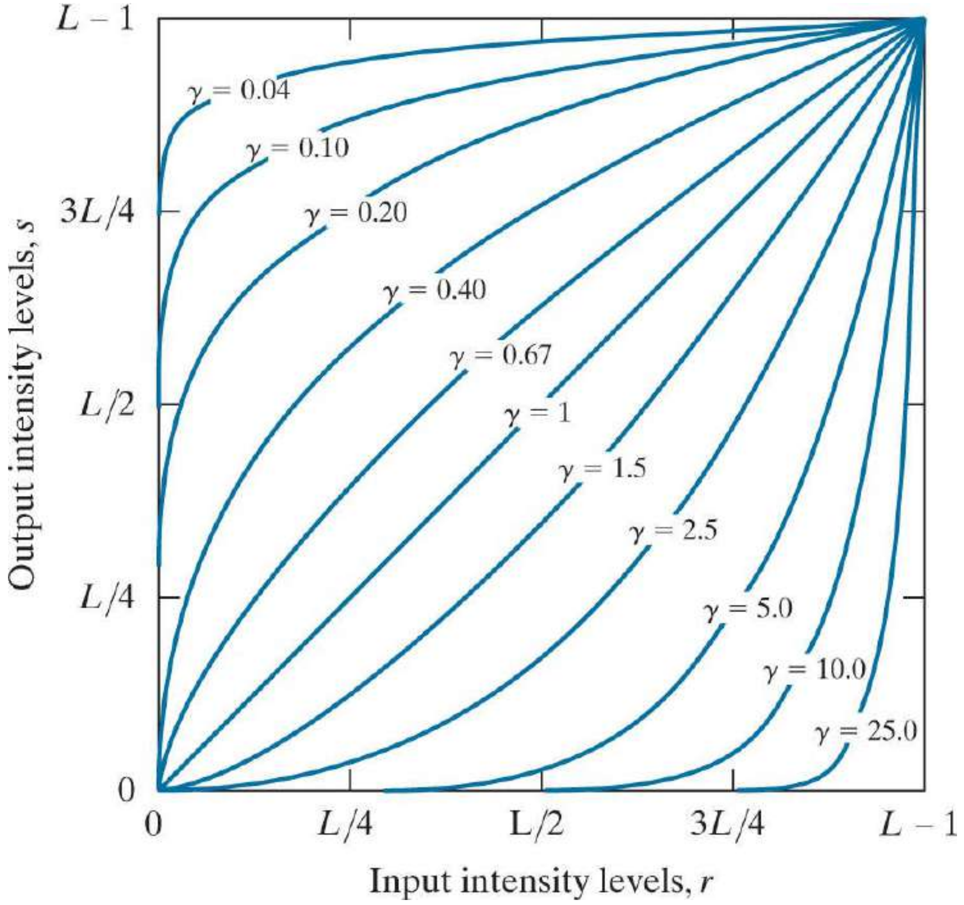
PRAPROSES CITRA DIGITAL

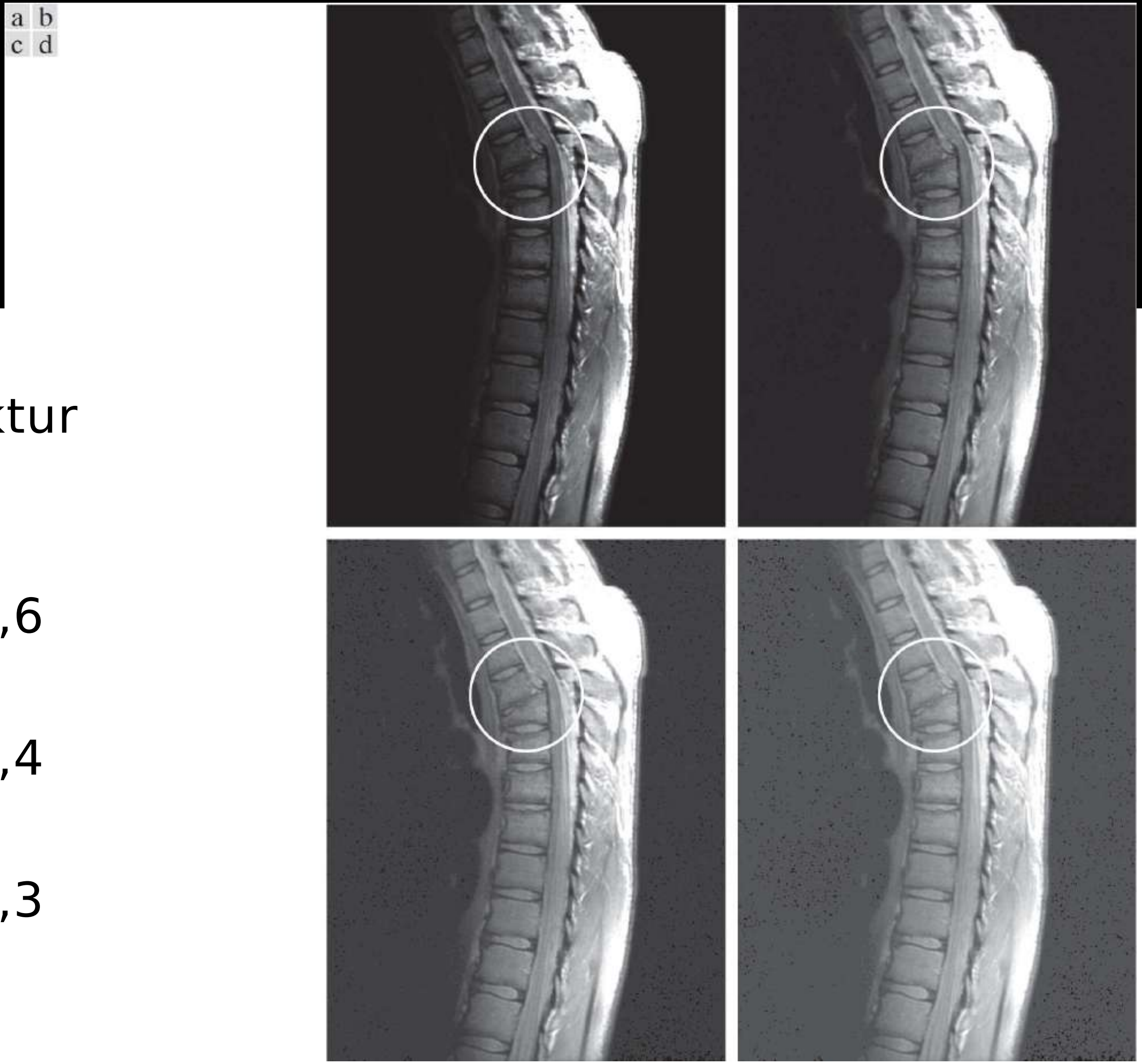
Perbaikan kontras dengan fungsi transformasi intensitas

METODE

Transformasi Power-Law (Gamma): mengubah intensitas citra input dengan rumus

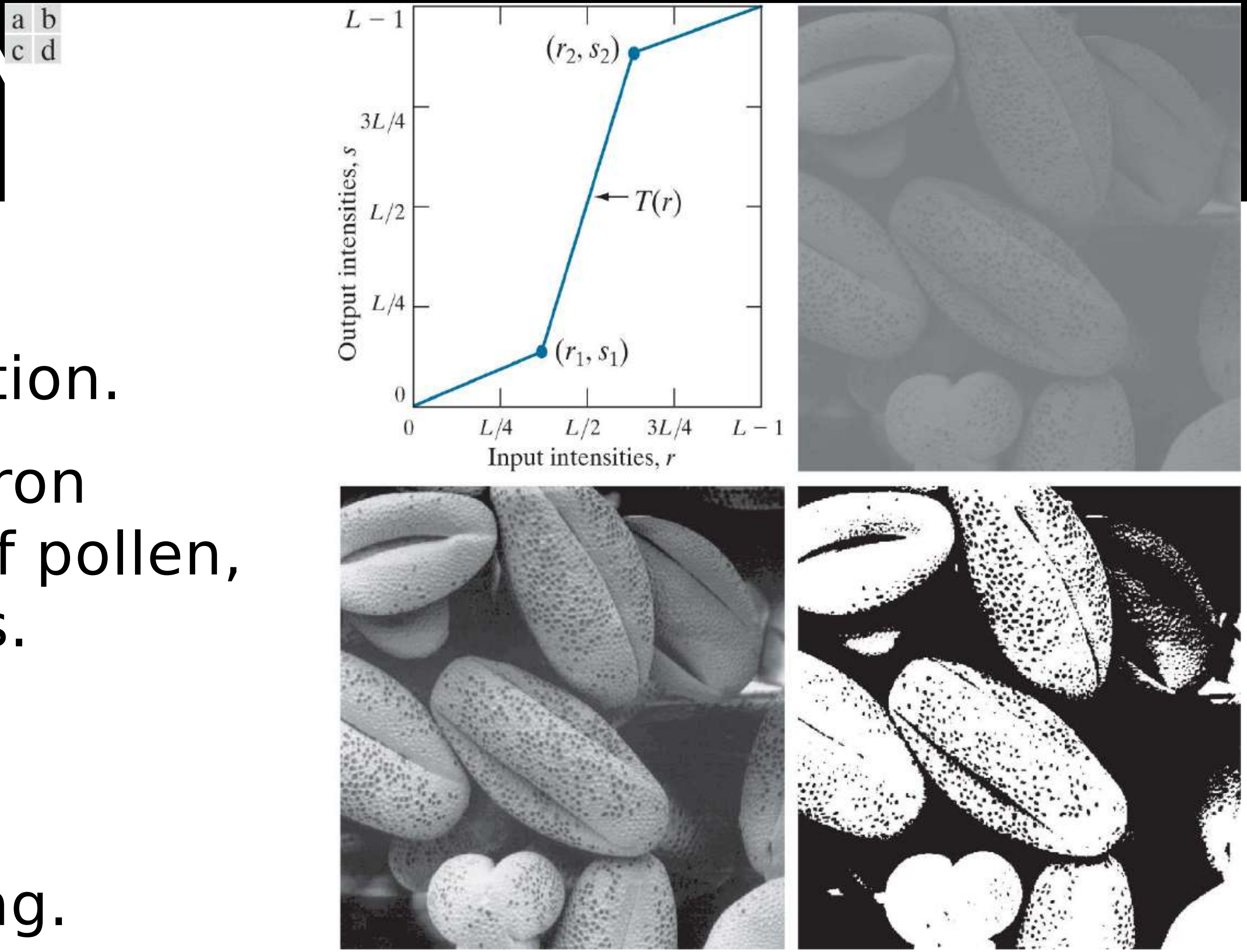


CONTOH



a) MRI tulang dengan area fraktur yang dilingkari
b) Hasil transformasi gamma dengan nilai gamma (γ) = 0,6
c) Hasil transformasi gamma dengan nilai gamma (γ) = 0,4
d) Hasil transformasi gamma dengan nilai gamma (γ) = 0,3

