



# INTRODUCCION A LA VISION COMPUTACIONAL

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Universidad del Desarrollo

Clase 01

# PRESENTACIÓN



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# CLASE DE HOY

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- Reglas del Juego
  - ¿Qué es la Vision Computacional?
  - Estado del Arte
  - Introducción a imágenes y procesamiento de imágenes
  - Principales Librerías
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# REGLAS DEL JUEGO

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- Clases expositivas
- Clases prácticas
- Evaluación: Tarea dual

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# OBJETIVOS DEL CURSO

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- Introducir los conceptos fundamentales de visión computacional
  - Introducir las técnicas y librerías básicas de procesamiento y análisis de imágenes
  - Presentar las principales aplicaciones
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# BIBLIOGRAFÍA

- Libro Base: Programming Computer Vision with Python"  
by Jan Erik Solem.

<http://programmingcomputervision.com>

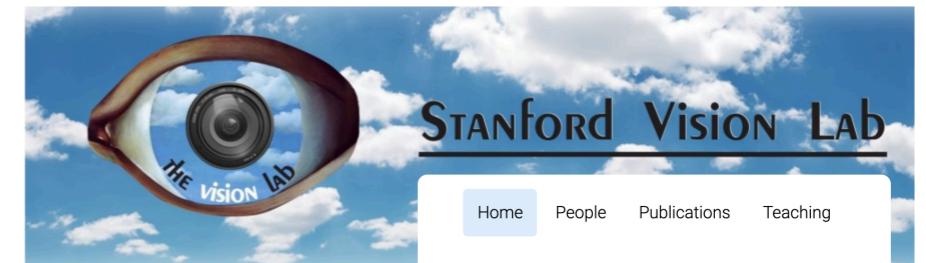
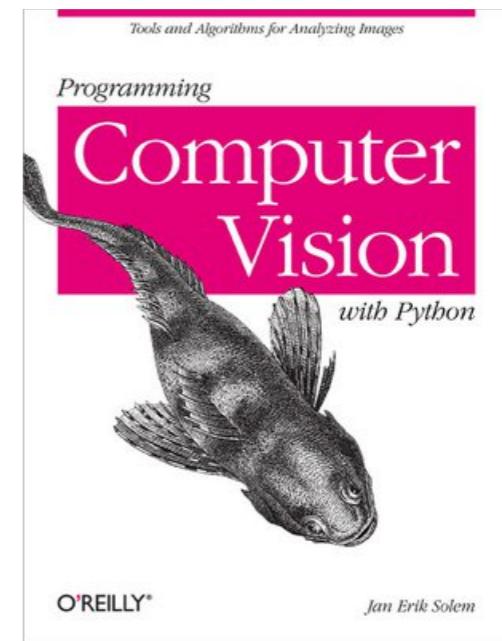
- Cursos de Stanford

[http://vision.stanford.edu/teaching/cs131\\_fall1819/index.html](http://vision.stanford.edu/teaching/cs131_fall1819/index.html)

<http://cs231n.stanford.edu/>

- El material en español estará disponible aquí

[https://github.com/calipsotornasol/intro\\_computer\\_vision](https://github.com/calipsotornasol/intro_computer_vision)



# ¿QUÉ ES LA VISION COMPUTACIONAL?



- La visión computacional es una disciplina que construye la base teórica que permite a los sistemas artificiales extraer información a partir de imágenes y videos.
- Es interdisciplinaria ya que surge a partir de la interacción de múltiples disciplinas tales como ciencias de las ciencias cognitivas, computación, física y matemáticas.

Física

Biología

Psicología

Computación

Matemáticas

Neurociencia

Ciencias  
Cognitivas

Algoritmos

Sistemas,  
Arquitectura

Information  
retrieval

Computer  
Vision

Machine Learning

Robotica

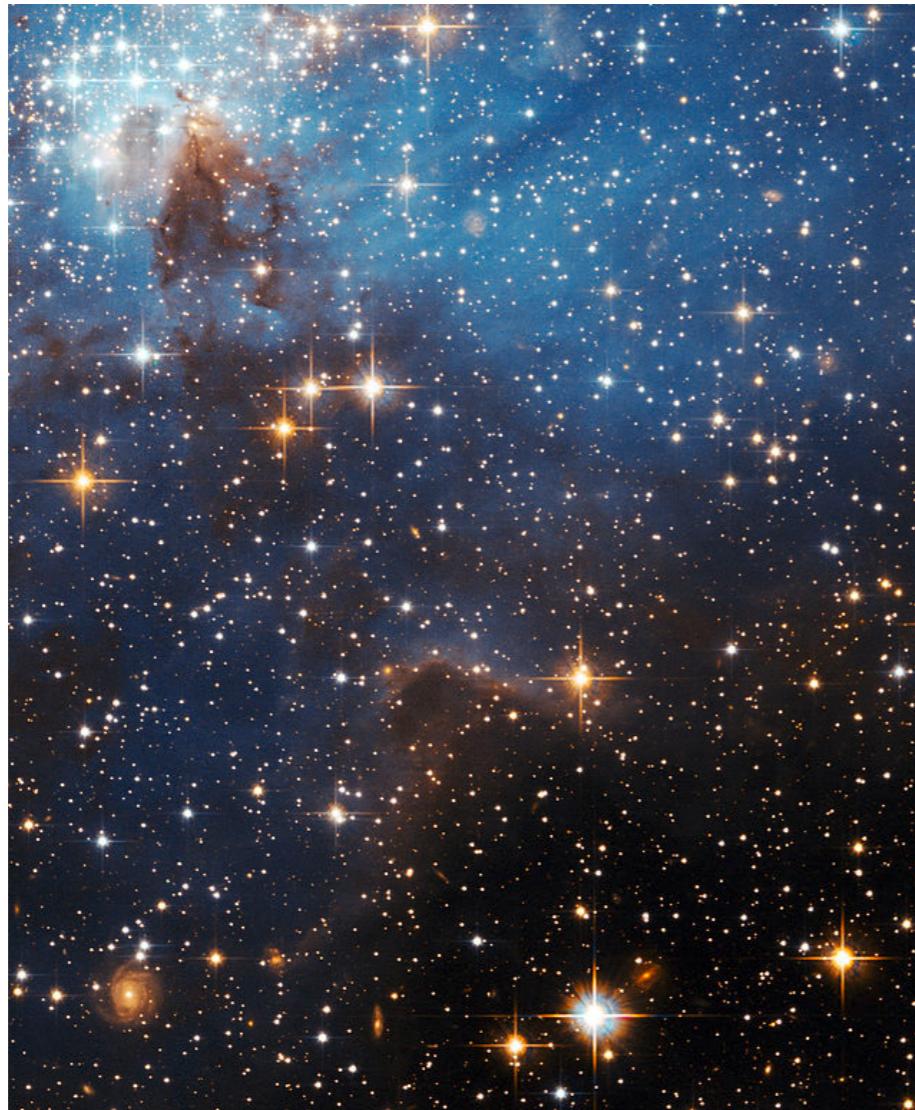
Voz, NLP

Optica

Procesamiento  
de imágenes

# ¿PARA QUÉ SIRVE?

Puente entre  
el significado y los pixeles



Lo que vemos!



0	3	2	5	4	7	6	9	8
3	0	1	2	3	4	5	6	7
2	1	0	3	2	5	4	7	6
5	2	3	0	1	2	3	4	5
4	3	2	1	0	3	2	5	4
7	4	5	2	3	0	1	2	3
6	5	4	3	2	1	0	3	2
9	6	7	4	5	2	3	0	1
8	7	6	5	4	3	2	1	0

Lo que el computador ve!

