EE 604
Digital Image Processing

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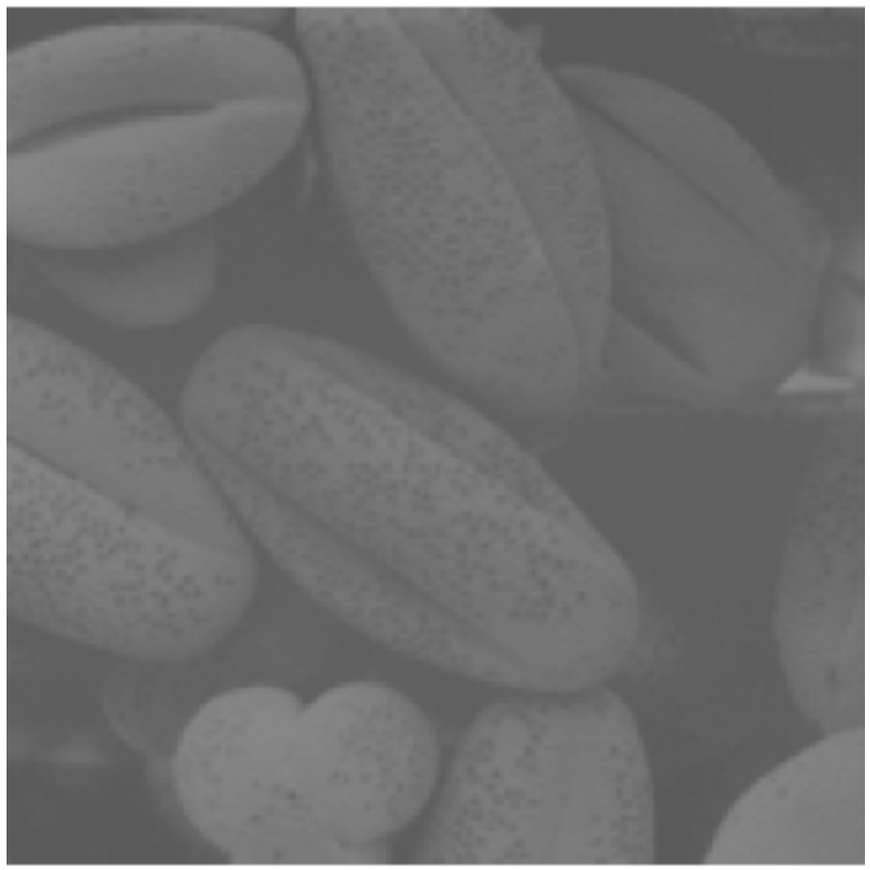
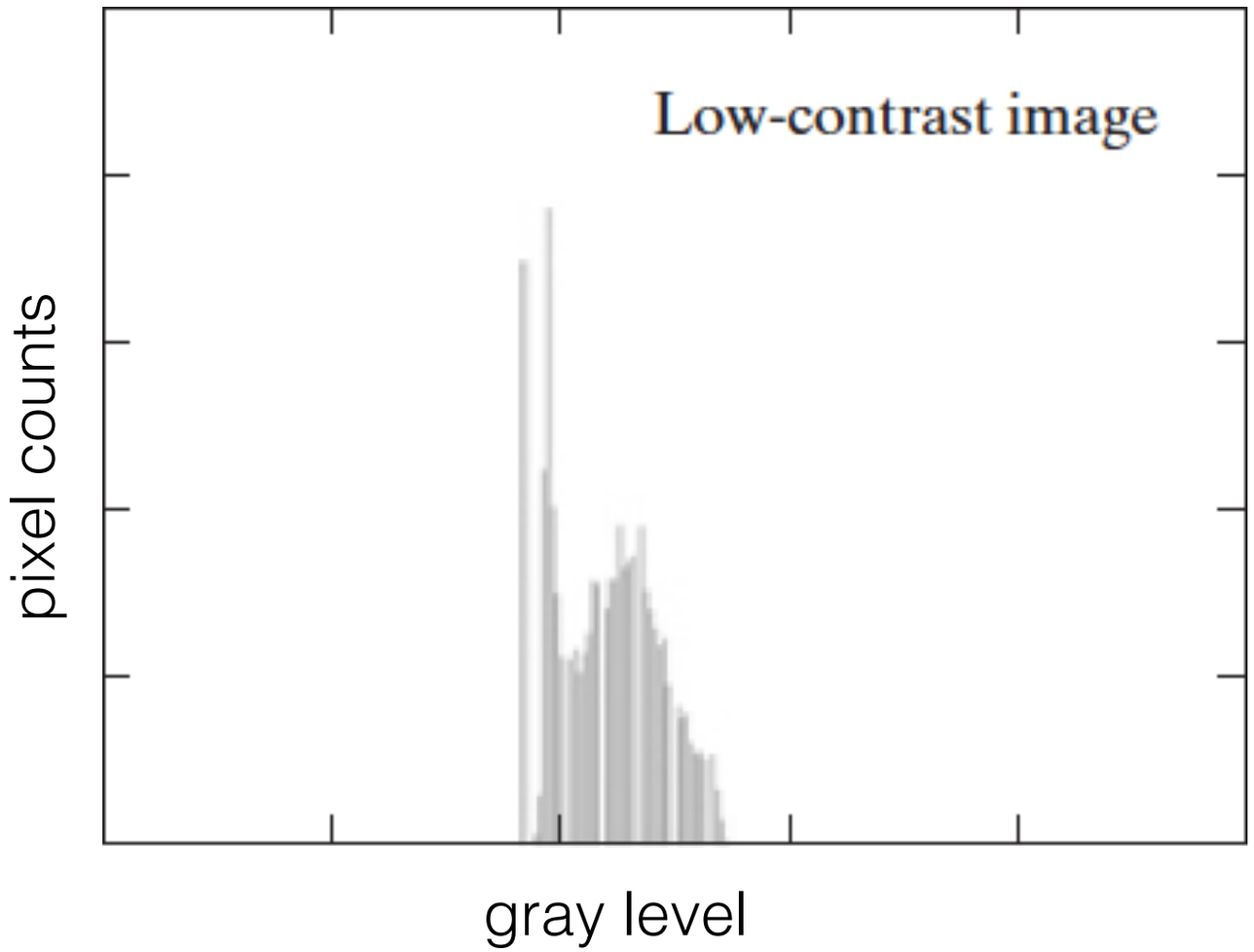
Lecture outline