CONTRAST STRETCHIN

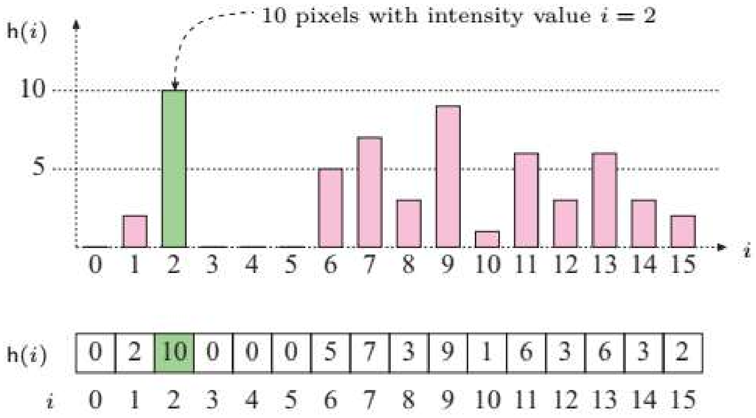


a) Piecewise linear transformation function.
b) A low-contrast electron microscope image of pollen, magnified 700 times.
c) Result of contrast stretching.
d) Result of thresholding.

PRAPROSES CITRA DIGITAL

Pemrosesan histogram

IMAGE HISTOGRAM

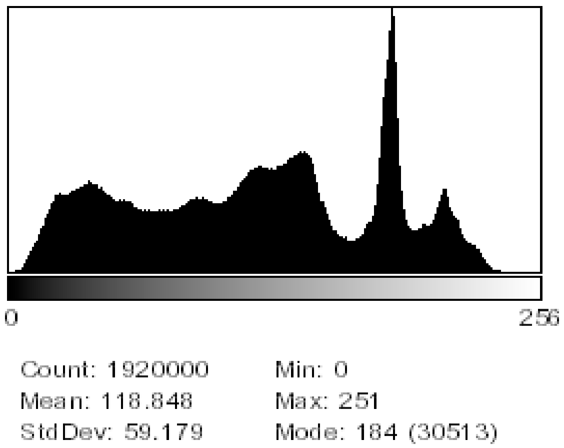


Histogram vector for an image with K = 16 possible intensity values.

The indices of the vector element i = 0 . . . 15 represent intensity values.

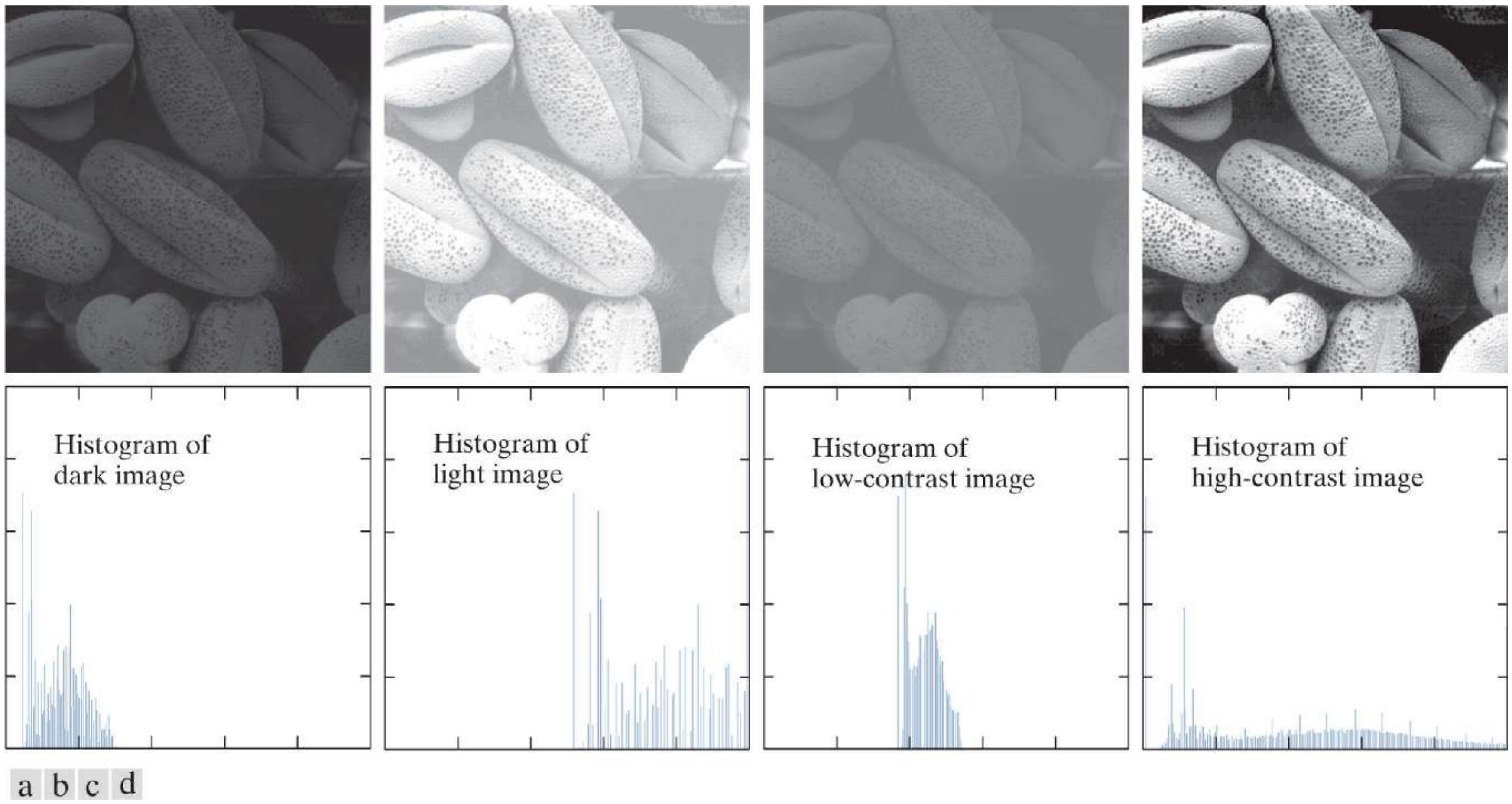
The value of 10 at index 2 means that the image contains 10 pixels of intensity value 2.

IMAGE HISTOGRAM



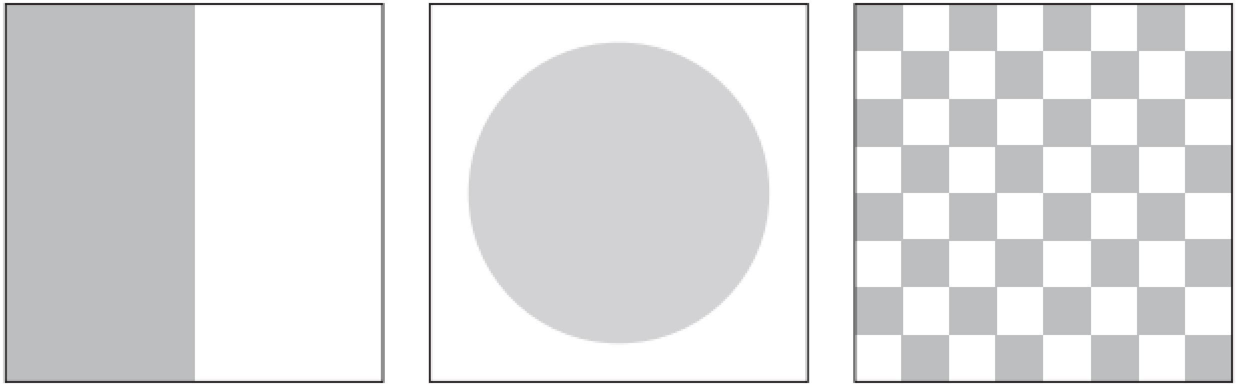
An 8-bit grayscale image and a histogram depicting the frequency distribution of its 256 intensity values

JENIS CITRA DAN HISTOGRAMNYA



JENIS CITRA DAN HISTOGRAMNYA

Is it possible to reconstruct an image using only its histogram?