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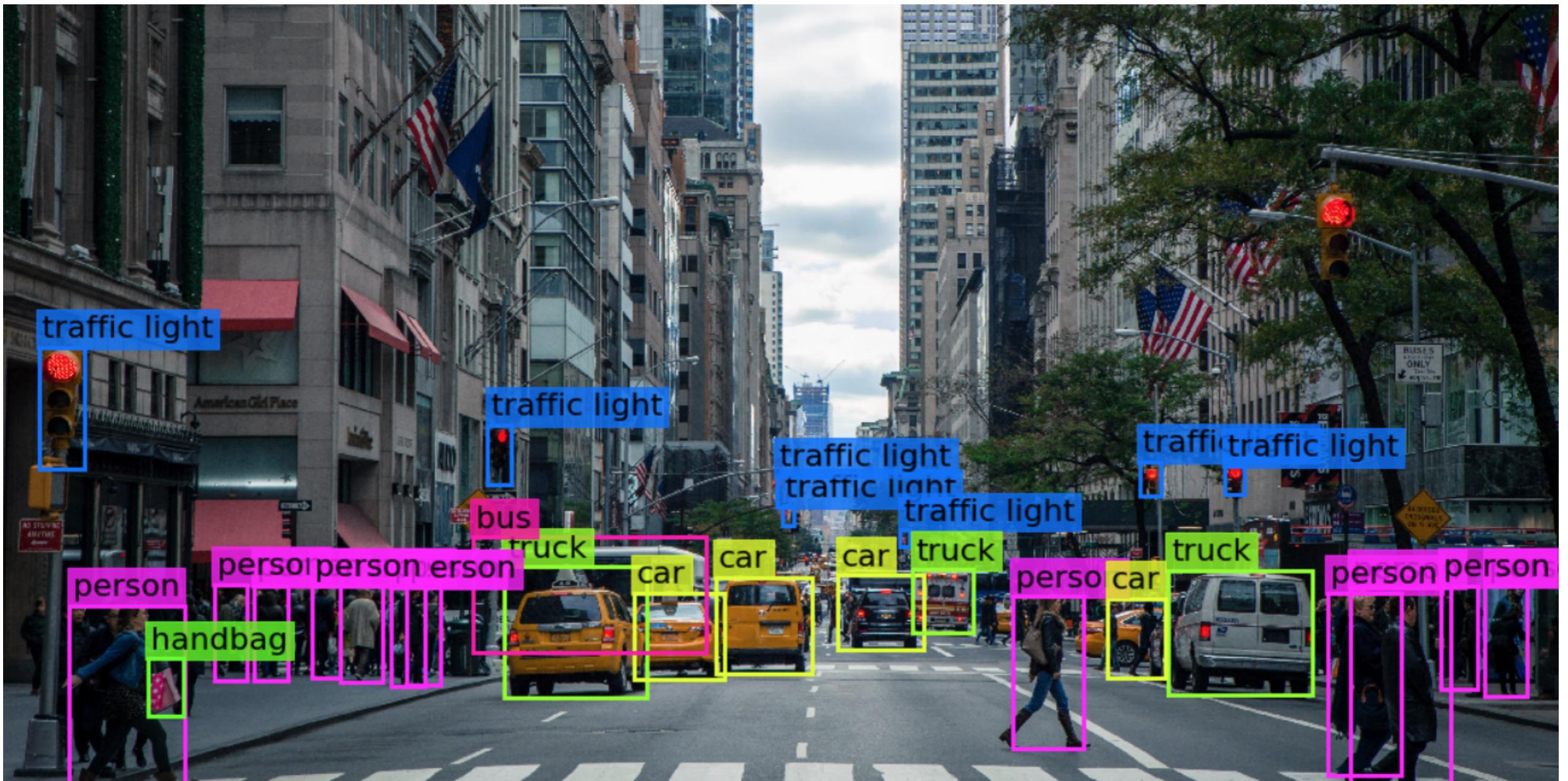
# ETAPAS

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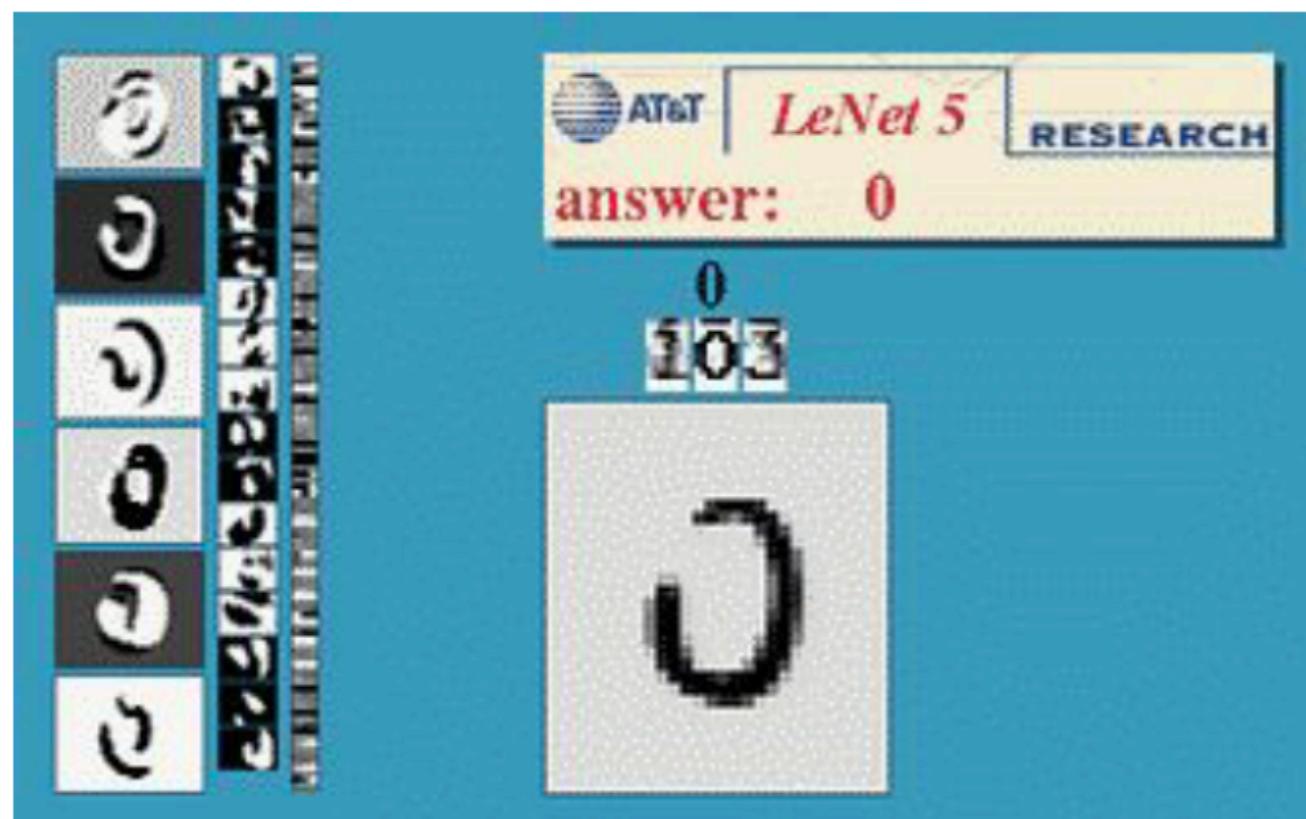
Un sistema de visión computacional transforma un dato no estructurado en uno estructurado para poder tomar decisiones. Las principales etapas asociadas al procesamiento de una imagen digital son:

