

Herramientas

Visión por computador



Herramientas del curso

Formación básica

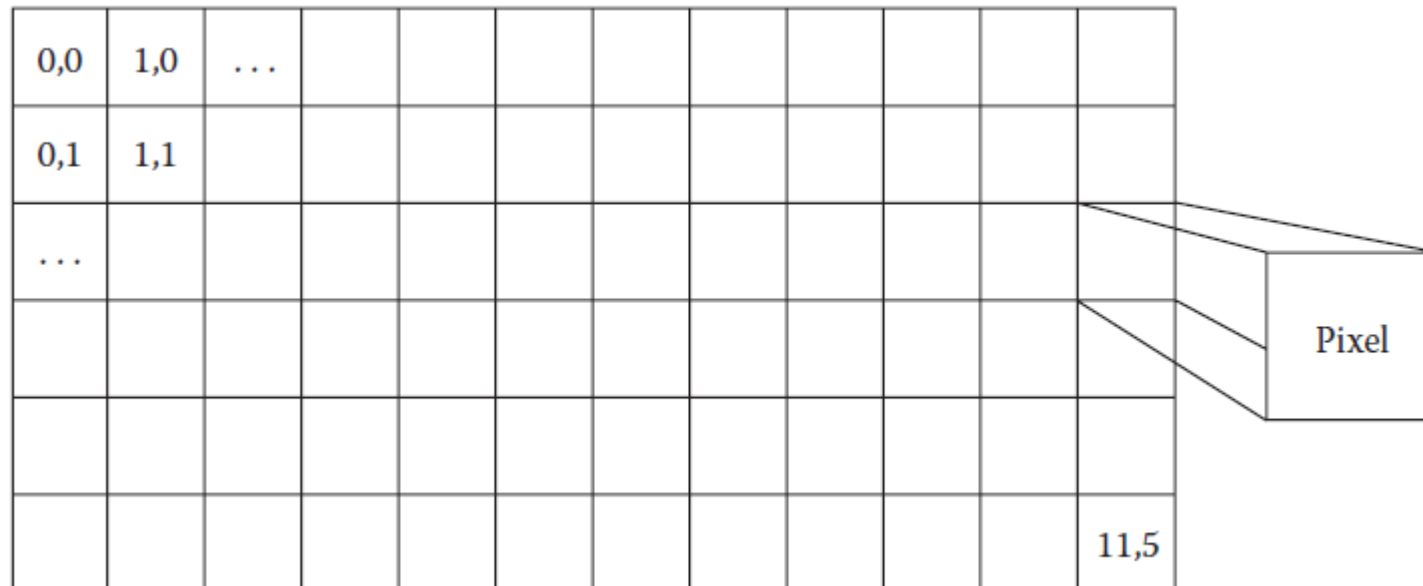
- ✓ Álgebra matricial.
- ✓ Estadística.
- ✓ Física de la luz.

Lenguajes de programación y librerías.

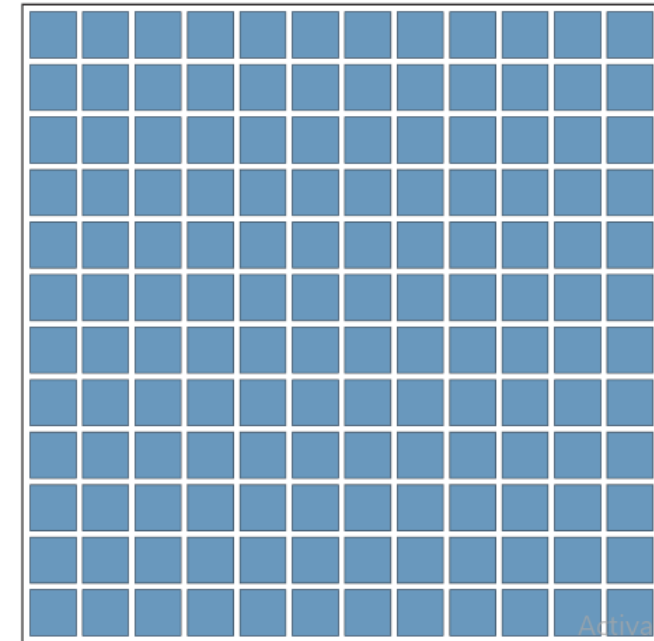
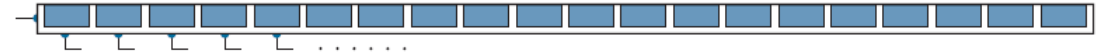
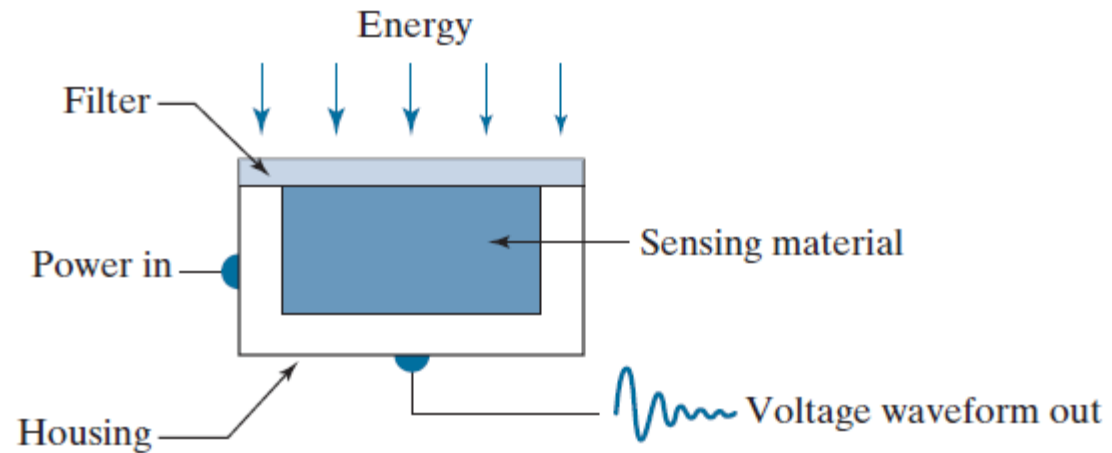
- Python (Numpy, Matplotlib).
- Pillow.
- Scikit image.
- Open CV.



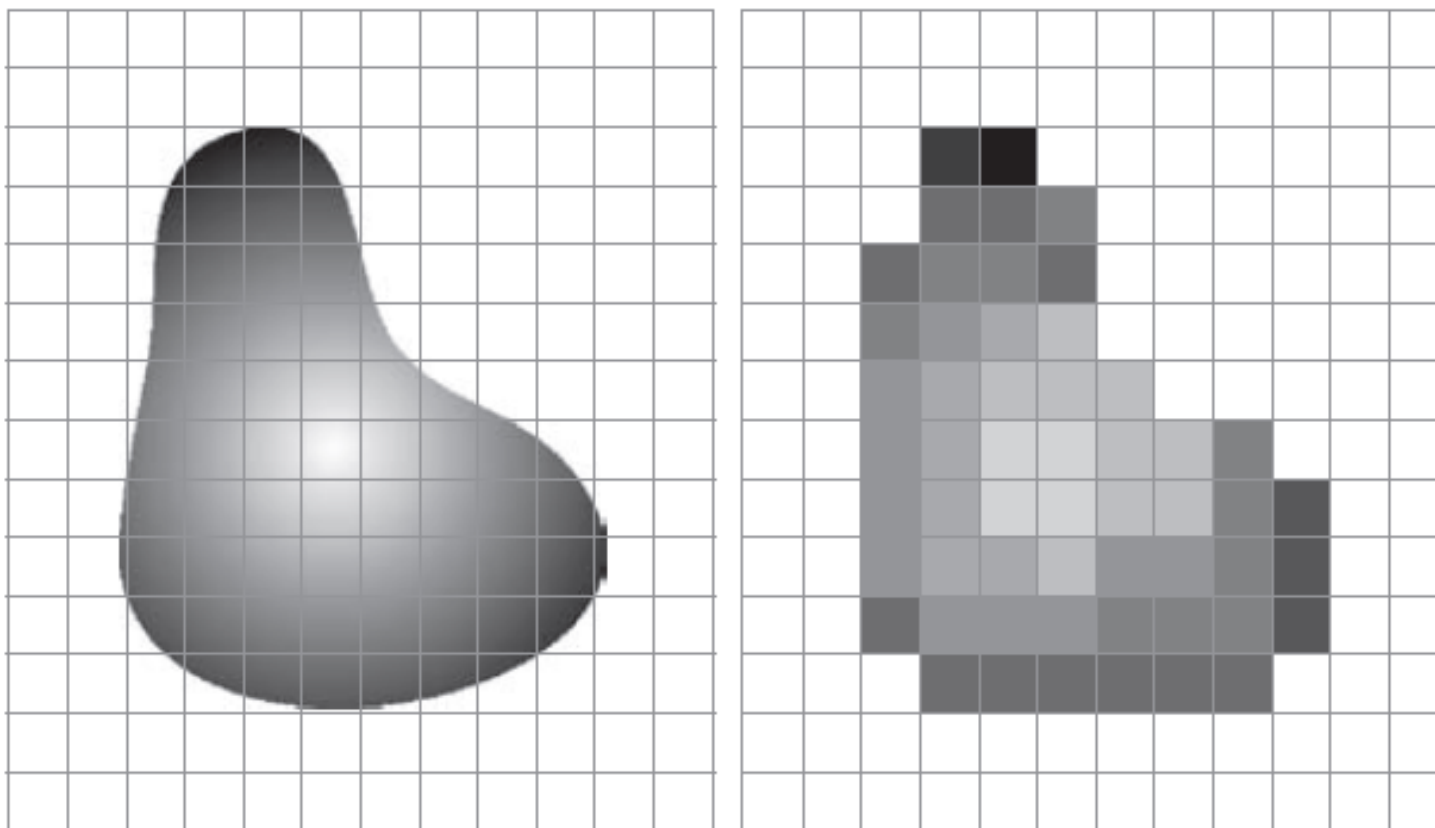
¿Qué es una imagen?



