DLL: MedNIST Exam Classification with MONAI

Kuan (Kevin) Zhang, PhD

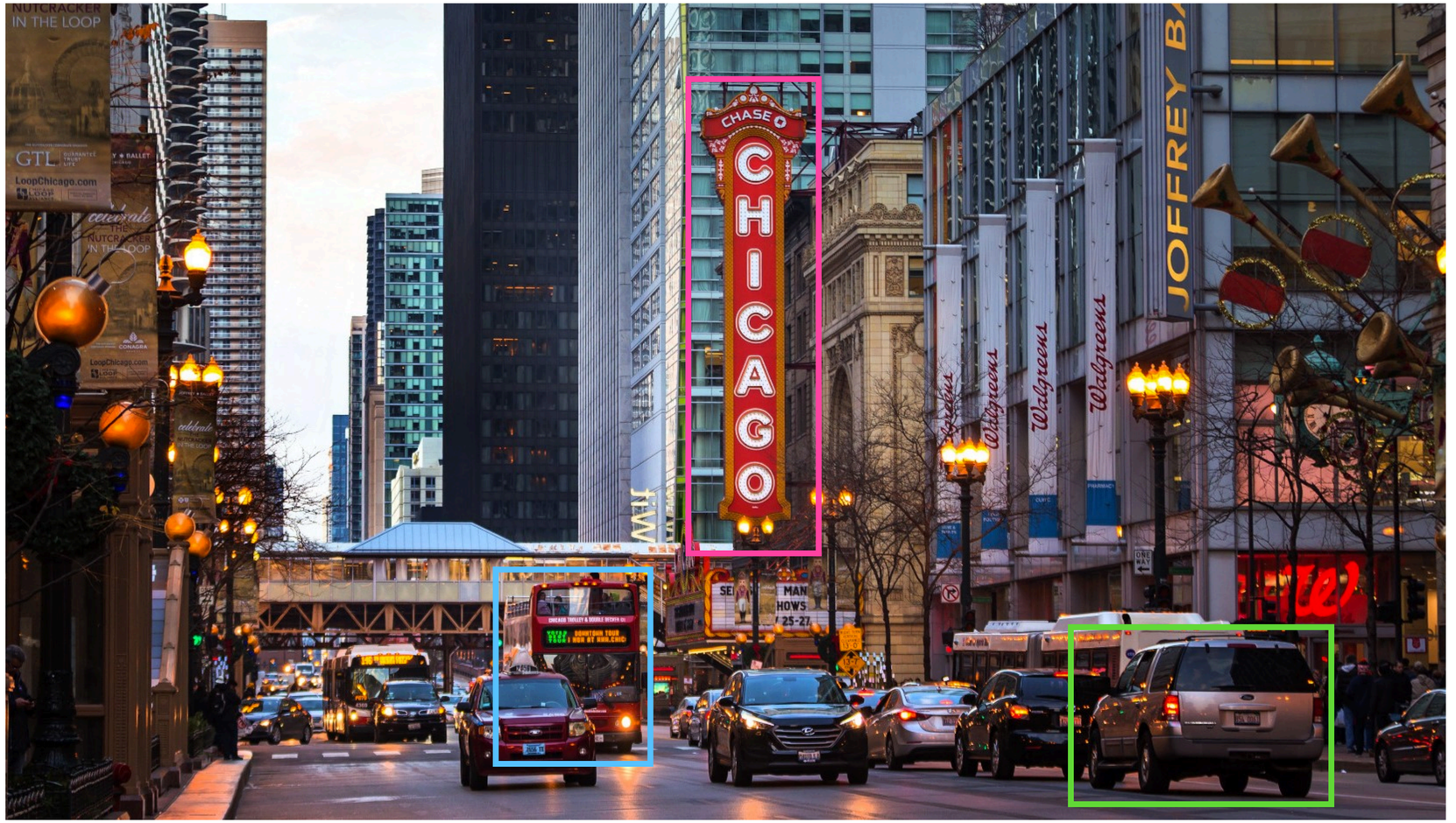
Assistant Professor of Radiology

Diagnostic Physics Resident

Department of Radiology, Mayo Clinic, Rochester, MN

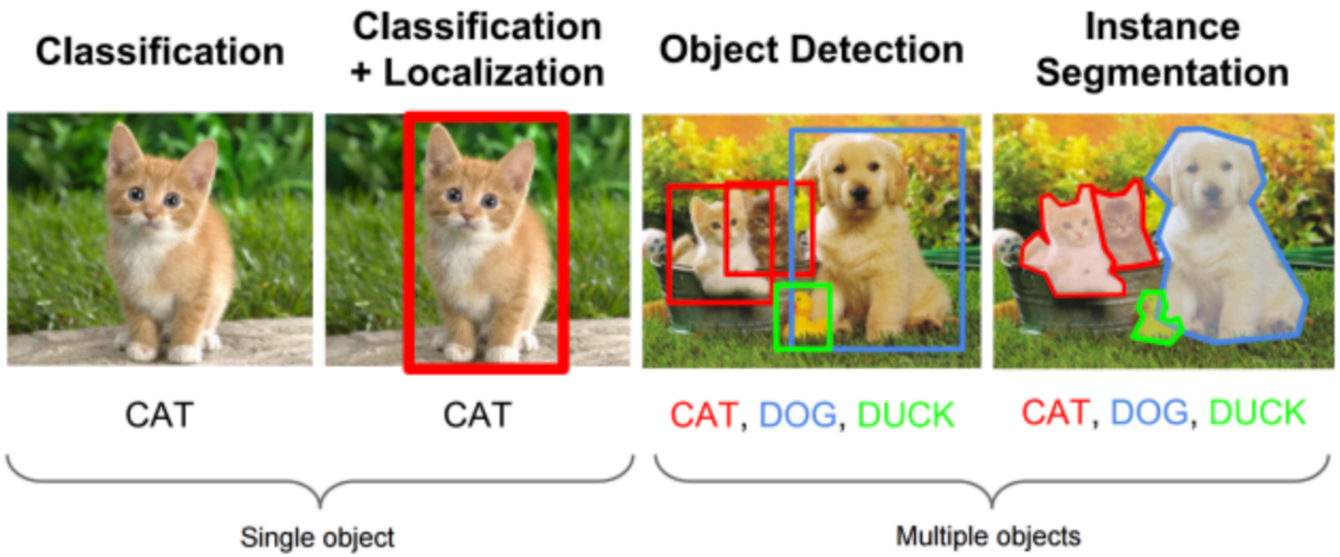
Computer vision