1. Adquisición
  2. Procesamiento
  3. Análisis
  4. Entendimiento
  5. Generación de información
-

# EJEMPLOS



# RECONOCIMIENTO ÓPTICO DE CARACTERES (OCR)



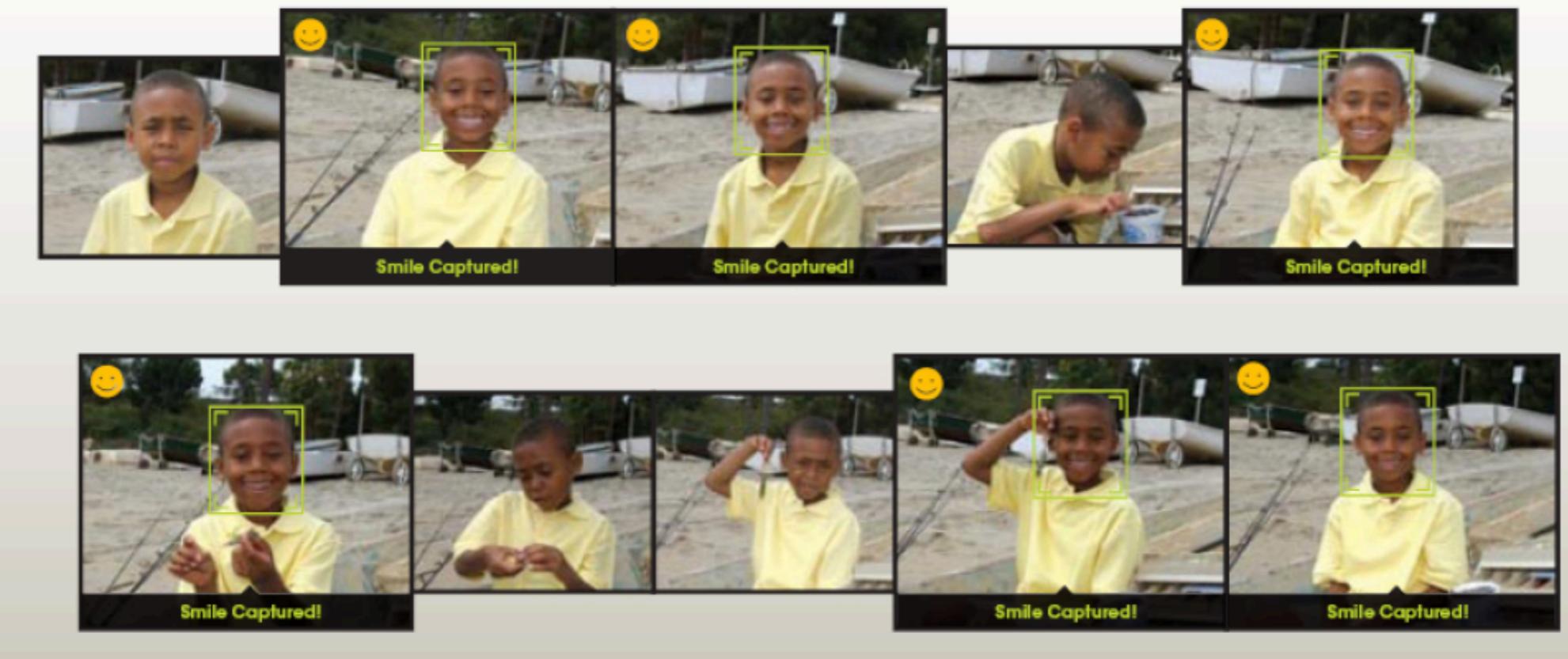
# DETECCIÓN DE CARAS



# DETECCIÓN DE SONRISAS

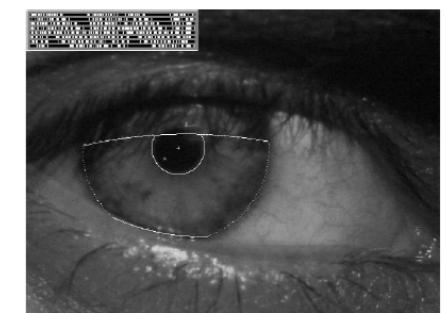
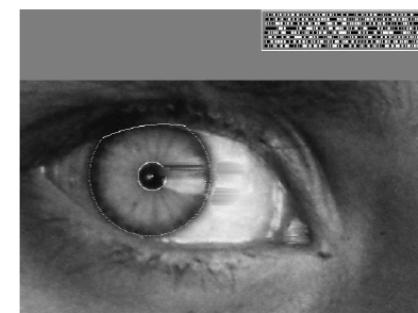
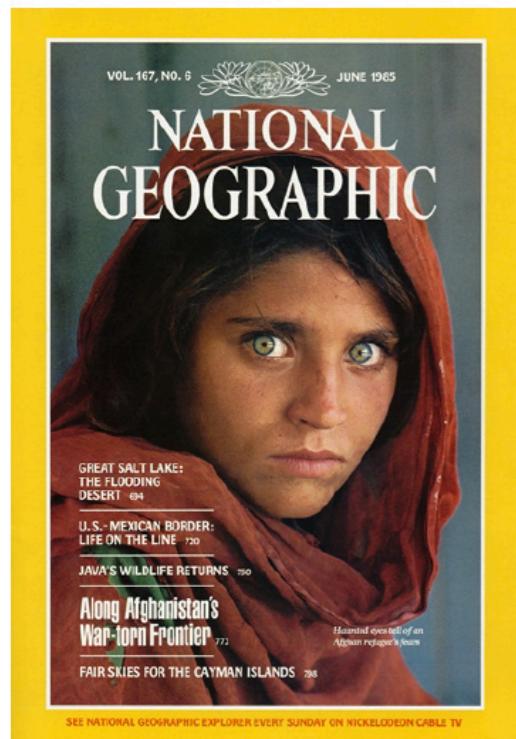
## The Smile Shutter flow

Imagine a camera smart enough to catch every smile! In Smile Shutter Mode, your Cyber-shot® camera can automatically trip the shutter at just the right instant to catch the perfect expression.



[Sony Cyber-shot® T70 Digital Still Camera](#)

# BIOMETRIA (IRIS)



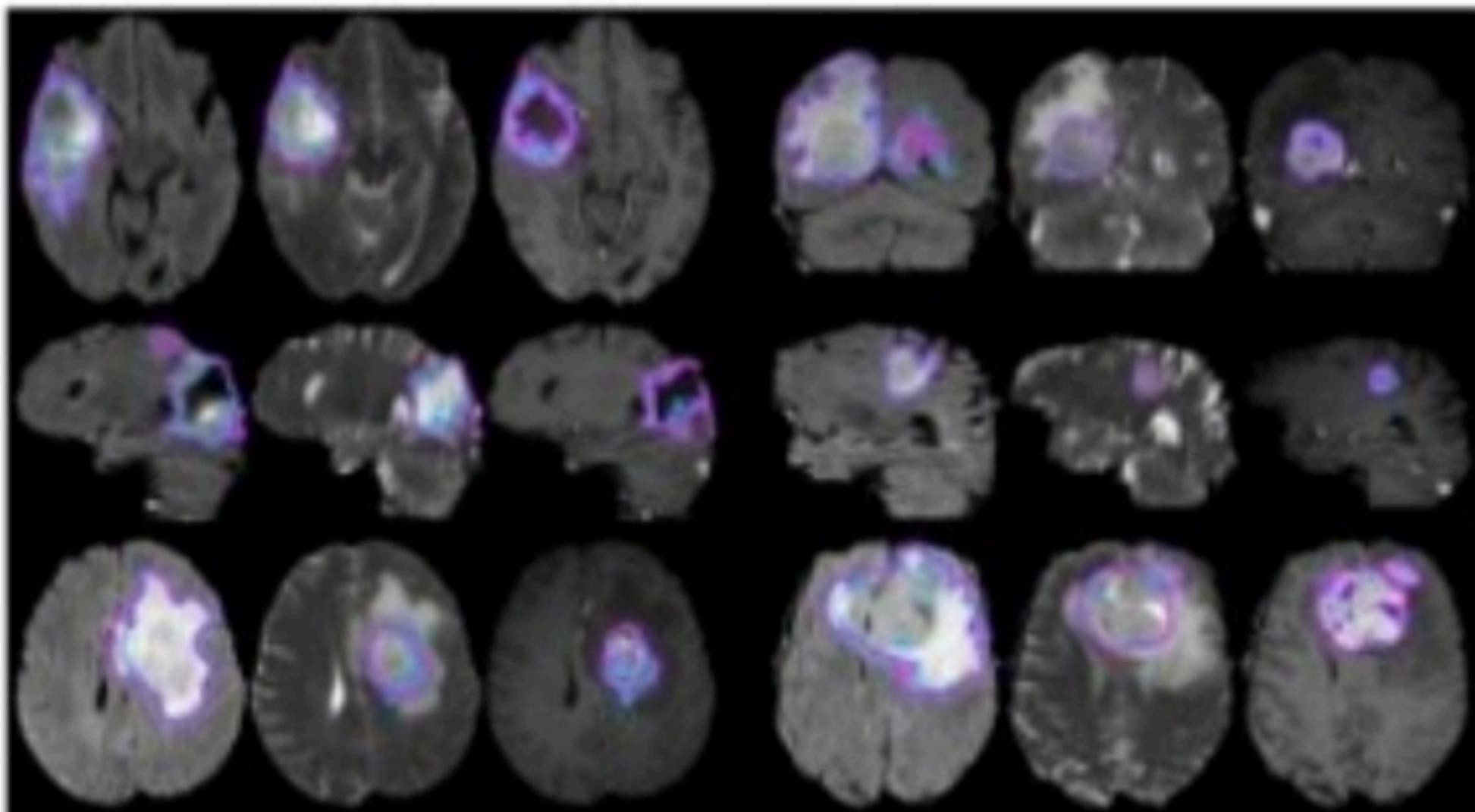
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# BIOMETRIA (HUELLAS)

