Procesamiento Digital de Imágenes

Redes Neuronales Convolucionales

Universidad Autónoma de Manizales

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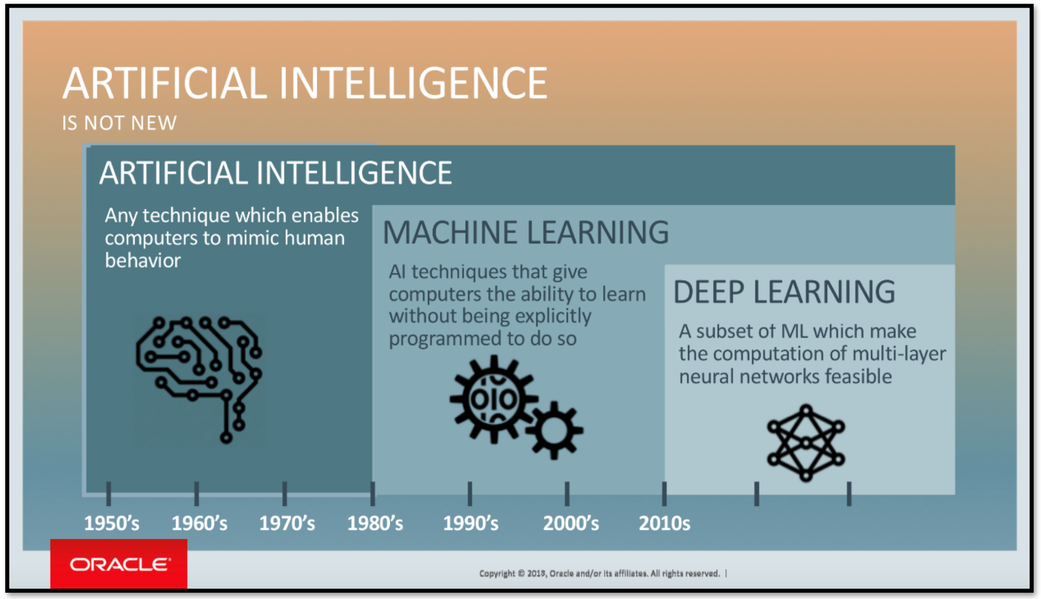
Inteligencia Artificial

Conjunto de técnicas que permiten a los computadores **imitar** la inteligencia o el comportamiento humano.

Basadas principalmente en la matemática, estadística y programación.