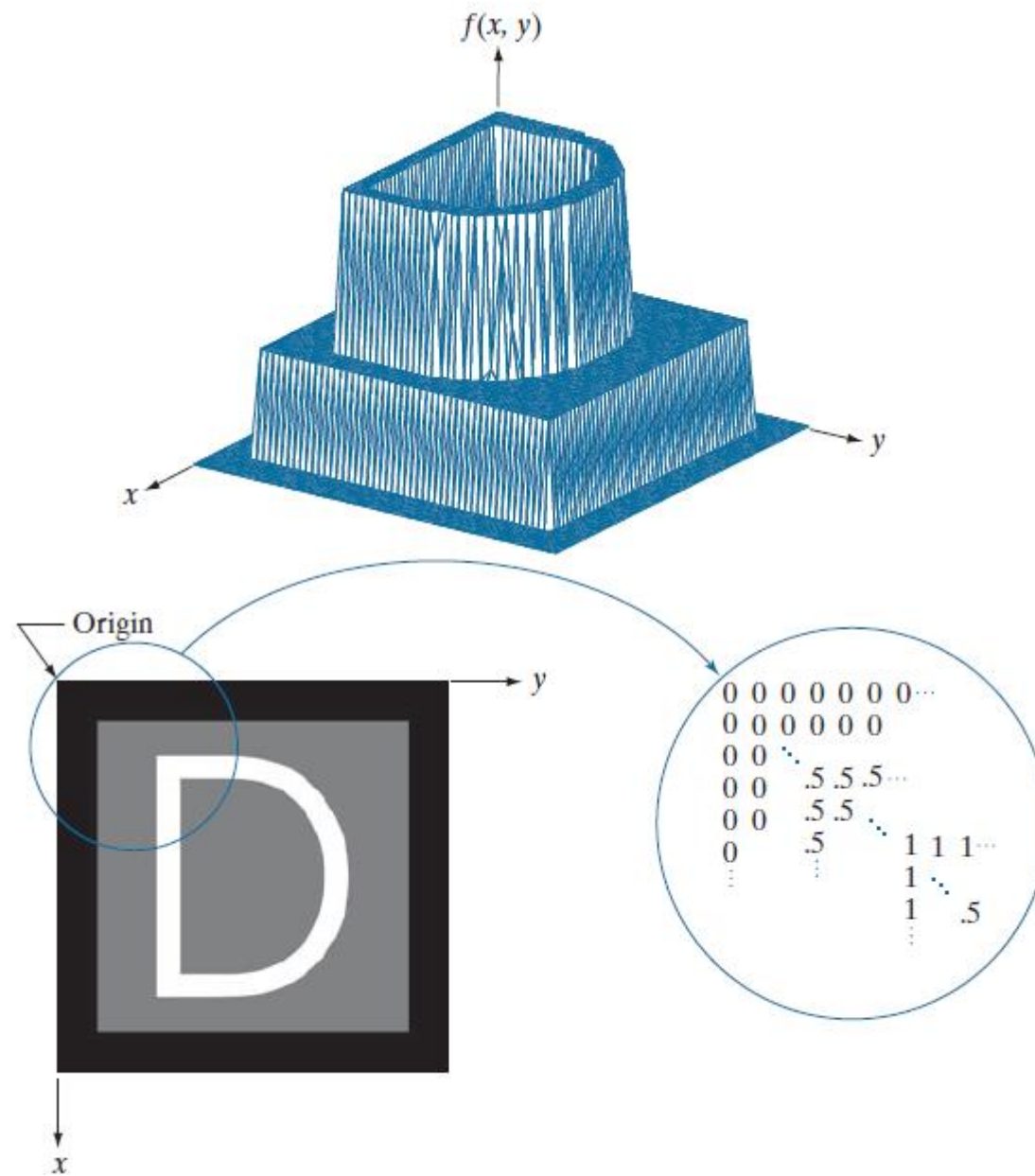
Adquisición de la imagen



Activar Windows
Vea a Configuración para activar W

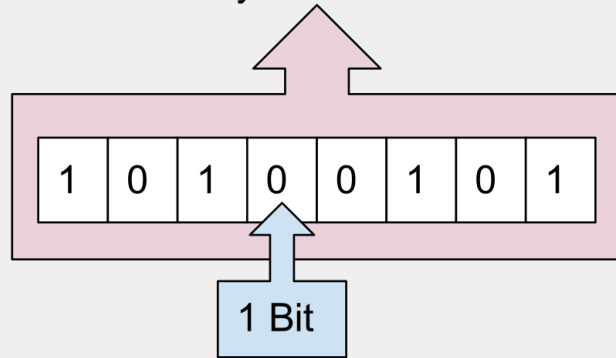


(Gonzales y Woods, 2018)



(Gonzales y Woods, 2018)

1 Byte = 8 Bits

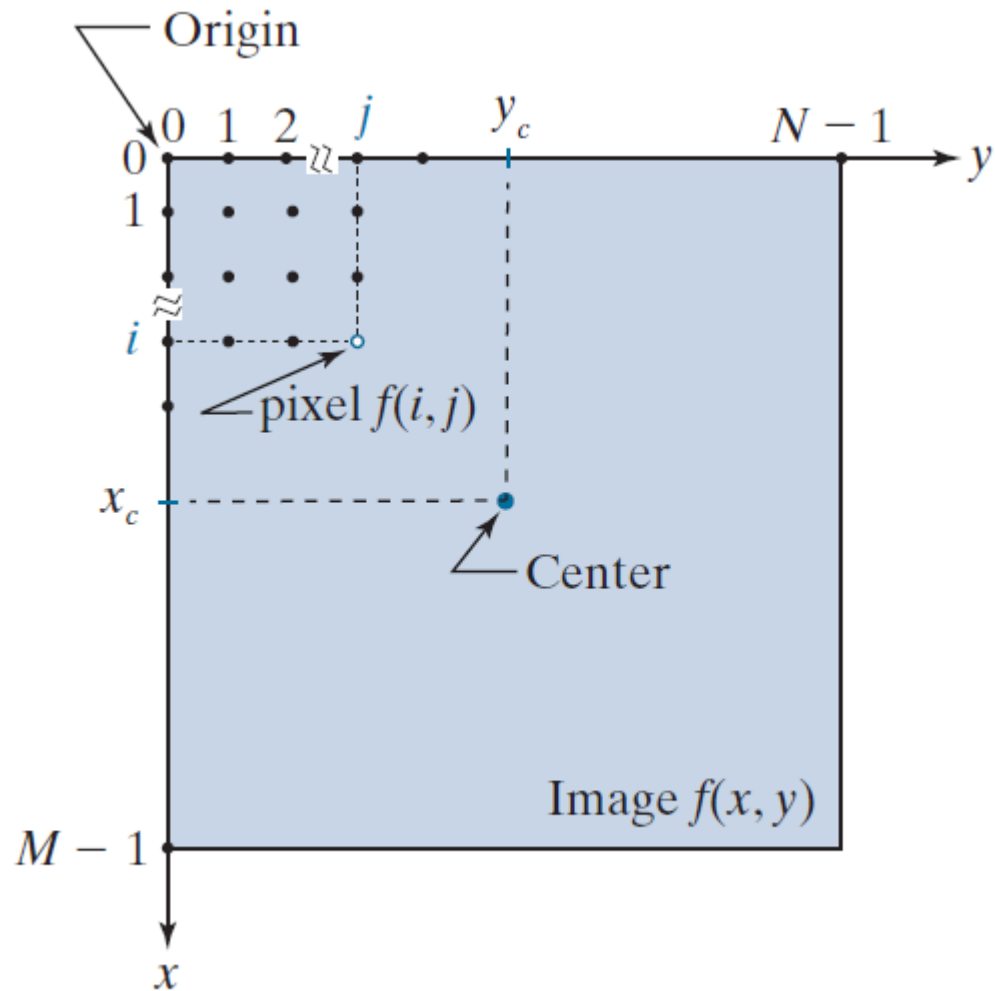


1 byte = 8 bits
1 kilobyte = 1024 bytes
1 megabyte = 1024 kilobyte
1 gigabyte = 1024 megabyte
1 terabyte = 1024 gigabyte

