UNIVERSITÀ DEGLI STUDI DI PADOVA

Image representation and coding

Stefano Ghidoni

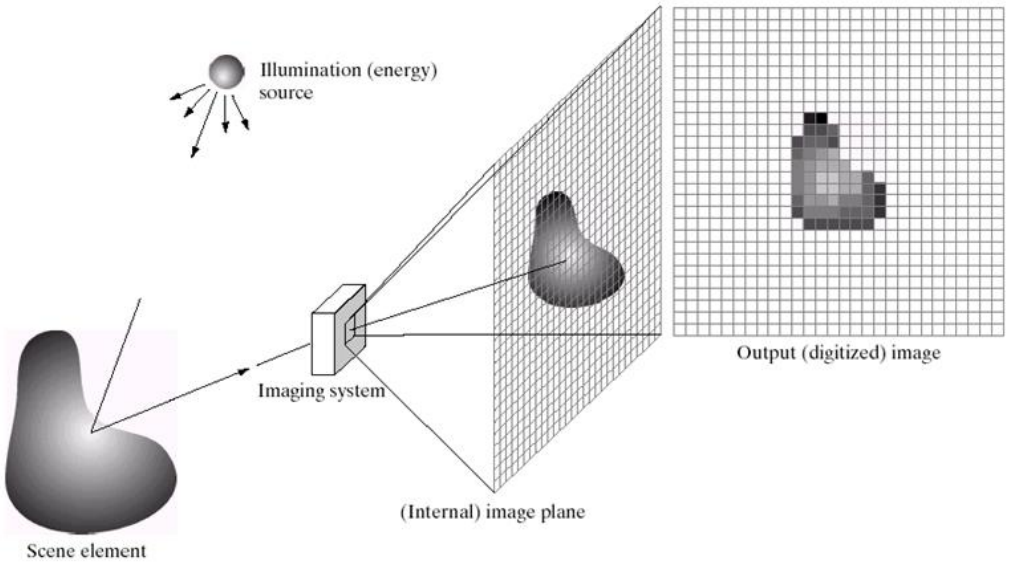
DIPARTIMENTO
DI INGEGNERIA
DELL'INFORMAZIONE

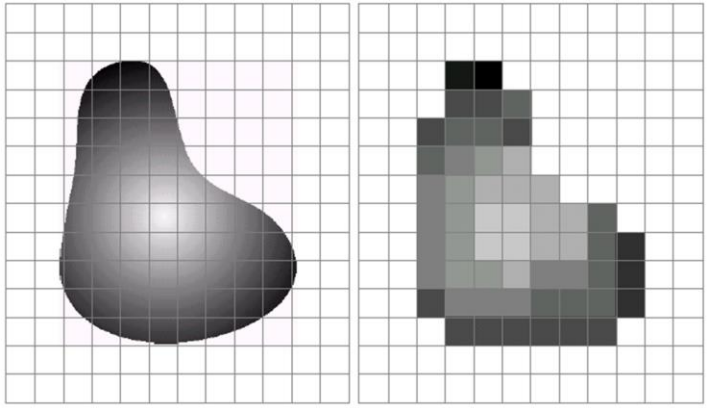
INTELLIGENT AUTONOMOUS SYSTEMS LAB

Agenda

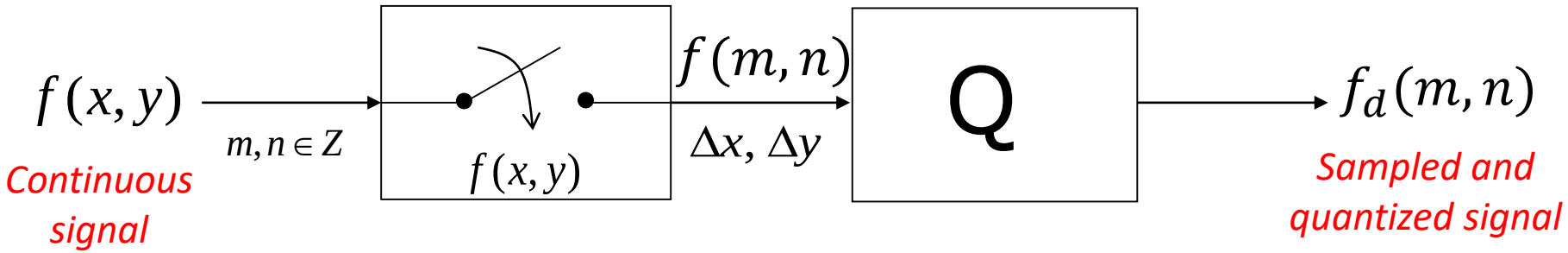
- Digital image coding
- Spatial resolution
- Gray level resolution