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# IMAGENES MÉDICAS



CLICQUE EN LA IMAGEN PARA VERLA EN GRANDE

# AUTOS INTELIGENTES

►► manufacturer products      consumer products ◀◀

## Our Vision. Your Safety.

rear looking camera      forward looking camera      side looking camera

› **EyeQ** Vision on a Chip

› read more

› **Vision Applications**

Road, Vehicle, Pedestrian Protection and more

› read more

› **AWS** Advance Warning System

› read more

**News**

- › Mobileye Advanced Technologies Power Volvo Cars World First Collision Warning With Auto Brake System
- › Volvo: New Collision Warning with Auto Brake Helps Prevent Rear-end

› all news

**Events**

- › Mobileye at Equip Auto, Paris, France
- › Mobileye at SEMA, Las Vegas, NV

› read more

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# EXPLORACIÓN ESPACIAL

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# ESPECTRO ELECTROMAGNETICO

## El Espectro Electromagnético

¿Penetra la atmósfera terrestre?



Longitud de onda (metros)

Radio      Microondas      Infrarojo      Visible      Ultravioleta      Rayos-X      Rayos Gamma

$10^3$

$10^{-2}$

Infrarojo

$10^{-5}$

Visible

$.5 \times 10^{-6}$

Ultravioleta

$10^{-8}$

Rayos-X

$10^{-10}$

Rayos Gamma

$10^{-12}$

Del tamaño de...



Edificios



Humanos



Abeja



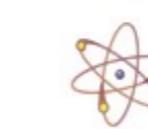
Alfiler



Protozoarios



Moléculas

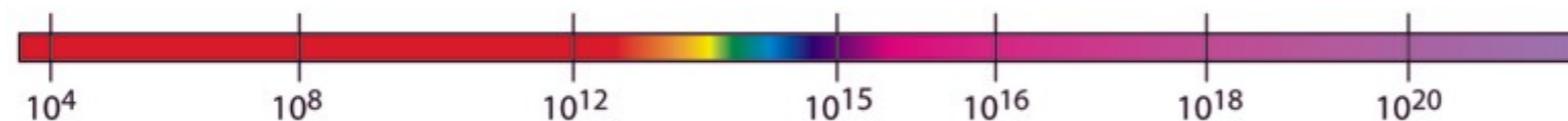


Átomos



Nucleo Atómico

Frecuencia (Hz)



Temperatura de los cuerpos emitendo la onda (K)



Visto en [DiosEsImaginario.com](http://DiosEsImaginario.com)

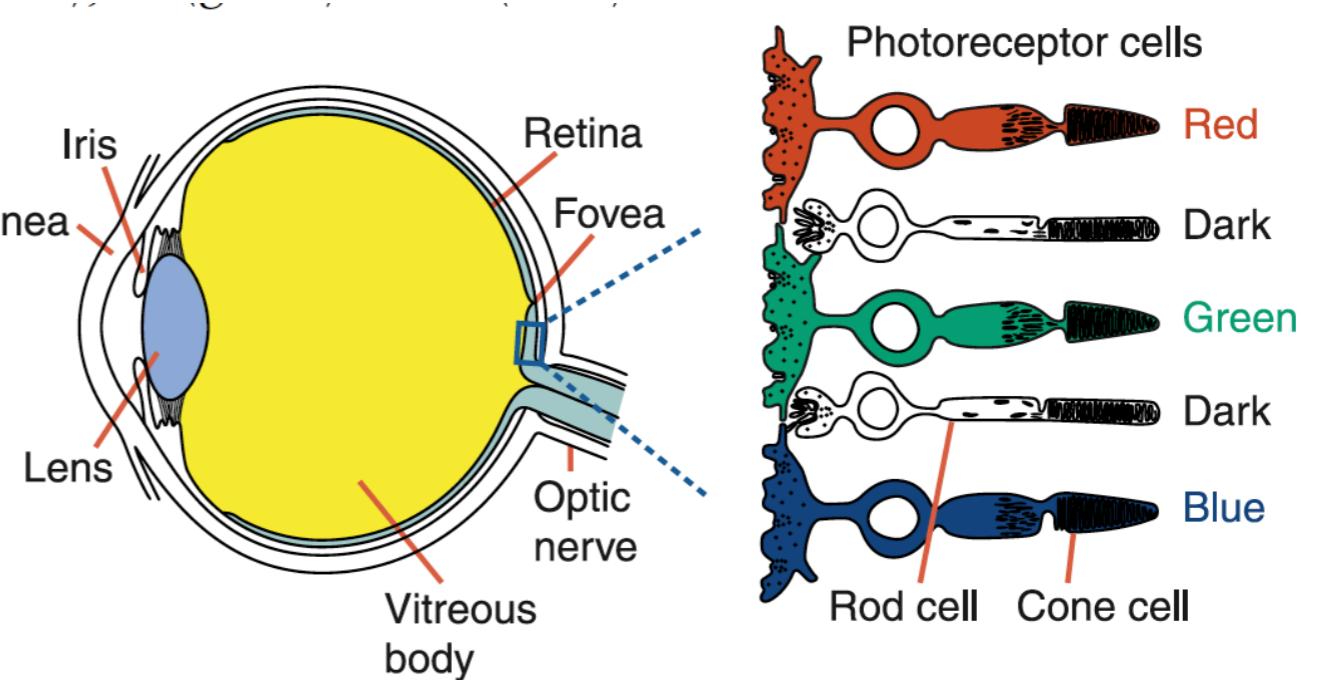
Espectro electromagnético:  
distribución energética del conjunto  
de las ondas electromagnéticas.