Created by: Frank Carmody 2016
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CÓDIGO BINARIO

A	01000001	N	01001110	a	01100001	n	01101110
B	01000010	O	01001111	b	01100010	o	01101111
C	01000011	P	01010000	c	01100011	p	01110000
D	01000100	Q	01010001	d	01100100	q	01110001
E	01000101	R	01010010	e	01100101	r	01110010
F	01000110	S	01010011	f	01100110	s	01110011
G	01000111	T	01010100	g	01100111	t	01110100
H	01001000	U	01010101	h	01101000	u	01110101
I	01001001	V	01010110	i	01101001	v	01110110
J	01001010	W	01010111	j	01101010	w	01110111
K	01001011	X	01011000	k	01101011	x	01111000
L	01001100	Y	01011001	l	01101100	y	01111001
M	01001101	Z	01011010	m	01101101	z	01111010



- M y N son enteros positivos.
- El valor de cada pixel (Intensidad): L
- Los niveles de L son discretos y están igualmente espaciados.
- Son números enteros en el rango: $[0, L - 1]$

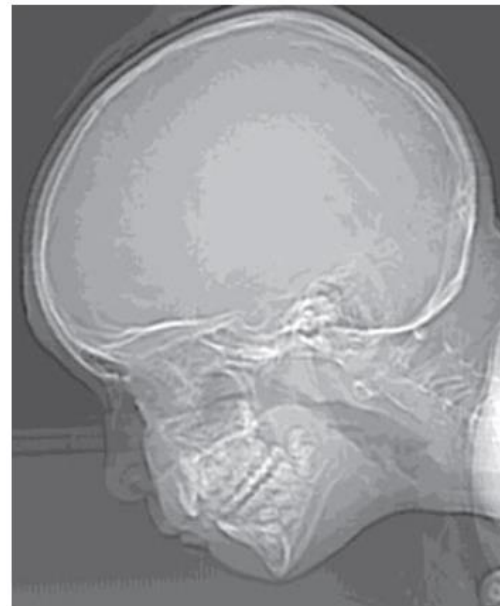
$$L = 2^k$$



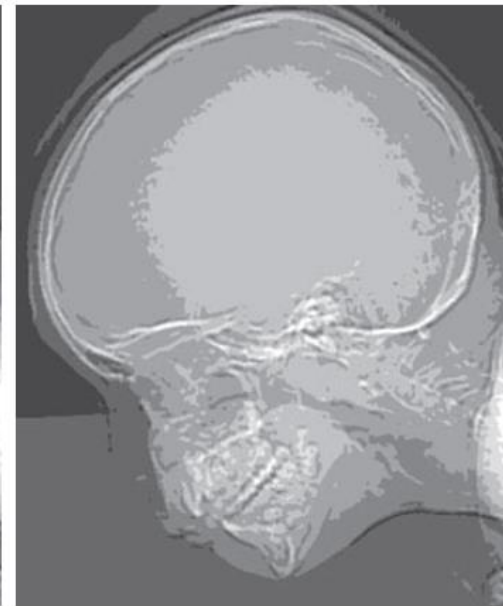
$2^8 = \text{imagen de 8 bits (L = 256)}$



$2^7 = \text{imagen de 7 bits (L = 128)}$



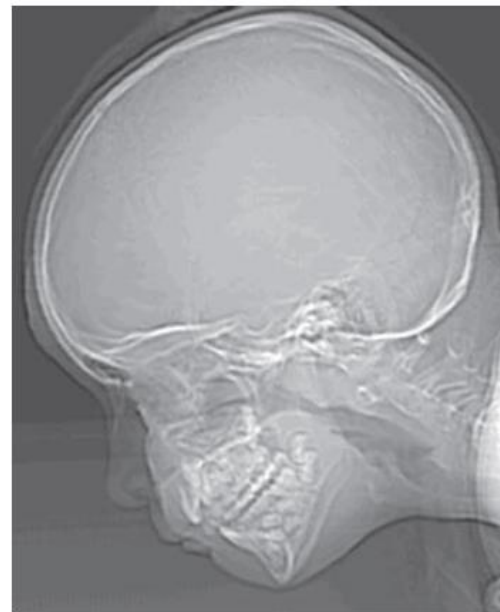
$2^4 = \text{imagen de 4 bits (L = 16)}$



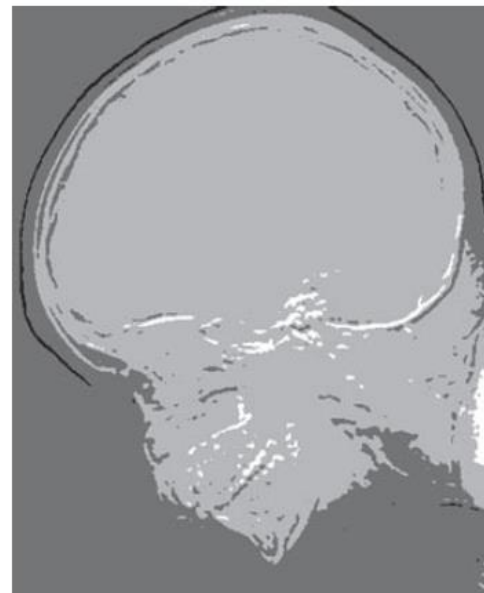
$2^3 = \text{imagen de 3 bits (L = 8)}$



$2^6 = \text{imagen de 6 bits (L = 64)}$



$2^5 = \text{imagen de 5 bits (L = 32)}$



$2^2 = \text{imagen de 2 bits (L = 4)}$



$2^1 = \text{imagen de 1 bit (L = 2)}$

Almacenamiento

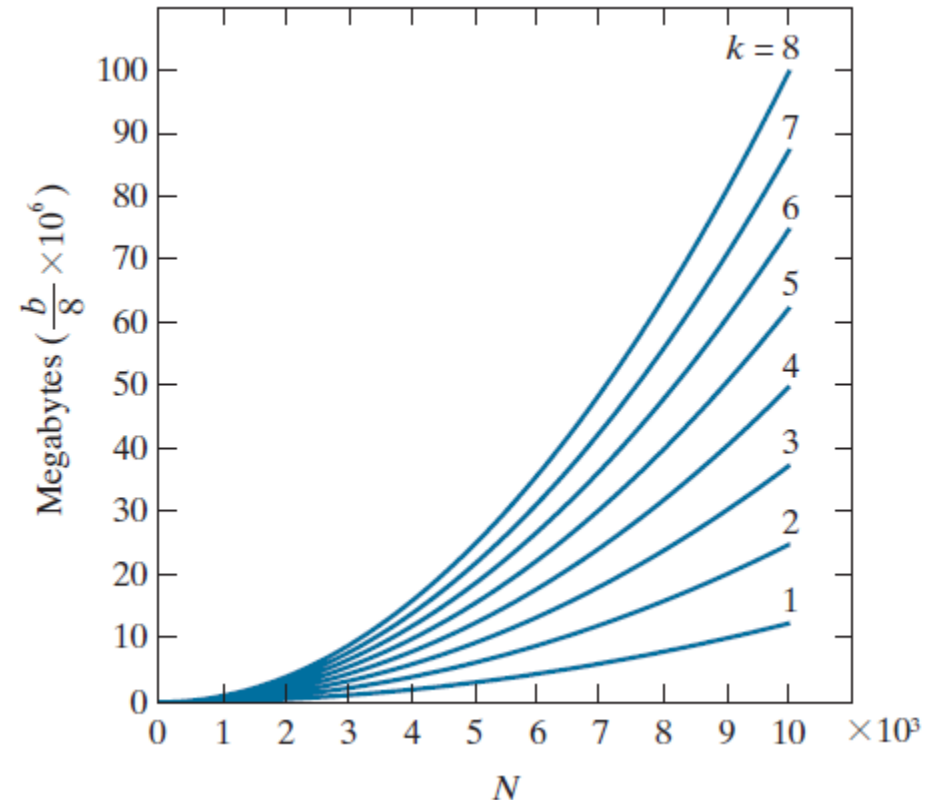
- El número, b , de bits necesarios para almacenar una imagen digital es:

$$b = M \times N \times k$$








Cuando $M = N$, esta ecuación se convierte en

$$b = N^2 k$$

(Gonzales y Woods, 2018)



