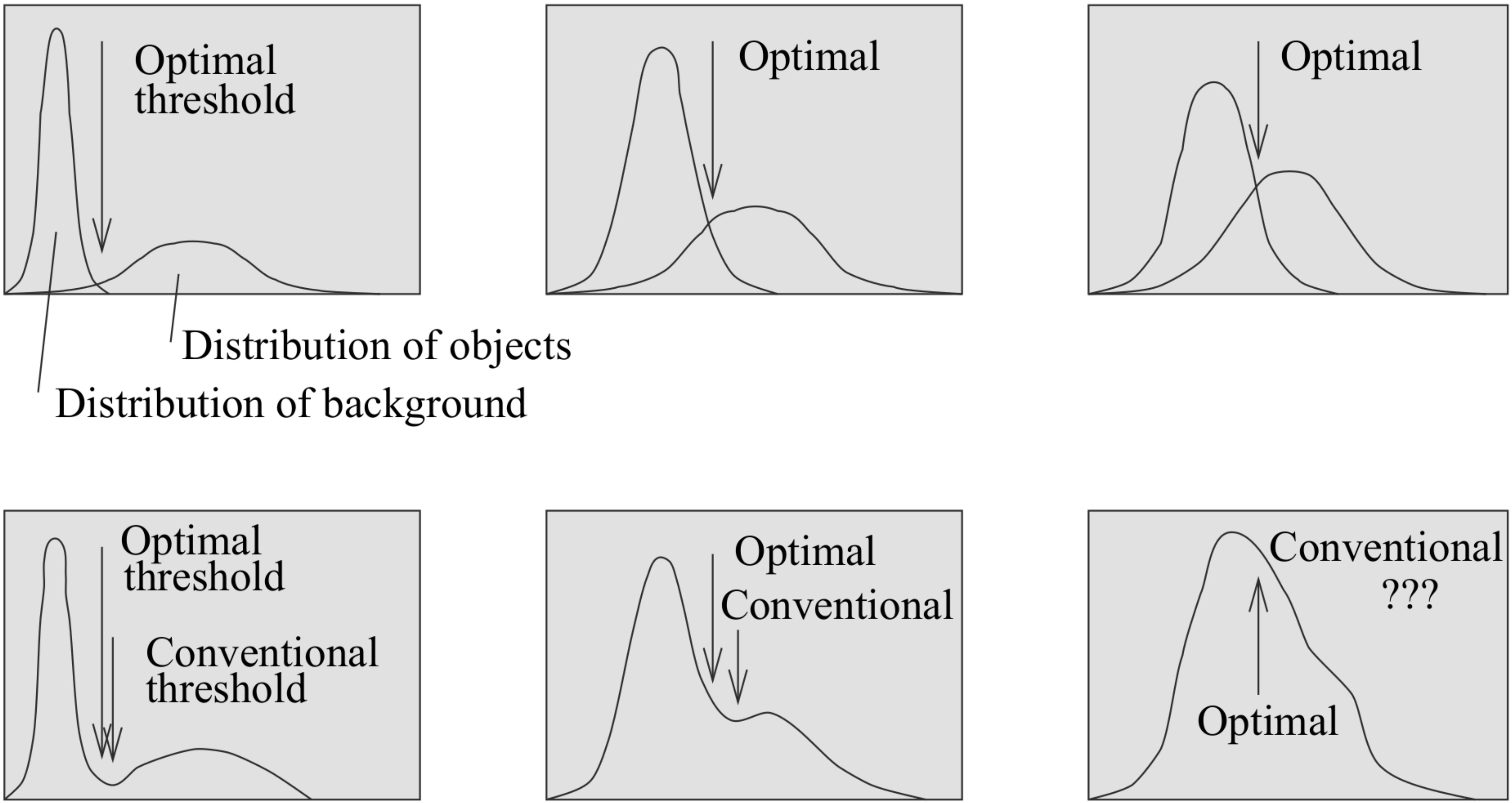
$$\theta(f,t) = \begin{cases} 1 & \text{if } f \geq t, \\ 0 & \text{else,} \end{cases}$$



Prahovanie

Prahovanie podľa úrovne jasu




Optimal
threshold
Optimal
Optimal
Distribution of objects
Distribution of background
Optimal
threshold
Conventional
threshold
Optimal
Conventional
Conventional
???
Optimal

Algorithm 6.2: Otsu's threshold detection

1. For an image I on G gray levels, compute the gray-level histogram $H(0), H(1), \ldots, H(G-1)$. Normalize the histogram by dividing through by the number of pixels in I—the histogram now represents the probability of each gray-level.