En general CV trabaja con las  
longitudes de onda del **espectro visible**

# PERCEPCIÓN DEL COLOR

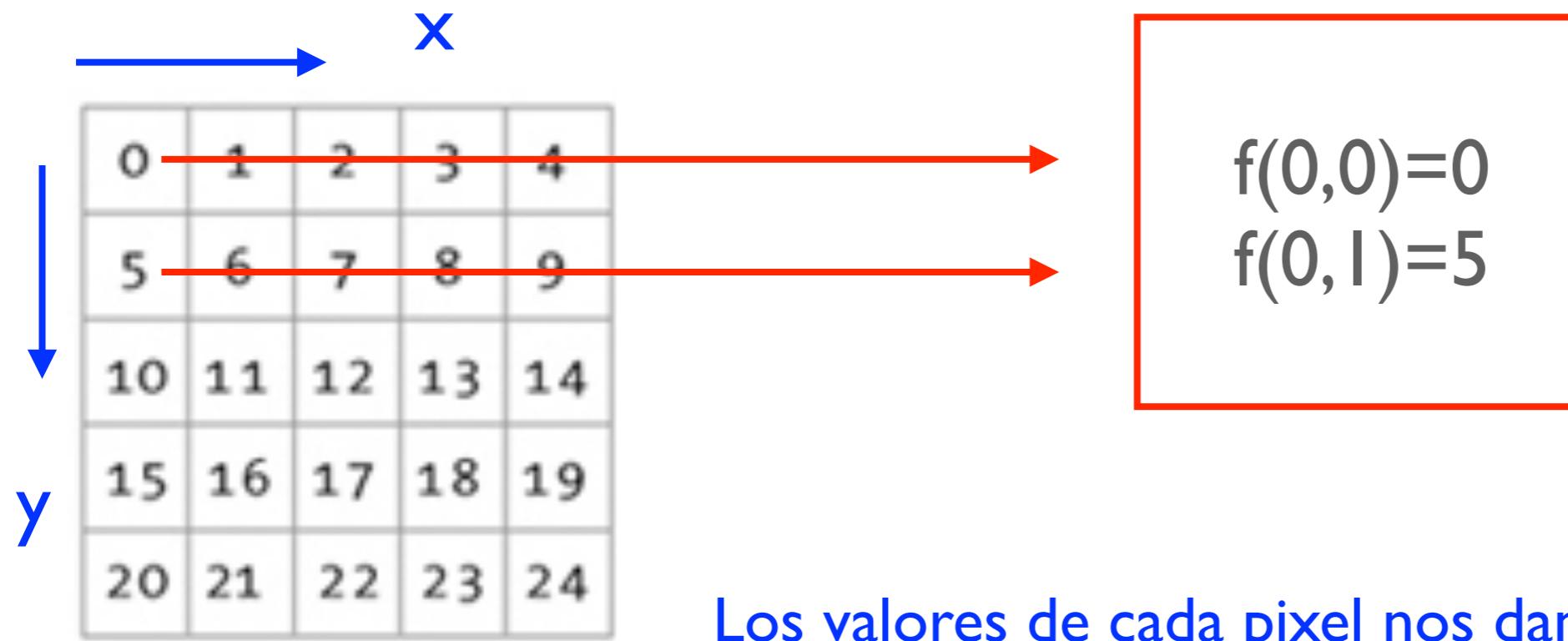
Los ojos humanos tienen dos tipos de células sensibles a la luz o fotorreceptores: los bastones y los conos.

- Los bastones son los encargados de aportar la información de color.
- Existen tres tipos de conos con respuestas frecuenciales diferentes.
- La sensación de color se puede definir como la respuesta de los conos al espectro radiado por el objeto observado. Luego hay tres respuestas diferentes, una por cada color (RGB).



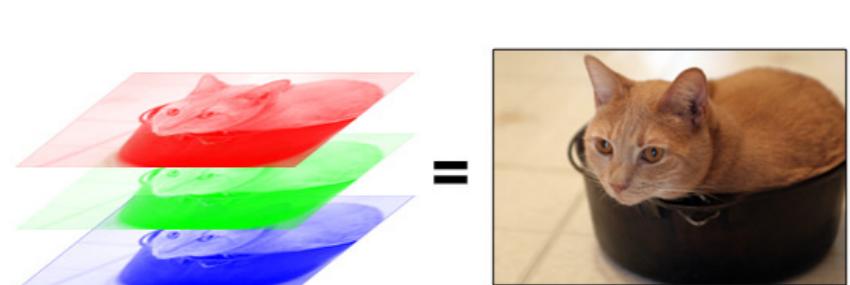
# ¿QUÉ ES UNA IMAGEN?

Es una función  $f(x,y)$  que entrega la intensidad en la posición  $(x, y)$ .



# RGB

- Composición del color en términos de la intensidad de los colores primarios de la luz (Red, Green and Blue).
- Imagen a color RGB. Tres funciones juntas.



$$\boxed{f(x,y) = g(x,y)}$$

$r(x,y)$   
 $b(x,y)$

→ R rojo  
→ G verde  
→ B azul

- Otros modelos de color (CMYK, sRGB).

# PROFUNDIDAD DEL COLOR

- La profundidad de color o bits por pixel (bpp) se refiere a la cantidad de **bits** de información necesarios para representar el color de un **píxel** en una imagen.
- Una profundidad de bits de  $n$  implica que cada pixel de la imagen puede tener  $2^n$  posibles valores ( $2^n$  colores distintos).

1 **bit por píxel:**  $2^1 = 2$  colores

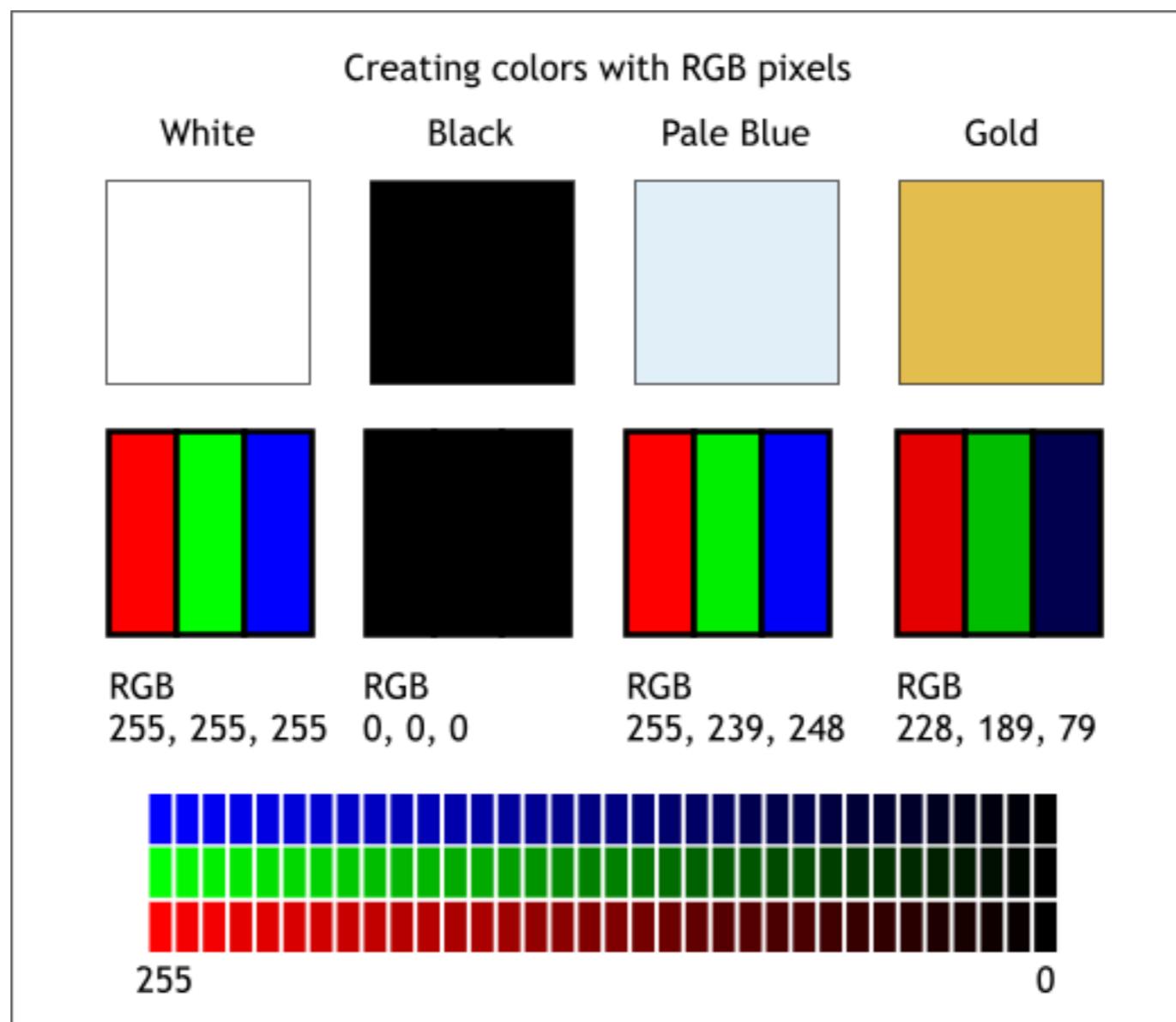
2 **bits por píxel:**  $2^2 = 4$  colores