Image formation





Sampling and quantization



- Sampling:

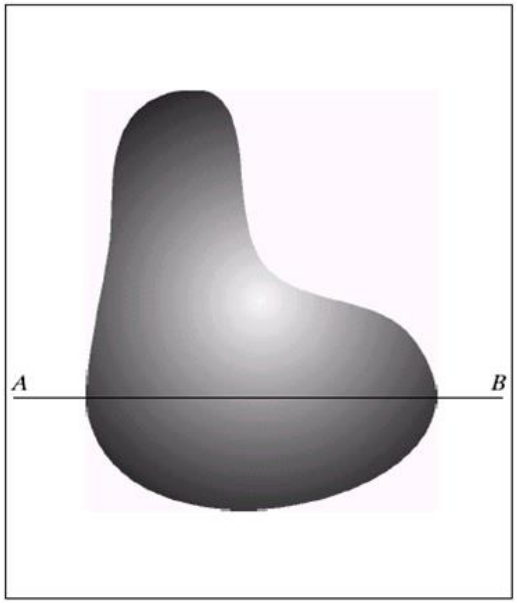
$$f(m,n) \triangleq f(m\Delta x, n\Delta y)$$

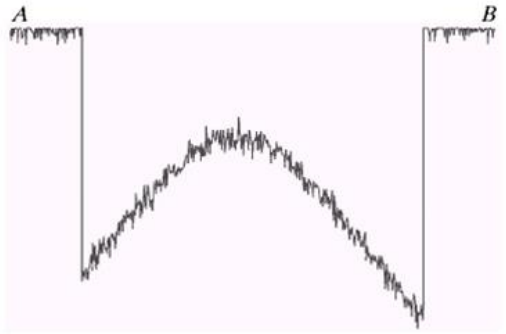
  - Δx and Δy sampling period along *x* and *y* axis

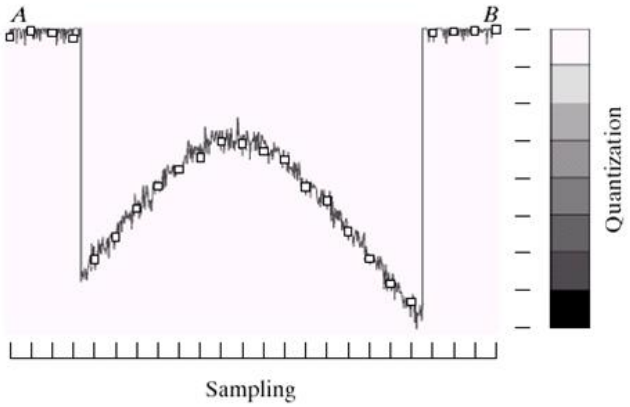
- Quantization:

