GÖRÜNTÜ İŞLEME

HAFTA 4 DÖNÜŞÜMLER UZAYSAL FİLTRELEME

DERS İÇERİĞİ

- Histogram İşleme
- Filtreleme Temelleri

HİSTOGRAM

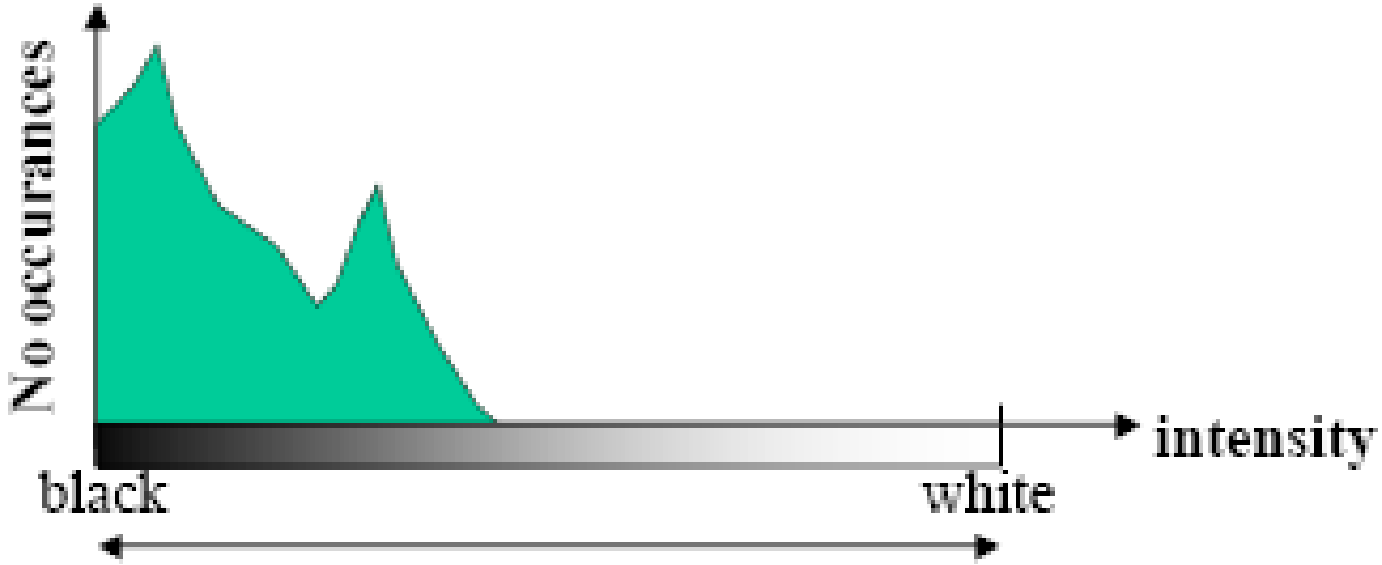
- Histogram bir resimdeki renk değerlerinin sayısını gösteren grafiktir.
- Histogram dengeleme veya eşitleme de bir resimdeki renk değerlerinin belli bir yerde kümelenmiş olmasından kaynaklanan, renk dağılımı bozukluğunu gidermek için kullanılan bir yöntemdir

HİSTOGRAM

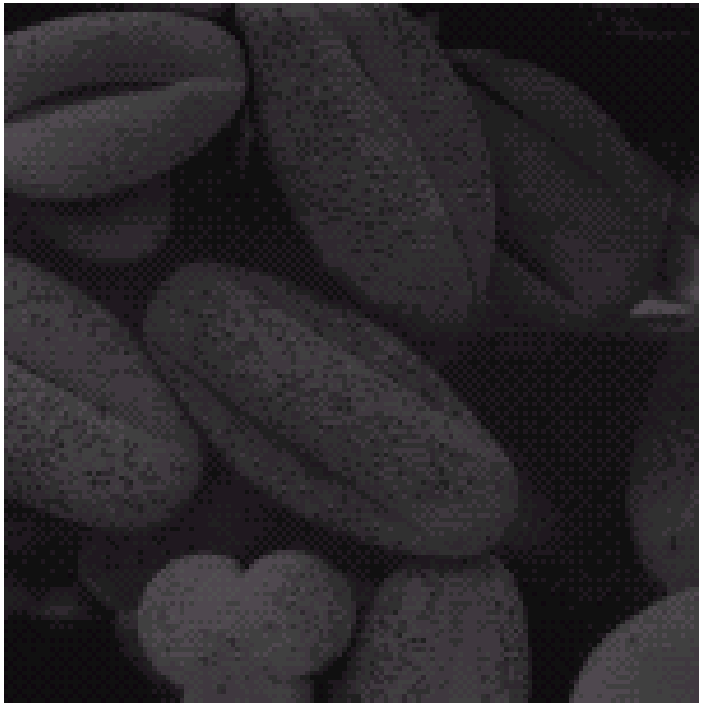
- Histogram matematiksel olarak aşağıdaki şekilde gösterilebilir.
- $h(r_k)=n_k$

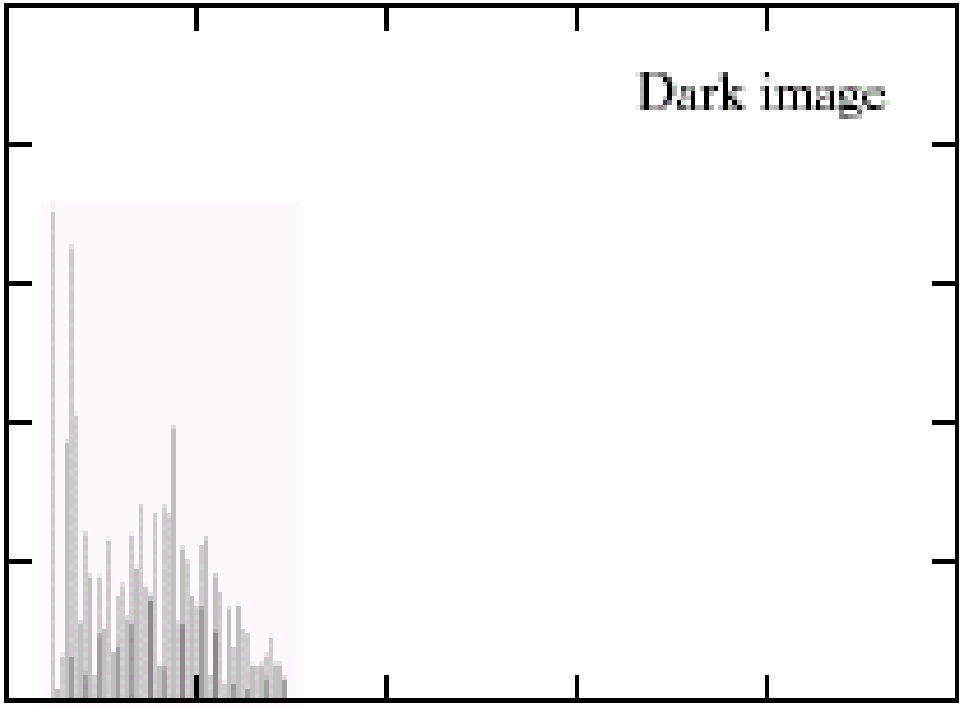
r_k: k'nıncı parlaklık değeri
n_k: k nıncı parlaklık değerinin görüntüdeki sayısı