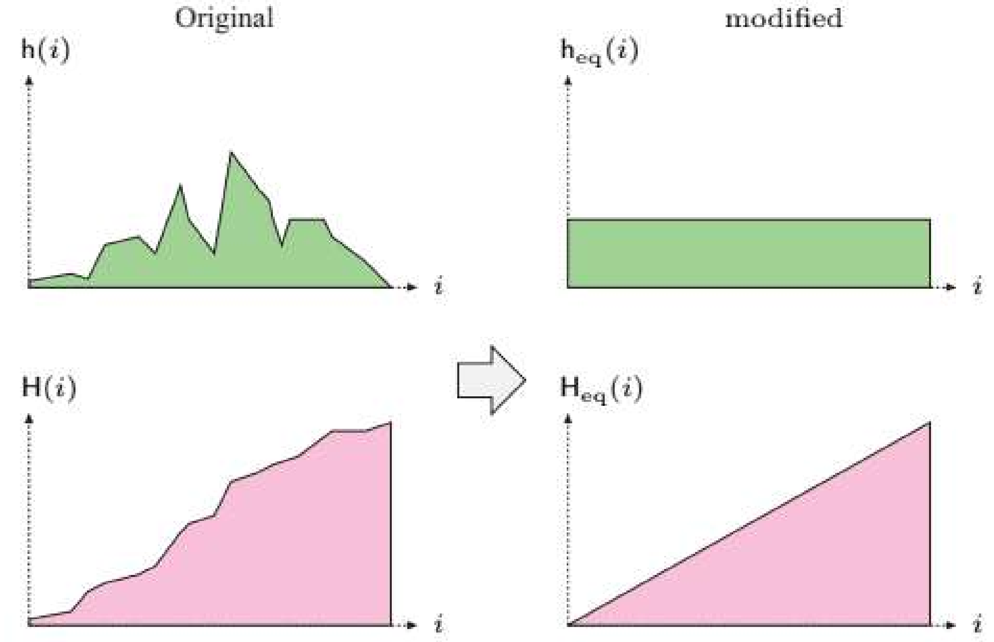
Three very different images with identical histograms

PRAPROSES CITRA DIGITAL

Pemerataan iluminasi

HISTOGRAM EQUALIZATION

find and apply a point operation such that the histogram of the modified image approximates a *uniform* distribution



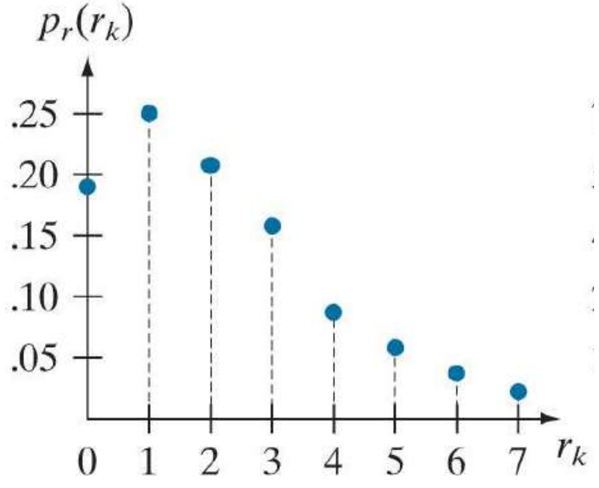
The cumulative target histogram must thus be approximately wedge-shaped

CONTOH HISTOGRAM EQUALIZATION

TABLE 3.1

Intensity distribution and histogram values for a 3-bit, 64×64 digital image.

r_k	n_k	$p_r(r_k) = n_k/MN$
$r_0 = 0$	790	0.19
$r_1 = 1$	1023	0.25
$r_2 = 2$	850	0.21
$r_3 = 3$	656	0.16
$r_4 = 4$	329	0.08
$r_5 = 5$	245	0.06
$r_6 = 6$	122	0.03
$r_7 = 7$	81	0.02



CONTOH HISTOGRAM EQUALIZATION

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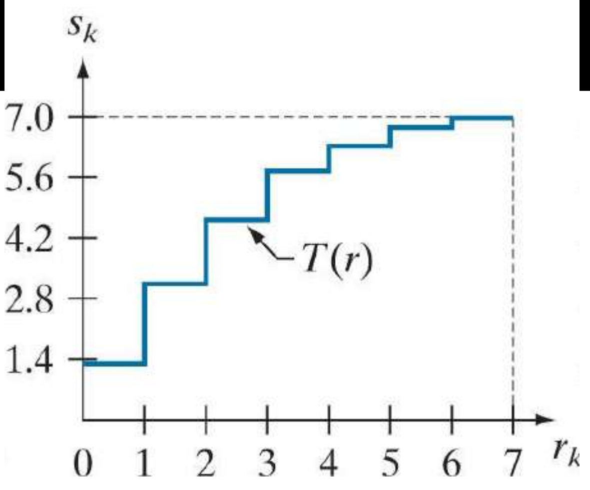


$$s_k = T(r_k) = (L-1)\sum_{j=0}^{k} p_r(r_j) \quad k = 0, 1, 2, \ldots, L-1$$

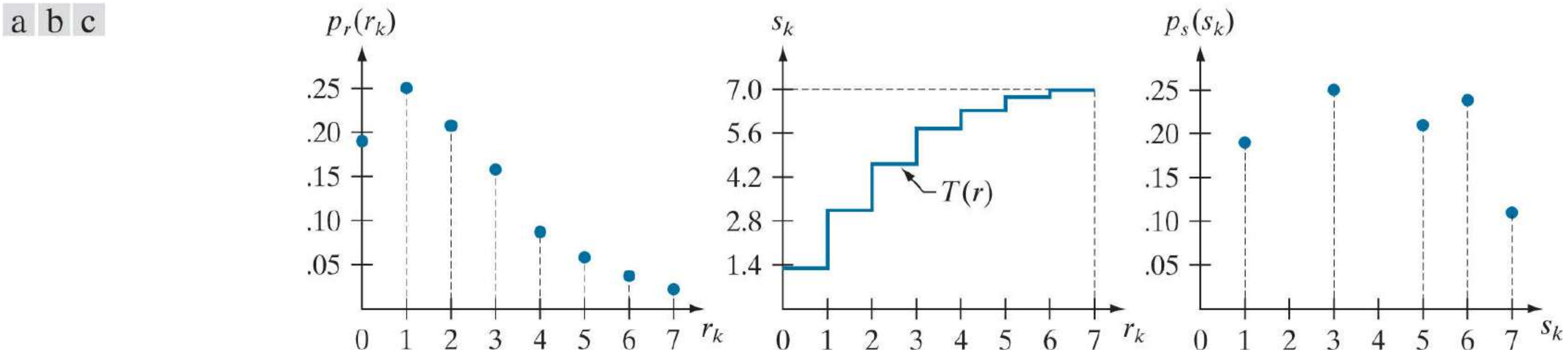
$$s_0 = T(r_0) = 7\sum_{j=0}^{0} p_r(r_j) = 7p_r(r_0) = 1.33$$

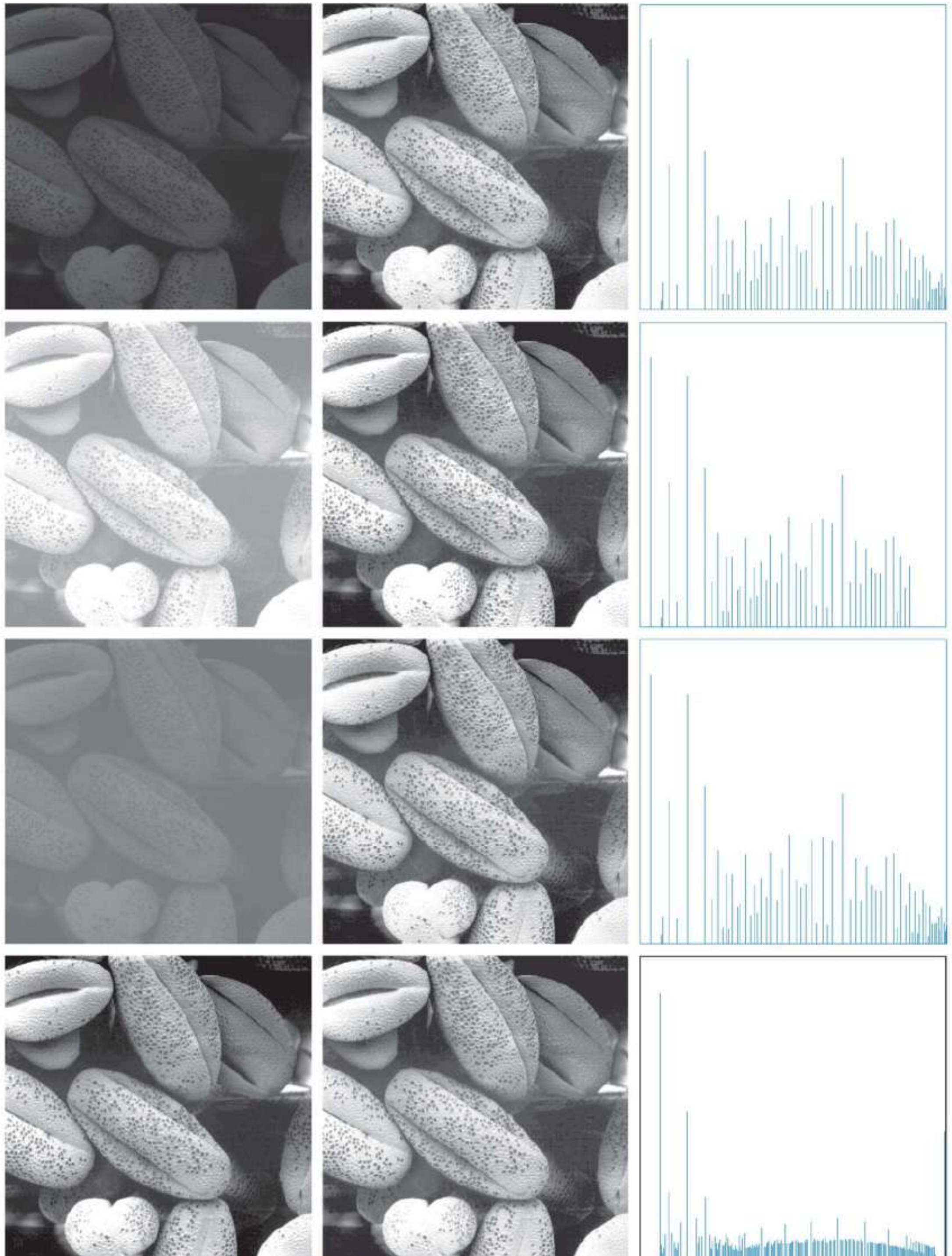
$s_0 = 1.33 \rightarrow 1 \quad s_2 = 4.55 \rightarrow 5 \quad s_4 = 6.23 \rightarrow 6 \quad s_6 = 6.86 \rightarrow 7$