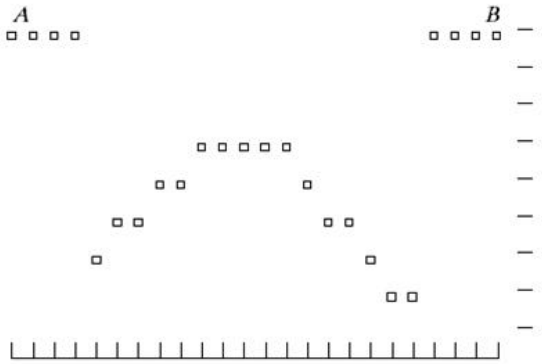
$$f_d(m,n) = Q[f(m,n)]$$

Sampling and quantization

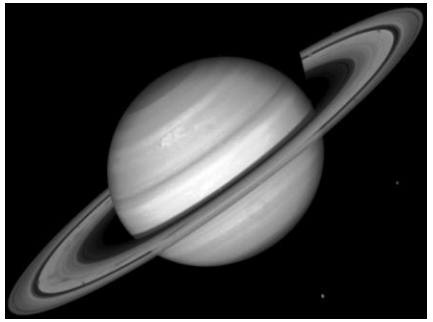








Digital gray level images



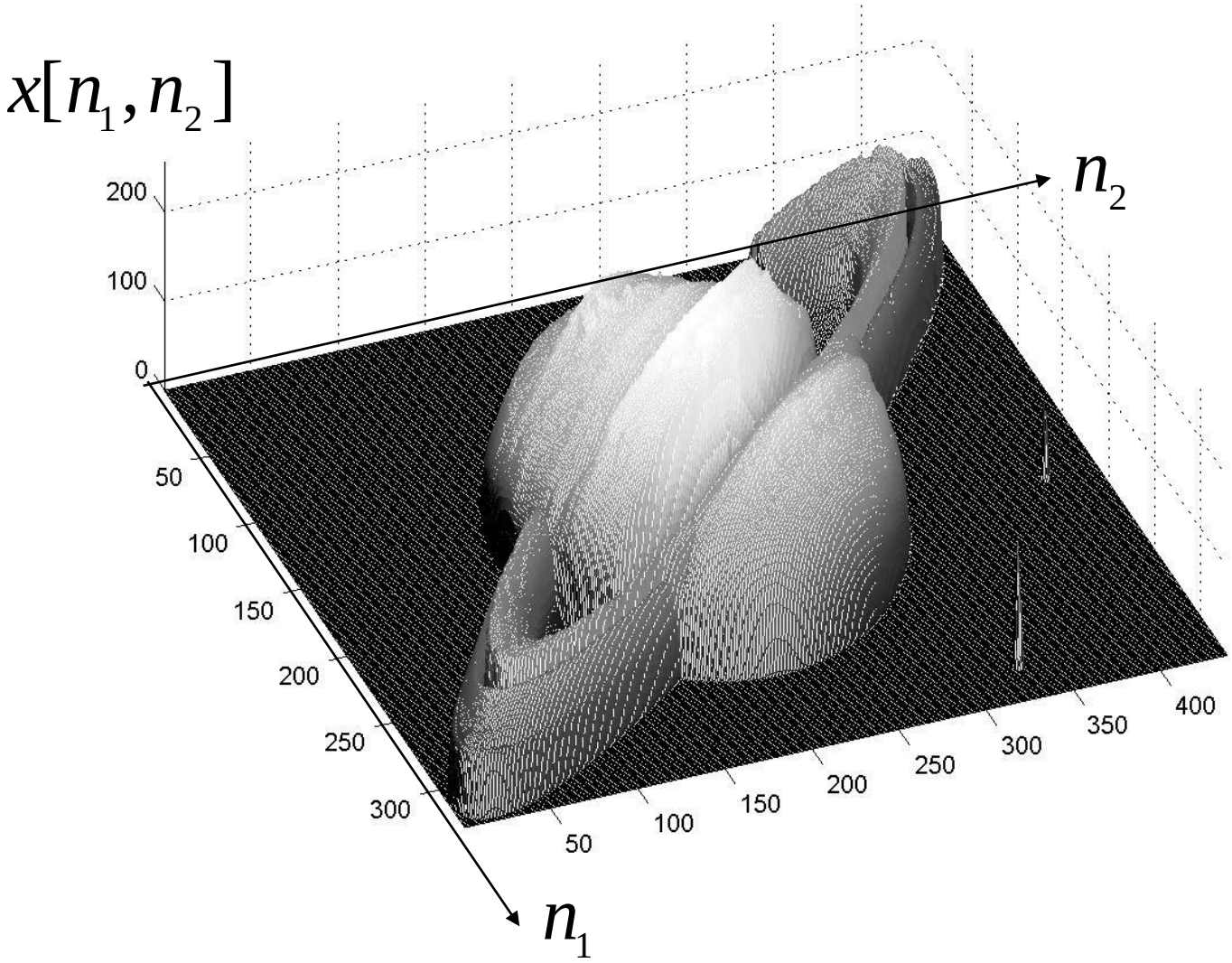


Image coordinate system(s)