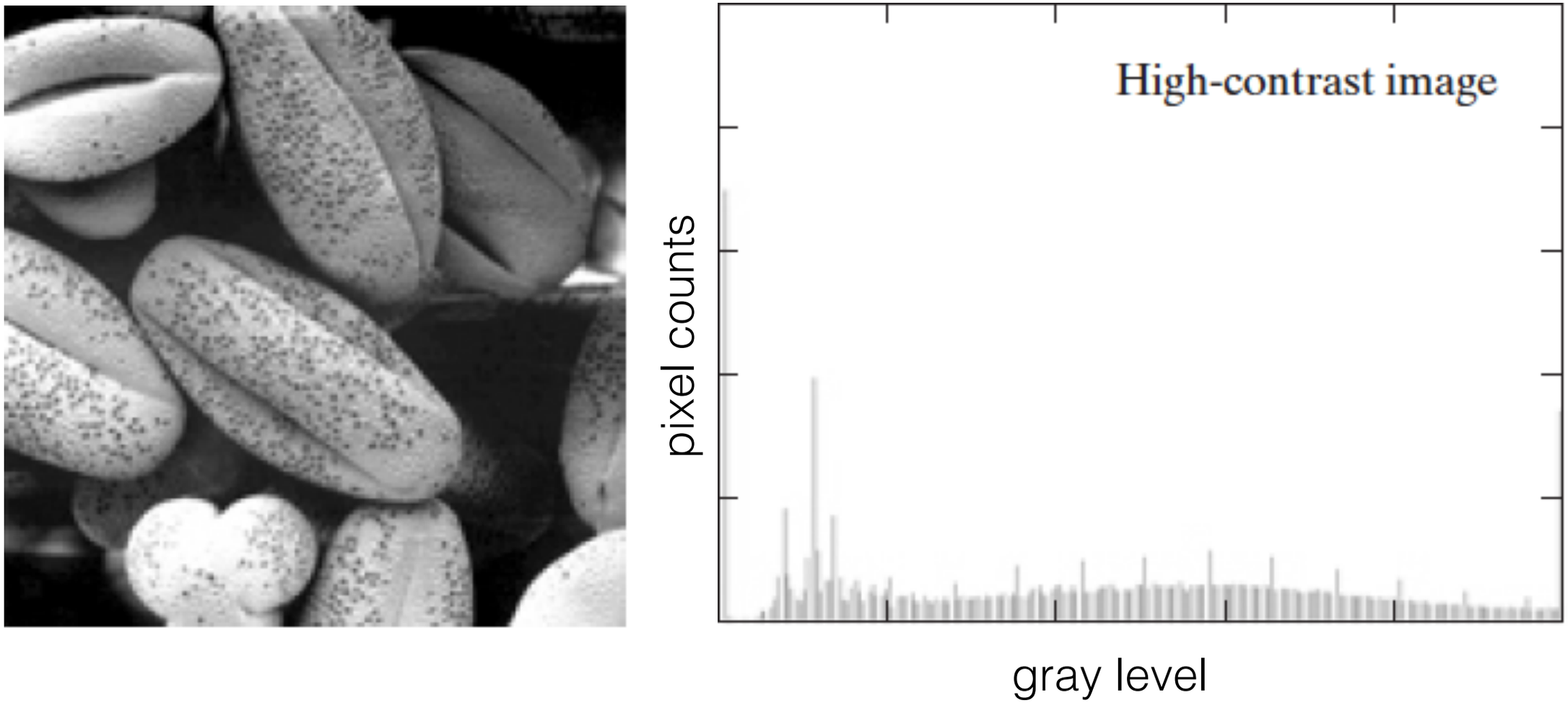
- **Histogram processing (contd.)**
- **Image subtraction and averaging**
- **Spatial domain filtering**
    - **Smoothing**
    - **Sharpening**

