



INTRODUCCION A LA VISION COMPUTACIONAL

Daniela Opitz

Universidad del Desarrollo

Clase 01

PRESENTACIÓN



Daniela Opitz

Investigadora Instituto Data Science UDD

PhD. Física UNSW Sydney



Contacto:

e-mail: dopitz@udd.cl github: <https://github.com/calipsotornasol> LinkedIn: <https://www.linkedin.com/in/dani-opitz/>

CLASE DE HOY

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

REGLAS DEL JUEGO

- Clases expositivas
- Clases prácticas
- Evaluación:
 - Presentación breve de alguna aplicación de cv (30%)
 - Tarea (70%)

OBJETIVOS DEL CURSO

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

BIBLIOGRAFÍA

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

<http://programmingcomputervision.com>

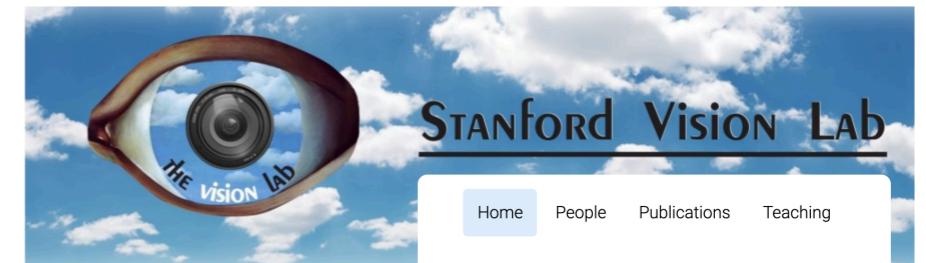
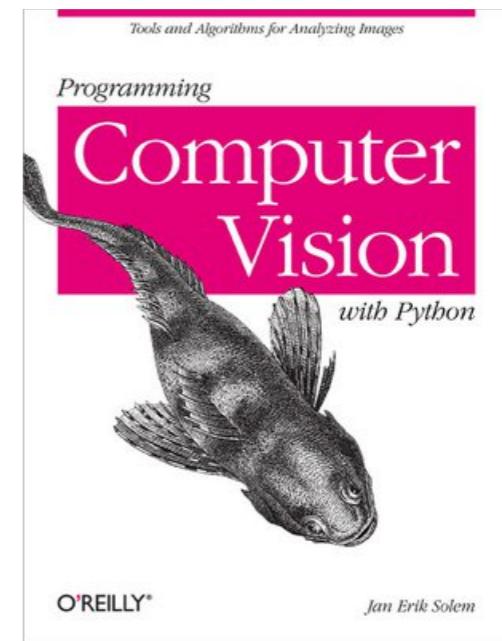
- Cursos de Stanford