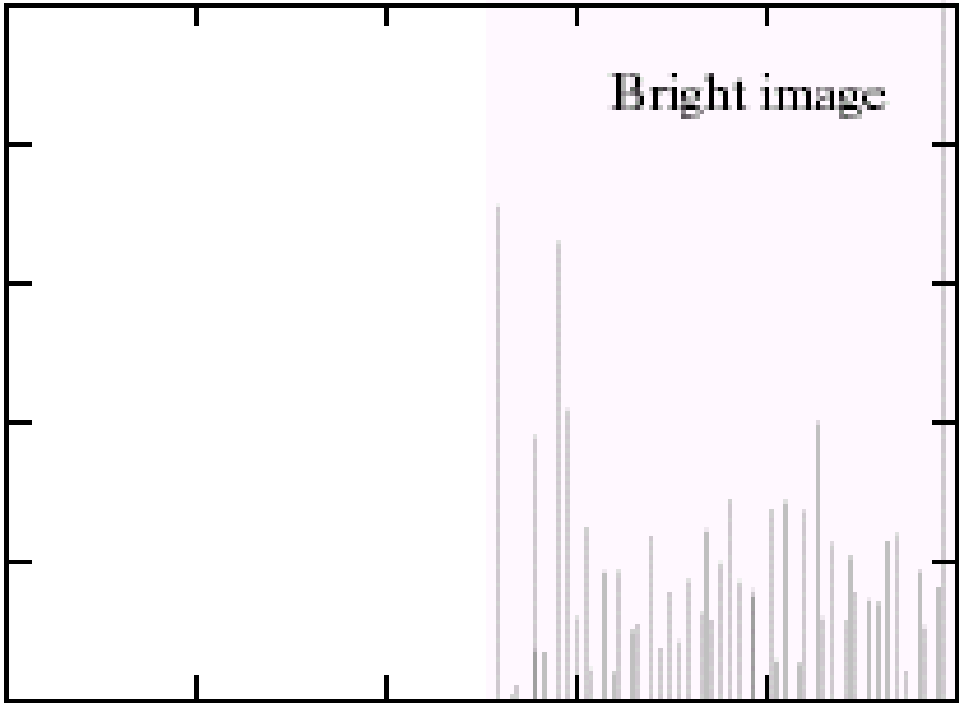
HİSTOGRAM

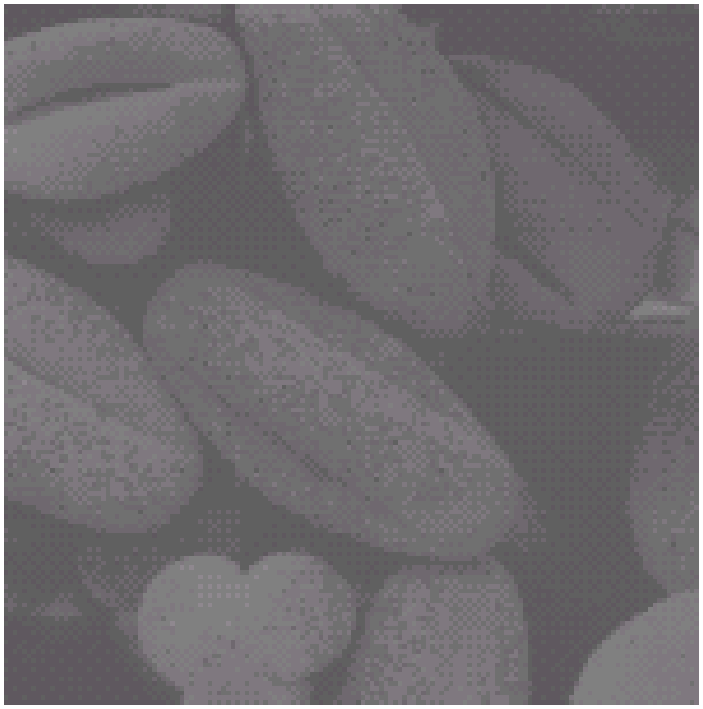


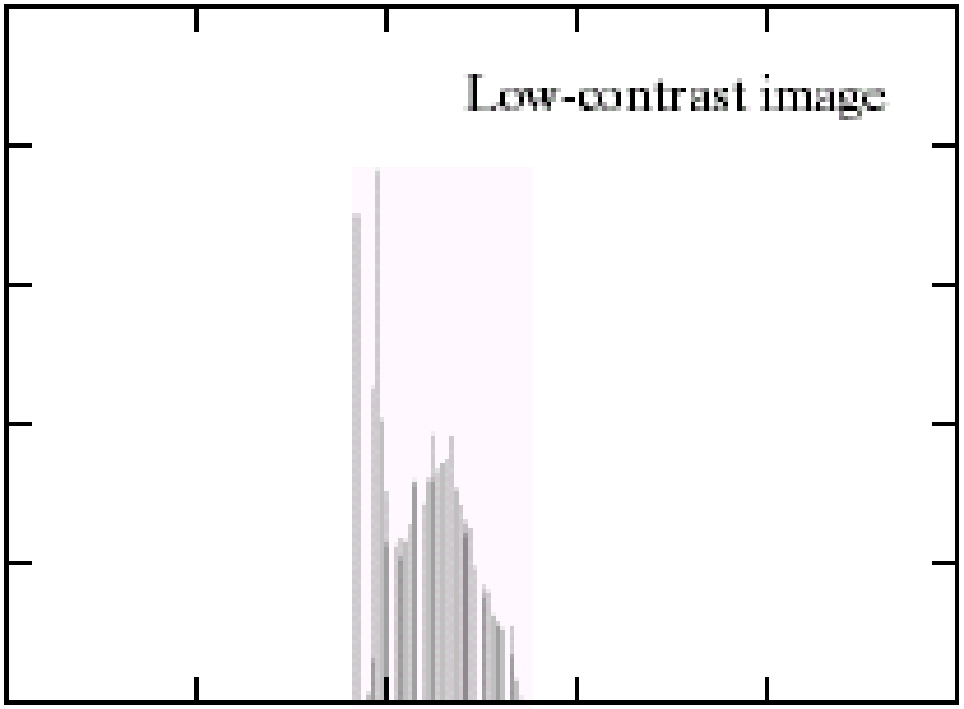
8-bit parlaklıklı görüntüde 256 gri seviye vardır. Tüm değerler ilk 100 değerde toplanırsa renkleri fark etmek zorlaşır.

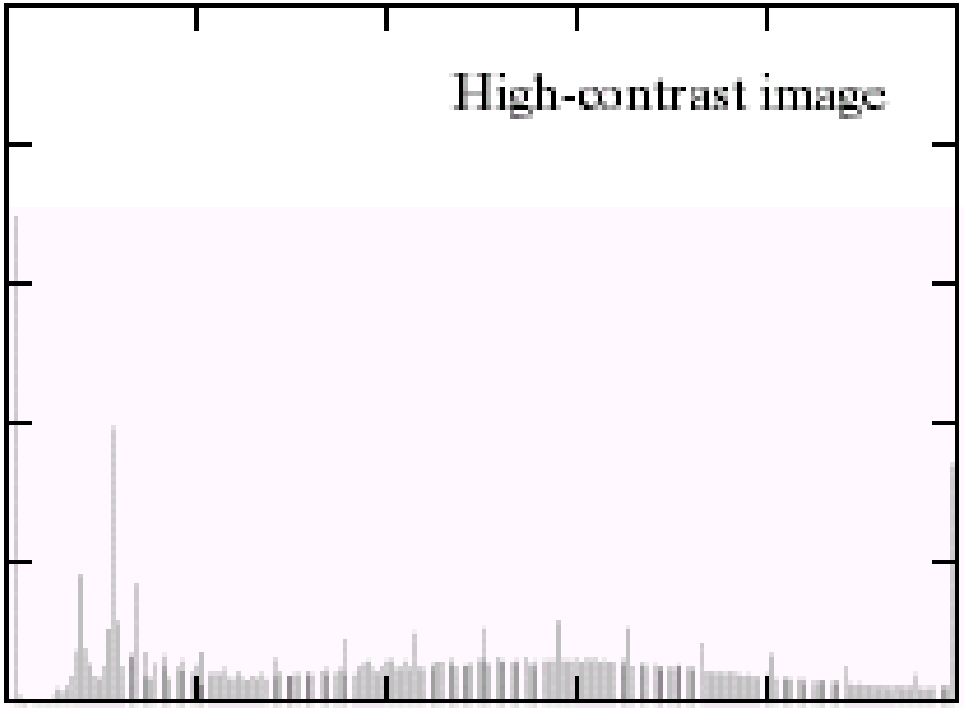



Dark image


Bright image

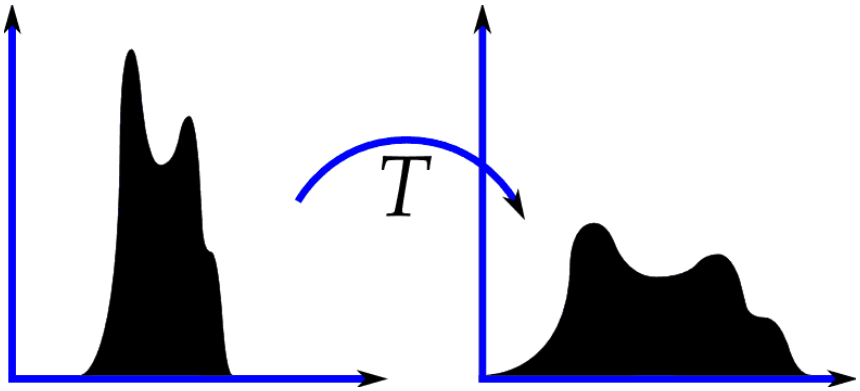



Low-contrast image


High-contrast image

HİSTOGRAM STRETCHING

- Dönüştürülen ve orijinal histogramlar olasılık yoğunluk fonksiyonları ile ifade edilebilirler.



$$p_x(i) = p(x = i) = \frac{n_i}{n}, \quad 0 \leq i < L$$

HİSTOGRAM EŞİTLEME

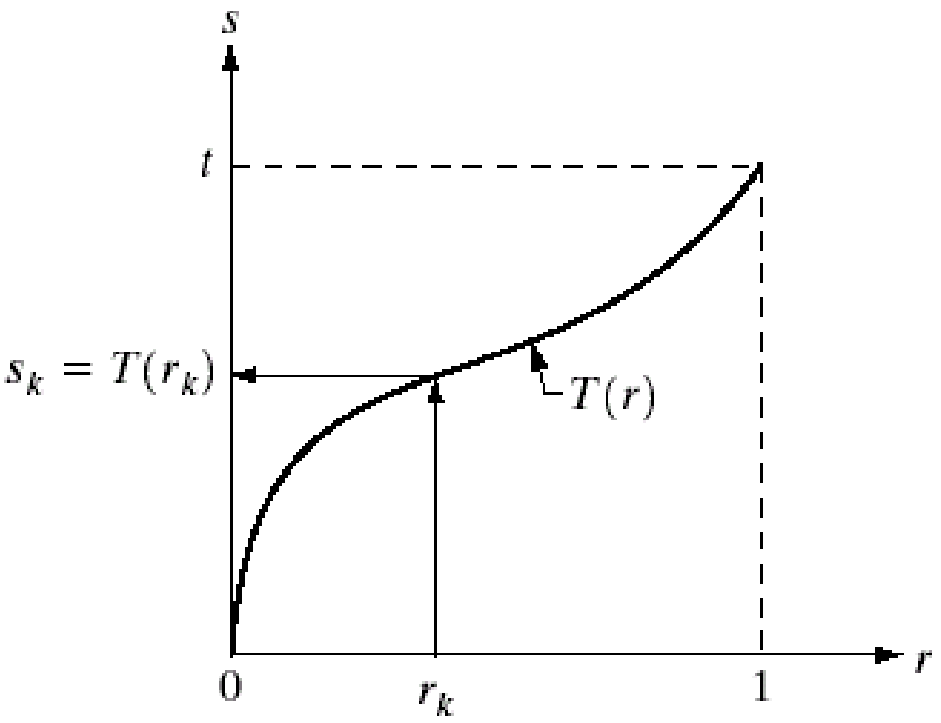


FIGURE 3.16 A gray-level transformation function that is both single valued and monotonically increasing.