Histogram processing

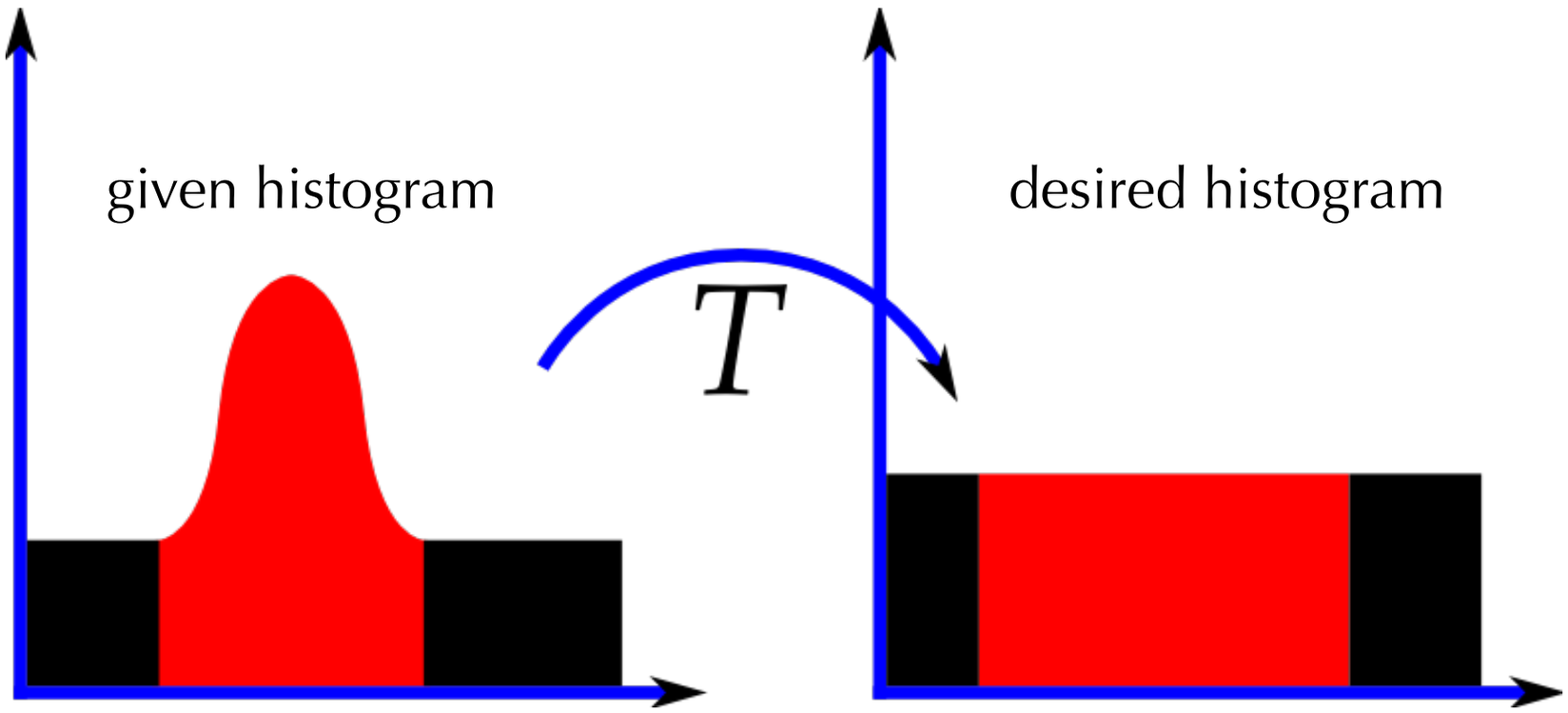




Histogram processing



Histogram equalization

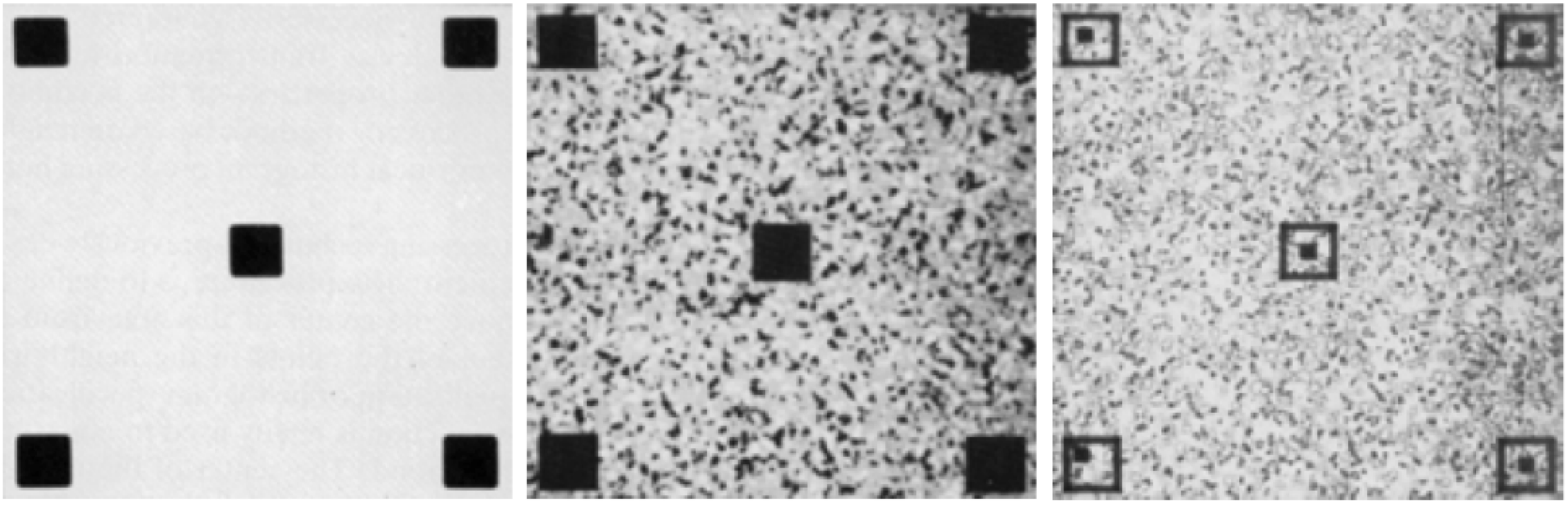