http://vision.stanford.edu/teaching/cs131_fall1819/index.html

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

- El material en español estará disponible aquí

https://github.com/calipsotornasol/intro_computer_vision



¿QUÉ ES LA VISIÓN 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

Optica

Ciencias
Cognitivas

Procesamiento
de imágenes

Computer
Vision

Algoritmos

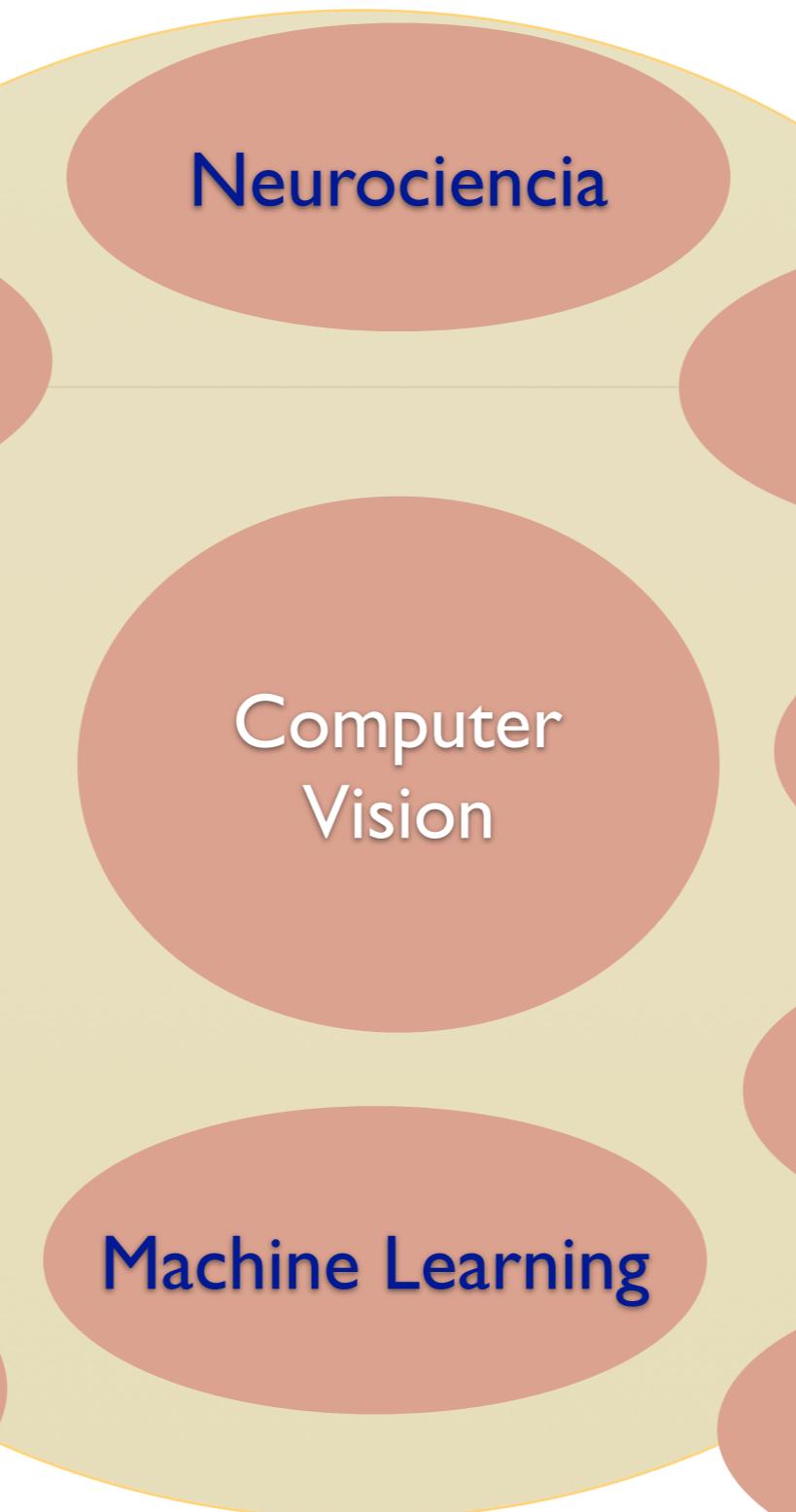
Voz, NLP

Sistemas,
Arquitectura

Robotica

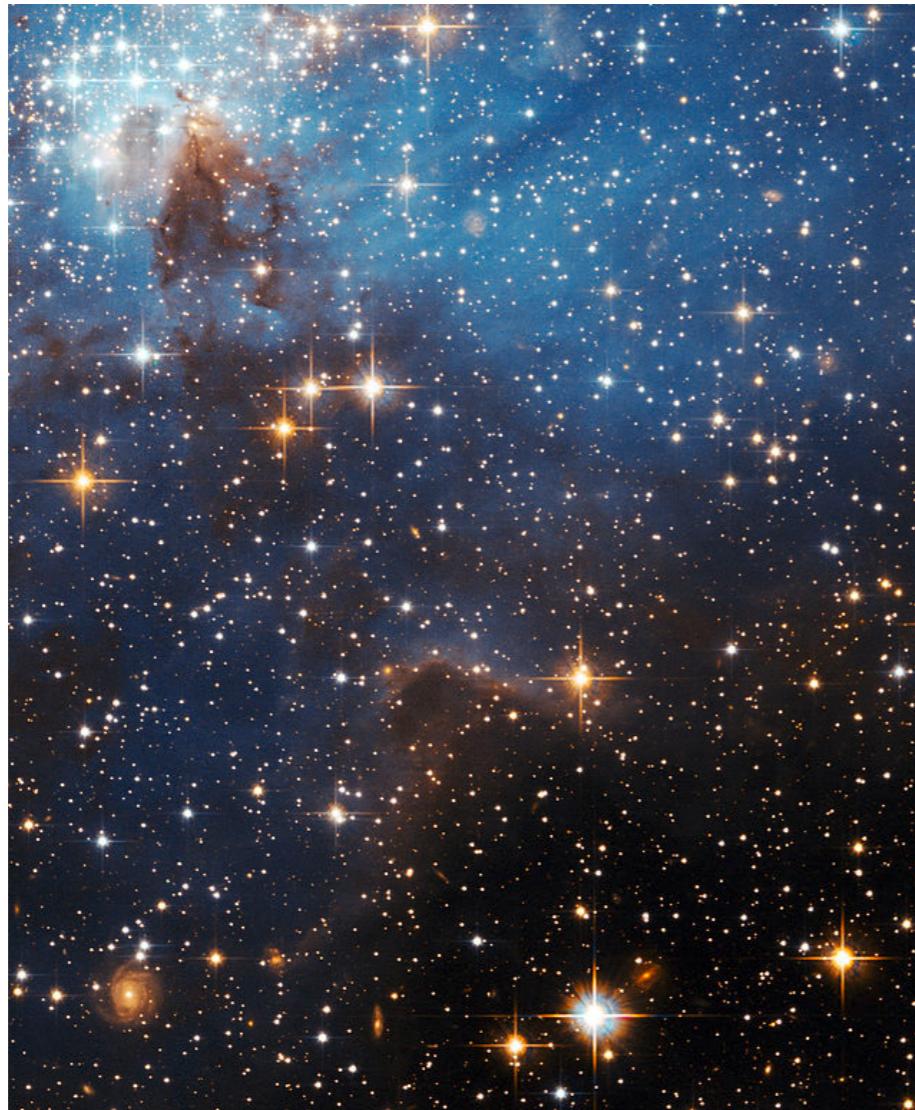
Machine Learning

Information
retrieval



¿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!

QUE TAN DIFÍCIL ES?

- Hay una gran brecha entre píxeles y el significado
- Un computador ve en una imagen RGB 200x200 es un conjunto de 120.000 valores (200x200x3).
- Cómo traducimos todos estos número a información significativa?

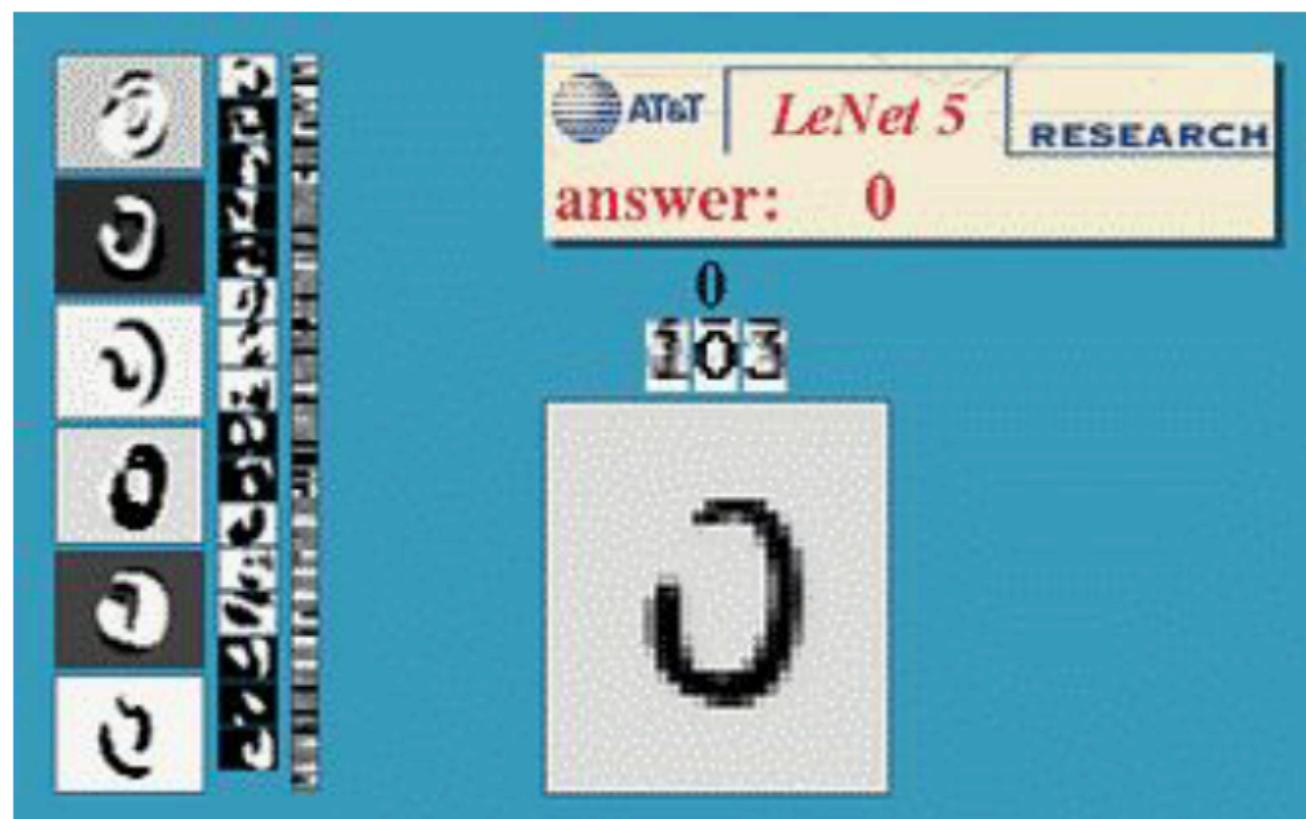
PRINCIPALES LIBRERÍAS Y FRAMEWORKS DE CV