To discover from images what is present in the world, where things are, what actions are taking place, to predict and anticipate events in the world.



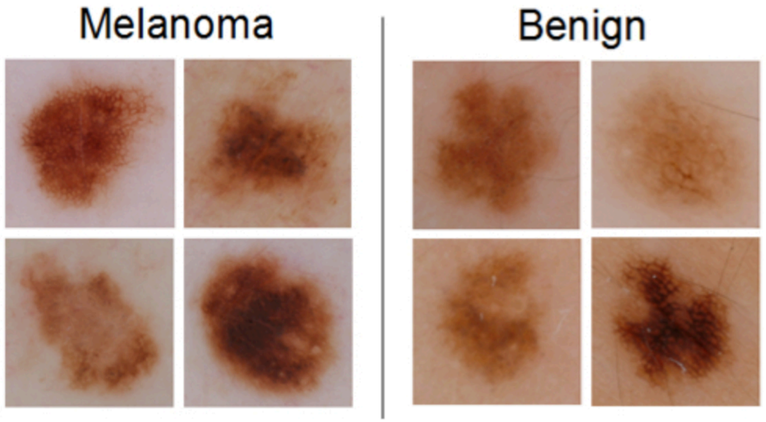
Computer vision

Deep learning computer vision tasks: Classification vs Detection vs Segmentation.

