



AI: Medical Imaging

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Outline

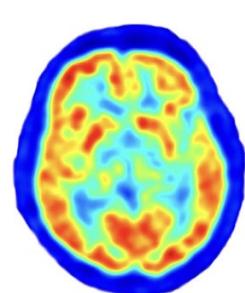
- Medical Imaging
- Convolutional Neural Networks
- Image Classification and Segmentation with Jupyter Notebooks

What is Medical Imaging?

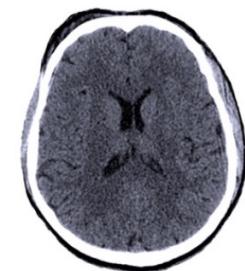
- Medical imaging refers to techniques for the visualization the interior of body tissues. Applications:
 - 1) Disease diagnosis
 - 2) Treatment planning
 - 3) Image-guided surgery



Medical Imaging Modalities



PET/SPECT
Nuclear Medicine



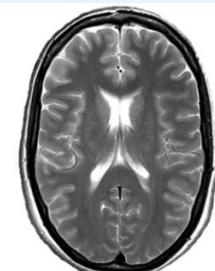
CT
Computerized Axial Tomography



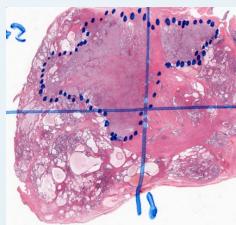
Ultrasound
Sonography



X-Ray
Electromagnetic Radiation

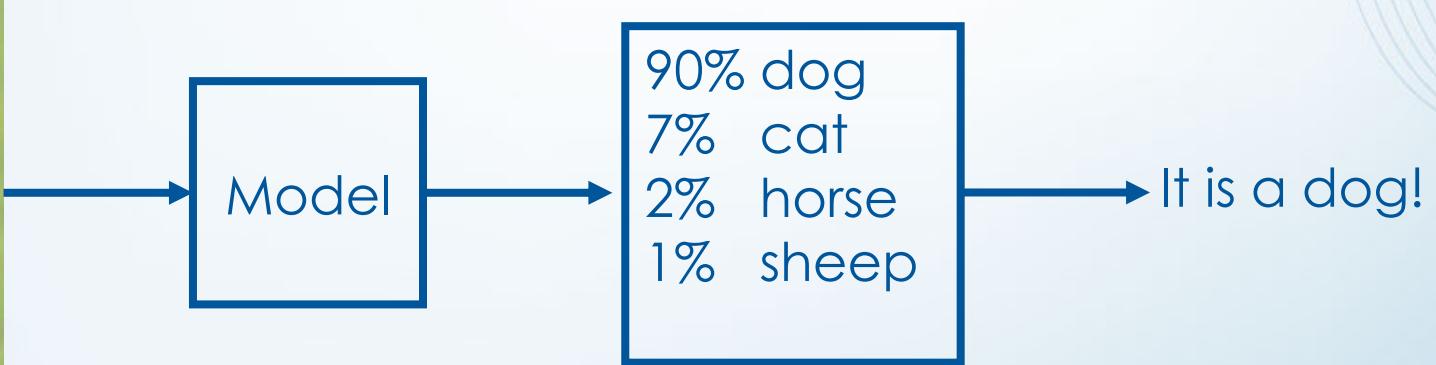


MRI
Magnetic Resonance Imaging