2. For each possible threshold $t = 0, \ldots, G-2$ partition the histogram into background B (gray-levels less than or equal to t), and foreground F (gray-levels more than t).

3. Compute $\sigma_B(t), \sigma_F(t)$, the variance of the background and foreground gray-levels. Compute the probability of a pixel being background

$$\omega_B(t) = \sum_{j=0}^{t} H(j)$$

and $\omega_F(t)$ similarly.

Set

$$\sigma(t) = \omega_B(t)\sigma_B(t) + \omega_F(t)\sigma_F(t)$$

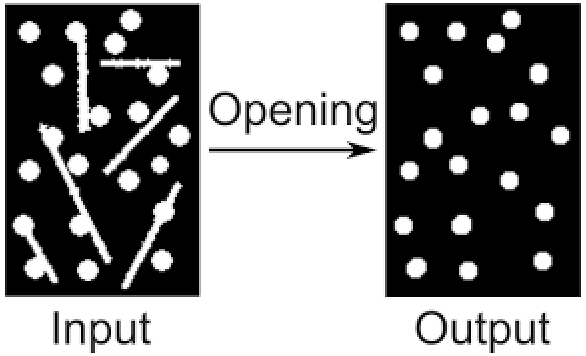
and select as threshold $\hat{t} = \min_t(\sigma(t))$.

Metrika, vzdialenosť, susedstvo

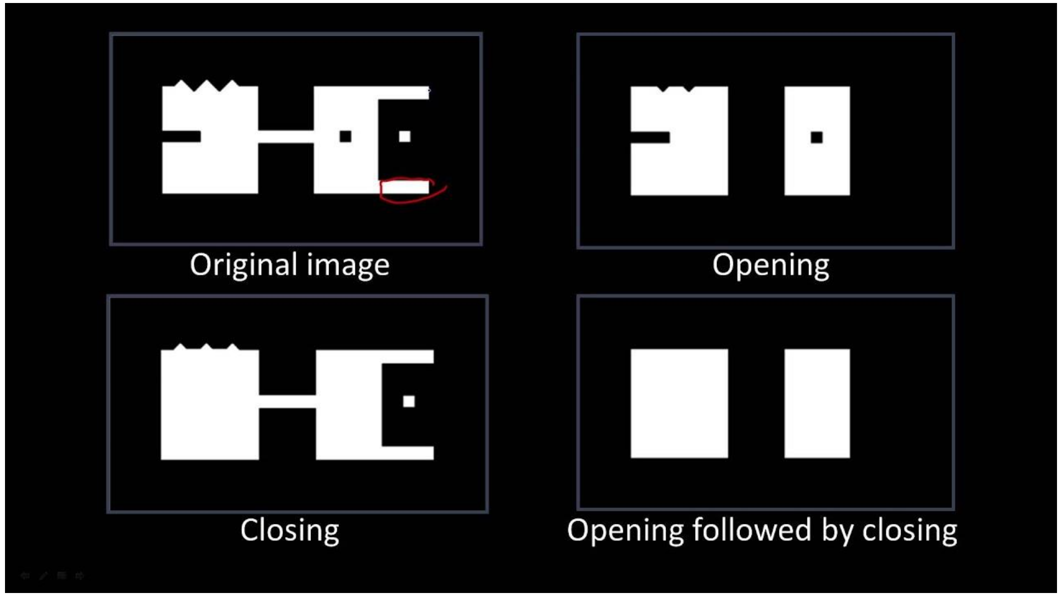
Matematická morfológia

Dilatácia a Erózia

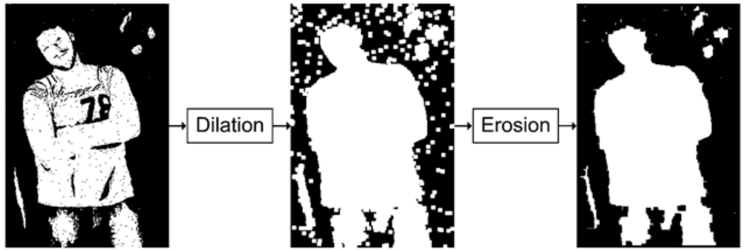
Otvorenie a uzavretie

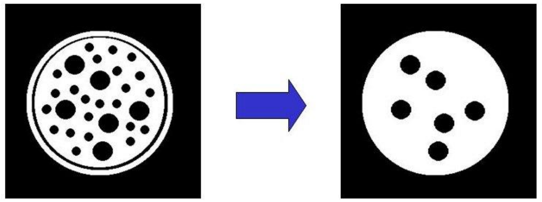


- Opening = erózia + dilatácia
  - Zväčší diery
  - Odstráni malé objekty
  - Oddelí objekty



