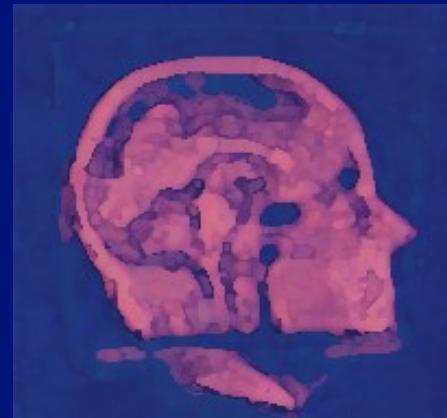


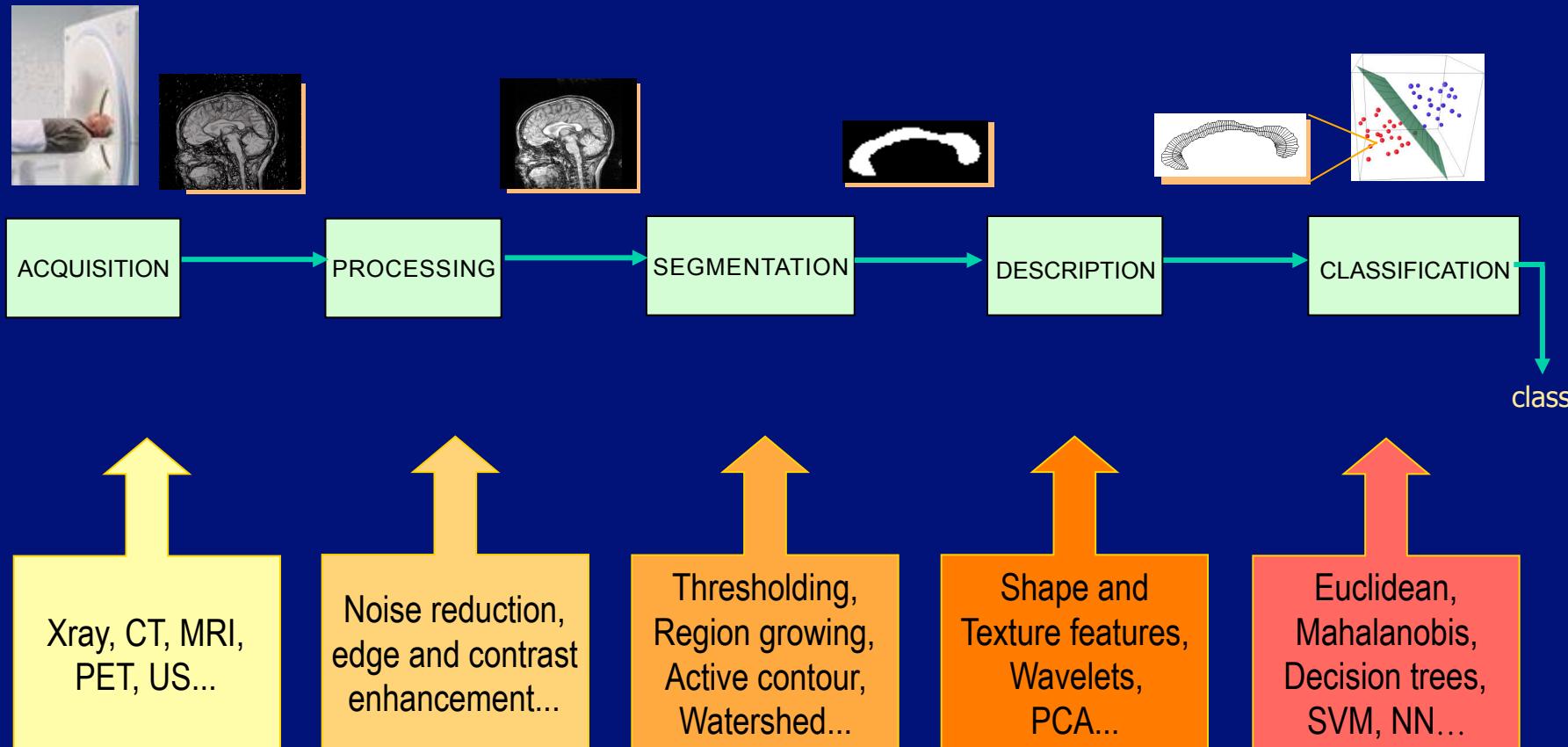
Deep Learning in Computer Vision



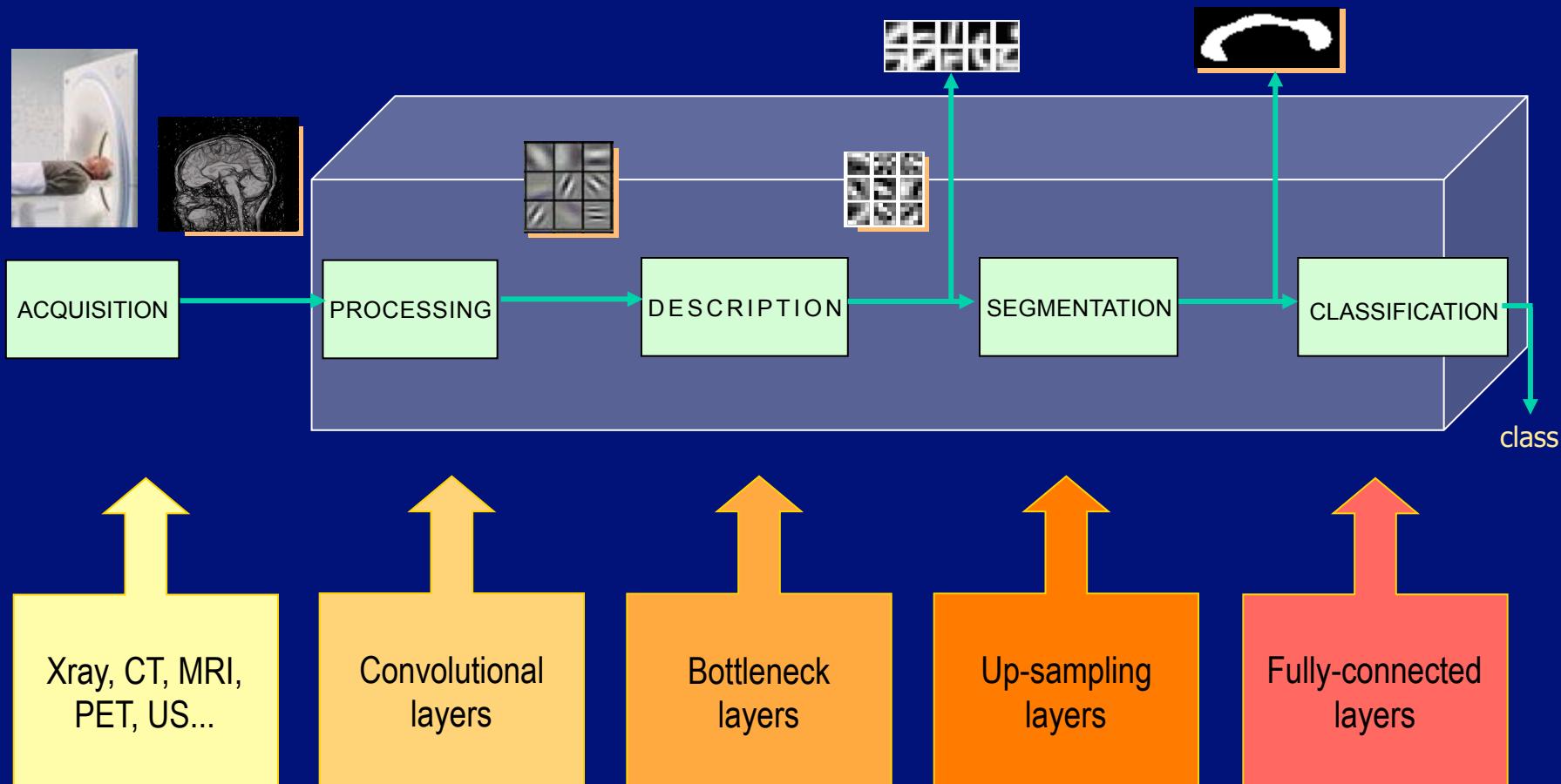
Alexei Manso Corrêa Machado

Pontifical Catholic University of Minas Gerais – D. Computer Science

Classical Computer Vision Process



Computer Vision with DL



What is learning?