HİSTOGRAM EŞİTLEME

$$T(r) = round\left(255 \frac{\text{Number of pixels with intensity } i \le r}{\text{Total number of pixels}} \right)$$

$$= round\left(255 \sum_{i=0}^{r} \frac{\text{Number of pixels with intensity } i}{\text{Total number of pixels}} \right)$$

$$= round\left(255 \sum_{i=0}^{r} p(i) \right) \qquad 0 \le r \le 255$$

HİSTOGRAM EŞİTLEME

- Histogram Eşitleme Örneği
- Parlaklık ve görüntüdeki sayıları
- 0 1 2 3 4 5 6 7
- 10 20 12 8 0 0 0 0

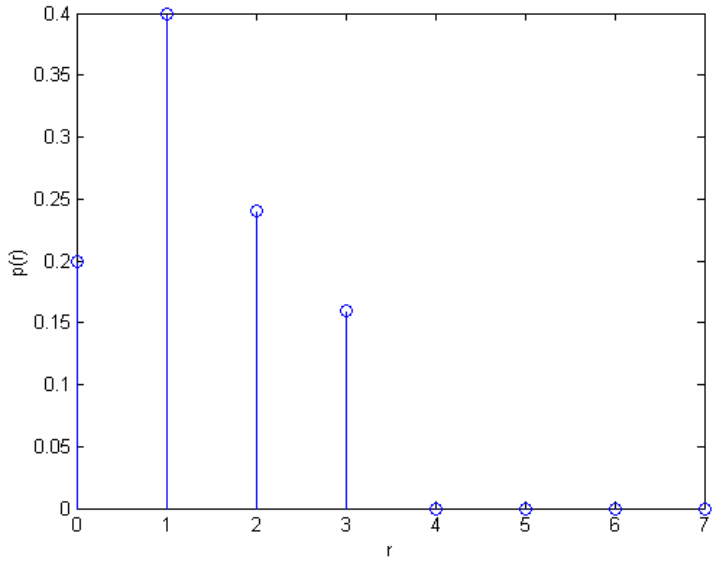
$$p(0) = 10/50 = 0.2$$

$$p(1) = 20/50 = 0.4$$

$$p(2) = 12/50 = 0.24$$

$$p(3) = 8/50 = 0.16$$

$$p(r) = 0/50 = 0, \quad r = 4,5,6,7$$



HİSTOGRAM EŞİTLEME

$$T(r) = round\left(7\sum_{i=0}^{r} p(i) \right)$$

$$T(0) = round\ \ 7*p(0)\ \ = round\ \ 7*0.2\ \ = 1$$

$$T(1) = round\ \ 7*\ \ p(0)+p(1)\ \ \ = round\ \ 7*0.6\ \ = 4$$

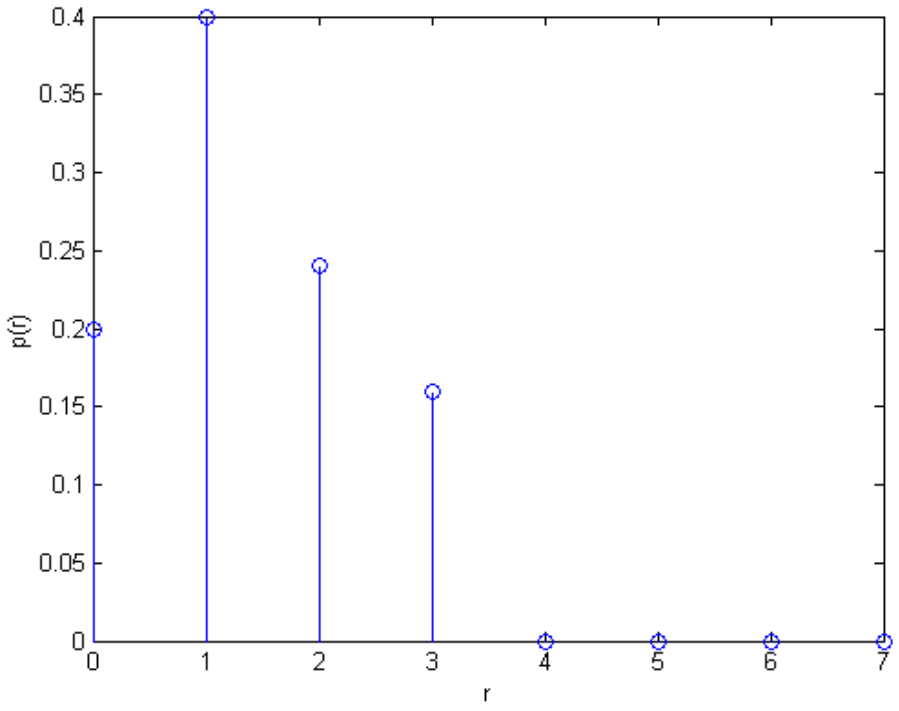
$$T(2) = round\ \ 7*\ \ p(0)+p(1)+p(2)\ \ \ = round\ \ 7*0.84\ \ = 6$$

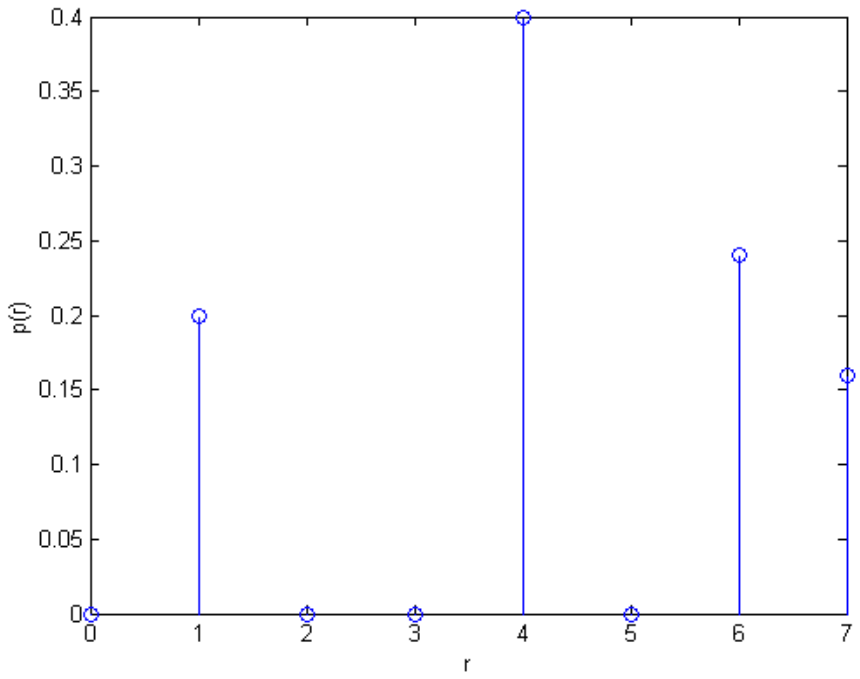
$$T(3) = round\ \ 7*\ \ p(0)+p(1)+p(2)+p(3)\ \ \ = 7$$