https://blogs.oracle.com/bigdata/difference-ai-machine-learning-deep-learning

Inteligencia Artificial

1955: Término Inteligencia Artificial

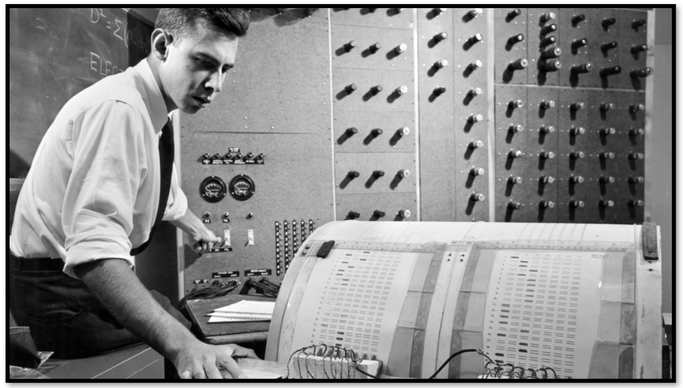
1958: Perceptron

1989: Red neuronal convolucional

1997: Deep Blue vence al campeón de ajedrez

2012: Clasificación ImageNet

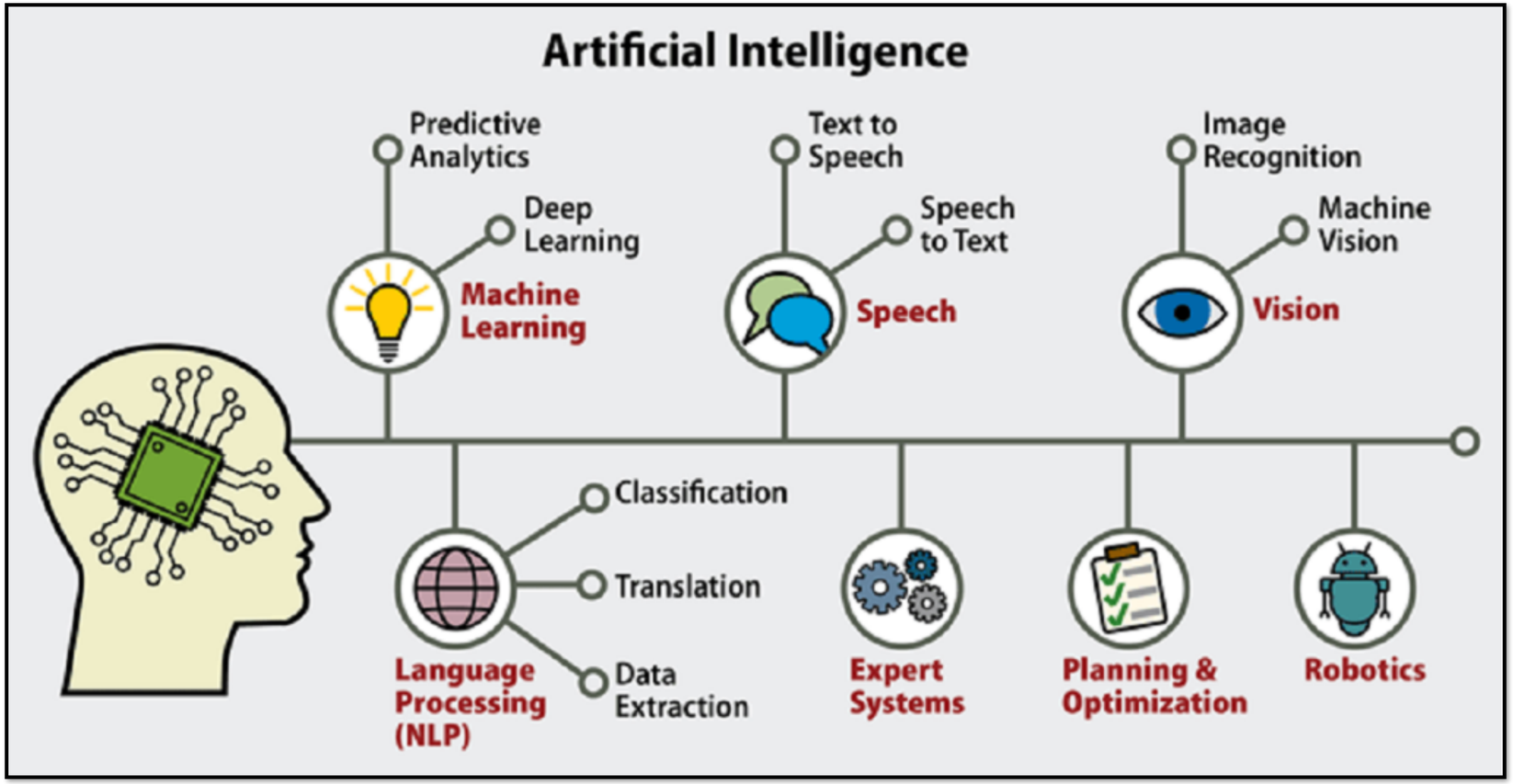
2017: Google propone los Transformers



https://news.cornell.edu

https://www.nationalgeographic.com.es

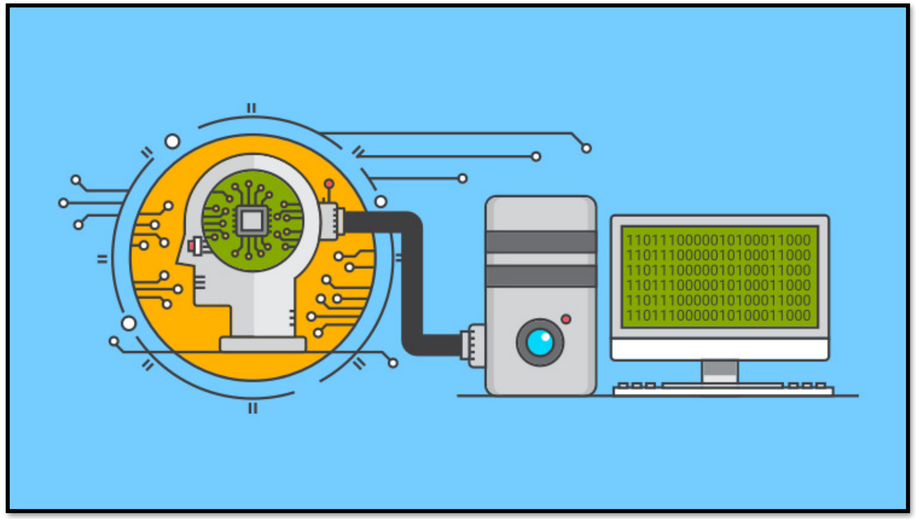
Inteligencia Artificial



https://theedugarage.com/2020/05/25/artificial-intelligence/

Machine Learning (ML)

El aprendizaje de máquina o Machine Learning es un área de la inteligencia artificial que permite a los computadores **aprender a partir de la experiencia** (de los datos).

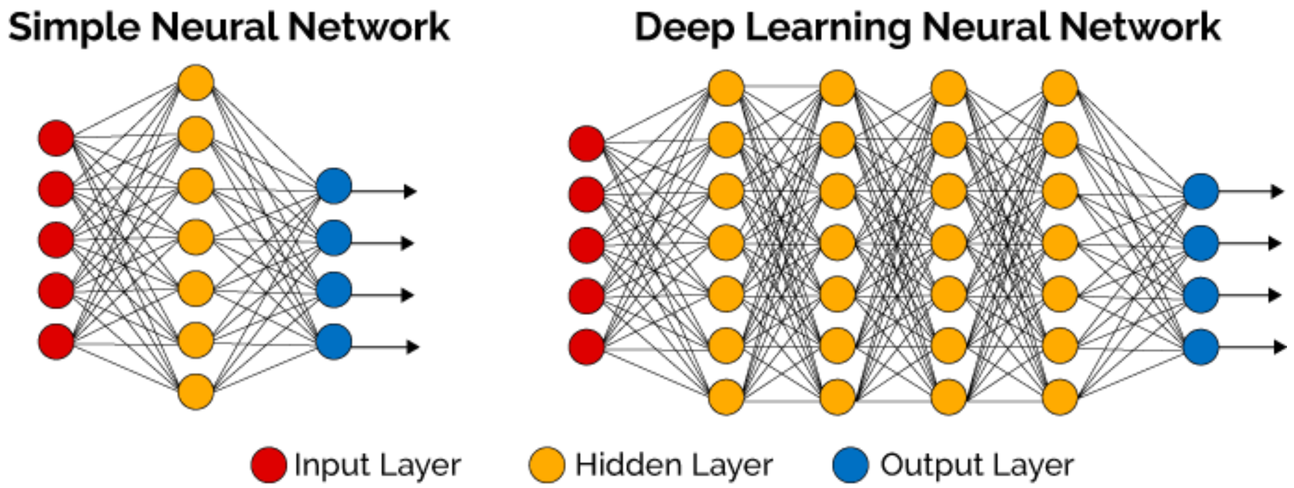


https://www.iberdrola.com

Deep Learning (DL)

El aprendizaje profundo o Deep Learning, se refiere a los modelos de ML que involucran **redes neuronales artificiales profundas**.

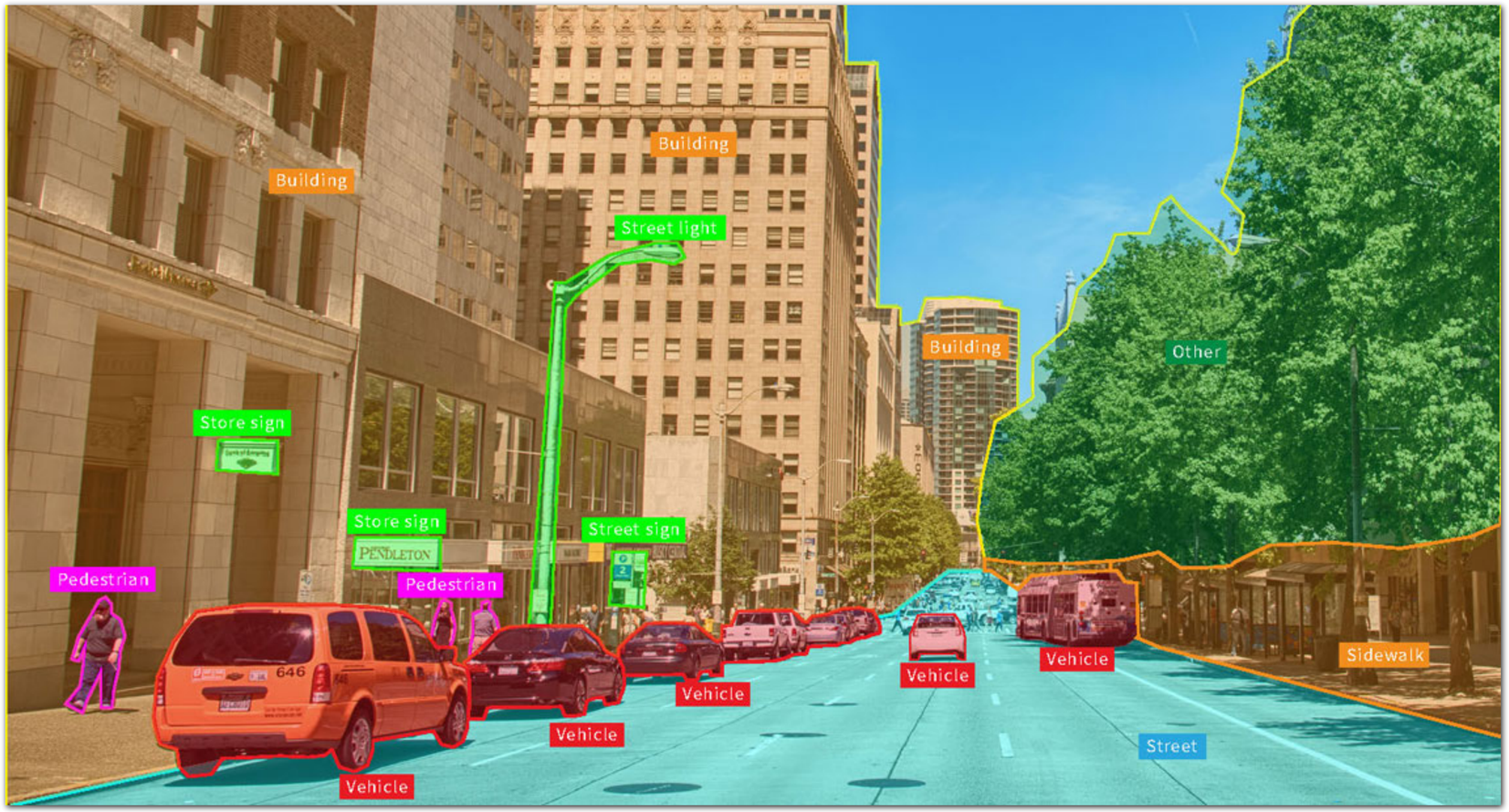
Ideales para problemas complejos como el reconocimiento y detección de objetos en imágenes.