- Closing = dilatácia + erózia
  - Zachová malé objekty
  - Odstráni diery
  - Spojí objekty





Morfologické operácie

- Počet jednotiek

dilation: $\text{dilate}(f, s) = \theta(c, 1)$;

erosion: $\text{erode}(f, s) = \theta(c, S)$;

majority: $\text{maj}(f, s) = \theta(c, S/2)$;

opening: $\text{open}(f, s) = \text{dilate}(\text{erode}(f, s), s)$;

closing: $\text{close}(f, s) = \text{erode}(\text{dilate}(f, s), s)$.

(a) (b) (c) (d) (e) (f)

Distance transform

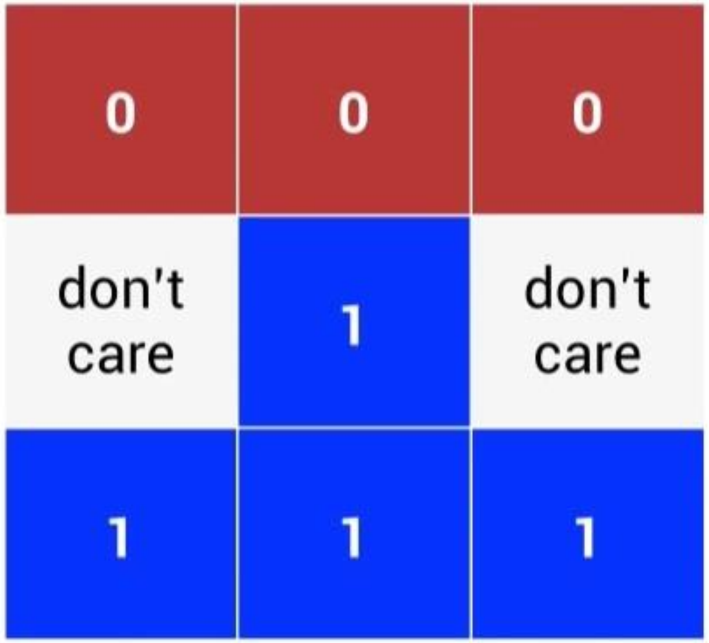
0	0	0	0	1	0	0
0	0	1	1	1	0	0
0	1	1	1	1	1	0
0	1	1	1	1	1	0
0	1	1	1	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0

0	0	0	0	1	0	0
0	0	1	1	2	0	0
0	1	2	2	3	1	0
0	1	2	3			

0	0	0	0	1	0	0
0	0	1	1	2	0	0
0	1	2	2	3	1	0
0	1	2	2	1	1	0
0	1	2	1	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0

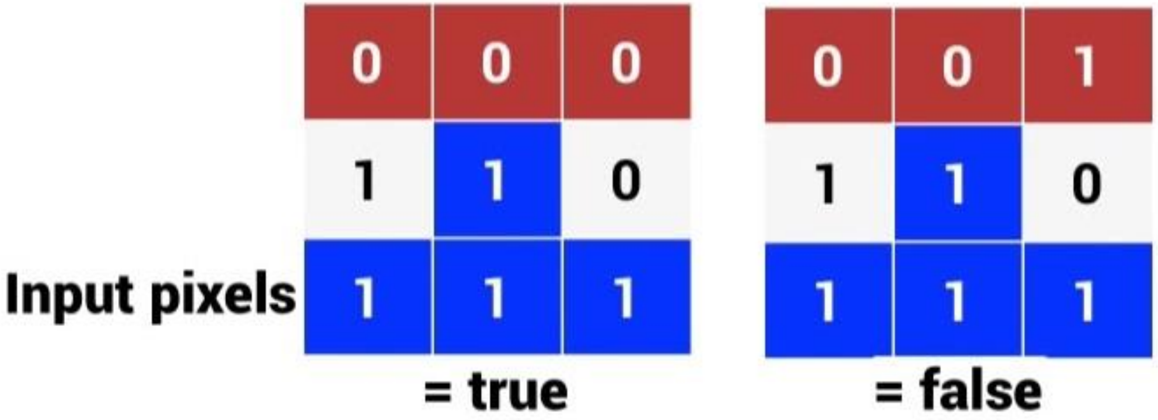
0	0	0	0	1	0	0
0	0	1	1	1	0	0
0	1	2	2	2	1	0
0	1	2	2	1	1	0
0	1	2	1	0	0	0
0	0	1	0	0	0	0
0	0	0	0	0	0	0