$$T(r) = 7, \quad r = 4,5,6,7$$

Intensity	0	1	2	3	4	5	6	7
Number of pixels	0	10	0	0	20	0	12	8

HİSTOGRAM EŞİTLEME



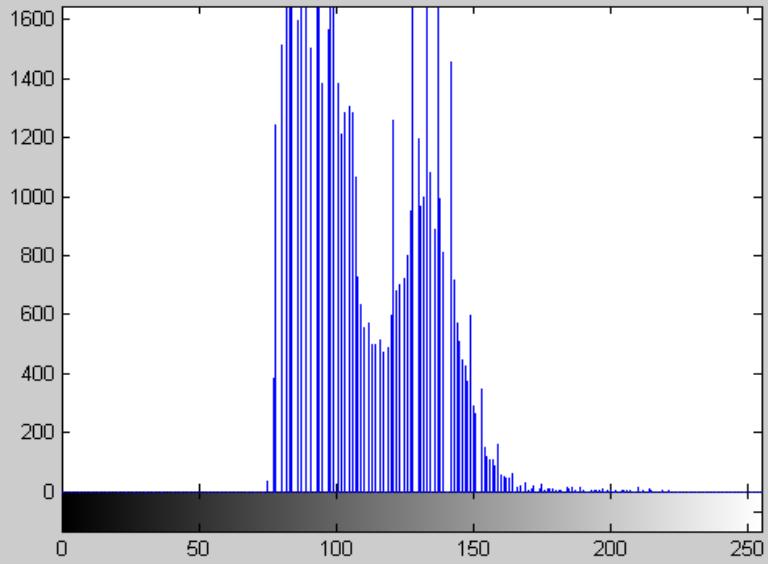


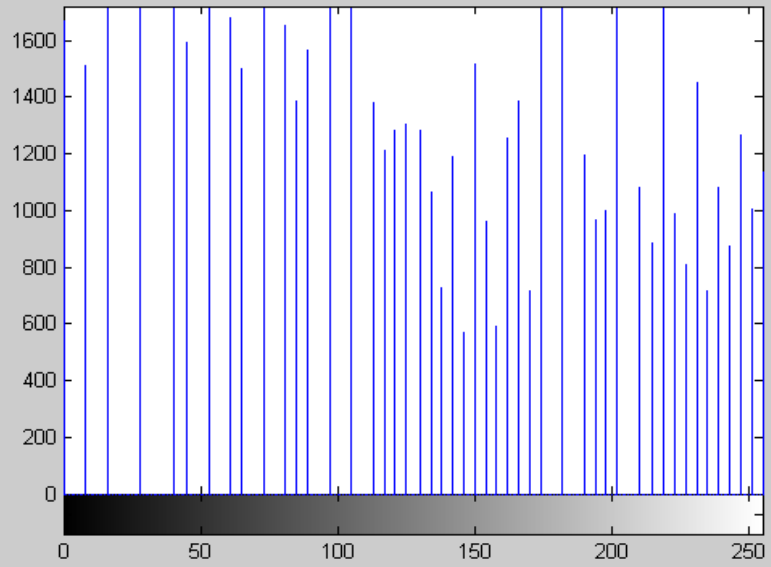
HİSTOGRAM EŞİTLEME

- Histogram Eşitleme Örneği
- Parlaklık ve görüntüdeki sayıları

0	1	2	3	4	5	6	7
790	1023	850	656	329	245	122	81

HİSTOGRAM EŞİTLEME





HİSTOGRAM EŞLEŞTİRME

- İşlenecek olan histogramın bazen başka bir görüntünün histogramına benzer olması gerekebilir.
- Bir histogramın başka bir histograma benzetilmesi işlemine histogram eşleştirme denir.

BÖLGESEL HİSTOGRAM İŞLEME

- İşlenilen histogram işleme algoritmaları tüm görüntüye uygulanıyor. Fakat bölgesel histogram eşitleme sadece bir bölgeye uygulanıyor.
- Global histogram işleme resmin tümünün iyileştirilmesi için,
- Local histogram işleme ise bölgesel olarak iyileştirmesi için
- kullanılır.

LİNEER FİLTRELEME TEMELLERİ

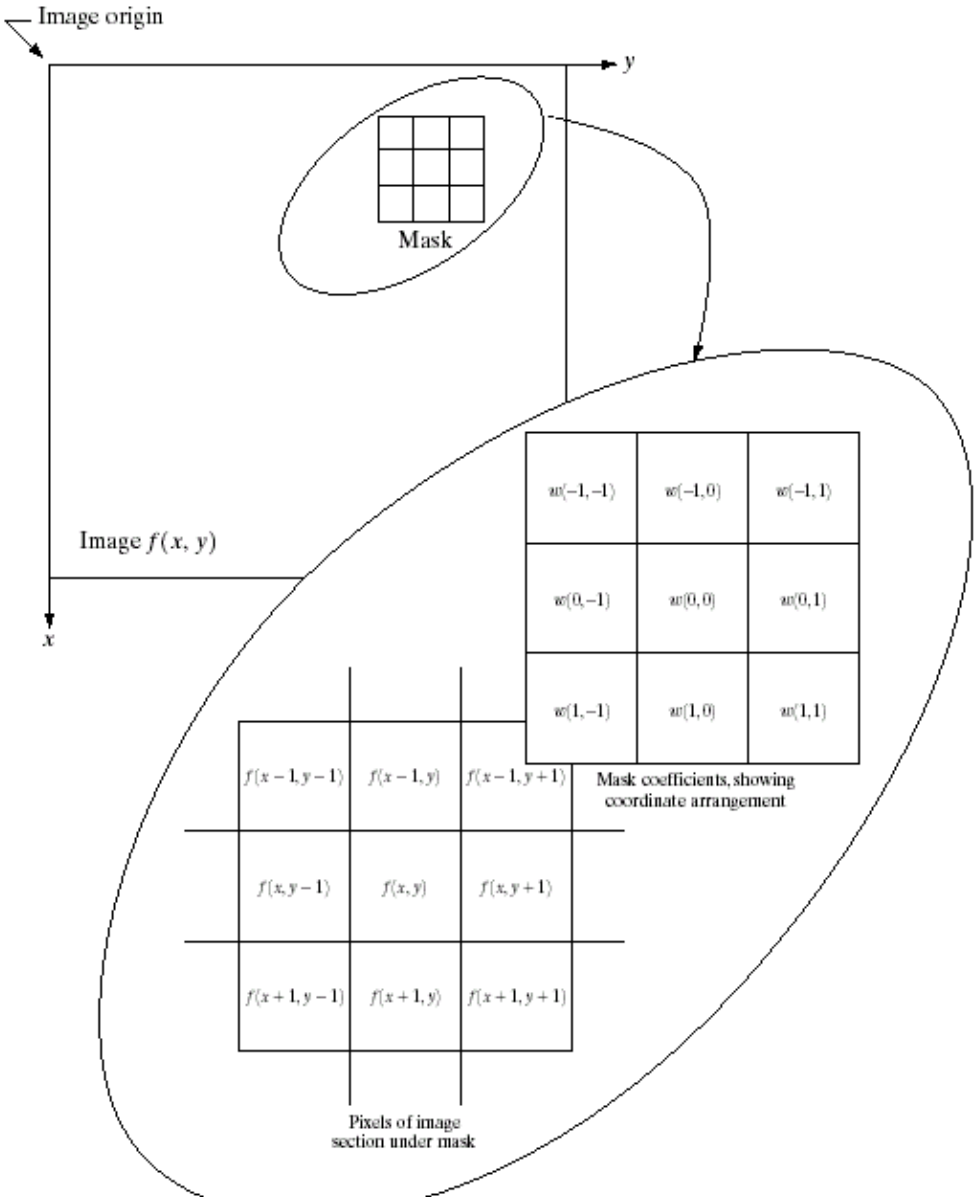
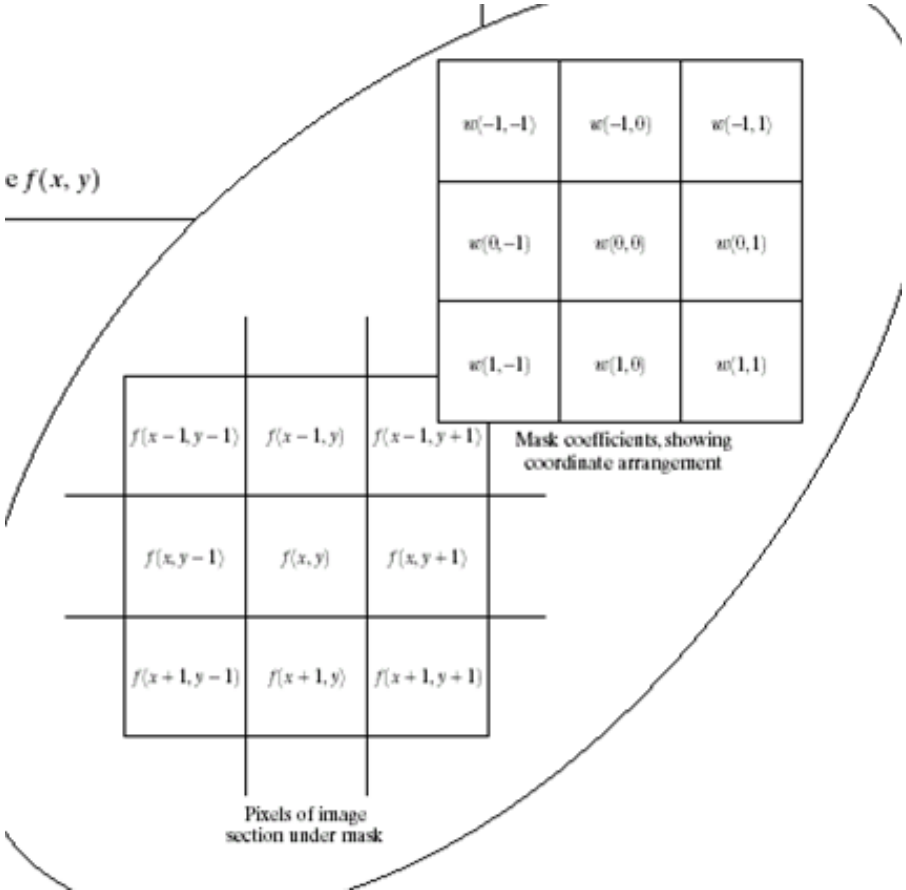


FIGURE 3.32 The mechanics of spatial filtering. The magnified drawing shows a 3×3 mask and the image section directly under it; the image section is shown displaced out from under the mask for ease of readability.