- 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

EJEMPLOS



RECONOCIMIENTO ÓPTICO DE CARACTERES (OCR)



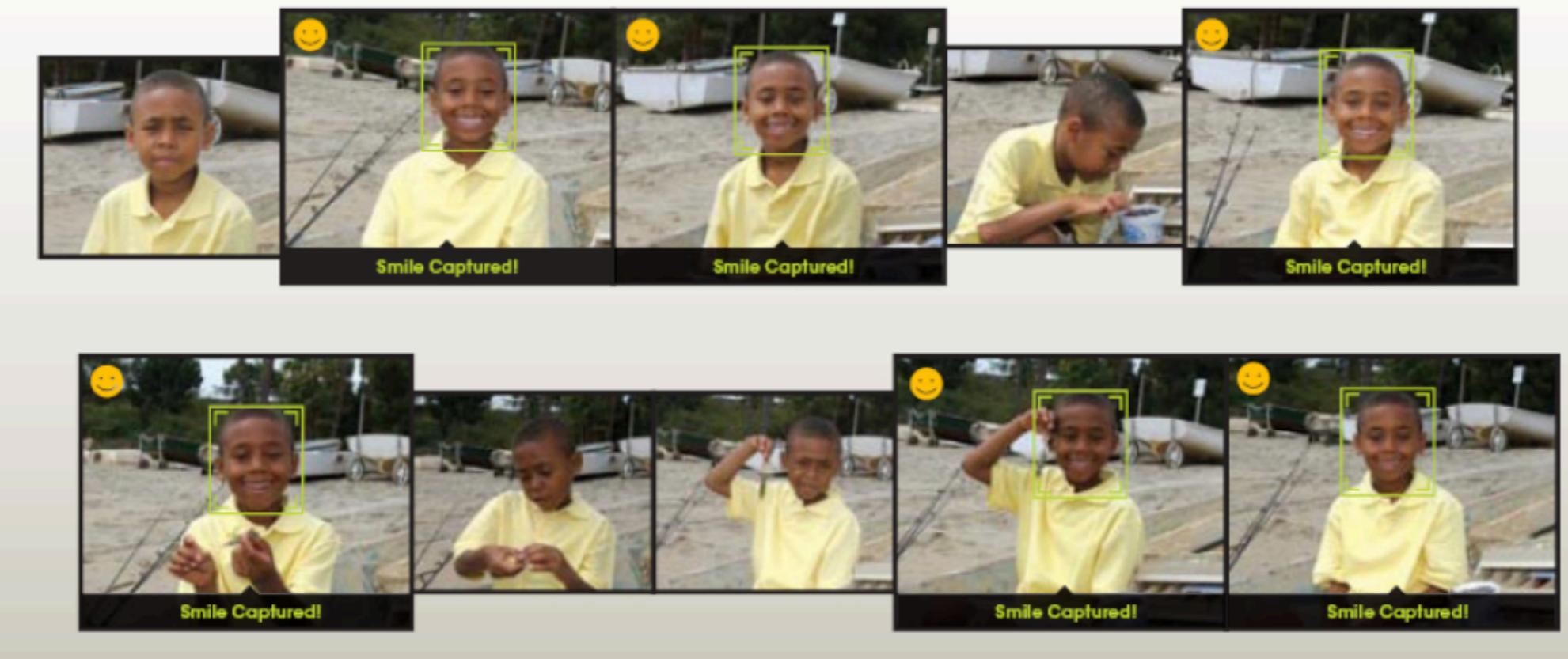
DETECCIÓN DE CARAS



DETECCIÓN DE SONRISAS

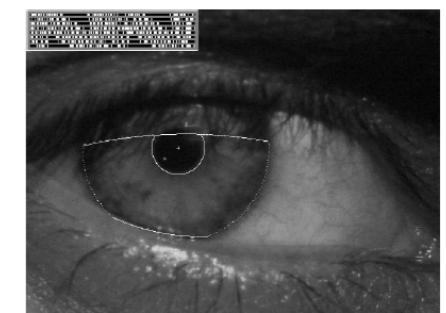
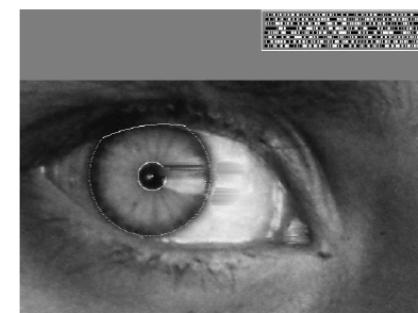
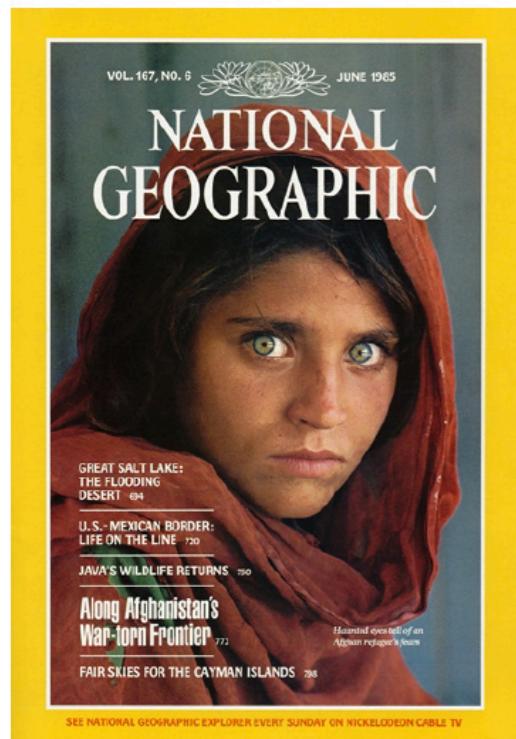
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[Sony Cyber-shot® T70 Digital Still Camera](#)