https://miro.medium.com

Visión por computador

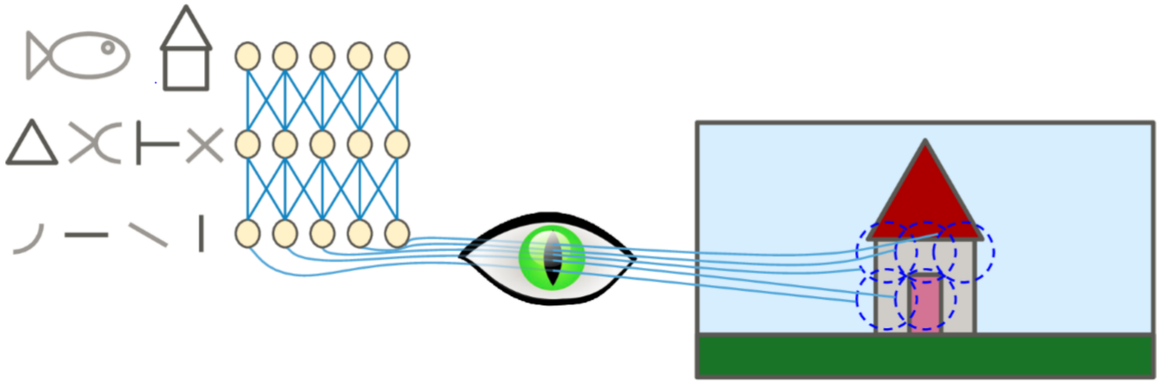
¿Cómo observa un computador?

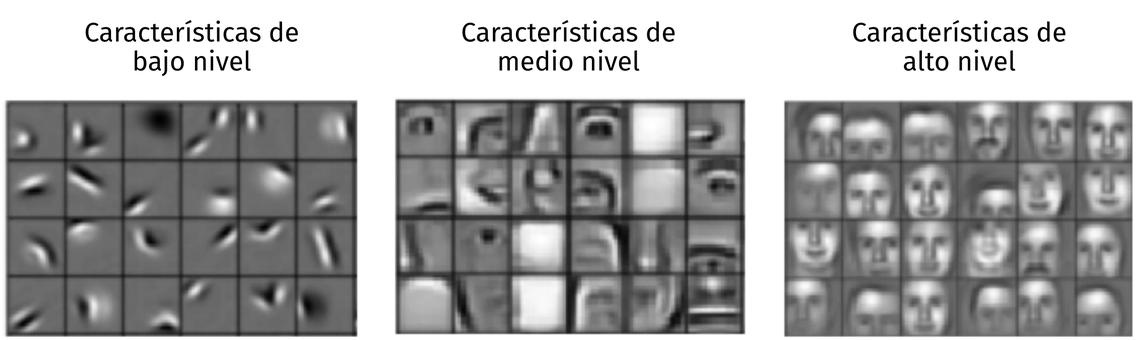


https://larevueia.fr

Visión por computador

David H. Hubel y Torsten Wiesel (1959): Muchas neuronas tienen un pequeño **campo receptivo local**, reaccionan sólo a los estímulos visuales situados en una región limitada del campo visual