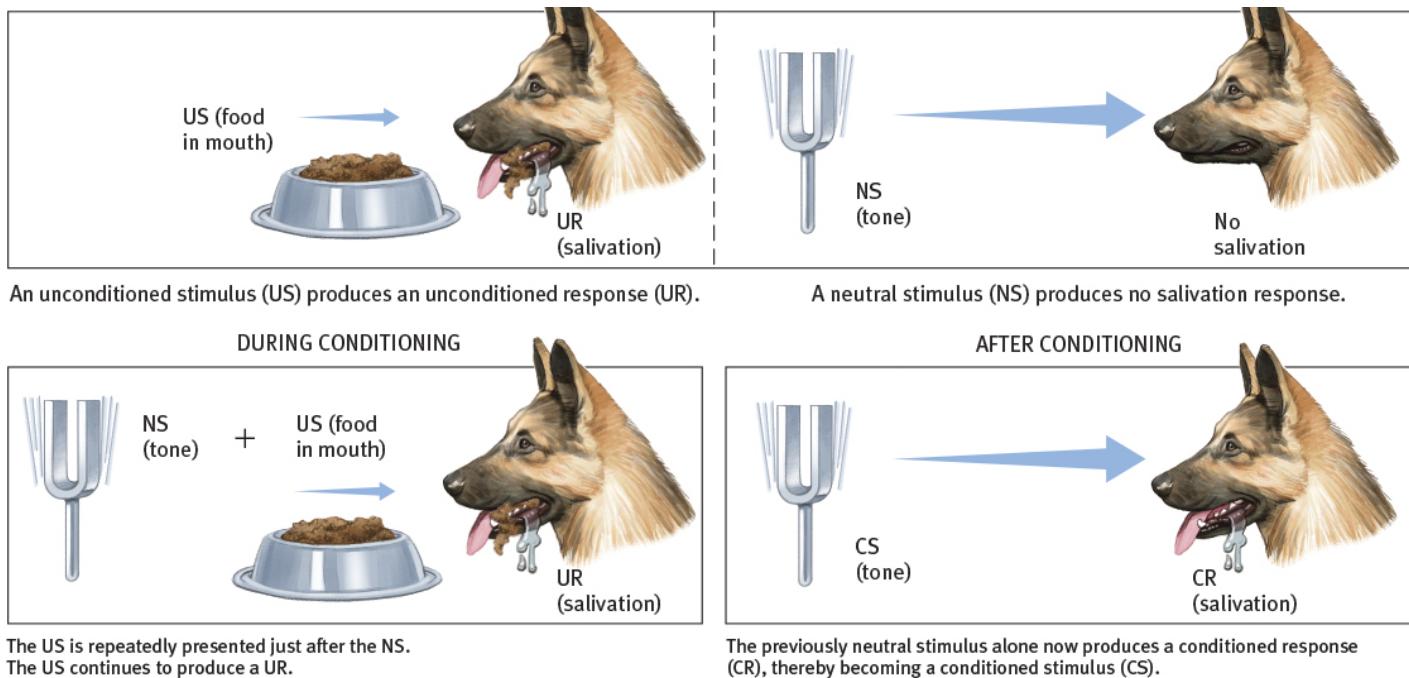
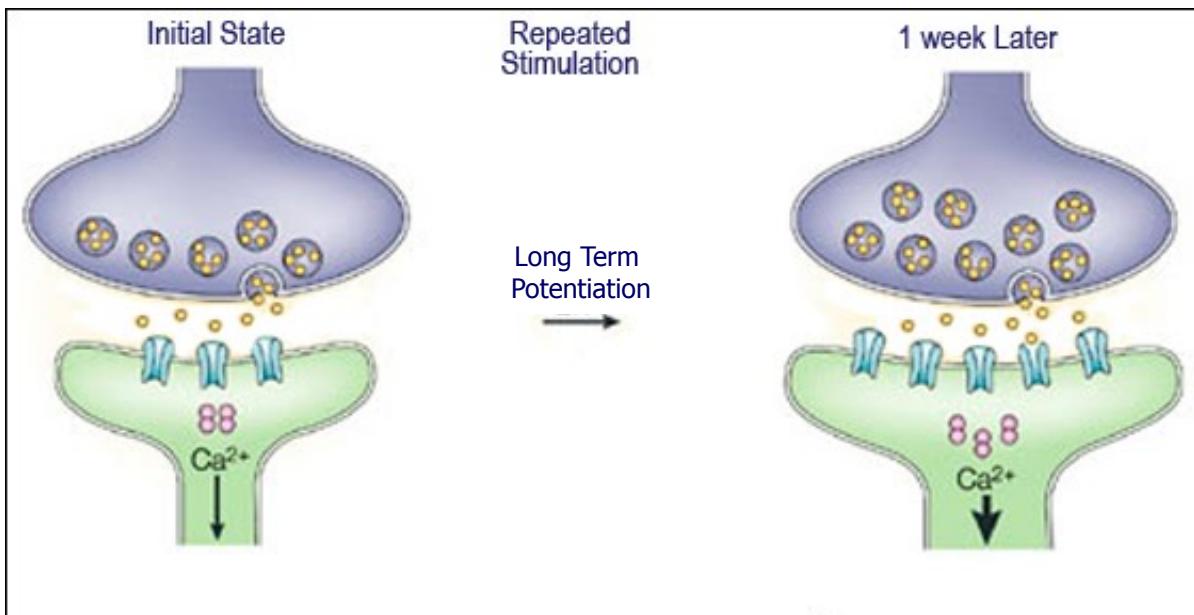


Figure 6.3

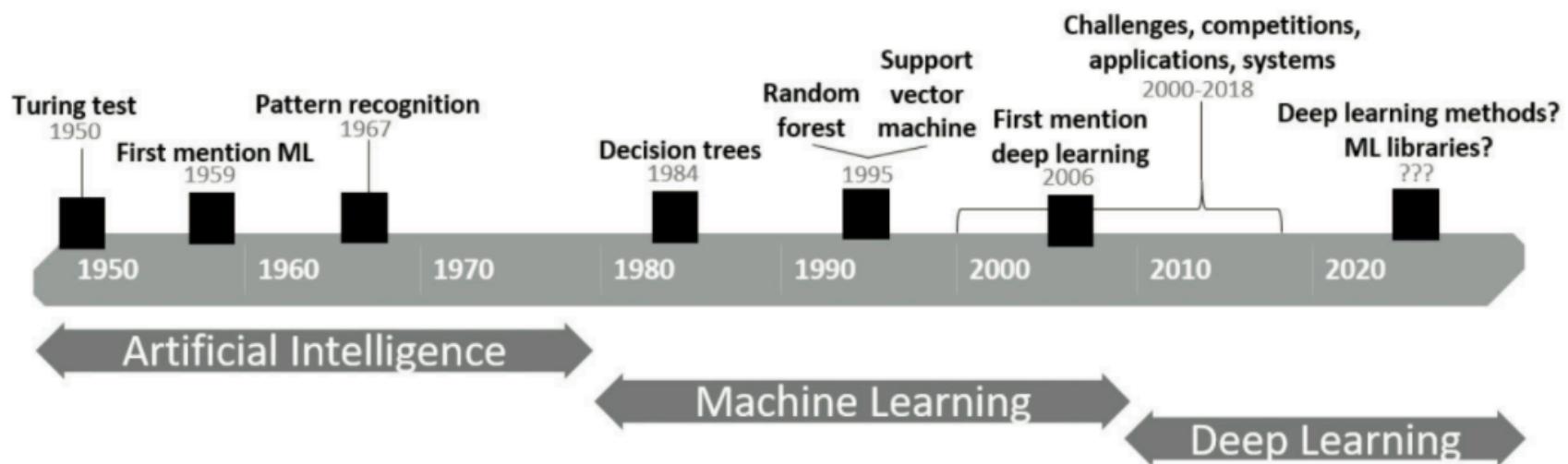
www.macmillanhighered.com

What is learning?