Hit or miss

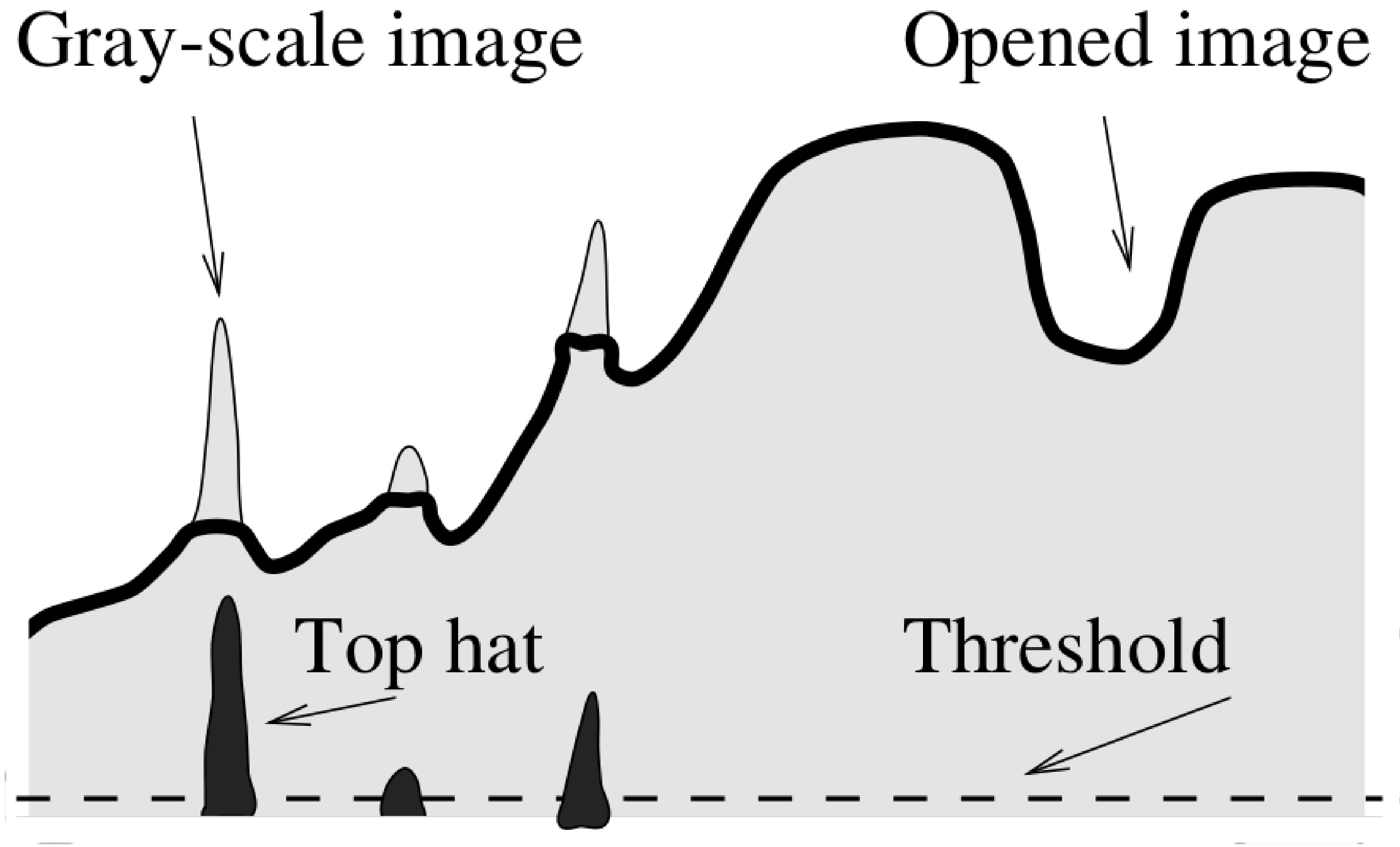


Structuring element

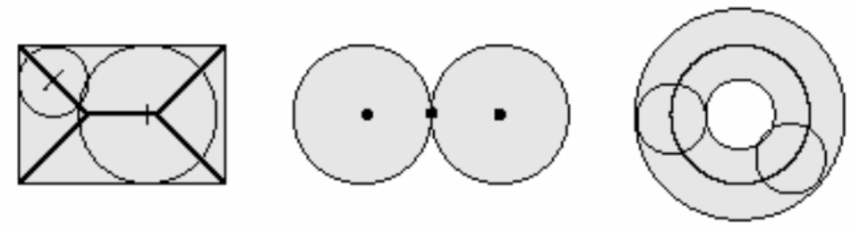
- The structuring element has pixels with 3 values
  - 0: corresponding pixel must be 0
  - 1: corresponding pixel must be 1
  - don't care