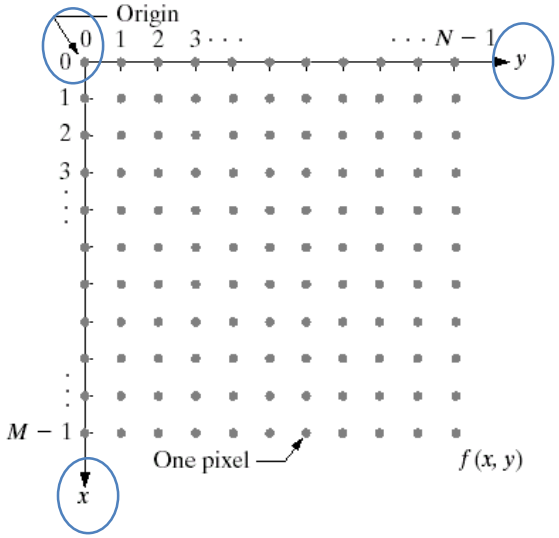
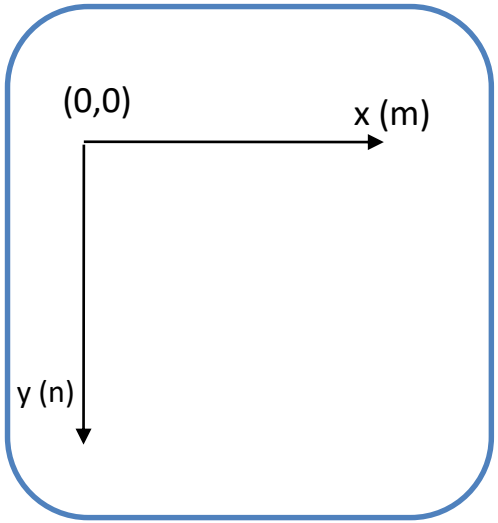


FIGURE 2.18 Coordinate convention used in this book to represent digital images.



Caveats

- Vertical axis usually pointing down
- (x, y) vs (r, c)
- Starting index: 0 vs 1

	Origin	(x,y)	X Axis	Y Axis
Computer Vision (this course)	**(0,0)**	**(c,r)**	**O**	**V**
Gonzalez- Woods	(0,0)	(r,c)	V	O
Matlab	(1,1)	(r,c)	V	O
Image processing libraries (C++, Java, OpenCV)	(0,0)	(c,r)	O	V
Gimp (and most photo-editing softwares)	(0,0)	(c,r)	O	V

Digital color image

n_2

n_1

$$x[n_1, n_2] = \begin{bmatrix} r[n_1, n_2] \\ g[n_1, n_2] \\ b[n_1, n_2] \end{bmatrix}$$