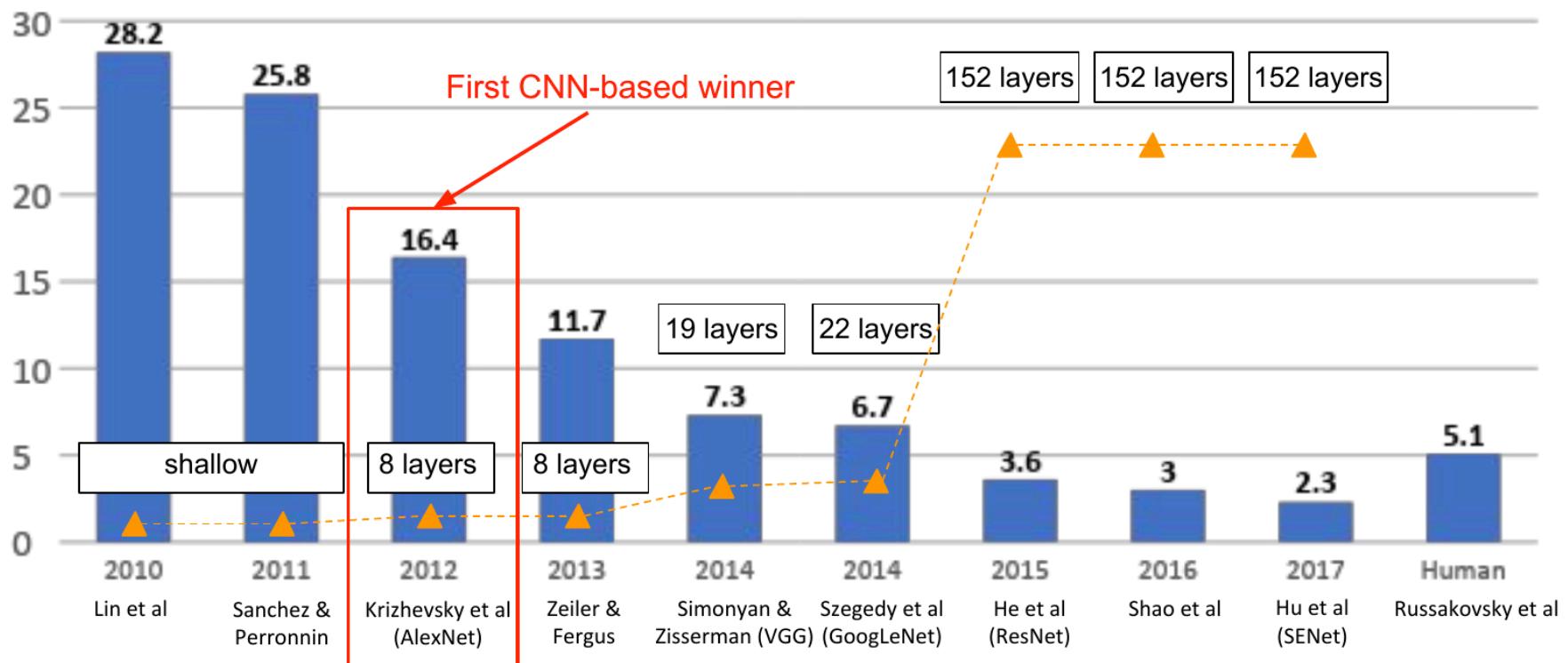
sites.google.com/site/mcauliffeneur493

Machine Learning X Deep Learning



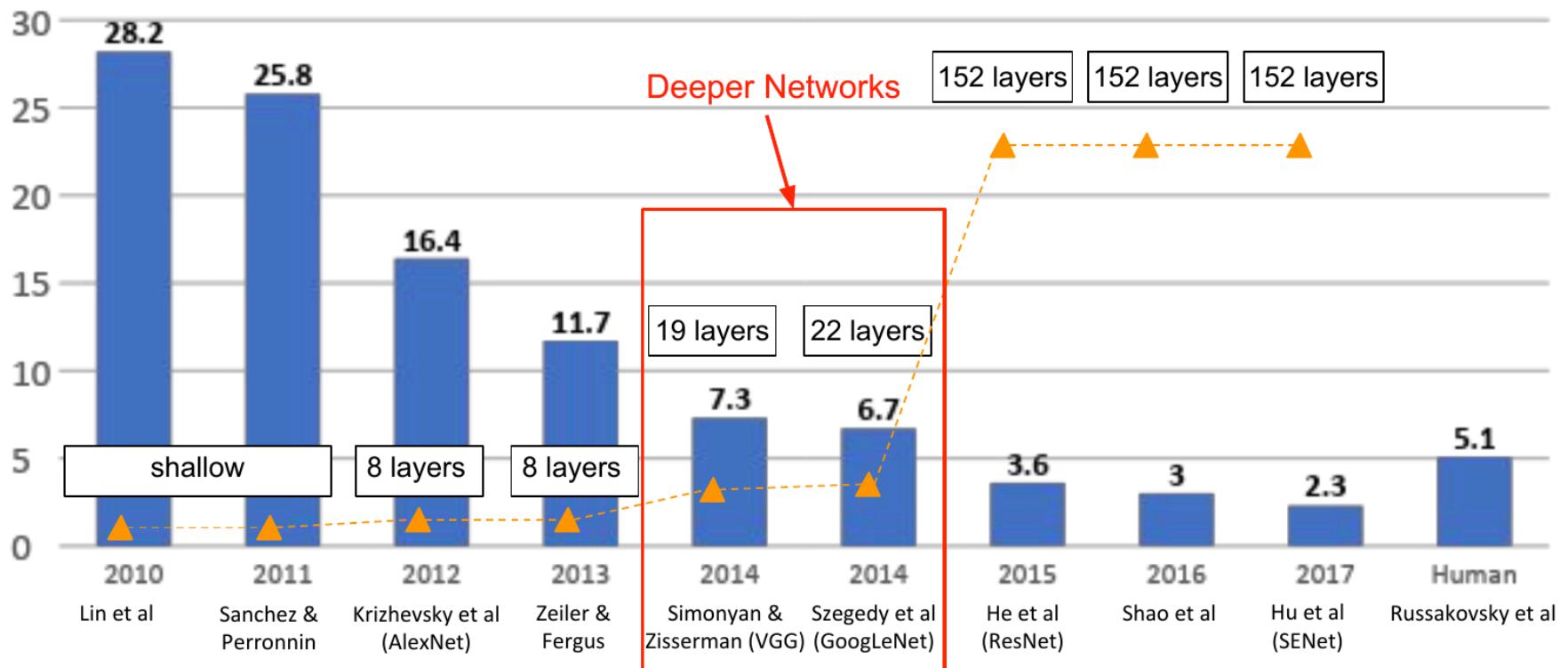
Machine Learning X Deep Learning

ImageNet Challenge



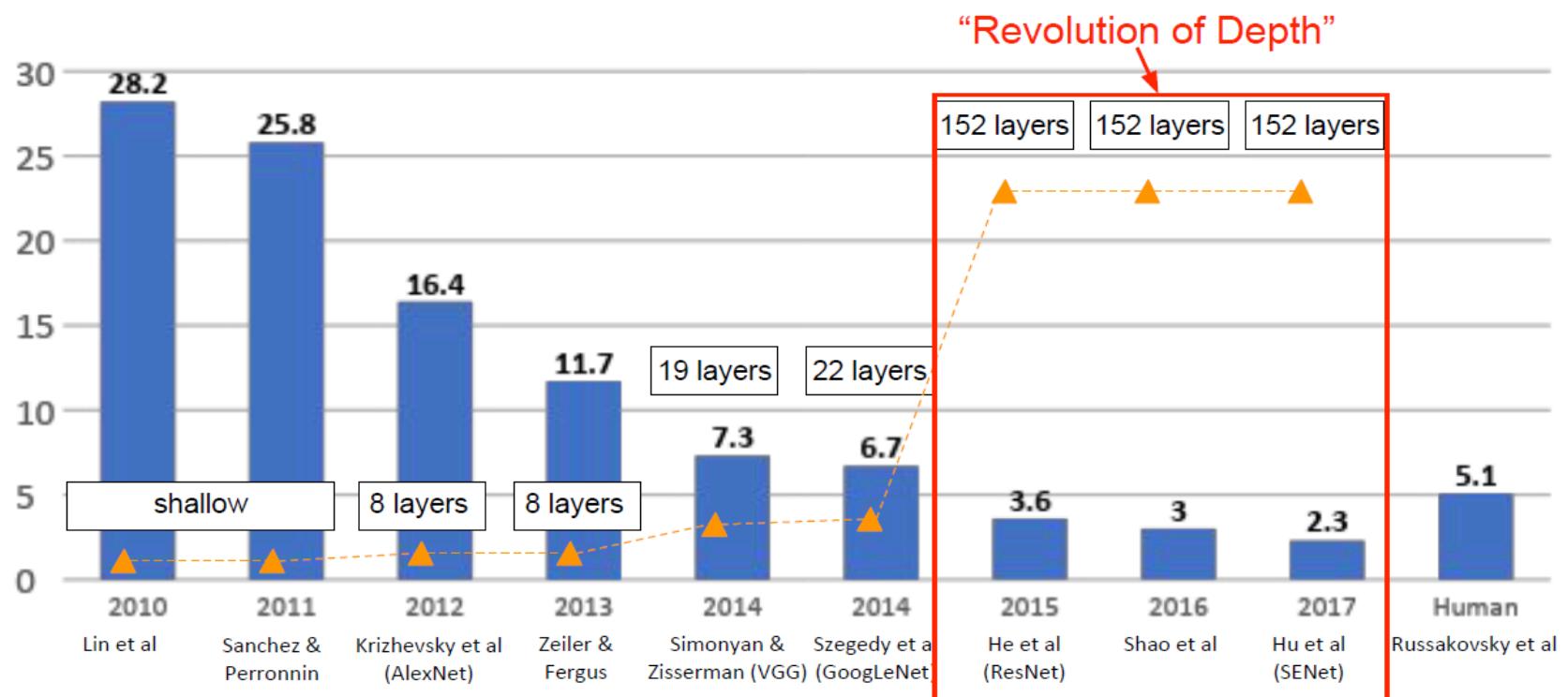
Machine Learning X Deep Learning

ImageNet Challenge

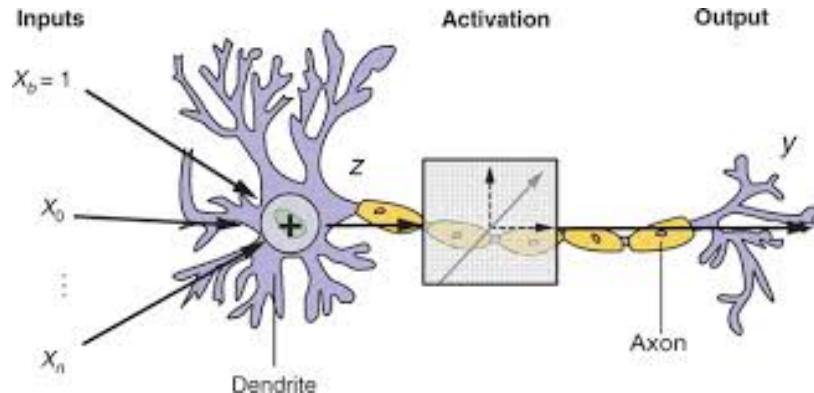


Machine Learning X Deep Learning

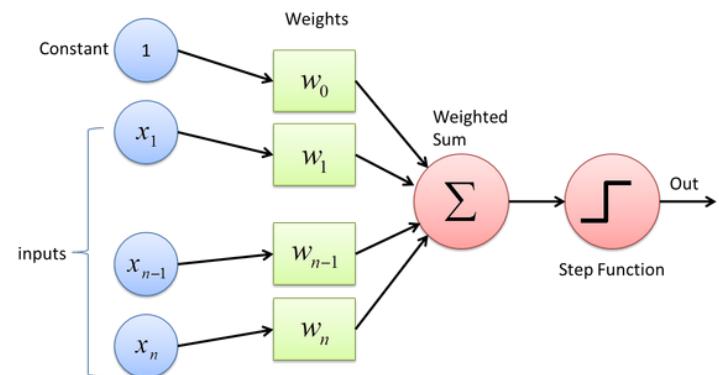
ImageNet Challenge



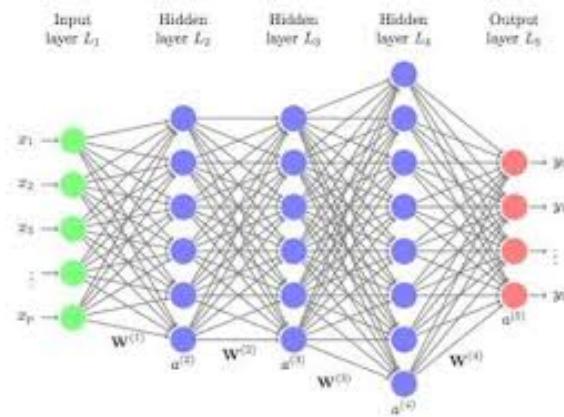