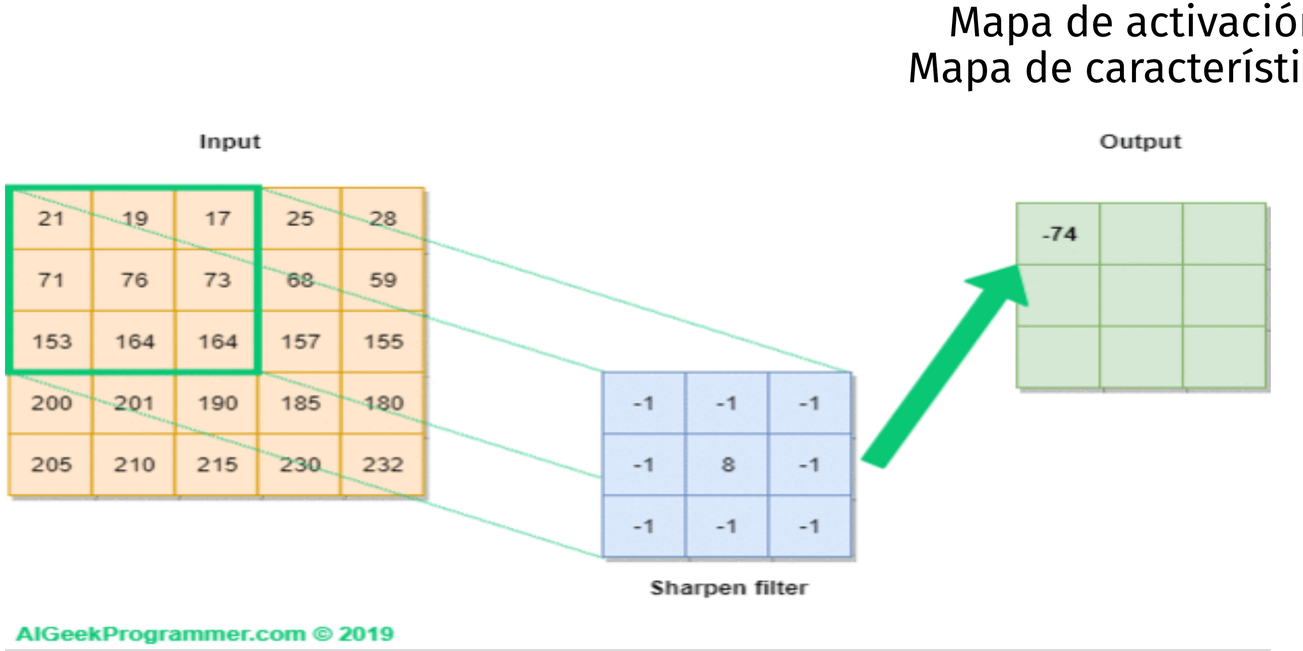




http://introtodeeplearning.com/

Redes Neuronales Convolucionales

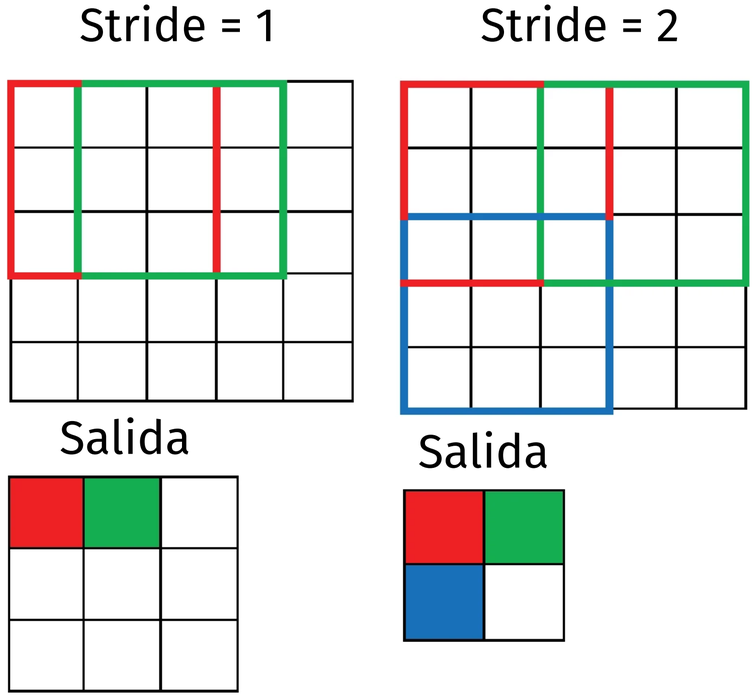
Convolución

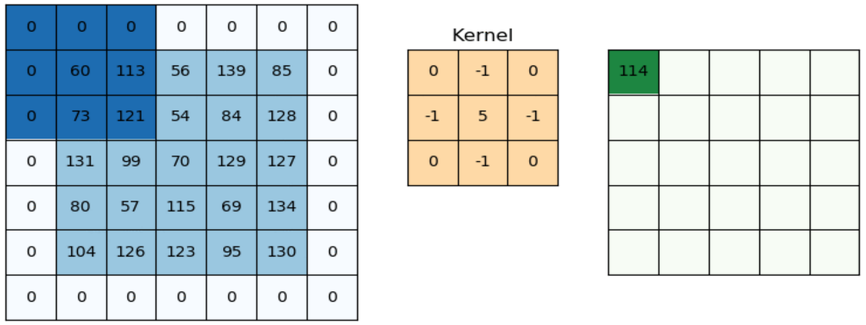


https://aigeekprogrammer.com

Redes Neuronales Convolucionales

Stride y *Padding*





$$n_{out} = \left(\frac{n_{in} + 2p - k}{s} \right) + 1$$

$n_{in} =$ *Tamaño de entrada*

$p =$ *Tamaño del padding*

$k =$ *Tamaño del filtro de la convolución*

$s =$ *Tamaño del stride*

$n_{out} =$ *Tamaño del mapa de características*

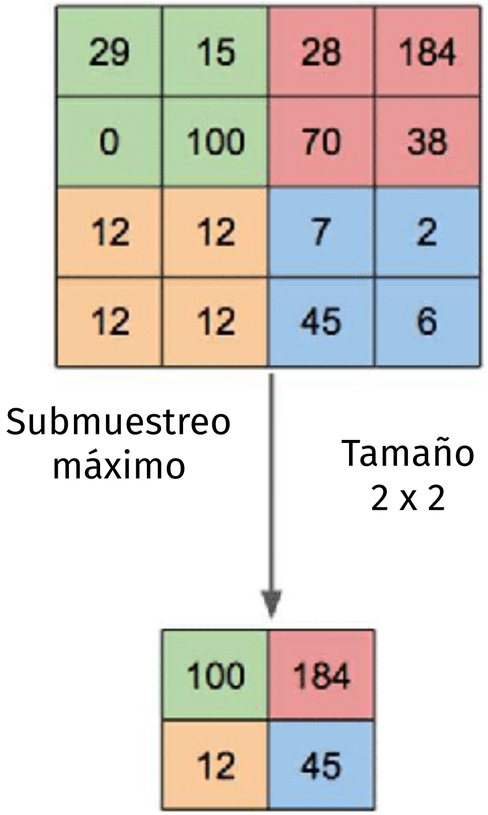
https://www.analyticsvidhya.com/blog/2022/03/basics-of-cnn-in-deep-learning/

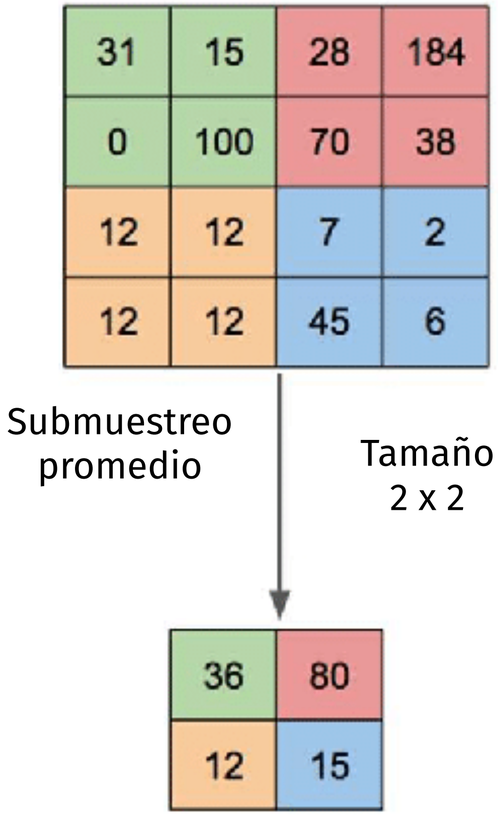
https://setosa.io/ev/image-kernels/

https://medium.com/@draj0718/zero-padding-in-convolutional-neural-networks-bf1410438e99