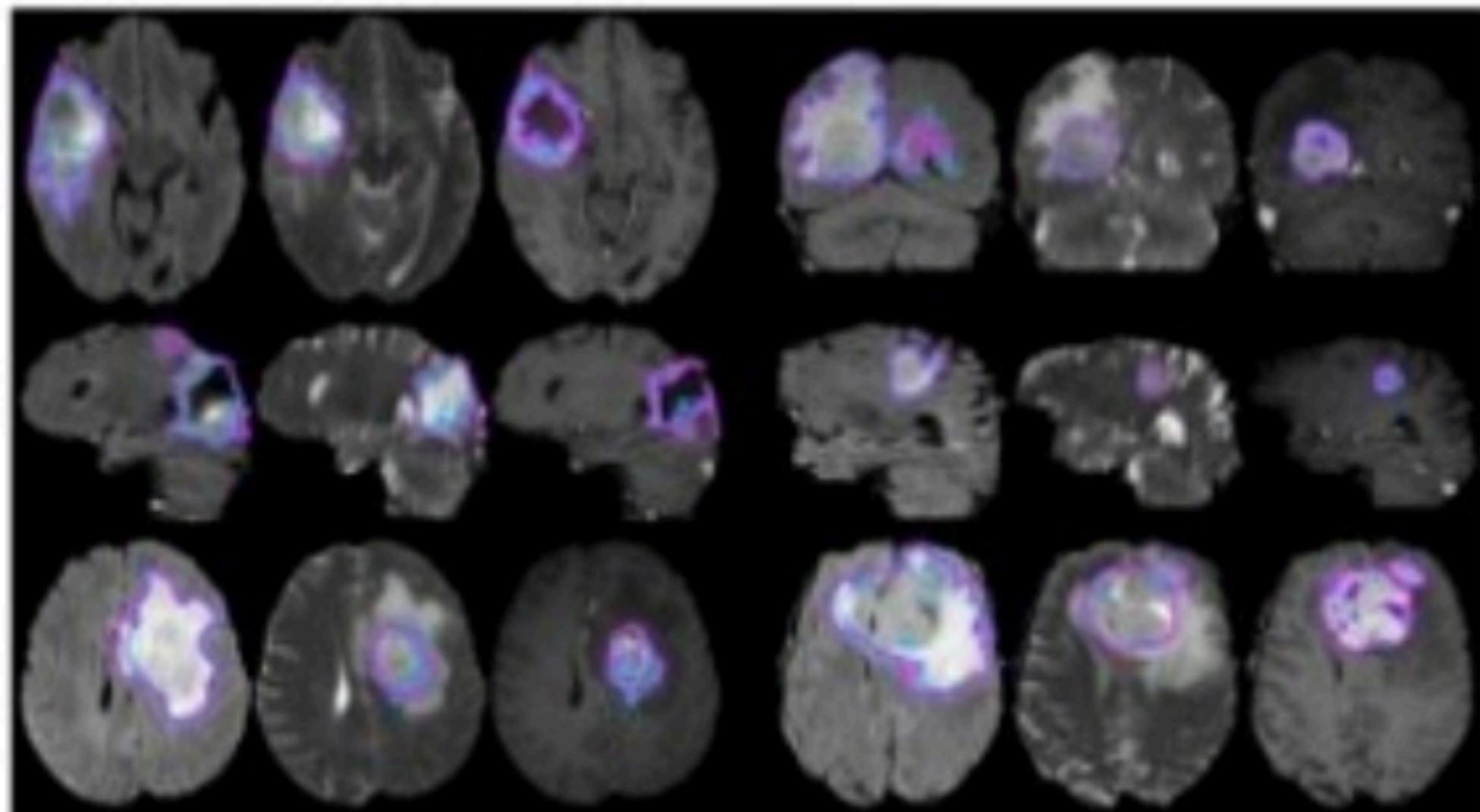
BIOMETRIA (IRIS)



BIOMETRIA (HUELLAS)