Multi-Layer Perceptron



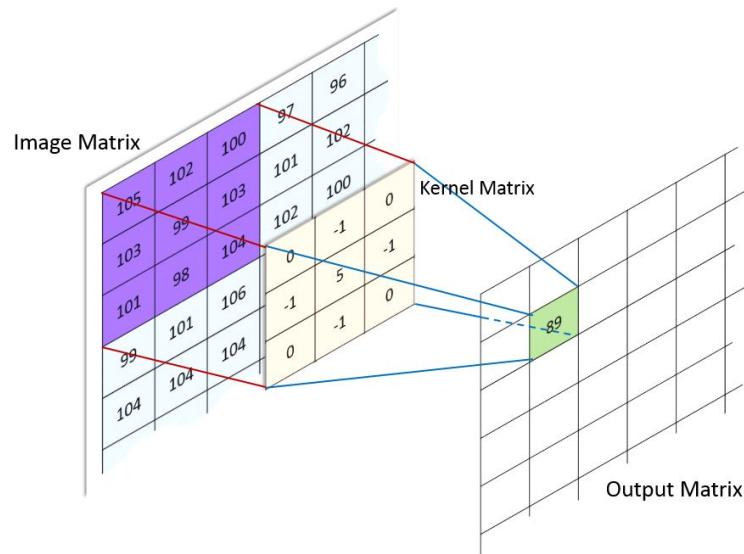
livebook.manning.com



towardsdatascience.com



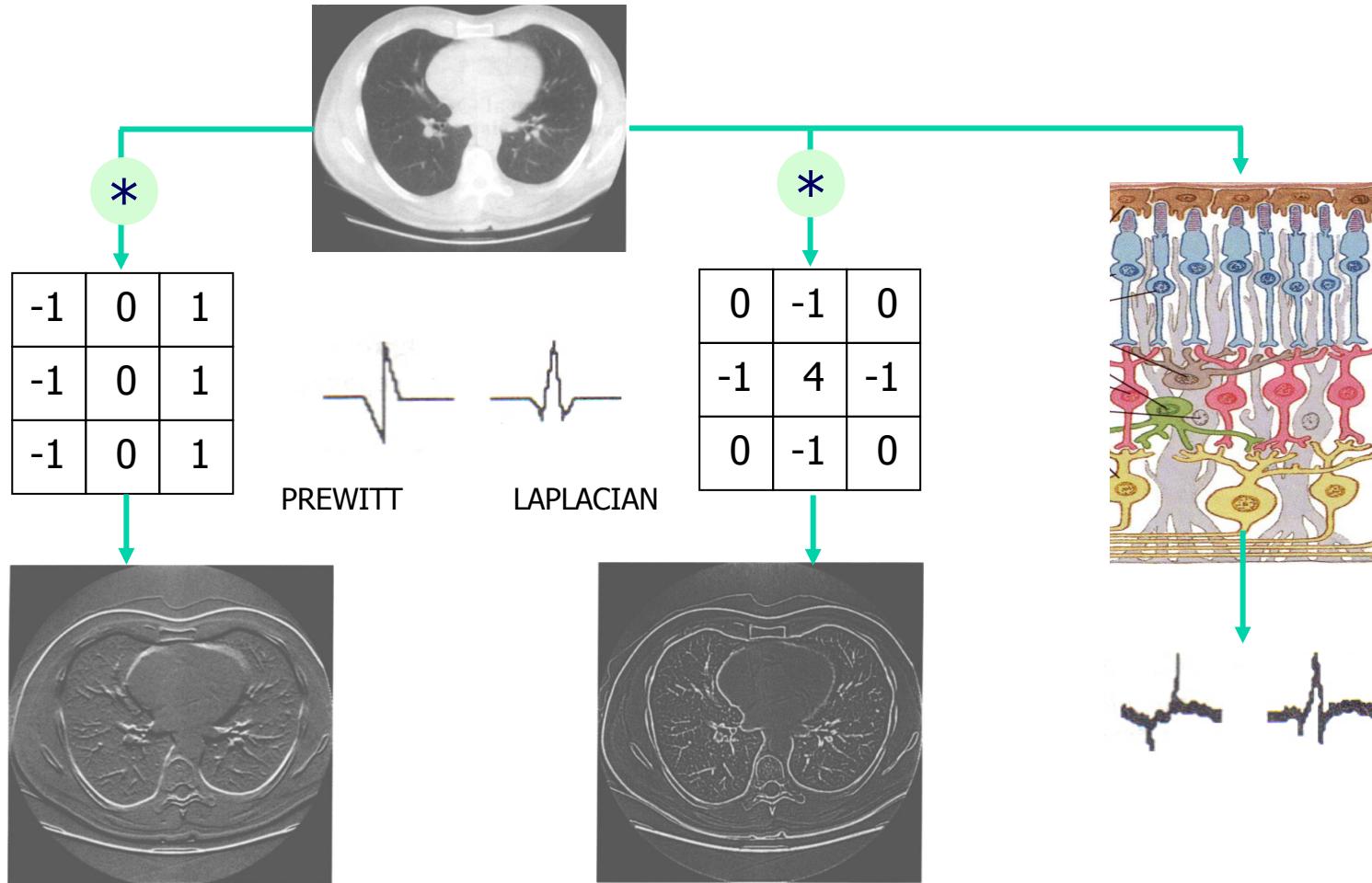
Convolutional Neural Networks



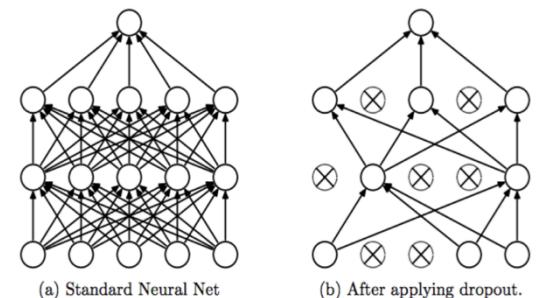
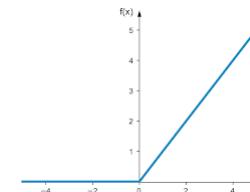
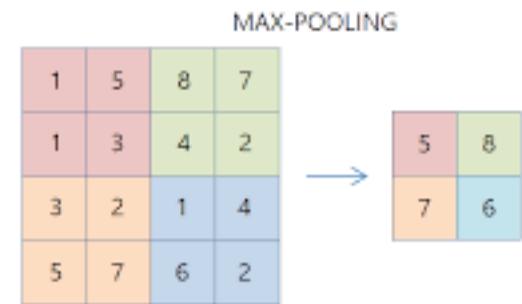
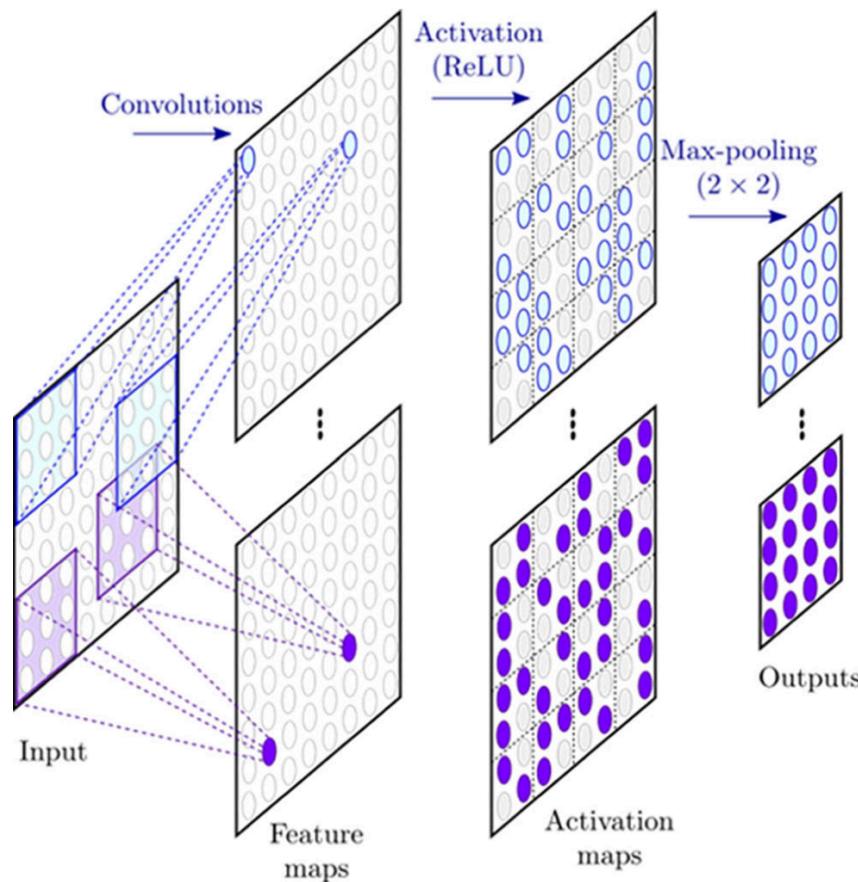
machinelearningguru.com

$$f[x,y] * g[x,y] = \sum_{n_1=-\infty}^{\infty} \sum_{n_2=-\infty}^{\infty} f[n_1, n_2] \cdot g[x - n_1, y - n_2]$$