Redes Neuronales Convolucionales

Pooling





$$M_p = \frac{M}{p}$$

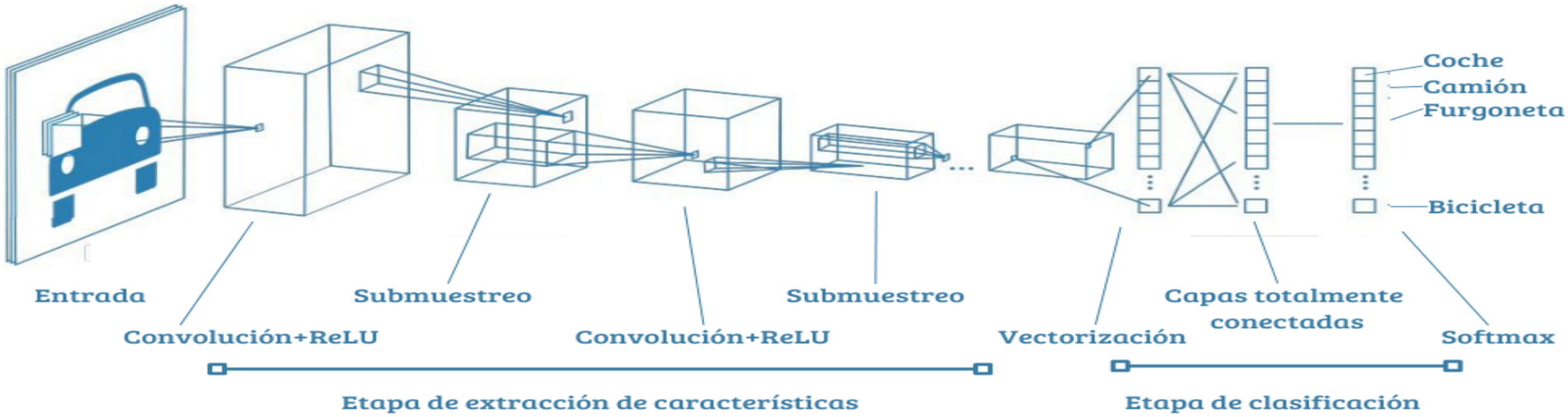
$M =$ *Tamaño del mapa original*

$p =$ *Tamaño del submuestreo*

$M_p =$ *Tamaño del mapa después de aplicar el submuestreo*

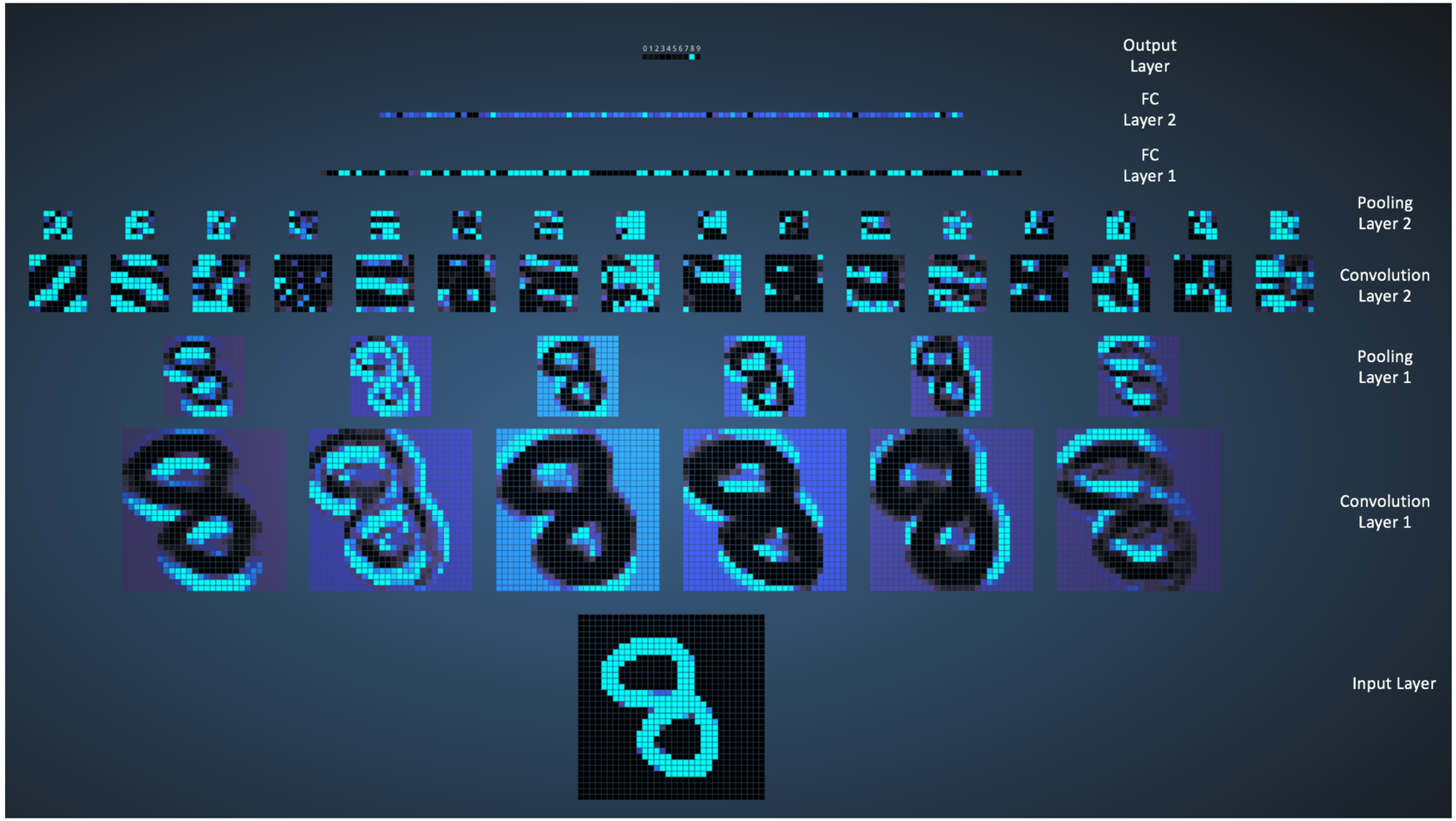
https://www.linkedin.com/pulse/max-pooling-combining-channels-using-11-convolutions-field-n-bhatt/
http://dx.doi.org/10.1088/1742-6596/1201/1/012052