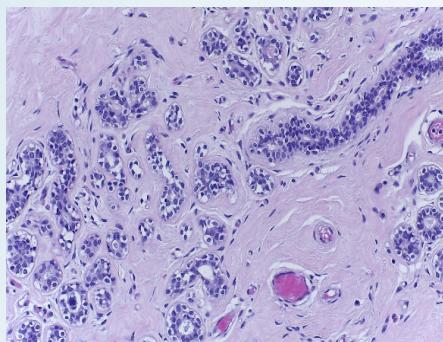


Histopathology
H&E Staining

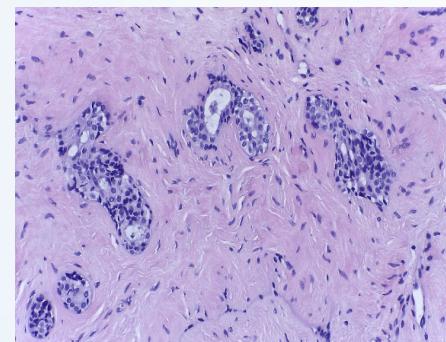
Image Classification



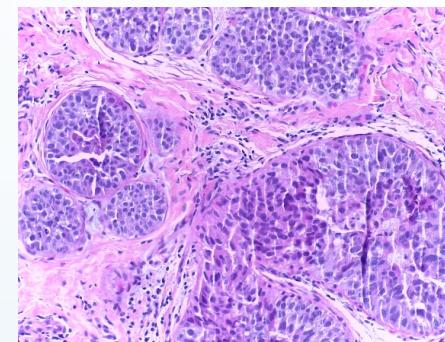
Clinical Applications



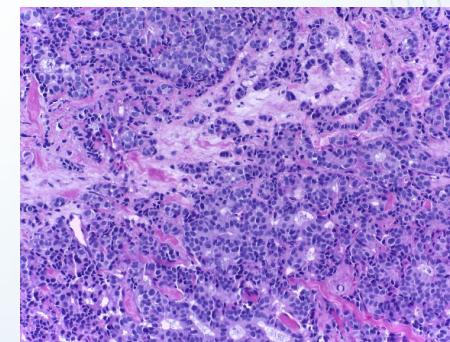
Normal



Benign



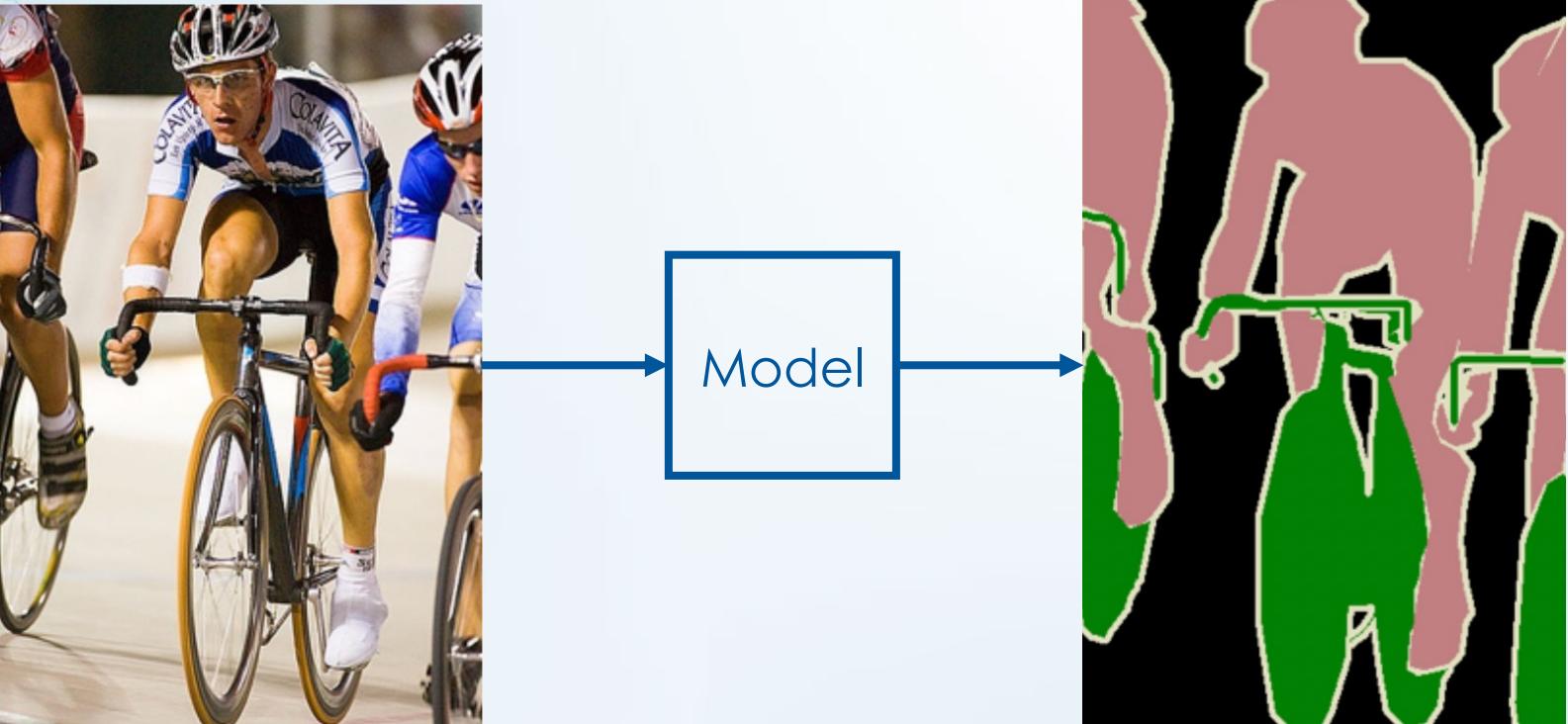
in situ carcinoma



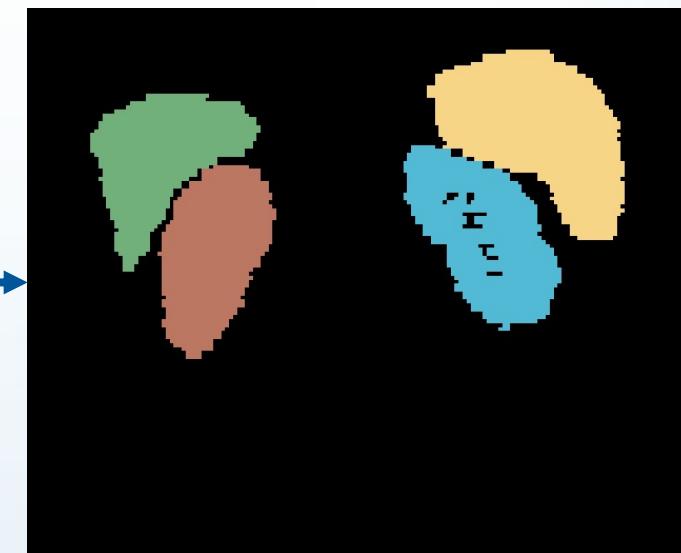
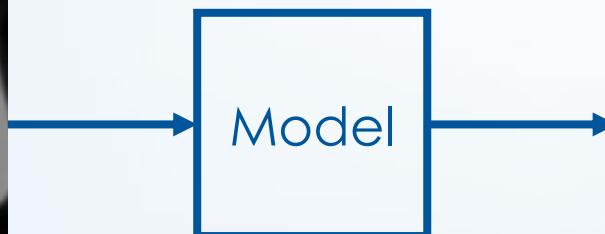
Invasive carcinoma