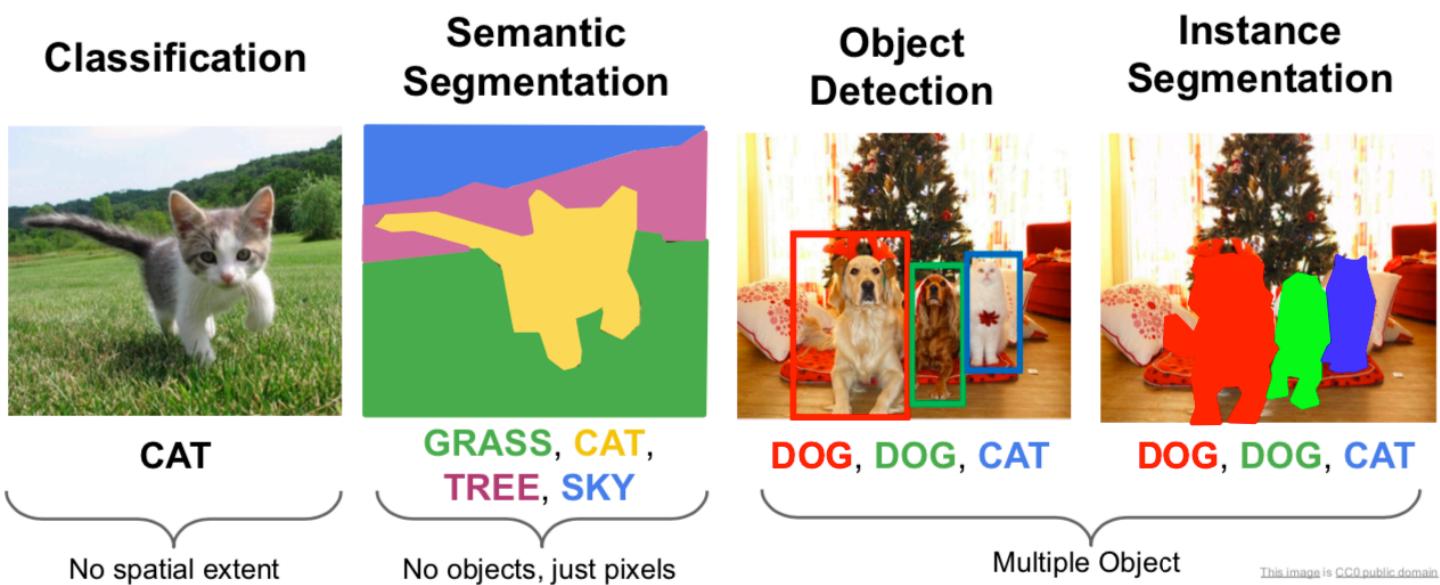
Convolutional Neural Networks



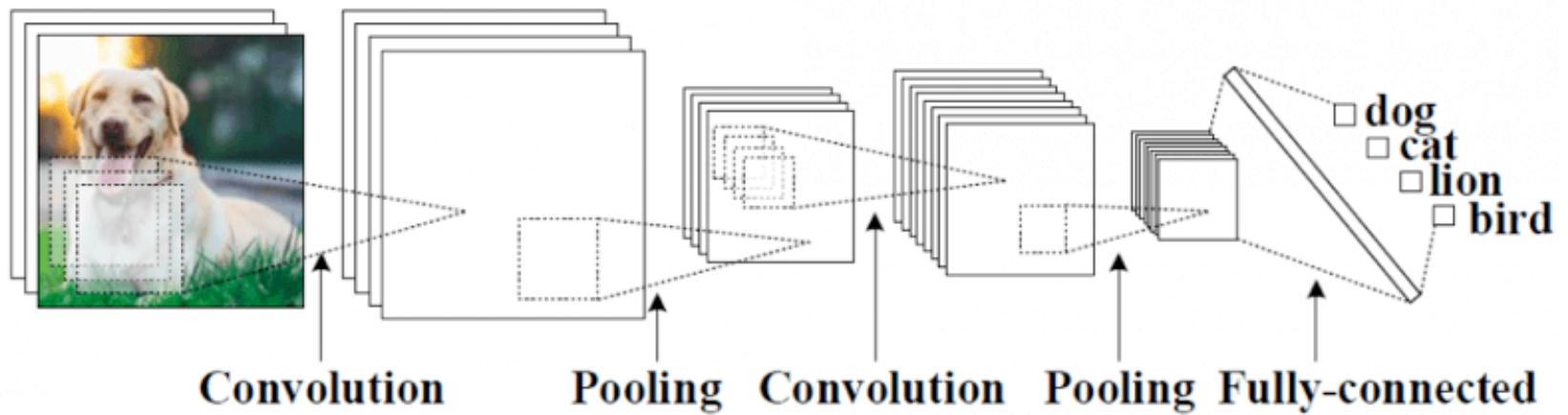
Convolutional Neural Networks



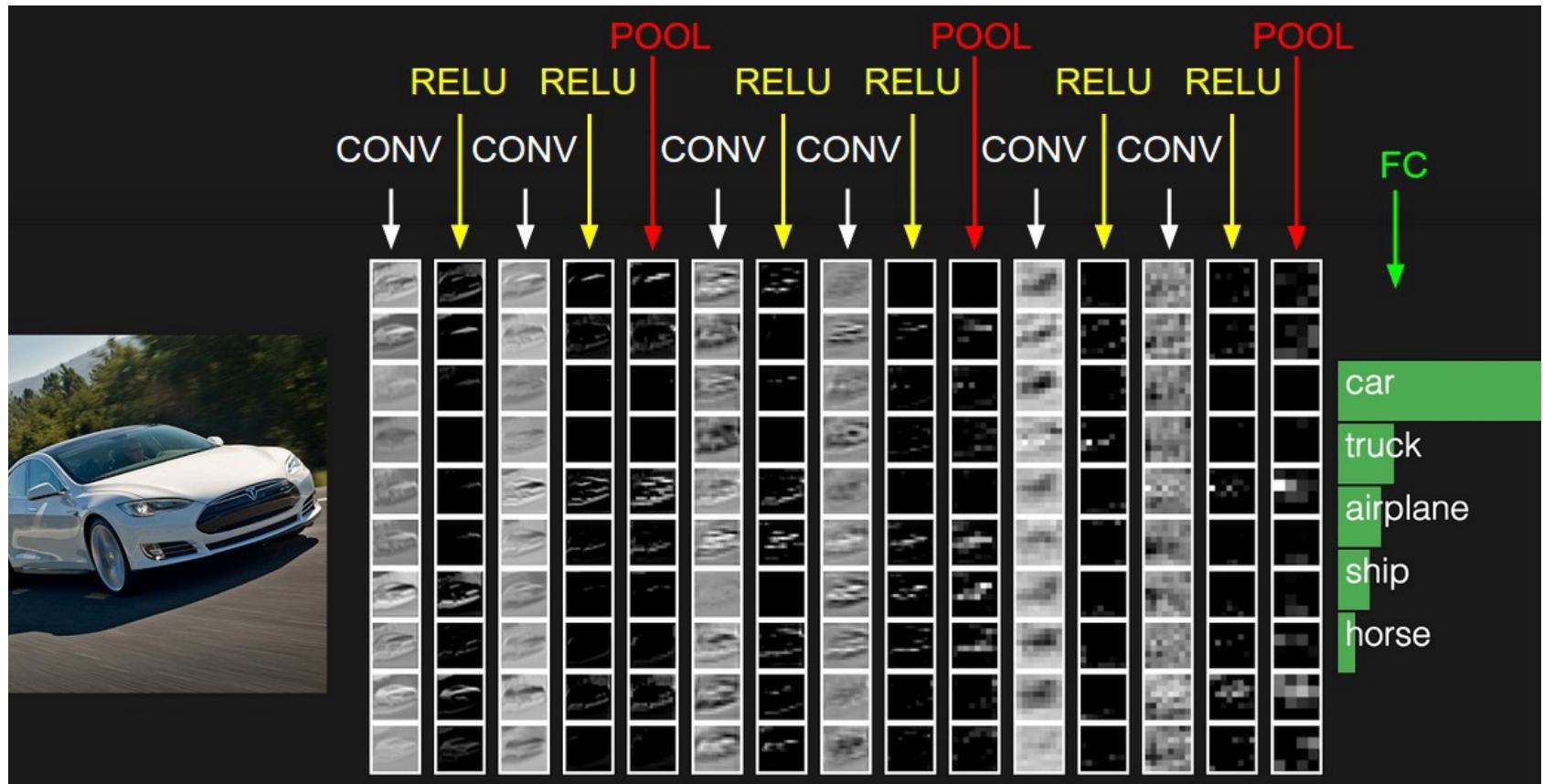
Computer Vision Tasks



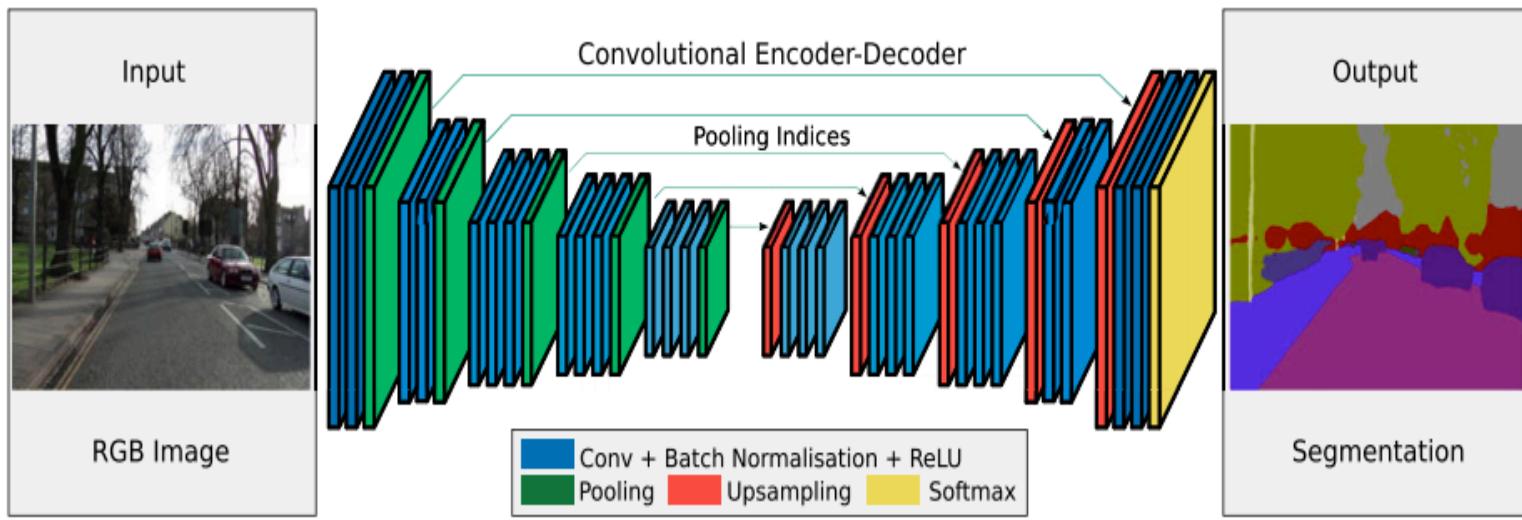
Convolutional Neural Networks



Convolutional Neural Networks

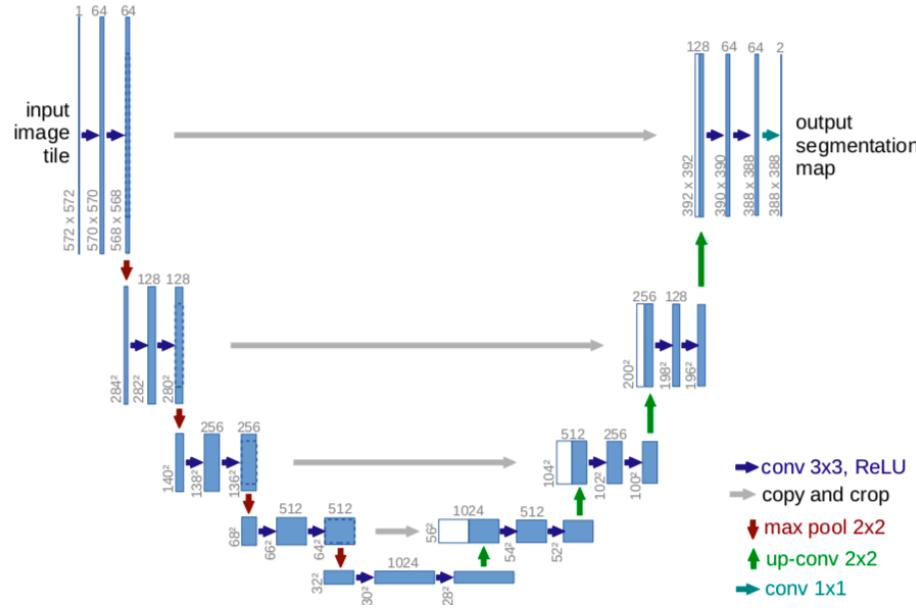


Fully Convolutional Networks



Badrinarayanan 2016