LİNEER FİLTRELEME TEMELLERİ

- Diyelim ki MxN boyutundaki bir görüntü mxn boyutundaki bir filtre ile lineer filtreleme işlemine tabii tutuluyor.



LİNEER FİLTRELEME TEMELLERİ

Bu durumda sonuç aşağıdaki gibi hesaplanır.

$$g(x,y) = \sum_{s=-a}^{a}\sum_{t=-b}^{b} w(s,t) f(x+s, y+t)$$

$$a = (m-1)/2$$

$$b = (n-1)/2$$

$$x = 0,1,2,\ldots,M-1$$

$$y = 0,1,2,\ldots,N-1$$

Lineer filtreleme işlemi convolution işlemi diye adlandırılır.

LİNEER FİLTRELEME TEMELLERİ

FIGURE 3.33
Another representation of a general 3 × 3 spatial filter mask.

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

$$R = w_1 z_1 + w_2 z_2 + \ldots + w_{mn} z_{mn} = \sum_{i=1}^{mn} w_i z_i$$

For the 3 x 3 general mask the response at any point (x,y) in the image is given by

$$R = w_1 z_1 + w_2 z_2 + \ldots + w_9 z_9 = \sum_{i=1}^{9} w_i z_i$$

SMOOTHING FILTERS

- Smoothing filtreler blurlaştırma ve gürültü azaltmak için kullanılırlar.
- Blurlama görüntüden küçük bir kısmı çıkarmadan önce yapılan bir uygulamadır.

SMOOTHING FILTERS

$\frac{1}{9} \times$

1	1	1
1	1	1
1	1	1

Spatial averaging filter (or box filter)

$\frac{1}{16} \times$

1	2	1
2	4	2
1	2	1

Weighted averaging filter

a b

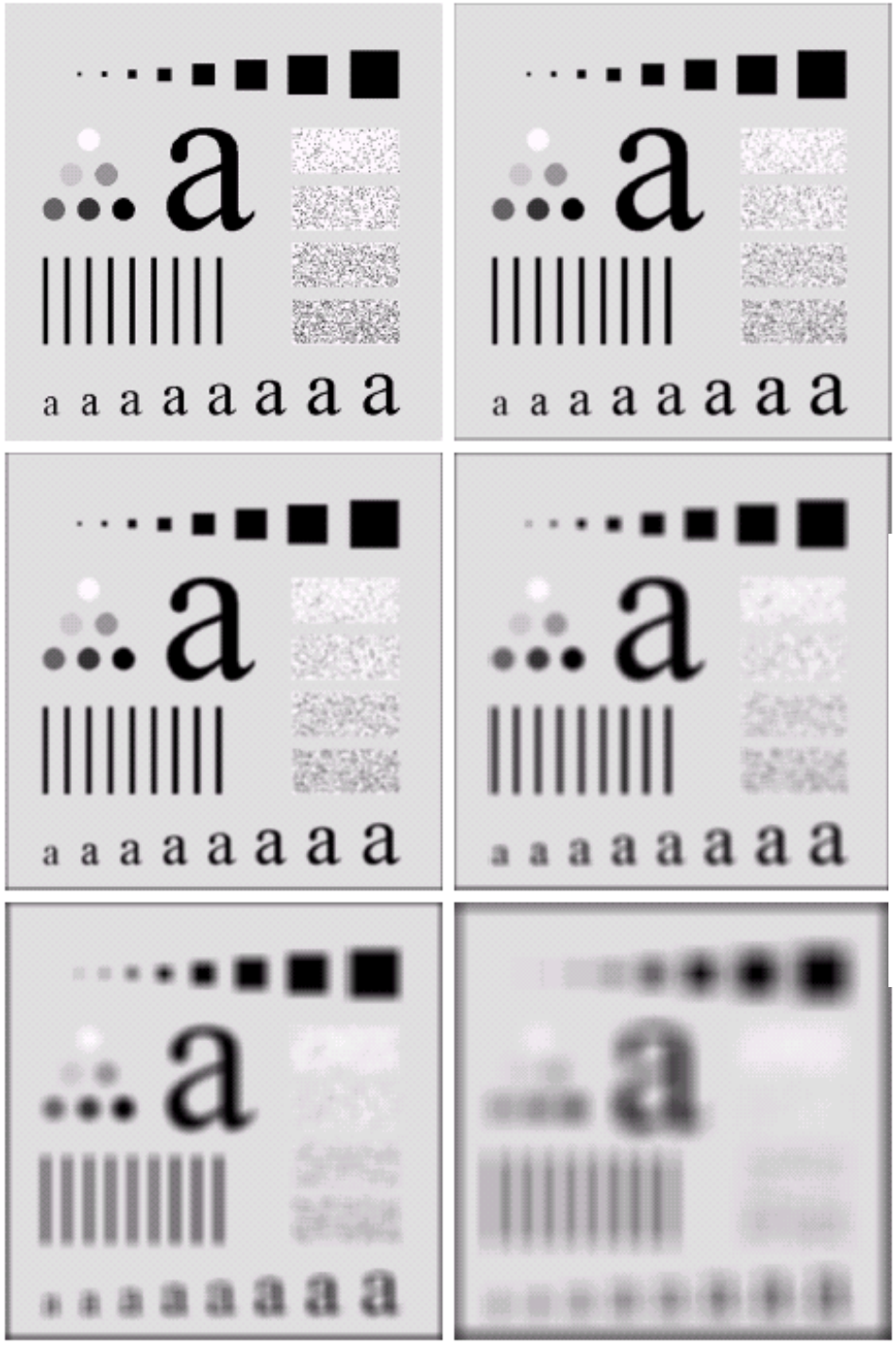
FIGURE 3.34 Two 3×3 smoothing (averaging) filter masks. The constant multiplier in front of each mask is equal to the sum of the values of its coefficients, as is required to compute an average.

$$R = \frac{1}{9} \sum_{i=1}^{9} z_i$$

SMOOTHING FILTERS

The general implementation for filtering an M x N image with a weighted averaging filter of size m x n (m and n odd) is given by the expression

$$g(x,y) = \frac{\sum_{s=-a}^{a}\sum_{t=-b}^{b} w(s,t) f(x+s, y+t)}{\sum_{s=-a}^{a}\sum_{t=-b}^{b} w(s,t)}$$

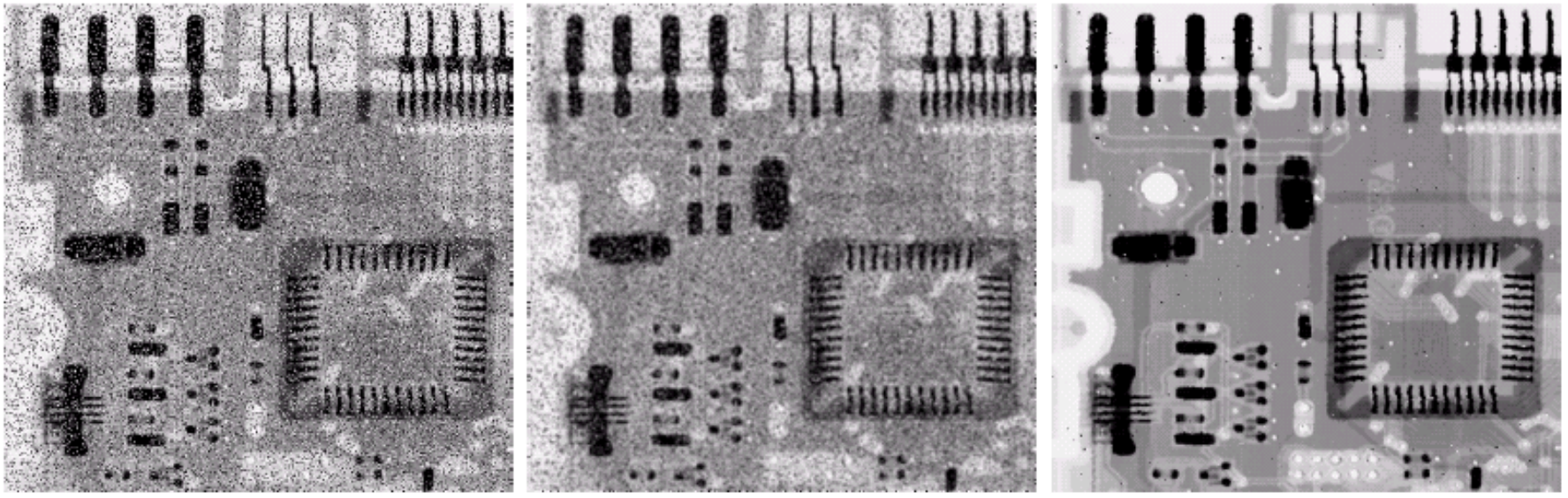


a b
c d
e f

FIGURE 3.35 (a) Original image, of size 500 × 500 pixels. (b)–(f) Results of smoothing with square averaging filter masks of sizes $n = 3, 5, 9, 15$, and 35, respectively. The black squares at the top are of sizes 3, 5, 9, 15, 25, 35, 45, and 55 pixels, respectively; their borders are 25 pixels apart. The letters at the bottom range in size from 10 to 24 points, in increments of 2 points; the large letter at the top is 60 points. The vertical bars are 5 pixels wide and 100 pixels high; their separation is 20 pixels. The diameter of the circles is 25 pixels, and their borders are 15 pixels apart; their gray levels range from 0% to 100% black in increments of 20%. The background of the image is 10% black. The noisy rectangles are of size 50 × 120 pixels.