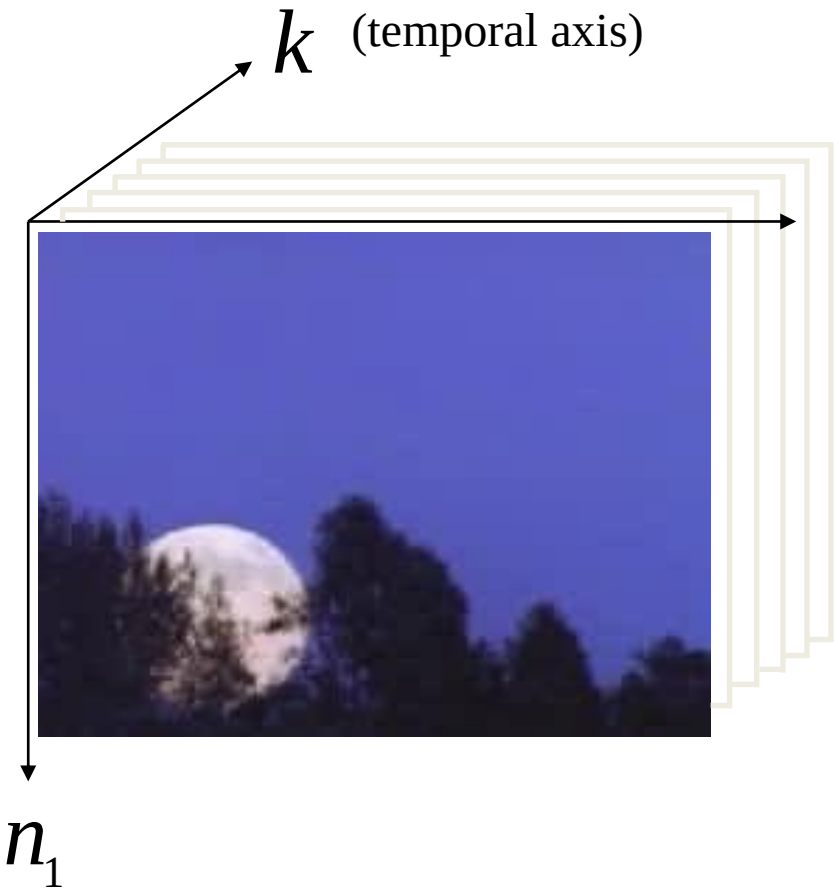
Digital color image

$b[n_1, n_2]$

$g[n_1, n_2]$

$r[n_1, n_2]$

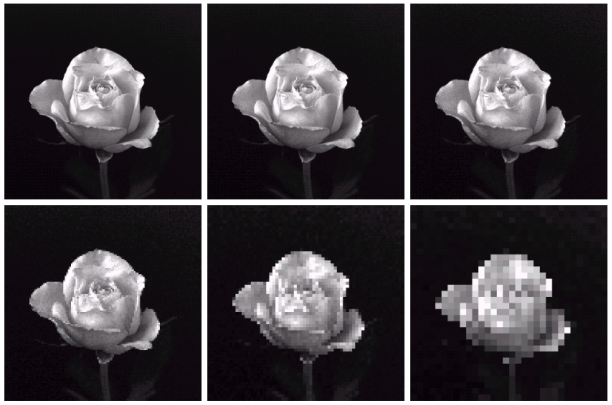
Digital color video



$$x[n_1, n_2, k] = \begin{bmatrix} r[n_1, n_2, k] \\ g[n_1, n_2, k] \\ b[n_1, n_2, k] \end{bmatrix}$$

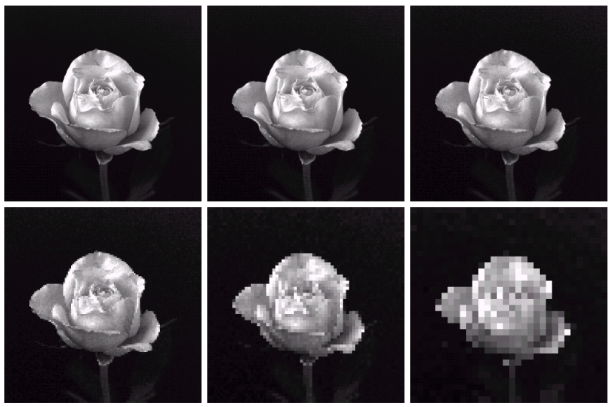
Spatial & gray-level resolution

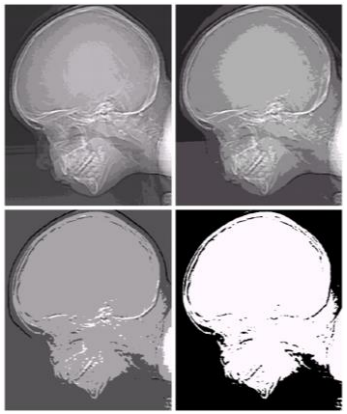
- Spatial resolution – influences the smallest detectable detail in the image
  - # of pixels per unit distance