$s_1 = 3.08 \rightarrow 3 \quad s_3 = 5.67 \rightarrow 6 \quad s_5 = 6.65 \rightarrow 7 \quad s_7 = 7.00 \rightarrow 7$

$s_1 = T(r_1) = 3.08, s_2 = 4.55, s_3 = 5.67, s_4 = 6.23, s_5 = 6.65, s_6 = 6.86,$ and $s_7 = 7.00.$

CONTOH HISTOGRAM EQUALIZATION



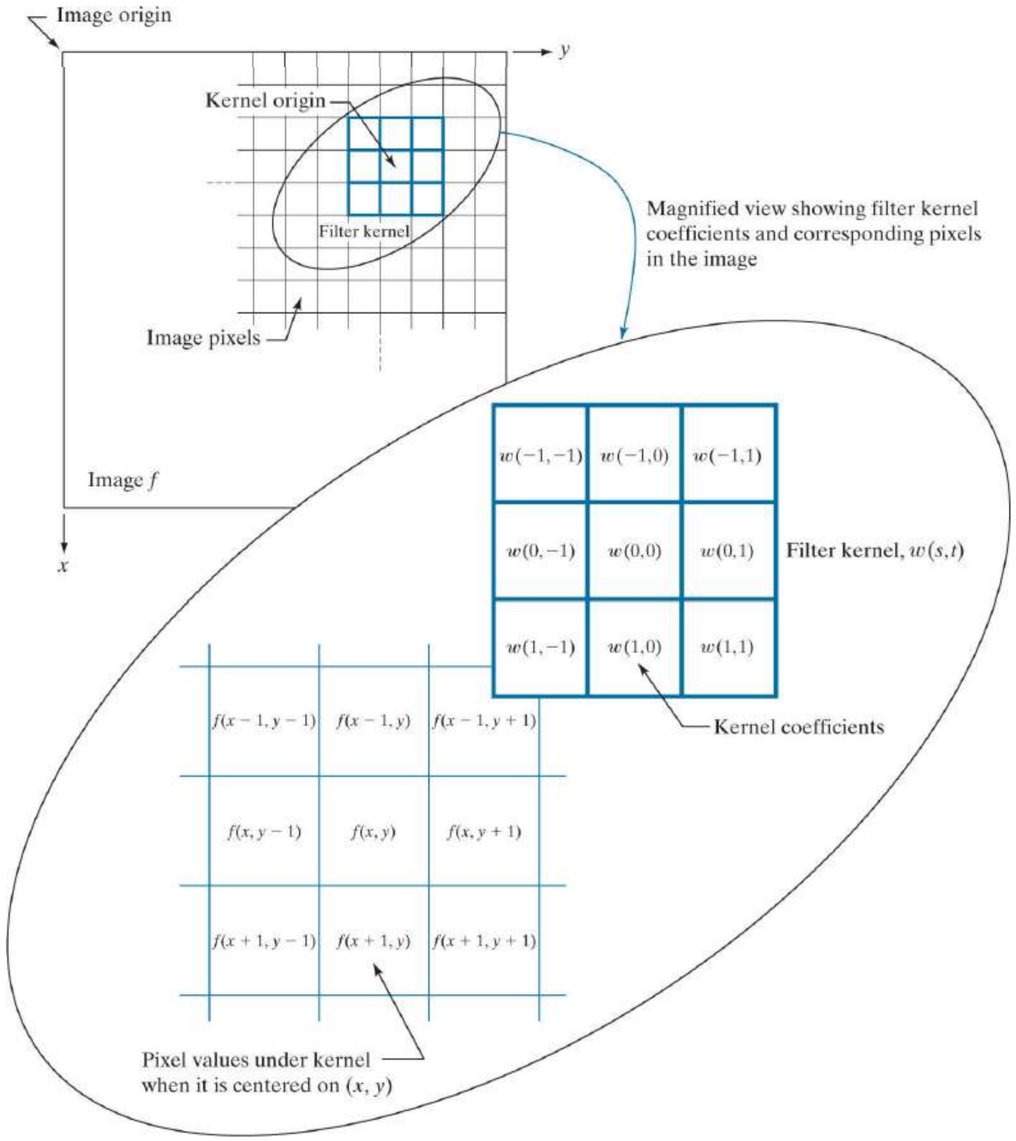


PRAPROSES CITRA DIGITAL

Filter spasial lowpass dan highpass

LINEAR SPATIAL FILTERING USING 3X3 KERNEL

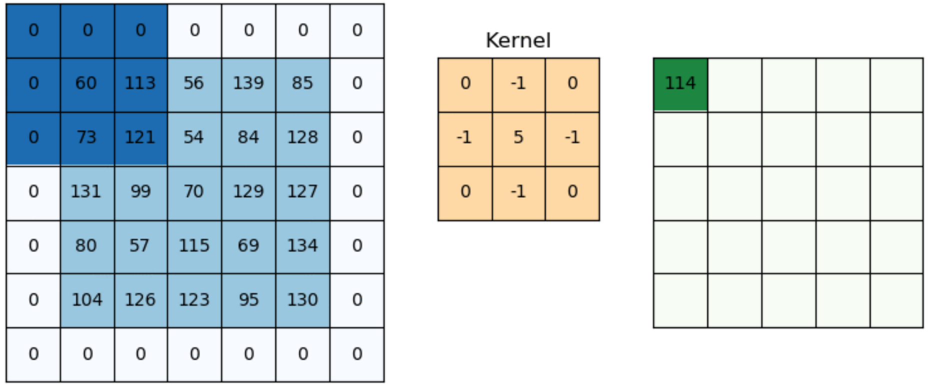
As coordinates *x* and *y* are varied, the center of the kernel moves from pixel to pixel, generating the filtered image, *g*, in the process



$$g(x,\ y) = w(-1,\ -1)f(x-1,\ y-1) + w(-1,\ 0)f(x-1,\ y) + \ldots$$
$$+\, w(0,\ 0)f(x,\ y) + \ldots + w(1,\ 1)f(x+1,\ y+1)$$

LINEAR SPATIAL FILTERING USING 3X3 KERNEL

As coordinates *x* and *y* are varied, the center of the kernel moves from pixel to pixel, generating the filtered image, *g*, in the process



$$g(x, y) = w(-1, -1)f(x-1, y-1) + w(-1, 0)f(x-1, y) + \ldots$$
$$+ w(0, 0)f(x, y) + \ldots + w(1, 1)f(x+1, y+1)$$

SMOOTHING (AVERAGING) KERNELS (FILTERS)

- used to reduce sharp transitions in intensity
- can be used for noise reduction