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

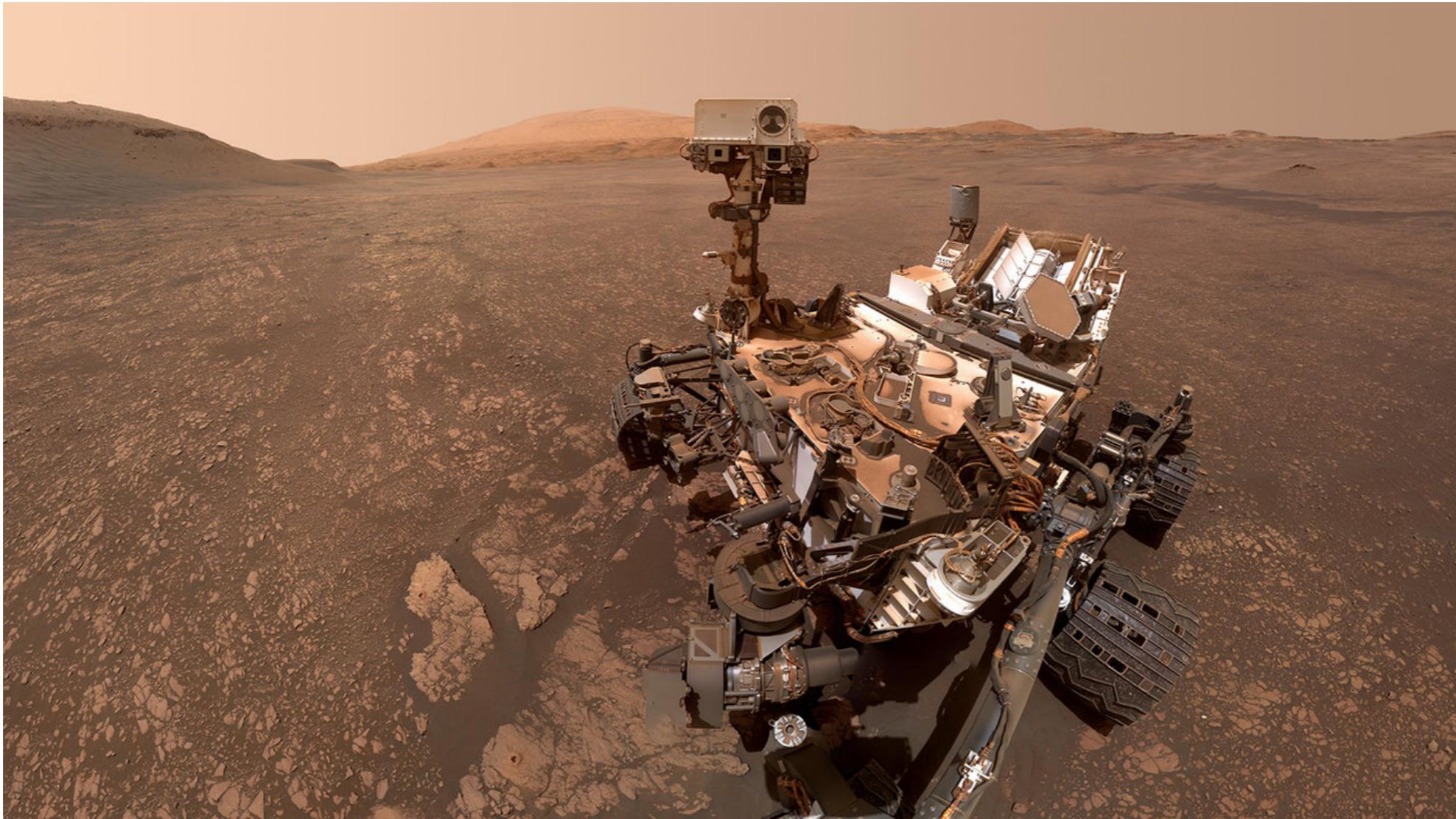
› all news

Events

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

› read more

EXPLORACIÓN ESPACIAL



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



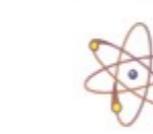
Alfiler



Protozoarios



Moléculas

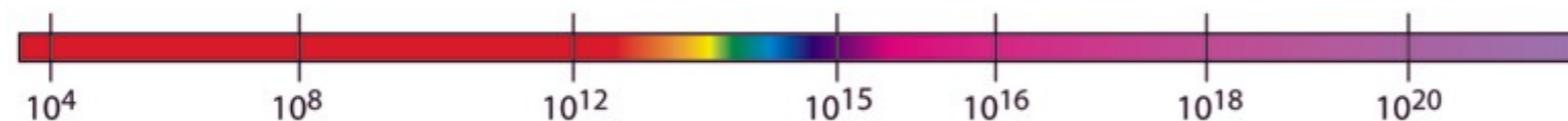


Átomos

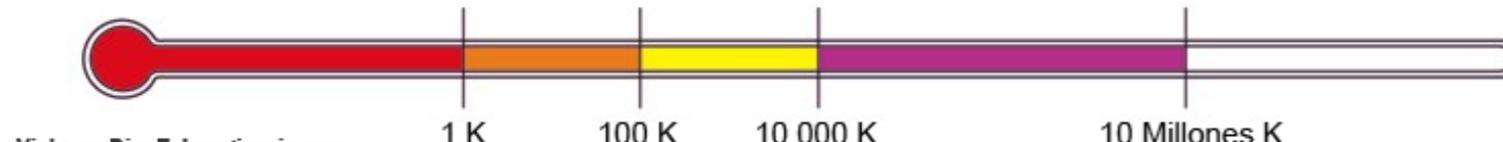


Nucleo Atómico

Frecuencia (Hz)



Temperatura de los cuerpos emitendo la onda (K)



Visto en DiosEsImaginario.com

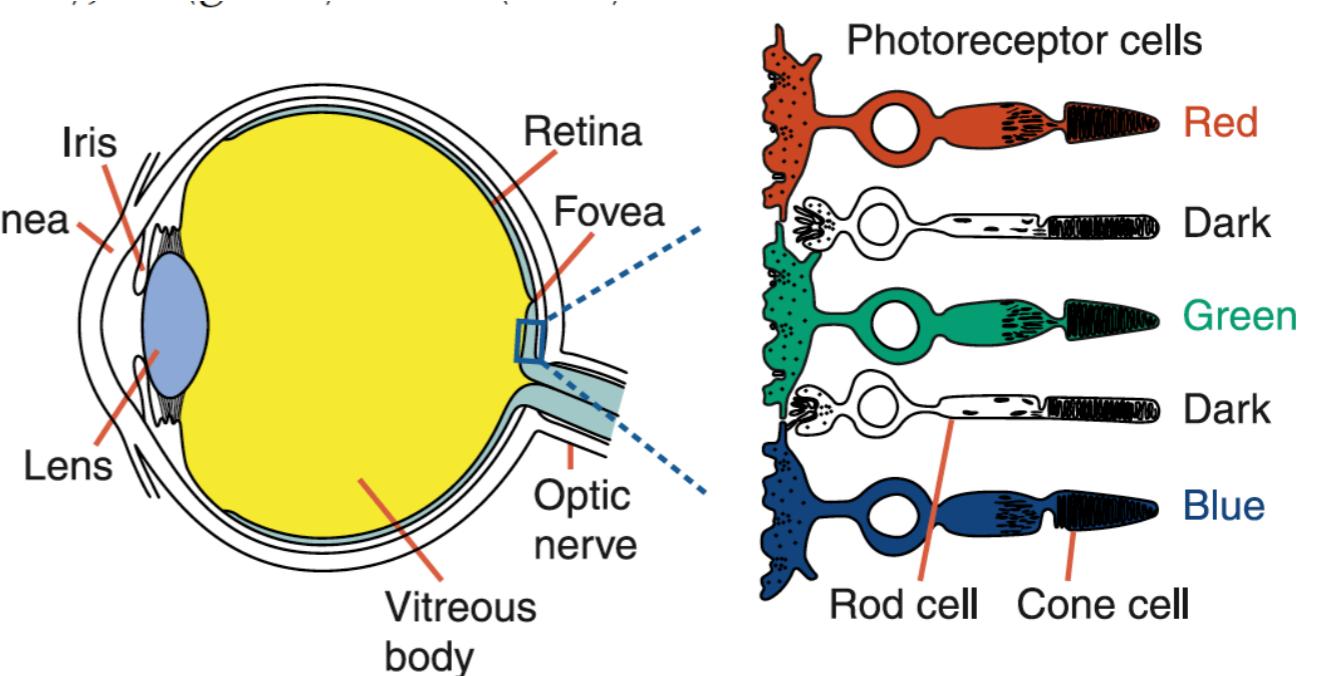
Espectro electromagnético:
distribución energética del conjunto
de las ondas electromagnéticas.

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

PERCEPCIÓN DEL COLOR

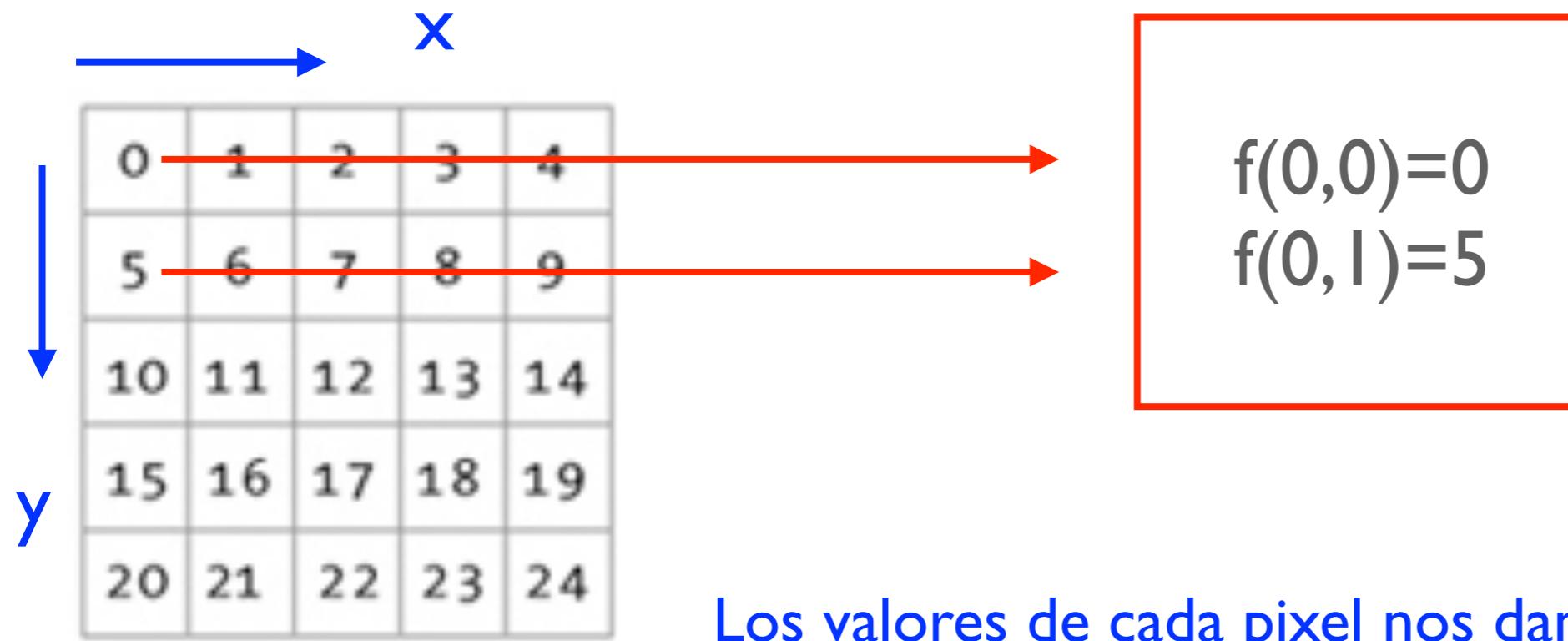
Los ojos humanos tienen dos tipos de células sensibles a la luz o fotorreceptores: los bastones y los conos.