3 **bits por píxel:**  $2^3 = 8$  colores

8 **bits por píxel:**  $2^8 = 256$  colores

**True Color: 24 bits por pixel**

# 8 BITS POR PIXEL (256 OPCIONES)



# CONVERSION A ESCALA DE GRISES

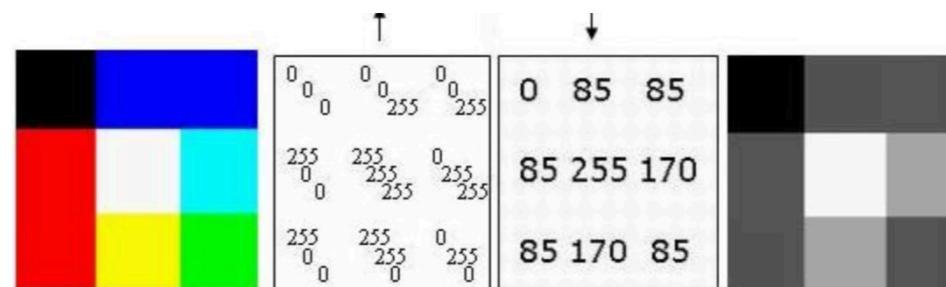
Algunos métodos:

- **Lightness:** Calcula la media de los valores extremos.

$$\min(R,G,B) + \max(R,G,B)/2$$

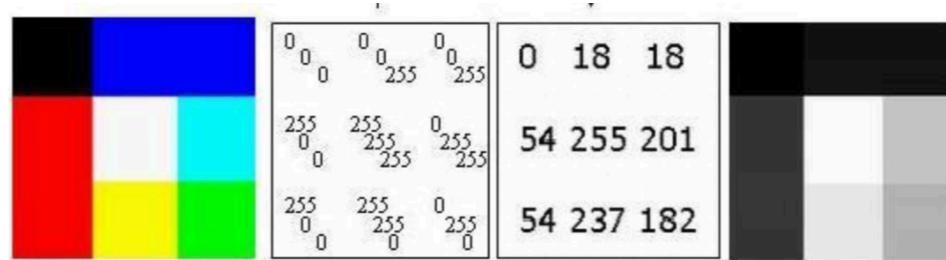
- **Average:** Promedia los valores RGB que componen la imagen.

$$R+G+B / 3$$



- **Luminosity:** Promedio ponderado de los valores RGB.

$$0.21R + 0.71G + 0.07B$$



# ALGUNOS TIPOS DE IMÁGENES (RASTER)

<b>Tipo</b>	<b>Compresión</b>	<b>Extensión</b>
JPEG	con pérdida	JPG o JPEG
TIFF	con pérdida/sin pérdida	TIFF o TIF
GIF	sin pérdida	GIF
BITMAP	sin pérdida	BMP
PNG	sin pérdida	PNG
FITS	sin pérdida	FITS

# PROCESAMIENTO DE IMÁGENES

En procesamiento de imágenes consiste de operaciones que convierten una imagen  $f$  en una imagen  $g$ .