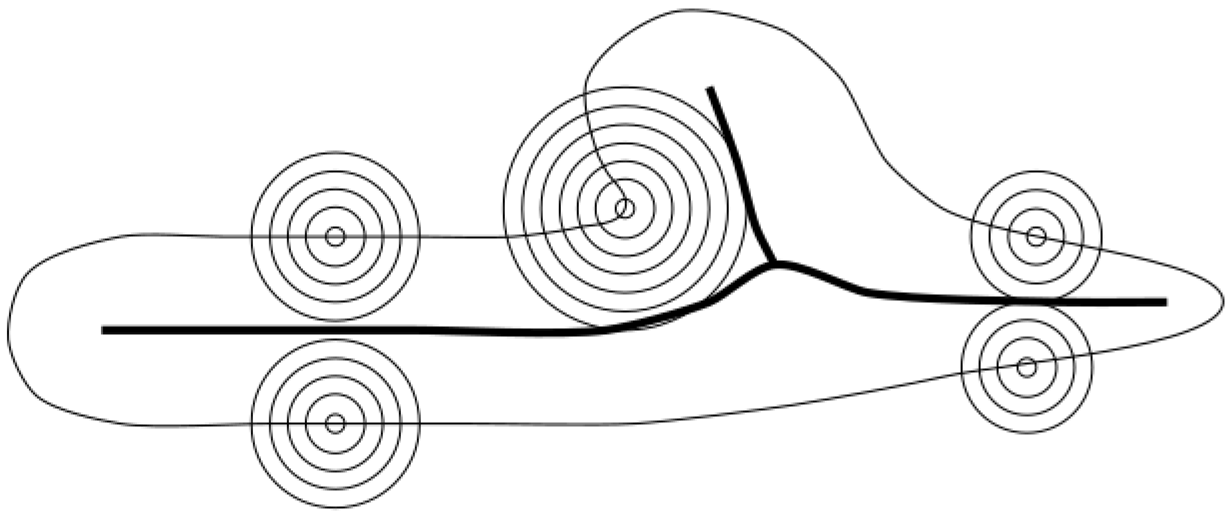


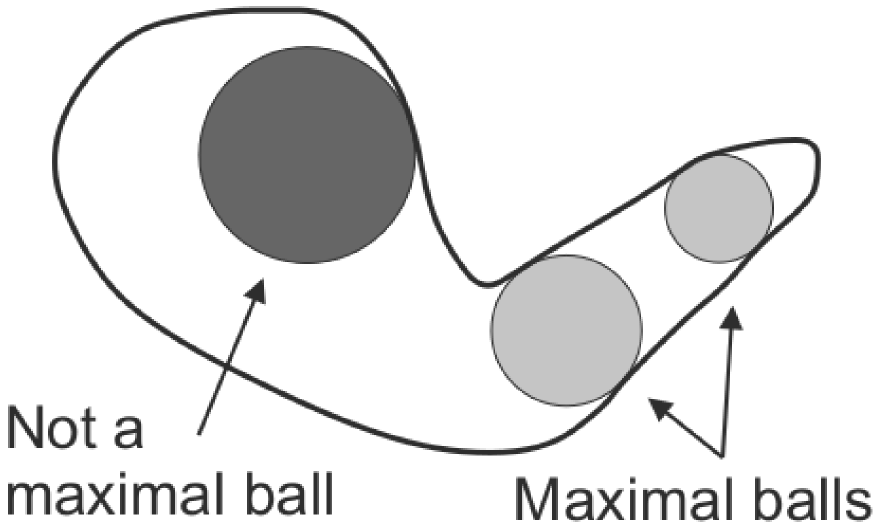