- 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).



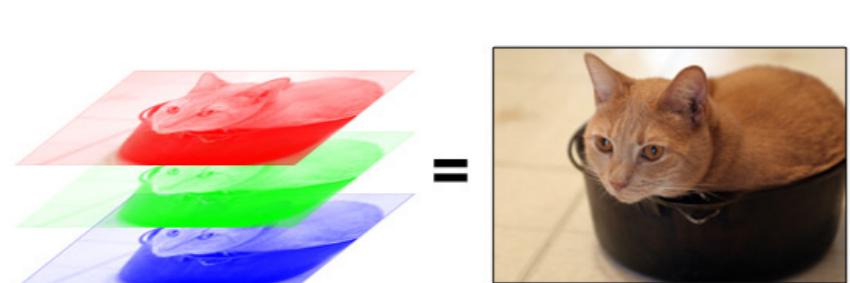
¿QUÉ ES UNA IMAGEN?

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

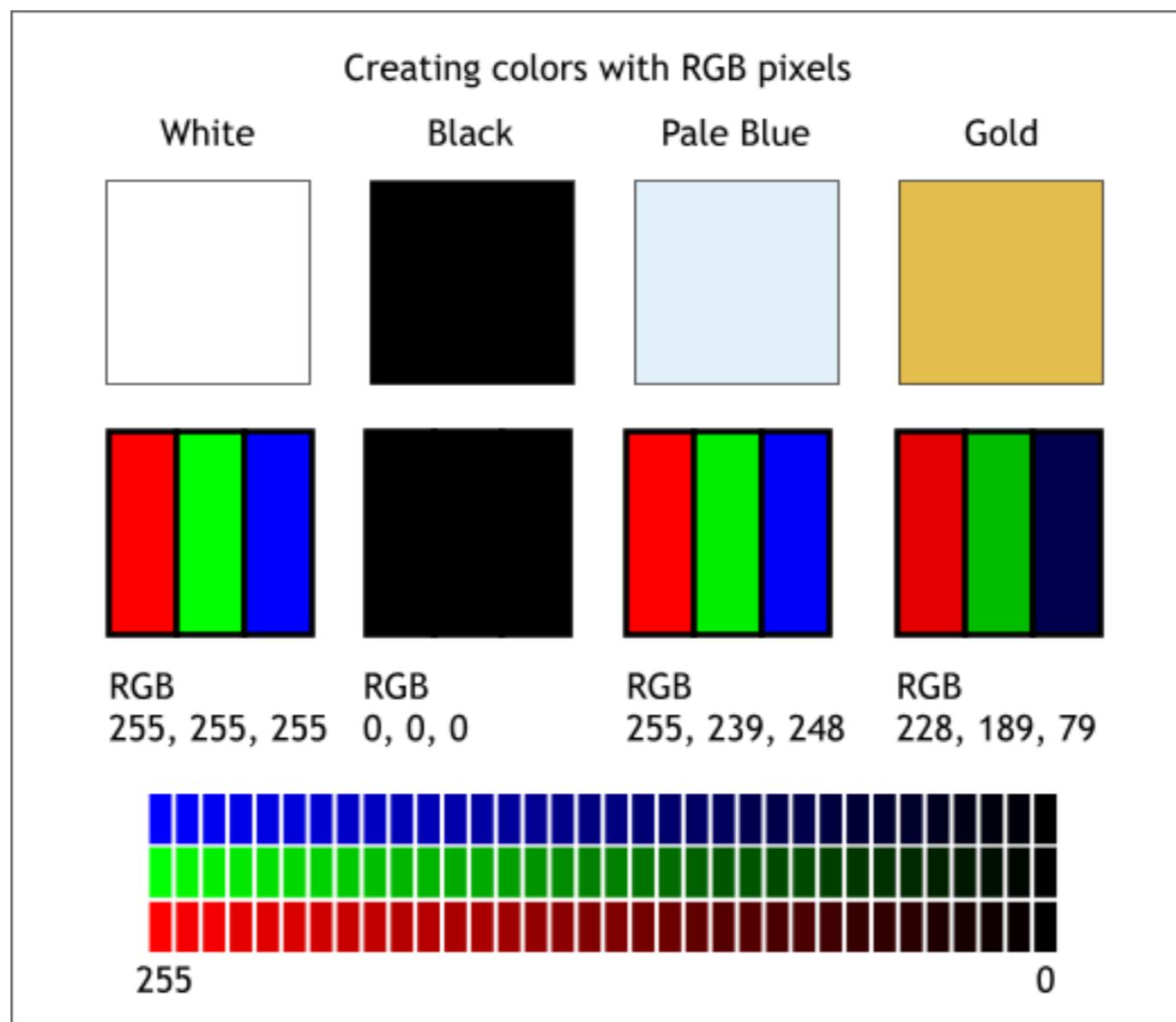
2 **bits por píxel:** $2^2 = 4$ colores

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)