The main idea

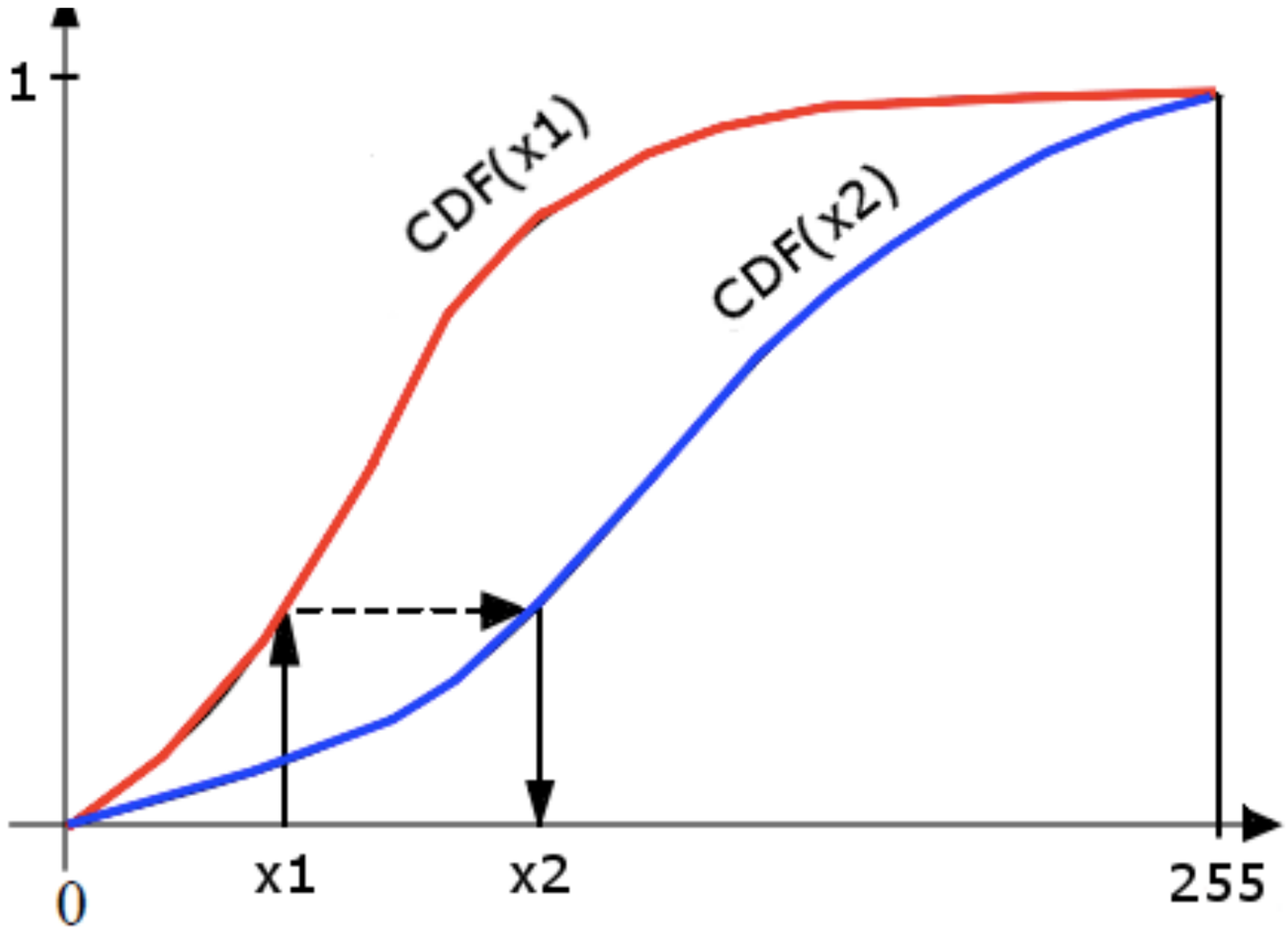
image source: wikipedia

Histogram equalization

Local histogram equalization