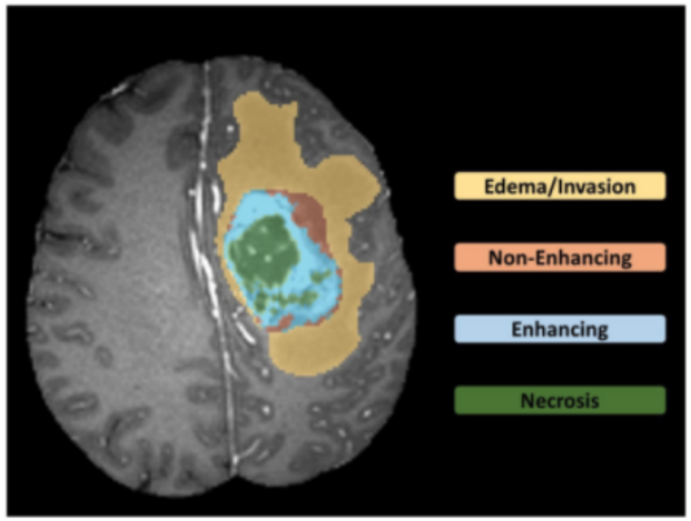


Computer vision in medicine

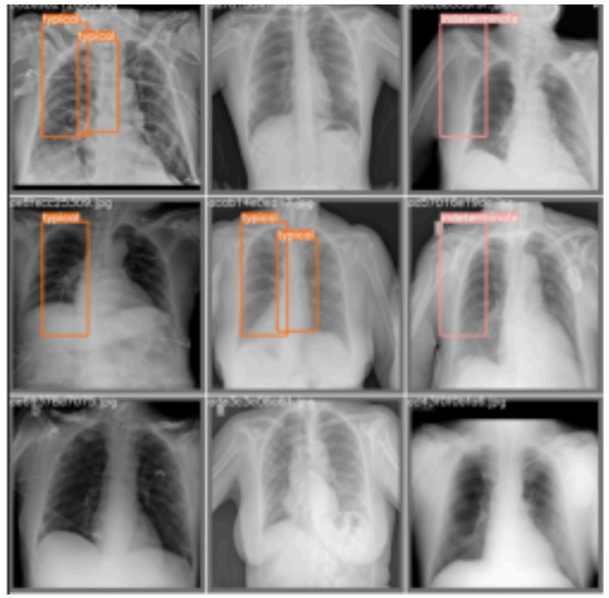
The goal of (computer vision) radiology applications is to improve the quality of care, and reduce the healthcare cost, since the algorithm is more robust and automatic.