Spatial & gray-level resolution

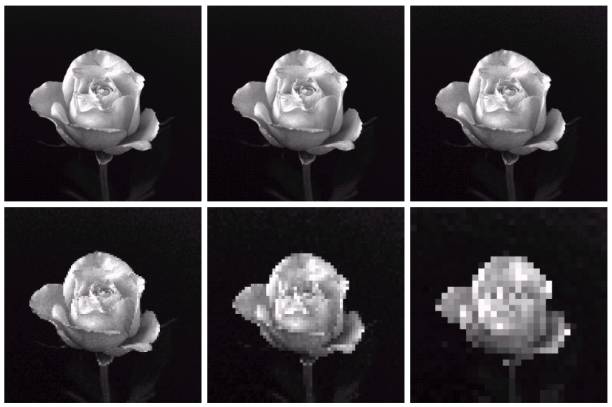
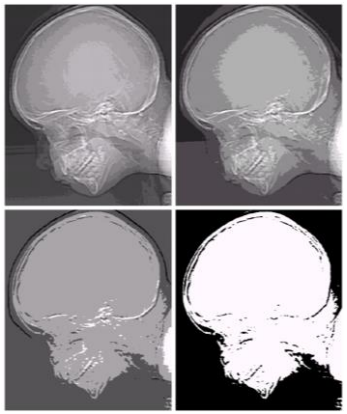
- Spatial resolution – influences the smallest detectable detail in the image
- Gray-level/intensity resolution – smallest detectable change in gray level
  - # of bits per pixel