Histogram matching



source: wikipedia

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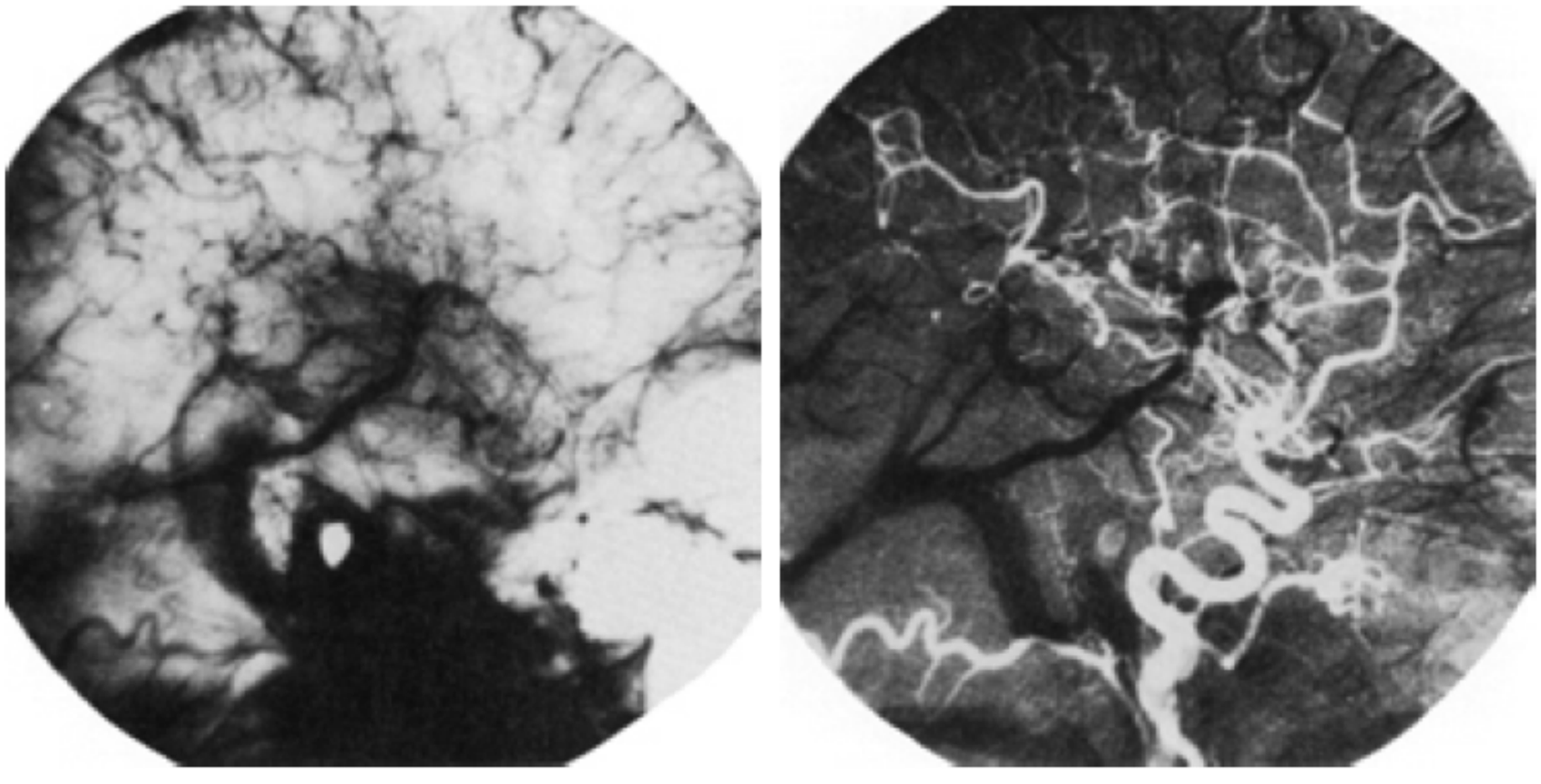
Image subtraction