NON LİNEER FILTERS

The best known example is the median filter. Median filters are particularly effective in the presence of impulse noise, also called salt-and-pepper noise because of its appearance as white and black dots superimposed on an image.



a b c

FIGURE 3.37 (a) X-ray image of circuit board corrupted by salt-and-pepper noise. (b) Noise reduction with a 3×3 averaging mask. (c) Noise reduction with a 3×3 median filter. (Original image courtesy of Mr. Joseph E. Pascente, Lixi, Inc.)

NON LİNEER FILTERS

original image

1px median filter

3px median filter

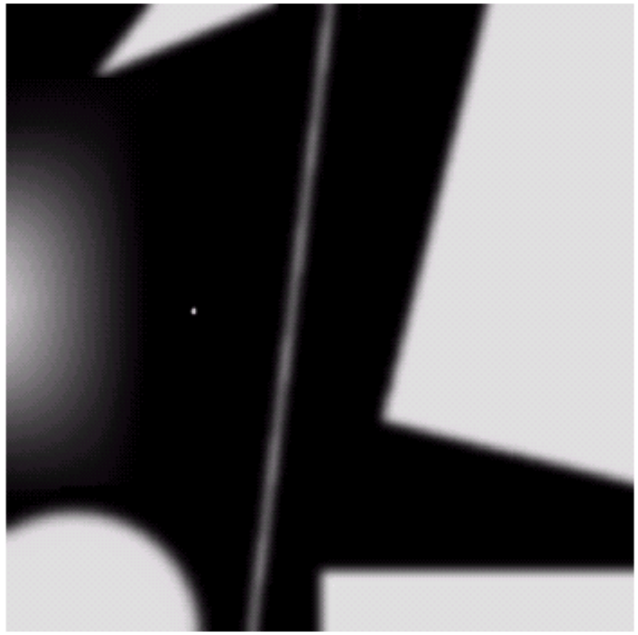
10px median filter

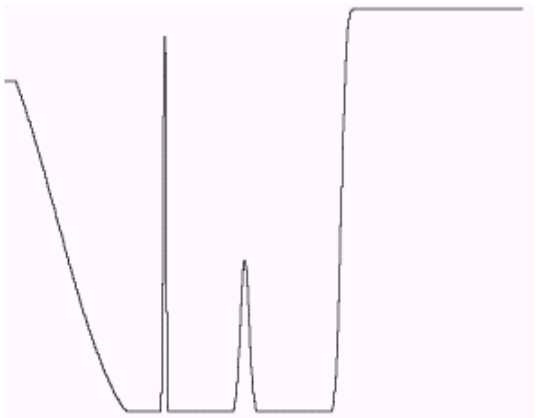
NON LİNEER FILTERS

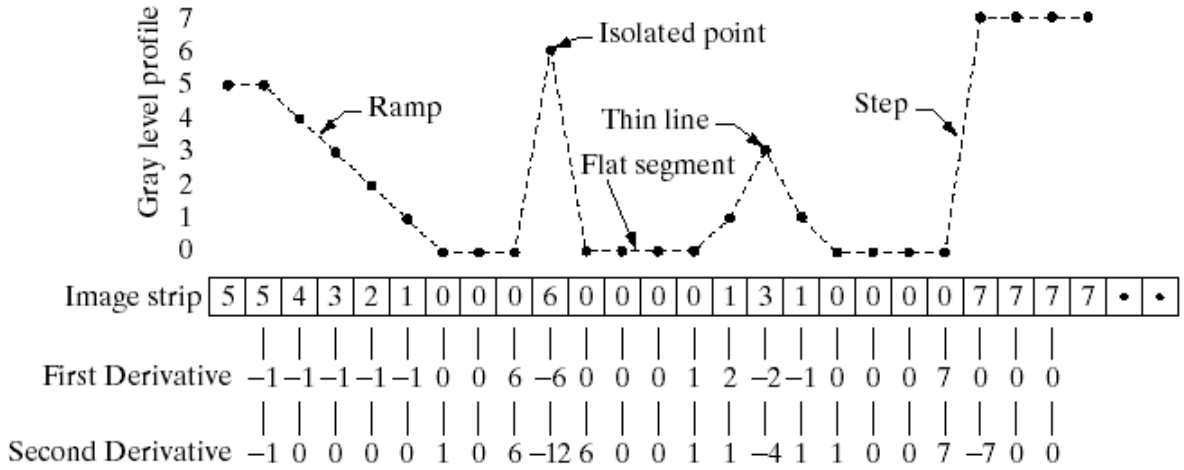
SHARPENING FILTERS

a b
c

FIGURE 3.38
(a) A simple image. (b) 1-D horizontal gray-level profile along the center of the image and including the isolated noise point.
(c) Simplified profile (the points are joined by dashed lines to simplify interpretation).







SHARPENING FILTERS

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

$$\frac{\partial^2 f}{\partial^2 x^2} = f(x+1, y) + f(x-1, y) - 2f(x, y)$$

$$\frac{\partial^2 f}{\partial^2 y^2} = f(x, y+1) + f(x, y-1) - 2f(x, y)$$

0	1	0
1	−4	1
0	1	0

$$\nabla^2 f = [f(x+1, y) + f(x-1, y) + f(x, y+1) + f(x, y-1)] - 4f(x, y). \quad (3.7\text{-}4)$$