Skin cancer classification



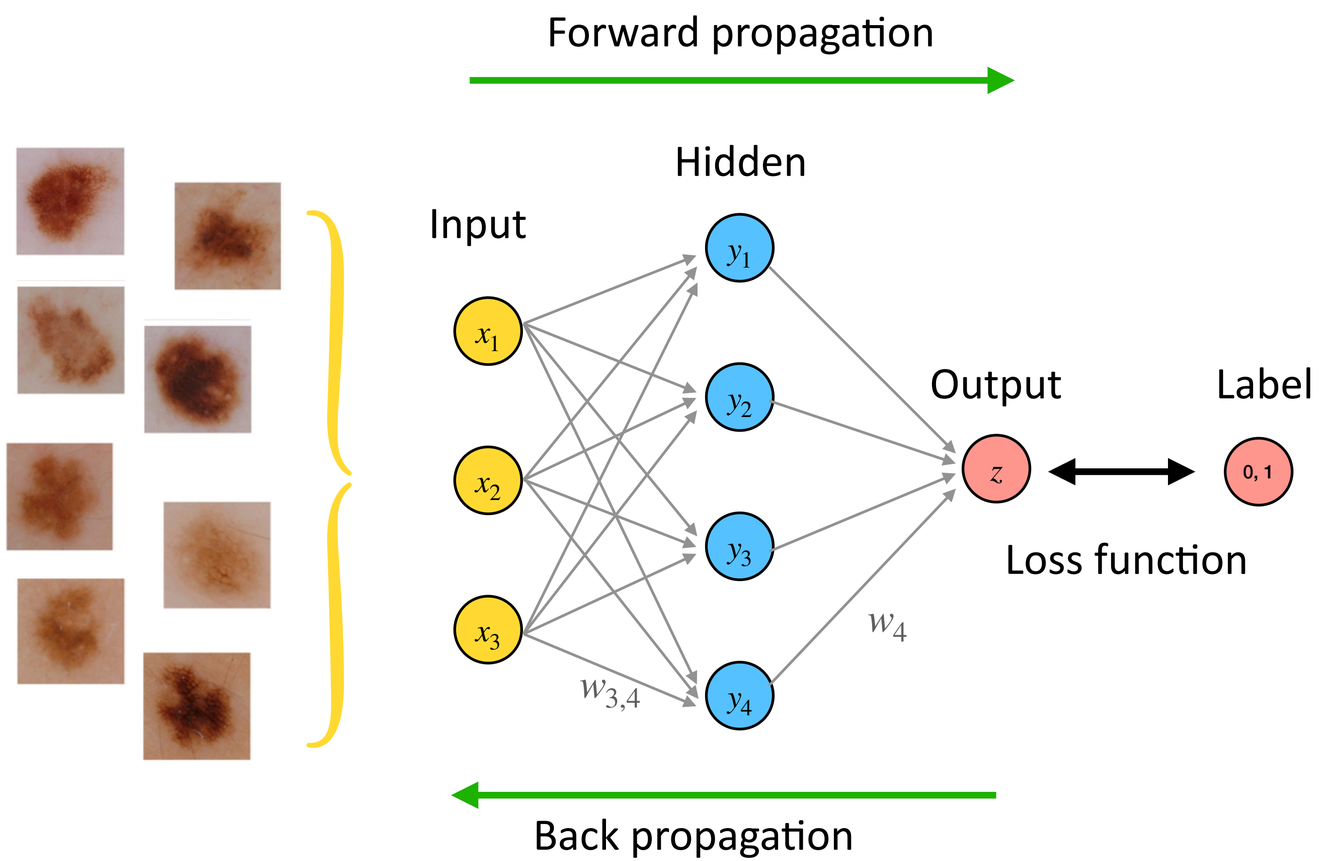
Tumor segmentation of GBM



COVID-19 detection

Model

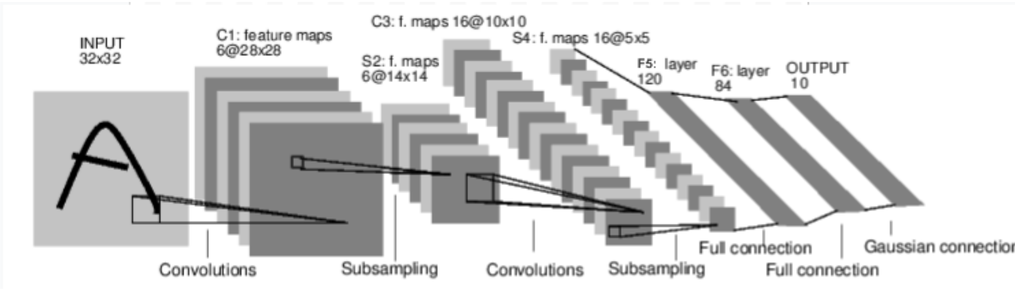
- A basic artificial neural network (ANN):



For example, a simple calculation for neuron y_1 at hidden layer:

$$y_1 = x_1 w_{1,1} + x_2 w_{2,1} + x_3 w_{3,1} + b_1$$

- Why convolutional neural networks (CNN)?