SISTEMAS DE VISIÓN

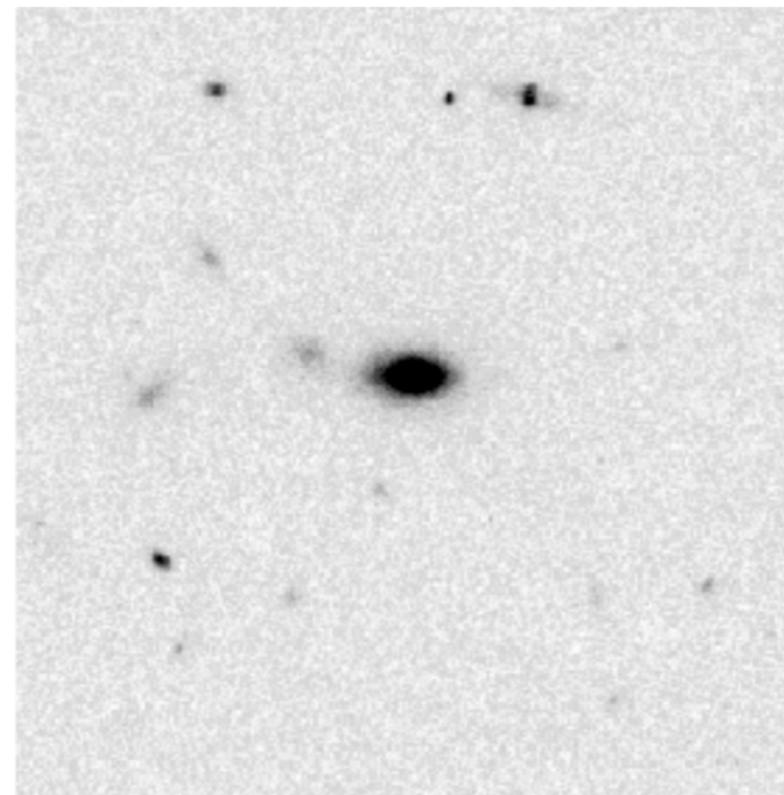
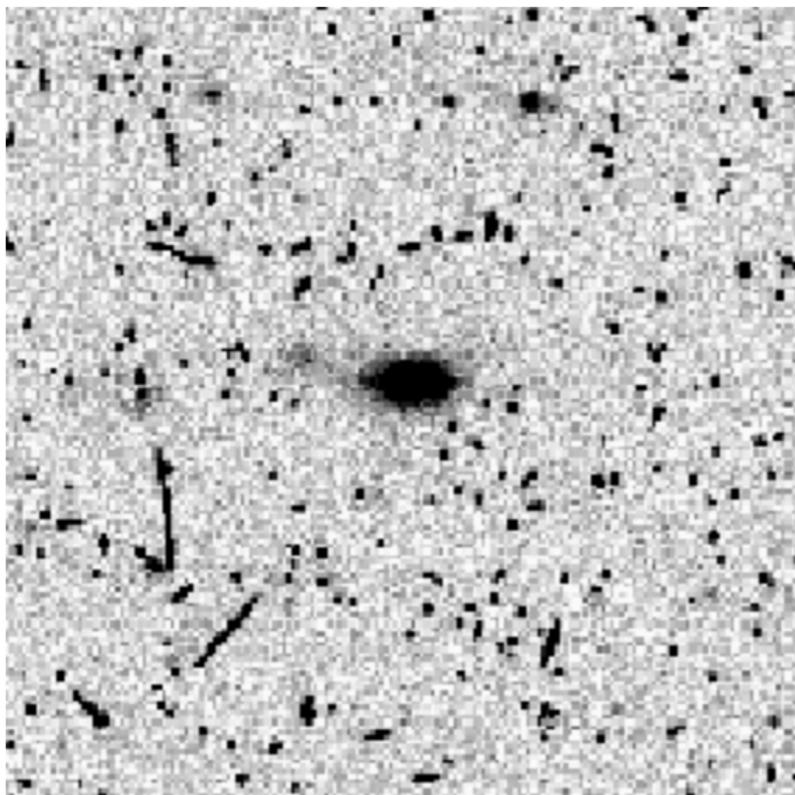


ETAPAS

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
-

ADQUISICIÓN: DITHERING



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

PROCESAMIENTO DE IMÁGENES

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

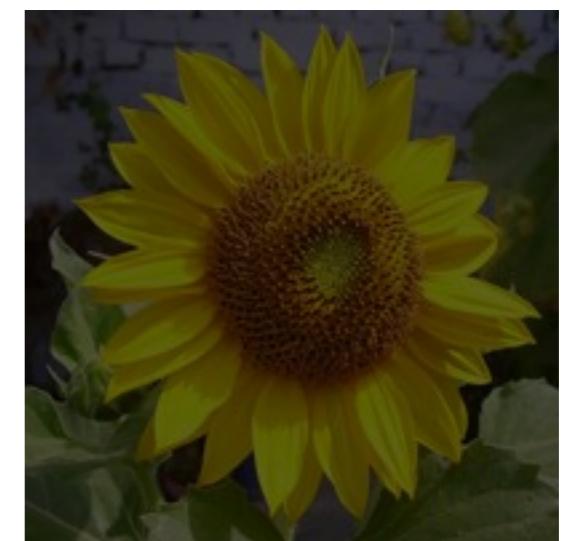
$$f(x,y)$$



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



$$g(x,y)$$



PROCESAMIENTO: CONVERSION A ESCALA DE GRISES

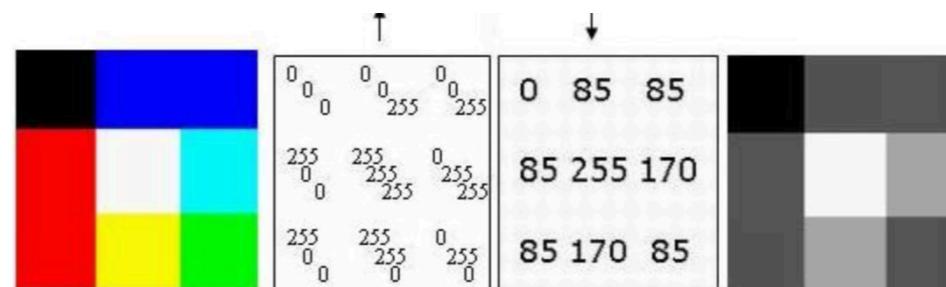
Algunos métodos:

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

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

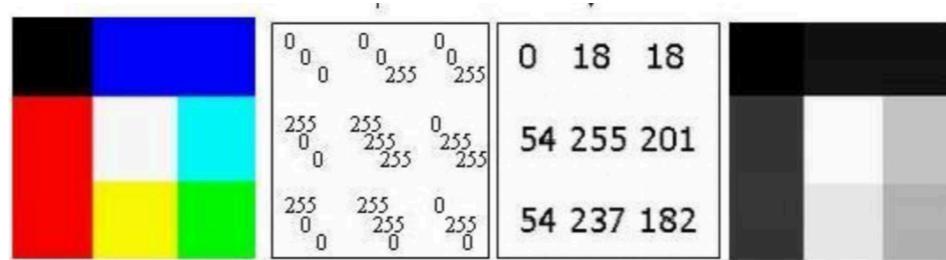
- **Average:** Promedia los valores RGB que componen la imagen.

$$R+G+B / 3$$



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

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



PROCESAMIENTO: STACKING



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

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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.

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

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APT NO.	