U-Nets and Semantic Segmentation

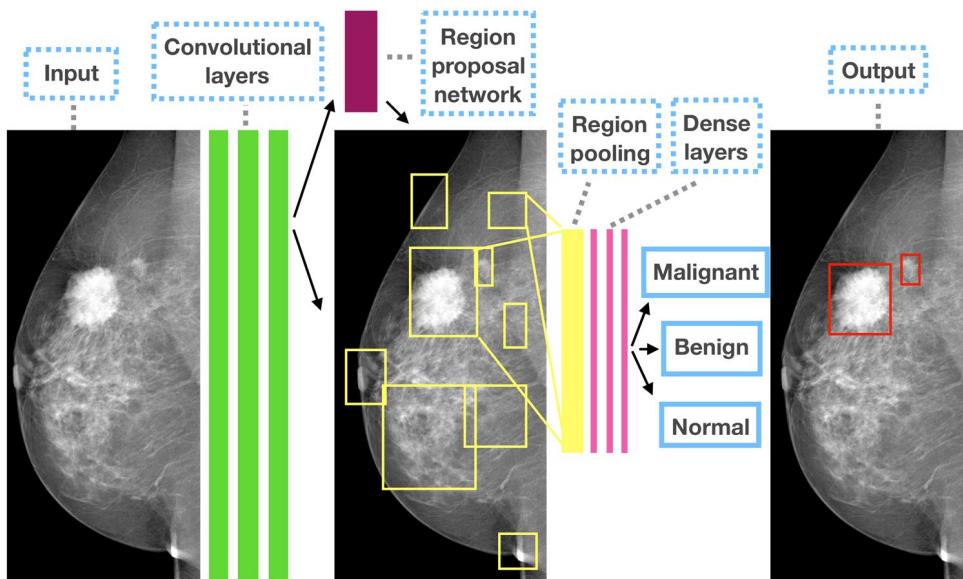


datascience.stackexchange.com

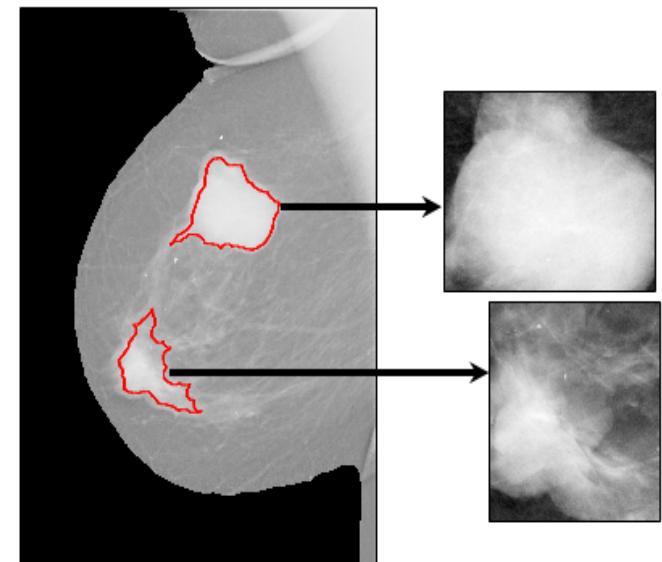


Heo 2019

Detection and Segmentation

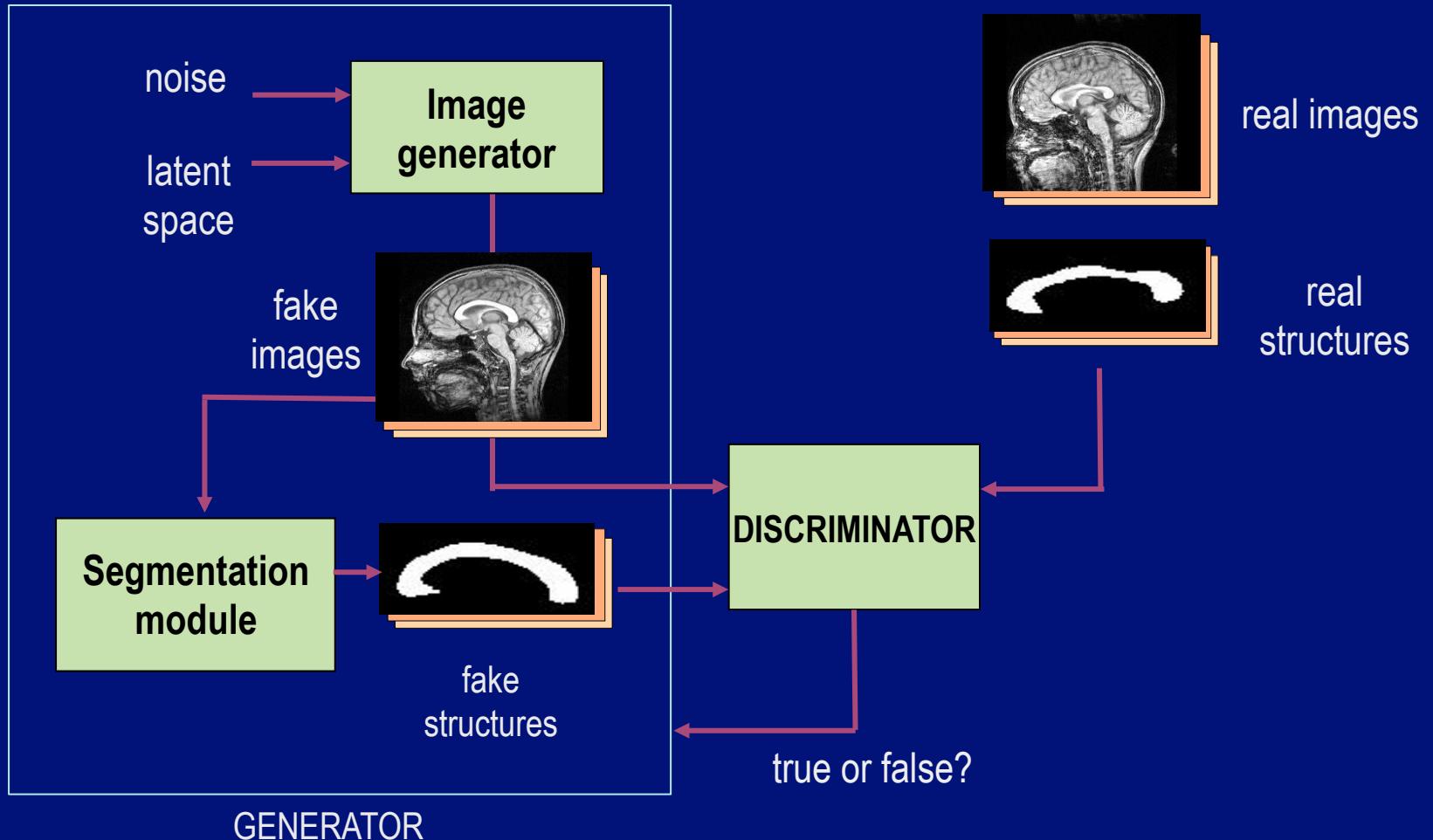


A2b Healthcare

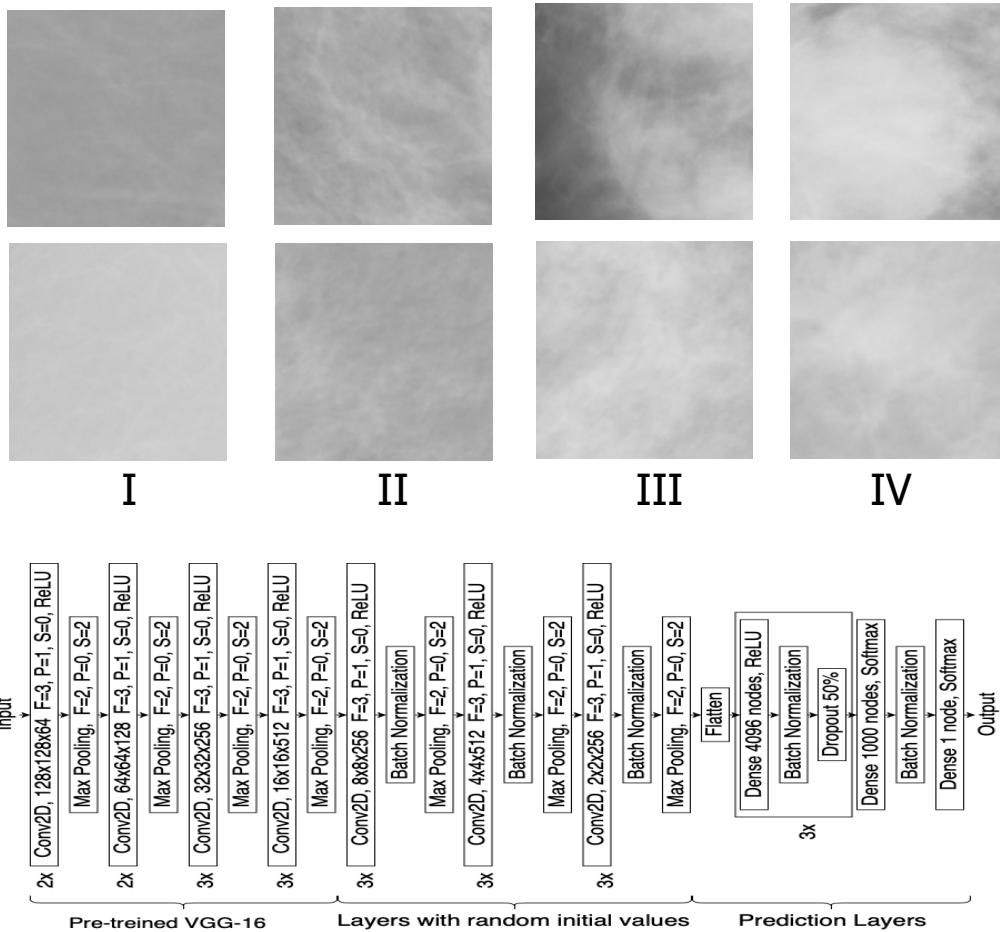


bioimage.knu.ac.kr

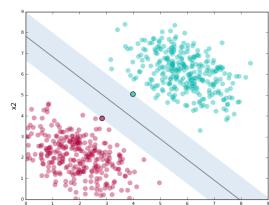
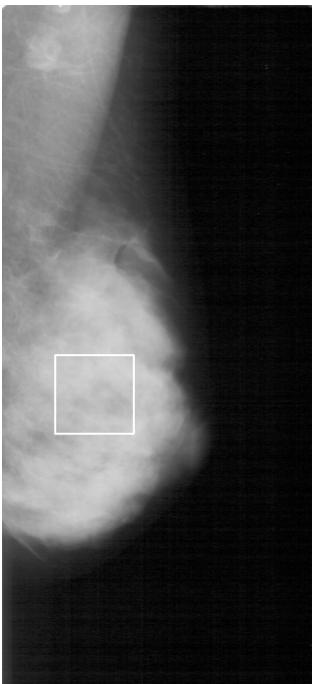
Generative Adversarial Networks