SHARPENING FILTERS

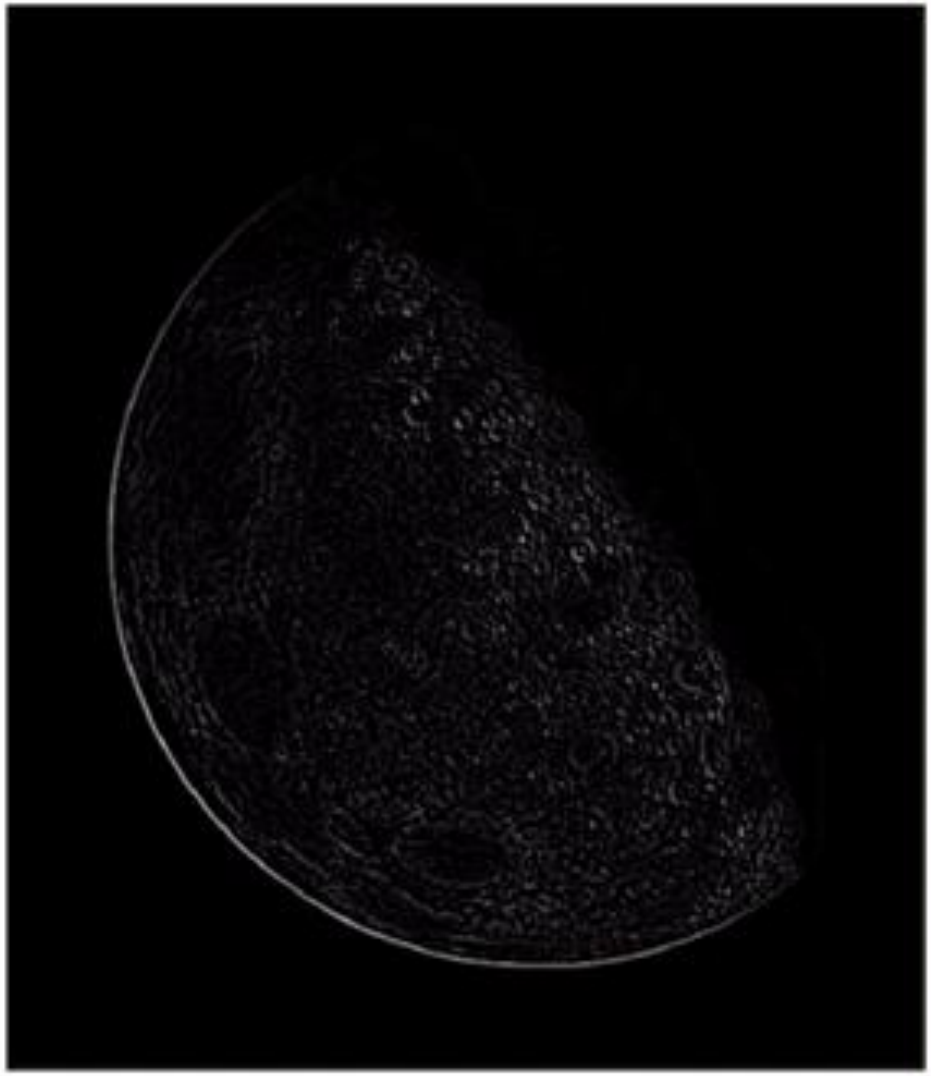
0	1	0
1	−4	1
0	1	0

1	1	1
1	−8	1
1	1	1

0	−1	0
−1	4	−1
0	−1	0

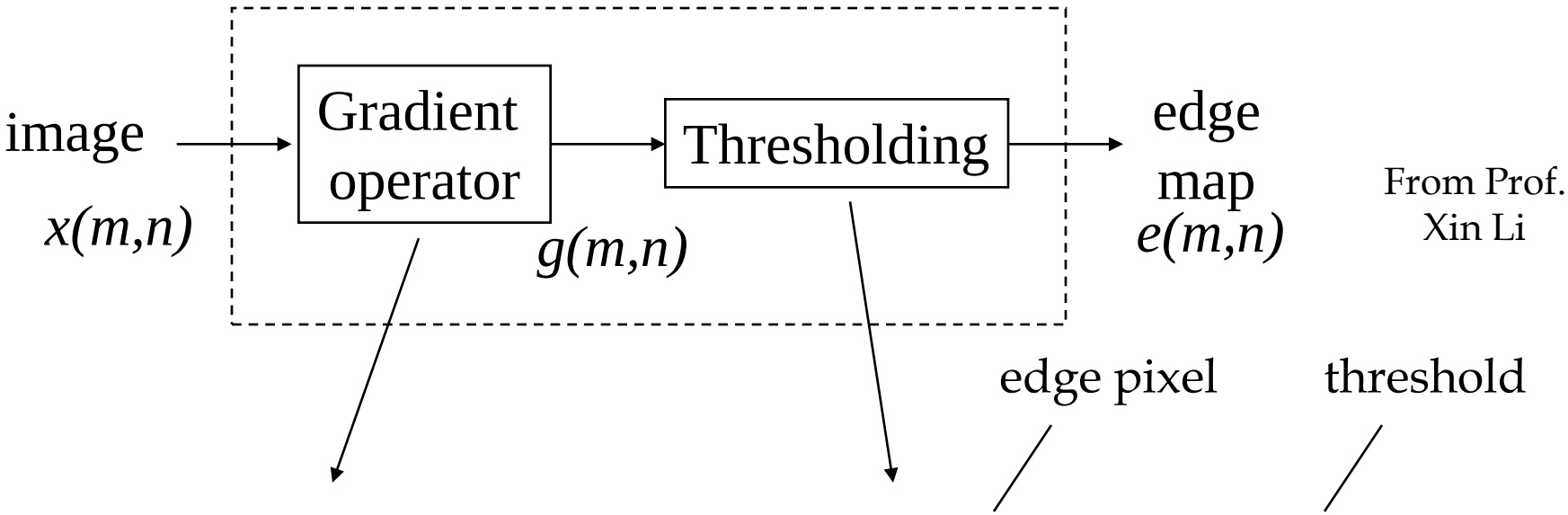
−1	−1	−1
−1	8	−1
−1	−1	−1

SHARPENING FILTERS

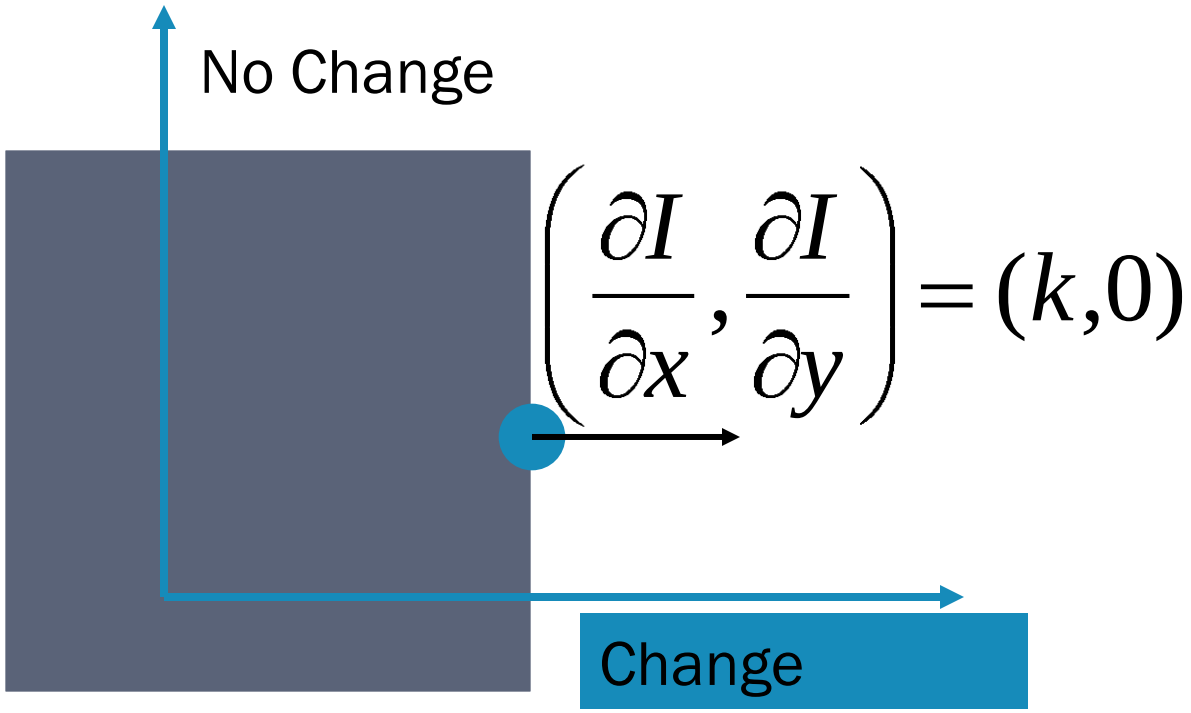


First Derivative (Gradient-Based) Methods

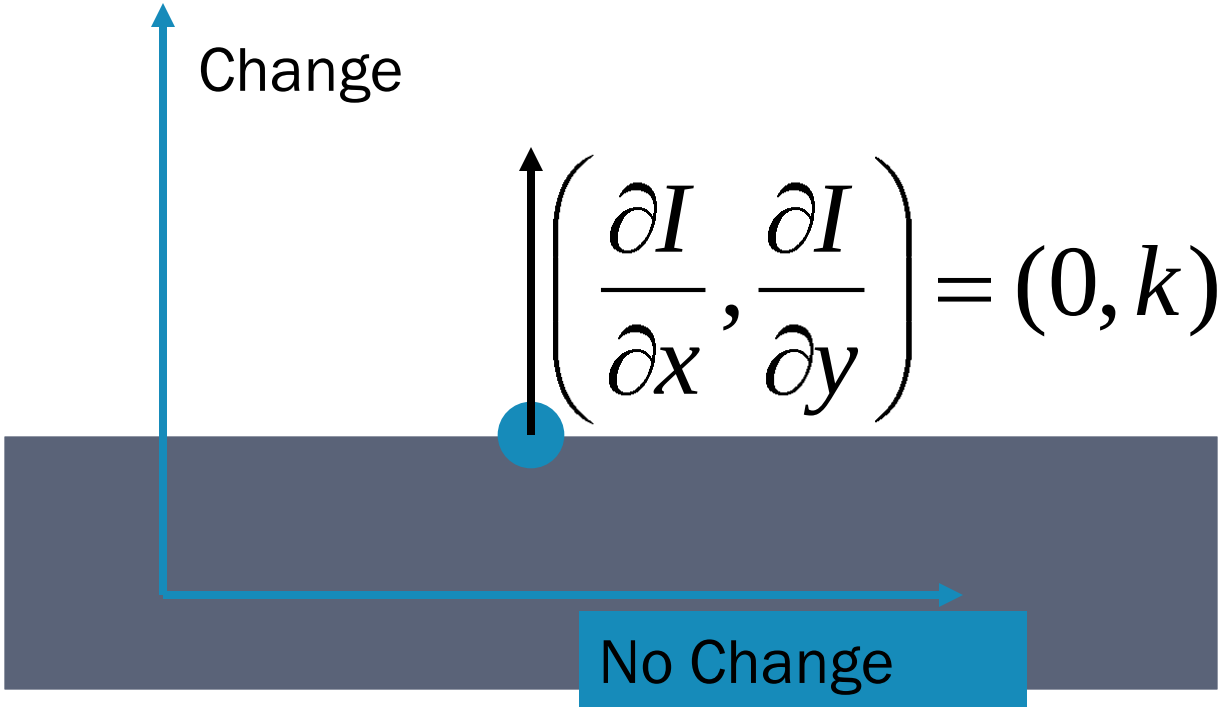
- **Motivation**
  - Detect sudden changes in image intensity
  - Gradient: sensitive to intensity changes



What is the gradient?



What is the gradient?