If Different From Residence Address

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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

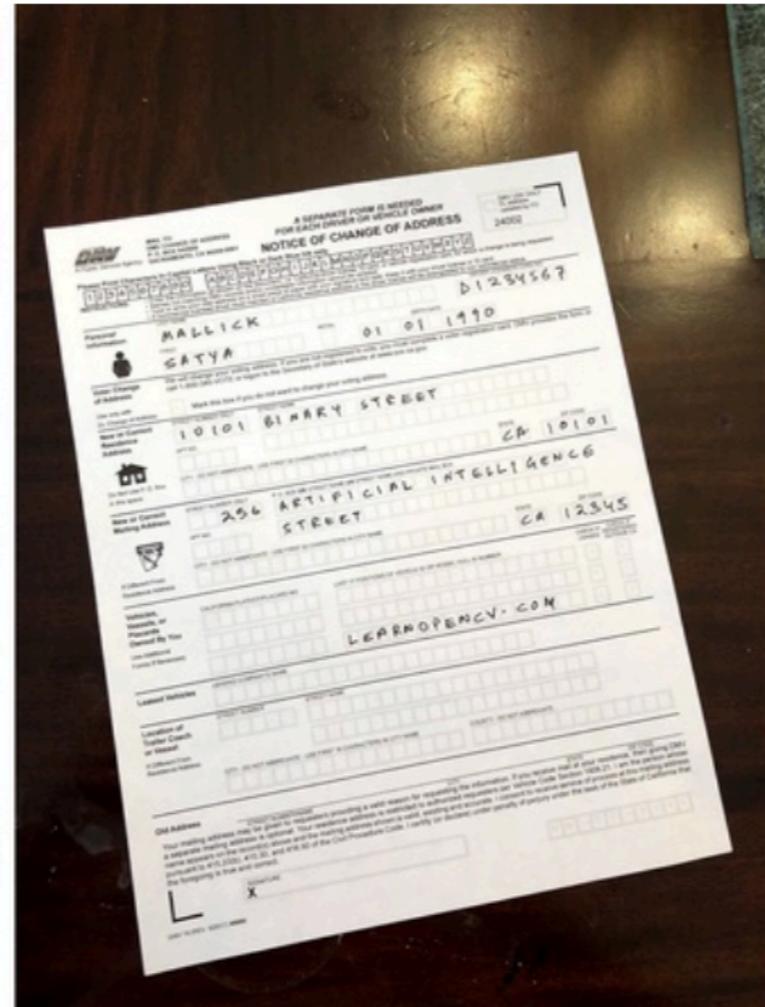
STREET NUMBER STATE ZIP CODE
Your mailing address may be given to requesters providing a valid reason for requesting the information. If you receive mail at your residence, then giving DMV a separate mailing address is optional. Your residence address is restricted to authorized requesters per Vehicle 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**



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BIRTH DATE			

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LEASING COMPANY'S NAME

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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

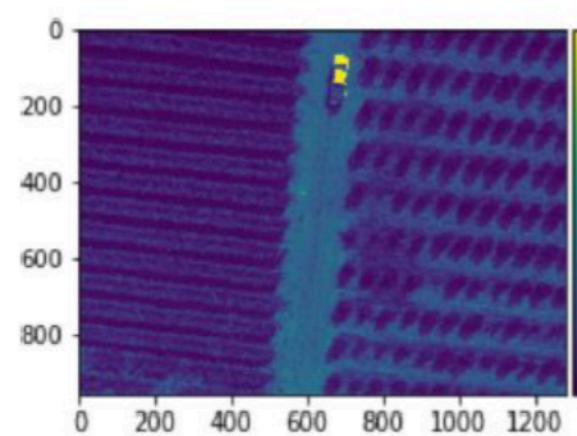


Figura 3. Banda Azul

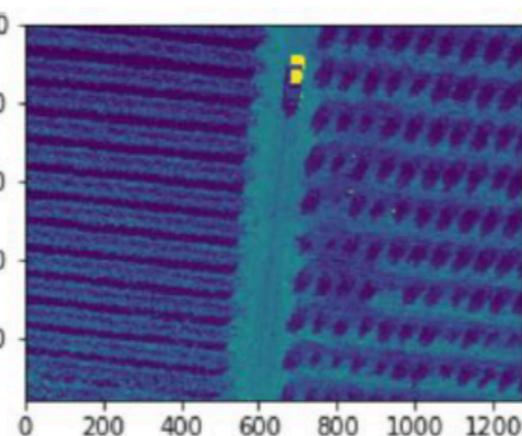


Figura 4. Banda Verde

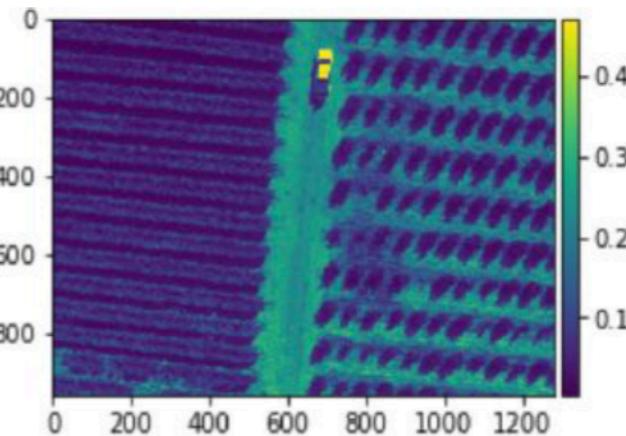


Figura 5. Banda Roja

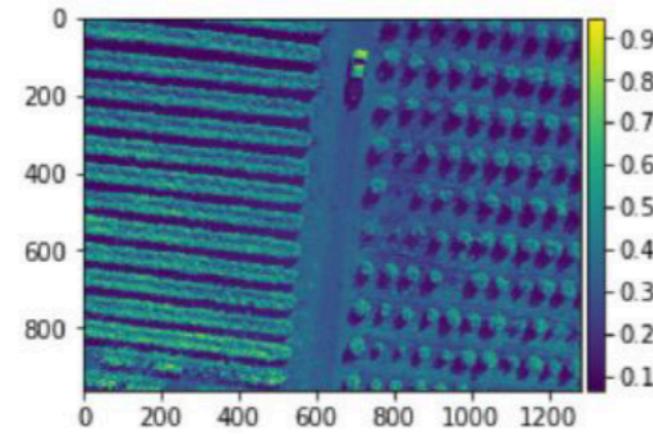


Figura 6. Banda Infrarrojo Cercano

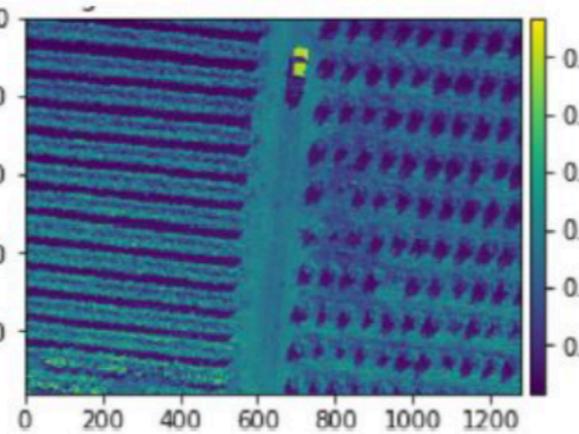


Figura 7. Banda Rededge

ALGUNOS TIPOS DE IMÁGENES (RASTER)

Tipo	Compresión	Extensión
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

JUPYTER