a b

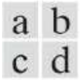
(a) $\frac{1}{9} \times$

1	1	1
1	1	1
1	1	1

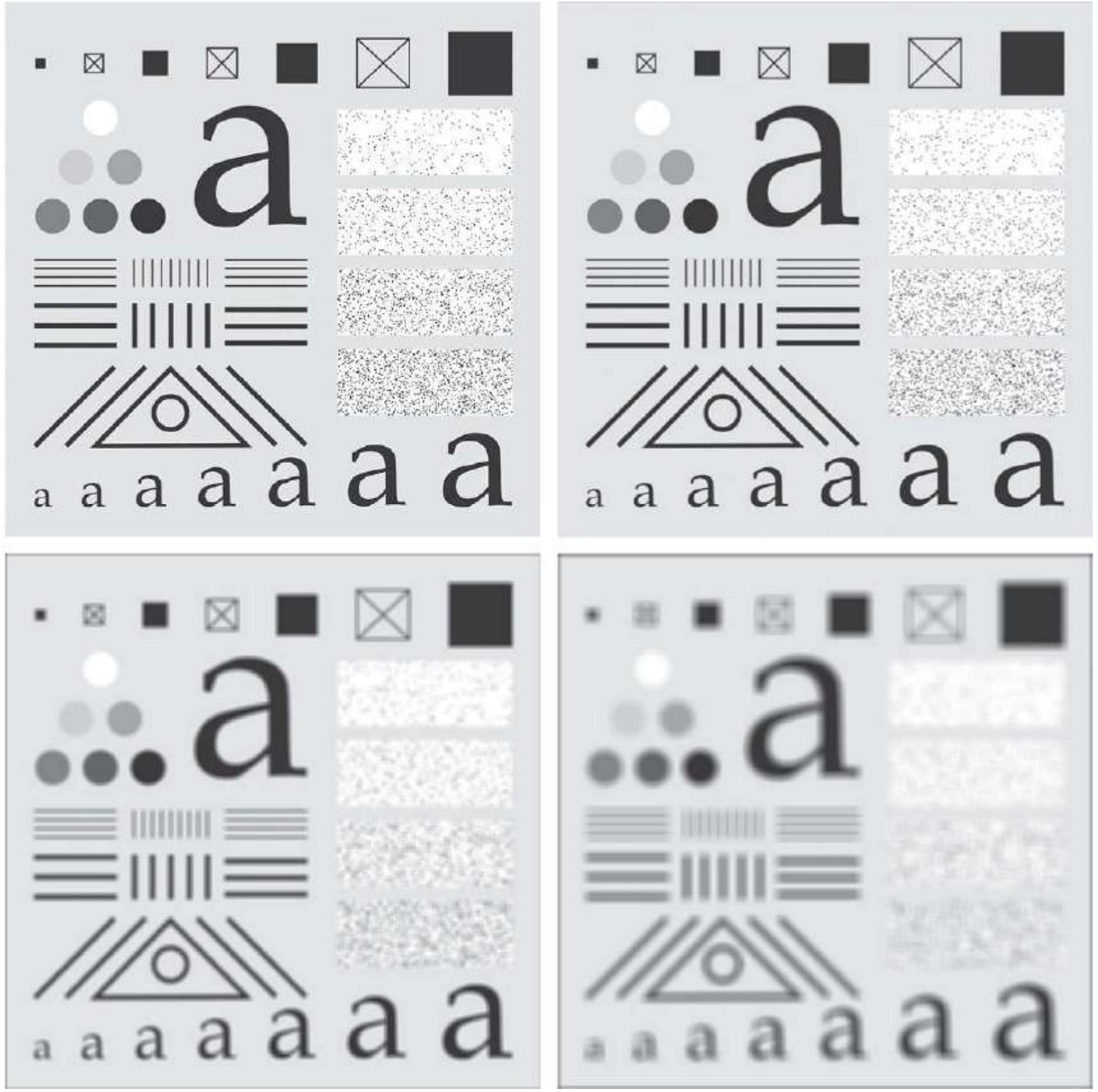
(b) $\frac{1}{4.8976} \times$

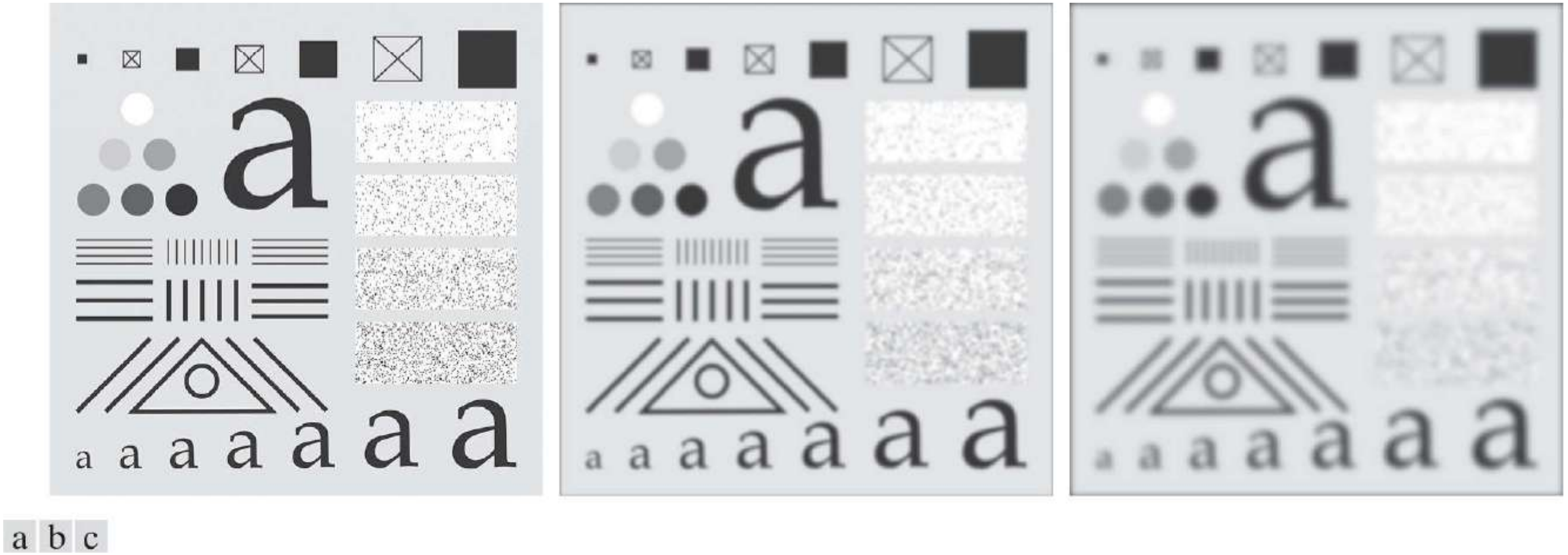
0.3679	0.6065	0.3679
0.6065	1.0000	0.6065
0.3679	0.6065	0.3679

(a) is a *box* kernel; (b) is a *Gaussian* kernel.



(a) Test pattern of size pixels. (b)-(d) Results of lowpass filtering with **box kernels** of sizes and respectively





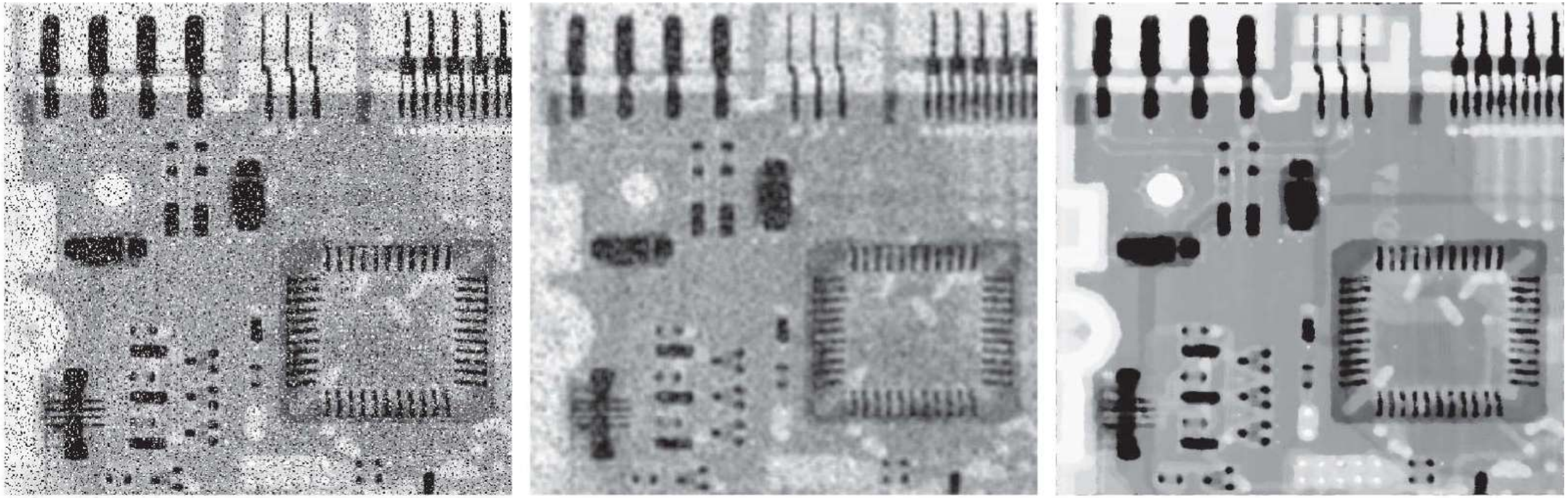
(a)A test pattern of size 1024 x 1024.
(b) Result of lowpass filtering the pattern with a Gaussian kernel of size 21 x 21, with standard deviations = 3.5
(c) Result of using a kernel of size 43 x43, with standard deviations = 7.

SHADING CORRECTION

a b c

a) Image shaded by a shading pattern oriented in the direction. The image size: 1024 x 1024. The inner square sizes: 128 x 128.
b) Estimate of the shading patterns obtained using lowpass filtering. The result of filtering the image with a 512 x 512 Gaussian kernel with standard deviations = 128.
c) Result of dividing (a) by (b).

MEDIAN FILTERS



a b c

a) X-ray image of a circuit board, corrupted by salt-and-pepper noise.
b) Noise reduction using a 19 x 19 Gaussian lowpass filter kernel with standard deviations = 3.
c) Noise reduction using a 7 x 7 median filter.

SHARPENING USING THE SECOND DERIVATIVE – THE LAPLACIAN

$$\nabla^2 f(x,y) = f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1) - 4f(x,y)$$

0	1	0
1	−4	1
0	1	0

1	1	1
1	−8	1
1	1	1

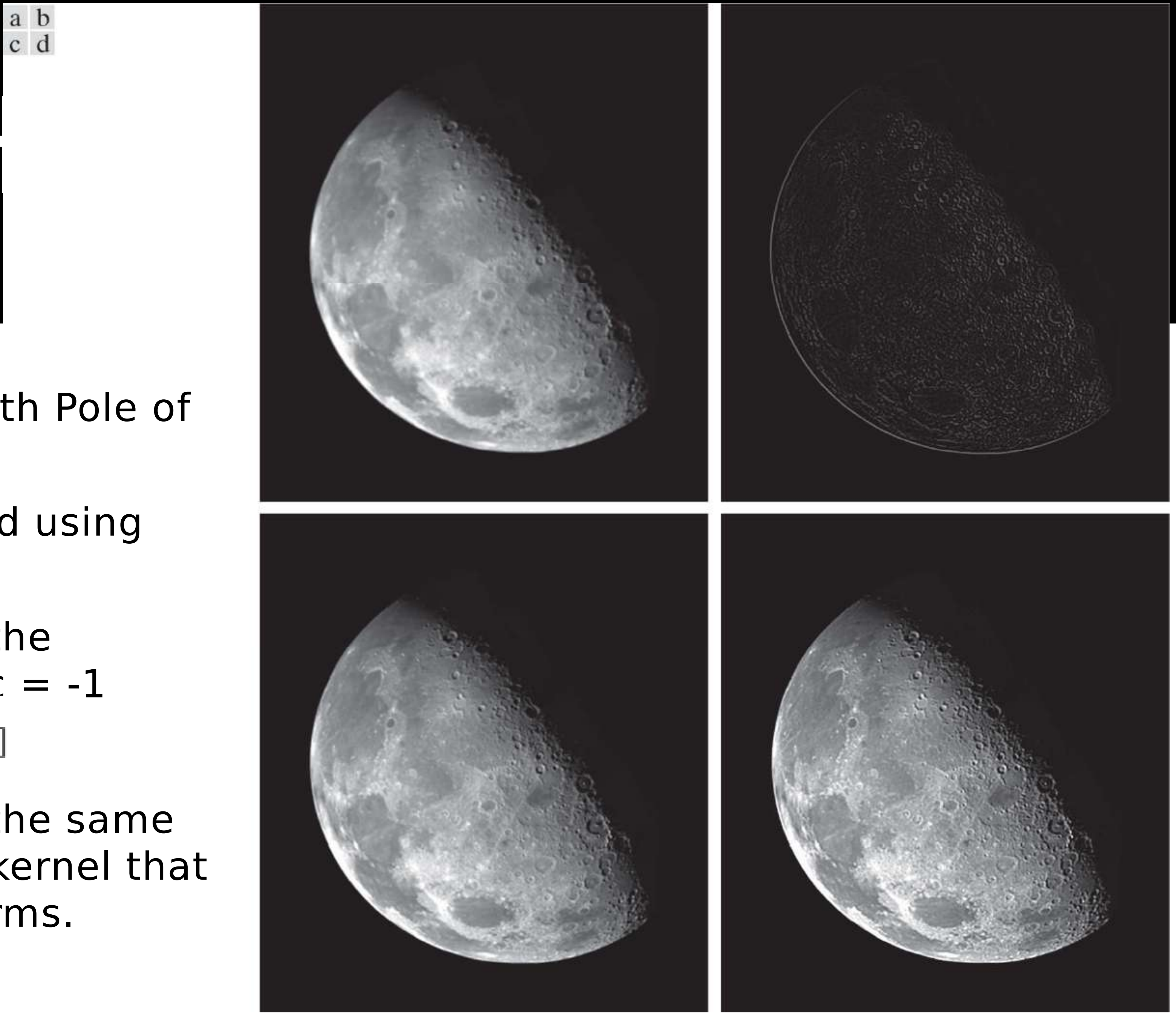
0	−1	0
−1	4	−1
0	−1	0

−1	−1	−1
−1	8	−1
−1	−1	−1

a b c d

a) Laplacian kernel.
b) Kernel used to implement an extension of this equation that includes the diagonal terms.
c) and (d) Two other Laplacian kernel