Classification of Microscopy Images of Breast Tissue

Image Segmentation



Clinical Applications

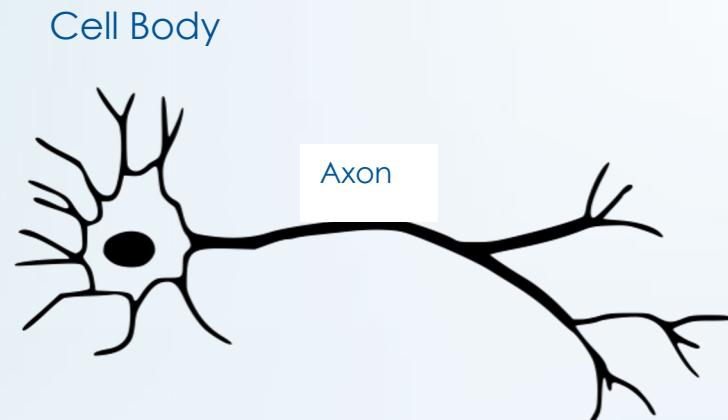


Spleen
Left kidney
Liver
Right kidney
Background

Multi-organ Segmentation on Abdominal CT

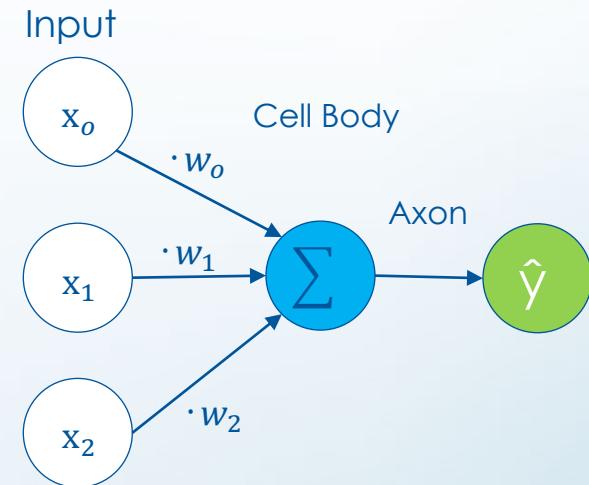
Artificial Neural Networks

Biological Neuron



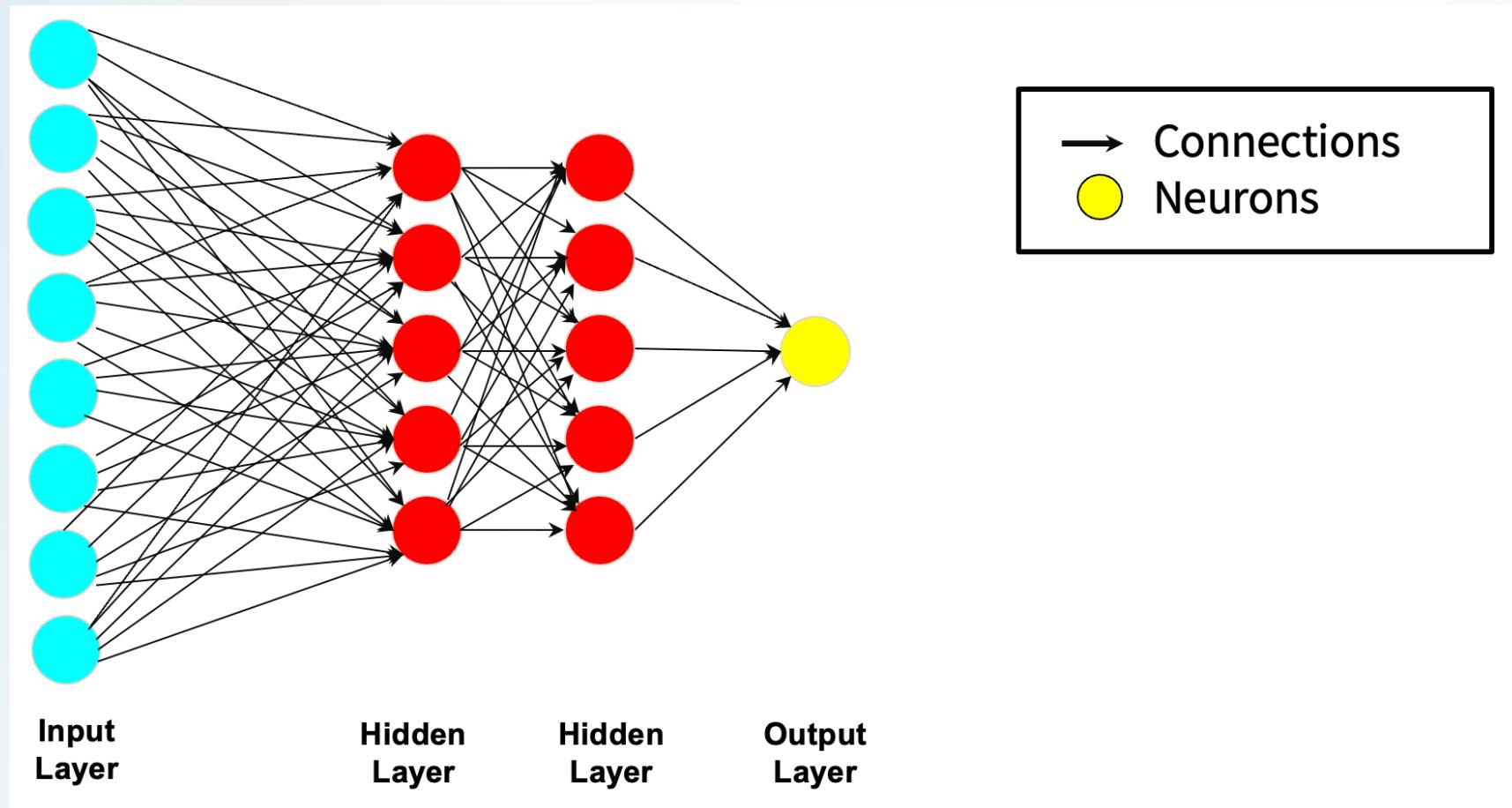
- Feed Forward
- Knowledge in connections