Ejemplo de datos de imagen en escala de grises

Image data	00000000	01000000	00100110	11110000	10101100	01000110	11111111
Coordinate	(0,0)	(0,1)	(0,2)	(0,3)	(11,3)	(11,4)	(11,5)
Gray value	0	128	38	240	172	70	255
Intensity							

Tipos de archivos para imágenes

A Comparison of Common Image File Formats

Full name	Extension	Compression	Allows tagging	Description
Bitmap (BMP)	.bmp	Lossless	No	Can make use of limited compression, but is often uncompressed. This results in very large file sizes.
Portable Network Graphic (PNG)	.png	Lossless	No	Now very common, reasonable lossless encoding now makes PNG preferable to BMP in many situations.
Tagged Image File Format (TIFF)	.tiff	Lossless	Yes	Often used in scientific research. Uses lossless encoding but also allows a significant amount of extra information to be included in tags.
Joint Photographic Experts Group (JPEG)	.jpg, .jpeg	Lossy	Yes	Generally used to store photographs, the lossy compression in JPEG might be unsuitable for scientific use. However, the amount of compression can be altered, and at low levels a large decrease in file size can still be obtained, with minimal loss in quality.
Graphics Interchange Format (GIF)	.gif	Lossy	No	GIF compression uses a color palette of only 256 colors, and is unsuitable for scientific use in most cases.

(Dutta Gupta and Yasuomi Ibaraki,2016)

Algebra matricial

- Suma y resta.

$$A = \begin{pmatrix} 2 & 0 & 1 \\ 3 & 0 & 0 \\ 5 & 1 & 1 \end{pmatrix} \quad B = \begin{pmatrix} 1 & 0 & 1 \\ 1 & 2 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

$$A + B = \begin{pmatrix} 2+1 & 0+0 & 1+1 \\ 3+1 & 0+2 & 0+1 \\ 5+1 & 1+1 & 1+0 \end{pmatrix} = \begin{pmatrix} 3 & 0 & 2 \\ 4 & 2 & 1 \\ 6 & 2 & 1 \end{pmatrix}$$

$$A - B = \begin{pmatrix} 2-1 & 0-0 & 1-1 \\ 3-1 & 0-2 & 0-1 \\ 5-1 & 1-1 & 1-0 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 \\ 2 & -2 & -1 \\ 4 & 0 & 1 \end{pmatrix}$$

Algebra matricial

- Multiplicación de matrices.

$$\begin{pmatrix} 1 & 2 \\ 4 & 5 \\ 7 & 8 \end{pmatrix} \cdot \begin{pmatrix} 1 & 2 & 3 \\ 0 & 5 & 2 \end{pmatrix} = \begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{pmatrix}$$

3 x 2 2 x 3 3 x 3

Si se pueden multiplicar

$$\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \cdot \begin{pmatrix} 1 & 2 & 3 \\ 0 & 5 & 2 \end{pmatrix}$$

3 x 3 2 x 3

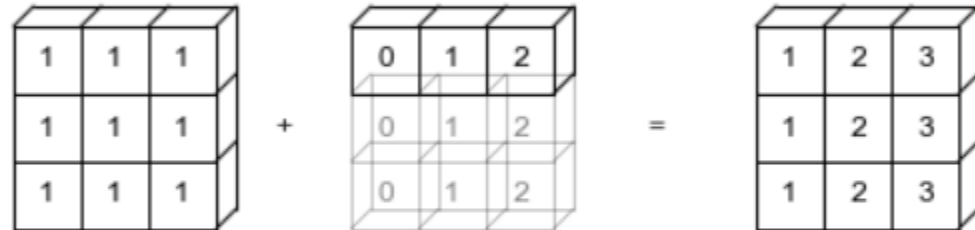
No se pueden multiplicar

Broadcasting - Numpy

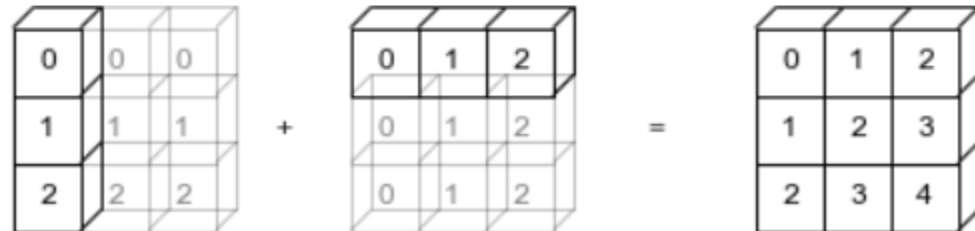
`np.arange(3)+5`



`np.ones((3,3))+np.arange(3)`



`np.arange(3).reshape((3,1))+np.arange(3)`



Algebra matricial

^ Matriz transpuesta

Matriz Transpuesta (A^T)

$$\text{Sea } A = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$$

$$A^T = \begin{bmatrix} a_{11} & a_{21} & a_{31} \\ a_{12} & a_{22} & a_{32} \\ a_{13} & a_{23} & a_{33} \end{bmatrix}$$

Se cambian filas por columnas.

Propiedades de la transpuesta

1. $(A^T)^T = A$
2. $(A + B)^T = A^T + B^T$
3. $(c \cdot A)^T = c \cdot A^T$
4. $(A \cdot B)^T = B^T \cdot A^T$

^ Matriz inversa

Matriz Inversa (A^{-1})

$$\text{Sea } A = \begin{bmatrix} 1 & 0 & 3 \\ 0 & 1 & -2 \\ 1 & 1 & 2 \end{bmatrix}, A^{-1} = \begin{bmatrix} 4 & 3 & 3 \\ -2 & -1 & -2 \\ -1 & -1 & 3 \end{bmatrix}$$

Fórmulas para obtenerla

$$A^{-1} = \frac{1}{\det A} \cdot A$$

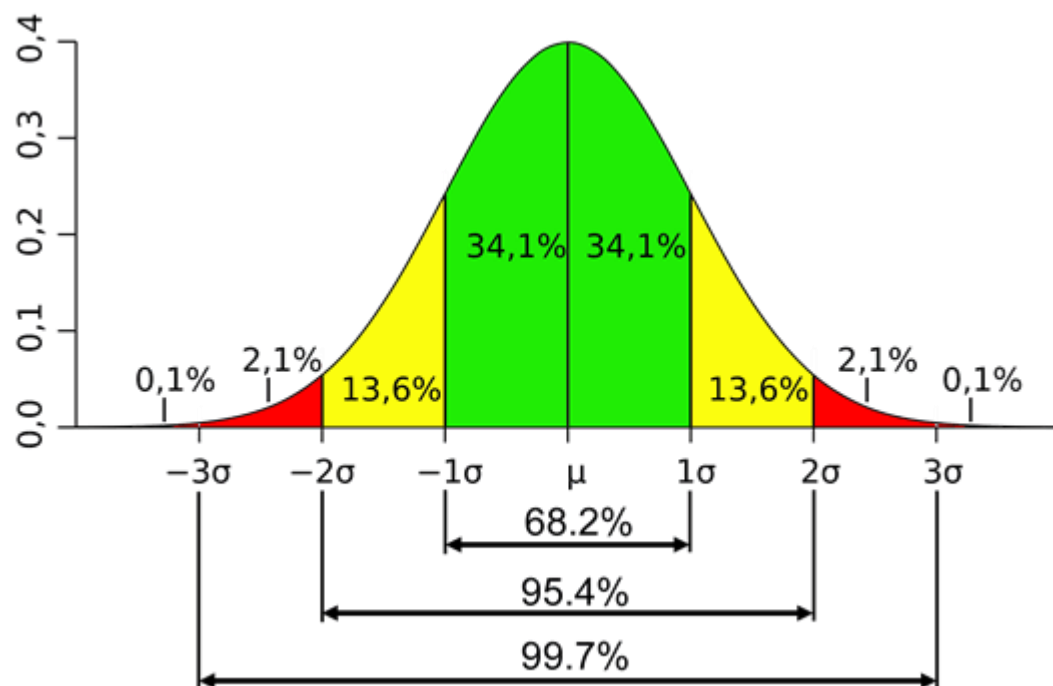
$$A^{-1} = \frac{1}{\det A} \cdot \text{adj } A$$

Propiedades de la inversa

1. $x = A^{-1} \cdot b$
2. $(A \cdot B)^{-1} = B^{-1} \cdot A^{-1}$
3. $(A^{-1})^{-1} = A$
4. $A^{-1}A = I$

Estadística

- Probabilidad



MEDIDAS DE DISPERSIÓN

VARIANZA	DESVIACIÓN ESTÁNDAR
$\sigma^2 = \frac{\sum_1^N (x_i - \bar{X})^2}{N}$	$\sigma = \sqrt{\frac{\sum_1^N (x_i - \bar{X})^2}{N}}$

- X → Variable sobre la que se pretenden calcular la varianza.
- x_i → Observación número i de la variable X . i puede tomará valores entre 1 y n .
- N → Número de observaciones.
- \bar{x} → Es la media de la variable X .