Redes Neuronales Convolucionales



https://www.mathworks.com/discovery/convolutional-neural-network-matlab.html

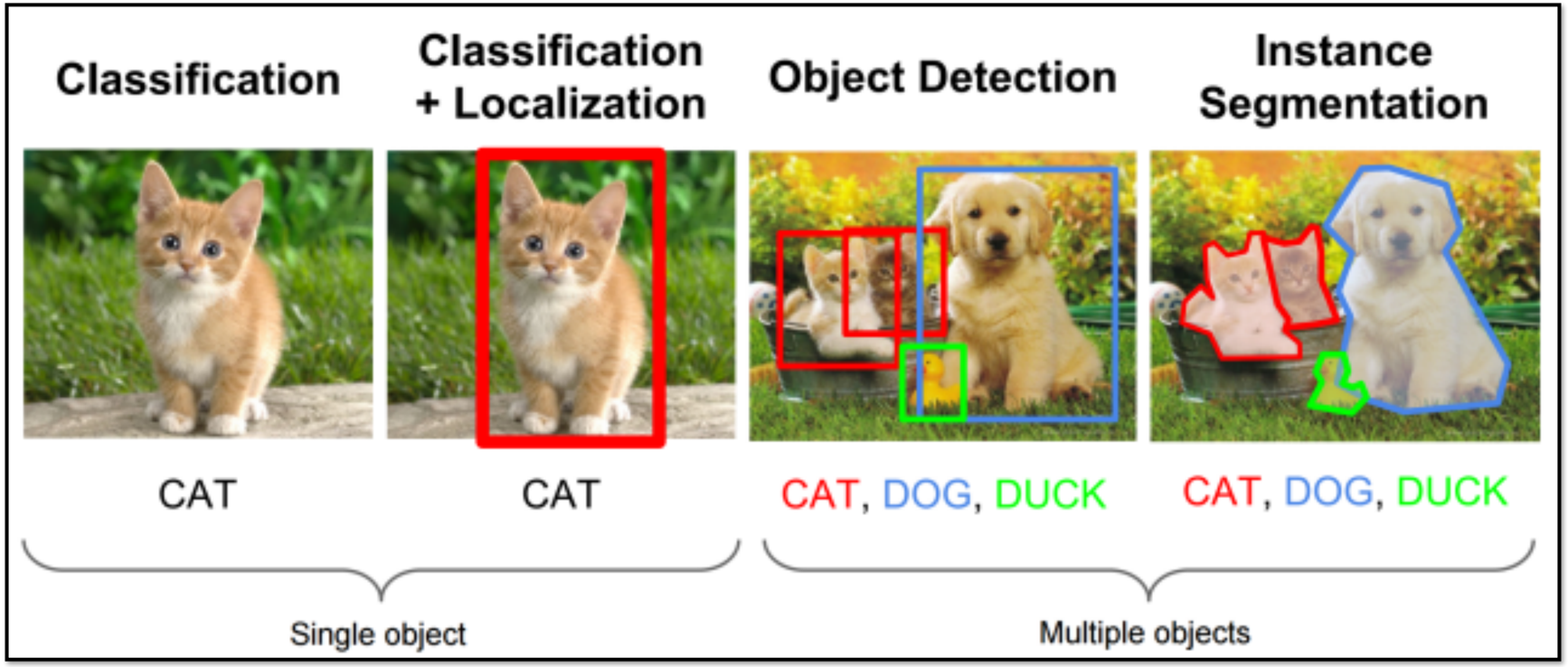
Redes Neuronales Convolucionales



https://www.kdnuggets.com/2016/11/intuitive-explanation-convolutional-neural-networks.html/3

Redes Neuronales Convolucionales

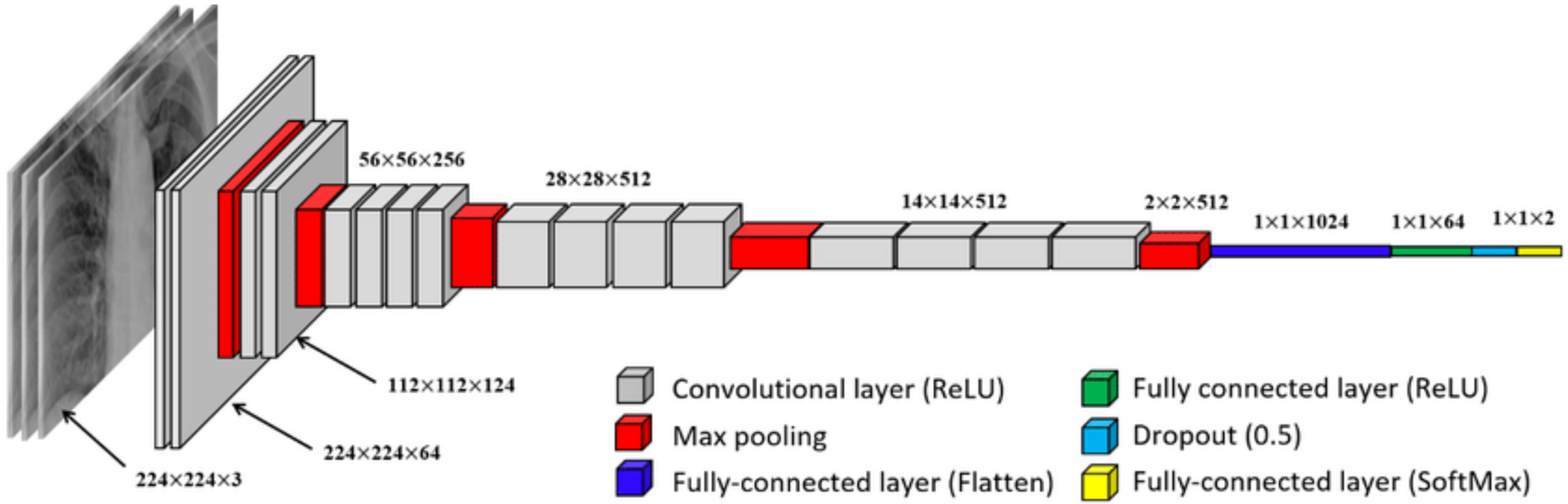
Simulación de una CNN



https://appsilondatascience.com

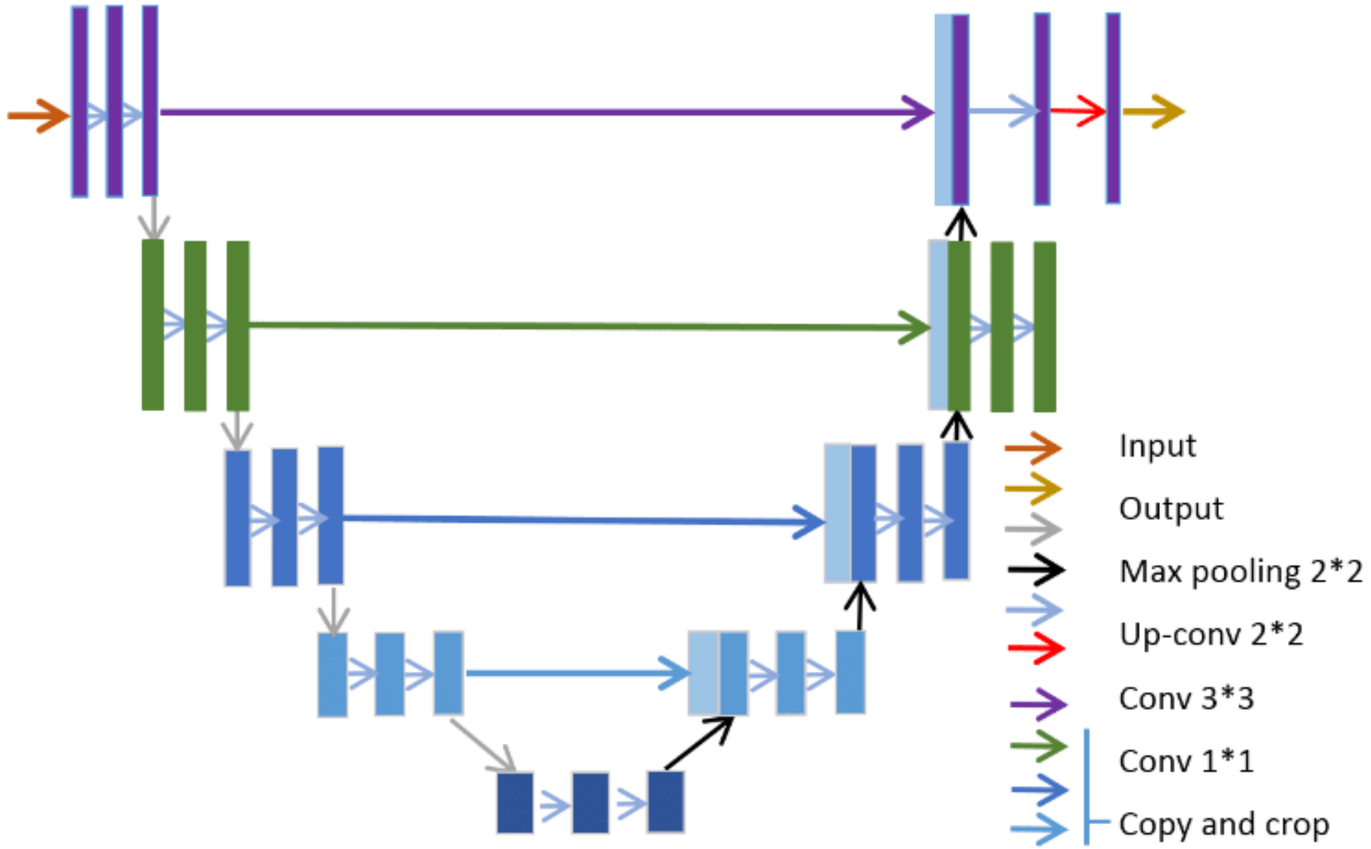
Clasificación

VGG19



Segmentación

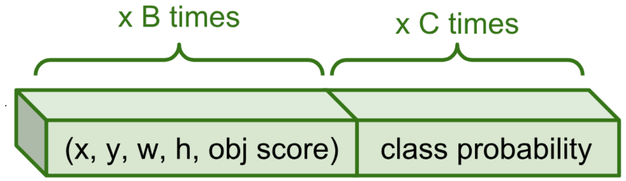
U-Net: Convolutional Networks for Biomedical Image Segmentation