Artificial Neuron



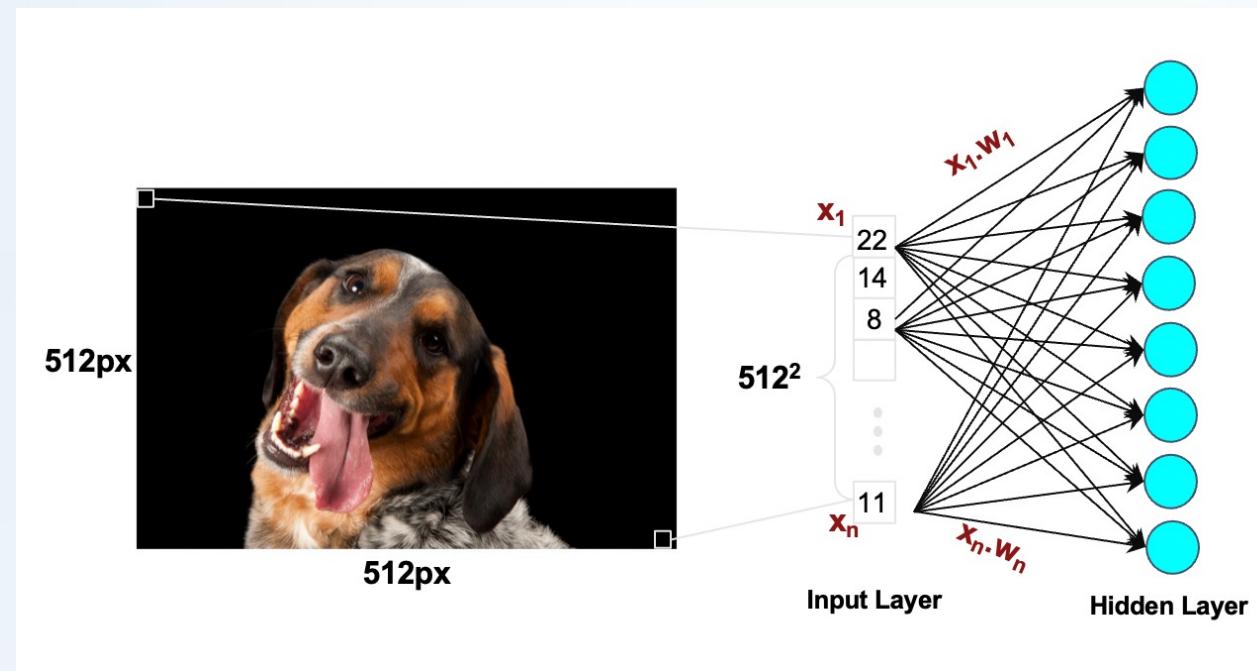
- Connections defined by weights w_i
- **Optimization Task In Neural Networks:
Learning w_i**