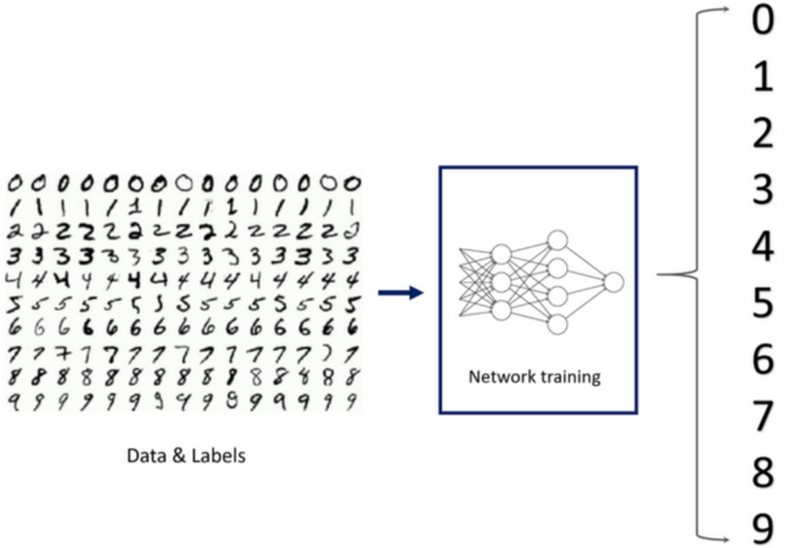
ConvNet from pytorch.org

- For Images with 28×28 pixels in greyscale, $28 \times 28 \times 1 = 784$ neurons are needed to build the input layer. Similarly, for 3D clinical images such as MRI, we will need more than 30 million $(512 \times 512 \times 128)$ neurons for a layer, and connection between layers is not really manageable.

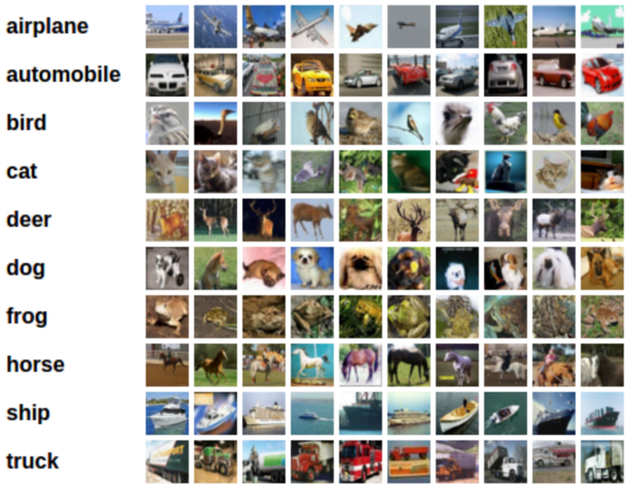
- When it comes to images, there seems to be little correlation or relation between two individual pixels far away from each other.

Datasets

The MNIST database is a large database of handwritten digits that is widely used for training and testing ML computer vision algorithms.