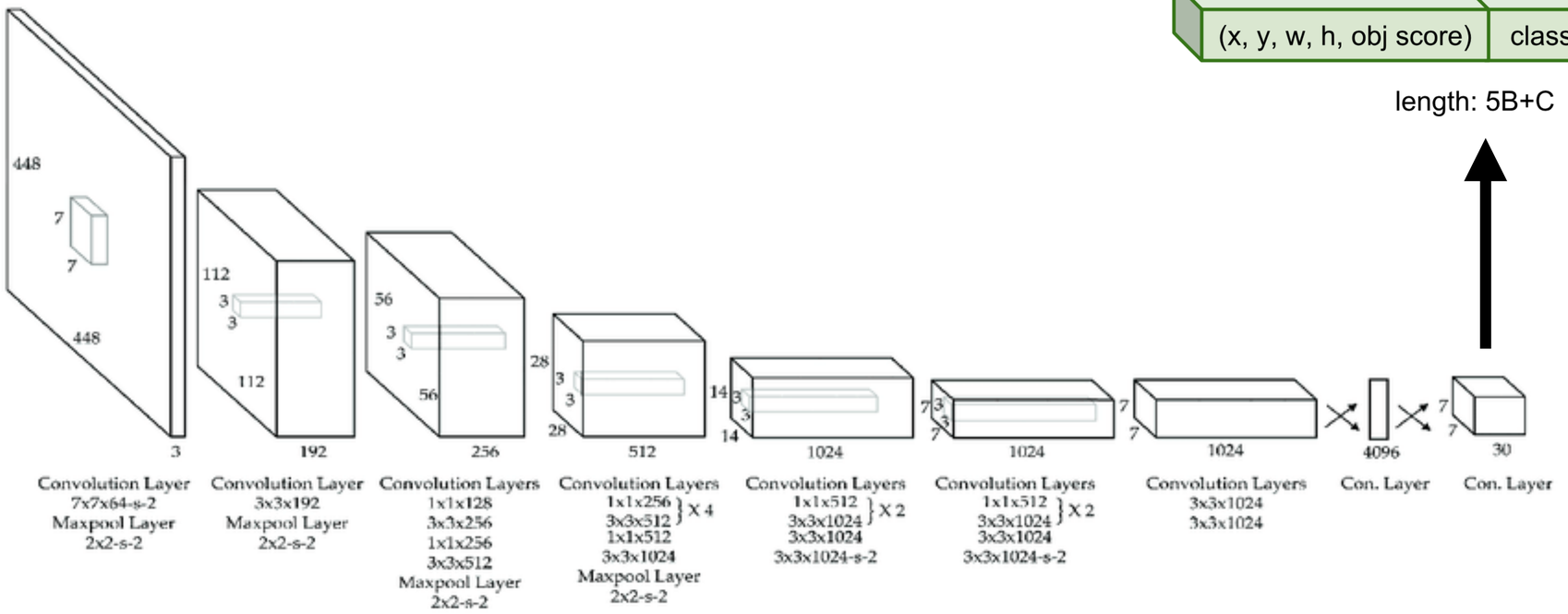


Detección de objetos

YOLO

https://www.analyticsvidhya.com





Aplicaciones

Identification of Covid-19 from X-ray images using Convolutional Neural Networks

[Noticia UAM]

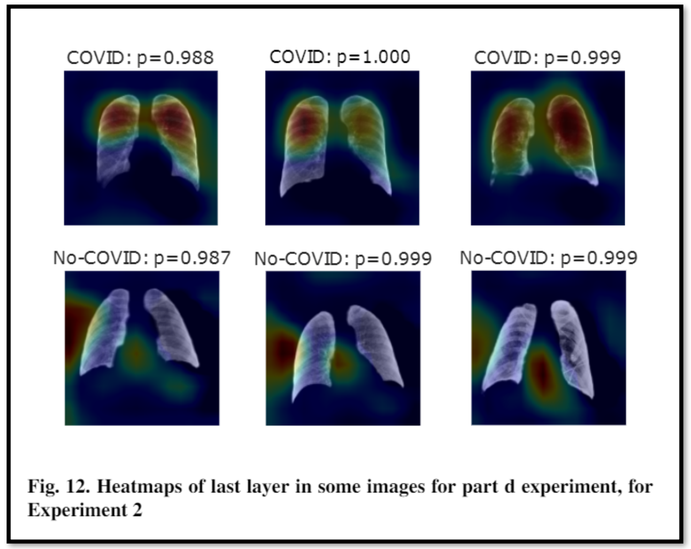


Fig. 12. Heatmaps of last layer in some images for part d experiment, for Experiment 2