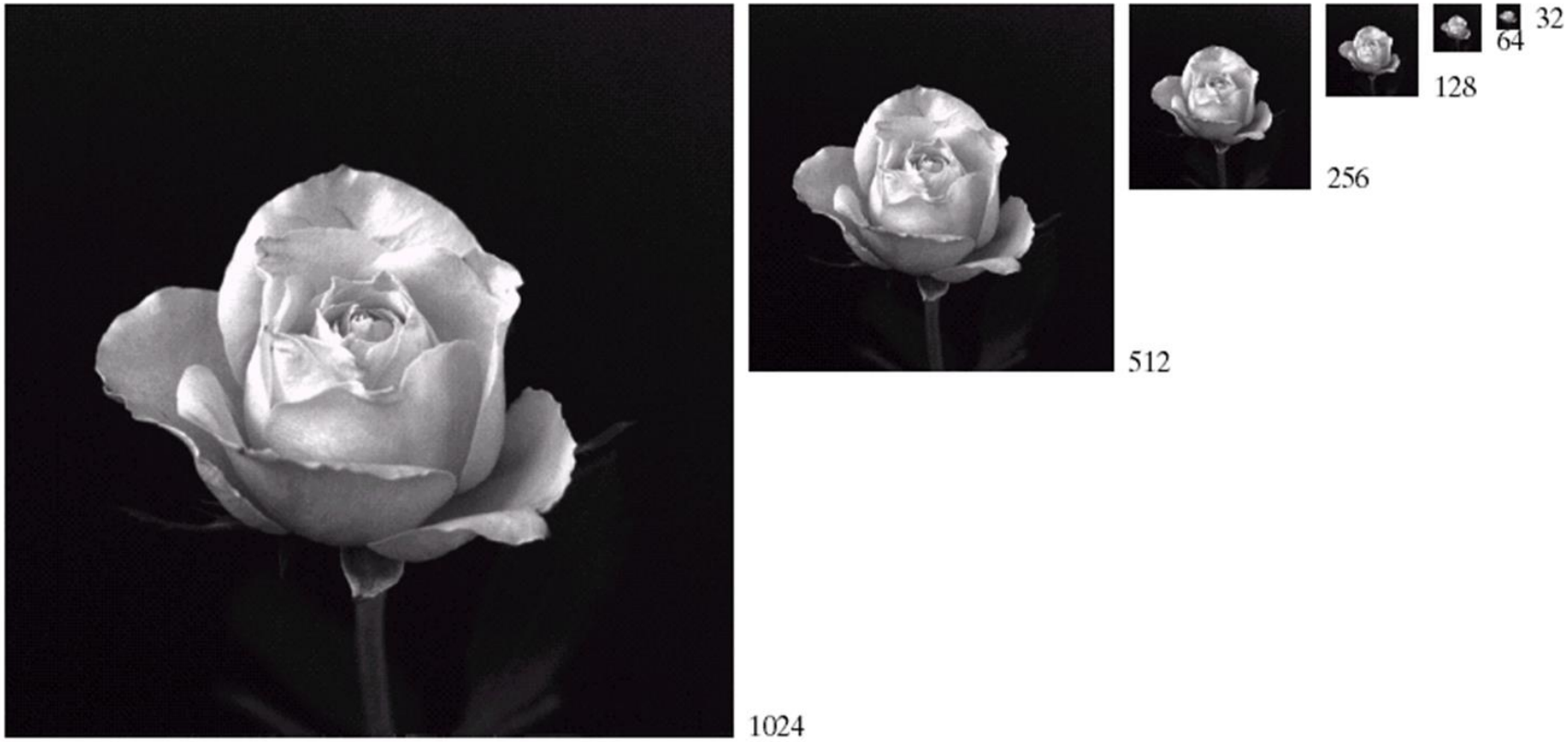


Spatial & gray-level resolution

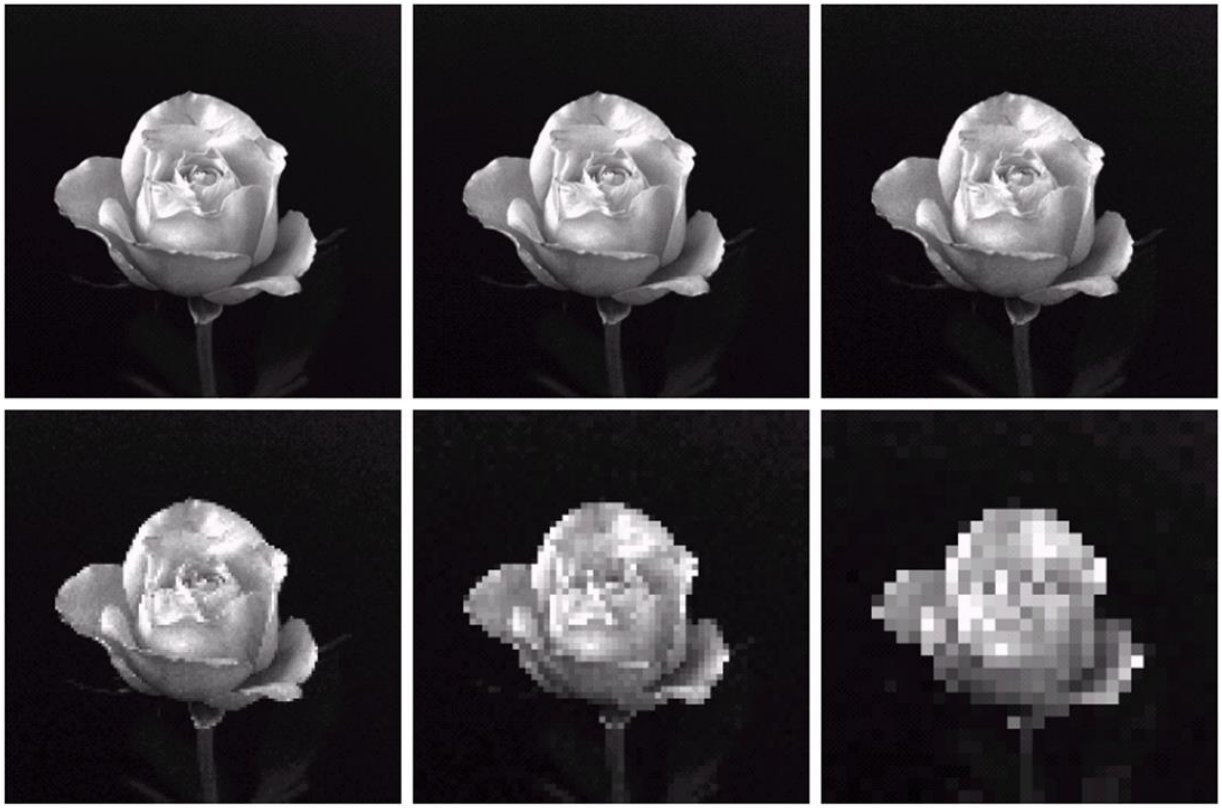
- Spatial resolution – smallest detectable detail in the image
- Gray-level resolution – smallest detectable change in gray level
- Contrast – difference between highest and lowest gray level in the image