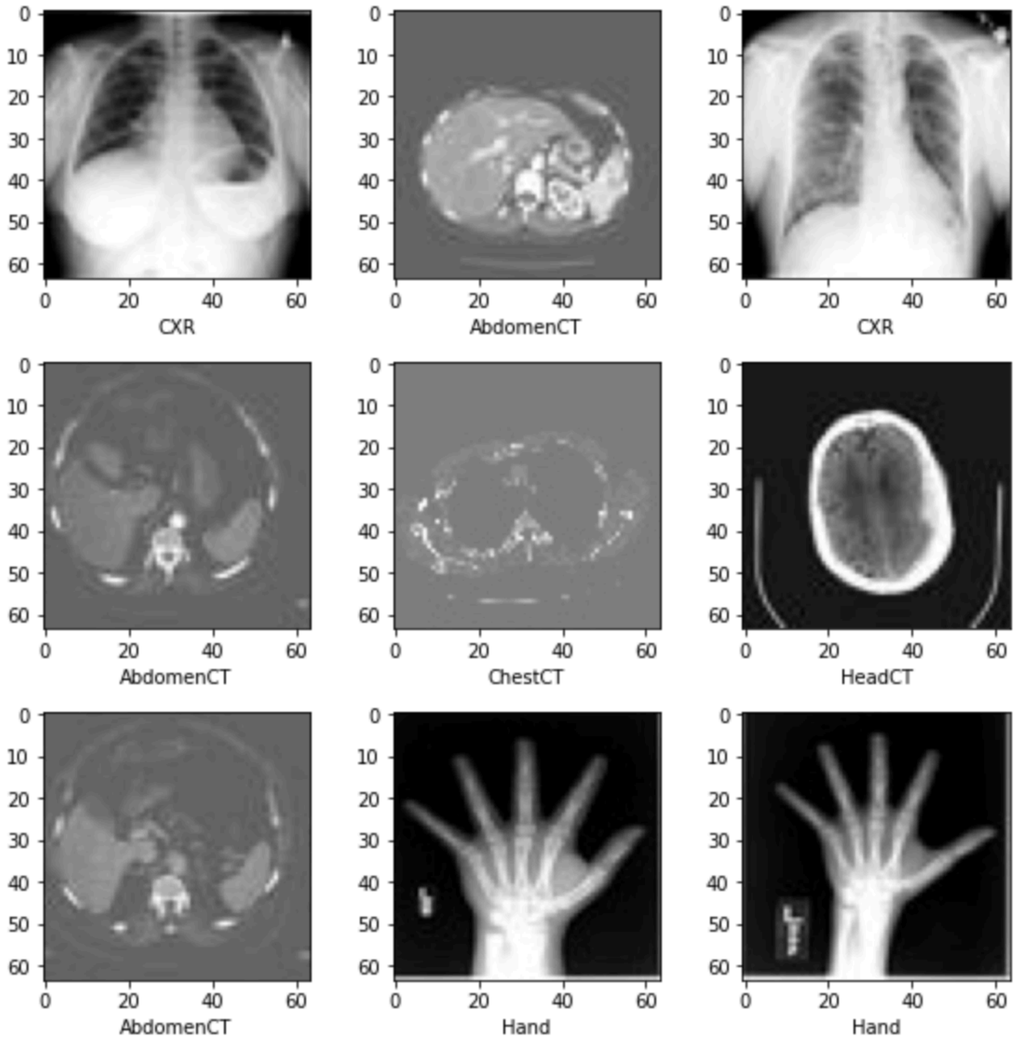
CIFAR10 dataset has classes such as ‘airplane’, ‘automobile’, ‘bird’, ‘cat’, ‘deer’, ‘dog’, ‘frog’, ‘horse’, ‘ship’, ‘truck’.



MedNIST dataset

The MedNIST database are MRI, CT, X-ray images gathered from TCIA, the RSNA Bone Age Challenge, and the NIH Chest X-ray dataset.

There are 6 folders in the dataset: ‘Hand’, ‘AbdomenCT’, ‘CXR’, ‘ChestCT’, ‘BreastMRI’, and ‘HeadCT’. Data counts are respectively, 10000, 10000, 10000, 10000, 8954, and 10000.



Flowchart of the notebook

Part 1: Install packages and get the dataset

‘Hand’, ‘AbdomenCT’, ‘CXR’, ‘ChestCT’, ‘BreastMRI’, and ‘HeadCT’

Part 2: Create datasets & Pre-process with MONAI

Training, val, test datasets & Dataset and Dataloader & Monai transforms

Part 3: Define the model & perform the training

DenseNet from Monai.networks & training circles

Part 4: Evaluate the best-metric model

Thank you!

Contact:

Kuan (Kevin) Zhang, Ph.D.
zhang.kuan@mayo.edu (twitter: @KZhangMayo)

Bradley J. Erickson, M.D., Ph.D.
bje@mayo.edu (twitter: @Slowvak)

Mayo AI Lab

Mayo Clinic, Rochester, MN