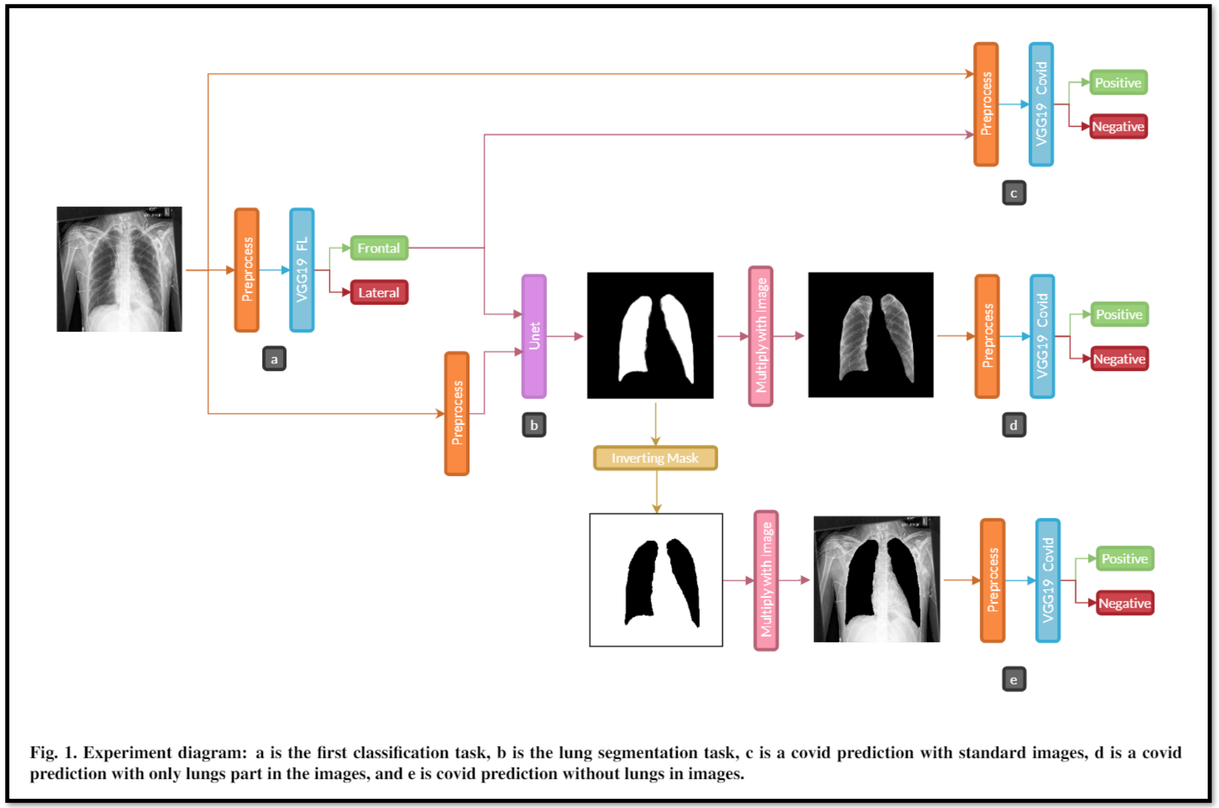
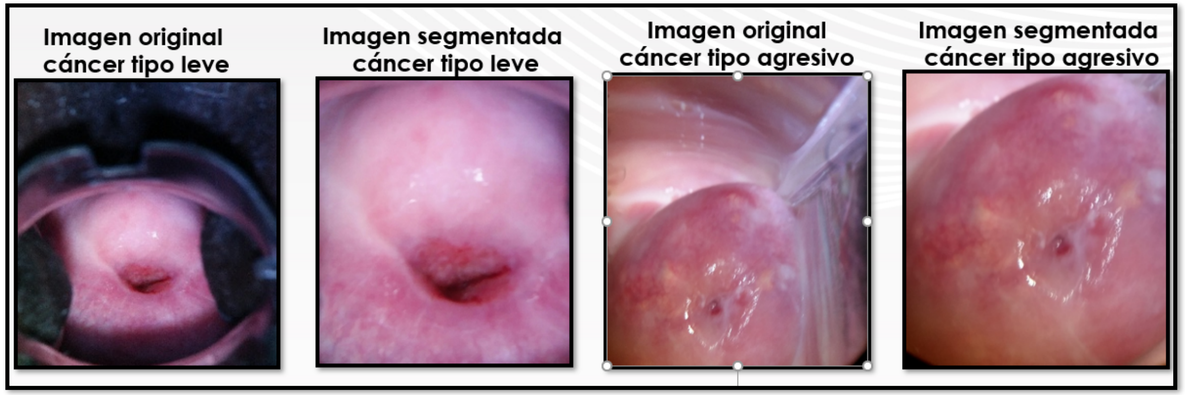


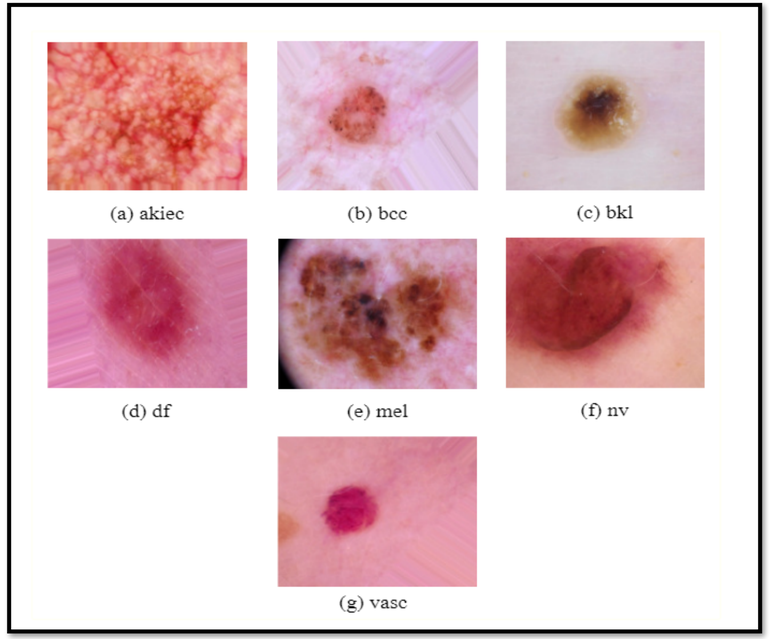
Fig. 1. Experiment diagram: a is the first classification task, b is the lung segmentation task, c is a covid prediction with standard images, d is a covid prediction with only lungs part in the images, and e is covid prediction without lungs in images.

Aplicaciones

Classification of cervical cancer using Convolutional Neural Networks, Transfer Learning and Data Augmentation

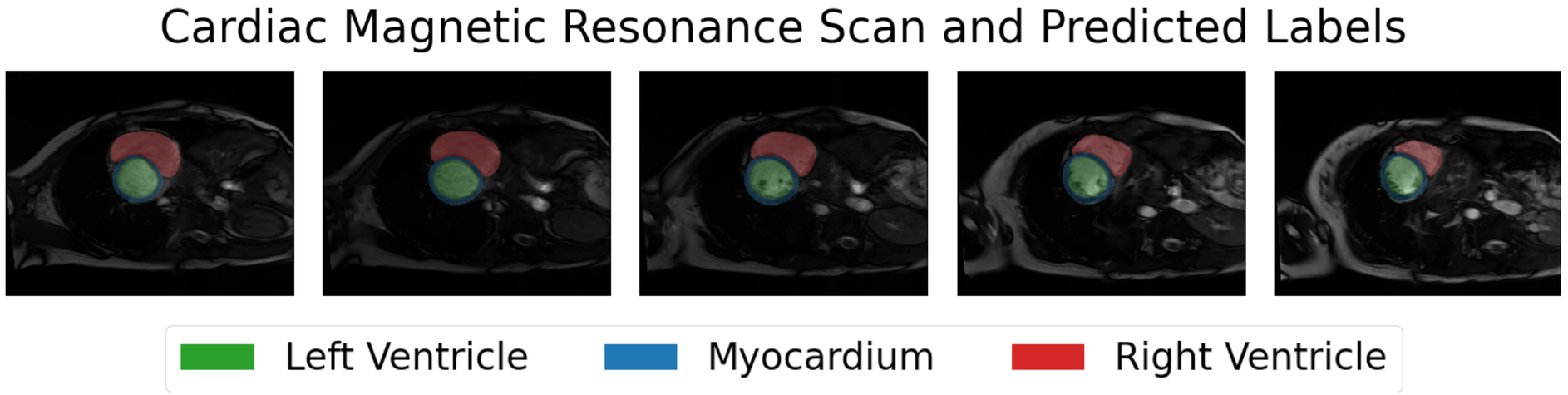


Classification of skin lesions using Convolutional Neural Networks, Transfer Learning and Data Augmentation



Aplicaciones

Deep Learning Based Classification and
Segmentation for Cardiac Magnetic Resonance
Imaging with Respiratory Motion Artifacts



Aplicaciones

Identification of Alzheimer's using Convolutional Neural Networks