$$g(x,y) = f(x,y) - \underbrace{m(x,y)}_{\text{mask}}$$

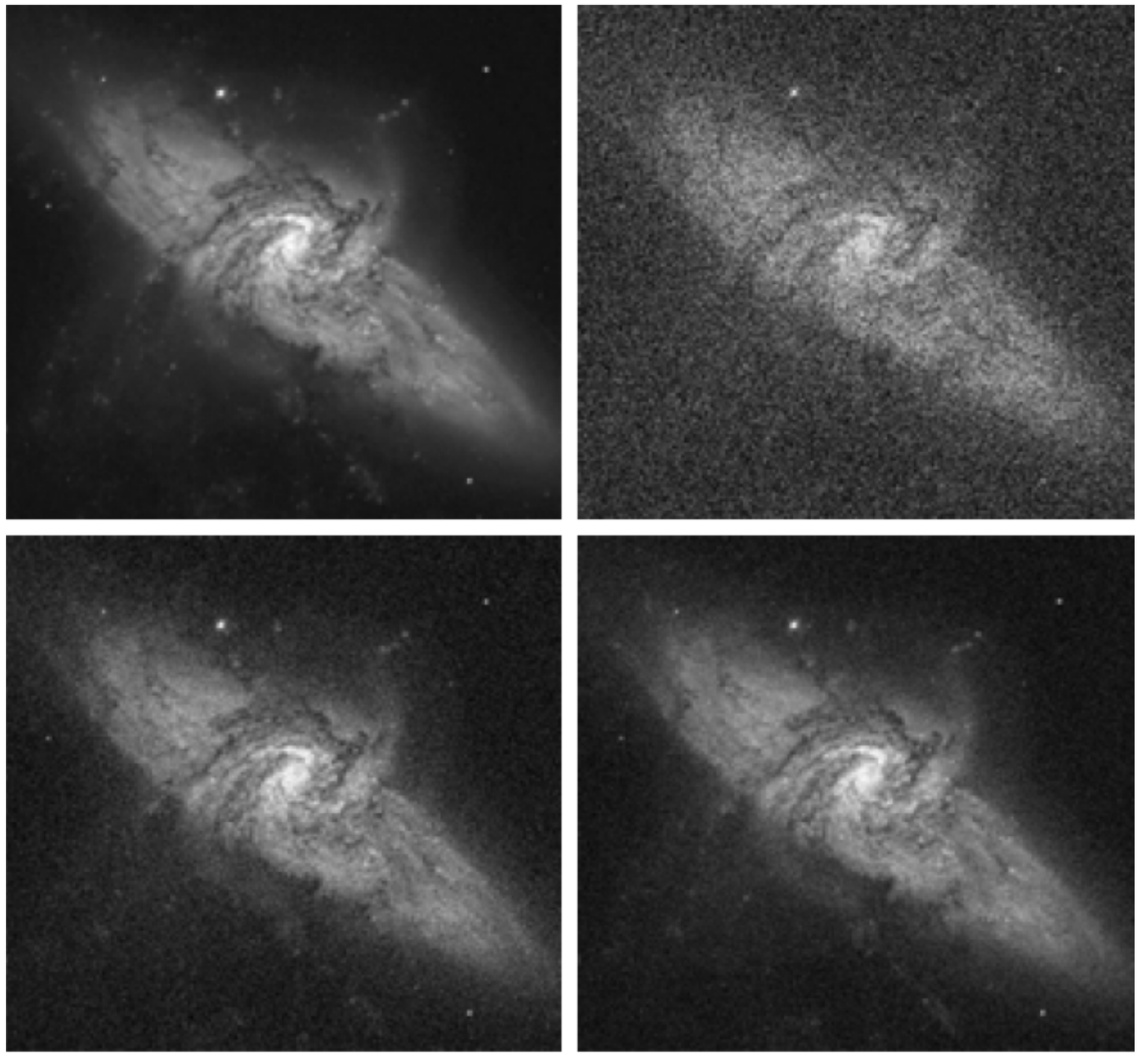


Mask mode radiography

Image averaging

$$g(x,y) = f(x,y) + \eta(x,y)$$

$$\hat{g}(x,y) = \frac{1}{K}\sum_{j=1}^{K} g_j(x,y)$$



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- Histogram processing (contd.)
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- **Spatial domain filtering**
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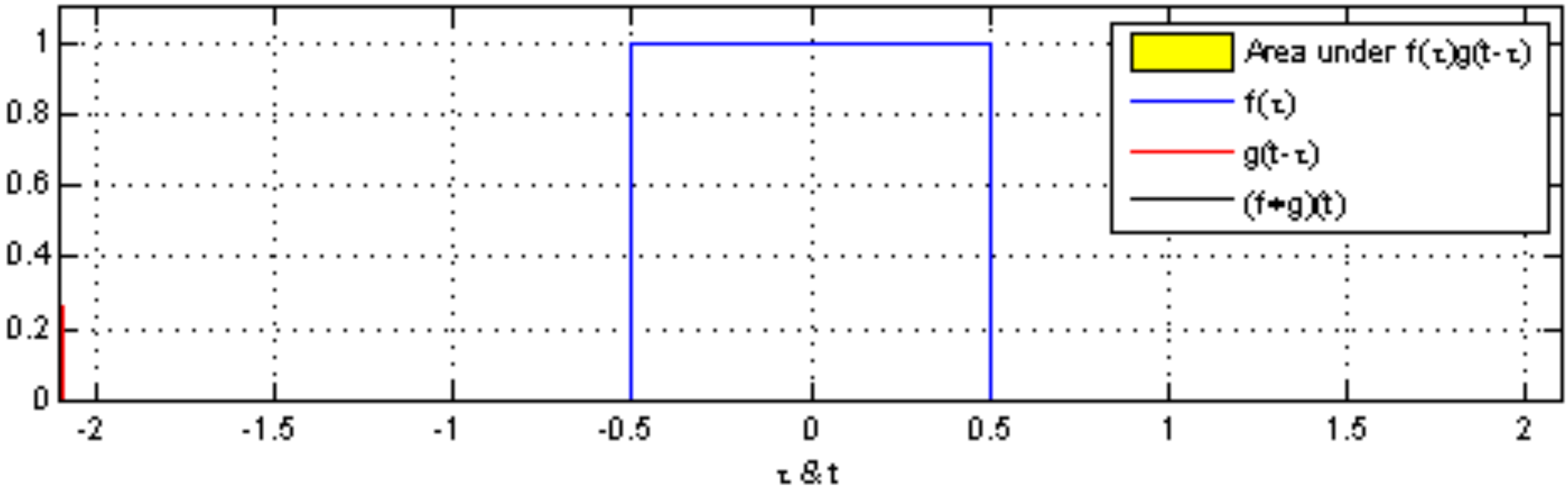
Spatial filtering