Fully-Connected Neural Network

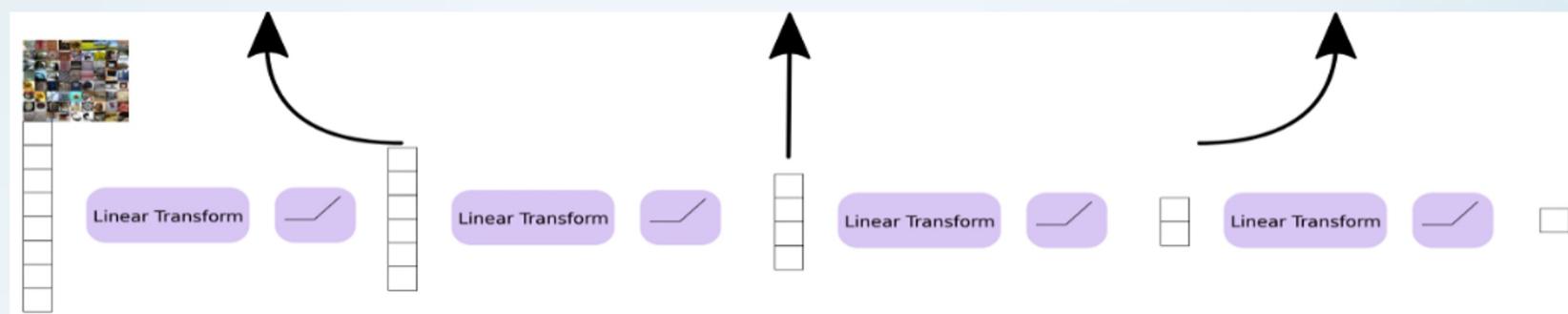


Fully-Connected Neural Network

- Assume an image, 512×512 pixels, & **One** hidden layer with 8 neurons
 - $(3 * 512^2 + 1) * 8 > 6$ million trainable weights
 - Lose track of spatial correlation