CONTOH

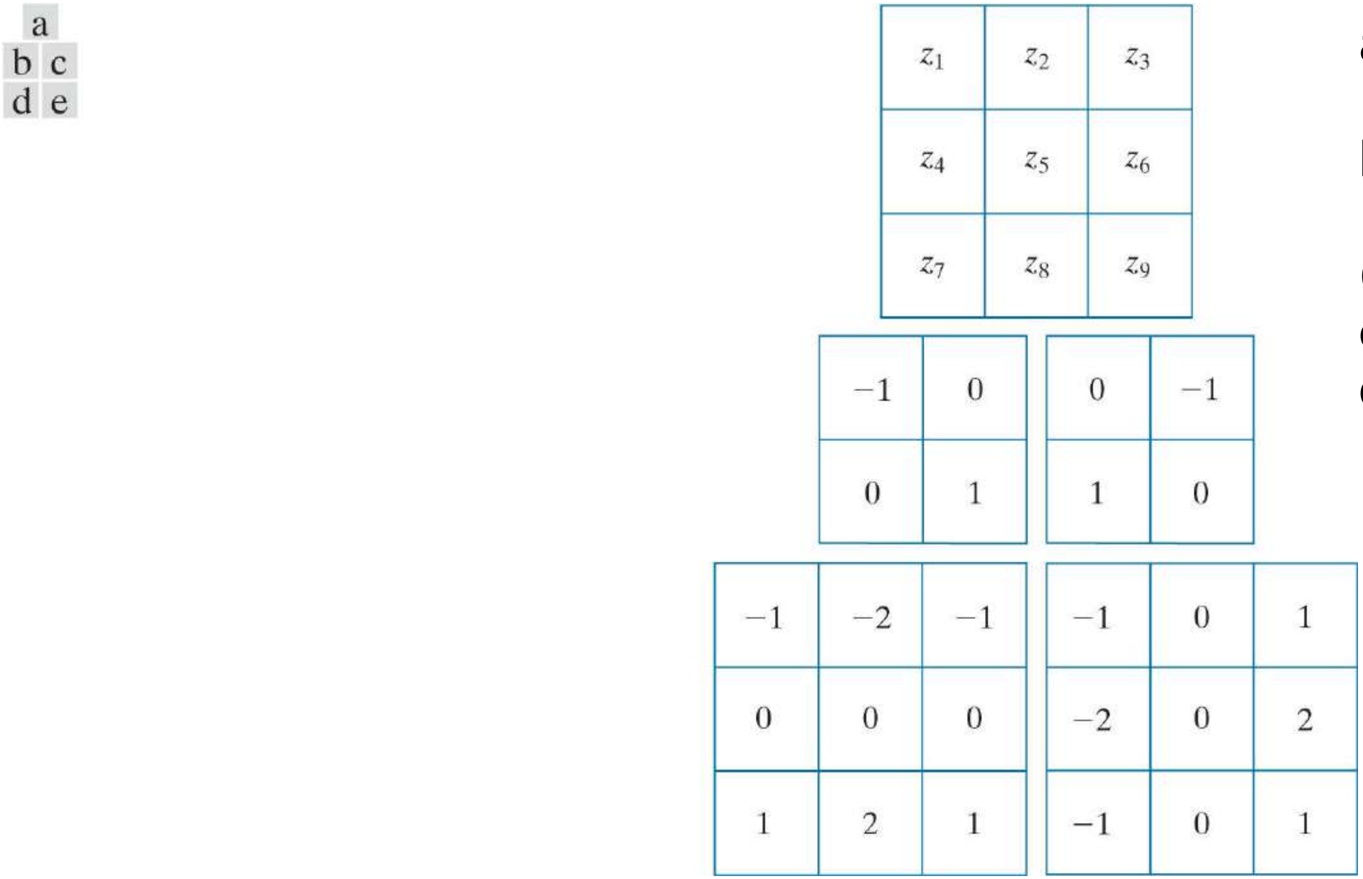


a) Blurred image of the North Pole of the moon.
b) Laplacian image obtained using the Laplacian kernel.
c) Image sharpened using the following equation with c = -1

$$g(x, y) = f(x, y) + c[\nabla^2 f(x, y)]$$

d) Image sharpened using the same procedure, but with the kernel that includes the diagonal terms.

SHARPENING USING THE FIRST DERIVATIVE – THE GRADIENT



a) A region of an image, where the *z*s are intensity values.
b) – (c) Roberts cross-gradient operators.

(d)–(e) Sobel operators. All the kernel coefficients sum to zero, as expected of a derivative operator.

$$g_x = \frac{\partial f}{\partial x} = (z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)$$

$$g_y = \frac{\partial f}{\partial y} = (z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)$$

SHARPENING USING THE FIRST DERIVATIVE – THE GRADIENT

The Image Gradient Magnitude

$$M(x,y) = [g_x^2 + g_y^2]^{\frac{1}{2}} = [[(z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)]^2$$

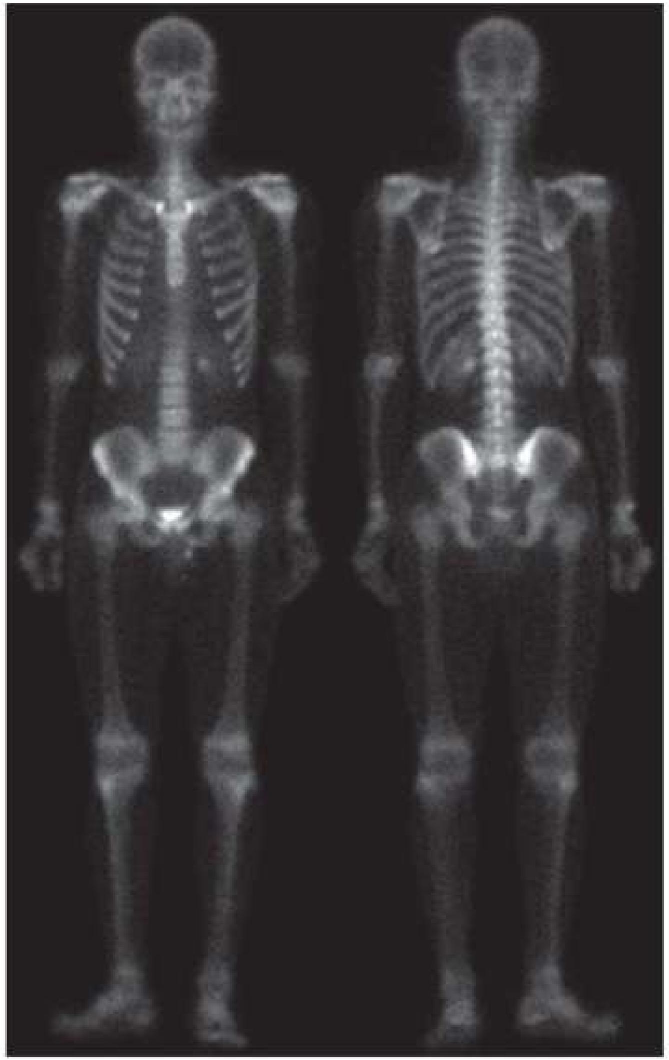
$$+[(z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)]^2]^{\frac{1}{2}}$$

PRAPROSES CITRA DIGITAL

Metode kombinasi filter spasial

IMAGE OF WHOLE BODY BONE SCAN

used to detect diseases such as bone infections and tumors



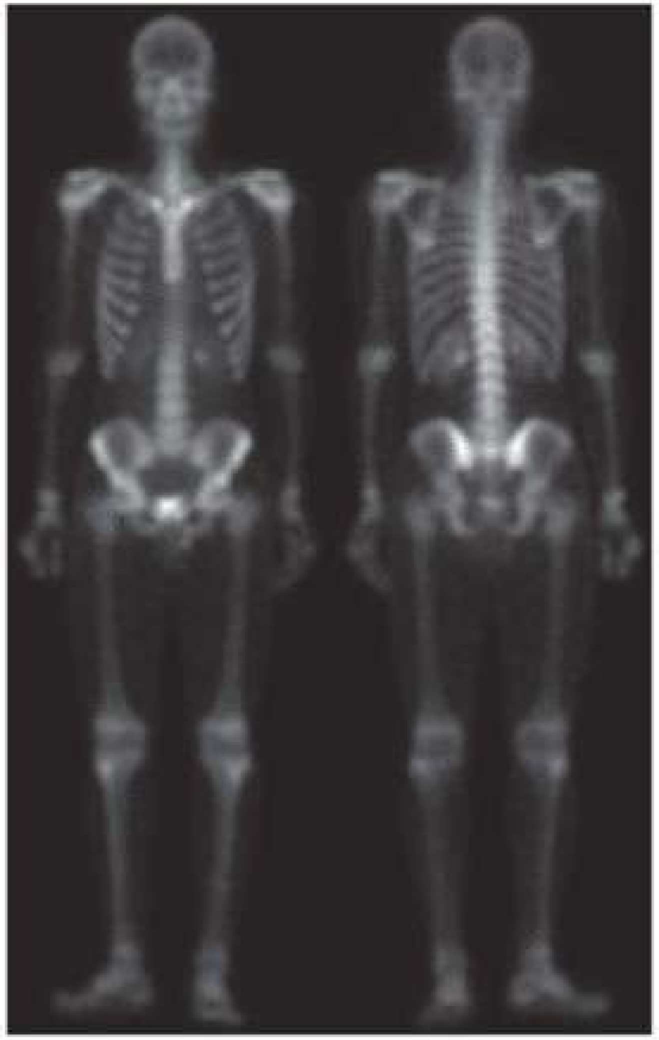
THE LAPLACIAN OF THE IMAGE OF WHOLE BODY BONE SCAN

obtained using the following kernel :