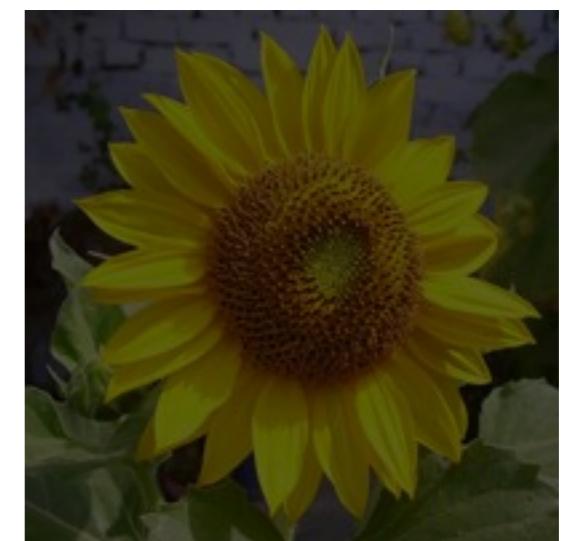
$$f(x,y)$$



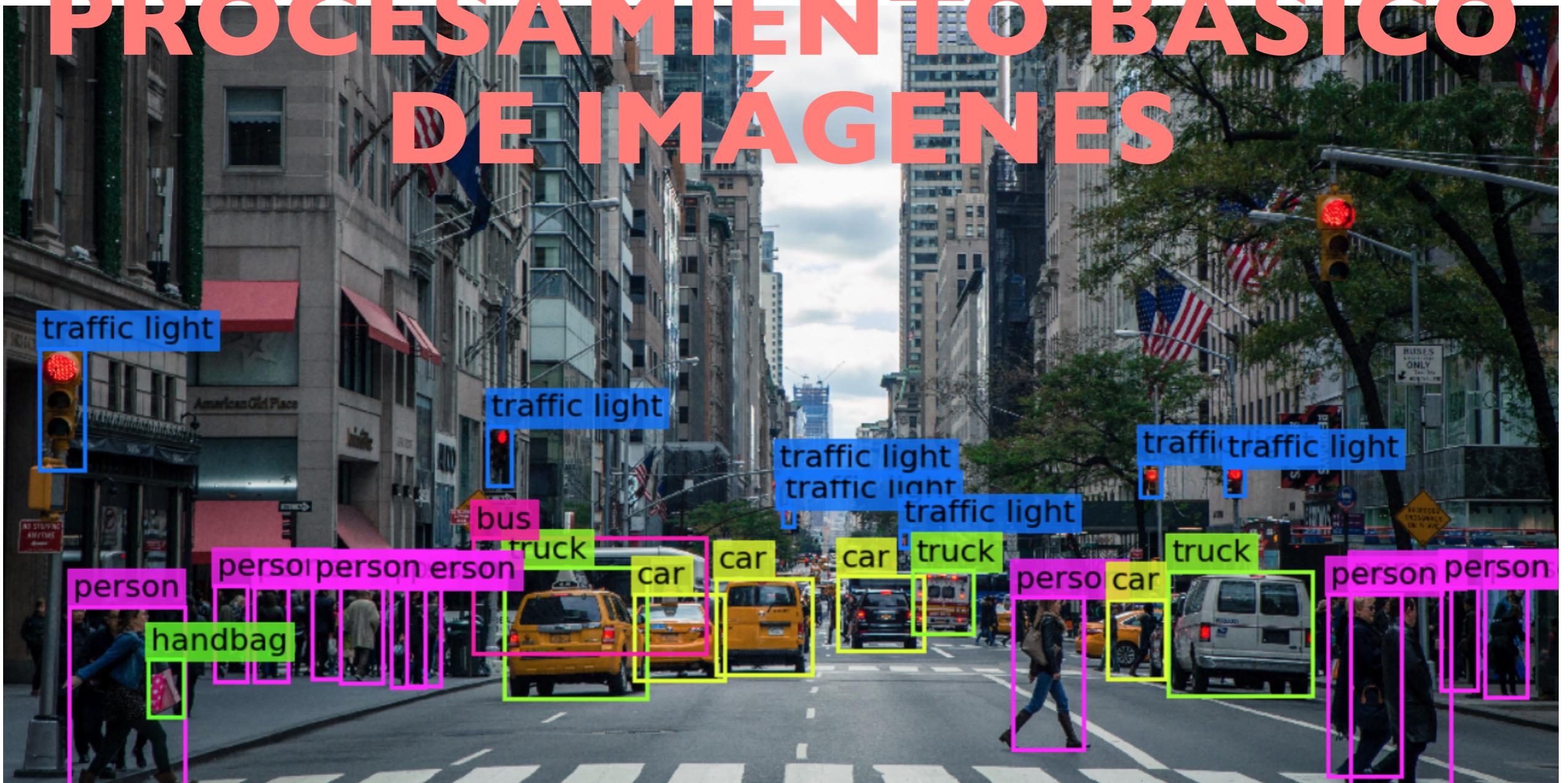
$$T(f(x,y))$$



$$g(x,y)$$



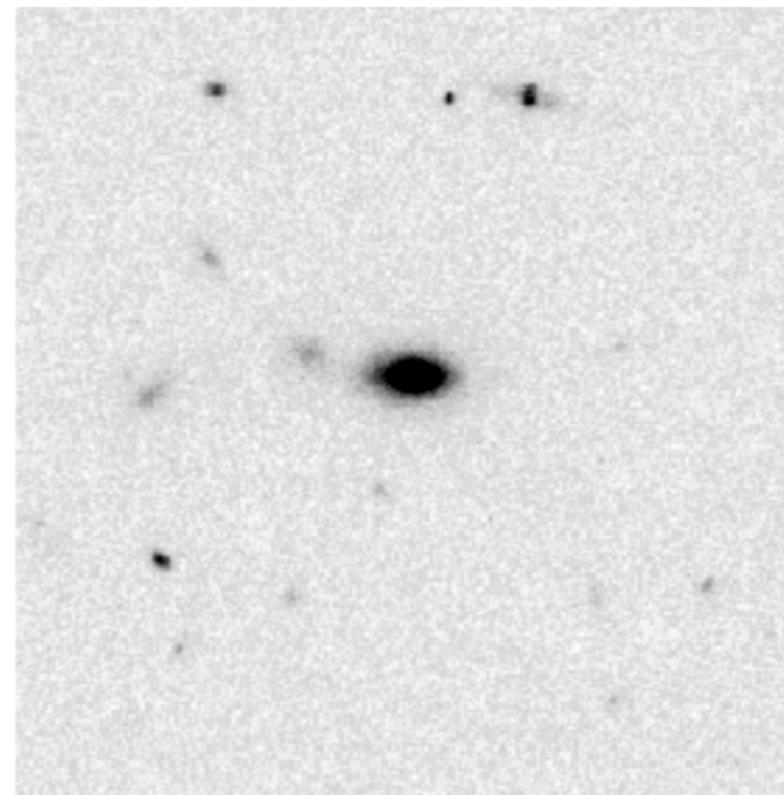
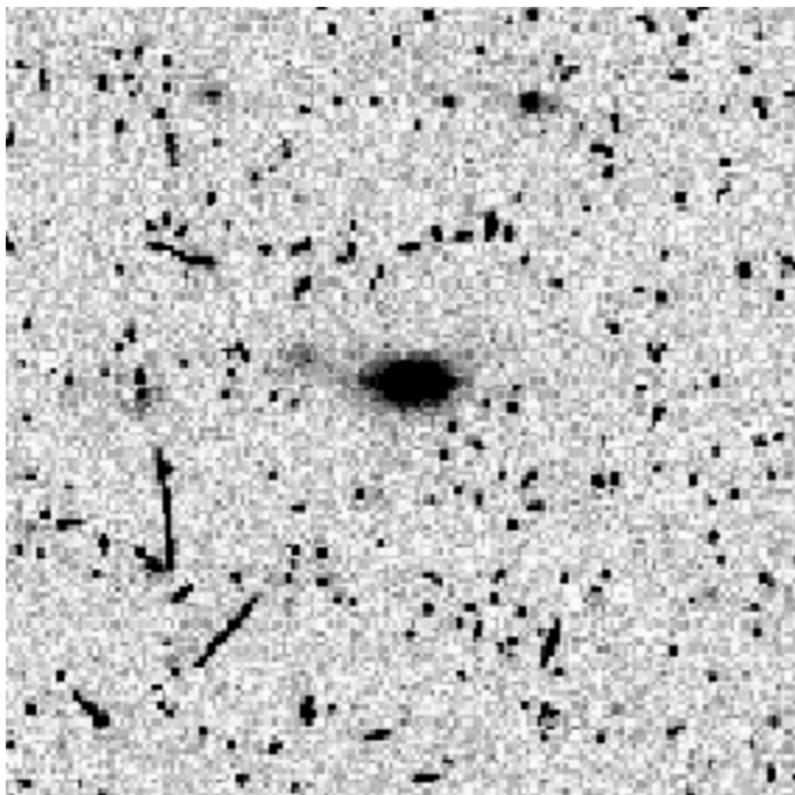
# EJEMPLOS DE TÉCNICAS DE ADQUISICIÓN Y PROCESAMIENTO BÁSICO DE IMÁGENES



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# ADQUISICIÓN: DITHERING

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Estrategia de adquisición que mejora el procesamiento. Pequeño movimiento intencional de la cámara entre una exposición y otra para eliminar píxeles con defectos.

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# PROCESAMIENTO: STACKING

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# PROCESAMIENTO: ELIMINACIÓN DEL RUIDO

Original



Noisy image



Denoised image



# PROCESAMIENTO: ALINEAMIENTO

**MAIL TO:**  
DMV CHANGE OF ADDRESS  
P.O. BOX 9009  
SACRAMENTO, CA 94289-0909

**A SEPARATE FORM IS NEEDED  
FOR EACH DRIVER OR VEHICLE OWNER**

**NOTICE OF CHANGE OF ADDRESS**

Please Print Characters In Capital Letters Using Black or Dark Blue Ink only.

1234567890 ABCDEFGHIJKLMNOPQRSTUVWXYZ

**INSTRUCTIONS:**

- Enter the information requested in the document. A California driver license (ID card), or vehicle registration card, for whom a change is being requested.
- Name not matching DMV records and/or unnecessary information cannot be updated.
- Date or write your new address on a small piece of paper with your signature and place it with your driver license or ID card.
- Address or write your new address on a small piece of paper with your signature and place it with your driver license or ID card. Your name will be disregarded if non-commercial status.

**Personal Information**

LAST NAME	DRIVER LICENSE/ID CARD NO.		
FIRST	INITIAL	BIRTH DATE	
BIRTH DATE			

**Voter Change of Address**

We will change your voting address. If you are not registered to vote, you must complete a voter registration card. DMV provides the form or call 1-800-345-VOTE or logon to the Secretary of State's website at [www.sos.ca.gov](http://www.sos.ca.gov).

Mark this box if you do not want to change your voting address.

**New or Correct Residence Address**

STREET NUMBER ONLY	STREET NAME
APT NO.	

**Do Not Use P.O. Box in this space**

CITY - DO NOT ABBREVIATE - USE FIRST 20 CHARACTERS IN CITY NAME STATE ZIP CODE

**New or Correct Mailing Address**

STREET NUMBER ONLY	P.O. BOX OR STREET NAME OR STREET NAME AND PRIVATE MAIL BOX
APT NO.	