Texture Classification

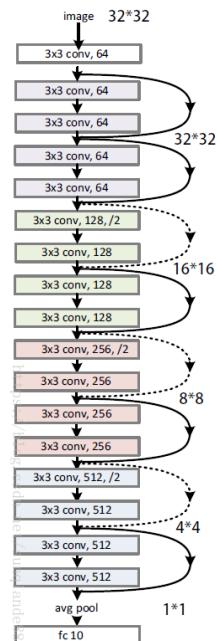


Texture Classification



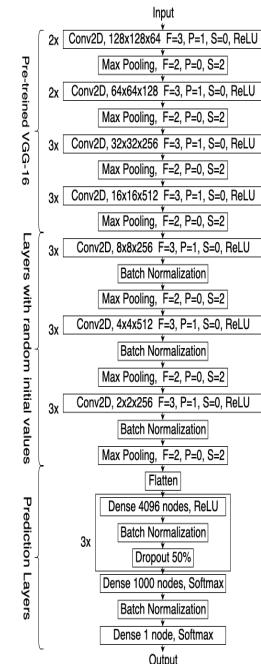
Rungue 2018
Haralick + SVM
cascade

68%



Lehman 2019
ResNet18

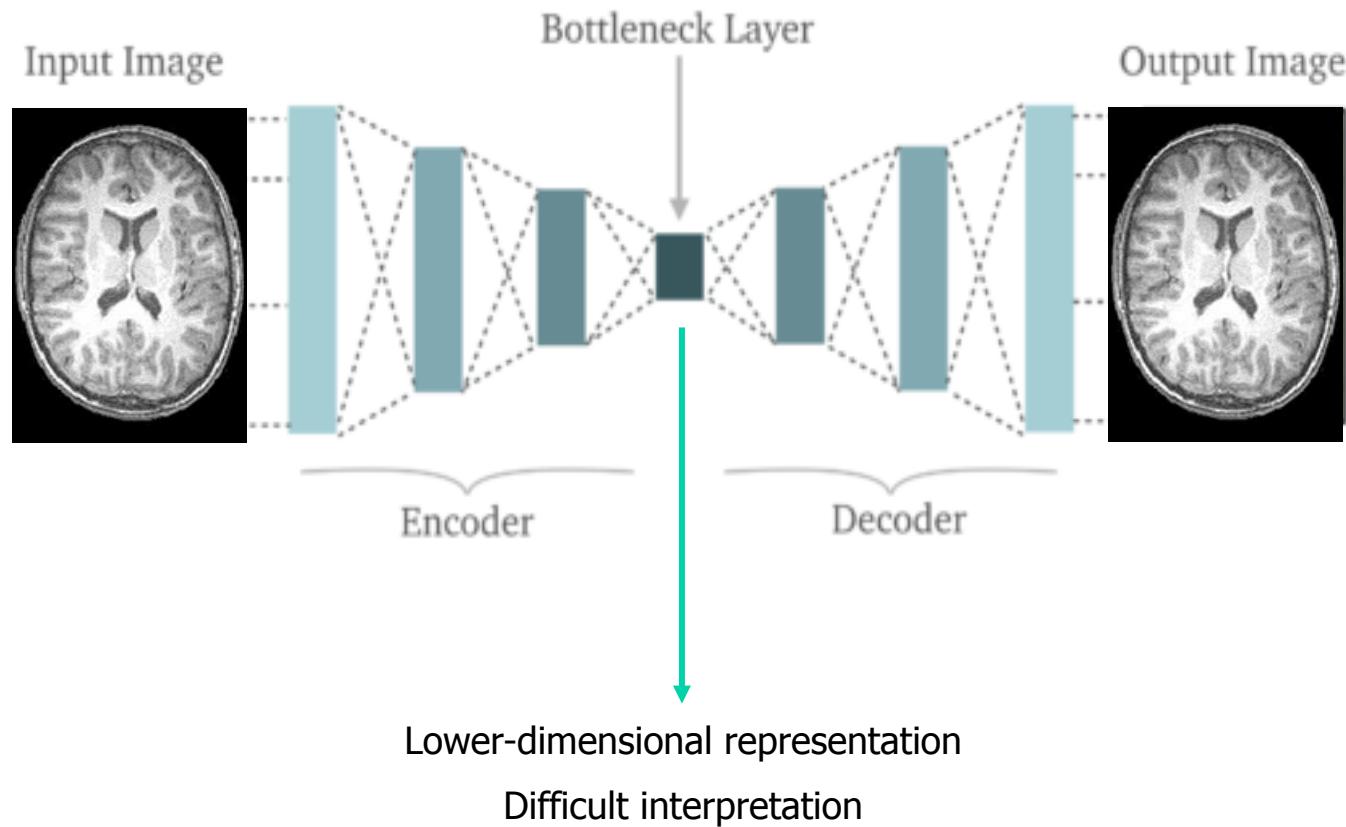
67%



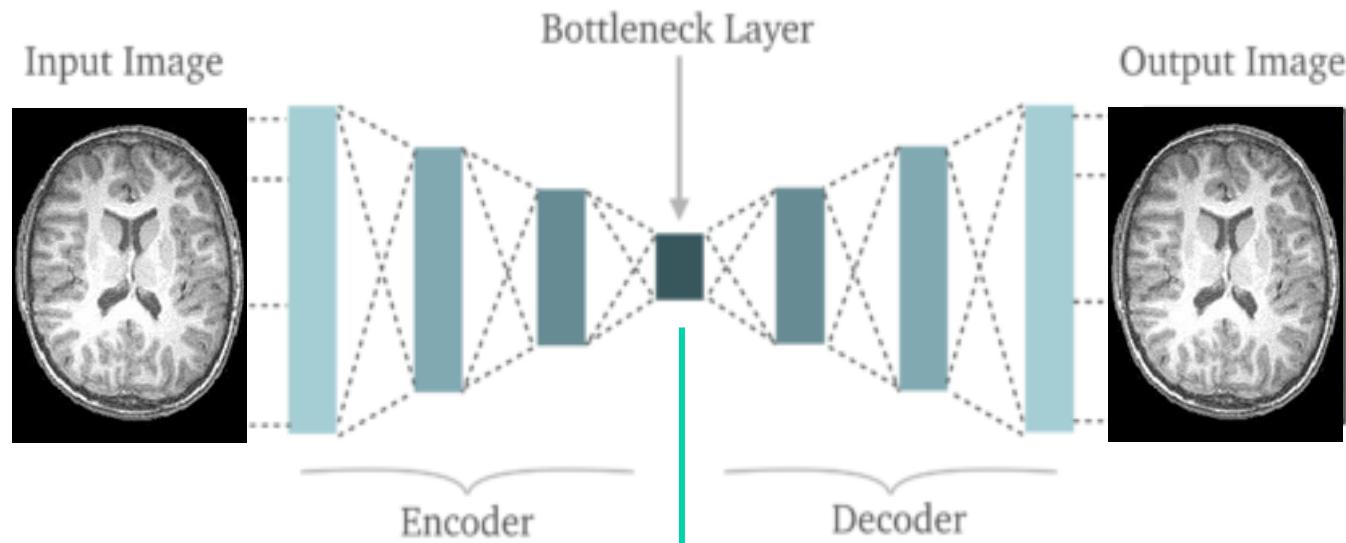
Carvalho &
Machado 2019
VGG16 cascade

70%

Auto-Encoders



Variational Auto-Encoders



Lower-dimensional representation

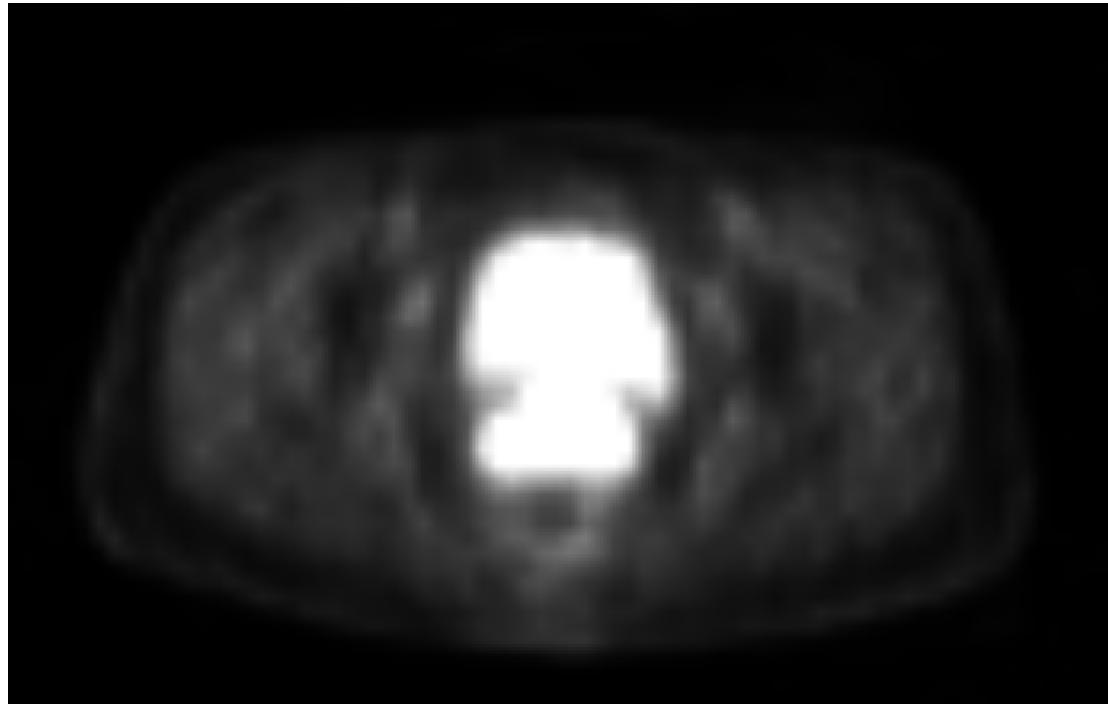
Composed of means and standard deviations