Gradient-Based Methods

- **Gradient Operators**

g_1 g_2

Local gradient vector:

Robert:

Prewitt:

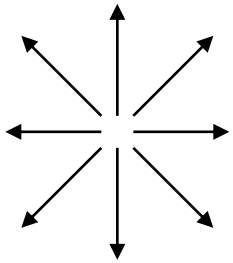
Gradient magnitude:

Sobel:

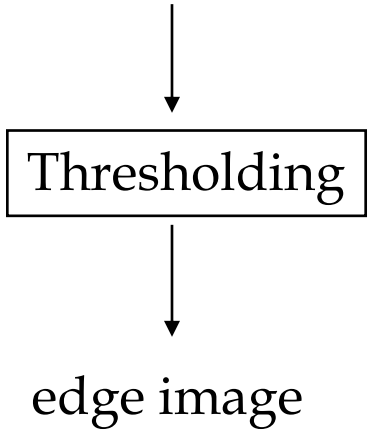
Approximation:

Gradient-Based Methods

- **Generalization: Compass Operator**



maximal magnitude:



Gradient-Based Methods

original image

Example

A 9x9 original image is given by

9	9	9	9	9	9	9	2	2
9	8	9	9	9	9	2	2	2
9	9	9	9	9	9	3	2	2
9	9	9	9	9	2	2	2	2
7	9	9	9	9	2	2	2	2
9	9	9	9	2	2	2	2	2
9	9	9	9	2	2	2	4	2
9	9	9	2	2	2	2	2	2
9	9	2	2	2	2	1	2	2

1) Use Robert gradient operator to find its edges

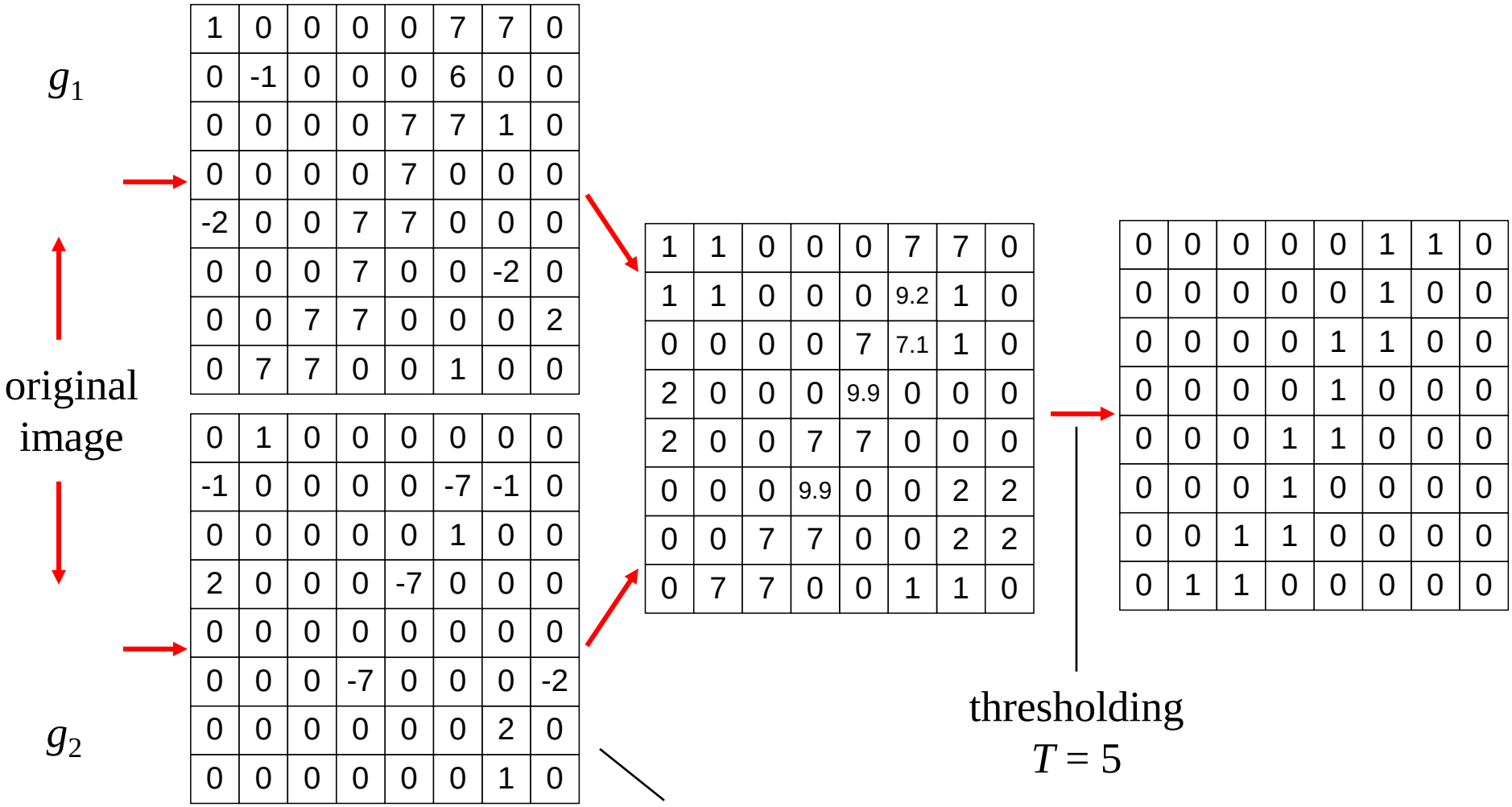
Use to estimate the gradient magnitude, and use $T = 5$ as the threshold for edge detection

2) Use Sobel gradient operator to find its edges

Use to estimate the gradient magnitude, and use $T = 20$ as the threshold for edge detection

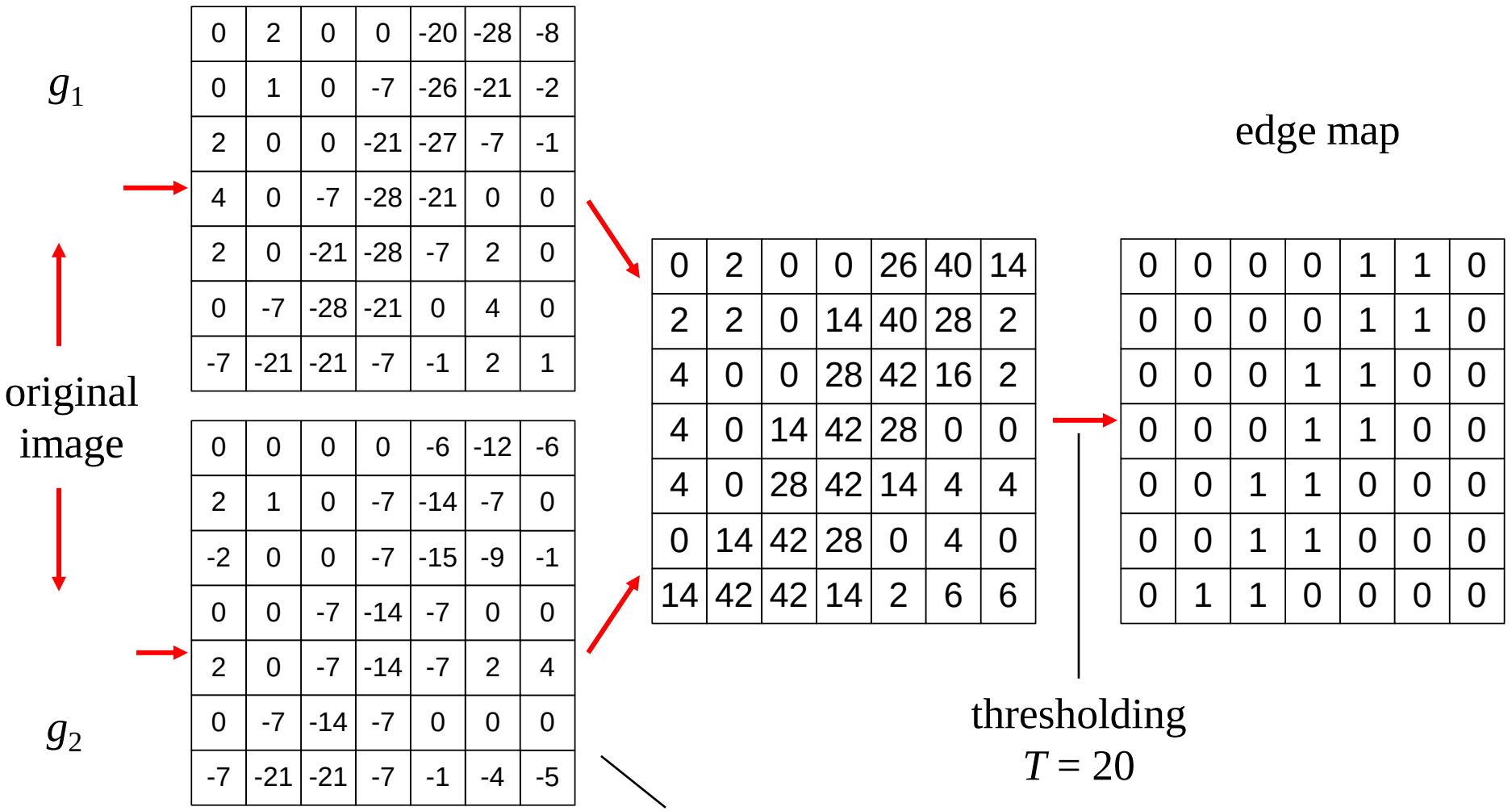
Example

1) Use Robert gradient operator



Example

2) Use Sobel gradient operator



ORIGINAL IMAGE

ROBERT EDGE

PREWITT EDGE

LAPLACE EDGE

UYGULAMA

- Görüntünün Histogramını Çıkarma
- stretchlim komutu
- Görüntünün Histogramını Eşitleme
- Stretching komutu
- Filtreleme
- Salt and pepper ve median
- Example
- Robert,Prewitt ve Laplace
- İmage Addition
- İmage Cropping

ÖDEV 3

- lena512.png görüntüsü için
- Histogramı çizilecek
- Histogram stretching uygulanacak
- Average filter uygulanacak
- Salt and pepper gürültüsü eklenecek
- Median filtere uygulanacak
- Tüm görüntüye 3 parlaklık değeri arttırılacak
- Görüntünün 300*200 pixelinden başlayıp 200 e 200 lük bir kısmı kesilecek.
- Son teslim önümüzdeki hafta

ÖNÜMÜZDEKİ HAFTA

Frekans domendinde işlemler

SORULAR ?