**If Different From Residence Address**

CITY - DO NOT ABBREVIATE - USE FIRST 20 CHARACTERS IN CITY NAME STATE ZIP CODE

**Vehicle, Vessels, or Placards Owned By You**

CALIFORNIA PLATE OR PLACARD NO. LAST 17 POSITIONS OF VEHICLE ID OR VESSEL HULL ID NUMBER CHECK IF LEASER/LESSOR OUTSIDE CA

**Use Additional Form If Necessary**

**Leased Vehicles**

LEASING COMPANY'S NAME

**Location of Trailer Coach or Vessel**

STREET NUMBER STREET NAME

**If Different From Residence Address**

CITY - DO NOT ABBREVIATE - USE FIRST 10 CHARACTERS IN CITY NAME COUNTY - DO NOT ABBREVIATE

**Old Address**

STREET NUMBER STATE ZIP CODE  
Your mailing address may be given to requesters providing a valid reason for requesting the information. If you receive mail at your residence, then giving DMV a separate mailing address is optional. Your residence address is restricted to authorized requesters per Vehicle Code Section 1808.21. I am the person whose name appears on the record(s) above and the mailing address shown is valid, existing and accurate. I consent to receive service of process at this mailing address pursuant to 415.20(b), 415.30, and 416.90 of the Civil Procedure Code. I certify (or declare) under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

SIGNATURE X

MM-DD-YYYY

DMV 14-005V 02/01/12 00000

**Print** **Clear Form**



**MAIL TO:**  
DMV CHANGE OF ADDRESS  
P.O. BOX 9009  
SACRAMENTO, CA 94289-0909

**A SEPARATE FORM IS NEEDED  
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BIRTH DATE			

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APT NO.	

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**Use Additional Form If Necessary**

**Leased Vehicles**

LEASING COMPANY'S NAME

**Location of Trailer Coach or Vessel**

STREET NUMBER STREET NAME

**If Different From Residence Address**

CITY - DO NOT ABBREVIATE - USE FIRST 10 CHARACTERS IN CITY NAME COUNTY - DO NOT ABBREVIATE

**Old Address**

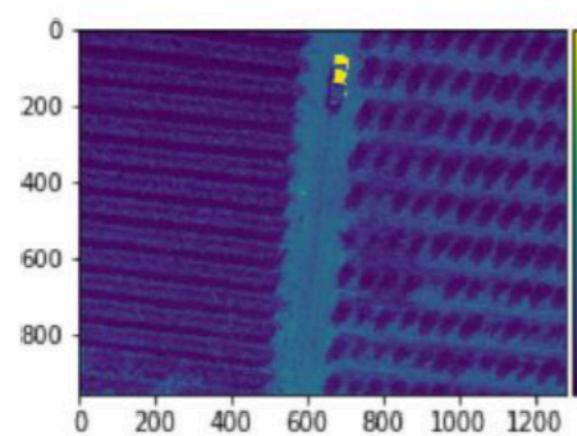
STREET NUMBER STATE ZIP CODE  
Your mailing address may be given to requesters providing a valid reason for requesting the information. If you receive mail at your residence, then giving DMV a separate mailing address is optional. Your residence address is restricted to authorized requesters per Vehicle Code Section 1808.21. I am the person whose name appears on the record(s) above and the mailing address shown is valid, existing and accurate. I consent to receive service of process at this mailing address pursuant to 415.20(b), 415.30, and 416.90 of the Civil Procedure Code. I certify (or declare) under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

SIGNATURE X

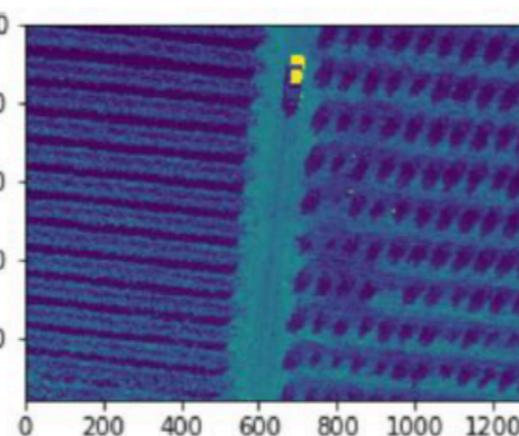
MM-DD-YYYY

DMV 14-005V 02/01/12 00000

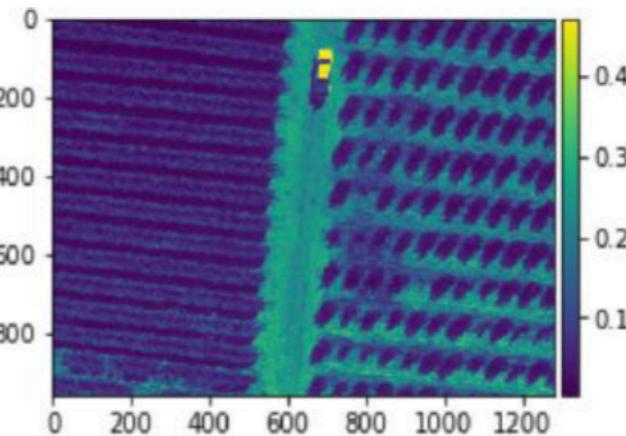
# PROCESAMIENTO: ALINEAMIENTO DIFERENTES BANDAS



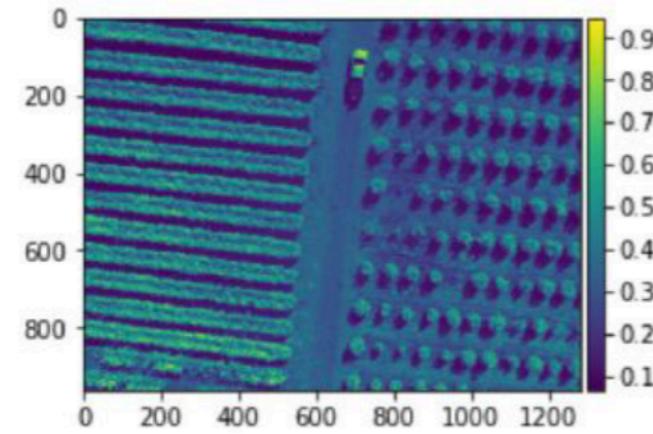
**Figura 3. Banda Azul**



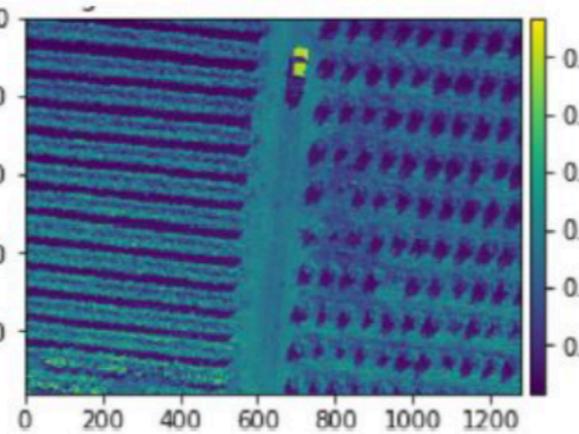
**Figura 4. Banda Verde**



**Figura 5. Banda Roja**



**Figura 6. Banda Infrarrojo Cercano**



**Figura 7. Banda Rededge**

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# PRINCIPALES LIBRERÍAS Y FRAMEWORKS DE CV

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- Los principales lenguajes de programación utilizados son: Matlab, Python, C++, C, R.
- Las principales librerías usadas son: Computer vision toolbox (Matlab), Image processing toolbox (Matlab), OpenCV (C++, Python), Dlib (C++, Python, R), Scikit-Image (Python), OpenFace (Python).
- Los frameworks principalmente usados son: Tensorflow (Google), Torch (Facebook), CNTK (Microsoft), Caffe

# JUPYTER