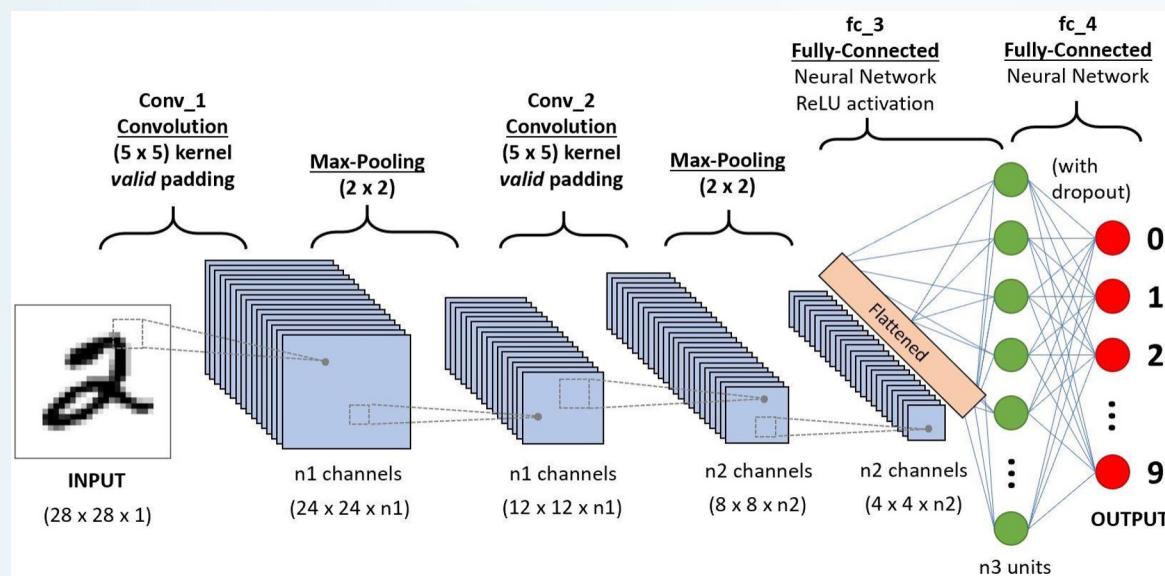
Convolutional Neural Networks



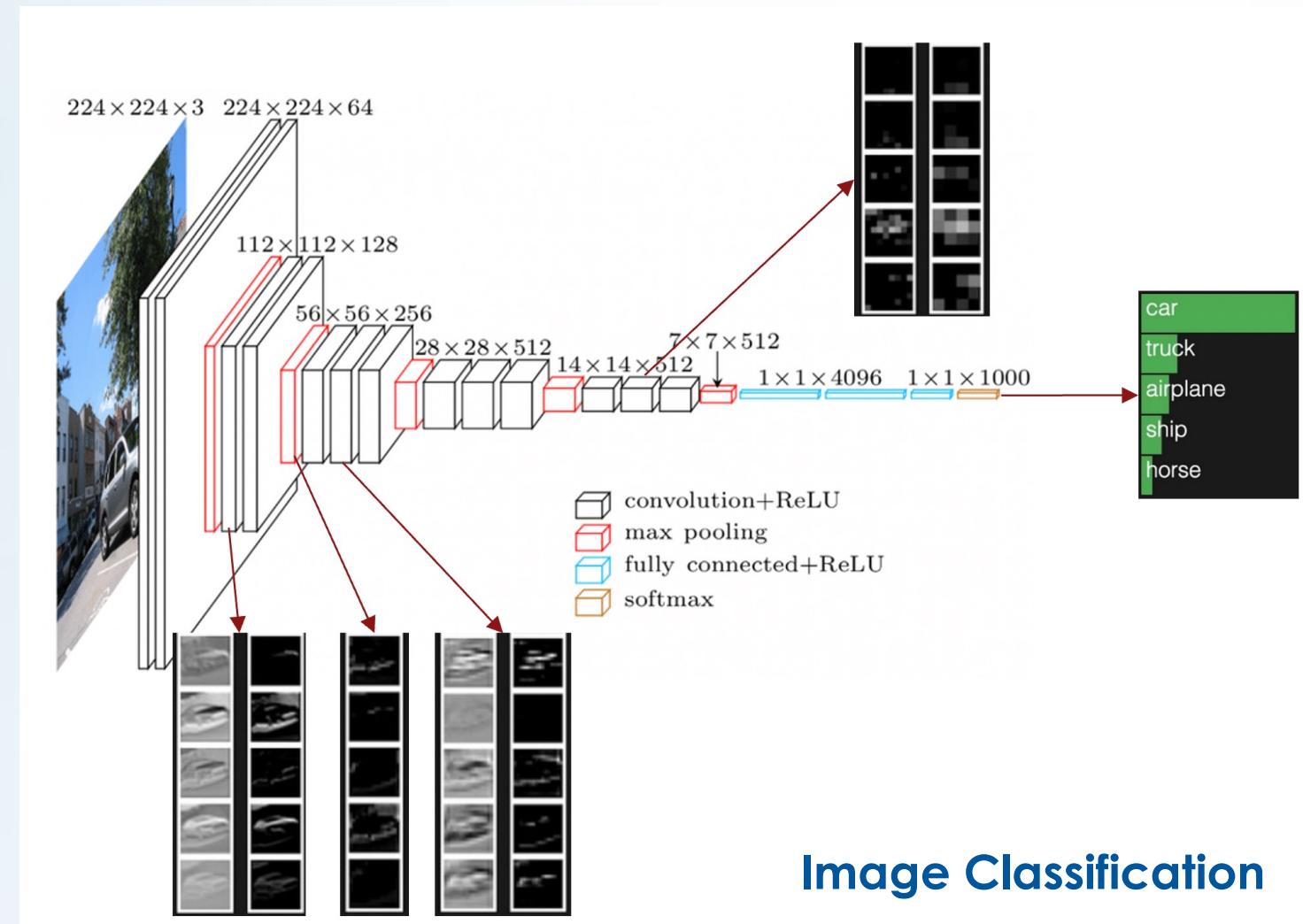
Convolutional Neural Networks

Four essential building blocks:

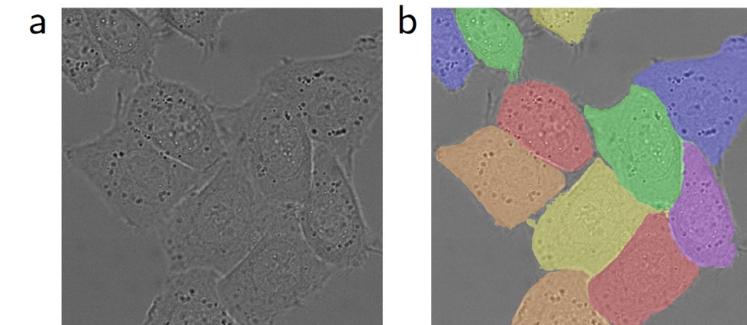
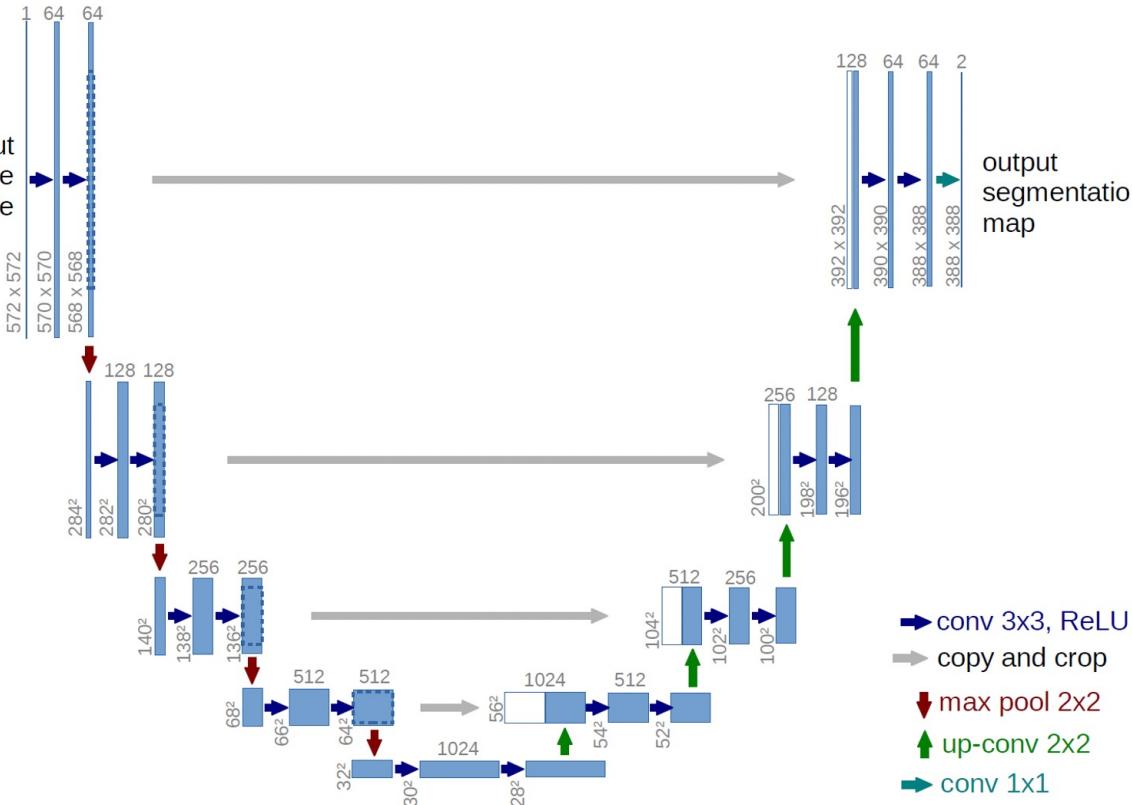
- **Convolutional layer:** Feature extraction
- **Pooling layer:** Compress information, decrease the number of parameters
- **Activation function:** Allows for Nonlinearity
- **Last layer:** Fully-connected for classification



Convolutional Neural Networks – VGG 16



U-Net - Semantic Segmentation



- Popular Network in Medical Imaging
- Used for Segmentation
 - Developed for Cell Images
 - Currently applied to numerous (any) medical problems.