Top hat



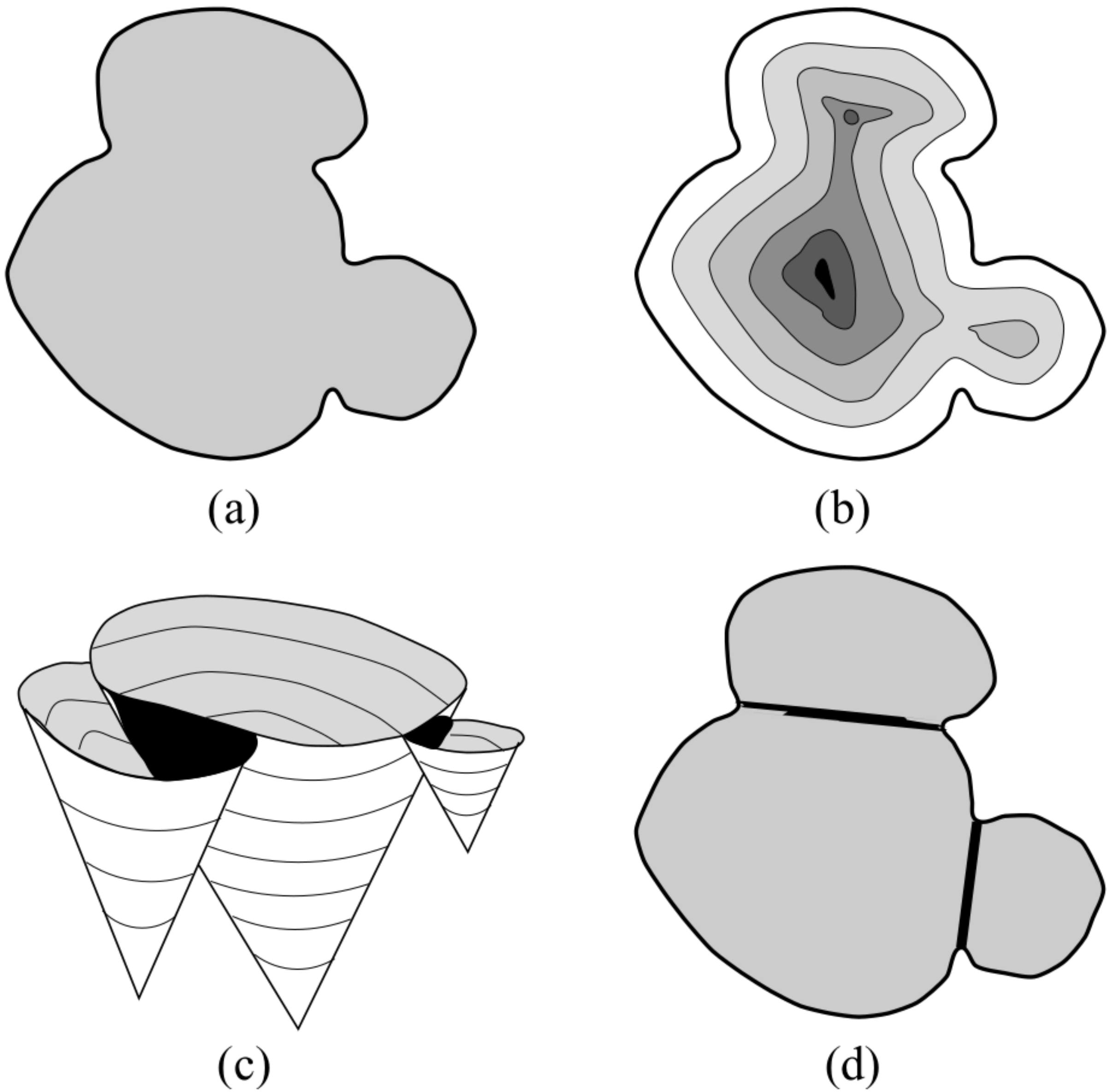
Skeleton







Watershed



Granulometry