RANGO ESTADÍSTICO	COEFICIENTE DE VARIACIÓN
$R = Máx_x - Mín_x$	$CV = \frac{\sigma_x}{ \bar{X} }$
<ul style="list-style-type: none">• R → Es el rango.• $Máx$ → Es el valor máximo de la muestra o población.• $Mín$ → Es el valor mínimo de la muestra o población estadística.• x → Es la variable sobre la que se pretende calcular esta medida.	<ul style="list-style-type: none">• X → Variable sobre la que se pretenden calcular la varianza.• σ_x → Desviación típica de la variable X.• \bar{x} → Es la media de la variable X en valor absoluto con $\bar{x} \neq 0$.

Histogramas de frecuencia

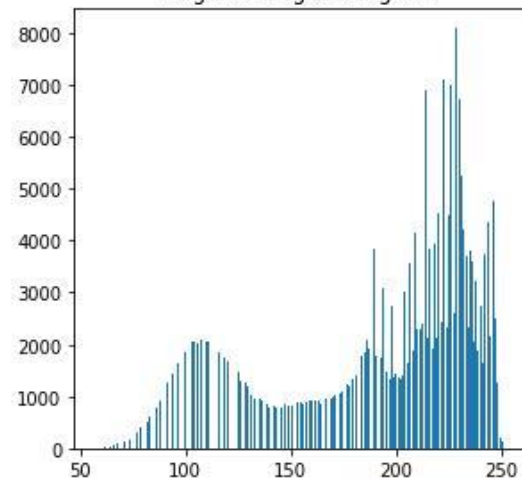
original image



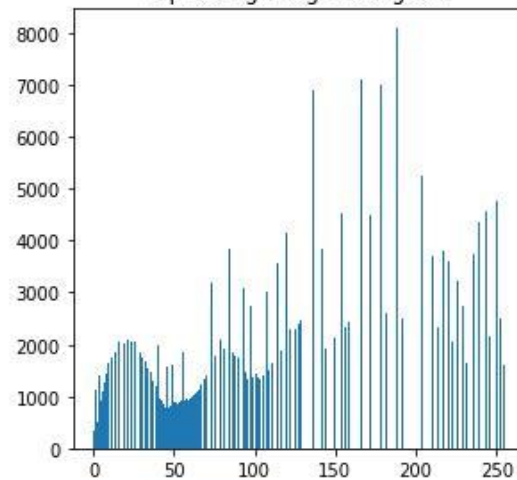
equalizing image



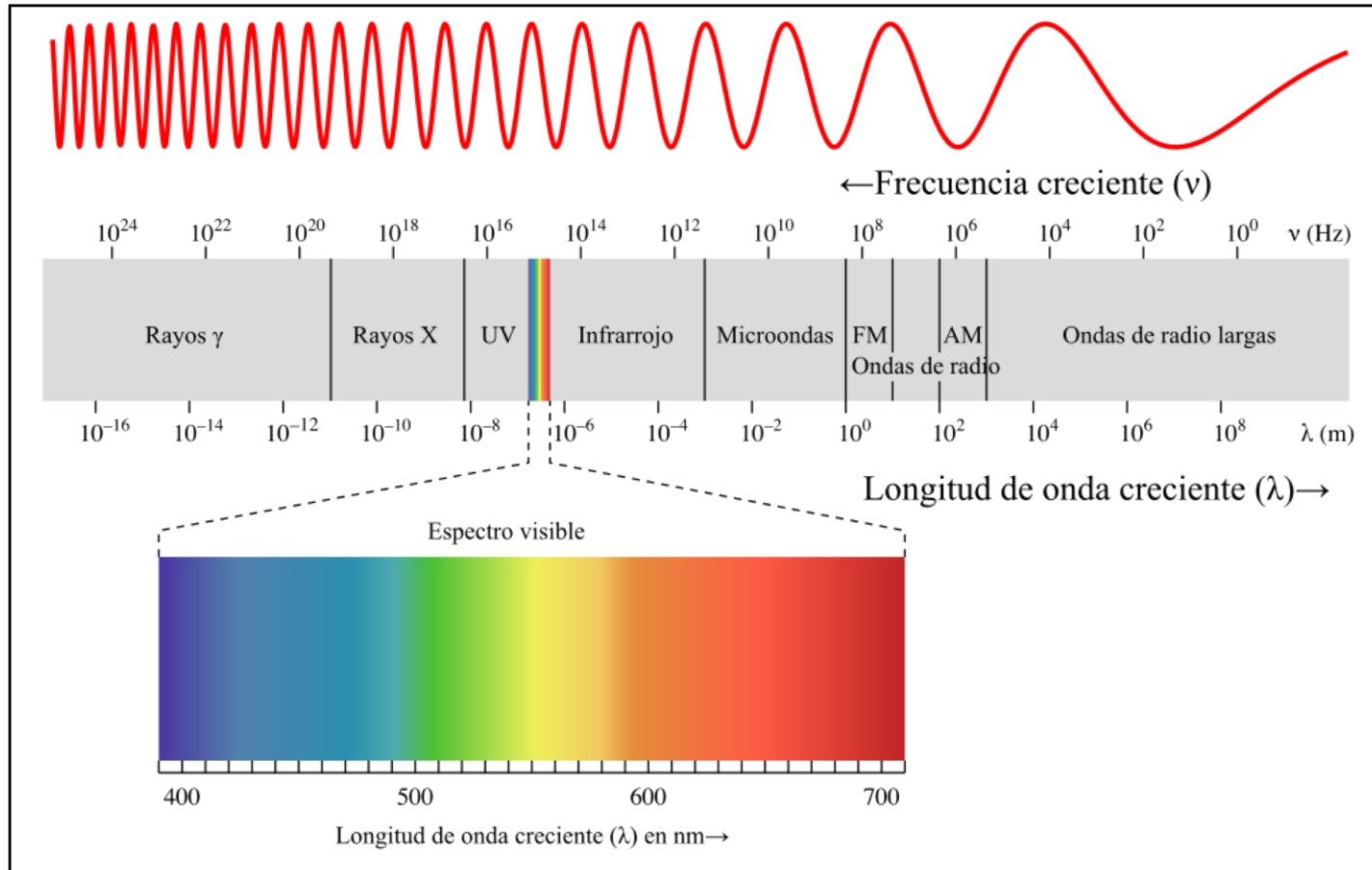
original image histogram



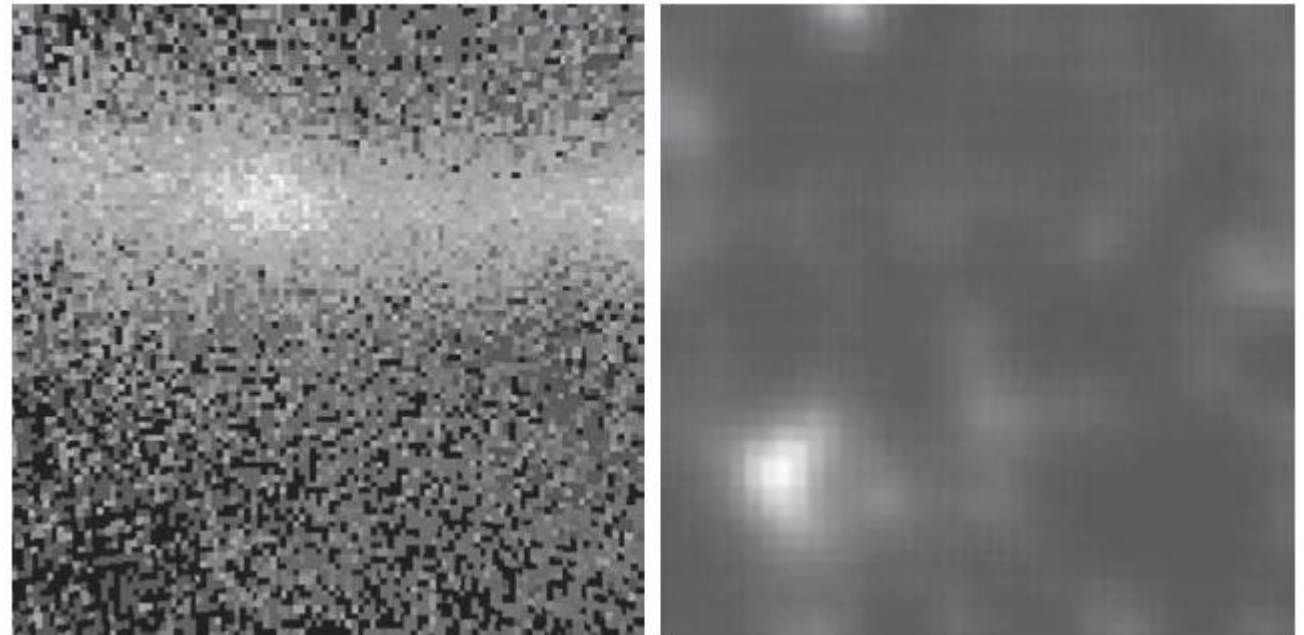
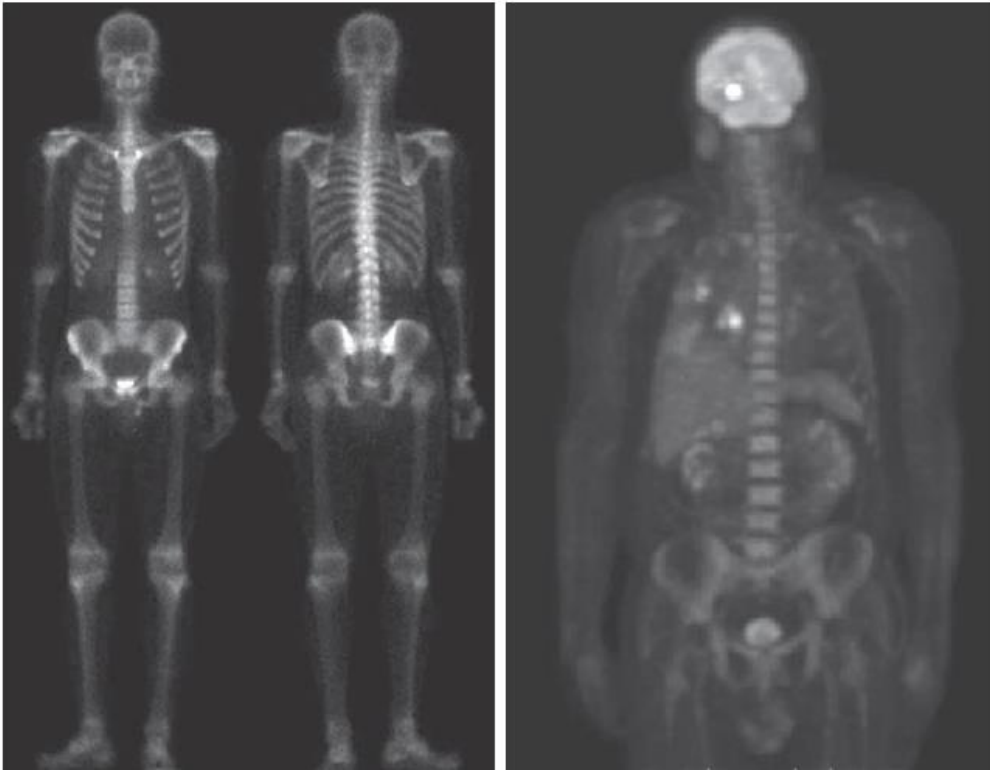
equalizing image histogram



Luz y el espectro electromagnético

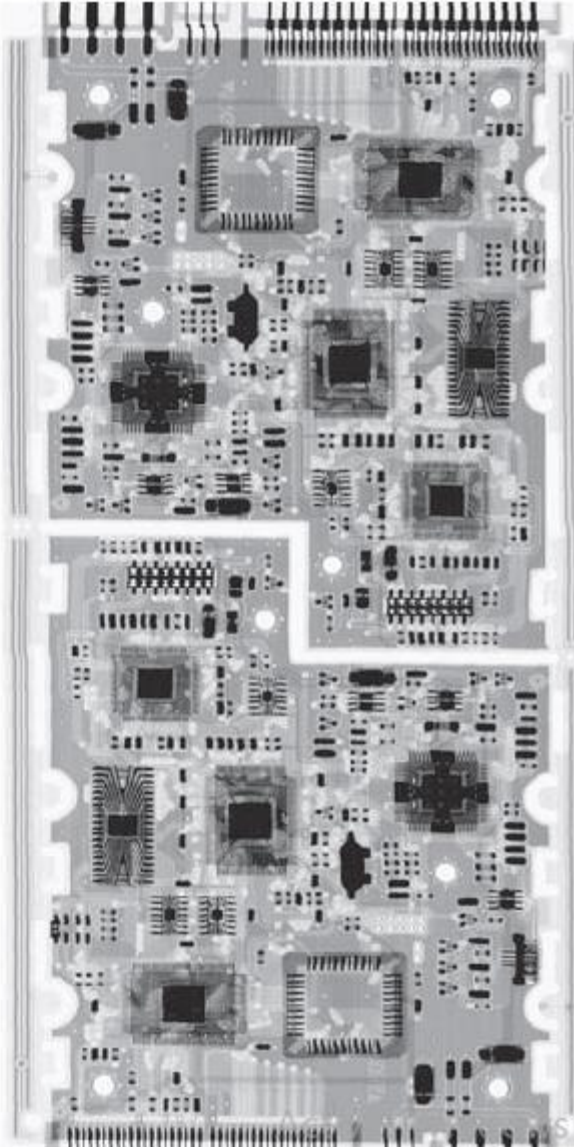
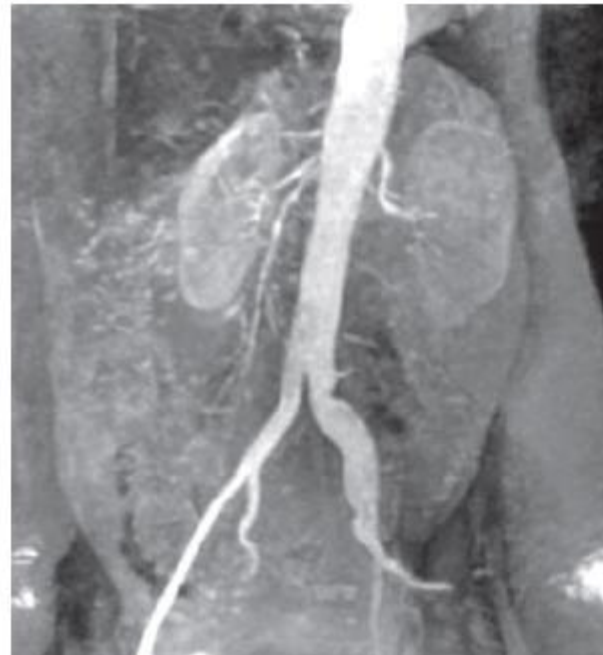