Allows for the generation of new data

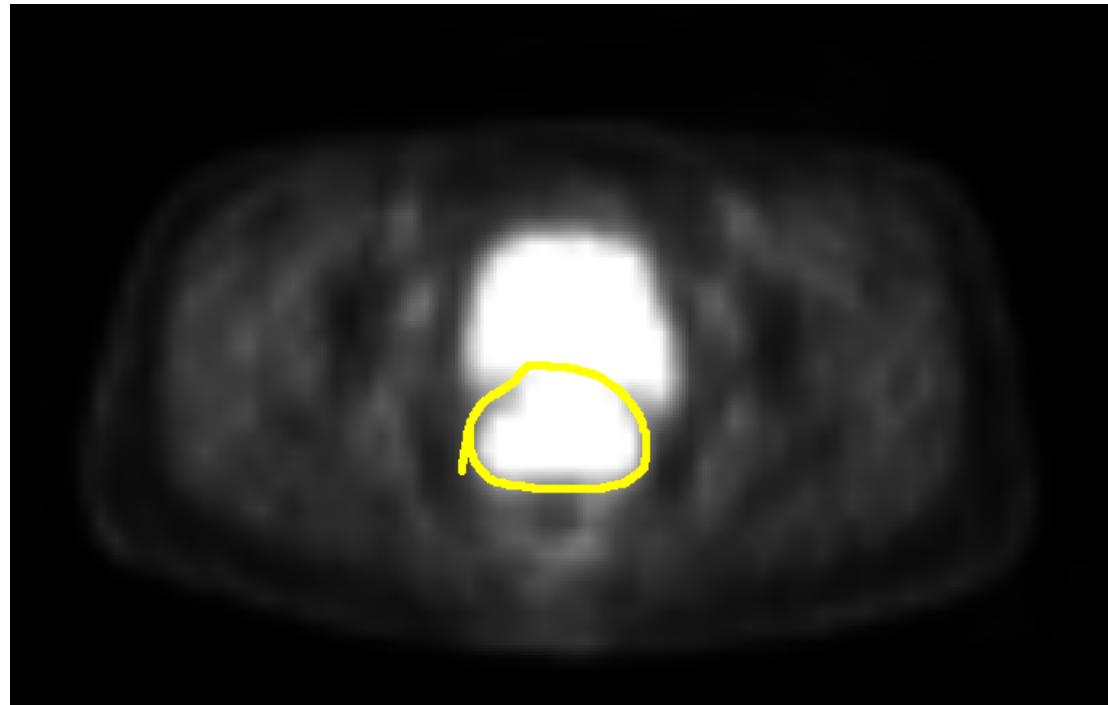
Sample size

- Deep learning methods require lots of data
- Sample is usually small; variable space is high-dimensional
- Exams can be expensive and potentially harmful: a PET scan is around US\$5K, so a study with 100 patients would cost half million dollars!
- Public datasets are scarce
- Sample may be imbalanced
- Data augmentation techniques are limited, sometimes questionable and results must be checked by physicians
- Transfer learning may be used to mitigate this problem

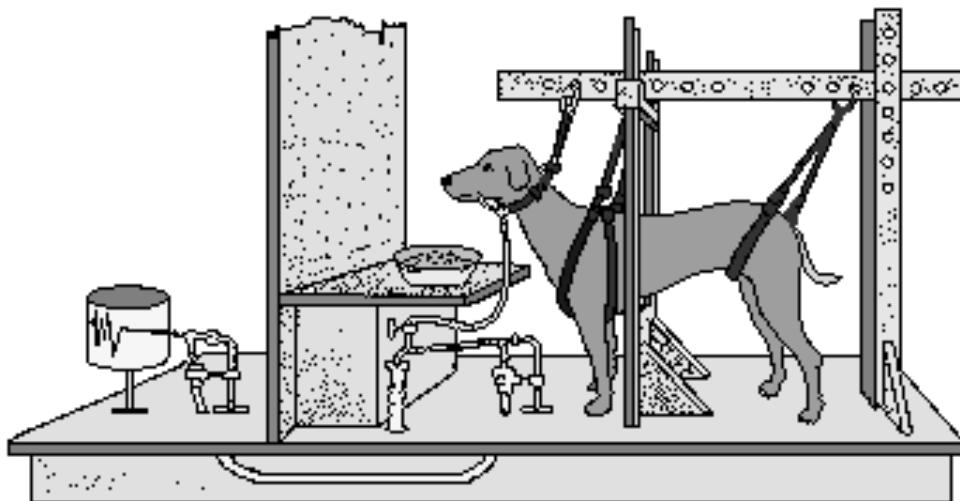
How to obtain ground truth data for validation?



How to obtain ground truth data for validation?



Overfitting and Pavlov's Experimental Neurosis

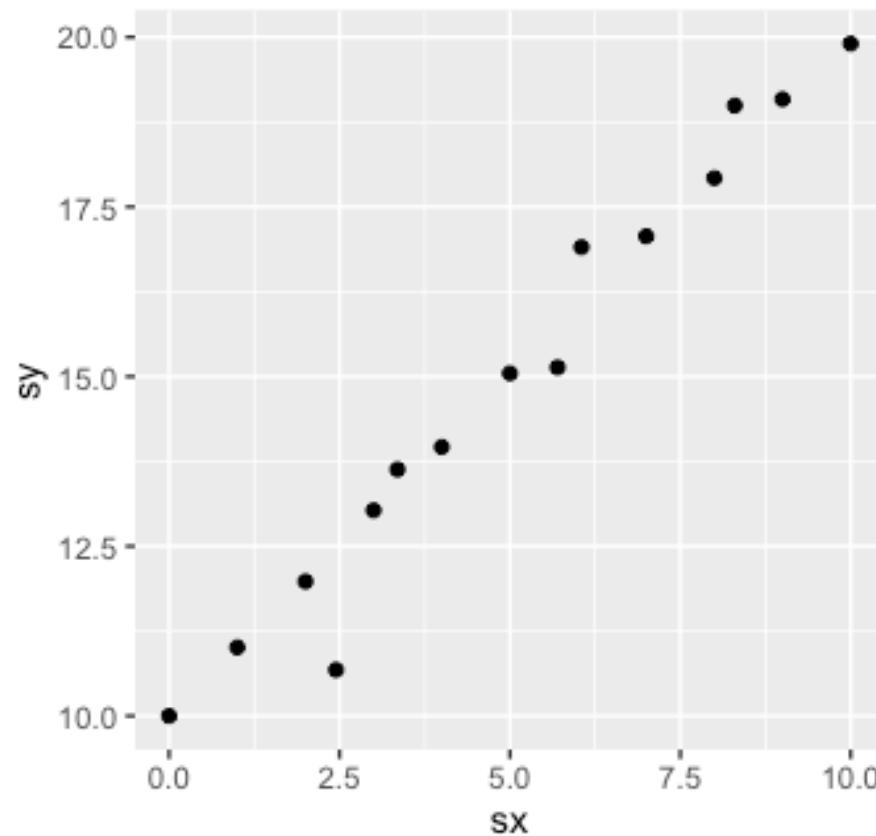


www.massey.ac.nz

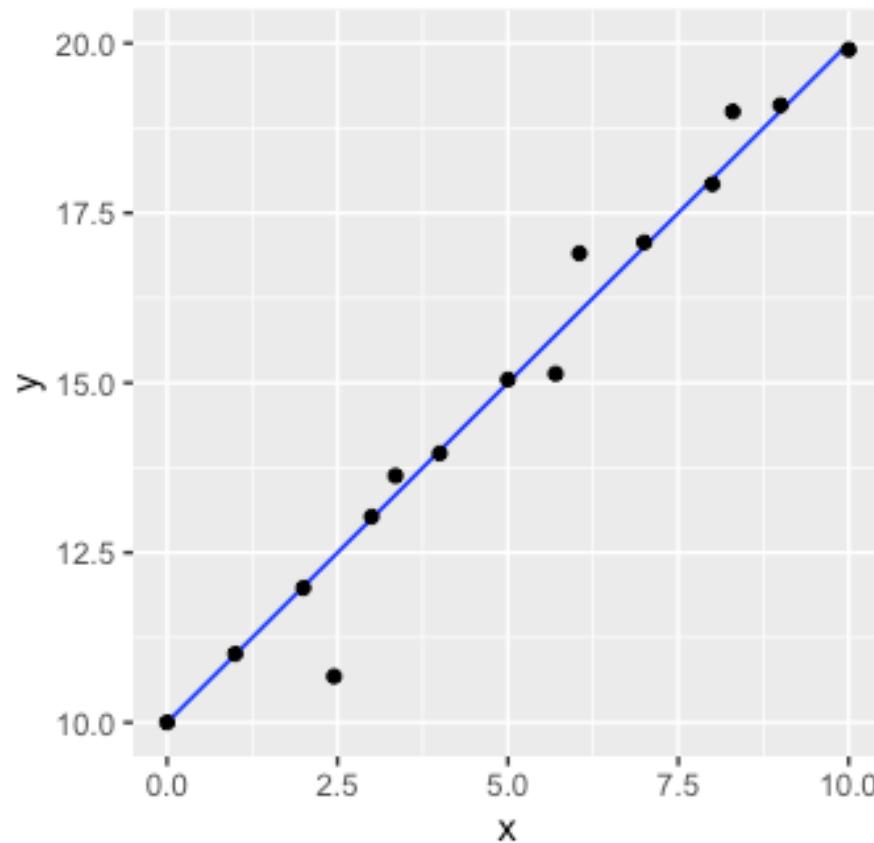


www.youtube.com

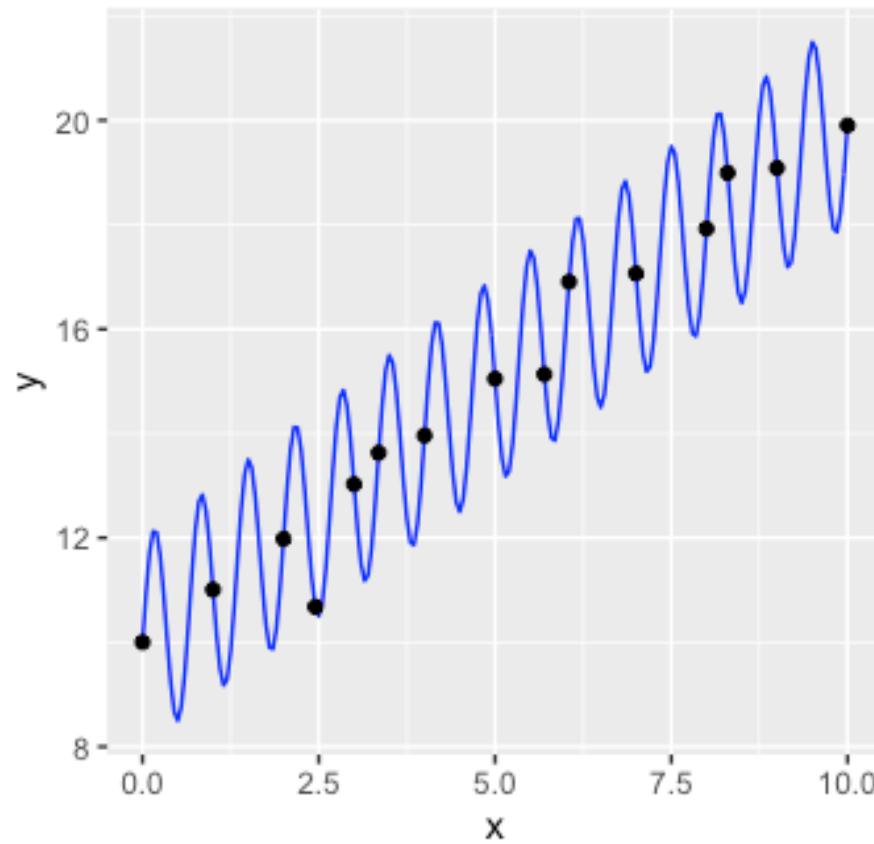
Overfitting



Overfitting



Overfitting



Overfitting