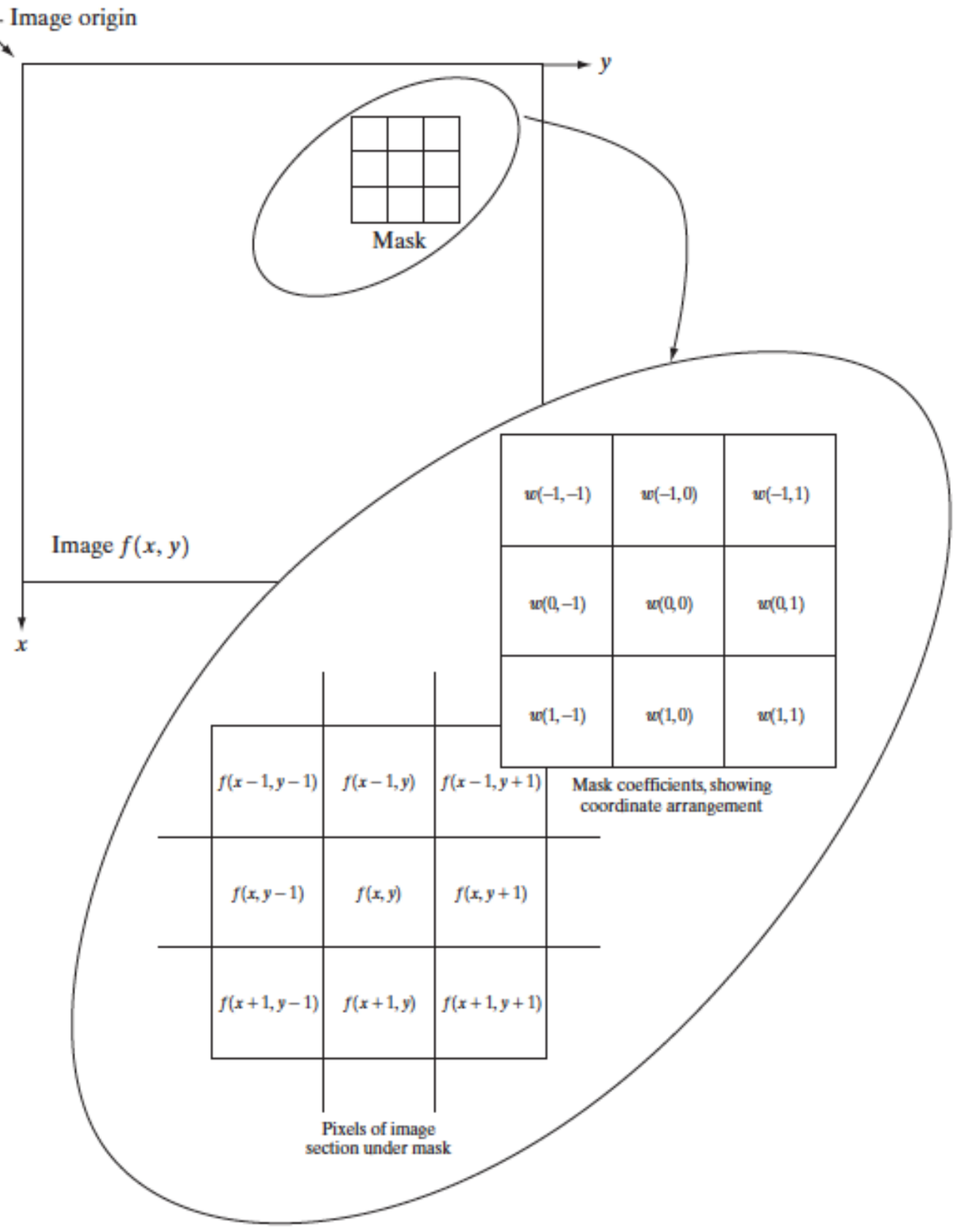
- Spatial filtering : 2D convolution
- Task: Design masks to achieve desired effect
    - Smoothing
    - Sharpening

1D convolution



Source: wikipedia

2D convolution



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Smoothing filters

- Averaging filters
    - Mean, Weighted averaging
- Order-statistics filter
    - Median, Min, Max
- Effect of mask size?
- How to handle boundaries