Rayos Gamma



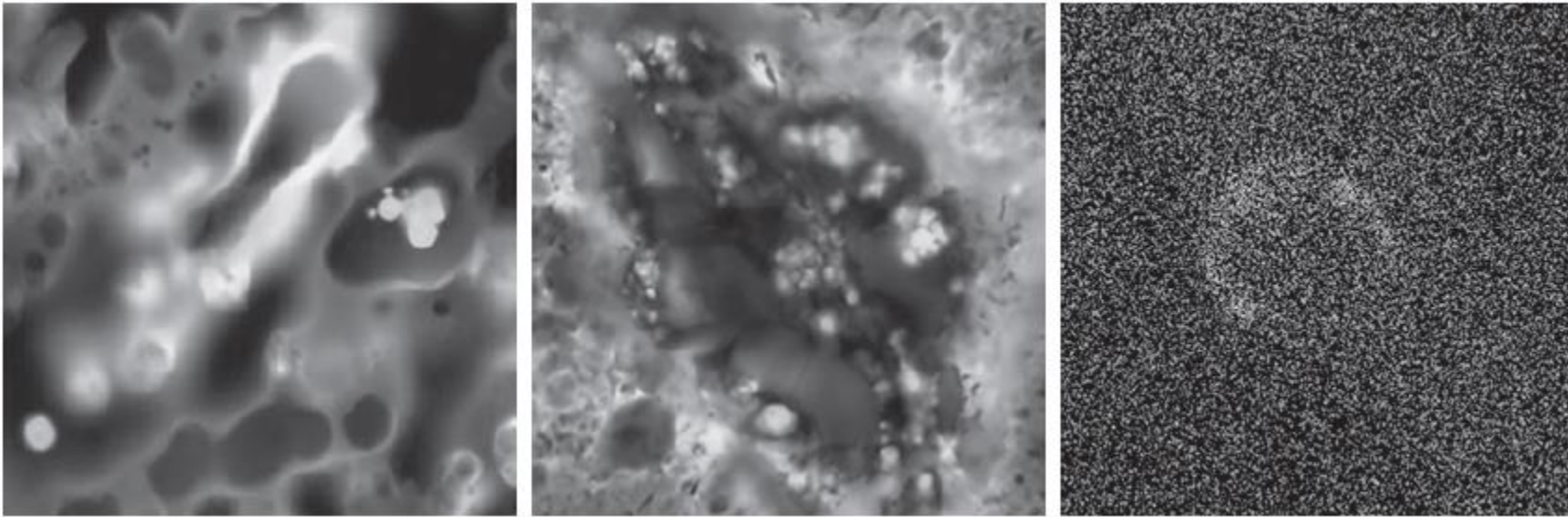
Fuente: Gonzalez y Woods 2018

Rayos X



Fuente: Gonzalez y Woods 2018

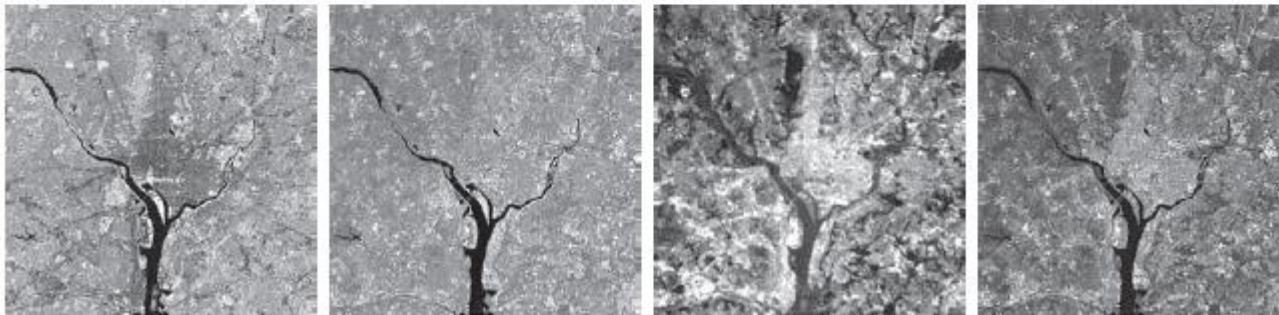
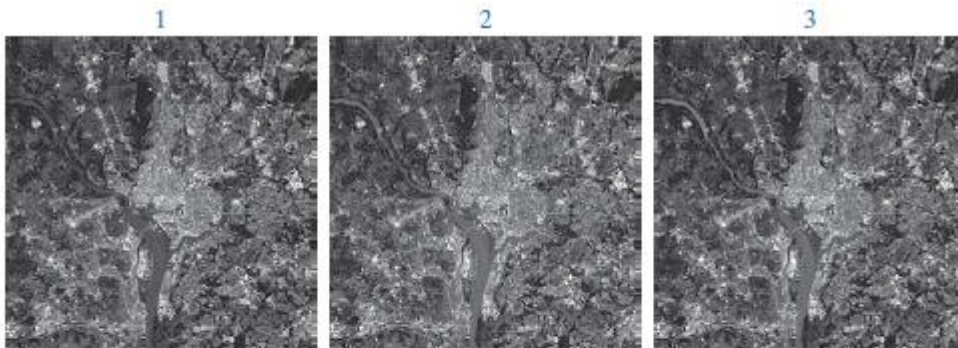
Ultravioleta



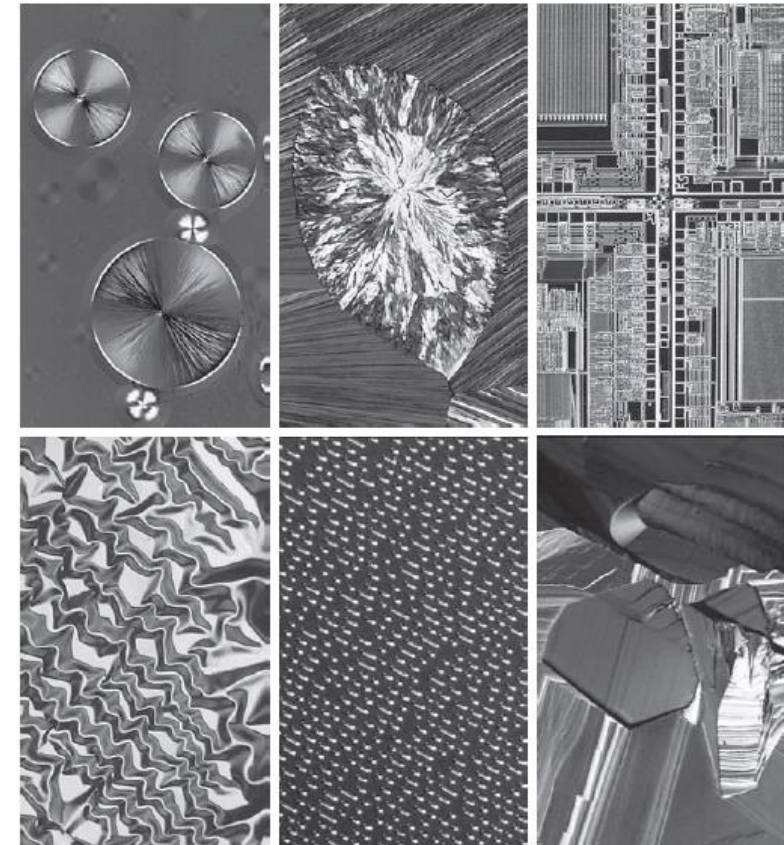
Fuente: Gonzalez y Woods 2018

Bandas visible e infrarojas

Band No.	Name	Wavelength (μm)	Characteristics and Uses
1	Visible blue	0.45–0.52	Maximum water penetration
2	Visible green	0.53–0.61	Measures plant vigor
3	Visible red	0.63–0.69	Vegetation discrimination
4	Near infrared	0.78–0.90	Biomass and shoreline mapping
5	Middle infrared	1.55–1.75	Moisture content: soil/vegetation
6	Thermal infrared	10.4–12.5	Soil moisture; thermal mapping
7	Short-wave infrared	2.09–2.35	Mineral mapping