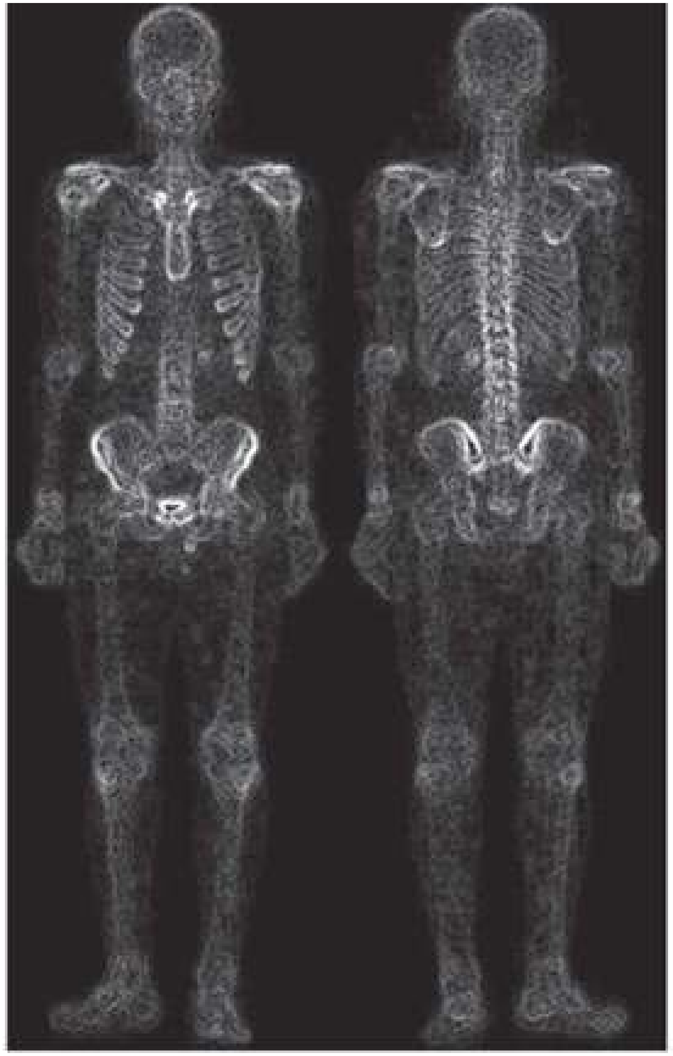
−1	−1	−1
−1	8	−1
−1	−1	−1

THE SHARPENED IMAGE OF WHOLE BODY BONE SCAN

Sharpened image obtained by adding the input image and the Laplacian image

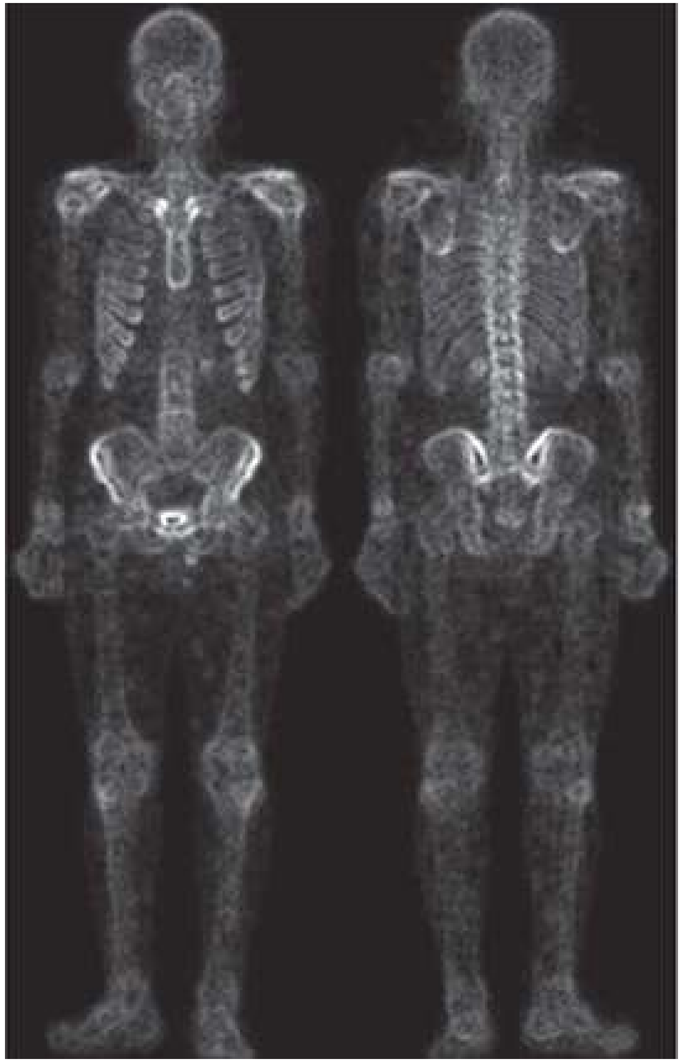


THE SOBEL GRADIENT OF IMAGE OF WHOLE BODY BONE SCAN



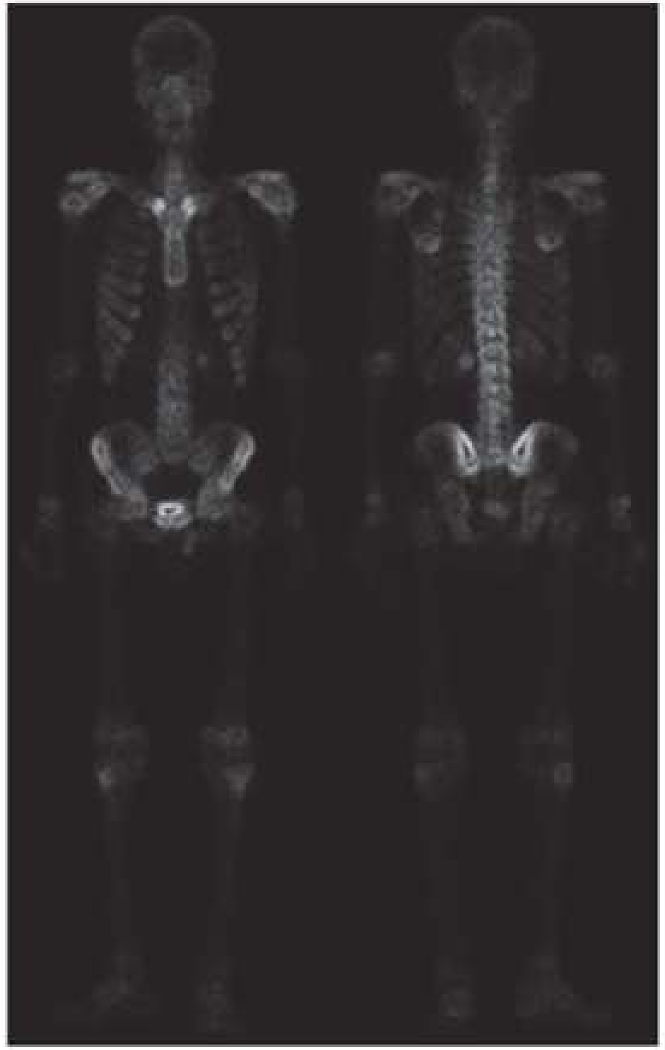
THE SMOOTHED SOBEL IMAGE OF WHOLE BODY BONE SCAN

Sobel image smoothed with a 5 x 5 box filter



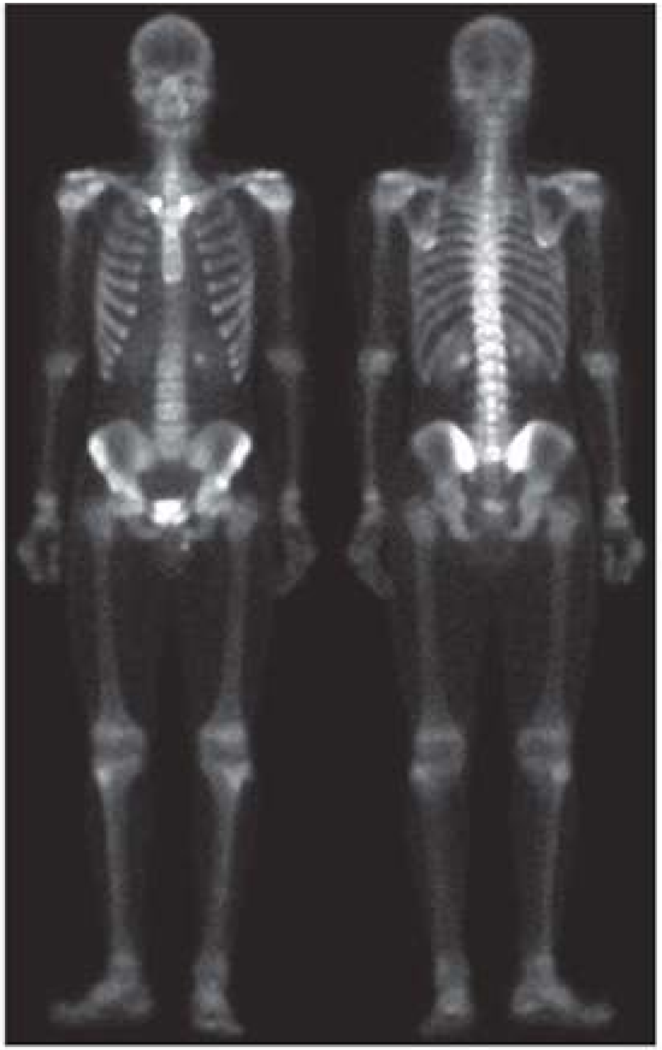
THE MASK IMAGE OF WHOLE BODY BONE SCAN

Mask image formed by the product of the Laplacian image and the smoothed Sobel image