Smoothing filters

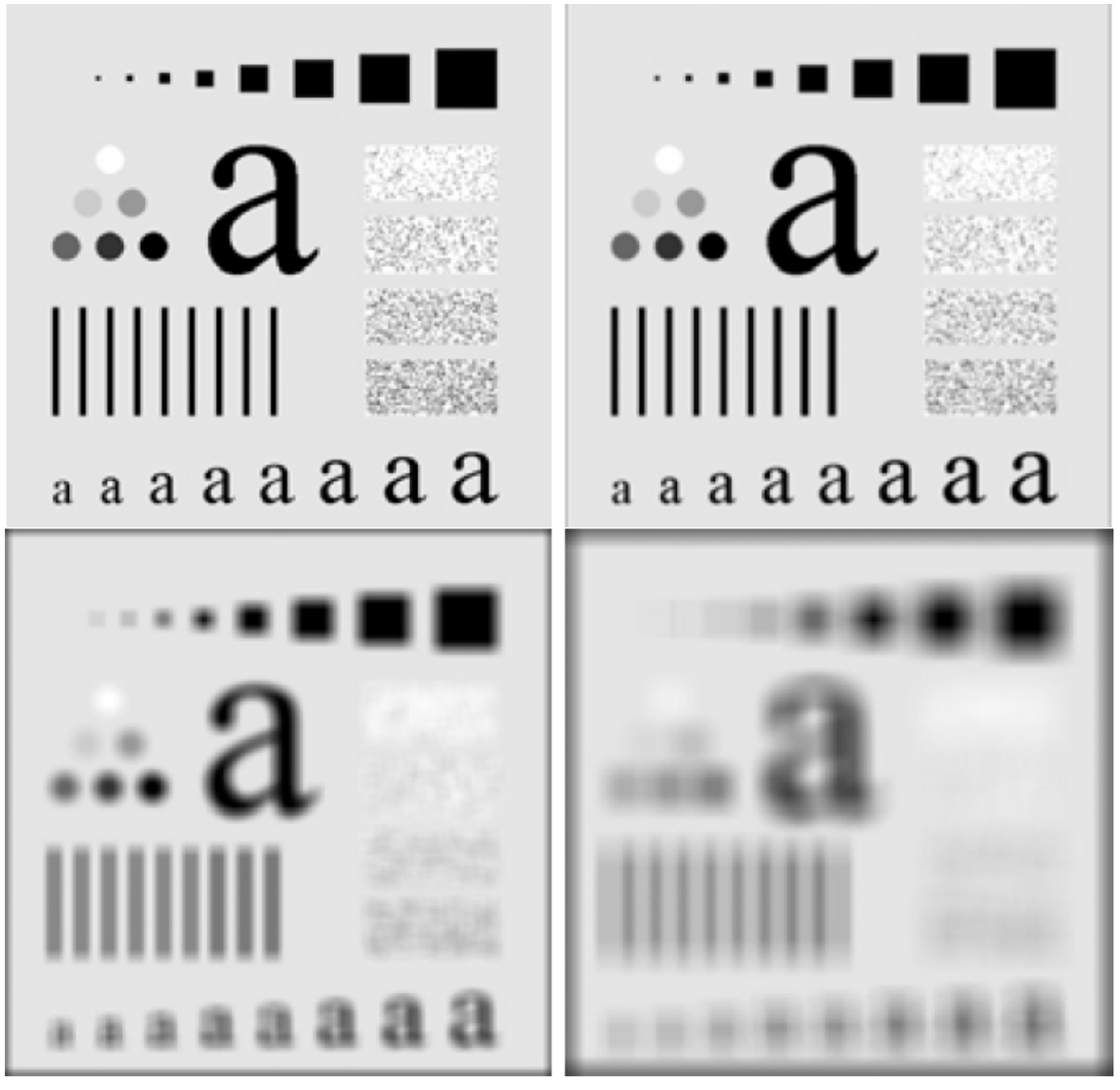
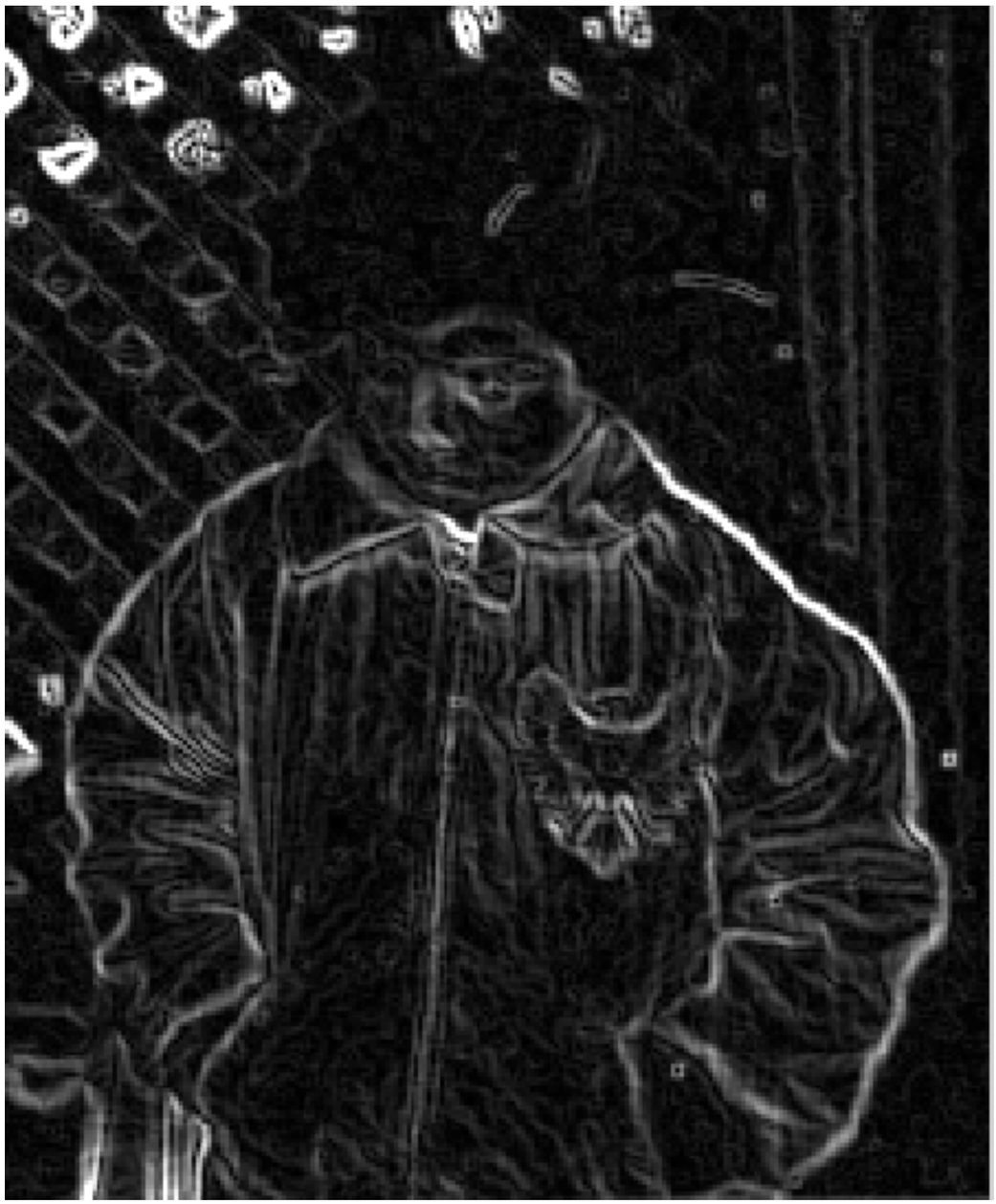


Image derivatives



Sharpening by Laplacian mask