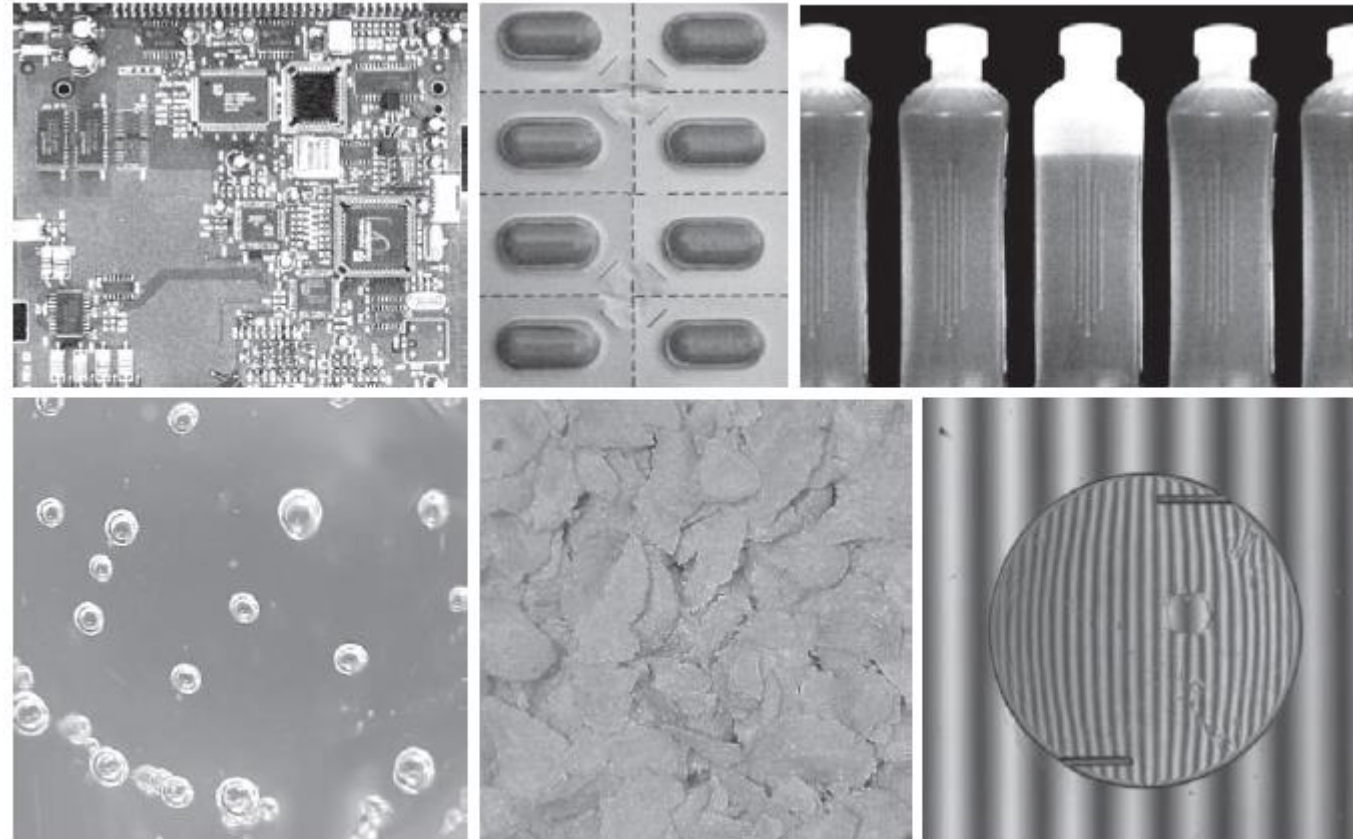


Fuente: ⁴Gonzalez y Woods 2018



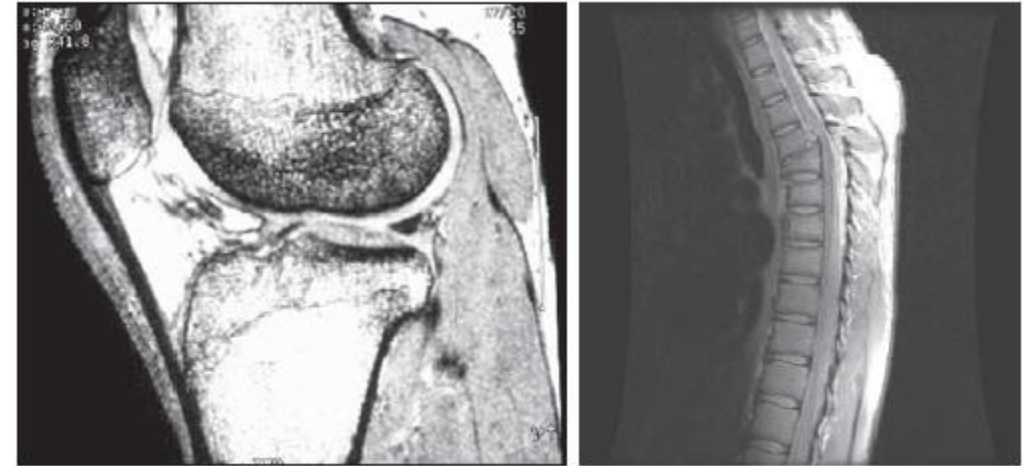
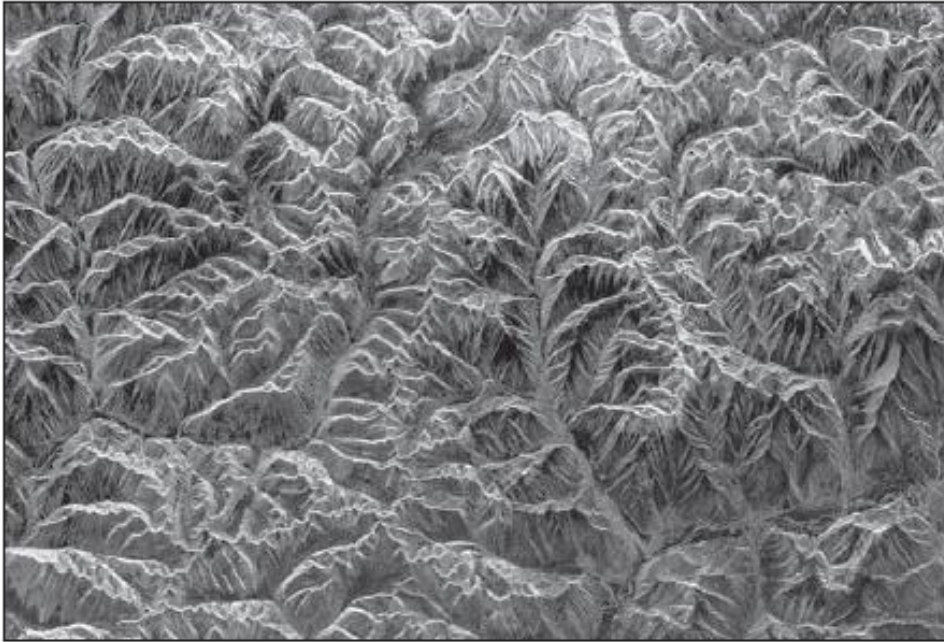
- (a) Taxol (anticancer agent).
- (b) Cholesterol.
- (c) Microprocessor.
- (d) Nickel oxide thin film.
- (e) Surface of audio CD .
- (f) Organic superconductor.

Banda visible

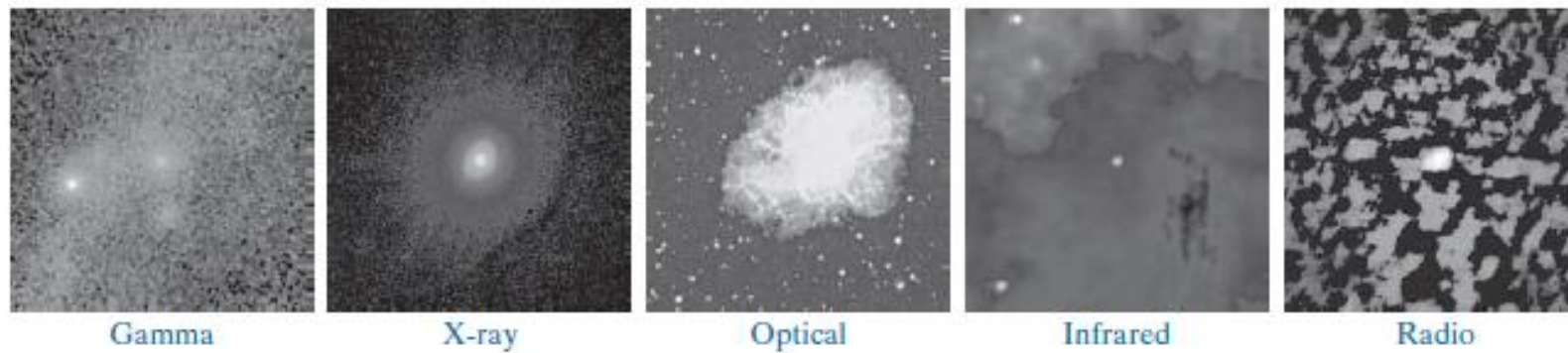


(a) Circuit board controller. (b) Packaged pills. (c) Bottles. (d) Air bubbles in a clear plastic product. (e) Cereal. (f) image of intraocular implant.

Micro ondas y MRI (Magnetic Resonance Imaging)



Todos los espectro



Images of the Crab Pulsar (in the center of each image) covering the electromagnetic spectrum. (Courtesy of NASA.)

- <https://scikit-image.org/>



scikit-image
image processing in python

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Stable ([release notes](#))
0.18.3 - August 2021

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Development
pre-0.19

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[StackOverflow](#) *code help*

Image processing in Python

scikit-image is a collection of algorithms for image processing. It is available **free of charge and free of restriction**. We pride ourselves on high-quality, peer-reviewed code, written by an active **community of volunteers**.

[Download](#)

If you find this project useful, please cite:

[[BiBTeX](#)]

Stéfan van der Walt, Johannes L. Schönberger, Juan Nunez-Iglesias, François Boulogne, Joshua D. Warner, Neil Yager, Emmanuelle Gouillart, Tony Yu and the scikit-image contributors. **scikit-image: Image processing in Python**. PeerJ 2:e453 (2014) <https://doi.org/10.7717/peerj.453>

Activar Windows

- <https://opencv.org/releases/>