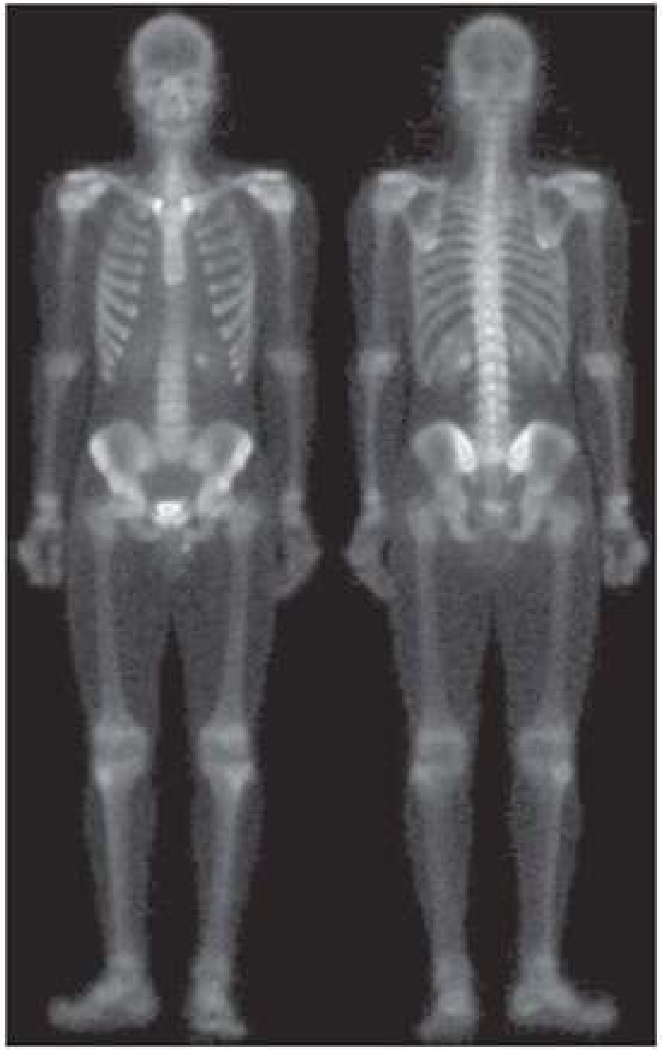
THE SHARPENED IMAGE OF WHOLE BODY BONE SCAN

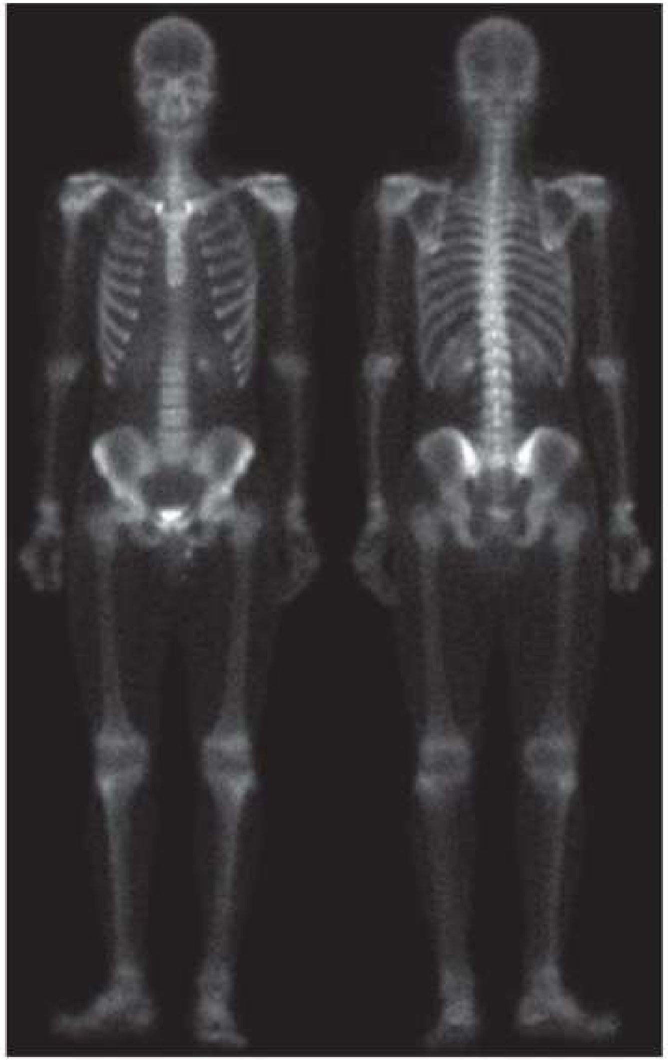
Add the original image with the mask image

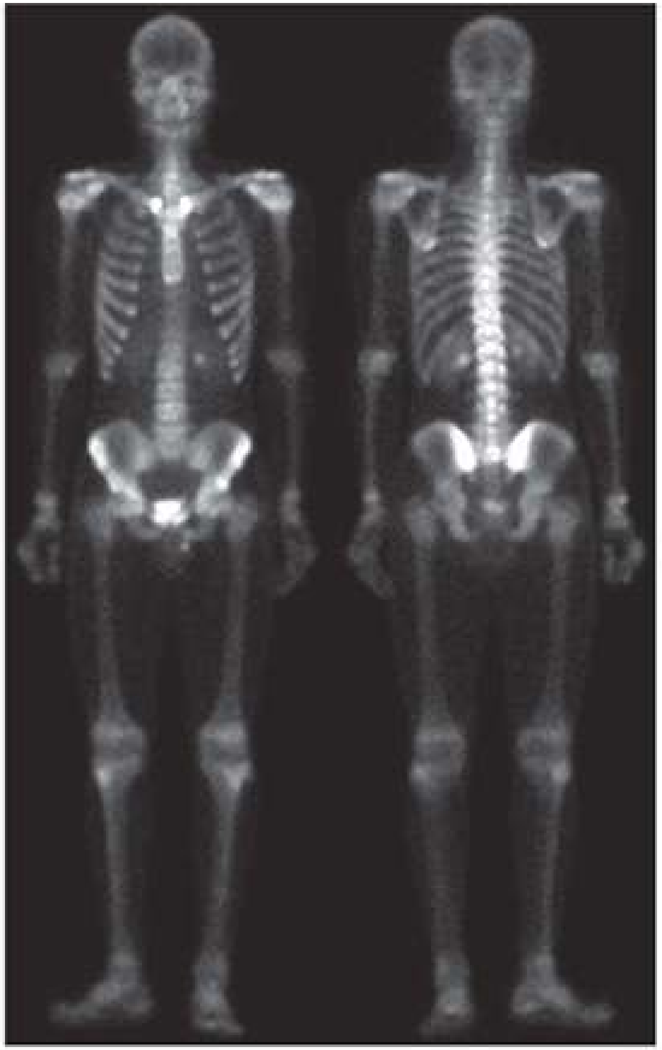


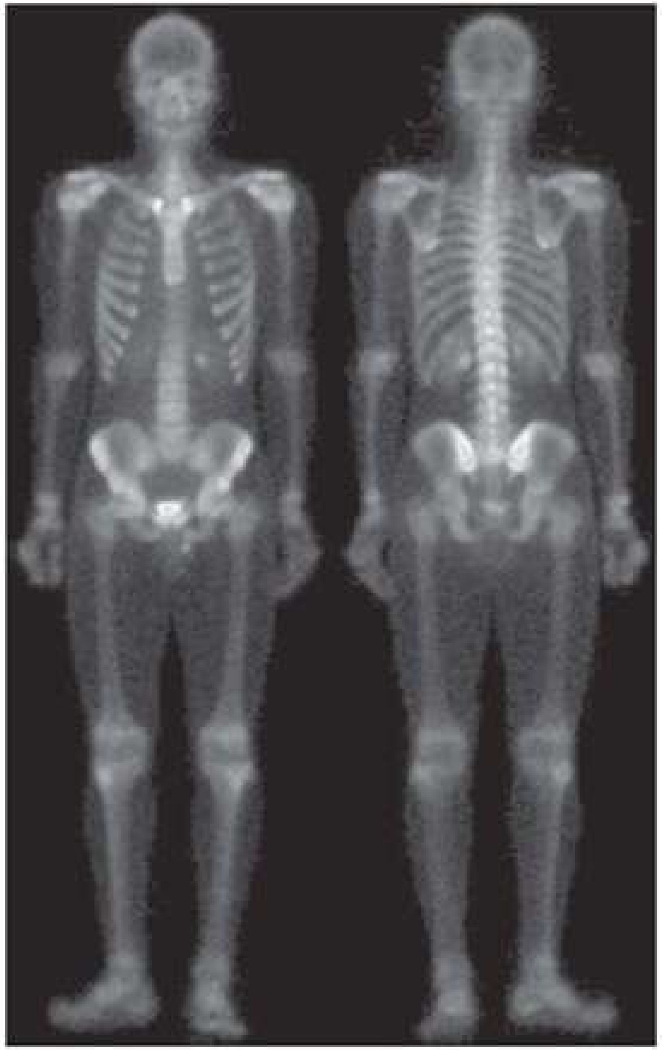
THE TRANSFORMED IMAGE OF WHOLE BODY BONE SCAN

Apply the power-law transformation to the sharpened image (γ = 0.5)









TERIMA KASIH