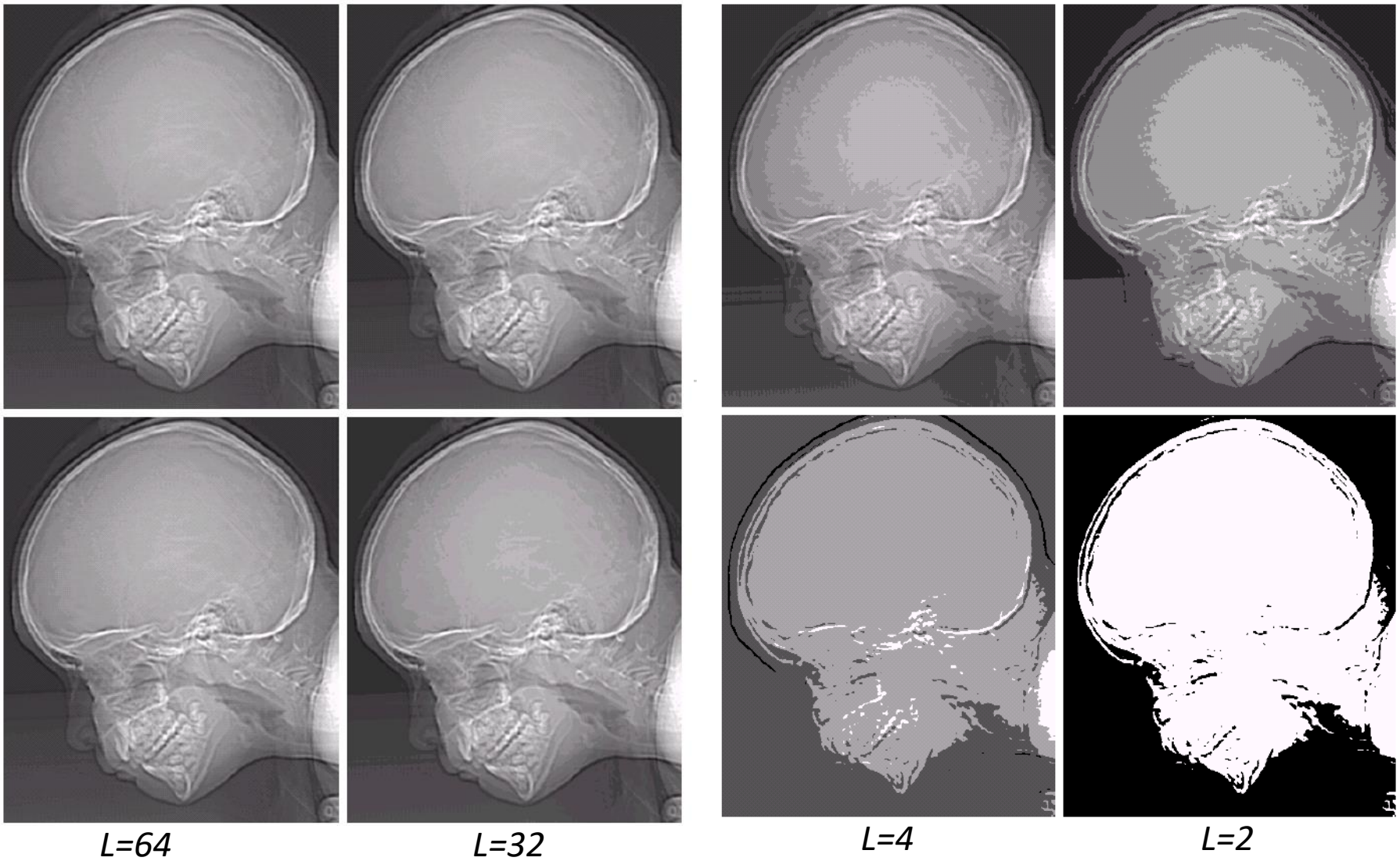
Spatial resolution – example



Spatial resolution – example



Gray-level resolution – example



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